



Quality, Honesty and Beauty
in Science and Technology Communication

PCST 2012

12th International Public Communication of Science and Technology Conference



Book of Papers

Edited by Massimiano Bucchi and Brian Trench

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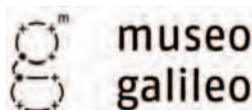


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PCST2012

**12th International Public Communication of Science and Technology Conference
Florence, Italy, 18-20 April 2012**

**Quality, Honesty and Beauty
in Science and Technology Communication**



BOOK OF PAPERS

Edited by Massimiano Bucchi and Brian Trench

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Foreword

The papers in this volume of Proceedings are a sample of the 450-plus presentations made to the 12th International Conference on Public Communication of Science and Technology held in Florence in April 2012.

These papers were received in response to a call to all presenters to submit papers up to three months after the conference. Except where indicated otherwise in the table of contents, these papers were presented either to parallel sessions of individual papers or to pre-arranged panel sessions.

The full programme of the conference remains available at <http://www.pcst2012.org/> where you can also find the [book of abstracts](#) and a summary presentation of the [results of an evaluation](#) of the conference by participants.

We hope you find enlightenment and enjoyment in this record of several stimulating days in Florence.

Massimiano Bucchi and Brian Trench

Co-chairs, Programme Committee, PCST2012



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1. Good, Clean and Fair: the ‘Slow’ Public Communication of Science and Technology Manifesto

Massimiano Bucchi, *Science and Technology in Society Programme, University of Trento, Italy*

Le quali opere sí perfettamente finì Andrea,
che più desiderare non si potrebbe,
se nate non che lavorate fossero;
così sono elleno di nettezza, di bellezza
e di grazia ben finite e ben condotte.

In quelle si scorge la osservanzia e le misure dell'arte (...)

Giorgio Vasari, *Le vite de' più eccellenti architetti, pittori architetti e scultori italiani, da Cimabue insino a' tempi nostri*

I am guided by the beauty of our weapons

Leonard Cohen, *First We Take Manhattan*

Why should we care about quality in PCST?

More than 25 years after the Royal Society report on Public Understanding of Science, there is hardly any doubt that science communication efforts aimed at non-expert audiences have increased in quantity and intensity on a global scale.

Public engagement and outreach activities have now become a routine – when not a prominent – feature for several research institutions in Europe. Budget and human resources are devoted to these activities, and researchers themselves are increasingly and even institutionally encouraged to pursue this ‘third mission’ alongside more traditional research and teaching duties¹.

However, it would not be easy for scholars and practitioners in this field, as well as for policy makers, institutions and actors involved in these communication processes to agree on the impact of these activities, on the long term implications of the ‘science communication movement’ and on which indicators we should develop and employ in order to assess such impacts. In other words, to tell the difference between ‘good’, ‘bad’ and ‘average’ public communication of science just as we do for other activities.

As recent studies clearly showed for the European context, while research and teaching functions of scientific institutions can count on established – albeit from time to time still discussed – indicators, public engagement functions are often still performed as a sort of ‘goodwill exercise’ (Bucchi and Neresini, 2011). Despite increasing general emphasis on public engagement and remarkable performances by a limited number of institutions, *a culture*



¹ See for instance Miller et al. (2002) and the European charter of researchers (2005). This document is available at http://ec.europa.eu/eracareers/pdf/am509774CEE_EN_E4.pdf

of public engagement still seems to be lacking among most research institutions in Europe – meaning an organizational culture in which these activities are appropriately recognised, evaluated and rewarded as part and parcel of the organisation life, routine activities, and identity as well as a relevant element of the broader institutional landscape in which the organisation operates; an element, for example, to be taken into account when relating to funders and policy-makers or when assessing and benchmarking its performances in relation to other organisations in the same area. In this light, having access to indicators and standards of performances might provide substantial support for those institutions and policy actors that wish to take seriously the challenge of public engagement and societal dialogue.

In short, the first reason why we should care for quality is that public communication of science should now be mature to pass from a ‘heroic phase’, in which ‘everything goes’ for the sake of communicating science, to a phase in which quality is the central concern for all parties involved.

The second reason why we should care for quality has to do with what I would define as ‘the crisis of mediators’. This crisis is not specific to science communication, but certainly particularly relevant to our field. Due to several factors which include the increasingly central role of digital media and the ever more pressing public relations push by research institutions, traditional mediators of science communication like newspapers, magazines, TV shows and science museums and centres see their centrality undermined as filters and guarantors of the quality of information. In PCST 1.0 (to use a familiar analogy with the web), the problem of quality was solved by the public by substantially resorting to information ‘brands’ and to their reputation. By and large, readers, viewers and visitors could confidently rely upon the idea that content printed in the science sections of the *New York Times* or *Il Corriere della Sera*, or broadcast by BBC or included in a major science exhibition would be a high-quality extract of results and ideas filtering from the scientific community.

In PCST 2.0, end-users have access to an unprecedented amount and variety of materials, including ‘direct-to-consumers’ materials provided by research institutions. More important, they have access to science in its making and highly controversial debates among specialists. Some of the implications of this new scenario have been spectacularly highlighted by cases like the online publication of email exchanges among climate scientists and, more recently, by the case of the ‘fast neutrinos’ – a controversy unfolding under the eyes of the public (and perhaps, another major brand, CERN, now under discussion?).

What does quality mean in PCST?

If the reasons mentioned above help clarify why we should care for quality, it is much more complex to establish what quality means in PCST; or more pragmatically, how do we tell the difference between good, bad and average PCST?

As you know, our field – and the topic of science communication more in general – has long been dominated by a normative impulse. Advisory reports and training courses have been arranged in many countries in order to instruct science journalists (and more recently, scientists too) on ‘dos and don’ts’, providing suggestions and sometimes even recipes for either better serving the logic of the research community or for exploiting media logics and routines. During the 1970s, Kantrowitz’s suggestion of an institution of scientific judgment—a science court designed to filter and certify the quality of scientific expertise to the benefit



of policy-makers – received presidential support in the US as well as severe criticism from scholars and commentators (Kantrowitz, 1967; Jurs, 2010). Various other attempts and calls to regulate science communication have failed for several reasons, including concerns for democracy.

Those of us studying the contemporary, broader dynamics of science in society are familiar with the two key – and often overlapping – arrangements that societies have used historically to deal with the results and products of science and technology and their implications. The first is the regulatory framework; i.e. state legislation and authorities defining ‘what should be done and what should not be done’. The second is the moral dimension, sometimes (too) simplistically identified with the ethics of specific professions – the idea being that the control on what should be done and should not be done lies firmly in the conscience of scientists and journalists.

Both these arrangements are facing significant limits and difficulties in our era and in the context of PCST 2.0. The regulatory arrangement is challenged by science and technology objects that have been defined – particularly with regard to the life sciences – as ‘mobile and private’, (think of genetic tests), making the usual nation-based regulatory tools and controls increasingly permeable. Likewise, the achievement of a moral consensus also appears less and less viable in the context of increasingly pluralistic and fragmented societies.

Moreover, one of the distinctive features of contemporary communication technologies and environments is to substantially displace traditional concepts of legal and moral responsibility. Who is responsible for contents, collective discussions and shared material on the web? The authors, those who upload it, viewers/readers, those who link it?



There is, however, at least another dimension through which we solve, in some circumstances, the issue of what should be done and should not be done, namely the aesthetic dimension. For example, and I hope you will forgive such a trivial example since we are in Italy, in Italy there is no law, nor any other compelling moral arrangement forbidding cappuccino after lunch, but every Italian knows this should not be done.

In a more general and conceptual sense, what we mean by *style* is the ability to perform this function of selection – and thereby quality definition – in different ways other than through policy obligation or moral duties. The last, incomplete piece of writing by Italo Calvino is the series of Norton lectures that he was supposed to deliver at Harvard. They deal with six different qualities – with style, broadly speaking – that it would be interesting to apply to science communication: lightness, quickness, exactitude, visibility, multiplicity, consistency².

But let me give you three short examples of style as a way to deal with the issue of quality, as well as to achieve certain results. Again, you will forgive me if I draw these examples from the Italian tradition, albeit all three are known internationally. By doing this, I certainly do not intend to suggest that style is only an Italian prerogative. Indeed, I am myself a great admirer of several established style traditions – e.g. British pop music, Scandinavian design, Japanese cuisine. The first example involves a famous figure from the history of science, who has a dedicated museum here in Florence – quite appropriate to introducing my final reflections.

[Video excerpts follow]

² Calvino (1988) only completed the first five lectures; of the sixth one, we know only the topic.

Style, science, communication

Nowadays, *style* is preeminently regarded as something which has to do with artistic expression, fashion, and taste. However, *style* has also been extensively studied in relation to the history, philosophy and sociology of the sciences. The classical work of Alistair Crombie identified (again!) six dominant styles of scientific inquiry and demonstration throughout the history of science. In his seminal analysis of the historical and social transformations of science theories and their public communication that was a source of inspiration for Thomas Kuhn's concept of paradigm, Ludwik Fleck emphasized the central role of styles of thought (*Denkstil*) as a socially reinforced and compelling "mood", constraining perception and orienting action, through which a community identifies problems of interest and appropriate research methods, together with "a technical and literary style characteristic of the given system of knowledge" (Fleck, 1935, eng. trans. 1979, 99).

In this perspective, communication on different levels – specialist and popular – of the same thought collectives leads to the corroboration and enhancement of "thought currency". Since an individual quite often belongs to multiple thought collectives at the same time, this results in intercollective communication across different domains and contributes to the shaping of scientific visions. The biography of Galileo offers beautiful examples in this respect, when he applied his competence in drawing and *chiaroscuro* to interpret his observations of the moon surface, or when he apparently solved the problem of dividing time into equal units for his experiments on the acceleration of falling bodies by resorting, as the son of a renowned musician, to musical rhythm (Bredekamp, 2007; Drake, 1975). For similar reasons, Galileo was inclined to describe orbits in circular form, elliptical orbits being in profound contrast with his humanistic training and aesthetic taste (Panofsky, 1956).

In the field of art, studies have shown the normative and perceptually binding force of decorative styles and patterns characterizing different historical and cultural contexts (Gombrich, 1979). During the Italian Renaissance, the term *virtuoso* (from the latin *virtus*, meaning power or capability) identified the moral spur of both "rational artists" and early natural philosophers as "a program for relating man to the world as perceiver and knower and agent in the context of his integral, moral, social and cosmological existence [...] a common style in the mastery of self, or nature, and of mankind alike by the rational anticipation of effects" (Crombie, 1996: 90). A style perfectly embodied by Galileo and other key figures of the scientific revolution.

In the following centuries, another Italian term, *Buongusto* ("good taste") became a powerful guidance for European elites in gastronomy as well as in culture at large, incorporating and summarizing new scientific knowledge, moral expectations and taste.

The 'slow' public communication of science and technology manifesto

By focusing on the concept of style and its importance for science communication – and more generally, for the history of science and its interactions with social domains – I wish to suggest that we should look at the theme of quality not only as a technical problem (i.e. finding appropriate indicators of performance and impact). Rather, I suggest the need for a broader vision of science communication that reflects a vision of science as an integral part of contemporary culture. From this point of view, science communication is not meant to be



just a ‘technical fix’ to impose social consensus, based on a narrow interpretation – albeit currently dominant in several policy contexts, including the EU – of science as a mere driving force of technological innovation and economic development.

One way, perhaps quite simplistic, to describe my proposal is as an invitation to integrate common discussions of the “ethics of science communication” with a no-less crucial discussion of the “aesthetics of science communication”. Another, perhaps more comprehensive way of presenting my argument would be as a call for a more humanistic, and indeed more humane, vision of science communication that moves away from the limits of its technocratic, functional definitions. In his *Discours sur le style* read when he became a member of the Académie Française in 1753 – a lecture that became standard reading for French pupils for almost a century - the naturalist George-Louis Leclerc, Comte de Buffon, argued that only style made scientific knowledge distinctively human and durable despite the quick obsolescence of its content. “Les choses [les connaissances, les faits et les découvertes] sont hors de l’homme, le style est l’homme même” (Buffon, 1753, 2007 : 427). In Bruno Latour’s terms, style could thus be described as bridging human and non-human actors in the weaving of knowledge production and communication.

But since I have cited the influential concept of *Buongusto*, let me conclude with an analogy to the food domain, and to another globally influential - although more recent – Italian movement, Slow Food, which heralded a new attitude to food as “good, clean and fair”.

Although this is, of course, not yet true in many parts of the world, one could argue that a reflection on the quality of science communication is just as mature as the reflection on food in a society which has increasingly satisfied its hunger for science communication and now has the possibility to focus on the quality and meaning of that food.

Thus, 21st century public communication of science should – or at least could – be *good*, meaning it pays special attention and care to quality. It should not praise and approve any science communication effort just for the sake of its aims or goodwill, but apply scrupulous scrutiny just as to any other performance and domain. It should reward best practices and openly and frankly criticize worst practices.

PCST should be fair. “Fairness” has also a strong historical and linguistic connection with quality, its root in many northern European languages recalling aesthetic harmony as well as equity, beauty and capability to please, moral purity and lack of bias. Related verbs in Dutch and German (*vegen*, *fegen*) refer to adorning, decorating, and cleaning (Scarry, 1999). PCST should be fair not only to institutions and actors promoting communication efforts, but to all parties involved, particularly in an era in which the distinctions between users, suppliers, mediators and even producers of information is increasingly blurred. One lesson from the crisis of the deficit model and traditional approaches is that fairness in the process is not less important than content accuracy as a criterion in discussing and evaluating the ‘success’ and implications of science communication. Finally, fairness may be interpreted as the openness to criticism and self-reflexivity. If science aims at becoming an integral part of contemporary culture, for example like art or sport, then it should eventually be amenable to criticism, selective incorporation and even misinterpretation just as those other areas.

PCST should be clean (again, as we have seen, cleanliness is etymologically connected with fairness), not necessarily meaning devoid of bias and subjective interests. New communicative scenarios have multiplied the number and variety of providers of science communication,



which inevitably bring in their own aims and strategies. Yet, transparency and willingness to problematize one's own definition of science communication – as well as the rationale underlying it – are probably among the keys to avoiding increasing generalized public distrust and sense of confusion in a time of proliferating, polyphonic and often controversial communication. PCST 2.0 requires, most of all, a more active and competent user, capable of discerning quality, although in her/his own terms. This probably calls, even more than in the past, on public institutions to provide stronger educational infrastructures rather than to invest in short-term, short-sighted communication efforts.

This is my interpretation of the topic of this conference, *Quality, Honesty and Beauty in Science Communication*. To me, they are different facets of the same, profound challenge that contemporary transformations in science and in society pose to us as science communicators and scholars. I really hope you enjoy the rest of conference and thank you again for being so many here in Florence.

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2. Panel discussion: Quality and Responsibility in Patient Engagement with Scientific Research Outputs

Cathy Southworth¹, *EuroSyStem and OptiStem, UK*; **Federica Balzani** *Member of the AISM National Group of Young People with MS, Italy*; **Emma Kemp**, *EuroStemCell, UK*; **Gianvito Martino**, *San Raffaele Hospital, Italy*; **Karen Walshe**, *British Library and Patients Participate! Project, UK*

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Context

There is a growing body of evidence that suggests that quality patient engagement improves the health outcomes of individuals, improving both patient knowledge and experience, including a better appreciation of treatments and their outcomes (Coulter and Ellins, 2007; Coulter 2012). One aspect of this engagement is the communication of current research developments from basic science to translational work. *Patients Participate* explored with various stakeholders the form this type of communication should take to best serve the needs of patients. The recommendations from this project and the underlying drive for more patient-centred health research information raises several questions for those science communicators and/or public engagement practitioners working in research institutions. It was with these practical considerations in mind that we put together this panel discussion; maybe if we opened up these questions to the wider community we could see ways forward.



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Federica Balzani: A patient's perspective

Federica's talk can be read in full in Appendix A.

Research is about the patient more than any other person as it affects their life and health in a very personal way. We want to know where the research that affects us is at and how it has evolved, explained in terms we understand. Including:

- The differences in research in the US and Europe and why they exist.
- How medicines are developed, tested and monitored and the motives of development for pharmaceutical companies.
- The process of research – How funding works, what is funded and why.

For most young patients, the preferred mode of communication is the internet, but it is important that this information is reliable. Real-time information, especially when taking part in clinical trials would be preferable. Face-to-face meetings and conferences with researchers also have an important role, especially when the programme is designed by the patients. Overall, we'd like to be more at the centre; to be able to ask questions and express opinions, so that our experience of the condition can contribute to and direct research.

Gianvito Martino: A scientist's perspective

As a scientist and clinician I'm confronted with questions every time I interact with patients (see appendix B for example questions). The consequence of this for scientists is that: (1) I have to be constantly updated on news about stem cells (this is not always the case among physicians) in order to judge the robustness of such news; (2) I have to try to explain to patients as much as possible about what is going on in the field using simple but precise wording; (3) Solid relationships need to be built between scientists, patients and patients' associations in order to be consistent with each other when providing information. All of this needs time to dedicate to patients which is to me, in these days, as important as curing them appropriately.

Karen Walshe: Multi-stakeholder's view – 'Patients Participate!'

The British Library's Science team worked in partnership with the Association of Medical Research Charities and University of Bath on a JISC-funded project called Patients Participate. The project looked at ways to make sense of scientific literature for patients, the public and anyone interested in biomedical and health research.

We held a workshop in June 2011 and invited representatives from patient groups, funders, researchers, publishers and libraries and asked: 'How can we work together in making sense of the scientific literature, to truly open up research findings for everyone who is interested?' Patients told us they want easy-to-understand, evidence-based information relating to biomedical and health research, in the form of plain-English summaries. Meanwhile, scientific researchers often find it challenging to communicate complex scientific information to the public in an accessible and engaging way. To explore how researchers could be supported, we interviewed representatives of organisations who currently produce easy-to-understand information on biomedical research for the public, and asked how they do it.

The project produced a set of reports and case studies which give insights into best practice in producing plain English summaries of research and guidance for those starting out, all available at <http://www.bl.uk/science-patients-participate>

Emma Kemp: A science communicator's view

EuroStemCell is an EU-funded project focused on engagement of a wide range of European publics with stem cell and regenerative medicine research. Patients are amongst our key stakeholder groups and we consider provision of reliable, accurate, up-to-date and trustworthy information on the latest science as a major part of our role. Our website, www.eurostemcell.org, is at the heart of this effort. Putting together the content for the site in a responsible and effective way means involving both the scientific experts and the patients we hope to reach. As science communicators, our role is to facilitate that process. Responsibility also means being transparent about the sources of our information. One of the important strengths of our project is the direct involvement of many leading scientists, each of whom is named and associated visibly with information they help to produce. We have confidence in the quality of our information and we know it is being used. However, production of carefully thought out and reviewed content takes time. A challenge we face and would like to discuss



is, 'How do we react quickly AND responsibly to breaking news? Can social media help us with this?'

Cathy Southworth

Optistem (<http://www.optistem.org/>) is a pan-European research consortium, funded by the European Commission, focused on the use of stem cells in muscle and epithelial disease. As a consortium we have a commitment to quality public engagement. One of our main stakeholders is patients. Having reflected on the Patients Participate' project we felt that producing 'lay summaries' of our main research papers would be an effective and practical way of making our research more accessible to a wider audience. Setting out on this task presented several questions: Who would write the lay summaries? Which papers should we choose? What should the structure and layout be? And, how will the summaries be disseminated? The issues that these questions raised centred around five considerations: accuracy, accessibility, relevance and credibility of the summaries and available time and resources. The approach we took was:

1. Written by a scientist using guidelines, edited by a science communicator, checked by the paper author.
2. The project co-ordinator (scientific lead) selects the most significant paper releases.
3. A structure and layout developed and evaluated by a patient organisation.
4. Disseminated via our websites Optistem and Eurostemcell but also through relevant patient group websites.

