SISSA – International School for Advanced Studies Journal of Science Communication
ISSN 1824 – 2049 http://jcom.sissa.it/

Comment

NANOTECHNOLOGIES AND EMERGING CULTURAL SPACES FOR THE PUBLIC COMMUNICATION OF SCIENCE AND TECHNOLOGIES

Fear of being irrelevant? Science communication and nanotechnology as an 'internal' controversy

Andrea Lorenzet

ABSTRACT: How can technoscientific controversies be interpreted in terms of their public communication? This essay explores the case of nanotechnology to describe how one of the most innovative and cutting-edge technoscientific fields has moved from a grey goo scenario of PCTS that described similarities with biotechnology and GMOs, underlining the risks of potential conflicts between science and society, to the idea of an 'internal' controversy, that is a debate mainly present in discussions within professional groups. The conclusions suggest how the study of public communication of technoscientific controversies, and in particular of internal controversies such as nanotechnology, has lead to consideration of the idea of moving from a risk frame in public participation initiatives to a more open discussion on daily life, work activities, technological innovation, cultural representations, art and others.

1. Introduction: technoscientific controversies and PCST

Technoscientific controversies are defined as knowledge issues that trigger intense communication processes among a heterogeneous set of participants, and not only within the scientific community.[1] If they represented a novelty some years ago, right at the beginning of the struggles and confrontations that involved researchers and society during the biotechnology "years of controversy"[2] and the intense circulation of public discussions on issues such as GMOs[3,4] and human cloning,[5] it is now more common to consider science and technology as a domain that has a relevant and impacting social negotiation dimension.

The spread of technoscientific controversies reflects the growing relevance of two main factors affecting the relationship between science and society today: first, a manifested need of the scientific community to find new opportunities and procedures for adequate external communication, and second, the presence of divergent views, misunderstandings and disagreements both at the level of the scientific community and in the interaction with broader society.

The changes brought by these factors are ongoing and still imperfect for many reasons, but they appear today as a clear path in which society is more involved in science and, at the same time, science is more involved in society.[6,7] In order to prevent controversies from transforming into chronic conflicts, scholarly reflection within Science and Technology Studies has, over the last thirty years, developed a very sophisticated understanding of the mechanisms regarding media exposure of scientific facts and experts,[8] of the communication processes and of the practices taking place in research environments[9,10] and at the intersection between science and policy making,[11] and of the dynamics of public participation to scientific issues.[12] Moreover, research in the growing field of Public Communication of Science and Technology (PCST) has described the changes in communication models brought by the increased public role of science and scientists, indicating how criteria such as the changing conditions of public relevance of technoscientific issues, the priority assigned to some strands of research by the media, decision makers and in general by society, the consultations and negotiations that involve experts coming from different disciplines inside and outside the scientific community have impacted on the structure of scientific communication.[13]

While previous models insisted on the linear and one-way transfer of knowledge from the experts to the public and policy making in the frame of popularization of science and technocracy,[14] we are now in the phase of understanding the impact of the 'cross-talk' model of science communication,[15] that entails multiple fluxes and directions of communication going from the experts to the public, and also the other way round, and that is therefore in general terms more appropriate for interpreting public communication of technoscientific controversies.

Some distinctions are nevertheless necessary. When describing the metaphor of the 'cross-talk' Bucchi has stressed the unpredictability of contemporary public communication of science, but controversies are not necessarily in the domain of pure relativism. Even if the context of controversies is surely fuzzier and more complex when compared to the more traditional contexts of popularization, some basic characteristics of communication of technoscientific controversies can be identified by looking at how they involve actors, which actors they involve, and which is the main communication model that concretely guides their spreading. This work leads to recognize that not all controversies communicate with the public in the same way and that within a given controversy multiple models of communication can be present at the same time.

