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RESEARCH ARTICLE

Living in an intermedial world: intermediality as a methodology of historical inquiry to uncover the social dimension of science communication

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Abstract

Audiences for science in the media live and operate, as agents who endow science with social and cultural meanings, in an intermedial world. Following cultural tracers through time and across media, and attending to a key actors' category, intermediality, historians of the public culture of science can access the social dimension of the mediation of science. Adopting an intermedial approach allows us to attune the historiography of the public culture of science to the evolution of science communication scholarship over the past three decades, and understand the role of audiences in the production of cultural meanings about science.

One of the crucial problems for scholars interested in historicizing the public culture of science, and investigating the place and placing of science in society and culture, is to understand how the media, as vectors of discourses of and about the sciences in public contexts, stand in relation to the production of scientific knowledge. This is especially the case with such contexts as those subsumed under the umbrella term 'popular culture', where the press, television, radio, cinema, theatre, museums and the Internet reign supreme. The question of interest here is not that of *communication* per se, understood as the linear, unidirectional transfer of a message from one emitter to a receiver.[1] It is rather that of *mediation*, a process which encompasses the social dimension of communication. The notion, according to media scholar Roger Silverstone, is 'fundamentally dialectical'.[2] Informed notably by Stuart Hall's work on audience agency (the encoding/decoding model), mediation focuses attention on the production of meanings in social contexts, as a collaborative process involving both message producers and receivers, and leading to the transformation of all participants, including the material means involved and the context in which mediation takes place.[3]

To look at mediation is to pay attention to institutions and technologies of communication. It is to explore the co-shaping of the contents of communication and the social

[1] Claude Elwood Shannon, 'A mathematical theory of communication', *Bell System Technical Journal* (1948) 27(3), pp. 379–423.

[2] Roger Silverstone, 'The sociology of mediation and communication', in Bryan S. Turner, Chris Rojek and Craig Calhoun (eds.), *The SAGE Handbook of Sociology*, London: Sage, 2005, pp. 188–207, 189.

[3] Stuart Hall, 'Encoding/decoding', in Stuart Hall, Dorothy Hobson, Andrew Love and Paul Willis (eds.), *Culture, Media, Language*, London: Hutchinson, 1980, pp. 128–38.

contexts in which they are produced and consumed. This notion invites the analyst to explore both how the social context of mediation contributes to shaping the message, and how mediated contents participate in generating and maintaining specific social orders. Intermedial studies concern themselves more specifically with one aspect of the social dimension of mediation – the fact that producers and consumers of media contents, as well as these contents themselves, are situated in a multimedia context. Intermediality acknowledges that no media content is produced, circulates or is consumed in isolation, making it a necessity to capture the conversations and exchanges between media if one is to understand the production of cultural meanings.

Audiences deploy their agency through practices of meaning production applied to communicative artefacts and in relation to social arrangements.[4] Communication infrastructure is constituted by the tryptic of practices, artefacts and social arrangements. Audiences' active production of meaning, through their engagement with this infrastructure, consists in modifying the social and political work that this infrastructure is doing to suit their informational needs.[5] The notion of social arrangement, which cannot be dissociated from the rest of the infrastructure, brings to the fore the question of the *context* in which instances of communication happen. This in turn makes accessing and understanding contexts of instances of communication crucial to making sense of the social role of science communication.

Media are sociotechnical assemblages that generate social relations through the practices of production and consumption aggregated around artefacts.[6] It follows that a research agenda to investigate science and the media through the notion of mediation will invite researchers to examine how, when science circulates in public contexts, 'people reflect on the status of their own knowledge and situate themselves *vis a vis* science and *vis a vis* others in relation to science'.[7] From this perspective, studies of mediation highlight the profound social nature of both the production and the reception of mediated contents. The process is circular: the production, circulation and consumption of cultural meanings about science through films, television programmes, museum displays or newspaper articles participate in the formation of social arrangements around science which in turn imbue scientific knowledge and practices with further meanings in society.

In this afterword, I first discuss some of the scholarship in science studies examining the relationship between the communication of science and its production. In the light of the studies assembled here, I then reflect on the value of intermediality as an approach, or methodology, for historians of science wishing to understand the media's role in placing science in society and culture. I highlight first the notion of 'cultural tracer', and second the idea that intermediality is an actors' category which should enable analysts to place audiences front and centre in their investigations of the public culture of science.[8]

[4] Susan Leigh Star and Geoffrey C. Bowker, 'How to infrastructure', in Leah A. Lievrouw and Sonia M. Livingstone (eds.), *Handbook of New Media: Social Shaping and Social Consequences of ICTs*, London: Sage, 2006, pp. 230–45.