On reflection we still have questions about the best means of disseminating the summaries to patients to ensure a wide reach and also distributing guidelines and examples of our work to the wider science communication community. The time needed to produce summaries is quite intensive and so sustainability beyond the end of the consortium will need to be considered.

Discussions

The panellists agreed on four requirements of quality patient engagement with research outputs:

1. Accurate, accessible and consistent material
2. Solid scientist-patient-patient group relationships
3. Both web and face-to-face interaction
4. Patient-centred

Discussions with the audience focused on experiences of patient engagement and ways science communicators could support the communication of research. (See appendix C for the list of questions used to provoke discussion). The question of whether research papers represented 'accuracy' was asked, in relation to the way in which scientific papers



are published. The writing of accessible 'consensus papers' by several scientists in the field was suggested, which could prove more valuable than summaries of many individual papers. It was also considered that in addition to communicating the research, it was imperative to communicate about the research process. It was felt that doing this would empower individuals to interpret and assess research information themselves. The question also arose about the communication of unpublished data, particularly that data which may have shown that a particular method or approach didn't work. The use of 'consensus papers' could arguably include such unpublished work. But the difficulty of accessing this information even within the scientific field was noted. There was a general consensus that the best funding model for the production of 'lay summaries' was through the dissemination part of individual research grants.

Development of face-to-face relationships was agreed to be important not just in the communication of research information but in the building of trust. Whilst research clinicians often developed patient and patient-group relationships through their work, it was felt that science communicators and public engagement practitioners within institutions had a role to play in forging links between these groups and basic scientists. On this theme, it was also suggested that general practitioners and other healthcare practitioners were important target groups for the communication of research outputs, as these people were often the first contact for patients, many of whom will have research-related questions instigated by searches on the World Wide Web.

A suggestion was made that information about research outputs aimed at patients and provided on the web could be rated by readers, in order to get direct feedback from target groups. This question of evaluating quality led to discussions on the availability of guidance for scientists and public engagement practitioners on how to write material for patients. We agreed that it would be useful for guidelines, developed alongside the evaluation of material, to be more widely disseminated amongst science communicators and public engagement practitioners to prevent duplication of work. The Patients Participate project website was recommended for accessing resources to support such writing.



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3. **Changing the Conversation: A case study exploring the use of targeted science communication to influence national dialogue about cancer research in the United States**

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Introduction

Over the last 40 years the one powerful metaphor, the “war on cancer,” has become ubiquitous in the lexicon of patients, physicians, scientists, and policy makers engaged in discussions about cancer. Though there are many reasons why these various groups find value in integrating this metaphor into their lives, the metaphor is problematic for those who must engage these audiences in conversations about the progress made in the field of cancer research. Generally, a war is only over when a winner is declared. In this case, that would require an approach or treatment that leads to the eradication of cancer. In the 1970s, this may have seemed like a reasonable goal, but our understanding of cancer biology has changed dramatically in the last 40 years.



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We now know that a scientifically realistic outcome is that some cancers – relatively few – will be cured outright with amazingly successful treatments; we will be able to better prevent many cancers as we learn what triggers initiation and progression of cancer; most cancers will be diagnosed earlier and more thoroughly, allowing for better informed approaches to care; and the rest of cancers will be treated as chronic disease, vastly improving the length and quality of life of people living with cancer. Unfortunately, this narrative is not consistent with the “war” metaphor which requires an all or nothing resolution. Accordingly, the Office of Public Affairs and Research Communication at the National Cancer Institute has been engaged in various strategic science communication efforts intended to ensure that this more accurate framing is reflected in discussions among strategic stakeholder groups.

The birth of a metaphor

Shortly following the signing of the National Cancer Act on December 23, 1971, advocacy organizations in the United States began to herald what they now hailed as President Nixon’s “war on cancer”. Though Nixon never used these exact words, this did serve as a catchy rallying cry and neatly paraphrased what Nixon actually said in his *State of the Union Address* of 1971: “The time has come in America when the same kind of concentrated effort that split the atom and took man to the moon should be turned toward conquering this dread disease.”

By many accounts, this rallying cry has done great things for the field of cancer research. Thousands of activists have been motivated to contribute time, emotional support, and money to patients and researchers as part of the “war on cancer.” This was a war in which an ordinary citizen could feel empowered to engage, and for many years this collective action drove progress in research and clinical care resulting in significantly better patient outcomes than

were seen in 1971. Not only are incidence and death rates continuing to fall for the majority of cancer types, but the scientific community has a dramatically better understanding of how cancer develops and reacts in the body. However, this story of progress has regularly been eclipsed by media statements that we have lost or are losing the “war on cancer.”

Creating a new frame for progress

Given that the metaphor is so pervasive, the NCI public affairs team determined that it was unrealistic to expect that the “war on cancer” metaphor could be stricken from the cancer community’s lexicon. However, the team saw an opportunity to create a research-positive counter-narrative that reinforces the progress that has been made and redefines success based on what research has shown us about cancer. The desired outcome is that all high-level discussions on the topic of cancer research reflect this counter-narrative. To that end, the public affairs management team developed a three-tiered message matrix that captured central themes, subthemes, and proposed individual story lines that support the themes.

There are three central themes, eight subthemes, and an infinite number of story lines that could be created to support the themes. It is important to note that the matrix was developed as a messaging tool to reach strategic stakeholder groups, including policy-makers, thought leaders, and other third party surrogates engaged in the cancer research and policy arena.

The central themes capture general concepts that reflect the current state of science and funding related to cancer research and treatment. The subthemes expand on the implications of this current state. It is these subthemes that capture the most important points that the Institute hopes are most openly reflected in the discussions about progress and future research direction. As research findings emerge, the findings can then be associated with the most appropriate theme and subtheme.



Strategic Integrated Communications Management

Once the strategic messages had been identified, the public affairs management team sought to integrate the use of these strategic messages throughout all public affairs channels and platforms. The following activities were identified as priority targets for integrating this content:

- Media relations
- Third party public affairs partners
- Research news and budget communications administrative tools

In most cases, integration strategies resulted in proactive content development and stakeholder outreach. However, the balance of proactive to reactive strategies varied by activity.

Media Relations

The NCI has two media relations functions: an historically robust and responsive public information function and a newly established proactive placement function. The strategic messages were integrated into both functions in order to ensure that media coverage of cancer

research appropriately reflected the message point identified in the message matrix, thus influencing the dialogue of strategic stakeholders exposed to this media coverage. On the responsive side, when requests were not on a specific research finding or an interview request for specific person, the team promoted matrix-supporting story lines and provided context and resources that reinforced the matrix themes. This was particularly important as the 40th anniversary of the National Cancer Act approached.

Proactive media relations activities also used the message matrix to guide story pitching and story placement. The Institute's Director was very sensitive about calling broad attention to the anniversary of the National Cancer Act. However, there were other milestones that could be utilized throughout the year to set the stage for this dialogue, and a targeted effort could frame the conversation with critical stakeholders on the date of the Act's anniversary. Additionally, the public affairs team arranged a radio interview with the Institute Director on the day of the anniversary of the Act on NPR's Science Friday, which is closely followed by many of the strategic stakeholder groups intended to be the recipients of these messages.

Third party public affairs partners

There is a large network of organizations in the U.S. who have a vested interest in NCI's success. These organizations include public policy think tanks, patient advocacy organizations, and research institutions who receive NCI funding. Most of these organizations also have sophisticated public affairs operations that support research communication, grass roots advocacy efforts, and fundraising. Through these activities, these stakeholders reach virtually all potential strategic audiences in addition to a wide range of more general public audiences who might be inclined to engage in discussions related to cancer research and policy. In 2011, the NCI Office of Public Affairs and Research Communication established a proactive public affairs team tasked specifically with reaching out to these public affairs partners.

There are hundreds of research institutions in the U.S. that receive funding from NCI. There are 66 NCI-designated cancer centers that are particularly aligned with NCI's interests. The public affairs team focused primarily on efforts to strengthen relationships with these cancer centre PIOs. This required hiring a staff person specifically tasked with fostering strong working relationships with these PIOs. This staff person's role is to engage in discussions with these PIOs about their communications and news activities and identify opportunities to partner on message development when strategic stakeholders will be targeted. In these activities, it has been very important that the matrix messages do not directly contradict the "war on cancer" metaphor since these centers find this metaphor to be a powerful fundraising message, and it is our desire to harmoniously integrate the matrix counter-narrative.

Research news and grant communications administrative tools

As a complement to these relationship-building exercises, NCI's public affairs team engaged the grants administration team at its parent organization, the National Institutes of Health, to identify opportunities to integrate research-positive messaging in its externally facing activities. The grants administration office manages a publicly available database of all grants awarded by the 27 institutes and centres of the NIH. This database is used regularly as a resource by the media and policy makers. An approach to associating news releases and stories with the grants in the database was developed, and the team not only found a new channel



to push its messages, but is furthering public understanding of this research and its value by providing access to what is generally more lay friendly language on the topic. The NCI public affairs team began a pilot project in 2011 to feed such news releases and stories into this database.



4. When Errors Occur: Failure Reports/Public Failures

Deborah Dysart Gale, Peter Grogono, Concordia University, Montreal

Introduction

In recent years, the social importance of technology and the technogenic nature of social problems have highlighted the need for engineers' active participation in the democratic deliberative process. But, as noted by civil engineer and author Samuel Florman, "At a time when we need engineers who are leaders, and leaders who understand engineering, we are not producing either" (1996, p. xiv). Engineering educators and accreditation boards seek to remediate this problem by introducing new skills into the curriculum, including awareness of the "non-technical implications of engineering practice" (European Network for Accreditation of Engineering Education, 2008), "broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context" (American Accreditation Board for Engineering and Technology, 2012), and engineering's "interactions . . . with the economic, social, health, safety, legal, and cultural aspects of society" (Canadian Engineering Accreditation Board, 2008).



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Such curricular inclusions prepare engineers to participate as experts and engaged citizens in public debate about technology-related issues. The pedagogical question is how to provide engineering students with the skills to communicate effectively with the general public, beyond the rhetorical culture of engineering. The project uses the trope of *failure* to explore the rhetorical culture of engineering. In particular, we examine how the *Failure Reports* of the international development organization Engineers without Borders, while presented as transgressive discourse, affirm and reinforce the dominant discourse of engineering.

Rhetorical Culture

As all professions, engineering is organized around a corpus of knowledge and practices, as well as norms, beliefs and values, which together characterize engineering's rhetorical culture. Cyphert (2001) describes "stable rhetorical culture" as possessing "a matrix of moral presumption, prudent politics, common sense, and public decency . . . enforced by a securely knotted web of rhetorical norms" enabling community response to exigencies and productive decision-making (p. 379).

The rhetorical culture of engineering is stable, not static, continuously adjusting to internal and external exigencies. Its rhetorical rules are flexible enough to accommodate plurality of views, but strong enough to ultimately maintain organizational and professional stability. De Certeau characterizes the discursive that maintain this balance as strategies and tactics (1988). Strategies reinforce power relationships, while tactics challenge and resist the status quo. Citing Foucault, however, Fassett and Warren (2004) observe that because power circulates throughout a community, tactics paradoxically reinforce the power structure by acknowledging its dominance.

As a means of exploring the strategies and tactics of the rhetorical culture of engineering, we explore the use the trope of *failure*. As noted by Samuel Florman, the public view of

engineers has alternated between benefactors of mankind and the authors of technological malevolence, depending on the perceived goodness, effectiveness, and benefit of engineering products. *Failure* becomes a crucial trope for engineers, in the profession and wider society.

Failure as Trope

In general social discourse, failure presents an occasion for rhetorical repair of image. Rhetorical tools for this purpose are summarized by Edwards (2008):

- Denial (including blaming victims)
- Mortification (accepting full responsibility)
- Evading responsibility (an accident or derailing of best intentions)
- “Reasonable practitioner” response to provocation
- Reducing offensiveness, associating act with less offensive acts or differentiating from something worse.

Corrective strategies may include:

- Offering a form of symbolic compensation (such as accepting responsibility or blame)
- Reimbursing or repairing the damage
- Outline steps to prevent recurrence



By successfully combining these discursive tools, the competent rhetor moves the incidence of failure to a positive conclusion. While these rules obtain in general discourse, they are not utilized in the rhetorical culture of engineering. Rather, *failure* is viewed as inevitable and, if properly appreciated, the main catalyst of improvement, an essential part of the engineering process:

Everything designed has its limits and its flaws . . . designers are constantly criticizing the world of things, which is what leads to new designs for new things . . . failure is the key to design (Petroski, 1985, p. 42).

Within the rhetorical culture of engineering, failure is not an occasion to acknowledge responsibility and promise to prevent recurrence, but rather as the key to progressive engineering practice. This obligation is professional and collective, not moral or individual. Engineering work occurs within teams. Individuals, insofar as they can be held responsible for an engineering failure, may not be the proper agent to assess or remediate it. Assessment falls to forensic engineers, publishing in journals such as *Engineering Failure Analysis* and *Journal of Failure Analysis and Prevention*, in which failure is presented as a function of methods and materials rather than to engineers personally.

The difference in use of *failure* in general and engineering discourse is a cogent illustration of incommensurability between the two discursive communities. While general discourse seeks personal responsibility and acknowledgement of the harms brought by failure, engineering discourse looks only to structure, methods and materials. This incommensurability finds expression in the assertion that engineers are detached from the negative social and human impacts of their practice.

Failure Reports as Rhetorical Resistance

There are, of course, voices of dissent within engineering, whose tactical discourse calls for greater attention to the human impact of engineering. Such voices are heard from Engineers Without Borders (EWB), a nationally coordinated volunteer group with chapters at major universities, pursues sustainable, community-focused development projects in Africa. Since 2008, EWB Canada has submitted annual *Failure Reports*. It also instituted admittingfailure.com, a website inviting members of the development community to share stories of failures as a means “towards humility, innovation and learning”. These efforts aim to “establish new levels of transparency, collaboration and innovation within the development sector.”

Such tropes as *humility* and *collaboration* position EWB in opposition to dominant engineering discourse, a position tactically pursued in the *Failure Reports*. There the trope *failure* is used in the general discursive sense. The contributors, it is asserted, speak in term of personal failing and responsibility rather than on materials and methods. The reports themselves are organized with an introduction, followed by a forward by a mid-level EWB officer, a table of contents, and finally stories of failure written by returning field workers or even prominent EWB personalities. The introductions, written by non-engineers, symbolically link public and engineers. Bill Gates, Sr., in the 2010 issue, called the reports an act of “bold leadership”, while Sarah Elizabeth Lewis, in her introduction to the 2011 issue, called them “courageous”, citing EWB’s “humility, transparency, and self-criticality.”



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In the content of the reports, the authors accept personal responsibility for failure in a number of situations: poor preparation for critical meetings with politicians, incomplete understanding of complex local power structures, hubris and impatience in moving forward public projects without adequate local support. Such reports transgress dominant engineering discourse and evidence many of the characteristics of the rhetorical management of failure found in general discourse, especially accepting personal responsibility, acknowledging harm and consideration of appropriate redress.

However, while the reports deviate from the rhetorical culture of engineering in admitting personal responsibility for failure, they return to their rhetorical roots when proposing corrective strategies. Here, the authors become forensic engineers, critiquing their performance as “failed parts”. A poorly prepared meeting with a politician becomes an occasion for “improved knowledge management”, inappropriate advocacy of a prototype is a problem of project management with premature scale-up.

Conclusion: Hybrid Rhetoric

The rhetorical strategy of the *Failure Reports* thus represents an interesting hybrid. On one hand, it transgresses the dominant discourse of engineering by reflecting directly on the role of the individual engineer in the negative impact of his or her practice. In so doing, this rhetoric forms a collaborative link with the general public, explicitly rejecting failure as the opportunity for improvement. On the other hand, the discourse of the *Failure Reports* reverts to dominant engineering discourse on the subject of remediation/redress, treating human failure as the subject of engineer processes.

This hybrid rhetoric offers a positive, “best of both worlds” model: the moral reflection prescribed by general discourse, together with the outcomes-focused problem solving approach of engineering discourse.

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5. Making technologies and their publics visible in science communication: the case of low-carbon technology

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In recent years, UK government, research funders, learned societies and industry have sponsored numerous dedicated initiatives to engage publics around so-called emerging technologies. These include various “top-down” attempts to communicate basic scientific knowledge, convey enthusiasm about research and possibilities for future technological applications (especially common in the biomedical domain) and increasingly, communicate science related to emerging collective problems (climate change especially). They also include ostensibly more interactive efforts, such as public dialogues on topics such as GM crops, stem cells and nanoscience.

These efforts have been widely studied as attempts to *create* or constitute publics around science and technology in specific ways that are open to question (e.g. Irwin 2001, Irwin 2006, Martin 2008, Michael 2009, Mohr 2011). By contrast, the ‘self-creation’ or *emergence* of active publics has traditionally not been considered in the public engagement literature, though it has been studied under the rubric of social movement studies, or latterly, citizenship (e.g. Elam & Bertilsson 2003, Hess 2010, Walker et.al. 2007). Active publics have, however, begun to impact on discussions of public engagement since 2003’s *GM Nation?* where self-selected, highly motivated individuals armed with various critiques of GM crops attended open events organised to discuss the possibility of commercialising GM, and overturned all ‘normal’ expectations of how such public dialogues should be run. In light of critiques by policy-makers and dialogue evaluators that these ‘uninvited’ publics were unrepresentative of the general public, policy expectations of public dialogue as a space meant only for ‘innocent citizens’ have in turn been critically examined (Lezaun and Soneryd 2007, Wynne 2007).

We ask here, firstly, how can we account for different ways in which publics are constituted around science and technology? We suggest that examining the socio-technical network around an imagined or existing technology can illuminate the *creation* or *emergence* of publics (including those of the kind ‘unwanted’ or ‘uninvited’ by science policy-makers or engagement practitioners). Secondly, we ask *which* publics are made visible through these networks, suggesting that networks are bounded by the actors within.

‘Upstream’ and ‘Downstream’ technologies

Our first step contrasts the differing nature of engagement that takes place ‘upstream’ (with a ‘technology in principle’, where economic and physical configurations are yet to be determined) and engagement ‘downstream’ (where economic, physical, technological and social implications are readily apparent, with applications proximate or already in existence).

Our underpinning hypothesis is that where engagement is ‘upstream’, there is more opportunity to carefully manage the engagement process and bring in the right sort of publics (from the organisers’ standpoint). Even where there is significant controversy, there is potential for ‘friendly’ engagement as in 2008’s UK stem cell dialogue (Mohr, Raman and



Elliott 2009). By contrast, where the technology is already evident, its tangibility or materiality makes a difference. Efforts to stage-manage public proceedings persist but they're more likely to be disrupted by publics organised around the entanglements that structure the technology.

Upstream and Downstream Communication: Differing Challenges	
Upstream is unformed, conceptual	Downstream is tangible, here in the world
Publics are shadowy, unknown, not yet emerged	Emerged publics more typical
Engagement focuses on knowledge and risk	Engagement closely aligned with enrolment (and marketing)
Public voice via friendly science engagement or carefully designed formal dialogues	Public voice often more agonistic with contested power, sometimes negotiated via regulators, planning processes
Consensus is an ideal to be pursued	Opposition can quickly become hostile and entrenched
Conflict often based on knowledge claims, sometimes innate values	Conflict focuses on the shape this technology takes, and features of the wider (socio-technical) network
Engagement work can be carefully designed - so can its publics	Efforts to 'stage-manage' remain



To illustrate some network aspects that shape the emergence of active publics, we present two short cases based on renewable energy technology in Scotland. The first draws on the case of wind energy to show how a perceived diffuse support for renewable energy in principle can quickly become irrelevant in the face of a specific *material* proposal. The second, on proposed biomass plants, shows networks wider than the local, as global effects and publics are evoked during processes of opposition.