An initial way of interpreting controversies is to look at the reasons why different institutions and groups are involved in them. For example, local committees that take part in controversies like those that mobilize against the installation of mobile antennas in a neighbourhood are differently motivated from ordinary citizens reading about the confrontations and struggles regarding GMOs in the global media; while the former feel the need to defend and guard their land or home space, the latter are seeking to be correctly and fairly informed about a global issue to which they can be attached to different degrees. More considerations can be then made about the specific content of communication, and how metaphors and cultural representations influence public perception of technoscientific fields, not only at the level of public opinion, but also inside and within the professionals directly involved in a controversial technoscientific area.

Also in reference to those two aspects, here we address the issue of nanotechnology, the novel and emerging field of technoscience that has been particularly able to attract interest and funding in recent years, and that has caused a lot of debates and discussions, in particular within the professional world. So, we ask: how can nanotechnology be defined in terms of its public communication? How does the emergence of this technoscientific field help to clarify the features of public communication of technoscientific controversies?

2. Nanotechnology and the *grey goo* scenario of science communication

Several comments have been made in order to describe the communication of nanotechnology; these have been mainly pointing to the fact that nanotechnology should have been particularly careful as to not repeat the errors made in the case of biotechnology. Such errors have been recognized for their incapacity in adequately controlling the media exposure of scientists and experts, and, above all, in a limited consideration by members of the scientific community and policy makers of public perception mechanisms and social impacts of research.

Also for these reasons, at the early stages of the development of nanotechnologies, many scholars suggested with emphasis the need to address the social and ethical issues related to the future impacts of nanotechnologies, starting from the premise that these impacts were considered to be very huge and leading to a new forthcoming industrial revolution.[16] This view was also somehow connected to images and discourses put forward by a group of 'visionary engineers' guided by MIT graduate Eric Drexler,[17] hyping and generating expectations about the potentialities of nanotechnological applications in the future, thanks to an imagined nano-based production system called 'molecular manufacturing'.[18,19]

The importance of ethical and social issues brought by nanotechnology was also stressed in an influential paper hosted by UNESCO on its website:[20]

> As the science of NT leaps ahead, the ethics lags behind. Activist groups have appropriately identified this gap, and begun to exploit it. We believe that there is danger of derailing NT if serious study of NT's ethical, environmental, economic, legal, and social implications does not reach the speed of progress in the science.[21]

This interpretation contributed to the generation of a *grey goo* scenario around the communication of nanotechnology that insisted on the potential problems and on the negative implications that the spreading of public discussions on nanotechnology could have had for the development of nanotechnology itself. This was caused in part by the visionary hype that was surrounding and accompanying the development of nanotechnology and at the same time, by the lessons coming from the previous negative experience of public debates on GMOs:

> In August 2002, at the World Summit on Sustainable Development in Johannesburg, an organization called ETC held several workshops calling for a moratorium on the deployment of nanomaterials. Meanwhile, over the past few years expenditure on research and development in nanotechnology (NT) has increased dramatically [2]. These two trends seem to be on a collision course towards a showdown of the type that we saw with GM crops.[22]

> There are still relatively few empirical or theoretical studies on the public perception of nanotechnologies. Those that exist evince a recurrent concern that can be summed up as follows: the emerging sector of nanotechnologies must take care not to repeat the mistakes committed by biotechnologies.[23]

At the same time, an articulated debate on the epistemology of nanotechnology became relevant within the philosophy of science; in 2007 German philosopher Alfred Nordmann proposed another parallelism between nanotechnology and GM food, based on the concept of *noumenal* technology, defined as a technology able to 'heighten anxiety':

> Genetically modified food serve as a paradigm for this and, depending on how it develops, so may nanotechnology. They begin as purposeful interventions in nature (e.g. pesticide resistance) but their effects cannot ordinarily be observed or tracked even as they propagate through human bodies. Rather than reduce anxiety by assimilating nature to culture and by rationalizing the world through technology, such noumenal technology heightens anxiety. […] Such 'freestanding' nanotechnologies that are thought to act below the thresholds of perceptions and responsibility, provoke a mixture of abhorrence, awe, and fear that does not fit into the calculus of rationality.[24]

These comments all show how at the beginning of the nanotechnological adventure, the public fate of nanotechnology had been compared for several reasons to that of biotechnology, with the goal of motivating a greater deal of attention on nanotechnology's social and ethical issues on the side of the professionals working in the nanotechnology sectors, and therefore preventing the spread of disagreements and conflicts between science and society.