[5] Star and Bowker, op. cit. (4), p. 242.

[6] Leah A. Lievrouw, 'Materiality and media in communication and technology studies: an unfinished project', in Tarleton Gillespie, Pablo J. Boczkowski and Kirsten A. Foot (eds.), *Media Technologies: Essays on Communication, Materiality, and Society*, London: Penguin Random House, 2014, pp. 21–51.

[7] Rosemary McKechnie, 'Insiders and outsiders: identifying experts on home ground', in Brian Wynne and Alan Irwin (eds.), *Misunderstanding Science*, Cambridge: Cambridge University Press, 1996, pp. 126–51, 129.

[8] James A. Secord, *Victorian Sensation: The Extraordinary Publication, Reception, and Secret Authorship of* Vestiges of the Natural History of Creation, Chicago: University of Chicago Press, 2000.

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Placing science in society and culture

Historians of science Roger Cooter and Stephen Pumfrey famously noted in 1994,

> From coffee houses to comic books and chemistry sets, from pulpits to pubs and picture palaces, from amateur clubs to advertising companies, from Science Parks to Jurassic Park, our ignorance both of the low drama and the high art of science's diffusion and modes of popular production and reproduction is staggering.[9]

Over the past thirty years, vast strides in scholarship have contributed to remedying the ignorance deplored in this quotation. It is now well established among historians of science that science should be seen as 'a form of communicative action', and that knowledge production is largely dependent not only on conversations between scientists, but also on conversations taking place in society at large via different media.[10] This understanding follows in no small measure from Steven Shapin and Simon Schaffer's foundational study of the construction of experimental science in the late seventeenth century. In their study of the controversy between Robert Boyle and Thomas Hobbes, they showed how debates in front of audiences of witnesses came to be considered crucial to the creation of matters of facts.[11] Shapin further demonstrated in his study of the social history of truth how the codes of gentlemanly conversation were one of the touchstones of this process.[12] Building on these insights highlighting the necessary mediated nature of knowledge production, historians of science have since explored the blanks on the map that Cooter and Pumfrey identified.

Detailed studies of science in the museum, on film and television, on the radio, and in the pub have appeared.[13] We've learned much about popular-science magazines and books in the nineteenth and early twentieth centuries; about novels, public lectures and performances of science from the eighteenth century onward; about entertainment cinema, science fiction, theatre and so on.[14] Yet, as Boon in his introduction indicates, this

[9] Roger Cooter and Stephen Pumfrey, 'Separate spheres and public places: reflections on the history of science popularization and science in popular culture', *History of Science* (1994) 32(3), pp. 237–67, 237.

[10] James A. Secord, 'Knowledge in transit', *Isis* (2004) 95(4), pp. 654–72, 661; Secord, op. cit. (8).

[11] Steven Shapin and Simon Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life*, Princeton, NJ: Princeton University Press, 1985.

[12] Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England*, Chicago: University of Chicago Press, 1994.

[13] Sharon Macdonald (ed.), *The Politics of Display: Museums, Science, Culture,* London: Routledge, 1998; Tim Boon, *Films of Fact: A History of Science in Documentary Films and Television*, London: Wallflower Press, 2008; Jean-Baptiste Gouyon, 'Picturing Big Science on television in the post-war period: the case of BBC science programmes', in Panagiotis Charitos, Theodore Arabatzis, Harry Cliff, Günther Dissertori, Juliette Forneris and Jason Li-Ying (eds.), *Big Science in the 21st Century: Economic and Societal Impacts*, Bristol: IOP Publishing, 2023, pp. 36-1–36-14; Allan Jones, 'Science in the making: 1930s citizen science on the BBC', *History of Education* (2020) 49(3), pp. 327–43; Jones, 'Elite science and the BBC: a 1950s contest of ownership', *BJHS* (2014) 47(4), pp. 701–23; Jared Robert Keller, 'The expanding role of science journalism: BBC radio in post-war Britain', in Felicity Mellor (ed.), *Insights on Science Journalism*, London: Routledge, 2024 pp. 33–50; Anne Secord, 'Science in the pub: artisan botanists in early nineteenth-century Lancashire', *History of Science* (1994) 32(3), pp. 269–315.

