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Comment

Nanotechnologies and emerging cultural spaces for the public communication of science and technologies: an introduction

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ABSTRACT: In the last decade, social studies of nanotechnology have been characterized by a specific focus on the role of communication and cultural representations. Scholars have documented a proliferation of the forms through which this research area has been represented, communicated and debated within different social contexts. This Jcom section concentrates on the proliferation of cultural spaces where nanotechnologies are articulated and shaped in society. The intent is that of showing how these different cultural spaces — with their specific features and implications — raise multiple issues and involve distinct perspectives concerning nanotechnology. More specifically, the articles presented in the section outline and characterize three different cultural spaces where nanotechnologies are communicated: science museums, hackerspaces and the web. The overall section's argumentation is that the study of the communication of nanotechnology requires to consider a multiplicity of different cultural spaces and, moreover, that the attention to the differences existing between these spaces is a powerful perspective to explore and make sense of the varieties of ways in which nanotechnologies circulate in society.

1. Introduction: nanotechnologies, science communication and cultural spaces

We already know that over the last decade nanotechnologies and other emerging technologies have attracted in different ways the interest of scholars involved in the social study of science communication and of the role of science in society. In this area of studies one of the pivotal ideas is that "communication" and "science" are not separate entities, but rather they represent closely linked and interacting elements that, mixed together, contribute in generating what we identify as the science in society. This special section of the *Journal of Science Communication* aims at contributing to this view by considering how a specific scientific area, that of nanotechnology, has assisted in these last few years to the development of existing and emerging "cultural spaces" in which nanotechnologies have been culturally articulated, stretched and performed. The articles collected here trace some recent trajectories in the representation of nanotechnology in society by looking at the mutual interactions between this research area and three different cultural spaces where authors have recognized specific patterns of circulation of ideas, representations, issues, practices relevant to understand the communication of nanotechnology in society.

This special journal section had its origins in a session organized at the 2012 PCST conference (Florence, Italy, April, 18–20) and titled "Arenas, Modalities and Pathways in the Public Communication of Emerging and Converging Technologies". The session was organized by myself with Simone Arnaldi on behalf of the CIGA of the University of Padua, an interdisciplinary centre for the study of the social, ethical and legal aspects of nanotechnology and emerging technologies. The aim of that session was to put together scholars form different countries who had developed researches in the social study of the communication of nanotechnologies and emerging technologies and hence able to contribute with reliable perspectives on the evolving relationship between nanotechnologies and science communications.

The initial idea in designing that conference session was to have an overview on the emerging issues and forms of communication of nanotechnologies and new emerging technologies in society. The basic theoretical input behind the session was that, in the last ten years, progresses in nanotechnology generated not only a series of technological developments and changes in the ways we look at these innovations, but

they also accompanied, and also drove, a series of transformations affecting practices, issues and attitudes in the realm of science communication in society. In short, while technology has certainly changed, at the same time the culture and practices of communication of science had not kept still: spaces, issues, practices of communication have evolved and have thus influenced the chances of science to intersect with much broader and differentiated social spheres.

As already noted above, the relationship between nanotechnology and the communication of science in society is nothing new for the social study of science. First researches on this topic begun to appear about ten years ago, mimicking approaches and perspectives already developed in the study of biotechnologies (i.e. Nisbet and Lewenstein,[1] Bucchi and Neresini,[2] Bauer and Gaskell[3]). Among the main studies of this initial phase of the research there are analyses on the representations and representative frames generated by press and journalists concerning this scientific area.[4,5] Other relevant researches adopted a different approach, focussing on how the public opinion "reacted" toward the representation produced by media (i.e. Scheufele and Lewenstein,[6] Lee et al.[7]).

In the following years, a growing interest toward nanotechnologies generated more patterns of research that have developed together with a proliferation of analyses of media and public opinions in different countries (for the Italian case see for example Arnaldi[8] and Neresini[9]). Another area of research on the communication of nanotechnology involved the emergence of representations of nanotechnologies outside the press and processes of news making and thus concentrated especially on different kinds of popular culture and fictional contents involving nanotechnologies (i.e. Hayles,[10] Milburn,[11] Nerlich[12]). Other distinctive dimensions of inquiry have been on the narratives regarding the future expectations generated about nanotechnology's development[13] and on the practices of involvement and participation of citizens into debates regarding ethical and social implications of nanotechnologies.[14,15,16]

As it is evident from this short and certainly incomplete review of the most important trajectories emerged in the social study of the communication of nanotechnology, this area has produced a huge and variegated collection of researches on the how nanotechnology circulated in the today contemporary culture. The articles presented here help to advance this debate by addressing the proliferation of social dimensions in which nanotechnologies are discussed by looking at three cultural spaces where nanotechnologies are represented and debated. These three cultural spaces are defined not just in terms of their physical characterization, but for the specific forms of science communication embodied in their practices, attitudes, interests and relations between actors involved.