3. Nanotechnology as an 'internal' controversy and the *professionalization* of the publics

While the debate among scientists, policy makers, social scientists and ethicists insisted on the need of guarding nanotechnology from being perceived, interpreted and understood by the public in a similar way to biotechnology and GMOs, when we look to the actual circulation of the debate about nanotechnology in the media during recent years we hardly see traces of public controversies. Arguably as a positive consequence of the social and ethical reflections accompanying nanotechnology from its early stages, it is a fact that the indicators of media monitoring and public opinion show how little nanotechnology has been considered in terms of a public controversial issue, and has become relevant in the years 2004–2012 in the public domain in a rather smooth way.

During the period of 2000 to 2010, surveys conducted on nanotechnology actually showed that the public, both in Europe and the United States, has not been very aware of nanotechnology,[25,26] that for the majority of the public, the benefits outweigh the risks[27] and that nanotechnologies are generally considered useful, good, and positive.[28] Most surprisingly, a survey conducted in the U.S. among nanoscientists and the general public showed that scientists were significantly more worried about some long-term potential negative impacts on health and the environment of nanotechnology than the greater public.[29]

Moreover, the information demand by citizens on the topic of nanotechnology — measured through the tool Google Trends,[30] which plots the frequency of Google searches for select keywords over time — highlights how there has been a progressive decrease in public interest toward nanotechnology over the last few years, and that this interest has never reached that of other global controversies, such as biotechnologies and climate change (chart 1).

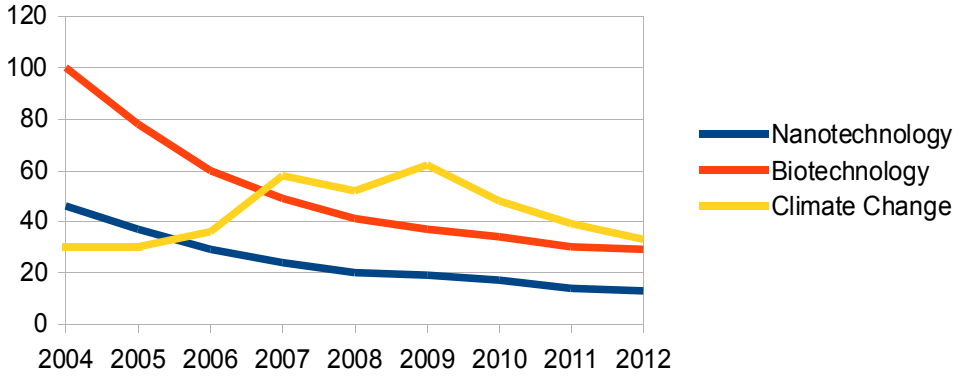

Chart 1. Global Information Demand on Google for nanotechnology, biotechnology, and climate change (source: Google Trends, normalized data).

At the same time, an analysis of the keywords mostly associated by Google users to 'nanotechnology'[31] shows that the interest in this topic is mostly guided by professional reasons. People who have searched on Google about nanotechnology, generally look for information in scientific journals such as 'Nature', or for information regarding research applications in this field (table 1). Also interesting is the search for definitions of 'nanoscience' and 'nanotechnology', as well as the interest in applications and engineering, thus showing that nanotechnology is understood and conceptualized as both a scientific discipline and a field of technological development and innovation.

1	nanotechnology journal	100
2	what is nanotechnology	75
3	Nanoscience	70
4	journal of nanotechnology	70
5	nanotechnology applications	60
6	nanoscience and nanotechnology	60
7	nature nanotechnology	60
8	nano technology	60
9	nanotechnology research	60
10	nanotechnology engineering	55

Table 1. Keywords mostly associated with "nanotechnology" by Google users (source: Google Trends).