[14] Aileen Fyfe, *Science and Salvation: Evangelical Popular Science Publishing in Victorian Britain*, Chicago: University of Chicago Press, 2004; Charlotte Sleigh, *Literature and Science*, Basingstoke: Palgrave MacMillan, 2007; Iwan Rhys Morus, 'Worlds of wonder: sensation and the Victorian scientific performance', *Isis* (2010) 101(4), pp. 806–16; Morus, 'Seeing and believing science', *Isis* (2006) 97(1), 101–10; David A. Kirby, *Lab Coats in Hollywood: Science, Scientists, and Cinema*, Cambridge, MA: MIT Press, 2011; Martin Willis, *Mesmerists, Monsters, and Machines: Science Fiction and the Cultures of Science in the Nineteenth Century*, Kent, OH: Kent State University Press, 2006; Kirsten E. Shepherd-Barr, '"Unmediated" science plays: seeing what sticks', in Martin Willis (ed.), *Staging Science: Scientific Performance on Street, Stage and Screen*, Basingstoke: Palgrave MacMillan, 2016, pp. 105–23.

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scholarship is in its vast majority mono-medial. Adopting an intermedial approach allows us to attune the historiography of the public culture of science to the evolution of science communication scholarship over the same three decades.

From a diffusionist, unilinear and monodirectional model of the presentation of scientific contents in public context, this scholarship now recognizes that science communication is the sum total of multiple synchronous exchanges about science happening in society.[15] Bruce Lewenstein, investigating the role of the mass media in the generation of scientific consensus in the context of the 1989 cold-fusion saga, proposed his 'web-model of science communication', and concluded that 'the model suggests that analyzing the role of the mass media in science cannot be accomplished in isolation, but must be an exploration of the complexity of interactions among *all* media'.[16] In a rejoinder to Lewenstein, Massimiano Bucchi and colleagues argued that science communication should be understood as 'cross-talk', or 'the interchanges of "ideas circulating in the public arena and in the specialist discourse"'.[17] This scholarship displaces the focus of investigations of science communication away from a media-centric approach and towards one centred on capturing audiences' experiences, situated as they are in the midst of a web of intersecting and criss-crossing media outputs.

Intermediality

The studies presented in this special issue stand as demonstrations of the historiographical potential of intermediality as a methodological approach for historians of science willing to understand the role of the media in science. As should be clear at this point, the term 'intermediality' designates the notion of the interactions between media in the cultural sphere. These interactions can be either synchronic or diachronic. They can take the form of (1) different media engaging with the same topic and referring to each other, (2) several media being used jointly to achieve one goal, or (3) different media forms being brought together to bear on one topic, through what is sometimes called convergence (e.g. digital media platforms mixing podcast, video, photography and written word in one story).[18] There can be an intertextual dimension to intermediality.[19] Yet, whereas intertextuality is mostly concerned with the meaning of texts and with signs within texts, intermediality accounts for the fact that media are more than texts. They are institutions, and technologies, and they can be approached from the standpoint of their audiences. Indeed, as already mentioned, media scholar Leah Lievrouw argues that media should be seen as 'socio-technical assemblages', objects existing in three dimensions.[20] They are simultaneously *artefacts*, embedded in a set of *practices*, and kernels around which *social arrangements* coalesce. And as much as a medium is all three at the same time, the analyst ought to consider these three dimensions

[15] Massimiano Bucchi, 'When scientists turn to the public: Alternative routes in science communication', *Public Understanding of Science* (1996) 5(4), pp. 375–94.

[16] Bruce V. Lewenstein, 'From fax to facts: communication in the cold fusion saga', *Social Studies of Science* (1995) 25(3), pp. 403–36, 427, original emphasis.

[17] Brian Trench and Massimiano Bucchi, 'Rethinking science communication as the social conversation around science', *Journal of Science Communication* (2021) 20(3), pp. 1–11, 5. Trench and Bucchi quote from Massimiano Bucchi and Andrea Lorenzet, 'Before and after science: science and technology in pop music, 1970–1990′, in Donghong Cheng, Michel Claessens, Nicholas R. J. Gascoigne, Jenni Metcalfe, Bernard Schiele and Shunke Shi (eds.), *Communicating Science in Social Contexts: New Models, New Practices*, 2008, pp. 139–50, 140.

