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Comment

ROAD MAPS FOR THE 21ST-CENTURY RESEARCH IN SCIENCE COMMUNICATION

Science communication, an emerging discipline

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ABSTRACT: Several publications have sought to define the field of science communication and review current issues and recent research. But the status of science communication is uncertain in disciplinary terms. This commentary considers two dimensions of the status of discipline as they apply to science communication – the clarity with which the field is defined and the level of development of theories to guide formal studies. It argues that further theoretical development is needed to support science communication's full emergence as a discipline.

Academic disciplines come in many different shapes and sizes, and with many different stories. Some grow in niches of established disciplines, others at the margins of two or more disciplines. Some result from schisms, others from chance encounters. Some develop in response to changing external conditions, others as a consequence of new techniques and technologies. The cases of, for example, cultural studies, nanotechnology, psychoanalysis and information science are all distinct and different.

Science communication as a subject of teaching and research in higher education has a short history and appears mainly as a response to external needs. But, reflexively, we need to consider whether its emergence reflects the strong tendency in academia towards fragmentation. Boggs (2000) refers to the dangers of hyperspecialism and associated insularity, Shapin (2005) to hyperprofessionalism and associated self-referentiality. There are material and symbolic incentives driving this trend: the successful definition of a new field may attract a re-orientation of research funding; to the pioneers in a new field may fall the rewards of establishing and leading societies and publications.

No single set of rules or criteria defines an activity as an academic discipline. But at least some of the following conditions are generally expected to be met for a discipline to be recognised as such:

- a bounded field of study;
- shared interests, terms and concepts;
- significant presence in teaching and research in the higher education sector;
- international reach;
- specialist scholarly publishing;
- organised communities or networks of scholars;
- a body of theoretical work that underpins empirical study.

We will concentrate on the first and last of these points in this essay, that is, the definition of the territory and the development of theory. The delimitation of the science communication field appears at first sight not that difficult: it concerns the communication between communities of scientists, interest groups, policy-makers and various publics. But, on further reflection, we have to consider whether science communication also includes communication between and within various scientific institutions and communities of scientists. This has received significantly less attention than the cross-sectoral communication between scientific communities and those of wider society. Even less attention has been given to the communication between various publics – without the involvement of scientists – on scientific issues. Thus, it can be seen that relatively narrow and relatively broad definitions are available to mark out the territory for science communication.

This delimitation issue becomes yet more complex when we consider the meaning of the acronym PCST which has been commonly used as a near-synonym for 'science communication'. T, for technology, potentially includes the extensive literature of advice on the uses and choices of consumer technologies, as well as communication between experts and publics on the technologies in, for example,

power generation or transport. PCST or science communication discussions and publications have given much less attention to technological developments than to those based on scientific research.

The neglect of technology in 'public communication of science and technology' is all the more surprising when one considers the relevance and impact of technology in setting the context of contemporary communication practices – including communication practices in and about science.

Those responsible for selection of submissions to the biennial PCST conference, as both of the present authors have been, frequently have to consider whether proposals fit, or not, within the framework. Where is the line drawn, for example, between informal science education, which is generally recognised as belonging to the field of science communication, and formal, school-based science education, which is not? Where is the line drawn between policy communication on science-based issues between experts and publics, which is generally recognised as belonging to the field of science communication, and communication between scientists and policy-makers which may be considered more appropriate to policy studies than to science communication?

For those within science communication it may appear self-evident that matters of environmental science are included within their field. But the intense scientific and political developments in global warming and climate change, in particular, have promoted the separate sub-discipline of environmental communication. The central presence in much current environmental communication of political and ethical issues, often outweighing the scientific, appears to mark it out as distinct from science communication. It may have more to draw from political communication than from science communication. Environmental communication has now claimed its place in the broader fields of mass communication research, sometimes as a close cousin of science communication, sometimes as a more distant relative.

The ground on which disciplines work and thus the boundaries between disciplines are continuously shifting. An old adage says that "good fences make good neighbours": relations between neighbours are likely to be better if the limits of each one's territory are recognised. For this to happen, neighbours have to know and acknowledge what each other is doing. In the early development of science communication, however, the fixing of fences resembled more the staking of claims in apparently uncharted territory. Only more recently have relations with other fields of study tended to be widely acknowledged.