A compared analysis of global and Italian information demand[32] (Google queries) and offer (newspaper coverage) gives other interesting insights; as displayed in chart 2, while the media tried to push the interest in nanotechnology, especially during the years between 2006 and 2008, both at a global level and in Italy, the public demonstrated being progressively detached from preoccupations regarding potential risks related to nanotechnology development.

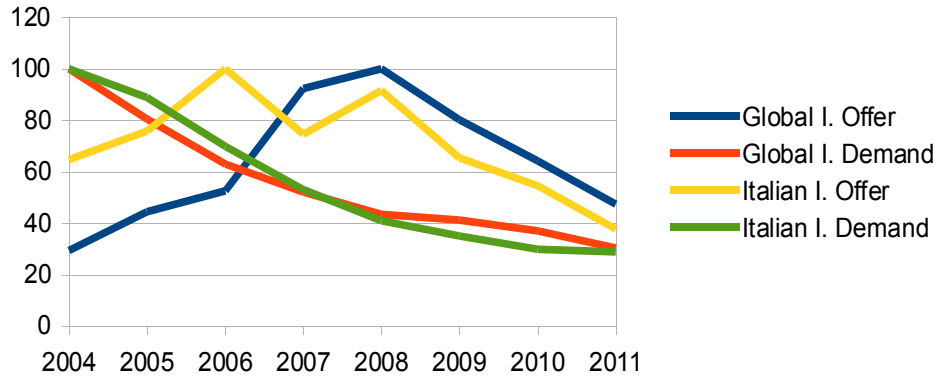

Chart 2. Demand and Information offer about nanotechnologies in the global and Italian press (Data: Google and selected newspapers archives).

The main controversial issues on nanotechnology in the period from 2006 to 2008 regarded the debate on the request of more research on potential risks related to the development of nanotechnology and on regulation of nanotechnology products. Among other initiatives, a call from the U.S. Food and Drug Administration for more regulation and safety in the nanotech production sectors followed the involvement of think tanks and NGOs such as the Canadian ETC group, that called for a moratorium on nanotech products.[33] These discussions were however more the reflection of interests belonging to selected professional groups already taking part in nanotechnology discussions, than the result of the presence of global public controversies involving large sectors of public opinion and the mass-media.

All these data taken together show that nanotechnology can be considered to be an 'internal' controversy, i.e. a debate in which discussions take place within professional groups (such as the scientific community, policy making, social scientists and ethicists, scientific journalists and so on) and tend not to reach wider audiences. While we lack at the moment clear indicators of the relevance of such internal controversies within the scientific community, we can nevertheless infer the relevance of nanotechnology discussions by considering the growing amount of funding received by the nanotechnology sector and the outputs of research; in the last 11 years, governments around the world have invested more than US$ 65.7 billion in this field (data 2000–2011)[34] while at the same time, a growing number of patents related to nanotechnology have been issued,[35] together with the realization of a number of nanotechnology-based consumer products that have increased year by year, as reported in the authoritative nanotechproject.org website.[36]

4. Beyond the 'risk' frame: internal controversies, PCST, and public participation

What can we learn from the nanotechnology experience for our understanding of the public communication of technoscientific controversies? The distance from the *grey goo* scenario of PCST and the structure of an internal controversy, which has emerged from the relationship between nanotechnology and the public, leads us to reconsider the Public Communication of Science and to reflect on its relationship with public participation in cases of controversies.

In terms of the structure of their public communication, internal controversies such as nanotechnology seek an active relationship with society and the public, but they seem to be limited in their 'popularity' in

the global media. At the same time, by engaging the public on societal and ethical issues from the very beginning, they are able to build a fruitful relationship that prevents the spreading of social conflicts and disagreements. But this is only part of the story. As demonstrated by several surveys on public opinion, very small sections of the public are actually aware of and informed on nanotechnology, leaving the question of participation and involvement open.