[18] Bruhn Jensen, 'Intermediality', in *The International Encyclopedia of Communication Theory and Philosophy*, 2016, at https://doi.org/10.1002/9781118766804.wbiect170, pp. 1–12

[19] Graham Allen, *Intertextuality*, London: Routledge, 2000. Allen, scholar in literary criticism, reminds us of the vanity of trying to provide a fundamental definition of the concept of intertextuality. 'Such a project would be doomed to failure.' Allen, op. cit., p. 2.

[20] Lievrouw, op. cit. (6).

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together, as they relate to each other. An intermedial approach would therefore investigate how interactions between media translate in interactions between artefacts, practices and social arrangements, as well as how these interactions contribute *in fine* to explain the place and placing of science in culture. Most crucially, what needs to be deciphered is which different audiences get involved (and how), through their engagement with science in the media, in 'the complex web of social and institutional relations' in which the practices of production of scientific facts are embedded.[21] As the case studies assembled in this issue show, an intermedial approach to science in the media can provide historians with the empirical means to gain insights into these questions. Getting such insights will contribute to further our understanding of the role that audiences for science communication historically play in placing science in society and culture.

Intermediality in practice

When historian of science Jim Secord published *Victorian Sensation*, the volume was, deservedly, feted as a historiographical tour de force.[22] In this investigation of the context of reception and consumption of the Victorian literary sensation *Vestiges of the Natural History of Creation*, 'an evolutionary epic' anonymously published in 1844, Secord retrieves what for the historian is often most elusive, the texture of conversations. *Vestiges*, Secord shows, was not just privately read:

> [It] was mentioned in thousands of letters and diaries, denounced and praised in pulpits, discussed on railway journeys, and annotated on an Alabama River steamboat. It was discussed at dinner parties, pubs, and soirées, reviewed in scores of periodicals and pamphlets.[23]

The book existed in an intermedial fabric. It is by examining this fabric, following *Vestiges* 'in conversation, solitude, authorship, learned debate, religious controversy, civic politics and the making of knowledge', that the historian could access the context in which *Vestiges* was used and appropriated, and therefore functioned as a piece of science communication that could mediate knowledge and participate in the social construction of matters of fact about evolution.[24]

Attending to the intermediality of *Vestiges* provides us with an understanding of the social function of the conversations about evolution that it prompted. As a piece of science communication, Secord found that *Vestiges* participated in maintaining the existing social order: 'Reading about evolutionary progress offered common questions to bridge divides that threatened the nation's stability. Controversies about class and gender – among many potentially explosive issues – could thereby be subsumed into discussions of nature's progress'.[25] The book naturalized the notion of progress, resonating with, at the same time as it contributed to reinforcing, the expansionist, acquisitive and future-driven public culture emerging from the Industrial Revolution.

Intermediality, as this example shows, can be a way to access the context of science communication and decipher the media landscape in which audiences for science communication find themselves, the context in which they can deploy their agency. This in turn enables the historian to identify the cultural trends in which specific popular-scientific works participate. *Vestiges* is an exceptional case. Massively circulated, reprinted several

[21] McKechnie, op. cit. (7), p. 129.
[22] Secord, op. cit. (8)
[23] Secord, op. cit. (8), p. 3.
[24] Secord, op. cit. (8), p. 3.
[25] Secord, op. cit. (8), p. 5.

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times, re-edited again and again over several years, it was a cultural phenomenon in its own right. What Secord calls a 'cultural tracer', *Vestiges* found its way into many milieux and many social and cultural settings. The traces left of its circulation weave the intermedial fabric in which *Vestiges* became embedded. Less ambitious in their breadth than Secord's book-length endeavour, the studies assembled here exemplify and add variety to how intermediality, applied to different 'cultural tracers', enables the analyst to retrieve different contexts of the mediation of science and capture its diverse social roles.

Cultural tracers

Nelson, O'Riordan and Kim (this issue) follow the CRISPR/Cas9 gene-editing technology as it moves in texts and images through news media over a decade. This enables them to make sense of social conversations about CRISPR and, more broadly, of innovations in human genetic modification, and how they evolved. These crosstalks about the science of genetics facilitate social debates about such fundamental notions as what it is to be human, and what promise research and innovation in genetics holds for the future of humanity. The cultural tracer CRISPR delineates wider sociopolitical deliberations about the normal and the pathological, discrimination and exclusion, and what science and scientists' role is in defining these categories. As Nelson, O'Riordan and Kim (this issue) note, 'Sociopolitical factors transform the idea of the embryo into the question of which embryo'. Following CRISPR as a cultural tracer further shows how the sociopolitical ramifications of scientific research are compounded with notions of national identity and cultural exclusion. Finally, the social conversations about CRISPR are revealed as a proxy for acting out a rivalry between China and the Anglo-American West, a variation on H.G. Wells's *The Island of Dr Moreau* (1896) horror story scaled up to continental dimensions.