Downstream begets (some) publics, though still masks others? Wind energy in Scotland

Scotland draws on a vast natural resource base (rich in wind and tidal energy) with some of the most aggressive renewable energy targets in Europe. As a mature technology with accessible entry costs, wind power has become a significant technology in harnessing this resource and meeting targets – not without controversy. Emergent publics have coalesced not so much around contested evidence for climate change, but around whether onshore wind is the *best* solution, and around physical manifestations of particular developments. Concerns span physical, procedural, commercial and political arenas – aspects which only come to light when technologies approach implementation. Active publics have disrupted numerous developments, expressing concerns about siting, scale, operating parameters, development process, ownership and physical grid connection as well as more technically-based issues such as intermittency. This explanation of the complexity of public response can be contrasted with more general exhortations of the 'green economy', where technology is

considered unambiguously good. By taking seriously the behaviour of emergent publics, we more fully see the nature and extent of the broader ‘socio-technical network’ opposition is embedded in.

Expanding networks – and publics: the biomass case

The wind energy network made visible by active publics only goes so far. More remote publics involved in producing materials that make up turbines are being made visible in trade and financial press, with concern about China’s control over the ‘rare earth metals’ essential for producing many modern technologies including PV cells and wind turbines. Interestingly, there is little discussion or elaboration of this in activism around Scottish wind power.

This is in direct contrast to proposals for new biomass capacity in Scotland. Where the wind energy case exemplifies local opposition and local concerns, the biomass case illustrates a more global public being invoked. Additional to immediate misgivings about siting, scale and local pollution, questions are also raised about where this biomass material comes from, what impacts its extraction has on the remote region, and what ethical promises can be given for the plant’s future operation.

So, do ‘technologies produce publics’?



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We might say yes, though in a way that is highly dependent on context where publics differ in origin and intent as well as composition and location. Publics created by a sponsor around upstream technologies can be contrasted with publics that emerge from civil society around near-market (downstream) technologies. Materiality makes a difference, and helps unpack the ‘black box’ of technology, making the wider socio-technical network more visible. However, this is an uneven ongoing process – in the low-carbon case, some parts of the network (and its publics) remain relatively invisible (e.g. the sourcing of rare earth metals in wind energy), though are becoming more visible elsewhere (e.g. the consequences of globally sourcing biomass for energy generation). Finally, we should not make the mistake of considering emergent publics to be solely oppositional – it is not difficult to find examples of emergent publics being incorporated into mechanisms of sustainable energy governance, or elsewhere, working with the pharmaceutical industry in the search for new treatments for rare diseases. Whether such public/private partnerships deliver fairer outcomes or represent a form of co-optation into elite agendas is a key question needing further research.

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6. Constitutive contexts of a discourse ecology: communicating risk in the aftermath of the Fukushima nuclear incident

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This paper reports on early findings from a study examining Canadian Internet-based communication (from government, industry, news media and the public) associated with the risk of radiation exposure to Canadians from the Fukushima nuclear incident. Our approach acknowledges Hawk's (2004) view that Internet 'texts' must be considered in the context of their production and reception, that is, defined and studied within their specific contexts of use.

While risk communication researchers have emphasised 'situation' in the communication of risks (e.g. Blythe, Grabill and Riley, 2008; Boholm, 2009; Sellnow and Sellnow, 2004), much of this research has focused on the methods used to analyse localised concerns. Methods for identifying communication contexts pose challenges, however, when potential risks are spread over large geographical areas, and when related communication events primarily occur over the Internet.



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In fact, the bulk of rhetorical and discourse analytic work on risk communication focuses on the analysis of media reporting. As such, it tends not to consider intersecting discourses that make up the wider communication context (Stewart, 2005). Bazerman (2001) is one of the few researchers to explore contextual factors of radiation risk communication outside media reporting. In a rhetorical analysis of anti-nuclear group newsletters during the Cold War period, Bazerman concludes that researchers need to explore "the entire sets of relations, actions and texts within which information is formed and deployed" (p. 290-1).

We analysed a set of intersecting communicative events that represent a pivotal moment in the online Canadian discourse on radiation risk: the announcement by Canada's Prime Minister, Stephen Harper, that the Fukushima incident posed no radiation threat to Canadians. This announcement was made by Hon. Stephen Harper at an unrelated press event on 15 March 2011. It was the focus of a Canadian Broadcasting Commission (CBC) online media article containing statements gathered from previous media articles, an online statement from the British Columbia government advising people not to take iodide tablets, and an interview with Health Canada's senior medical adviser (also advising Canadians not to take iodide tablets). The CBC article also cited the Ontario Ministry of Health and Long-Term Care website about the stockpile of emergency nuclear supplies.

Along with the CBC report, we analysed Internet-based texts associated with Harper's announcement: 877 public comments posted in response to the CBC article, and Internet sources cited by posters of these comments. At the micro level of analysis, we looked at features of these texts that indexed the location and state of knowledge (e.g. reported speech and modality). At the macro level, we investigated the chains of citation linking comments

on the discussion board to other Internet genres, and the contexts these citations introduced or emphasised.

Exigencies that shape participation in public discussions of risk

While there is much to be said about the data we analysed, for the purposes of this presentation we focus on the ways posters report, assess and take up the speech of others. Reports of speech, chains of citation and other markers of interdiscursivity (modal expressions) are important sites for investigations of online risk communication. We aim to better understand such communication as a discourse ecology, one that accounts for, to borrow Bazerman's (2001) wording, the social relations, actions and texts within which information about radiation risk was formed, deployed and managed.

Authoritative Speech and Authorising Contexts

What is most notable in the analysis of posters' comments about Harper's claim that the Fukushima incident posed no risk to Canadians was the way in which participants in this discourse managed the official discourse and in managing it widened its discursive terms of reference. On a syntactic level, evidence of this management shows up in what has been called referred-to speech (Chafe, 1994), the naming of a speech event rather than a direct or indirect report of what was said:

[Harper's] unheeded (but politically expedient) **remarks**

But I don't trust our governments [sic] **statement**

While such instances of referred-to speech can appear to authorise speakers' utterances, as de-contextualised, officialising entities, these particular instances index a kind of de-authorised (and above, untrustworthy) utterance status; Harper's utterance – though the focus of attention here – is taken up and circulated among many other utterances or kinds of utterance (e.g. on-line media reports, scientific data, blogs). These instances of referred-to speech also occur alongside indirect reports of Harper's speech that draw on political and economic contexts not related to the question of radiation risks:

This is the same Stephen Harper . . . who told us . . . not to worry about a recession because there was no down turn in sight . . . ? And now he's going to pretend to be a nuclear physicist and tell us not to worry about radiation . . . ?

While many posters defend Harper's right to speak, many more cite his past political and economic statements as an opportunity to question the credibility of a Prime Minister who is about to launch a federal election. Ostensibly about the risks of radiation, these statements intersect to shift contexts of utterance.

Traffic in knowledge: Certainty and Uncertainty

In the CBC online article, radiation risk is expressed in terms of certainty; in fact, syntactically, there are a number of features, including 'existential there' (see below for one of four instances in this text), that construct statements as authoritative and propositions as factual.

there is no evidence of a scenario that presents any risk to this country in terms of these things



In contrast, the public comments associated with this article shift the discourse from political truth or fact to uncertainty, for example:

If dust from Chinese dust storms **can** make it across the pacific, it **seems likely** that radiation could too

We would expect to see these constructions of uncertainty (e.g. the use of epistemic modal expressions such as ‘seems likely’) in the scientific or research genres. These features open up the definition of risk to more uncertainty, intervening in the certain political agenda setting discourse and keeping alternative interpretations of risk in play. The assessment of concern for radiation risk to Canadians from Fukushima, while reduced in the CBC media article, is amplified in many of the public comments.

Discourse relationships in chains of citation

We also isolated public comments linked to other Internet-based sources. Posters introduced Internet-based texts from alternative media sources (PrisonPlanet, Counterpunch, and M&C), and mainstream media commentary, particularly international media (United States, Australian, Russian, and Reuters). These texts were cited to support perceptions of a lack of quality or bias in Canadian mainstream coverage of radiation risk.



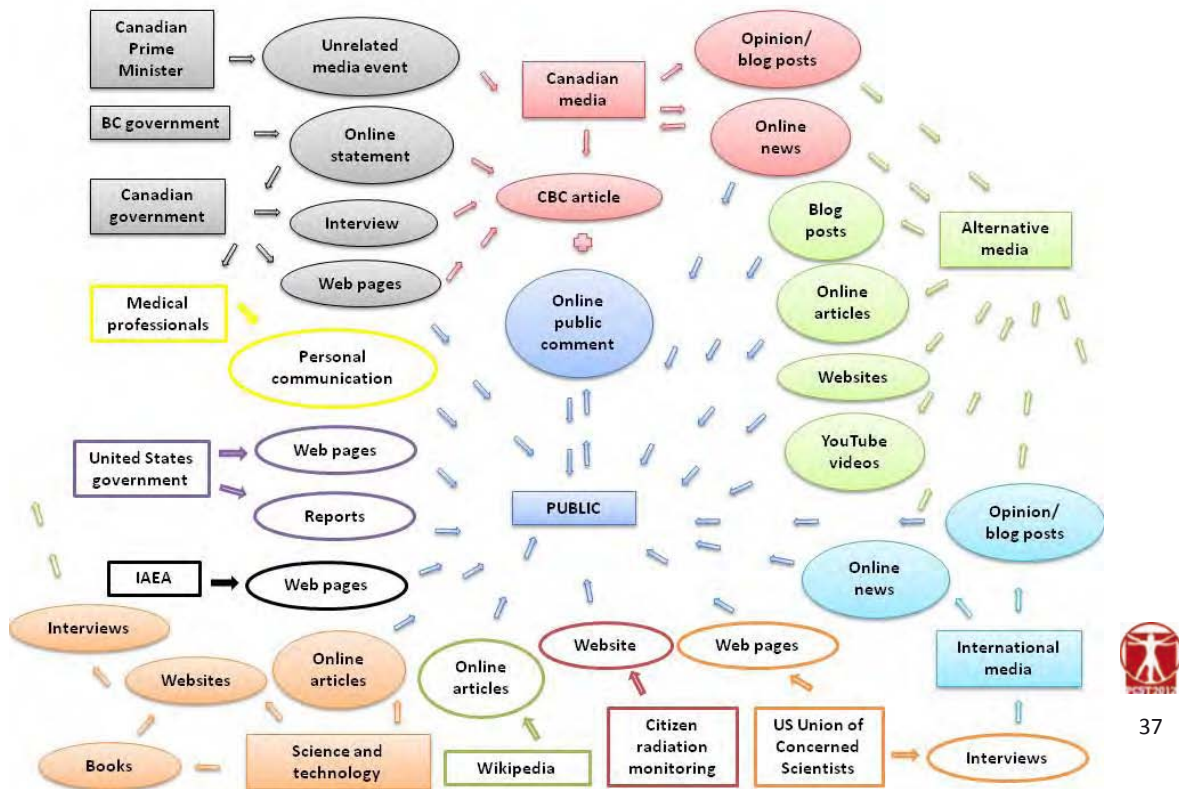
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Posters also cited scientific sources on assessing radiation risk in general (e.g. international radiation monitoring websites, and online articles from scientific bodies about radiation and its effects). The US Union of Concerned Scientists (webpage and comments in the Guardian online) was cited in relation to how far radiation plumes could travel. Posters also referred to a citizen radiation monitoring website for independently identifying radiation levels on the West Coast of Canada.

Interestingly, posters only cited government webpages unrelated to Canadian radiation risk from Fukushima: the safety of full body x-ray scanners (Health Canada’s Healthy Living page on full body scanners) and Canada’s humanitarian efforts in Japan (the Disaster Assistance Response Team). United States government reports and webpages on radiation risk protocols (more stringent) and the use of iodide (recommended) were also cited.

While Figure 1 (below) does not represent all the related Internet genres and discourse communities at the time of the Prime Minister’s announcement, it provides us with a sense of the range of contexts that are brought into Internet-based public discussion of risk.

Figure 1: Internet discourse ecology for Canadian radiation risk communication



Some reflections

Not surprisingly, the Internet public presented in this discourse ecology are engaged, skeptical and uncertain in response to government and media reporting of radiation risk to Canadians. Posters were resistant to the certainty expressed by government in media reporting, and were open to alternative interpretations of the risk situation. While posters look to other mainstream media sources (Canadian and International) for information, they also engage with materials produced by alternative media, scientific groups, citizen science groups, and science advocacy groups. So while public comments may, to an extent, be shaped by and respond to mainstream Canadian media commentary—a criticism Murdoch (2010) makes about public discussions of risk on the Internet—it is clear that posters are actively engaged in a process of sustaining and regulating talk about the context of utterance itself (e.g. who has the right to speak) and introducing new contexts into the discussion through other Internet-based sources (e.g. the dangers of full-body x-ray scanners and political and economic contexts external to radiation risk).

The discourse ecology approach shows promise for examining the dialogic aspects of large-scale risk communication events. It provides a way to investigate the interactions of multiple discourse communities and the contexts of their interactions on a broad scale. Future research in the larger project will investigate if/how the discourses of communities shift over time, including the function of communicative feedback loops into the system.

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7. Representing science-in-the-making in exhibitions

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This paper looks at three exhibitions to examine the changing roles of science exhibitions from places of “cold” science, where stable knowledge is communicated, to places that increasingly engage with “hot” science, controversial research, open debates and unfinished science.

The Open Research Laboratory

The first example is the Open Research Laboratory at the Deutsches Museum in Munich. Seen as a means to encourage the public understanding of research, this functional laboratory-in-the-museum has been set up in space accessible to the museum visitors.

The open research laboratory carries out and shows “live” research in nanotechnology. The aim of this laboratory is to display, explain, and discuss nanotechnology and, at the same time, to carry out research activities. At first sight, the open research laboratory looks like an ordinary laboratory. We see scientific equipment on benches, such as a scanning tunneling microscope; there are computers, researchers, chairs, and desks; experiments are being carried out. Yet, putting research and researchers on display inside a museum means rethinking and reorganising the laboratory’s material and social architecture. So monitors have been duplicated to enable visitors to see what the researchers see on their computer screens. Other elements that were added include: a 1.2-metre glass wall to separate the laboratory and the visitor, large video screens, demonstration objects, information boards, posters, leaflets and flyers.

Clearly, the laboratory-in-the-museum has to deal with a new, “extended” object-world. The laboratory is populated by objects that *perform* work (like a microscope), objects that *display* and *explain* work (like models used for demonstrations), and objects that *focus* and *frame* attention on the performance and explanation of work (posters and information boards, signs).

There are several challenges for the researchers who work in the open research laboratory: they have to be “on display”; they have to cope with a certain level of noise; they have to work within museum opening hours; they are not working inside their university for a certain period. Challenges also lie in communication between the researchers and the visitors. In a museum, researchers not only interact with peers but with a diverse audience, which means that they have to explain their research to lay people and limit their use of scientific jargon. What’s more, they have to initiate discussions with visitors and encourage them to ask questions. For researchers, the laboratory-in-the-museum redraws the lines between essentially private and public spaces, between scientific research and science communication, and between experiment and experience.

The majority of the visitors like very much the discussions they had and they comment positively on the comprehensiveness of the explanations given. Yet, most visitors do not



seem to experience their visit to the open research laboratory as a real “dialogue”. Most schoolchildren feel it to be a “situation at school” rather than a “discussion” or a “round of research between friends”. The museum’s experience also shows that instilling a pro-active attitude in visitors and getting them to ask questions is anything but easy. Some visitors reportedly do not “dare to disturb” the researchers.

The *Gallery of Research*

My second example is the *Gallery of Research*, a gallery that was due to open in 2006 in Vienna. Here is how the gallery was described on promotional material to advertise the first pilot event in the (unfinished) gallery: “The Gallery brings together scientists and artists (...), and engages them in a reflection on alternative ways of communicating scientific results to a larger public of non-experts. The public debate on GM food is only an occasion to talk about new forms of science communication. A purpose-built installation will confront the visitor with the complex ethical, social and political dilemmas of the food controversies”.

The Gallery’s purpose was “to tackle not only successful scientific findings, but also challenges, unpredictable turns, pitfalls, failures and aberrations in research”. The project experimented with a new architecture of display, drawing on art installation and science, in order to create a forum in which various groups could debate, and where art and science could be brought together. The exhibition included, amongst other things, a video installation showing an anti-GM demonstration, an art installation with empty tins with labels of GM crops, a wall with keywords (in different size and colour, depending on their significance in the controversy), a timeline of the GM history. The exhibition was described as a “blend of art installation, original scientific research and live performance aimed at positioning the visitor in a simulated public space” (Yaneva et al. 2009). According to the gallery director, the whole installation provided a “setting that is reminiscent to the atmosphere created by the controversy. (...) the tensions in the debate were also reproduced by the irregular geometry of the installation” (personal interview).

However, one of the problems was that the invited scientists were not at ease with their new, more performative roles. Also, the public was “not yet comfortable enough to explore new methods of science communication, based on art installation techniques, simulation and fair, i.e. to stroll, to ask questions to the presenters, to engage in communication, to question (...) to look behind the scenes” (Yaneva et al. 2009).

The gallery was to open in October 2006, but eventually never did. The displays shown during the first pilot event caused some agitation: the press found the event “strange” and “elitist”; the Austrian Academy of Science wanted the concept to be rethought and did not approve of a reworked version; and, after two years of work, the director of the gallery eventually quit her job.

The *wahr/falsch inc.*

A final example is the “wahr/falsch inc.” exhibition (true/wrong inc.). The exhibition took place in summer 2006 and presented 11 “hot spots”, that is, controversial topics (such as doping, the end of oil, life on Mars, or allergies). These topics were exhibited as 11 modules in 11 different locations in the city of Vienna, along the pathway of U-Bahn number 1. The exhibition was advertised as follows:



“Eleven small exhibitions [...] deal with sensitive issues on the relationship between science and society. What is true and what is wrong? “Die wahr/falsch inc.” raises questions in the form of images, installations, radio plays and discussions, that put science into question. [...] In doing so, “die wahr/falsch inc.” does not deliver answers, because science – like art – only ever asks new questions. [...] Essential is the role of the visitors who, with their knowledge and their questions, become part of the “wahr/falsch inc.””.

The curators used an “expanded mix of methods” for the displays and wanted to make sure that “during the exhibition, things can happen”, i.e. that visitors did not encounter an already finished exhibition (personal interview).

The exhibition revealed some of the characteristics of controversy from the perspective of sociology of science: the multiplicity of voices and arguments; the attempt for symmetry between positions, such as right and wrong; the uncertainty and ambiguity of any scientific project. Yet it also points to one of the inherent challenges when exhibiting controversy: to try to reveal the messiness and complexity of science without confusing visitors too much. The weekly Austrian newspaper *Falter* wrote that the exhibition was “partly more a research project than an exhibition: clever and creative on the level of content, deficient in terms of communication” and they judged some elements of the exhibition “impressive” and an “eye-opener”, but “too demanding” overall.

The texture of controversy

The examples discussed in this paper brought together a range of different actors, stressed the uncertain nature of science, and had to deal with some difficulties to communicate their message. While revealing the unfinished character of research and the multiplicity of positions in controversies, these exhibitions operate two kinds of shifts: from a display that answers to a display that questions and from an exhibition that represents existing matters to an exhibition that performs, creates, and experiments with new ones. Not only did the exhibitions represent “hot research”, they also, to a certain degree, became “hot” themselves, for they stressed the uncertain character of science and experimented with the very essence of exhibitions: communication with the public.

A controversy moves the single object from being the primary focus in an exhibition and concentrates instead on positions and relationships between actors and objects. The move from cold science to hot research means that a process, rather than a product, is on display. While the “cold” way to exhibit science is through stabilised objects, the “hot” way works through highlighting the multiple relationships between visitors and objects and between the positions of the various contenders in a controversy. Hence, symmetry and tension come in different guises: between art and science; between right and wrong; between various voices, views, interests. The museum object is thereby opened up in several ways: to be flexibly interpreted, to be engaged with, to be questioned, to be challenged and misunderstood.