Some researchers have continued to argue for the separate development and definition of science communication (e.g. Burns, O'Connor, Stocklmayr 2003). This tendency may reflect the early preponderance of natural scientists, or those with a background in natural sciences, in the practice, teaching and discussion of science communication. The science communication movement grew as an advocacy for more public communication by scientists and for particular approaches to that activity.

Fuller (2010) considers that "the field continues to bear the marks of its origins as a public relations concern on the part of authoritative scientific bodies". This has contributed to the tendency to define this field of activity as separate and distinct but also to the heavier emphasis on proposals for what science communication should be than to systematic analysis of what it is and why it is so. It can be argued that the preference for such normative over analytical approaches has stunted the development of theoretical perspectives in science communication.

Well-established disciplines tend to have well-established theories, often associated with major figures in the founding or development of the discipline. In the humanities and social sciences more than in the natural sciences, theories and their authors can endure as references for centuries, even millennia – consider the cases of Marx, Weber and Durkheim in sociology, or Freud and Jung in psychology and psychoanalysis, or even Plato in political science and Socrates in philosophy. It implies no commitment to a great-men theory of history to acknowledge that these authors developed theories, models and concepts that have lasting value. Their continuing 'presence' is both a cause and effect of the stability and maturity of the disciplines they continue to inform.

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. In our introduction to the *Handbook of Public Communication of Science and Technology* (Bucchi, Trench 2008), we noted that several contributions reflected "the gradual shift in policy discourse from keywords such as 'popularisation' and 'public understanding of science' to 'dialogue', 'engagement' and 'participation'". Many articles, papers and theses exploring these terms and their meanings or examining their applications in policy and practice have contributed valuably to the clarification and deepening of the concepts.

An extended synthesis of this continuing discussion including proposals on how these recurrent terms should best be understood – even a synthesis and proposals that were themselves open to contest and further development – would mark a major step in the emergence of science communication as a discipline.

It is notable that in fields of communication closely related to science communication, such as risk communication, health communication and science education, similar discussions and reflections on models have taken place over a somewhat earlier period, though these developments have happened largely without reference to each other. In each case, the audiences or publics and their needs were increasingly foregrounded, as top-down models were progressively displaced or supplemented by more inclusive, egalitarian or participatory models.

In risk communication, Sandman (1987) added 'subjective' factors to which established risk experts had paid little or no attention. In health communication, the contrast is made between a 'medical model' based on transmission of expert knowledge and an 'educational model' that takes account of the perceptions and understandings of the sectors of the population. Borchelt (2001) noted that "as the disciplines of science communication *per se* and health communication have matured, many academicians have chosen one field as a specialty to the exclusion of the other. This has led to the development of two very distinct fields of endeavour that have lost much of their potential for interdisciplinary collaboration and mutual cross-fertilization".

In public relations, Grunig and Hunt (1984) contrasted one-way public information and publicity models with two-way models, that may be 'asymmetrical' (that is, aimed to persuade more effectively through gathering information on publics) or 'symmetrical' (that is, referring to mutual understanding, exchange of information and negotiation of mutually beneficial solutions)

In science education, there has also been increasing emphasis on the need to engage students more actively, based on 'interactive', 'inquiry-based' or 'project-based' approaches that stress the understandings and experiences that students bring. Indeed, it was from the field of educational theory that the concept of a contextual model was derived, and that model was for some time proposed as a better alternative to the deficit model of science communication, though generally without explicit reference to its theoretical origins.

Science communication as a defined field of study has grown over the last 20-30 years in the intersections of science education, social studies of science, mass communication, museology and several other longer-established academic and professional activities. It was shaped as much by political and institutional concerns as by intellectual interests. It is accommodated in several distinctly different ways within higher education and research systems. It developed as a field of formal study only after it was a named practice with associated training and education programmes.