The focus on the communication of science in terms of cultural spaces allows recognizing that cultural meanings, as well as social practices of communication, exist in relation with specific socio-material boundaries that organize the processes of creation of meaning and communication. This is even more relevant when we remember that the authority and credibility of science — as Thomas Gieryn[17,18] has repeatedly noted — is also a matter of cultural cartography. In science, indeed, cultural boundaries that set the cardinal points of interpretation are under a process of constant redefinition and recreation: an ever going process of adjustment of those differences and distances that distinguish credible, legitimate and authentic cultural spaces from other ones.

Considering the communication of nanotechnology trough a spatial metaphor means also that the diverse emerging representations and ideas about nanotechnologies can be conceived by looking at the different features that characterize these spaces. Moreover, it helps in recognizing how these specific spaces have their own trajectories and qualities that affect the ways in which nanotechnology, and science in general, are culturally constructed and articulated. Looking to the communication of nanotechnology in term of the diverse cultural spaces where the communication occurs also means to highlight the intrinsic multi-layered and polycentric nature of science in society, one of the main reasons why science is today articulated culturally in many and often contrasting ways in our western contemporary world.

2. Three cultural spaces for nanotechnolgoies: museums, hackerspaces and the web

The articles constituting this *Jcom* special section deal with three different cultural spaces where the communication of nanotechnologies develops. By looking at these different spaces, the articles recognize some of the specific practices, issues, processes, discourses and scopes that produce very different cultural articulations of nanotechnology in the today society. They do not consider just how nanotechnologies are communicated, but they try to put on the foreground how nanotechnologies are

constructed, transformed and debated according to a set of peculiar practices and features characterizing the cultural spaces considered.

The opening article by Brice Laurant, titled *Science museums as political places. Representing nanotechnology in European science museums*, open the section by presenting a rather traditional and well-established space for the communication of science: the museum. As the same author notes, science museums are not neutral spaces for the representation of science. The science museum is one of the pieces of the broader socio-political process that shapes the role of science and, more in general, the contemporary citizenship or, as the author writes, "a place where the organization of democracy itself is at stake". Even if museums are established spaces for communicating science, Laurant shows in the article that the recent European exhibitions on nanotechnologies have implied several changes in both museums' practices, the European policy of science communication and also the same idea of what should be communicated and represented.

Firstly, Laurant makes reference to how the rising of nanotechnology has interacted with new trends in museums' exhibitions, mainly consisting in the growing interactivity with visitors and in the tendency to present science as an ongoing activity rather than a "science already-made". This helps to highlight how the specific museums' patterns of evolution have be part of emerging political aims and institutional requests to perform nanotechnologies in a consensual way in front of the public. Moreover, the article also makes reference to the differences existing between the "European way" to communicate nanotechnologies and the attitude characterizing the United States. This further point raised in the paper gives an insight into the local (in this case say regional) "embebbedness" of science museums' practices and also into the fact that common trends — such as interactivity and the science-in-the-making — could be characterized by slightly different articulations in different places.

What is perhaps even more interesting in Laurant's article is when it addresses the changes occurring in museum's communication in terms of a shift from the "public understanding of science" to the "scientific understanding of the public", in so doing highlighting the growing centrality of the monitoring of citizens' opinion as a pivotal point of reference in science communication as well as in European policies. In sum, Laurant presents the link between nanotechnologies and science museums as anything but static and unproblematic. Museums' exhibitions have evolved together with new inputs coming from both the evolving practices of science communication and the political strategies planned at European level. Being the epicenter of an institutional and reliable form of science communication, linked with official policies and strategies, science museums represent specific cultural spaces that carry particular perspectives, problems and issues about both communication of science, nanotechnology and citizens' role in science advancements.

The significant role of science museum in the development of a large-scale communication emerges in a clearer way from the contrasts emerging when we consider the topic of the second article of this section and titled *NanoŠmano lab in Ljubljana: Disruptive Prototypes and Experimental Governance of Nanotechnologies in the Hackerspaces.* In this article, Denisa Kera develops further the relationship between nanotechnology and science communication by describing how hackerspaces are sites for an alternative form of science communication about nanotechnologies.