A “hot” exhibition about controversy is about movement: the bringing together of a various methods, actors, views, materials, arguments. How can a museum – an institution that stabilises, orders, classifies, frames, freezes – display and contain “hot” topics, that is, topics that radiate in so many directions? Are there some topics that are “too hot to handle”? Exhibition makers have to negotiate a position between a politics of moderation and a politics of controversy.



Further reading

Meyer, M. (2011) 'Researchers on display: moving the laboratory into the museum', *Museum Management and Curatorship*, 26(3): 261-272

Meyer, M. (2010) 'From "cold" science to "hot" research: the texture of controversy' in *Hot Topics, Public Culture, Museums*, Cambridge Scholars Publishing: 129-149

Yaneva, A., Rabesandratana, T. M., & Greiner, B. (2009). Staging scientific controversies; a gallery test on science museums' interactivity. *Public Understanding of Science* , 79-90



8. Comparison of national strategies: documentary analysis for Australia, Brazil, China and the United Kingdom

Karen Bultitude, Donghong Cheng, Graham Durant, Roland Jackson and Luisa Massarani

This brief paper forms part of ongoing work by the authors in contrasting national strategies for the popularisation of science and technology (PST), building on similar discussions at previous PCST meetingsⁱ. In particular we focus here on analysing the terminology used within four national strategy documents, contrasting key terms and highlighting important similarities and differences in approaches between the different countries. We also raise a series of important questions relating to future work in this area.

Procedure

The four countries chosen for analysis were Australiaⁱⁱ, Brazilⁱⁱⁱ, China^{iv} and the United Kingdom^v. Not only do these nations represent a wide geographical spread, but they also incorporate a range of political and social systems, as well as differing stages of technological development. Crucial to our work here was the fact that they all have documented and publicly available national strategies.



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A word frequency analysis was conducted on the text of each national document using the software NVivo9, in order to ascertain the main areas of emphasis within each strategy. Comparing the word frequencies of the written documents enabled a degree of objectivity in the analysis, which we felt was important due to the close involvement of key representatives from each country in the preparation of this paper. Raw text was extracted from each document, cleaned to remove formatting issues such as over-emphasis on header and footer text contents and imported into NVivo. Text frequency analysis was applied in the language in which the document was written, with the resulting word frequency tables translated into English for reporting here where appropriate. In addition to the automatic stop words within NVivo, an additional list was sourced from <http://www.ranks.nl/stopwords>, with other obvious¹ stop words added during the analysis. Obvious conjoined terms (such as 'public engagement') were also manually adjusted within the documents to appear as a single term within the NVivo word frequency analysis; these terms are reported as full phrases here, and the same terms were used across all documents in a given language.

For ease of comparison the data in Table 1 have also been converted into word clouds as shown in Figures 1 & 2. In the following analysis these data are combined with wider contextual information relating to each strategy. The word clouds were created using <http://www.wordle.net/> using the data from Table 1. The size of each word is in proportion to the extent of its presence within the document; the colour and orientation of the different words have no specific meaning here.

¹These included 'shall', 'work', 'group', 'no' (in Portuguese), 'às' (in Portuguese), 'also', 'use', 'report', 'new', 'can/can't'.

Results

The most common terms identified from the word frequency analyses are presented in Table 1.

	Australia	Brazil	China	UK
1	science, scientific (5.00)	social (3.28)	science, scientific (2.94)	science, scientific (3.34)
2	Australia (1.93)	public (2.19)	science literacy (1.9)	research, researchers (0.84)
3	nation, nationally (1.38)	science, scientific (2.10)	science and technology (1.77)	publics (0.66)
4	research, researchers (1.12)	CTI (1.94)	PS (1.75)	schools (0.59)
5	engagement (0.91)	development* (1.85)	development* (1.32)	STEM (0.56)
6	program (0.81)	promote (1.60)	education (1.30)	develop* (0.55)
7	activities (0.80)	technology (1.60)	training (1.25)	careers (0.52)
8	community (0.74)	culture, cultural (1.52)	raise (1.12)	scientist (0.52)
9	develop* (0.68)	research (1.26)	activities (1.05)	education (0.50)
10	science communication (0.68)	science and technology (1.18)	establish (1.05)	subject (0.49)
11	communication (0.62)	program (1.18)	rural (1.05)	UK (0.47)
12	need (0.62)	policies (1.09)	citizens (1.02)	training (0.44)
13	interest (0.56)	activities (1.01)	public (0.92)	need (0.43)
14	states (0.53)	create (1.01)	schools (0.87)	ethics (0.42)
15	publics (0.50)	actions (0.93)	capacity building (0.80)	governments (0.41)
16	provide (0.49)	heritage (0.93)	enhance (0.80)	public engagement (0.41)
17	innovative (0.48)	popularization (0.84)	implement (0.77)	support (0.41)
18	media (0.48)	innovation (0.84)	science education (0.75)	provide (0.40)
19	scientists (0.46)	communication (0.65)	resources (0.70)	recommendations (0.40)
20	schools (0.43)	economic (0.76)	areas (0.65)	engineers (0.39)

Table 1: Top 20 terms used within each of the national strategy documents. The numbers in brackets represent the weighted percentage of that word/phrase presence in the associated



document(s). *The term 'develop' had different connotations in different countries, as described in the main text here.

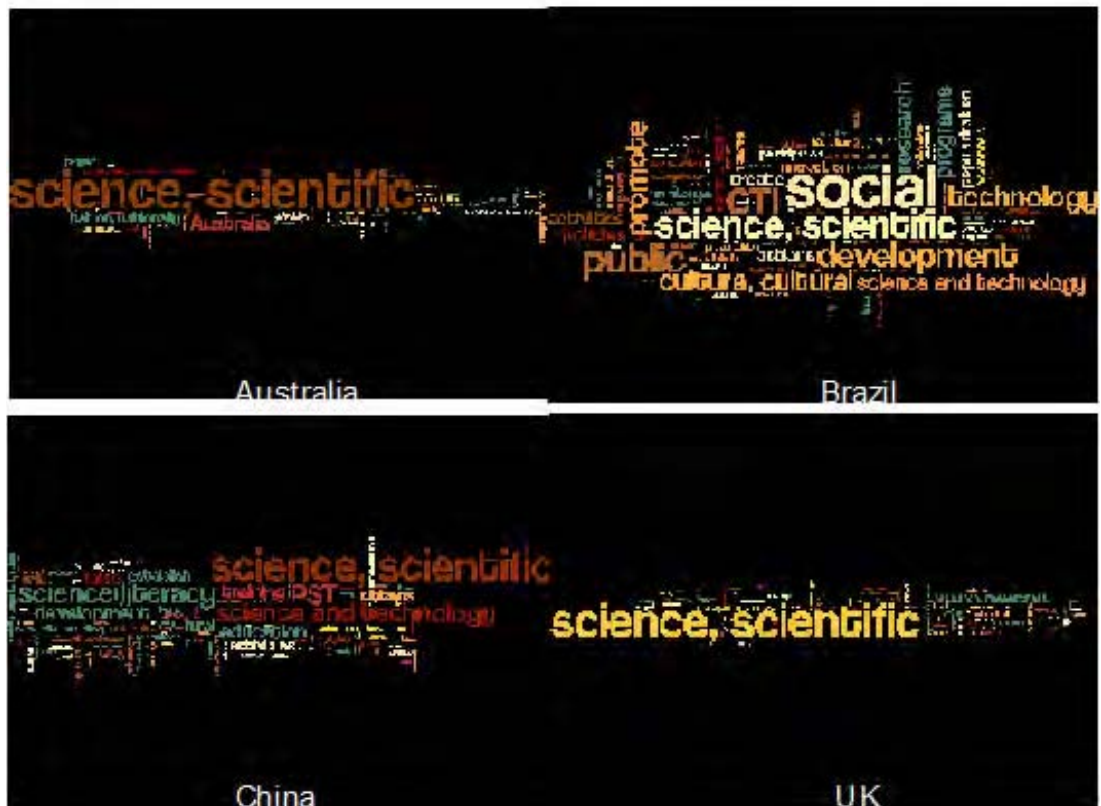


Figure 1: Word cloud representations of terminology within each of the national strategy documents





Key areas of emphasis

It is interesting that in the Brazilian document, 'science' takes a lower priority compared to 'social' and 'public'. This evidence is in line with the slightly different motivations within Brazil; popularization of science and technology is seen as a force for social change in Brazil, to overcome existing inequalities between different parts of society. The frequent reference to 'culture' and 'heritage' within the Brazilian document also reflects its ambitious vision. It should be noted that Brazil is in an earlier stage of development with its national strategy, meaning that there is perhaps more emphasis on the rationale and motivations for the strategy, rather than on the content of the programme itself.

A strong national agenda is clear within the Australian strategy, with 'Australia' and 'nation/nationally' as the second and third most frequent words used. This repeated emphasis of the national focus of the *Inspiring Australia* strategy reflects the political structure of that country, and in particular the strong historical devolution of many relevant aspects of government (such as certain education policies) to State and Territory level. By highlighting the need for cooperation at federal level, and by emphasising the national reach of the intended programmes, the strategy authors are likely attempting to overcome political divides that may otherwise prove detrimental to the strategy's successful implementation. This surmise is further supported by the additional presence of 'states' in the Australian list of most frequent terms.

Both Brazil and China refer explicitly to increased 'development' within their countries being a goal of their programmes, and this word arises frequently within their documents (in contrast to the verb 'develop' meaning 'produce' or 'create' which was the meaning within the Australian and UK documents). Indeed, a key stated aim of China's original *Scheme* was that⁴:

By 2020, China will see an enhanced development of science and technology related education, communication, and popularization. [...] Citizens' scientific literacy shall see a large improvement, reaching the early 21st century level of major developed countries.

Brazil and China also overtly aim to balance social inequalities through their stated strategies, for example, seeking to improve the economic stability or build capacity in rural areas.



The Chinese and UK strategies both have a strong emphasis on formal education, each with four terms out of their top 20 most frequent relating directly to education in some way. Further investigation of where these terms occur in context within the respective documents reveals that in the case of China the emphasis is fairly broad, encompassing educating and/or increasing the scientific literacy of the population at large, not just at school level. By contrast, within the UK the education-related terms within the top 20 are almost entirely schools oriented ('schools', 'careers', 'education' and 'subject'), and this situation is similar for Australia (although for the latter 'education' occurs just outside the top 20). Conversely, it is noticeable that within the Brazilian document formal education has a very low emphasis, with 'education' (and similar stem words such as 'educational') ranked at 54, and 'students' at 88.

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Evidence of the prominence of other audiences and/or partners is also present in Table 1; 'public/s' occurs in all four top 20 lists, reinforcing the stated intentions within all four strategies to engage audiences outside government and academia. Both the UK and Australia commonly refer to 'publics' rather than 'public', recognising the plurality and lack of homogeneity within the phrase 'the public'; use of such terms is perhaps a reflection of the nuances possible in a country's native language, which are lost in translation.

Finally, indications of the main types of outputs can also be gleaned from this analysis; 'activities' are prominent in Australia, China and Brazil, whilst 'training' is a major area of focus in China and the UK, albeit focusing on different audiences (professional communicators in China and gatekeepers such as researchers/teachers in the UK). Whilst the other strategies refer specifically to creating 'programs', 'policies' and/or resources (and provide further details within the respective documents), the UK approach is remarkable for focusing instead

on ‘recommendations’: the message is clear that this is not a binding document enforced by government, but instead a series of considered suggestions made by members of the various ‘expert groups’. The lack of central obligation is further enforced by the focus throughout the UK documents on supporting and/or encouraging various key players to become further involved (e.g. researchers, scientists and engineers) – without central government funding the success of the UK strategy relies on the wider input.

Next steps

The findings reported here represent a preliminary analysis of the documentary texts. We are currently deepening this analysis, for example, exploring the role of central government (and other key stakeholders) within each of the strategies. Within the four chosen case study countries there are contrasting values and political judgements driving the development of the different policies. However, as noted above, many similarities have also been observed to date across these very different political landscapes. This means that there is a potentially interesting question regarding whether PST approaches are broadly similar across national boundaries, but justified differently depending on the political culture. We are also keen to identify a robust mechanism for effectively comparing the extent of PST across different countries. Some preliminary work has begun in this area^{vi} however the scope is limited and many of the indicators used either aren’t available widely, or have previously been contested^{vii}. There is thus plenty of scope for further work in this area, thereby furthering sharing of effective practice of PST across national boundaries.



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9. Performing the aesthetics of science: visitors' speech, movements and gestures in the Museum of Natural History in Venice

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Cultural Background

Since the 1990s art has become an important mediator between science and the public and science has become a cultural agent whose activities are characterised by aesthetic and perceptual concerns. The “visual turn” that interested the humanities in the 1990s, interested the hard sciences too. Images became increasingly important not only inside the scientific laboratory, but also as a means to reach the lay public(s) and engage them with STS. Responding via their role as institutions concerned with public communication and engagement with science, museums of science and science centres also devote attention to images and the design of exhibits. The cross-fertilization between science, the arts and design is promoted not only through artist-scientist collaboration, but also through curatorial practices that merge the history and practice of science with aesthetical concerns.

The discipline of contemporary aesthetics has no shared agenda or set of questions that should define its field of investigation. Nevertheless, the primacy of perception over cognition in aesthetic experience and the critical reflection on notions of representation and image are examples of issues that are at stake in scholarly reflection in aesthetics, especially from a continental perspective. The term aesthetics can be used in two ways: first, aesthetics is a discipline concerned with the senses and the perceptual apprehension of forms; second, aesthetics is a discipline concerned with the appreciation and nature of beauty, art and taste.

This paper focuses on one case study, the recently refurbished Museum of Natural History in Venice (MNH), where I am completing a research project on adult visitors supported by the Department of Philosophy and Cultural Heritage at Ca' Foscari University, Venice. Founded in 1923 and housed in the Fontego dei Turchi, MNH contains a wide range of naturalist collections of great importance from a historical and scientific point of view. The first section is dedicated to fossils and paleontology, the second describes the evolution of the practice of collecting from the Wunderkammer to the birth of scientific museology; the third offers a different interpretation of the complexity of living forms, analyzed through the survival strategies developed by plant and animal species during evolution.

The research project: objectives and methods

Through a close examination of visitors' discourses and movements inside the museum space, my research seeks to show first, how the history and epistemology of science is mediated and enabled also by aesthetic concerns and, second, how visitors re-enact the aesthetics of science in their embodied sensory and cognitive experience of museum objects and spaces. My analysis is limited to adults visiting the museum without any mediation but of the exhibits. I use both quantitative and qualitative tools (ex-post semi-structured interviews, ethnographic observation, video recordings). The transcription and treatment of data (interviews and video-recordings) is based on multi-modal and discourse analysis, an approach that looks at



meaning “as an integration of ways of saying (informing), doing (action), and being (identity)” (Gee 2011: 8).

The video recordings exemplify – without being exhaustive – the range of movements and gestures enacted by museum visitors: we can think of the aesthetic body, as culturally shaped, entwined, and embedded in a complex network of relations, each of which has a distinctive character and dynamic. (Berleant 2004: 88). The bodily alignment to the exhibit, talks and gestures in front of it (pointing, discussing, showing, glancing, touching) reveal how visitors perceive and make sense of the exhibit influencing, simultaneously, their visit companions.

The visit to MNH as an aesthetic experience

Aesthetic appreciation originates in sensory perception and how this process is always entangled with associations, memories, feelings and meanings (Berleant 2004). An interview I made with a visitor exemplifies the relationship between aesthetics as sense perception, the power of imagination, and the knowledge possessed by the visitor:

*(The visitor is sitting on the sofa at the entrance hall, looking around and pointing at the external courtyard) You need to imagine (he closes his eyes for a moment) they work the silk there and then make the fabric that was then traded off // I was hoping to find something on the history of the building but probably everything is lost (xx) 15 , 16 pages I wrote about the Fontego , I’m glad that it is there and that I saw it = they built a temple here for the Muslims to pray = the interplay between the Jews, the Venetians, Muslims, Turkish ((*always pointing*)) rugs all around , you can smell the spices you can picture all this (xx) = all these were offices where they would negotiate (x) they would set up trades (xxx) // The exhibition is creative , dramatic , typically Venetian but I’m not into it (U, UK)*

This fragment of discourse is significant for the way the visitor sketches another museum or the museum before the museum with the power of his knowledge and imagination. The aesthetics of the building façade and interiors (almost lost due to recent refurbishments) is put into relationship with the former function of the building. The temporal stratification of the building is actualized through the visitor’s words and gestures that bring the aesthetic values of the Fontego dei Turchi backs to life as a temple for praying (the religious function) and as a place where trades were made and goods exchanged (the secular and commercial function).

Sometimes the particular form of a specimen allows an exchange between co-visitors that demonstrate how visitors enter in the museum with a wealth of knowledge and expectations, not necessarily scientific but related to first-hand perception and the experience they have of nature. In this sense, the dogmatism of some anti-scientific positions cannot be contrasted by trying to bridging the knowledge gap in visitors (according to the deficit model), because dogmatism does not simply arise from the weakness of our knowledge or of our demonstrations. Dogmatism arises from the fact that we take for reality the image we have of it, that the images that we use to describe reality become reality themselves. From being a mere term of comparison, the image becomes a bias to which reality should match. In some cases MNH successfully breaks this spell by placing nature (as such) in front of visitors’ senses; they immediately become aware of the appearance of animals and fossils. Here the



principle of beauty comes into play. The effort is to maintain the correspondence between the way the specimen looks in nature (form, colours, dimensions) and the way it is exhibited in the museum.

The room devoted to movement in the air is often recalled by visitors for its aesthetic value and, simultaneously, its scientific precision. The specimen are here displayed to explain the concept and dynamics of flight in a straightforward, intuitive manner without the need of any written text.

So wonderful (x) (*enacting the imaginary line of flight with the finger*) it looks like they (*the animals exhibited such as the birds and some mammals*) come to you (F, Italy)

The birds are beautiful (x) they did not arrange the animals in order to show movement, rather they attempt to make them moving (F, Brasil)

At the same time, however, visitors can be in doubt whether the specimen is false or true to nature. This belief is caused by the aesthetic values of some specimens that appear to be too polished, varnished and shiny after being restored:

one does not understand whether animals are real or not (x) = I thought fishes were false and birds real because there were pens and feathers = fishes are (xx) too inflated they have not being dried up // fossils are too much polished varnished this is not the way fossils are found, it might deceive visitors (M, US)



The word 'deception' shows how museologists should be aware that aesthetic choices are a matter of being responsible toward visitors. Another fragment highlights how aesthetical values are connected to the appearance of a world and, ultimately, to ethics:

It was more interesting than the Visual Arts Biennale (x) the exhibits here the sounds the images make manifest a world (xx) many, millions of worlds that are mutually reinforcing because they are placed side by side, even as a contrast, from one room to another (xx) this gives importance to worlds alternative to human beings, and thus make sure that they are considered in their total unquestionable dignity (F, France).

It is the aesthetics of life that you take in through the exhibitions of MNH. Life captured by a tableaux or by a sound that evokes distant lands and unknown instruments, or by scents like the cedar wood. Thus, by taking care of the exhibits, by enhancing their aesthetics and appealing to multi-sensory forms of perception, museum professionals and conservators help visitors not only to observe and learn, but also to take care for the world.