The communication of internal controversies such as nanotechnology can then be explained more clearly by making reference to a general ambiguity that seems to connect communication and participation during controversies; when a controversy is conflictual and polarized, top-down institutionally-organized participation initiatives that involve opposing factions may not be possible, because conflicts and polarization over controversial science prevent an easy negotiation and at the same time institutions and official experts may have problems of public legitimacy. In cases of internal controversies instead, adequate discussion with the larger public is possible but not easy, because the public, even if generally supportive, is rather detached and relatively poorly informed. Within this frame, internal controversies seem to be at an advantage in their relationship with the public when compared to more conflictual ones; even if they are less appealing to the larger audience, they are at the same time more responsible and careful in projecting and enacting their public role when this is considered necessary.

One additional issue about communication, participation and controversies regards the topic of risk;[37] many aspects dealing with participation during controversies are centred on the discussion of environmental or health risks and very often the frame of participation initiatives is strongly based on the discussion of risks, them being actual, projected or potential. One suggestion for making internal controversies more appealing to the public is therefore to not add unnecessarily to the discourse on the risks. Since the public is not worried and generally supportive, participation, in the case of internal controversies, can instead be enhanced in different ways, for example by opening the discussion to other concepts and topics that can stimulate involvement, such as the impact on daily life, work activities, technological innovation, cultural representations and art, among others. Moreover, an appropriate strategy of participation for internal controversies can be based on the specific targeting of audiences and from the involvement of professional groups that are already taking part in them not only as representatives of the institutions that speak to the public, but also as part of a specific public that is seeking direct dialogue with the policy level.

Notes and references

[1] T. Venturini (2009), *Diving in magma: How to explore controversies with actor-network theory*, in *Public Understanding of Science*, published on-line before print May 29.

[2] G. Gaskell and M.W. Bauer eds.(2001), *Biotechnology 1996–2000, the years of controversy*, Science Museum, London, U.K.

[3] L. Levidow (2000), *Genetically modified crops in the European Union: regulatory conflicts ad precautionary opportunities*, *Journal of Risk Research* **3**(3): 189–208.

[4] L. Levidow (2001), *Precautionary Uncertainty Regulating GM Crops in Europe*, *Social Studies of Science* **31**(6): 842–874.

[5] F. Neresini (2000), *And man descended from the sheep: the debate on cloning in the Italian press*, *Public Understanding of Science* **9**(4): 359–382.

[6] M. Bucchi (2004), *Can genetics help us rethink communication? Public communication of science as a 'double helix'*, *New Genetics and Society* **23**(3): 269–283.

[7] M. Bucchi (2004), *Science in Society. An introduction to social studies of science*, Routledge, London, U.K. and New York, U.S.A.

[8] M. Bucchi (1998), *Science and the media. Alternative Routes in Scientific Communication*, Routledge, London, U.K. and New York, U.S.A.

[9] B. Latour and S. Woolgar (1979), *Laboratory Life. The construction of scientific facts*, Sage, Beverly Hills (CA), U.S.A.

[10] K. Knorr Cetina (1999), *Epistemic cultures. How the sciences make knowledge*, Harvard University Press, Cambridge (MA), U.S.A.

[11] D. Guston (2000), *Between Politics and Science. Assuring the integrity and productivity of research*, Cambridge University Press, Cambridge, U.K.

[12] M. Bucchi and F. Neresini (2008), *Science and public participation*, in E. Hackett, O. Amsterdamska and M. Lynch eds., *Handbook of Science and Technology Studies*, third edition, MIT press, Cambridge (MA), U.S.A., pp. 449–473.

[13] M. Bucchi and B. Trench eds. (2008), *Handbook of Science Communication*, Routledge, London, U.K. and New York, U.S.A.

[14] M. Bucchi (2009), *Beyond technocracy. Science, Politics, and Citizens*, Springer, Heidelberg.

[15] See notes 6 and 7.

