"Too obvious today"? Revisiting the web model of science communication

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Introduction

In a 2013 blog post based on her contribution to a collection of essays on future directions for scientific advice (Doubleday & Wilsdon, 2013), Alice Bell (2013) commented that the networked view of science communication, probably first made explicit in Bruce Lewenstein's web model proposed more than twenty years ago, "seems almost too obvious today". Bell presumably was referring to the fact that science communication, like so many other forms of communication, increasingly takes place in online media with a high degree of interconnectedness. The networked view thus has become "too obvious" since everyone, including scientists, science communicators, and others, today is relying on information and communication technologies to communicate science. Moreover, for the last twenty years or so, networks and networked ideas have been proliferating in virtually all areas of the economy and society, disturbing traditional notions about professional hierarchy, linear communication and social orders (Castells, 2001). The fact that the networked electronic media has emerged as a principal means of public communication of science and technology has "made more completely porous than before the boundaries between professional and public communication, facilitating public access to previously private spaces, and thus 'turning science communication inside-out'" (Trench, 2008, p. 185).

Bell (2013) acknowledges that Lewenstein's model and the networked view of science communication carry an important message for scientists, policy-makers and the general public: "the simple messiness of scientific discourse". Scientists rarely speak in one voice, and the scientific literature is filled with uncertainty and controversy (Callon, Lacoumes, & Barthe, 2009; Engelhardt & Caplan, 1987; Machamer, Pera, & Baltas, 2000). Similarly, public communication of science and technology is diverse, even divergent, and the emergence of online media seems to have added – or maybe just made more explicit – such heterogeneity. Scientific disputes often spill over into the public domain with scientists using public discourse to promote controversial (new) ideas that are difficult to convey in the more limited technical discourse. In order to have relevance for others engaged in the practice of science and science communication, the "messiness" of it all needs to be somehow captured by our theoretical understanding of how science communication works, and this is why networked ideas about diversity and complexity such as those propounded by Lewenstein seem to be still relevant today.

More than a simple reminder of the messiness of scientific discourse and its relations to public discourse about science, Lewenstein's web model also still provides a fresh input into debates about appropriate models of public communication of science and technology. Put simply, there is a pressing need to go beyond the deficit-dialogue thinking that for a long time has permeated our field (Bucchi, 2008). Both deficit and dialogue models embody the kind of linear and orderly thinking that Lewenstein's web model was intended to break with. And for some reason both

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models seem to be very persistent, witness the recent essay competition in one of our main scholarly venues, *Public Understanding of Science*, asking the question: “Why does the ‘deficit concept’ not go away?” (Bauer, 2016). This paper attempts to reenact the web model by critically revisiting Lewenstein’s original ideas and tracing their (lack of) impact in theoretical reviews of models of science communication. How is it that despite their obviousness web models and networked ideas do not receive more attention than they do?

Lewenstein’s web model

Bruce Lewenstein (1995), in his study of the cold fusion controversy, introduced a web model of science communication (see figure 1), arguing that communication amongst scientists occurs through the use of many media interacting in complex ways. Specifically, he (1995, p. 403) reacted to “traditional, linear ‘dissemination and translation’ models of science communication”, such as those presented by the psychologist William Garvey (1979) (see figure 2). The new model was designed to take into account the permeable boundaries between different modes of communication – from formal publications to email and faxes – and to account for the fact that more communication may lead to greater complexity and instability. The communication environment described by the web model simply makes it more difficult for scientists and others to reach stable judgments. As Lewenstein (1995) noted, there’s an apparent paradox here: Communication is the “essence of science”, as Garvey (1979) said, yet, increased communication activity and increased number of communication contexts, at least in an intense and heated controversy such as cold fusion, seems to be correlated with confusion, uncertainty and indecision.