10. Architecture and Public Science Communication: the role of aesthetics and design in science and technology museums

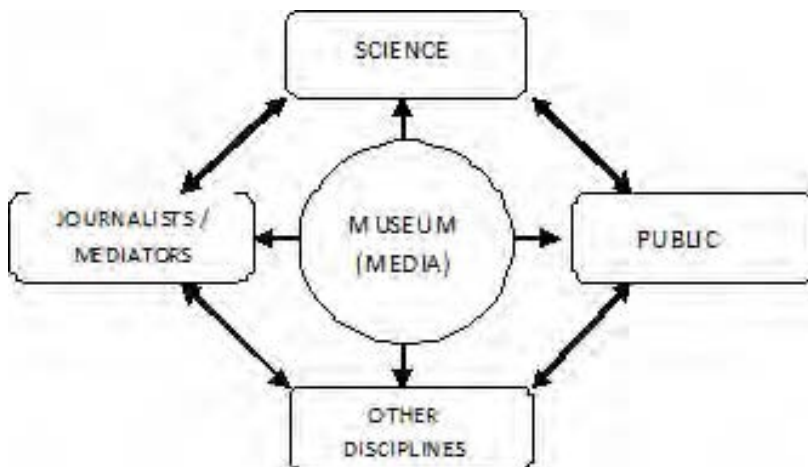
Patricia Ríos Cabello, *Instituto Tecnológico de Estudios Superiores de Monterrey, Campus Ciudad de México*

There are several reasons ranging from the people and experts involved in the design process of a science and technology museum, to the design proposal itself, that frequently leave aside important values that should be considered while seeking to bridge the gap between lay public and scientific knowledge. After all, the museum's design is an interdisciplinary process that requires multiple actors and perspectives.

The next few paragraphs suggest a multidisciplinary approach towards the planning and design of science and technology museums. The collaboration of scientists, architects, and the public itself, must be kept in mind as an asset to communicate scientific knowledge and promote public engagement.-

The first step is to envision the museum as an alternative medium to communicate science. The museum is the result of a creative and scientific process that oscillates between abstract logics and concrete conditions. This process allows different layers of information, history, culture, needs, and functions to merge into a materialized space that dialogues with its context and users. Therefore, it becomes the ideal target to propose it as a medium for science communication.

The following diagram, derived from the graphic representation of the classical canonical account, proposes a multi-directional model that allows and encourages scientists, journalist, other mediators, and the public, to constantly work together in search of new strategies to communicate science.



The challenge rests on creating a *place* that delivers scientific discourse through forms, spaces, materials, and connections that will engage the public into a memorable experience. The key word is the term "place". A place brings together the physical space and events



through time. According to Yi Fu Tuan, it embraces the layers of shaped collective memories, of culture, stability, and permanence until it becomes essential to a person's identity; it is where emotional ties are created. He points out three important aspects of architecture: man-made space can refine human feeling and perception, architectural space can define sensations and render them vividly, and that architecture "teaches".

The symbols and forms that are created become keys to comprehend reality. The building's enclosure or exposure, verticality and horizontality, mass, volume, light, colours and spaces are features to which our bodies respond. The built environment, like language, has the power to define and refine sensibility. Having said this, it is important to explore three values of spatial design that could enhance the museums capability to communicate scientific knowledge and improve the public's understanding of science: *legibility*, *appropriation*, and *accessibility*.

Kevin Lynch, in *The Image of the City*, defines *legibility* as the way in which space is arranged and therefore perceived by its users, open to new possibilities, capable of adapting to the needs of time and culture. Legibility is not only to be found in the city and open public spaces; it can be addressed in a variety of ways, including museums and science centres. It is important for science museums to provide orientation through its arrangement and design allowing visitors to understand the interacting possibilities between exhibits and spaces.

As Lynch mentions, it is essential to acknowledge that the surprise or labyrinthine element adds value to the environment in the form of enjoyment, interest, and unique understanding of space. These values are also addressed in the contemporary definition that T.W. Burns proposes on scientific communication: the use of skills, means, activities, and dialogues adapted to produce one or more of the following responses towards science: Awareness, Enjoyment, Interest, Opinion-forming and Understanding. Every intermediate step in the visitors' experience is crucial in order to motivate them to make the choice to continue to invest time and attention.

The second value is *appropriation*. Enric Pol defines it as the intrinsic process of human development, through which the person apprehends an experience through the immediate context of reality giving meaning to space. The process of appropriation results in identity forming and place attachment; where affect, emotions, and feelings are created and associated with a specific place. Furthermore, the conjunction of two apparently opposite values: stability and change, foster the process of appropriation allowing a person to become at the same time sensitive to scientific history and open to new discoveries.

Architecturally speaking, stability is represented by the permanent space; it symbolizes the rooted and accumulated memories. These spaces are responsible of producing the long term identity and cultural values on societies. They show the sure and solid progress in the mastery of nature. On the other hand, change is represented by the ephemeral space, made up by reversible relationships, unstable links, lightweight structures and fragile presences. This space represents the changing values of society; it gives room to new theories and discussion spaces.

The third value is *accessibility*, referring to the extent to which a place allows its users to enter, use, and walk around, regardless of any physical, sensory or mental impediment. In the last few years, accessibility has started to also address the social and cultural implications. Accessibility is closely related to inclusion; the practice where different groups of individuals



having different backgrounds such as race, sex, origin, and identity, are welcomed and equal. The process of inclusion facilitates the creation of a sense of belonging; feeling respected and valued, it allows the creation of common ground.

No matter the visitor's background and actual knowledge he/she should be able to become engaged in each of the museum's spaces. Elements such as ramps, recognizable entrances, seating, wide corridors, and transportation will make the museum physically accessible. Images, displays, audio, and visual media in different languages will allow users to understand information regardless age, knowledge, sex or ethnicity. The diversity of graphics and ways to present information in each space will allow the visitor to choose and understand in his own specific way._

The previously discussed values of design intend to create an emotional relationship between the users and the museum with the aim of establishing it as a place. There is a final aspect regarding active participation in the museum that should be addressed to consolidate the design process. *Public engagement* should be fostered from the early stages of the planning and design. An early contact with the public's expectations and current scientific knowledge will lead to a more conscious and responsible outcome. Moreover, the science and technology museum must symbolize a process of continuous search and understanding. The museum should be thought of as a building that will remain in a state of constant modification while discussing new research and state of the art discoveries. Keeping the public involved in this process will enhance the process of appropriation and identity forming.

These are some of the common values that exist between spatial design and public science communication; our responsibility is to continue exploring how these relationships and other elements can become assets of science and technology museums, engaging its public and promoting the public understanding of science.



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11. Between Ivory Tower and Spotlight. A Case Study on the Status Quo of PCST in Publicly Funded Research Centres

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Introduction

Scientists are increasingly required to be aware of their societal responsibility to foster sustainable public awareness of scientific results and to accomplish high credibility. Therefore, continuous Public Communication of Science and Technology (PCST) activities for science are necessary to effectively transfer research results for dissemination through the media to the public (e. g. Peters 2008).

The current state of the art of research in the field of science communication is still primarily concerned with the relationship between science and media (e. g. Göpfert & Ruß-Mohl 2000, Weingart 2001, Peters 2008), the evaluation of PCST activities, or new public relations (PR) concepts for science (e.g. Bühler et al. 2007, Hermannstädter 2007). Up to now two important aspects remain scientifically unconsidered: the scientists' attitude towards PCST activities and their practical implementation of public activities. Although surveys show that German scientists generally agree on the requirement of public communication (e.g. Peters 2008), it is still unresolved to what extent this attitude is also reflected in their practical work.



- 56 The German Research Foundation (DFG) is the largest organization for funding science and research in Germany. It is funded by the states and the federal government in Germany. The DFG explicitly demands science communication activities in their research programmes (DFG, 2012) to communicate research results to the public. However, until now there has been no scientific evaluation of this measure.

In my research, I examine the status quo of PCST in DFG-funded projects with a particular focus on the scientists themselves as stakeholders of the PCST process. Specifically, I am interested in answering the following questions:

- If and to what extent are scientists aware of the increasing need to get involved in science communication?
- How is this awareness implemented in their everyday work?
- Do scientists feel responsible for communicating science to the public?
- Which factors are important for successful PCST activities of scientists?

Approach and sample

The approach pursued is a qualitative empirical case study. It is a comparison of three DFG-funded Collaborative Research Centres (CRCs), which are defined as:

[...] institutions established at universities for a period of up to 12 years that enable researchers to pursue an outstanding research programme, crossing the boundaries of disciplines, institutes, departments and faculties. They facilitate

scientifically ambitious, complex, long-term research by concentrating and coordinating the resources available at a university. Universities submitting a proposal are expected to provide appropriate core support (DFG, 2012).

Thus, CRCs are a unique model of collective and cooperative research. They stand for outstanding scientific work with a high societal impact and are required to communicate their results to the public. To foster the PCST process of CRCs, the DFG implemented the module “Public Relations in CRC” in 2006. Here, innovative PR concepts, projects and even positions can be funded. The idea is to request scientists to leave their ivory tower and interact with the public. As publicly funded research centers with the concrete demand and (financial) support to do PCST activities, CRCs are suitable subjects of investigation for gaining insight into the research question of this approach.

The sample is composed of three CRCs, all located at the University of Bremen, Germany: CRC/Transregio 8 Spatial Cognition, CRC 597 Transformation of the State and CRC 747 Micro Cold Forming. The three CRCs are positioned in different fields of research and follow different PR strategies. This aims at getting as differentiated information about the implementation of the DFG module “Public Relations in CRC” as possible. On the other hand, all CRCs have access to the same infrastructure in terms of science communication – they are collaborating with the same university’s press office and act with the same (local) public.

In CRC/Transregio 8 Spatial Cognition researchers from informatics, psychology, and linguistics of the Universities of Bremen and Freiburg investigate human cognitive structures and abilities concerning space as well as basic structures to deal with spatial information. In terms of application they want to utilize these findings for software of autonomous systems. A PR professional coordinates the PCST activities of this CRC.

In CRC 597 Transformations of the State scientists from political science, law, sociology and economics work together to determine if, and precisely how, pressures from globalization and liberalization over the past thirty years have changed the core institutions and functions that define the classical nation state. PCST activities are primarily implemented through the publications series *TranState Working Papers* and related articles and exhibitions. Such activities are mainly initiated by the coordinator (non-professional in PR) of the CRC 597.

The central concern of CRC 747 Micro Cold Forming is the supply of processes and methods for the forming technical manufacturing of metallic micro components with comprehension of the essential aspects of the forming process. Their long-term PCST-project *micromal* is tailored to the public, well established and coordinated by a dedicated PR person.

Procedure

The data is collected on the basis of in-depth interviews. This qualitative research technique provides more detailed and rich information from the interviewee than what is available through other data collection methods, such as surveys with closed questions. The interview guideline is structured in three thematic blocks: “The role of science in/for the public”, “PCST in science”, and “Personal Experiences”. This thematic development – from more general beliefs to subjective involvement – allows a comfortable access to the topic before it comes to personal experiences. At the same time it covers the questions about the attitude towards the role of science and PCST and its practical implementation.



In each CRC, interviews are conducted with five scientists from different disciplines, different age and gender, and on different career levels. This variety promises findings with regard to the impact of these particular factors on the research questions.

Interviews with the coordinators and the scientific managers of the three CRCs deliver insight into the concepts, strategies, and organization of PCST activities in the respective CRC. CRC/Transregio 8 and CRC 747 Micro Cold Forming both employ a PR manager. They are also asked to report on their work and their experiences in working with the scientists.

An additional interview with the DFG-coordinator of the module “Public Relations in CRC” provides an insight into the idea of the module “Public Relations” and the expectations of the DFG towards the CRCs and their scientists. Additional interviews with the heads of the press office of the University of Bremen and the one of the DFG provide information about the general development of PCST activities in Germany and the estimation of the three CRCs’ PCST activities from the viewpoint of communication experts. Their external views help to put the scientists’ statements in context.

Preliminary Findings

A preliminary evaluation of the sample data suggests that three parameters are important in the context of the success of PCST activities: institutional organization of PCST activities, individual motivation, and individual factors such as age, gender, and scientific profile.

The interviews with junior and senior researchers from different scientific disciplines working in these three CRCs show that many scientists still seem not to consider PCST activities as one of their “main duties” (in contrast to research, publishing, obtaining research grants), but rather as a part of a scientist’s “soft skills”. Where PCST activities are established and implemented by a dedicated expert, researchers are more likely to participate in the process – irrespective of the scientific discipline.

These preliminary findings about motivation, organization, and individual factors suggest that public engagement of scientists does not solely depend on their scientific discipline but rather on the scientists’ personal attitude towards PCST. It is an interplay of three factors crucial for successful and lasting public engagement of scientists: the personal attitude of the scientists, the general establishment of PCST activities in the respective research group, and – with lower impact – the scientific field.

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12. How to bridge the gap between science public relations and science education

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Many universities and research institutes spend a great deal of human and financial resources to strengthen the professionalism of their public communication and media tools. With creativity and journalistic aplomb, they develop innovative and interactive formats: magazines, videos, science cafés, researchers' nights, science camps, workshops for schools, etc. Infotainment is a growing sector, in television science celebrities explain the world and science events and are appreciated very much by viewing families. The aims, results and benefits of research are clarified in a comprehensive manner full of relish and even fun. This growing communication output of research institutes shows their increased awareness of the need to address an audience outside the scientific community. But what's their impact?

The objectives of institutional science communication may vary from institute to institute according to the area of research, their social environment and their reputation. In general, it is intended to build a bridge between science and society, to inform and inspire people, and to encourage the public's esteem for scientific research. The public doesn't always understand what's going on behind the "closed doors of research" and wants to know how their tax money is being spent. Closing this gap is a real challenge because scientific self-conception does not necessarily need the public. Furthermore the sceptical approach of science to everyday explanations of phenomena and the attitude of scientists to stand apart does not create an equal relationship of esteem between scientists and lay people. There are those who know and those who learn.

So what are the outputs, results, and eventual impacts of science communication? How do science and scientists benefit? What about the benefit to the public? Many questions cry out for evaluation. Evaluation, however, is not always that easy, given the variety of different formats and functions of science communication, each with its own objectives and target groups. Key indicators – attendance at or appreciation of an event, for example – can be measured relatively easily; detecting long-term impacts such as changes in knowledge, intellectual positions or critical competences seems next to impossible. The in-house service departments of research institutes do much more than public relations work, they take part in building a science-based economy and society.

Scientific communication at EURAC

The European Academy (EURAC) in Bolzano in Tyrol, Italy, grew over 20 years to become a research institution of 280 people. The department for science communication aims primarily to accompany the scientific staff in their relations with the public. Regional topics and approaches are estimated highly. Some institutes, like the Institute for Mummies and the Iceman, are well known also outside the small country. A concept to evaluate the work of the scientific communication team is a special wish of the communicators as well as the institution. The evaluation concept of this approach was mixed, but mainly qualitative.



Science communicators at the EURAC produce classical press releases, a science magazine called *Academia*, a website and books. More and more also interactive formats are means to build up a relationship (face-to-face or virtual) with the public. Every second year a researchers' night includes many formats and activities. Some of the new formats are even discourse-oriented: in science camps for schools scientific interest and scientific education for children and teenagers is an important by-product of scientific efforts.

Exhibitions in the location, the EURAC Tower, help people pass the threshold, enter the building and lose their false respect. Some topics of risk must be debated openly, not just within the scientific community but also with politicians and citizens. And, many fields of research depend very much on the collaboration with common people; medical services can no longer be developed without those who are partners in the system.

Ten interviews with core staff members of the science communication team threw light on the way science communicators work: for example to tell stories about the finding of a new topic of research, the reframing of words in order to explain it better, the visual ways to present science not as old and old-fashioned but as young, international and ambitious. Corresponding interviews with ten people from the scientific side reached out for a better understanding of how the relationship of science oriented work goes together with explaining this work by journalistic ways and means.

In general, this relationship seems to be well established. Scientists are given the visible role, because they know best which topics they handle and how. But, of course, the communicator side has become important for specific aims of the institution too. They select the information, shape and produce the news, which may be accepted from the news market in which the institution is embedded and which is extremely important for the money given to scientific work. Science communicators know very precisely what they do and why. They are professionals in their field and work practically and reflectively, optimizing step-by-step their work flow and the outcomes. Still they cannot be sure how their work impacts on society. Also, they act under the paradigm of facts and numbers, though indicators of resonance and reception are surely not under their sole control.

The transparency reached in the institute is a success: communicators have helped to establish a well defined role play between themselves and the scientific staff. But still it lacks a totally open, sceptical and even critical debate, which would be desirable for an open society. Topics could be, for example, ethical questions regarding genetic research. Here, in-house communication faces a special challenge: encouraging criticism might be in conflict with the objectives of a press office and could be perceived as being disloyal. Staff members of a scientific institution who speak to tourist managers, pupils, politicians and other people concerned with the outcomes of science must understand the scientists' as well as the communicators' thinking. In both cases they have to be talented and trained in this special field. Conflict management and the willingness to integrate external multipliers like schools and associations is also part of that job description.

These dilemmas of a discourse-oriented science communication complicate also the evaluation of in-house communication: If the objective is the marketing of the institution, then key indicators (name recognition, for example) can easily be identified and sometimes also be measured; if scientific literacy of society is targeted, then it is doubtful that reasonable



indicators can be found. Here, it seems that evaluation can only be based on appropriate questions. Not only the institution, but also society has to decide, that discourse-oriented science must play a more explicit role in science communication in the future.

Of course, it is possible and desperately needed, that journalists know how many people read their magazines, which topics are of special interest, how much time people spend reading articles etc. So it would be easy to distribute survey questionnaires, but perhaps it is even more important to understand better how scientists work, how they communicate in their teams and how they communicate with the public with or without the help of science communicators.

Both sides would wish to establish a well-organized, fair and efficient relationship. An appropriate view of communicators, journalists, managers and scientists about their experiences, perspectives and roles, helps to understand how these tasks are done and how they could be done better. Challenges to the evaluation of institutional science communication are at first the clearing of the structure, the organization and the objectives of an institute and its communication in the context of its social environment and target groups.

New challenges are:

- The integration of the new social media into the daily work of scientists and communicators.
- Choosing strategies of popularization that are appropriate for the topic, the audience and the institution. This is very much a debate between communicator and scientist, not so much between communicator and audience.
- Photos, visual infographics, radio and television: all those formats are vehicles to foster understanding and learning. It is important to think how these vehicles can stimulate and attract the eyes of the reader without falling into the sphere of advertising. The spectrum between simple commercials and elaborated abstract science writing is so wide, that professionals are needed to choose the proper forms in between.

Only if communication work is perceived as positive, will scientists be ready to intensify their efforts and train themselves in the part they have to fulfill. Of course, it is crucial that they also know when they should let others speak for them. The turn from “Leave me alone, I have to work” to “Let’s discuss the point” is still a long way, but it is backed, assisted and supported in the EURAC by means of science communication and journalists who seek to convince scientists of the “art of listening, explaining and debating”.



13. Listening to change: children as change agents for science in society

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The project

SiS Catalyst (www.siscatalyst.eu) is a four- year project supported under the Mobilisation and Mutual Learning action plan of the European Commission's Science in Society programme. It is coordinated by the University of Liverpool, and it involves 34 partners and advisors from 20 countries.

SiS Catalyst aims at building a culture of engagement and listening. The approach is based on the simple idea that today's decisions in science and education are significant for tomorrow's citizens, students and researchers who are children and young people at this time. The project is about the global change in education culture that we need to embrace for our future, through addressing the fundamental question of how we include children in the dialogue between society and the scientific and technological communities.

SiS Catalyst supports science organizations to engage better with young people and to successfully establish strong ties from the earliest age possible - in particular to target those who are currently unlikely to progress to higher education because of their social, cultural or economic background.

The experience that children have of society is hugely valuable in developing outreach and awareness programmes delivered by universities, schools, science festivals, museums and other science in society intermediaries. SiS Catalyst creates awareness among institutions of learning that young people are a relevant audience to be listened to. This engagement must also be reflected within the governance and institutional development in order to be sustainable. SiS Catalyst promotes the overall understanding that we need to treat young people not only as consumers of educational programmes, but as contributors as well, and acknowledges the role that young people have in the modernisation in all spheres of science education: they are Agents of Change!

One of the work packages of the SiS Catalyst project is devoted to the development of the ergonomics of listening for young people, and how this listening can be transformed into institutional change. In the following, we present some of the initial actions of this work package.

General principles

The relationship of young people to science and higher education institutions is a very complex one. In the last decades, there has often been a tendency to oversimplify this relationship. For example, the (presumed) disaffection of young people for scientific careers was often



reduced to a matter of image, implying that if young people are turning away from science, it is not because they analysed what a scientific career would represent for their future, but because they had a “wrong” image of science. According to this approach, a correction of the public image of science, rather than a concrete change in scientific institutions, is supposed to generate a more positive attitude to scientific higher education.