For many aspects, hackerspaces represent the complete opposite of science museum exhibitions. While the latter have often an institutional role and are linked with broader policies, on the contrary hackerspaces are not connected with official scientific institutions and are generally self-financing; if museums have just recently started to implement forms of interactivity, hackerspace are inherently based on people's and citizens pro-activity. Science museum have a long history and embody a whole set of traditions and established practices in science communication; conversely, hackerspaces are a very recent phenomenon and are in the full process of discovery of their own potentialities for establishing new relationships between science, communication, and citizens.

Hackerspaces are a specific case of a broader phenomenon involving new models of science production and circulation "from below", a topic that has already been addressed in terms of "peer-to-peer science" in a previous *Jcom* special issue (see Delfanti[19]). Hackerspaces are a good example of how, in these last few years, alternative science is developing outside the walls of canonical laboratories and scientific institutions. They usually are spaces where people with interests in science & technologies can work and collaborate around specific projects and experiments. While primarily rooted in hardware and computer hacking culture, recently the work of hackerspaces is going in the direction of the so-called "biohacking"

and "do-it-yourself biology", i.e. activities involving experiments and projects about biology and also, as Kera shows in her article, nanotechnology.

More in particular, the article describes a particular experiment involving nanotechnology, developed at a hackerspace in Lubjana, Slovenia, called NanoŠmano Lab. The author use this example to show some of the main features that characterize hackerspaces as specific cultural spaces that articulate alternative practices and ideas around the role and the perception of nanotechnology in society. These spaces bring with them a specific set of cultural assumptions about what science, technologies and nanotechnologies are, and the Kera's article gives us the opportunity to see how a specific hackerspace's project site is linked with issues and questions connected with the way to consider the role of nanotechnologies in society. In these spaces, practices and activities are not just based on the need to stimulate an active involvement by people and citizens, but, with an ever deeper attitude, they are sites connected with the existence of entire communities sharing alternative models of interactions, political views and ideas about citizenship in relation with science and technology.

The quick report on the Slovenian hackerspace's project is interesting because it goes beyond the debate about the request of interactivity and involvement of citizens. The example tells us that these different spaces carrier a diverse set of assumptions about the science and society and on how nanotechnologies and our everyday lives intersect. As the authors note at the end of the article, the NanoŠmano's focus on the material and manual activities through which people participate marks an overturning of the usual cultural patterns mobilized in the representation of nanotechnologies: not something that revolutionizes our lives, but rather an ordinary presence in our everyday activities that we can manipulate and with which we even can play with. In short, this article lets us take a look to how alternative conceptions of the science-citizens nexus are rooted and strictly connected with a full set of assumptions, perspective and practices that characterize different cultural spaces such as hackerspaces are.

Finally, the third and last article of this special session, by Andrea Lorenzet, allows us to consider a different kind of cultural space for the circulation of nanotechnology in society, in this case the digital and virtual space of the world wide web. In this article, titled *Fear of being irrelevant? Science communication and nanotechnology as an 'internal' controversy*, the author aims at characterizing the circulation of issues and debates about nanotechnology in the World Wide Web, highlighting some peculiarities of the circulation of issues related with nanotechnologies and how there can be used as a source to understand the evolution of public controversies regarding this subject.

Starting from the idea that nanotechnologies have been recursively represented as a cause of a catastrophic event, such as the *grey goo*, Lorenzet refines the problem connected with the nanotechnogical risk by focussing on data generated from the monitoring of searches on search engines on the Internet referring to nanotechnological issues. The picture emerging from this work leads the author to characterize the web as a specific cultural space for the communication of nanotechnology: a space dominated by the professional involvement into the field, mainly connected with scientific research, academic publishing and corporate interests.

Hence, these and other data discussed in the article give the opportunity the author to ask provocatively if the debate about nanotechnology on the web is perhaps assuming the contours of an "internal controversy", a controversy that develops mainly within the professional sphere and that permeate only marginally the public and more mundane cultural space of citizens and consumers. The argument of the "internal controversy" is important because helps to consider how, in different cultural spaces, nanotechnologies are dealt with divergent perspectives, focussing on different issues, thus generating diverse processes of social framing.

The three articles presented in this special section certainly do not cover all the possible cultural spaces in which nanotechnologies are culturally articulated in society, nor did they manage to be fully comprehensive with respect to the specific situations they consider. However, taken together, they manage to draw, at least in part, a broader picture in which the relationship between nanotechnologies and communication in society has assumed a complex and very articulated arrangement. A broader picture that this *Jcom* special section has tried to explain in the light of a metaphorical map constituted by different cultural spaces with their own characteristics and peculiarities.

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