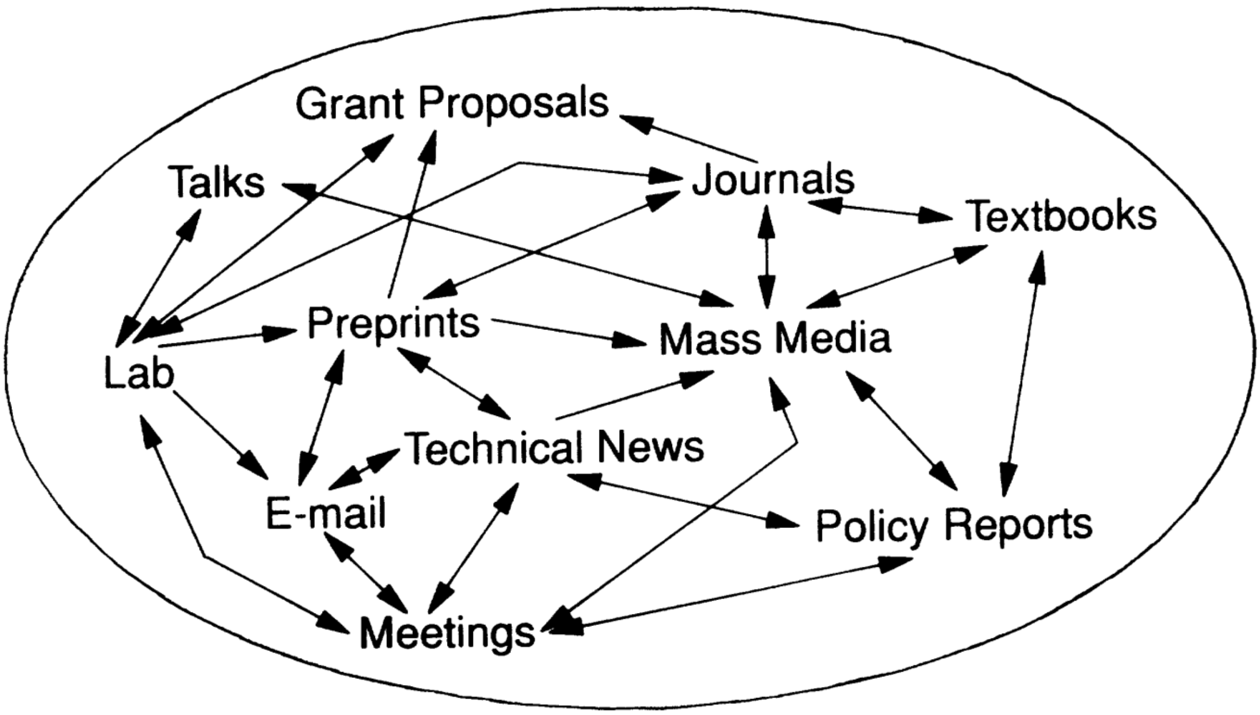

Fig. 1: The web of communication contexts (Lewenstein, 1995, p. 426)