Another example are the programmes promoting “science is fun”, reducing the disaffection to the fact that science mistakenly appears as boring in the eyes of young public, and therefore neglecting the very complex set of social, economical, familiar, personal values that trigger a young person’s choices concerning her future position in society. Or again the emphasis given to “positive role models strategies”, typically adopted to attract young girls to science, that unavoidably tend to apply a flattened, massified vision of what a “role model” is.

This reflect a vision derived from commercial marketing that works very well in that context, but that does not necessarily apply to the context of a life-choice. (The criteria that teenagers apply to choosing a pair of shoes are not the same as the criteria they apply to choosing their educational and professional future.)

This is not to say that these approaches have systematically failed, on the contrary. But their interpretation of the reality they address risks oversimplifying the target audience (and in some cases “stupidifying” it). In doing so, while possibly solving an attractiveness problem for science, *they tend to create hidden forms of exclusions*. The main drawback of these approaches is that they are mainly centered on values carried by the organizers of the activity, rather than starting from those carried by young people themselves, taking into account all their diversities.

One of the actions of the SiS Catalyst project is aimed at identifying ways in which the voice of young people, and their vision of science as part of their own future, can be at the heart of science in society activities.

Methodology

Step 1: semi-directed interviews

A first step was a field exploration consisting in semi-structured interviews with eight European institutions (universities, museums, CSOs, media centres, etc.) organising science in society activities involving children. The interviews focused on the general principles and the practical actions put in place in order to include the voice of children before (the planning and design phase), during (execution) and after (evaluation and refinement) the activity. A series of videos were realised following those interviews, where each of the institutions reported on a particular case in which they were successful in listening to young people and acting consequently. These can be found on the SiS Catalyst You Tube channel (www.youtube.com/user/siscatalyst1).

Step 2: workshops

The second step was the organisation of a series of pilot workshops involving teenagers, in which a “listening and empowering” approach was adopted. The workshops were held in



Paris, Liverpool, Ankara and Bucharest. The Liverpool workshops, led by Raul Araujo, were based on the forum theatre approach, and focused more specifically on social exclusion aspects. They involved a group of teenagers coming from underprivileged areas on the outskirts of Liverpool. The Ankara workshop involved a group of teenagers participating in the Eucu.net annual conference. It was based on the dreams of teenagers about the key values for tomorrow's education systems.

Two workshops were organised in Paris: a first one reconfiguring the scientist-teenager interactions in a programme of exploration of fluid dynamics research; a second one, in collaboration with KiiCS FP7 project, based on the interaction among research scientists (on brain-machine interface), teenagers and a professional scriptwriter, developing the young people's vision of the future starting from new perspectives opened by research. They both involved a group of teenagers coming from underprivileged areas on the outskirts of Paris.

The Bucharest "We are the future" workshop coincided with the 2012 Ministerial Conference and Third Bologna Policy Forum of ministers of education from Europe and beyond. It involved 20 young delegates coming from 13 countries and 4 continents.

We will report on the Interviews, and the Ankara, Liverpool and Paris workshop in forthcoming publications. We will include here a more detailed description of the Bucharest workshop.

The Bucharest workshop

A delegation of 20 young people from 13 countries, four continents and very different social and educational backgrounds, was given the opportunity to go to Bucharest alongside the Ministerial conference to take part in a two-day workshop to prepare themselves as junior advisers to the ministerial delegations. The workshop was particularly organised by KinderuniWien, the European Children University Network (Eucu.net), Traces, Paris Montagne and University of Liverpool (Raul Araujo).

The young people prepared questions they wanted to ask the ministers and decision-makers and designed business cards with their personal advice from their experiences of education as junior advisers. The workshop was designed in order for the young people to openly set the agenda and the rules of the actions to come. Although the official protocol of the ministerial conference imposed some strict rules (e.g. only four delegates were allowed on the conference site within the Romanian parliament house), the level of freedom given to the teenagers allowed an empowering approach, avoiding the obvious risk of instrumentalisation associated with this type of actions.

All the 20 young delegates got the opportunity to offer their advice to the Austrian Federal Minister for Science and Research, a high representative of the Romanian Ministry of Education and Research and the Rector and Vice-Rector of the University of Bucharest. A key element was the set-up of eye-to-eye, in-depth conversations between official representatives and young people. Such conversations took place around tables, giving the possibility to each young delegate to express him or herself, and "obliging" officials to a moment of real listening, as they had to provide clear answers or reflections to a very attentive and well-prepared audience of five or six teenagers looking directly into their eyes.

The four delegates allowed to enter the conference site were able to distribute the messages



prepared by their colleagues, written on specially prepared “young advisor” business cards and distributed to several official delegations visiting the SiS Catalyst stand on the conference venue.

A full report of the workshop outcomes, including all statements by the young advisors and their “message business cards”, can be found on the website: wearethefuture.siscatalyst.eu.



14. Science communication and democratic debate: friends or foes?

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Introduction: democratic challenges of science communication

Science and technology have not only pervaded our daily lives through the many technological products and services whose comfort we enjoy, but they have also taken centre-stage in many of today's social and political debates, especially in the context of new technologies such as biotechnology, nanotechnology and converging technologies and environmental risks (climate change, nuclear energy, etc.). In offering not only many potential benefits to health, quality of life or economic development, scientific and technological developments simultaneously confront us with tremendous democratic challenges, as they introduce known and unknown risks to health, the environment and social justice.

To adequately address these democratic challenges, it is imperative to investigate whether and to what extent science communication processes and practices contribute to facilitating or impeding democratic debate and democratic citizenship with regards to techno-environmental controversies. The aim of this paper is to put forward a new perspective in the field of science communication which allows for evaluation of science communication processes and practices in this light. The first section elaborates on the main components of this perspective, before arguing in a following section why the conventional approaches to science communication are incongruent with this perspective. This paper concludes by discussing its implications for designing and evaluating future science communication processes and practices.



A risk-conflicts perspective

The primary observation this paper starts from is that it has become impossible to approach techno-environmental controversies in terms of a deficit of scientific information which science communication needs to detect and remedy. Indeed, each of the involved parties in these controversies, whether scientific institutions, environmental NGOs, industry or citizen initiatives, are found to invoke scientific arguments to support their positions (Fennell 2009; Maesele 2009; McCormick 2009; Weingart 2004). Evidently, this invalidates conservative dichotomies such as science versus anti-science, science versus ideology (or religion or fear), rationality versus emotionality, etc., which are used to serve as a 'one-size-fits-all' characterization of public discussion about and resistance to new technologies.

The explanation of this situation lies in the specific nature of modern technological risks and the current heterogeneous nature of scientific disciplines: The rapid advances in science and technology and their ensuing intervention in society and nature have not contributed to a world of more certainty, quite to the contrary: today's technological risks belong to a specific category of risks which are imperceptible (unless in terms of physical and chemical formulas) and fundamentally intractable (in terms of spatio-temporal consequences), making scientific research a necessary condition for making sense of these risks (Beck 1992). Without

allocating research funds to investigate possible risks, these risks simply do not exist (a well-known problem in the case of genetically manipulated crops and food because of corporate patents).

However, scientific research is not only a necessary but also insufficient condition as the expansion of science has resulted in the development of different disciplinary and subdisciplinary epistemic cultures within science (Böschén et al. 2010; Knorr-Cetina 1999). These epistemic cultures include specific practices of generating, validating, communicating and investigating scientific knowledge and uncertainty leading to a variety of hypothetical scientific findings (either contradictory, complementary or incomparable) in the case of specific technological risks.

This leads to the conclusion that the often conflicting (and contested) claims to knowledge are selectively adopted by the involved social actors in these controversies in pursuing broader social, economic or political agendas (see also Carvalho 2005). Put differently: their respective value systems and/or material interests influence the acceptability and significance of specific scientific findings. Contrary to conventional thinking, the politicization of these techno-environmental controversies is to be encouraged and nurtured from a perspective of facilitating democratic debate and citizenship, as the organisation of spaces for fundamental politico-ideological conflict constitutes the essence of democratic politics (Mouffe 2005).

Therefore, techno-environmental controversies should be recognized conceptually and empirically as a new type of social conflict in late modern societies, 'risk conflicts', involving contestation between various actors over competing risk definitions, which are based on the confluence of on the one hand competing rationality claims (in terms of a selective use of epistemic cultures) and on the other competing values and interests (Maesele 2010a, 2010b, 2011, 2012).

This risk-conflicts perspective entails a Copernican revolution in the field of science communication: instead of approaching these controversies from an unproblematic notion of locating the 'scientific consensus' and the legitimate agents to speak on its behalf in opposition to those who distort 'the science' in promotion of 'special interests', it proposes to start from an identification of the competing values and interests at work, not (only) to explain the different interpretations of the state of the science, but to arrive at the heart of what is at stake in these controversies: a struggle between alternative (technological) futures based on competing analyses of how the world looks like today and how it should look like in the future. In effect, from a narrow view of these debates from a framework of science communication to a broader framework of political conflict, which entails ideological discussion and collective debate and choice.

The challenge for science communication

Conventionally, science communication is defined in terms of a transmission view that perceives the relation between science and society as a matter of transmitting information from what is considered a unitary and consensual scientific realm to society at large. By putting science 'outside' of society, the relationship between science and society is characterized as a matter – and primarily as a problem – of communication and information. This characterization necessarily involves the intervention of a category of professionals and



institutions performing this mediation task (e.g. science journalists and communicators, science museums and centres) which is conceived in terms of a metaphor of linguistic translation, reducing the problem of communicating science to the public to a matter of linguistic (but also increasingly persuasive) competence.

Although many scholars in the field (mainly sociologists and historians of science and media sociologists) have been proclaiming the end of this conceptualization of science communication for two decades for its reliance on outdated communication and sociology of science models (Bucchi 1996; Lewenstein 1992; Meyer 2006; Salleh 2004; Van Dijck 1998), it remains the prevailing way of thought: it displays a remarkable tenacity in official circles and public campaigns and is still prevalent in publications by science organizations and public institutions (Royal Society 2006), advocacy groups (Hartz & Chapell 1997) and science communication scholars (Willems 2003).

Two of its basic assumptions, however, are clearly incongruent with the context of modern techno-environmental controversies described above: it relies on an unproblematic notion of scientific consensus in debates about technological risk and regards the public acceptance of science and technology as simply a matter of overcoming resistance, either from 'special interest' groups, professional mediators - such as journalists - or the lay public, by more and better science diffusion. Moreover, this conceptualization is found to be most widespread in public debates during techno-environmental controversies, that is, when the conditions invalidating its assumptions are most intense.

This is because the conventional science communication approach serves as a powerful tool (for largely promotional institutional channels) in public discourse providing a repertoire of conceptual and rhetorical devices to eliminate the space for democratic debate between legitimate actors with legitimate – yet conflicting – positions. It serves to reify science and scientific authority in terms of a discourse of “sound science” which is used as a rhetorical tool to isolate unacknowledged (and unaccountable) value-laden assumptions and material interests in the introduction, development, promotion or safety regulation of new technologies. Furthermore, it primes the conservative dichotomies discussed above with the aim of distinguishing the “sound science” of dominant institutional actors and the “public fears” or epistemically-vacuous concerns of those who resist (the dominant institutional risk definition). Science communication processes and practices, which are primarily organised by dominant institutional actors, such as governments, science institutes or industrial associations, then act as the secondary validators of institutionally validated “facts” or dominant risk definitions (adapted from Gamson 1999).

Science communication and democratic debate: the way forward

The main implication of a risk-conflicts perspective for the design and evaluation of science communication processes and practices is a necessary shift in focus from communicating predefined institutionally validated scientific facts to assisting in the creation of spaces for the examination of the underlying value-laden assumptions and interests in competing risk definitions of the various actors involved in techno-environmental controversies. Democratic debate is only facilitated when these controversies are understood and framed as a struggle between – conflicting yet legitimate - alternative technological futures between – conflicting yet legitimate – actors (of which most are non-scientists), while being impeded when



characterized as predefined matters belonging to the realm of technocratic decision-making or ('free') market forces. This will introduce much needed issues such as power, unequal financial and cultural resources, structural inequalities, etc., within the science communication field and make the role of social, economic and political agendas in influencing the legitimacy of certain scientific findings (and their agents) above others, subject of public debate. In short, this paper calls for science communication processes and practices to be evaluated in terms of the extent to which they reveal the competing sets of value-laden assumptions and interests underlying opposing responses to uncertainty - instead of amplifying an idea of scientific consensus -, in other words, the extent to which they are found to facilitate democratic debate and citizenship.

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15. Scientific citizenship, public engagement and climate change

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Introduction

Frustrated by the failure of representative governments to create responsive climate policies at national and global levels, an increasing number of people are looking to public engagement as an essential component of successful climate governance. What it means to effectively engage the public in response to climate change remains an open and challenging question, bound up with differing definitions and assumptions about what constitutes 'publics', 'engagement' and even climate change.

While it is beyond the scope of this paper to address these complexities, our efforts focus on positioning *scientific citizenship* as an analytic lens to highlight the various configurations of knowledge, power and agency that take shape when citizens are drawn into public dialogues about climate change. The tangled relationship between science and citizenship has been a central feature of modern, industrialized societies for some time as techno-scientific advances not only open new spaces for citizen action, but also draw attention to the political nature of knowledge production, consumption and distribution. Taking into consideration the mutually constitutive nature of science and society, scholars situated in the field of science and technology studies have raised questions about shifting configurations of political inclusion and exclusion, as well as the distribution of rights and responsibilities, in contexts in which scientific knowledge is central to definitions of the public good (Elam and Bertilsson 2003; Jasanoff 2004; Wynne 2005). This work offers an alternative to the predominantly procedural focus of public participation and deliberative democracy scholarship that tends to rely on an ahistorical, decontextual and predominantly normative understanding of citizenship.

In what follows, we outline three working models of scientific citizenship, situating these within shifting relations between science and society that have taken shape over the past few decades. We do so in order to highlight the divergent assumptions about what constitutes good citizenship in relation to science. We conclude by raising questions about the extent of political and cognitive agency afforded to people when they are asked to engage with climate change and climate science.

Emerging models of scientific citizenship

According to the dominant model of science-society relations, only those with the appropriate professional designations and institutional affiliations qualify as scientific citizens. These individuals are bestowed with sets of cognitive rights and responsibilities such as the right to pursue inquiry, to be sceptical of existing knowledge claims and to disagree with popular sentiment, as well as the responsibility to make research open and transparent to public constituencies.

A series of social, political and economic transformations over the past few decades have



extended the scope of scientific citizenship beyond the domain of professional scientists to include the capacities of so-called ordinary citizens. The most significant transformation lies with increased opportunities for a range of social actors to be enrolled in knowledge politics, to speak back to, challenge and in some instances transform scientific processes, products, practices and institutions.

Definitions of scientific citizenship change depending on how they are linked with alternative configurations of democracy. We characterize the various working models of scientific citizenship as follows: the informed, the dialogic and the radical scientific citizen (see Elam and Bertilsson, 2003).

The informed citizen is the most anemic of the three with respect to the agency accorded to citizens. Grounded in liberal perspectives on democratic engagement and citizenship, citizens have the right to be informed about scientific issues, and once informed, have the right to make judgments about policy preferences. Reminiscent of the deficit model of science-society relations, knowledge production remains steadfastly in the institutions and practices of science, and knowledge is transferred in a one-way direction, from scientific institutions to the public. In essence, this is a model of the citizen as one who is encouraged to 'think like a scientist' in order to practice citizenship in relation to techno-scientific issues. The majority of public engagement approaches initiated by Western governments are predicated on this model, casting citizens as passive members of the public pre-occupied with questions of risk and safety rather than as active participants in agenda-setting for charting science and technology futures.



The dialogic citizen is grounded in the political ideals of deliberative democracy, and specifically the belief that collective decisions should be reached only after those affected by decisions have had the opportunity to contribute. It takes a procedural approach to citizenship, based on the assumption that the conditions of rational deliberation provide opportunity to reveal the best path forward and come to collective agreement. Rather than a focus on rights as with the liberal tradition, citizenship is viewed in line with a republican tradition as an ongoing practice of political judgment. Decision-making is seen as a matter of reaching consensus or a compromise among competing interests. In the context of organized public events, a more active role is granted to citizens in defining the consultation agenda, directing discussions, and contributing diverse forms of knowledge to the overall discussion.

The radical citizen connects scientific citizenship to a radical rather than a liberal or deliberative vision of democracy; as such, room is created for forms of confrontation with dominant scientific discourses and their underpinning ideologies (Mouffe, 2005). The assumption is that citizenship unfolds, not solely at the level of the individual, but through emergent social solidarities as well as political affiliations and interests that unite people around particular issues and visions of the public good. Radical democracy highlights, rather than attempts to conceal, the ideological and value conflicts at the heart of political debates. Science is not approached as a value-free body of knowledge, but as a historically and politically contingent mode of inquiry and style of practice.

Climate change and scientific citizenship

Once so-called ordinary citizens are enrolled in public dialogues about climate change, they are necessarily positioned in relation to these conflicting models of scientific citizenship. Science plays a fundamental and constitutive role in defining, demarcating, and illuminating the associated political and social challenges of climate change. The gap between the lived experience of weather with which most people are familiar and the opaque statistical constructs of a global climate underpins many contemporary political conflicts over climate change (Hulme, 2009). When asked to participate in formal or informal public dialogues about climate change, to what degree are citizens expected to consent to, challenge or contribute to knowledge about climate change? What are the implications of these expectations for democratic participation and shifting configurations of climate governance?

Bringing epistemic politics into focus, scientific citizenship illuminates the contradictory impulses, assumptions and values at play when non-expert citizens are asked to participate in public deliberations about techno-scientific issues, given what constitutes a 'good' citizen in these instances is not immediately apparent. In liberal and deliberative traditions, the unquestioned assumption tends to be that non-scientists must adopt the processes of scientific thinking in order to participate in public decision-making contexts. Although deliberative democracy offers agency to citizens, as Elam and Bertilsson argue, 'by valuing rationality, reserve, selflessness and powers of argumentation, deliberative democracy is a democratic politics played out on scientists' home turf' (2003: 243). As a result, hierarchies between experts and lay citizens remain entrenched where the capacity to set public agendas is tacitly handed over to 'institutionalized science and the power structures that may lie behind it' (Wynne, 2005: 71 – 72).

By highlighting the possibility of questioning and potentially transforming dominant knowledge claims and their ideological underpinnings, radical democracy opens space for more diverse voices and perspectives to inform public debates. Radical scientific citizenship offers an analytic framework for understanding emergent configurations of citizen-subjects that extends beyond the contribution of preferences, opinions and values to otherwise pre-defined and bounded technological discussions. It encompasses a broader vision in which citizens are situated as bearers of knowledge in their own right, connected with identities, cultures and world-views as well as entangled in global networks and solidarities. Its emphasis on the impossibility of a power- and value-free consensus, however, does not provide easy solutions for addressing the exigencies of climate change, particularly in a political context in which policy action has become stymied due to appeals to scientific uncertainty.

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16. Flat Earth and the Planet Sun

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With this paper I want to stress the key role of misconceptions removal in science teaching and public outreach. This consideration rise from a more than ten years' experience with classrooms all over Italy within the framework of several national public outreach programmes funded by the Italian Ministry of Research. I want to stress this point because the importance of misconceptions removal is frequently underestimated.

The data we present here refer to Italy [1] but for the purpose of this paper, we can honestly assume that they are quite similar in many other developed countries.

Numbers, in our case, are relevant: in a survey 52% of interviewees believe that antibiotics can eradicate both microbes and viruses, 45.6% have a significantly wrong idea of the size of an atom and, as the title of this paper claims, 52.5% of the sample thinks that the Sun is a planet. The even more worrying figure is that the percentage of people who respond correctly to all three questions is only 20%, one in five!