[16] M.C. Roco (2003), *Broader societal issues of nanotechnology*, in *Journal of Nanoparticle Research* **5**: 181–189.

[17] E. Drexler (1986), *Engines of creation. The coming era of nanotechnology*, Anchor Books, New York, U.S.A.
[18] S. Arnaldi (2010), *Ordering technology, excluding society: the division of labour and sociotechnical order in images of converging technologies*, *International Journal of Nanotechnology* **7**(2–3): 137–154.
[19] C. Selin (2007), *Expectationd and the emergence of nanotechnology*, *Science, Technology, and Human Values* **32**(2): 196–200.
[20] The paper is available at the following URL: http://portal.unesco.org/pv_obj_cache/pv_obj_id_81AA98C7F0D45A0AB9FF9CFA86959C86B6620400/filename/Mindthegap.pdf.
[21] A. Mnyusiwalla, A.S. Daar and P. Singer (2003), *'Mind the gap': science and ethics in nanotechnology*, *Nanotechnology* **14**: R9.
[22] Ibid.
[23] F. Neresini (2006), *Starting off on the wrong foot: the public perception of nanotechnologies and the deficit model*, *Nanotechnology Perceptions* **2**: 189–195.
[24] A. Nordmann (2005), *Noumenal Technology: reflections on the incredible tininess of nano*, *Techné: Research in Philosophy and Technology* **8**(3).
[25] M.D. Cobb and J. Macoubrie (2004), *Public Perceptions of Nanotechnology. Risks, benefits, and trust*, *Journal of Nanoparticle Research* **6**: 395–405.
[26] European Commission (2001), *Eurobarometer 55.2. Europeans, science, and technology*, available at http://ec.europa.eu/research/press/2001/pr0612en-report.pdf.
[27] See note 25.
[28] F. Neresini (2007), *Prima della prima*, *Sapere*, **LXXIII**(4): 6–13.
[29] D.A. Scheufele, E.A. Corley, S. Dunwoody, T.-J. Shih, E. Hillback and D.H. Guston (2007), *Scientists worry about some risks more than the public*, *Nature Nanotechnology* **2**: 732–734.
[30] Google Trends outputs data about searches by users on Google of selected keywords over time and in relation to other keywords. Data were collected at the website www.google.it/trends/ and display normalized values for the selected period of time.
[31] Data were collected through Google Trends and relate to the period of time between 2004 and 2012 on a global basis (all Google users, research conducted on the 28th of August 2012).
[32] Data about information demand was collected through Google trends. Data on Italian information offer was collected through the archives of two main Italian national newspapers (*Il Corriere della Sera* and *La Repubblica*), while global information offer though Google News archives.
[33] See the document "Nanoregulation: A recent scare involving nanotech products reveals that the technology is not yet properly regulated", available at the URL: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1559664/ (last accessed 22/11/2012).
[34] See http://www.cientifica.com/research/white-papers/global-nanotechnology-funding-2011/.
[35] Y. Dang, Y. Zhang, L. Fan, H. Chen and M.C. Roco (2010), *Trends in worldwive nanotechnology patent applications*, in *Journal of Nanoparticle Research* **12**(3): 687–706.
[36] See http://www.nanotechproject.org/inventories/consumer/analysis_draft/.
[37] U. Beck (1992), *Risk Society: Towards a New Modernity*, Sage, New Delhi, India.

Author

Andrea Lorenzet (Ph.D. in Sociology and Social Research, University of Trento 2008) is a Science and Technology Studies scholar and an expert in Public Communication of Science and Technology. He is currently a post-doc researcher at the Department FISPPA, University of Padova, where he is doing research on technoscientific controversies. He is also a collaborator at the research centre Observa Science in Society, where he is working on media monitoring and Web mining techniques.
E-mail: andrea.lorenzet@unipd.it.

HOW TO CITE: A. Lorenzet, *Fear of being irrelevant? Science communication and nanotechnology as an 'internal' controversy*, *Jcom* **11**(04) (2012) C04