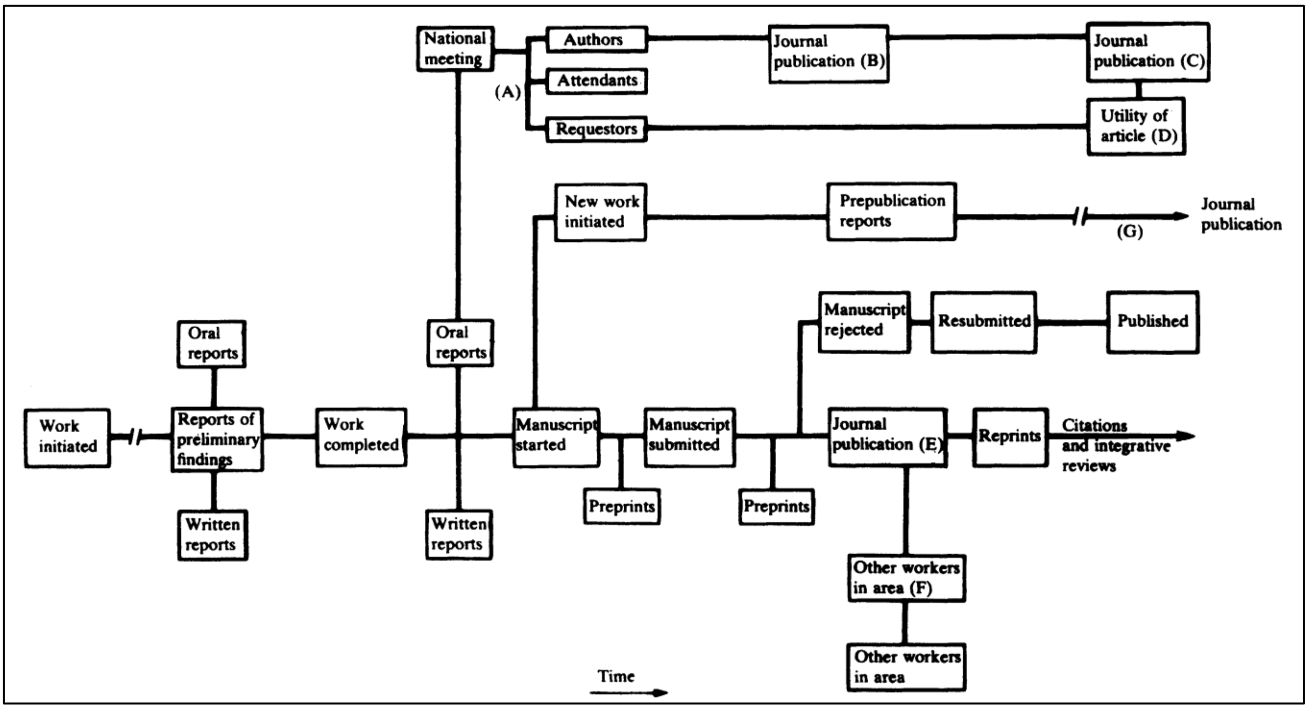

Fig. 2: Schematic overview of the scientific communication system
(Garvey, 1979, p. 169)

Lewenstein suggested that the web model of science communication could be applied to other, less controversy-ridden cases where the mass media and online modes of communication are important communication contexts to take into consideration – for scientists, science communicators and science communication scholars. According to this networked idea, mass media and online media influence the reception of research in the scientific community. In other words, scientists use many channels of communication as they form judgments and make decisions pertaining to research. This applies to heated issues such as cold fusion, but maybe also quite generally. There is some evidence from empirical studies that scientific impact (traditional metrics such as the number of citations) is correlated with mass media and online media coverage (often referred to as altmetrics = alternative metrics); still the nature and significance of such correlations are debated (Fanelli, 2013; Kiernan, 2003; Phillips, Kanter, Bednarczyk, & Tastad, 1991; Selvaraj, Borkar, & Prasad, 2014; Thelwall, Haustein, Larivière, & Sugimoto, 2013).

Neglecting the web model

Despite its obviousness Lewenstein's web model has received scant attention in science communication research. Most academic discussions about adequate modeling or theoretical understanding of science communication start out with some version of the linear model. Massimiano Bucchi (1998, p. 12) for example uses a linear, funnel-shaped "continuity model" to describe the "ideal communication flow in routine conditions" and "deviant cases" where public communication of science influence the very core of scientific knowledge production. Maja Horst (2008) presents three models of science communication – diffusion, deliberation and negotiation – all of which includes arrows to depict the relationship between science and the public. Horst's third model, negotiation, aims to the understand the communicative relationship between science and its publics in terms of "contextual networks of negotiations over usability, credibility and influence", but with no reference to the web model (Horst, 2008, p. 263). Even Lewenstein's own paper on "Models of public communication of science and technology" does not mention the web model, but rather present four other models: the deficit model, the contextual model, the lay expertise model and the public participation model (Lewenstein, 2003). The web model receives no mention in the two handbooks on public communication of science and technology published so far (Bucchi & Trench, 2014, 2008).

Expanding the web model

Lewenstein's web model (figure 1) includes the communication channels that seem particularly relevant to the cold fusion case. It may be seen as a first attempt to think more systematically about communication contexts relevant for scientists and others as they make informed judgments about scientific information and images of science. If we want to apply the web model more broadly we should take into account more communication contexts (see figure 3):