We could ask ourselves how this bad situation can exist: television, magazines, manuals, etc. continuously explain the correct use of antibiotics and that using them, for example, when we have a flu is useless. So, why we get a so high percentage of citizens taking this drug without any prescription, need or utility?



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Discussing astronomy we can consider that the figure for “the Sun as planet”, just as high, is not only due to a bad knowledge of this science. While studying at school that the Sun is a ball of “burning gas”, as is often incorrectly written in the books, our senses suggest to us that is actually the Sun that revolves around the Earth. We have to frankly dwell on this statement, because we see it rising to the east to get to a point of maximum height above the horizon and then decrease until it disappears after sunset each day. It is certainly true that in our cities it is more and more difficult to have this experience but the difference in the height of the Sun above the horizon at midday between December 20 and June 20 is generally correct in our common cognitive background.

Coming to “flat Earth”, this idea is a really very old; we know that different cultures have imagined a flat Earth resting on four turtles, four elephants and so on. Do not forget that the fact that the Earth is essentially flat is also the basis of Aristotelian cosmology, accepted with various modifications for a couple of centuries.

It would be a mistake to assume that this absurd misconception is confined to the past. There is more than one website that talks about this, in particular that of the Flat Earth Society, very well organized and structured in substantial material that claims to show the earth is really flat. Seeing is believing. [2]

Misconceptions are wrong ideas we have or we form of natural phenomena, mainly due to our sensory experience. In the simplest way we can say that for many phenomena we face in life we need to develop a “working model”, based on our experience. A misconception it is unintentional but is very dangerous: to remove it is mandatory in order to give new information or concepts. Otherwise it is like building a house on the sand, groundless: it will be fragile.

Astronomy, thanks to several projects in Europe and USA, is a discipline that in the past has been able to catalogue various misconceptions. For example in one site [3], linked with a well-known book, are listed up to 1,700 items sorted by type and topic with a briefing session. It is an important asset with an extensive bibliography on misconceptions in astronomy and science.

Just to quote the most common: the moon phases are due to the Earth's shadow, eclipses of the Moon are a particular lunar phase, the Moon emits light by itself etc. Other misconceptions are created nowadays by the media: think of an astronaut "floating without weight" on the International Space Station (no gravity in space!!??).

This is the key point we have to confront: how can we teach or speak on gravity if a boy or a girl has in his mind this misconception, that is: gravity is not present in the open space outside our Earth? We have to remove this misconception before to allow a correct understanding of physical phenomena. School and media should join, whenever possible, to use this method when they speak science.

[1] M. Bucchi and G. Pellegrini (eds.) *Annuario Scienza e Società* 2011, Edizioni il Mulino

[2] <http://theflatearthsociety.org/>

[3] <http://www.physics.umaine.edu/ncomins/> and references contained in the related book



17. Reassessing dialogue: reflections from an amateur astronomy event

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Over the past four decades, there have been a number of significant developments in the way science has been communicated to the wider public. The dominant focus on educational content with a one-way flow of information from scientists to members of the public has been criticised for not taking into account the social and cultural context of scientific knowledge (Irwin, 2009). In contrast, more recent approaches promote dialogue, participation and engagement between scientists, members of the public and other stakeholders.

However, there remains a significant question over these more recent arrangements: to what extent do members of the public desire educational content over dialogic approaches when they engage with the sciences? What do they value in an event where the sciences are involved? To explore this issue further, I investigated nine weekly public open evenings organised by the Institute of Astronomy at the University of Cambridge, UK. Each event typically consisted of a lecture aimed at general audiences followed by questions and answers. Guided observations of the night sky with the local amateur astronomy group followed if the weather was clear. If it was cloudy, staff provided tea and coffee and had informal discussions with the attendees.



- 78 A mixed methods approach resulted in a combination of data being collected. Participant observation through field notes complemented the collection of both quantitative and qualitative data from questionnaires. Audience demographics were analysed and participants were asked a number of questions relating to their general attitudes towards science outreach events and whether they wished to see more opportunities for dialogue.

Quantitative data: Who attends and Why?

In total, there were 254 responses to the quantitative questionnaire over nine open evenings. Once collated, the data indicated that the audiences were composed of individuals of diverse ages with a higher ratio of males to females (a ratio of approximately 2:1). The latter feature is not surprising as astronomy has been traditionally male-dominated both in the academic sphere and within the amateur astronomy movement. The majority of those who attended were local (from within the city of Cambridge) yet a surprisingly large proportion (nearly 18%) had travelled over 20 miles to be there. This is a testimony to the appeal of the event and perhaps the prestige associated with the University of Cambridge. The overwhelming majority of those attending do so with others: only 15% attended alone. This clearly demonstrates that, like many science communication events, the open evenings are social events as well as educational and /or engaging ones. Many attendees were 'regulars' and only half of those surveyed were attending for the first time.

One feature of the audience that is quite notable is how well educated the majority of attendees were. Approximately 68% of all respondents had a university qualification. Of these, approximately half were qualified in a scientific subject, suggesting that this event was

as appealing to those with a background in subjects other than the sciences. The high level of educational qualifications is perhaps not so surprising as the city of Cambridge has a higher-than-average percentage of the population with an undergraduate degree or equivalent (41% vs. 20% nationally). However, it does illustrate some of the challenges in engaging with citizens who have not studied academic subjects at degree level, or decide not to study science subjects beyond the age of 16.

When asked why they attended the event, approximately a third of respondents stated that it was due to a general curiosity about astronomy. Nearly 20% stated that they wanted to look through the telescopes, and 16% stated that the subject of the evening's lecture was one of the main draws. This could be interpreted as a desire on the part of these audiences to learn more about this scientific subject and to receive information from specialists in this field. To explore this issue in more detail, I conducted further research into the opinions of members of the audience.

Opinion Research

Overall, there were 33 responses to the qualitative survey. The majority of the feedback on the format of this event was very positive, with high praise for the organisers. The results generally echoed those of the first questionnaire with regard to motivational factors and the importance placed upon learning. The majority of these respondents attended in order to learn something new, or to put new knowledge into practice while observing the night sky on their own. This was true of both the lectures and the observation portion of the event. The following quote is indicative of this:

"I want to be enlightened, I like being taught, I like to find out interesting facts (although remembering them is another matter), for me it widens my horizons and that can't be bad."

The importance of learning was reinforced on closer examination of the responses given to a question which asked respondents what they considered to be the purpose of a science communication event, and what would make them want to attend. Interestingly, many respondents felt that an event where some sort of lecture was involved, or an 'open day' or some other situation that primarily involved the one-way transfer of information would be the hallmark of a desirable event. Several respondents also went on to state that they were attracted to events where they could learn something new – ideally from working scientists.

"I want to learn. If an event or place makes me think I can learn something, I would like to be a part of it."

One of my key interests in the opinion research was to explore views regarding the place for dialogic approaches to public astronomy events, and what kind of form such engagement may take. This was a difficult question for some of the respondents to answer and there were a number of people who responded with 'not sure' or 'don't know'. Most of the respondents, however (24 out of 33), attempted to answer this question and some suggested ways in which more dialogic approaches could be introduced. 11 respondents felt that more dialogue would be a good idea in theory.

"In principle it's a great idea, lots of your 'public' have knowledge and experience which would be good to share."



Interestingly, a number of respondents stated that some sort of learning would have to take place before any meaningful dialogue (or even a meaningful question and answer session) could occur. One of the respondents who suggested smaller seminar groups added the following caveat:

“It might work best if all concerned (especially the public) are asked to do ‘homework’ and prepare questions PRIOR to the workshop. Would involve much more commitment from public than just showing up.”

The view that members of the public require some level of scientific literacy before dialogic approaches can be successful leads to questions about the nature of dialogue itself, and perceptions of expertise (Davies, McCallie, Simonsson, Lehr, & Duensing, 2009). What can dialogic approaches deliver, and can they be framed to allow scientists and members of the public to genuinely learn from each other? This has important implications for all dialogic events, including those that form the basis of a consultation to inform science policy, and where there are societal or ethical implications.

Conclusions

The opinion data has revealed a number of insights about respondents' perception of public engagement and dialogic approaches within the context of an astronomy event. It could be argued that a desire for dialogue is not a pressing concern among those who responded to my questionnaire. There was little evidence in either of the questionnaires of attendees feeling excluded or disenfranchised from debates with these scientists at the Institute of Astronomy. The main appeal of this event, according to respondents, was the opportunity to learn something new from the lectures and to be inspired by the observation of the night sky. The enthusiasm and the accessibility of the scientists involved in running the event were valued by those attending. Several of the sub-set of respondents to the second questionnaire argued that they were already having an informal dialogue with the Institute scientists through the question and answer sessions, and on cloudy evenings over a cup of tea.

This is not to say that there is no need or opportunity to develop the idea of further dialogue. There is clearly an interest amongst some of those who responded to the questionnaires, despite the fact that this may not be fully informed by an adequate appreciation of what dialogue may actually mean and what kind of events may be available. However, given that a number of astronomy outreach programmes are making use of new communication technologies, there may be the potential for some innovative approaches that increase the opportunity for dialogue and active participation between professional and amateur astronomers, and other members of the public. The existence and prominence of the amateur astronomy community also adds another dimension to the debate, and another sphere through which dialogue and participation with these actors may be explored.

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18. The Diamond Planet - With great power comes great responsibility

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Gazing up at the sky and learning about stars and the universe has always sparked the people's interest and imagination. Fortunately, therefore, astronomy is well placed to champion outreach efforts aimed at raising public awareness of science more generally, as well as engaging young people in considering a career in physics, maths, ICT or engineering more specifically.

The Australian Research Council is now supporting a new collaborative research network in astronomy and “a new way of looking at the sky”: CAASTRO, the Centre of Excellence for All-sky Astrophysics (www.caastro.org). Centre members are located at six Australian universities across the country, as well as at four national and nine international partner institutions. By bringing together world-leading scientists in widefield astronomy, in observational and theoretical astrophysics, and in optical and radio astronomy, CAASTRO has a great potential for inspiring and training the next generation of scientists. Research in CAASTRO revolves around three interlinked themes: The Evolving Universe, The Dark Universe, and The Dynamic Universe – all carrying out key science with 21st century telescopes to culminate in the Square Kilometre Array (SKA). With big names, cutting-edge technology, and lots of new discoveries about our Universe, there should be no shortage of stories to showcase.

The opportunity and demand for astronomy-themed student engagement and public outreach have been widely embraced by numerous science and research centres. Activities have traditionally focused on public lectures, school visits or observatory tours, thereby reaching out to relatively small audiences of interested people in the local community. Hence, engaging these audiences often means ‘preaching to the choir’. We in CAASTRO are now finding our fit with these existing local activities and with the distributed nature of our Centre and are looking to communicate our science in a highly discoverable, inviting, interconnected, multi-medial way.

Maintaining an active and interactive Social Media presence promises to offer new powerful channels to exploit: Facebook ranked No.1 of Australian websites in early 2012 with every second person using it and 25-34 year olds being the largest age segment (according to <http://www.marginmedia.com.au>). YouTube takes second place in Australia (according to <http://www.quantcast.com>), and globally, schools are over-represented as browsing locations compared to the general internet population (according to <http://www.alexa.com>). Frequent posts to the CAASTRO Twitter account are further useful to draw together and at the same time expand the community of astronomy and science communication peers and alert followers to news items on our website, photos on Facebook, and new video uploads to YouTube.



Both Facebook and YouTube also reveal a very even gender split which conveniently predisposes them to portray science stories along with male and female role models in science in an equitable manner. So rather than pre-defining our audiences and formalising science engagement events, we are encouraging science engagement moments: that is, the casual interaction with scientific contents where users can choose how, what, and how much to learn about astrophysical research through social media.

Given the volatile and sometimes muckraking nature of social media attention, however, there is a fragile balance to strike between the entertainment value and the educational value of photo and video material in order to communicate science in all quality, honesty, and beauty. For instance, while providing scientific depth, video recordings of seminars and colloquia rarely attract a significant number of views from outside a tight circle of peers. To strike the balance, we are aiming to produce short (under five minutes) video press releases for selected CAASTRO publications that deliver a visually appealing presentation of a scientific result and introduce the scientists behind the research. In this regard, these videos are equally relevant to media outlets, as well as to members of the public and young people with an interest in the scientific method and the reality of astronomy research.

Our pilot story captured in a video press release was based on the paper “Transformation of a Star into a Planet in a Millisecond Pulsar Binary” by Bailes et al., published in *Science* in late August 2011. The journal’s high profile and multiple locally tweaked press releases (18 international authors at nine affiliated institutes) clearly contributed to the successful distribution of the story. Our video press release, a voiced-over animation, was embedded in these press releases and viewed 140,000 times within the first 24 hours of its release. From a strictly scientific point of view, the key result of this study can be summarised as “fills a gap in the binary pulsar family”, and it has now started to generate publications of follow-up observations, calculations, and speculations. In the media space, however, the discovery of “The Diamond Planet” was an instantaneous success that exceeded our expectations. Australian media monitors reported that within five days, the story had been picked up by:

- 12 Australian print media; 8 international print media;
- 22 Australian broadcasters; 1 international broadcaster;
- 113 Australian online media; 221 international online media.

The story was also frequently assigned alternative headlines to “The Diamond Planet” such as “The Big Bling Theory”, “Planet is a Girl’s best Friend”, “Pulsar in the Sky, with Diamonds”, and “It’s a Bird! It’s a Planet! It’s a gigantic Diamond!”. Since its publication in late August 2011, the discovery has sparked hundreds of spin-off clips on YouTube, with people not only re-posting our video, but also recording a new voice-over (often in languages other than English) or implementing more or different visual material. In addition to these interactions, we have found that “The Diamond Planet” soon had a Wikipedia entry, its own Facebook page, a techno song named after it, and hundreds of blog and forum entries (e.g. RandomnessWiki and Geekosystem). Even months after its publication, the story remains a common reference in the media – which is a spectacular outcome in the Public Communication of Science and Technology. The great risk attached to this level of penetrating public space is, however, to see the scientific message twisted or diluted beyond our control. In a number of forum discussions, for instance, the topic soon revolved around the possibility of mining excursions to “The Diamond Planet” and how this would impact on our economy...



Overall, we have to be pleased with the concepts of video press releases and social media contributing a new dimension of science communication. “The Diamond Planet” pilot story has shown that we have great power at our hands in reaching out to the unconverted, that is, science-by-stealth. We have to be very mindful of the great responsibility that comes with such power though and make sure not to neglect the quality and honesty of our research in preference to beauty. After all, every public engagement with scientific contents should be encouraged as it provides a valuable access point and an opportunity to communicate. Even “The Diamond Planet” mining discussion, for example, serves as a lead-in to talking about distances in space.



19. From art to astrophysics: how art inspires science communication. A show for planetariums to convey astronomical concepts throughout images, dialogue and art exhibition

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Premise: “earth” without “art” is just “eh”

The process which gives life to artworks because painters are inspired by the charm of the Sky is a well-known process. The beauty and mystery of Cosmos have always given mankind, and still give, a lot of masterpieces, from the Halley comet painted by Giotto in the Scrovegni Chapel to the Starry Nights by Vincent Van Gogh. But, what about the opposite process? How could art inspire science?

The Internet meme “earth” without “art” is just “eh” sounds very suitable for this project, which collects several input from different experts and expertises:

Alessandro Rinaldi (<http://www.alessandrorinaldi.net>) is an Italian artist present at the 54th Biennale International Art Exhibition of Venice. He has painted cosmic scenes, such as starry skies, constellations and moons which are specifically used for this project. He is also the father of the idea because it was he who asked the astrophysicist for the possibility to arrange an exhibition inside an astronomical observatory or a planetarium.

Giuliana Rubbia, a physicist working at the National Institute for Geophysics and Volcanology of Italy (<http://www.ingv.it>), has a long amateur theatre experience and a strong interest in the use of scientific content in plays.

Angela Misiano manages the Planetarium Pythagoras in Reggio Calabria (<http://www.planetariumpythagoras.com/>) where she organises throughout the year educational and entertaining shows about astronomy and the night sky.

Caterina Boccato, National Institute for Astrophysics of Italy (<http://www.inaf.it>), has the task of identifying and explaining in correct and simple manner the scientific concepts to be conveyed through this particular performance.

The rationale

For this project we referred to previous works and research. We combined an important work about Aesthetics and Astronomy, done by a group of experts in education and Astrophysics outreach with old studies about relations between Science and Art starting from the work of J. Arthur Thomson.



The first work about aesthetic and astronomy was conceived at the College of Education, by Jeff Smith who is co-director of the Educational Assessment Research Unit and his wife Lisa. One of their current projects is to identify how best to encourage people's appetite for information about space. They joined a group of scientists at the NASA-affiliated Harvard-Smithsonian Centre for Astrophysics to study the interplay between education, aesthetics and astronomy.

The Smiths knew that most people found images of space beautiful, but wondered how well they managed to communicate a scientific message. They discovered that reactions to art and to images of space are similar. The lay public may not have much specific knowledge, but is sufficiently attracted by the wonder of impressive works to want to find out more. One of the obvious conclusions of this work is that you don't need to be an artist to appreciate art and you don't need to be a scientist to appreciate science. What you do need is clear communication that helps in explaining what you are looking at and chances to have your questions easily and simply answered.

We combined these considerations with psychological ones. J. Arthur Thomson, in his book "Introduction to science", explained how there are three relations between Science and Art: (1) there is a scientific study of aesthetics; (2) Science has enormous stores of what may be called the raw materials of Art; and (3) there is an interesting psychological opposition between the two moods.



Aesthetics is a psychological science which inquires into the characteristics of that familiar experience which we call "enjoying Nature or Art", and of the rarer experience of productive artists.

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Human beings' emotional relation to Nature is primal and fundamental. The fundamental and ancient impressions are of the world-power, of the immensities, of the pervading order, and of the universal flux. To these modern science has added impressions of manifoldness, intricacy, inter-relatedness, and evolution. Nature is more than a mirror of our moods; the fundamental impressions are impersonal. While they have scientific validity, they are hardly less important in supplying the raw materials of poetry. Yet there is undoubted opposition between the scientific and the artistic mood; when either is in the saddle it must keep the other at a spear's length.

The performance: a dialogue between Science and Art

The final product of this project will be a drama performed in a particular theatre, built primarily for educational and entertaining shows about astronomy and the night sky: a planetarium. The public will be involved in an immersive show of artistic and astronomical images, and will listen to the two characters, Mr. A and Lady S, discussing both artistic and scientific aspects of each painting: from the raw material used for inspiring a painting to the scientific knowledge of the celestial objects represented in the painting.

The dialogue will be performed in a very classical way, using slides with alternating paintings and astronomical images according to what the two characters say at that moment. The story will be very simple. Starting from the painting in Fig. 1 for example, Science will ask Art "What is this, what does this painting represent?" and Art will explain its view, dream, vision but also the knowledge from which the painter took inspiration, giving Science the opportunity to introduce some scientific concepts.

The dialogue between Mrs. Science and Mr. Art will play on the duality of Art and Science but with a psychological game about Male and Female moods. This is done in order to stress more the interchange between these two moods, skills, and visions of the world. The dialogue will be also conducted very softly: both Science and Art have full respect for each other, they don't want to have the truth in their hands, in order to obey a fundamental process that you have to use if you want to convey some scientific message to your public: you have first to understand what model of reality your interlocutor has in his/her mind, then you have to demonstrate to him/her that he/she has some misconceptions in his/her mind and only after that you can explain the correct concept. Sometimes, the public can have the right idea in mind but maybe not complete or confused with something else...



Figure 1 – A painting for the dialogue between Mrs. Science and Mr. Art, courtesy of Alessandro Rinaldi. The public will have the opportunity of seeing real artworks in an exhibit inside the planetarium.

Future perspectives

The proposed format could be regarded as a new one for science outreach, where Astronomy could be replaced with Natural and Environmental Sciences, while dialogues around scientific issues could be performed inside planetariums as well as on other stages.