Cultural tracers, when it comes to science in the media, can take many shapes. In Curtis's investigation of the Bell System Science Series, animation, as a mode of representation, is a cultural tracer, in so far as it encapsulates changing assumptions and beliefs about what implicit discourses about science are assumed to be encapsulated in animated sequences. Animation has been a staple of science communication since the 1910s, because of the opportunity it offers to blend entertainment with education, 'a balance that the scientific community continues to seek' (Curtis, this issue). However, often also associated 'with the trivial and the infantile', animation can be perceived – and was perceived in the case that Curtis examines – as posing a threat to the 'legitimacy of science communication' (Curtis, this issue). A comparison of the fortunes of this mode of representation when considered in opposition to live-action sequences along the production history of one television series brings to the fore expectations and assumptions regarding the meanings about science that the audiovisual mediation of scientific knowledge should convey, but also about what social roles are deemed desirable for science communication. More broadly, following a mode of representation of science in popular culture as cultural tracer emphasizes the continued salience of issues of fabrication in visual representations of science.

Intermediality as an actors' category

The studies presented in this special issue also demonstrate that intermediality is an actors' category. The historical actors whose actions we investigate, such as the BBC's Alan Chivers and the Science Museum's William O'Dea (Cole, this issue), self-consciously adopted an intermedial approach to mediating science. In his piece, Cole looks at the production history between 1950 and 1971 of several BBC television programmes depicting displays at the Science Museum in London. Here, Cole details how a 'new television genre, the museum

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tour, was rooted in deliberate intermedial practice' (Cole, this issue). Science Museum workers, from the early 1950s onwards, deliberately borrowed techniques from other media when setting up their displays, not least 'scripting and storyboarding from cinema and television' (Cole, this issue). Schirrmacher (this issue), in his case study of the production of films about Frank Oppenheimer's Exploratorium, likewise exemplifies the intermedial approach of film producers and workers at the Californian science centre. Intermedial thinking was at the forefront when producing films that could convey the visitors' experience to viewers, and conversely when taking inspiration from the emotional and sensory experience of film spectatorship to assemble displays in the Exploratorium.

Finally, Ostherr (this issue) takes a historical view to explore the 'infodemics' which accompanied three emerging infectious disease (EID) outbreaks 'in real-time or live media of film, television, video and digital social media', and the responses of health officials in order to combat misinformation. Through her focus on 'the negative spaces of intermediality as potential sites for investigating and theorizing how health communications can fail in multimedia campaigns', Ostherr (this issue) highlights how not only media producers but also audiences for media content live and operate in an intermedial media landscape. Intermediality thus becomes an approach to retrieve not only the social context of media production but also that of media reception, when audiences perform their role as producers of cultural meanings about science.

Conclusion

Audiences for science communication have been cast in a variety of passive roles throughout the history of the communication of science in public contexts. Cheerleaders for a nascent profession in the nineteenth century, subjects of emerging technocratic politics at the turn of the century, markets for new technologies in the postwar period, 'cultural dupes' who need to be educated about science in the 1980s–1990s, participants in the scientific enterprise as engaged citizens in the late twentieth century and the early twenty-first.[26] Through intermedial studies, historians of the public culture of science can place audiences as agents at the centre of the picture. Through accessing the communication context, the intermedial world in which these audiences found themselves, it becomes possible to better grasp their agency as active participants in the construction of the public culture of science.

[26] Jean-Baptiste Gouyon, Cristiano Turbil, Franziska Kohlt, Kristian Nielsen and Charlotte Sleigh, 'Science communication and scientism: historical perspectives', in Martin W. Bauer and Bernard Schiele (eds.), *Science Communication: Taking a Step Back to Move Forward*, Paris: CNRS Editions, 2022, pp. 385–96; Charles Thorpe and Jane Gregory, 'Producing the post-Fordist public: the political economy of public engagement with science', *Science as Culture* (2010) 19(3), pp. 273–301; Brian Wynne, 'Public uptake of science: a case for institutional reflexivity', *Public Understanding of Science* (1993) 2(4), pp. 321–38; Alan Irwin, *Citizen Science: A Study of People, Expertise and Sustainable Development*, London: Routledge, 1995.

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