- Social media: The most obvious communication context to include today is social media. Many, including scientists, increasingly use social media to communicate and collaborate. Providing a more realistic view of how informal modes of electronic communication impact on scientists' understanding was one of the goals of Lewenstein's web model and, certainly, social media are important in this respect (Van Eperen & Marincola, 2011; Van Noorden, 2014)
- Science culture: Science plays an important role in many popular media that are dedicated to entertainment, not science communication. Indeed, science is pervasive in modern culture and views about science, including scientists' own views about science, probably is shaped by broad cultural impact. Including elements of "the culture of science" into the web model allows for many contexts outside the traditional channels of science communication to influence on how scientists think about and make decisions about science and scientific information (Bauer, Shukla, & Allum, 2012).
- Science education and research training: Throughout the educational system, science is presented in many different ways to pupils and students. These heterogeneous communicative contexts certainly influence the ways in which scientists and others understand scientific information and the nature of science. Including this context into our view of what science communication is all about will not only help expand the web model of science communication, but also potentially add to discussions about what is the nature of science and how should we think about including science communication in this relation (Nielsen, 2013).
- Science communication events: Even though the web model is particularly developed to describe complex relationships between online channels of science communication, we should not forget the communicative events that take place real-time in real-life. Science communication evens – from science festivals to public lectures – are important, but in an age where electronic communication often draws most of the attention, often overlooked contexts of science communication where scientists and many different audiences deliberate about science, scientific information and its impact on society (European Science Events Association, 2005).
- Organizational science communication: Inside research organizations, such as universities, an intense communicative activity is taking place. Usually organizations will make a distinction between internal and external communication, which both may – and probably will – influence scientists as they make decisions pertaining to their own research. Except for science PR, organizational communication has not been studied extensively as an important context of science communication and more work on how this context relate to other contexts in the expanded web model of science communication obviously is needed (Borchelt & Nielsen, 2014).

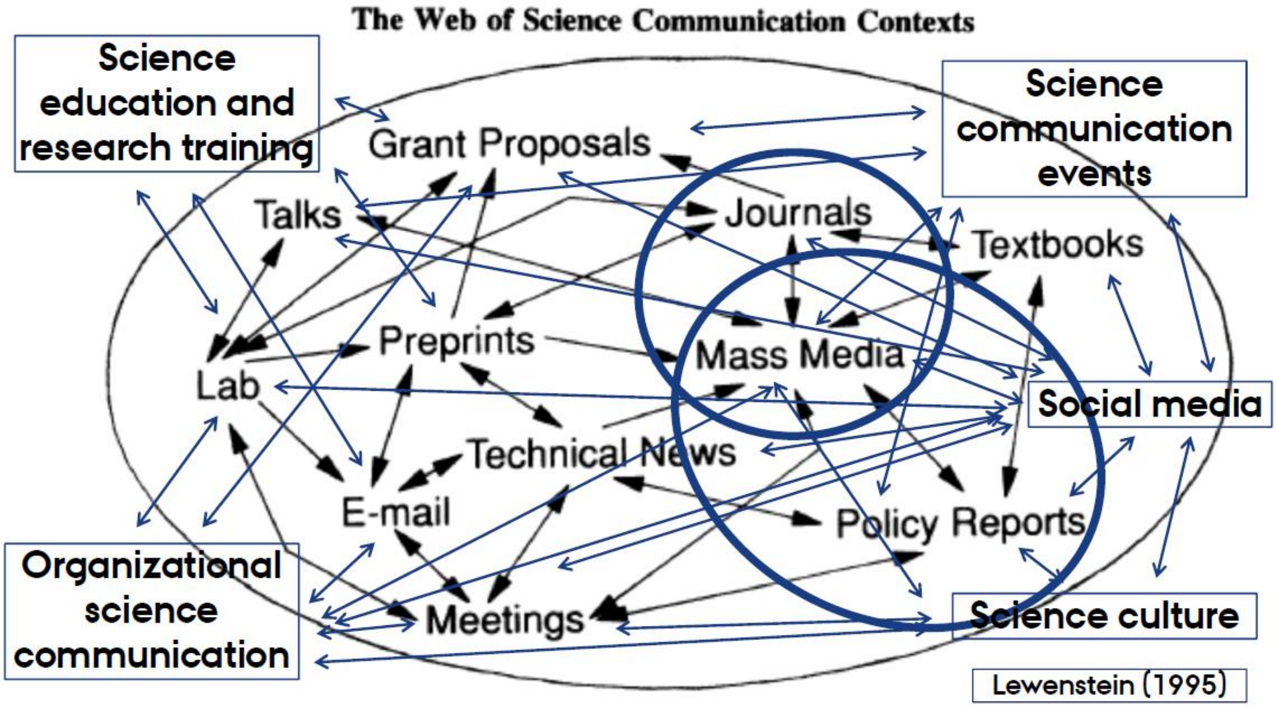

Fig. 3: The expanded web model of science communication contexts

Learning from the web model

The web model allows us to see science communication as a dispersed web of communication channels and contexts. As Alice Bell (2013) remarks in her blog post, this networked view will help us become more attentive to the sheer messiness of science communication. The web depicted in figure 3 certainly appears messy due to its high degree of interconnectedness. It serves a purpose as a constant reminder of the highly entangled nature of all forms of science communication. What we need to do next is to be able to qualify some of the characteristics of this web.