Reflecting these conditions and contributing to them, science communication is significantly under-theorised. In the *Handbook of Public Communication of Science and Technology*, we sought to present the state-of-knowledge in many aspects of science communication, as found, for example, in science museums and science centres, popular science writing, health promotion, public participation, journalism and risk governance. Several of the contributors to this volume are keenly interested and active in theoretical development. But it is fair to say that, while it revealed some established foci of attention and discussion, this collected volume also highlighted the diversity of themes and issues which are collated under the label of 'science communication' .

Ours is one of several similar publications published in 2008-10; these consist of edited collections of essays, reviews and studies of various aspects of science communication. There are more such collections in preparation. Many of these publications reflect the intention to support formal study of science communication and to promote its further development. But their form, as collections, also reflects the difficulty of achieving theoretical unity. We are not aware of any recent book-length publications, whether with single authors or joint authors, that propose a coherent framework for thinking about key issues in science communication. In his extensive review of research literature in science communication Weigold (2001) did not refer to any such work. Kohring (2006), in his 'theory-design' for science journalism, offers a relatively rare example, available in German only and thus with limited international reach.

We need such theoretical work to give researchers, students and professional practitioners better tools to describe and classify what they observe, to explain why things happen as they do, to understand relations and processes, to assess effects and outcomes, and to consider the likely consequences of an initiative of this kind or of that kind.

As with communication in general, the intellectual resources from which such theory may be drawn are various. Communication grew as an inter-discipline drawing on sociology, psychology, linguistics, philosophy, political science and other disciplines to emerge as a recognised discipline with its own sub-sectors in inter-personal, speech, mass, mediated, political and other forms and arenas of communication. Theories such as those of communication as culture (Carey 1989), media systems (Hallin and Mancini 2004) and the public sphere and communicative action (Habermas) may speak to science communication as effectively as to journalism or political communication. Fuller (2010) notes that "perhaps the most striking feature of science communication research is how relatively little of its agenda has been driven by mass communication studies or even more humanistic approaches to rhetoric normally found in 'communication departments'".

Crucial critiques of the scientific literacy orientation of science communication in the post-Sputnik era came from scholars either deeply grounded in communication or social studies of science (e.g. Trachtman 1981, Dornan 1990, Hilgartner 1990, Wynne 1991). The need remains for more intense and fruitful connection with general theoretical issues in science and technology studies. Themes like trust, the role of non-experts in knowledge production, process of knowledge transformation have been at the centre of theoretical reflection for many years in the history, philosophy and sociology of science; such themes are all relevant to think and rethink the role and transformations of science communication.

A number of important theoretical contributions to science communication in the past decades have actually aimed at bringing core theoretical sociological and epistemological issues into the area of science communication and public understanding of science, as, for example in the work of Stephen Hilgartner, Brian Wynne, Alan Irwin and Mike Michael. Along the same line, classic works by authors such as Ludwik Fleck, Thomas Kuhn and Robert K. Merton could also be fruitfully reappraised to address key issues in science communication (e.g. recognition, credibility, role of communication in knowledge transformation processes).

Science communication will benefit more from a clearer articulation and deeper exploration of its relations with its neighbours than from further insistence on its separateness and uniqueness. Most immediately, science communication needs to clarify where and how it relates with the older fields of science and technology studies, science education and health communication.

Science communication is a recognised field of study in which there are people active who come from very many different backgrounds. It has its own formal qualifications, professional education and research networks. It is not (yet) established as an academic discipline but that could emerge as a discipline with strong interdisciplinary characteristics or as a sub-discipline in the still-growing field of communication studies. Writing a decade ago, Logan (2001) suggested that "the sub-discipline of science mass communication and the broader field of mass communication research represent emerging, pioneer, and somewhat unsettled social sciences". That assessment remains valid.

Science communication's full flowering as a discipline depends at least in part on the successful articulation of theories that address key issues that research in this field faces. As a contribution to a research agenda for theoretical work in science communication we propose the following as key issues:

- Models of science communication – how do they develop? how do they operate? how do they inform practice?
- Publics for science – how do they differ? how do they make sense of science? how and why do they engage with science?
- Communicative authority of science – how is it won? how is it exercised? how is it lost?
- Social relations of science – how do scientific institutions and systems communicate with those of media, law, policy?
- Effectiveness – by what criteria, from what perspectives and with what methods is science communication to be evaluated?

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