The web of science communication, like communication in general, is both social and cognitive in nature. It brings together real people in social interaction, while at the same time facilitating knowledge dissemination and sharing. In this way, it resembles the “new invisible college” or “knowledge network” described by Caroline Wagner and colleagues in their work on the networked topology of science (Wagner, 2008; Wagner & Leydesdorff, 2005; Wagner, Park, & Leydesdorff, 2015). Importantly, Wagner notes that science networks such as those that can be obtained by following the citation structure of many papers are so-called scale-free networks. This implies that the number of links is unevenly distributed across nodes in the network. In fact, the degree of connectivity follows a power law which basically means that there are only a few nodes with a high number of connections to other nodes. These well-connected nodes often attract newcomers to the network, a feature often called “preferential attachment” (Wagner, 2008, pp. 42-43). Most nodes have relatively few connections. Clusters tend to form around local hubs in the network (see figure 4).

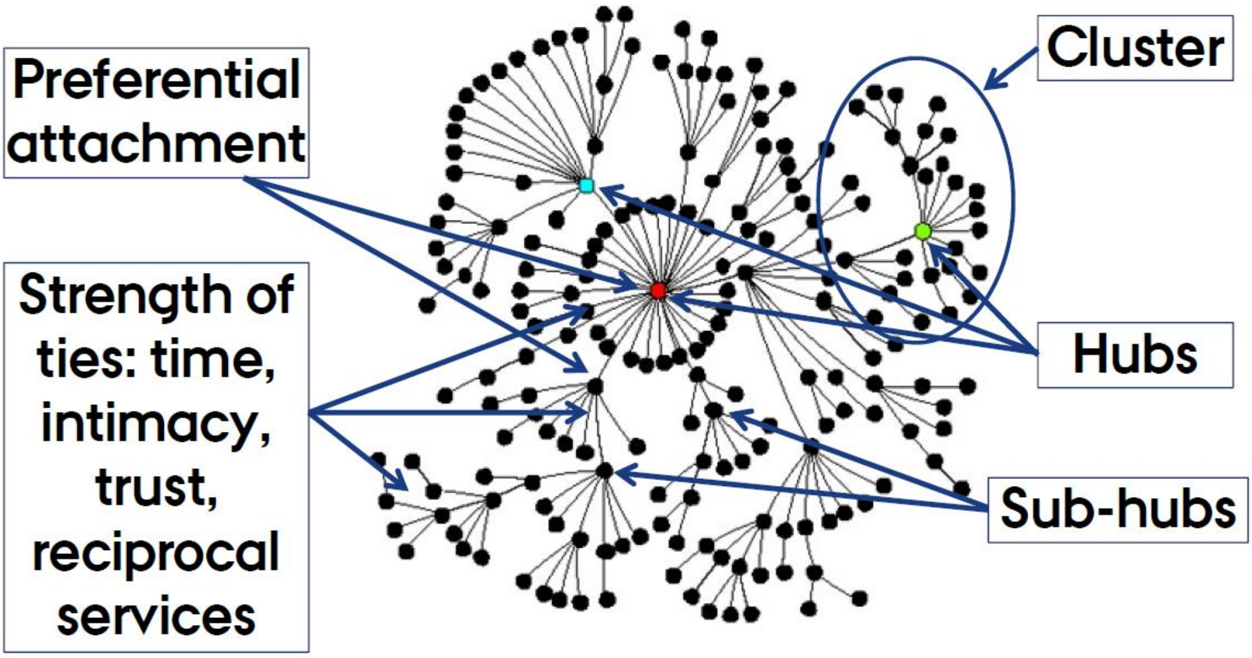

Fig. 4: The web of science communication depicted as a generalized scale-free network

The dynamics of scale-free networks may tell us something about the nature of webs of science communication. Seeing science communication as a socio-cognitive network consisting of nodes and links encourages us to probe more systematically into the relationships that form the backbone of the network. In particular we need to inquire more deeply into the quality of the ties that bind people and information together in the network. How strong or weak are those ties? How and why do some persist through time while others appear to be more fragile? What is the role of trust in forming and maintaining relationships across the network? What are the reciprocal services offered to participants in the network? These are some of the research questions that the expanded and revised web model may inspire, and I invite others to contribute other questions or agendas as they revisit Lewenstein's web model of science communication contexts.

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