20. Public Engagement with System Synthetics

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Introduction

The concept of a bio-based economy captures the idea of replacing fossil resources and chemical processes by biomass and biotechnological processes. This concerns the production of pharmaceuticals, chemicals, fuels, materials, and energy. Globally, many countries strive for a transition to a bio-based economy as it is expected to benefit society in terms of sustainability, energy security and public health (Langeveld & Sanders 2010). However, such a transition would require technological innovation, involving important changes requiring engagement of the society as a whole. Success in achieving these goals is co-dependent on the preparedness of individuals to make choices in daily life, with regard to food, transport and energy usage (Gijsberts et al 2005).



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Achieving engagement on issues that are relevant for the future is not trivial. Bio-art has a potential as an intermediary for the engagement between art, science and society. It can function as a 'double boundary object' (Star & Griesemer 1989), namely, a configuration between science and art and one between science and society (Hansen et al 2006). In this capacity, it has the potential to articulate social, cultural and moral dilemmas carried along by emergent science and technology. Bio-art makes them visible and tangible. By turning the innovation process into something concrete the artist and his work are able to question notions of innovation, and thus trigger dialogue.

System Synthetics is a bio-art project by designer Maurizio Montalti. He was one of the winners of the *Designers & Artists for Genomics Award 2010* (www.da4ga.nl). In this project he explored the impact and social consequences of the latest advances in life sciences and microbiology. The installation was on display for half a year at the natural history museum *Naturalis* in Leiden, the Netherlands. The Section Biotechnology and Society at TUDelft studies different approaches to public engagement. For the presente study engagement is understood as a state of being rather than a process. This 'state of engagement' comprises three spheres: cognition, affect and behaviour (Lorenzoni et al 2007). For engagement you need to know something about the subject, have a feeling relating to it and a behavioural intention. In this context Montalti's work was studied, questioning how the work affected the public and to what extent it triggered engagement with a bio-based economy.

Science-art

For the creation of *System Synthetics*, Montalti collaborated with scientists. This collaboration denotes the first boundary configuration, between science and art. By doing so he became a design-researcher. Montalti proposed an innovative approach to the problem of plastic

pollution of the environment. He wished to address the harmful consequences of man-made synthetic materials for human health and vulnerable ecosystems by establishing a form of functional symbiosis between fungi and other organisms. Two different types of organisms were selected; a filamentous fungus that has been found to be capable of depredating plastic materials, and the well-known and much used model organism for research, baker's yeast, which is able to produce alcohol and is exploited for the production of bio-ethanol. The use of biological organisms for production as expressed in Montalti's design resembles production methods for a bio-based economy.

In nature fungi are responsible for performing cycles of decomposition and transformation of organic and inorganic substrates. Unlike in a laboratory environment, where they are often grown and cultivated in a pure culture, fungi in nature co-exist with other micro-organisms. There they either compete with other micro-organisms or establish symbiotic relationships and become co-dependent. Different experiments were conducted in the lab in finding and defining the best conditions under which the two fungal organisms can co-exist. Using a variety of culture media and different inocula densities, the artist was able to define ideal conditions for the start of a peaceful co-existence.

While working in the laboratory it became clear that the aim of creating a man-made endosymbiotic organism in a short time was rather ambitious. The artist became aware of the complexity of scientific research: research requires much work, time and patience. Based on visualisations of the co-culture by using fluorescent proteins, Montalti was able to create a visionary sculpture that depicted the novel endosymbiotic man-made life form. By becoming a design-researcher he was able to critically reflect on his own role as designer to not only create new toxic things. Also he designed an installation that could address the problems of a man-made evolution of life.



Science-public

In the second boundary configuration, through bio-art the social worlds of science and society can connect and demonstrate what is going on in the world of science or what can be expected. *System Synthetics* aimed to provide new perspectives towards the role of microorganisms in society. It tried to inspire the public to discuss the potential benefits and further consequences that could derive from innovation in the form of man-made evolution of life. The work on display consisted of the visionary model, a process-film, and a tailor-made transparent bio-reactor apparatus in which the results of the conducted experiments were integrated (Montalti 2011). The exhibition created the opportunity to study how *System Synthetics* engages its visitors with a bio-based economy.

In order to assess the extent to which *System Synthetics* engages visitors three different methods have been used to allow for data triangulation. The visitors were observed to see how they reacted and interacted with the project. Short pre- and post interviews with almost 100 visitors were conducted to evaluate a possible change in the extent to which they were engaged. Four focus groups were organised to discuss more closely and in depth how visitors got engaged.

The collected data suggests that *System Synthetics* provided visitors with a better comprehension of what a bio-based economy would encompass. The visitors expressed

understanding of an industrial biotechnology process such as those used for the transition to a bio-based economy. While observing all aspects of *System Synthetic* visitors explained amongst themselves how the process from plastic to bioethanol may work. In the interviews and focus groups it was stated that this effect was much appreciated: visitors learned how fungi and yeasts would be used in the production process.

Most visitors were amazed by the vision presented by *Systems Synthetics* and were enthused by the idea that a fungi and a yeast could work together in the production of ethanol from plastic. The idea that this man-made organism could tackle the man-made problem of plastic pollution raised visitors' hopes for the future. The installation aroused feelings of amazement and hope amongst visitors. It gave them an emotional outlook to what a bio-based economy would mean for them.

On the behavioural aspect, *System Synthetics* triggered statements of personal responsibility amongst visitors. Interview and focus group data suggest they became more aware about their own actions in regard to handling plastic products and plastic waste. *System Synthetics* mobilised them to undertake personal action to reduce plastic waste or to further enhance its recycling. The visitors were emotionally aroused and expressed positive feelings of surprise and amazement. They were motivated and felt capable to change their actions, to take personal responsibility. Although the visitors gained knowledge about only a small aspect of a bio-based economy, the overall data seems to suggest that *System Synthetics* engaged visitors positively with the transition to a bio-based economy.



90 Conclusion

We have addressed both sides of *System Synthetics* as a double boundary object: on the one side between science and art and on the other side between art and society. We elaborated how it can trigger engagement with a bio-based economy. As a boundary object between science and art we demonstrated that *System Synthetics* is able to articulate the issues connected to the man-made evolution of life by combining and using fungi and yeasts for solving the man-made problem of plastic pollution. For *System Synthetics* as boundary object between science and society our results suggest such art is able to trigger engagement with a bio-based economy: museum visitors gained a broader understanding of the processes involved in the transition to a bio-based society, the installation aroused emotions and triggered visitors to take personal responsibility. A bio-based economy will necessitate a profound change of the production, use and re-use of everyday products such as plastic. It is a highly innovative and technical transition that so far occurs far from people's daily life and only reaches its economic viability and sustainability promises if every actor in society is engaged. We have demonstrated that it is possible to bring this reality a bit closer to people's daily life by using bio-art.

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21. Panel discussion: How to educate and train scientists and science communication students to perform well in science communication activities

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Introduction

When the first call for papers went out for the PCST conference 2012 in Florence, many researchers reacted to the theme of ‘professionalization’. From their suggestions for contributions it immediately became clear that the term was considered from a great variety of angles. Quite a few suggestions could be linked to the question of how to educate and train scientist and science communication students to perform well in science communication activities. Four speakers participated in a session focussed on this issue:

- Midori Takahashi, PhD, Shizuoka Science Museum in Japan: ‘Training Local Citizens as Science Communicators in a Science Museum as a Means of Cultivation of Science and Technology.’
- Liesbeth de Bakker, MSc, Freudenthal Institute for Science and Mathematics Education in The Netherlands: ‘Empowering science PhD students for engagement-oriented science communication.’
- Dr Ann van der Auweraert, Delft University of Technology in The Netherlands: ‘Science in dialogue training.’
- Dr Will J Grant, Australian National Centre for the Public Awareness of Science: ‘Development and challenges in science communication education.’

Caroline Wehrmann, assistant professor in Science Communication of Delft University of Technology in The Netherlands, moderated this session.

Five main questions arose: who has to be trained or educated in science communication, which educational approaches are used, how to design programmes or courses, what are the insights of evaluation of education programmes and what are the challenges in educating science communication practitioners? In this paper each of the above five questions will be addressed based on the four presentations that were given.

Who has to be trained or educated?

In science communication training programmes, students, scientists and science communication professionals are generally considered to be the main target groups. And indeed most of the speakers deal with training or education programmes which have such a target group. However, the presentation of Midori Takahashi focused on training a different target group: representatives from the lay public. These representatives are selected from



specific segments of the general public: 1) high school pupils, 2) university students and other interested adults and 3) retirees and / or housewives who have experience in science and technology. It is argued that they could be the ideal communicators within the Shizuoka Museum in Japan to introduce emerging social issues and to facilitate discussion. Each of those groups has to get a tailor-made training programme, and contributes in their own specific way to create a platform for cultivating science and technology in a local area.

Which educational approaches are used?

Engaging the public is a common teaching objective in some of the science communication courses as described in the presentations. Liesbeth de Bakker explained the educational approach she used to reach this teaching objective. In her science communication course for science PhD students the course design is based upon notions derived from constructivism (Woolfolk, Hughes & Wallop, 2008). Social constructivist views on learning emphasize the active role of the learner in building understanding and making sense of information. Therefore engagement is important. So the course participants worked together as a learning community. At the same time each participant could tailor the course to his or her needs (concern-based). Science communication skills were learned in real life situations with real lay public (situated learning / context-based). The PhD students, ideally from different science backgrounds, learned a lot from and together with each other through feedback sessions (experiential learning). As a consequence the role of the teacher was that of facilitator of the learning process and rather than instructor.



The teaching approach of the training course of Midori Takahashi at the Shizuoka Science Museum was also based on constructivism and discovery. The course participants learned to be science communicators through personal experience, reflection and feedback.

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How to design a course with a focus on engagement?

Ann van der Auweraert explained in her presentation in detail the design of her course at Delft University of Technology focusing on dialogue training. In developing this training the use of the participatory learning process is striking. The idea is to co-create knowledge through genuine dialogue. Both science communicator, in this case a scientist, and stakeholder share their knowledge and learn from each other by discussing issues from various perspectives. They use different frames and assumptions, deal with different values, norms and emotions, with controversies and uncertainties, and with types of knowledge other than pure academic knowledge. The participatory learning process is, according to Van der Auweraert, aided by substantive theoretical input, relevant and engaging case studies, simulations and practical exercises. One of the prerequisites is that all participants have to be open-minded and motivated to share knowledge and ideas.

What are the insights from evaluation of education programmes?

Once a course developer has decided upon his educational approach and course design he has to consider how to evaluate his course properly. One of the most important questions is whether or not the main learning objectives have been realised. In the case of the science

communication course for science PhD students (presented by De Bakker) a first critical reflection showed that the course did not meet its objective of fostering more engagement-oriented science communication. There seemed to be a gap between the call of the science communication research field for more engagement-oriented science communication (Wynne, 1991; Durant, 1993) and the practical and educational needs of the actual science communicators (in this case the PhD students who followed the course in science communication at Utrecht University).

The PhD students all agreed that in principle engagement-oriented science communication is a good thing, but they did not see the relevance of it for their own work at this moment. Therefore very few of them have invested in engagement-oriented activities after having finished the course and very few are willing to invest in education or training which is more engagement-oriented. They see this as something only relevant at a later stage in their career. For the moment these PhD students mainly wanted to develop or improve their basic communication skills to get their message across to the public, e.g. skills based on the sender-driven model of science communication.

What are the challenges?

From the presentations a general issue emerged. It seems that while the science communication research field is calling for more engagement-oriented science communication, the practitioners themselves tend to use the sender-driven model. Takahashi mentioned that her students preferred to be told what to do instead of using constructivism as an educational approach: constructivism or 'learning by doing' takes (too much) time. De Bakker identified a related problem. In her opinion it is hard to 'teach' engagement in science communication to junior researchers who have just taken their first steps on the path of science communication. They tend to prefer and implement science communication activities which are based on the sender-driven model.

Will Grant saw some other major challenges in the broader field of science communication. He noted that within academia there still is resistance amongst faculties ('Everybody can communicate, can't they?'). This is partly caused by the fact that the visibility of the science communication discipline is not very high. Even within the science communication community the views on what constitutes the science communication discipline diverge. He also mentioned challenges in the field of ethics of science communication and in formulating codes of conduct of science communication practitioners. Grant stated there is still a disparity between the researcher who focuses on theory and the practitioner who often is not convinced of the necessity of using theories, and has to deal with limited time and money.

Final remarks

The four presentations in this session all shed light on different aspects of a common theme: education for professionalization. This approach resulted in a broad overview of important issues which are interrelated. In this way a small step was taken to address important challenges in this field. Those interested in joining the deliberations on professionalization in science communication are invited to contact Caroline Wehrmann (c.wehrmann@tudelft.nl).



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22. Empowering science PhD students for engagement-oriented science communication

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Summary

In science communication there's a call for more engagement-oriented approaches but at the same time it seems science communicators are not ready (yet) to put them into practice. This empirical qualitative evaluation of an engagement-oriented science communication course shows that science PhD students who voluntarily followed the course have a positive attitude towards engagement with the public but don't act accordingly in their communication behaviour. They see it as something more relevant for later in their careers. Based on the study's findings, advice is given for improved teaching on engagement-oriented science communication.



Introduction

Engagement has become an important issue in science communication literature (Wynne, 1991; Durant, 1993). As a result science communication courses have turned their focus towards more engagement. Since 2007 the Freudenthal Institute for science and mathematics education (FIsme) of Utrecht University is offering such a course to science PhD students.

From a critical retrospective on this course carried out in 2010 (de Bakker & Waarlo, 2010), it emerged that one of the main goals of the course – to establish engagement – was not met. Course participants appeared not to practise it yet, although the first step in terms of awareness-raising on the issue of engagement had been made.

So how to adapt the course to better fulfil its aim? This empirical qualitative evaluation study aims to come up with suggestions through answering the following research questions:

- What are the longer-term learning outcomes of the science communication course for science PhD students in terms of knowledge, acquired skills and attitude towards engagement in science communication?
- Do the PhD students perceive a need for more engagement-oriented science communication after the course? If so,
- What are their expressed learning needs to qualify themselves further for engagement-oriented science communication?

Theoretical framework

Conceptual analysis engagement

The critical retrospective itself and the discussions that ensued at the PCST conference 2010 revealed a lot of confusion and different views surrounding the notion of engagement within science communication. This indicated a need for further conceptual clarification.

A literature review showed that engagement should best be seen as part of two-way communication, and therefore outside the realm of the classic, sender-driven model of science communication. Engagement in science communication can further be defined by 'aim', 'process' 'knowledge types', 'control', and 'reflective practice'. These variables seemed helpful in analysing the self-reported science communication behaviour of course participants.

Studying engagement in the course participants

For engagement-oriented science communication to take place, the course participants need to have the right attitude, skills and social environment. So these aspects were studied following Van der Auweraert (2008) who explored the science communication behaviour of scientists, using the model of planned behaviour (Ajzen, 2005). Based on this model (see figure 1) interview questions were formulated and interview data was analysed.

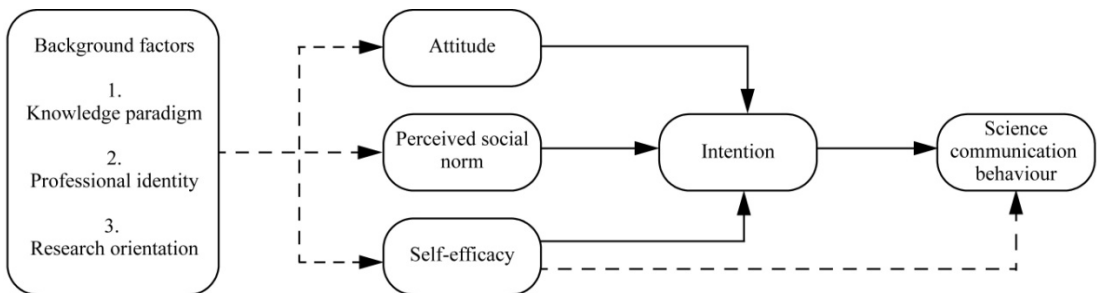


Figure 1: Conceptual model

Method

Science communication course

The course design is based on commonly held notions within the Freudenthal Institute derived from constructivism (Woolfolk, Hughes & Wallop, 2008). The course characteristics are: concern-based, situated learning (hence also context-based), experiential learning, and the teacher as 'facilitator'. It links theory of science communication to practice by facilitating participants to present their own PhD research projects to (real live) audiences with the intention of engaging publics and fostering dialogue.

Respondents

The respondents in this study are 12 PhD students out of a total population of 60 former



course participants. All 12 participated in the years 2009 or 2010 in the science communication course, so the longer-term effects of the science communication course could be studied. Care was taken that the sample was a fair cross-section of the whole population of course participants in terms of gender balance and scientific background.

Data collection and analysis

All respondents were interviewed for about an hour. The full sessions were audio recorded. The interview questions were based on Ajzen’s model of planned behaviour and the study’s research questions. In order to get a more in-depth insight into the respondent’s attitude towards engagement a ‘profile’ sheet was developed (see figure 2) based on the variables that help determine (the level of) engagement.

All interviews were transcribed and analysed. Based on the total results of the analysis, all participants were evaluated on their personal longer-term outcome of the course and it was determined where they stand in terms of engagement-oriented science communication.



'Me' in science communication							
		1	2	3	4	5	
Communication approach	Monologue						Dialogue
Aim / process	Explaining Informing						Mutual learning Questioning
Control	You						Other
Communication content 1 (Knowledge type)	Facts & figures						Application & implications
Communication content 2 (Reflective practice)	What and how?						Why?

Figure 2: 'Profile' form for respondents. For different variables respondents were asked to tick the boxes that best matched their self-reported behaviour in science communication and to clarify their answers

Results

Attitude: All twelve respondents confirmed that during and after the course they started 'putting the public first' when working on a communication product (receiver-oriented approach). In terms of attitude towards engagement-oriented science communication, eight are positive and four are negative. Those with a negative attitude perceive the public as not having the right or enough knowledge to be a valued partner in a dialogue about the PhD's research project.

Social norm: Half of the respondents said that in terms of their science communication activities their environment was indifferent, the other half said their environment allowed it but didn't stimulate it. As far as their supervisors are concerned, the PhD research has to come first. Science communication activities have to be carried out (mainly) in the student's own spare time.

Self efficacy (knowledge and skills): Respondents have been quite inactive in terms of public science communication. Sender-driven communication activities dominate over receiver-oriented communication activities.

When looking at the background characteristics of the respondents (i.e., knowledge paradigm; professional identity; research orientation) it was found that they corresponded nicely to an open or closed attitude towards engagement-oriented science communication.

Seven out of the twelve respondents said they were not in need of more engagement-oriented science communication. Three said, 'not yet' and two were positive about it.

About twice as many sender-driven communication activities were mentioned compared to engagement-oriented activities, 20 and 11 respectively. Examples of engagement-oriented activities given are: dialogue workshop, real life experiences, and interactive workshops with a real lay audience. The educational approach of the course should be based on constructivist notions, e.g. learning by doing, (peer) feedback, and situated learning.



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Conclusion

The main conclusion from this study is that there seems to be a gap between the call of science communication researchers for more engagement-oriented science communication (Wynne, 1991; Durant, 1993) and the practical and educational needs of the actual science communicators (in this case the PhD students who followed the course in science communication at Utrecht University). The PhD students all agree that in principle engagement-oriented science communication is a good thing but they don't see the relevance of it yet for their own work. Therefore very few of them have invested in engagement-oriented activities and very few are willing to invest in education or training which is more engagement-oriented. This is seen as something relevant only at a later stage in their career.

Suggestions for improved teaching of engagement-oriented science communication include an intake procedure for potential course candidates. Only those scientists in need of a more engagement-oriented approach in their science communication course will get it taught. It is expected senior scientists and scientists who are more constructivist, society-oriented and work more trans-disciplinary, will be more in need of engagement-oriented science communication. In addition, the course itself should be concern-based, and use principles of

experiential and situated learning with the teacher as facilitator rather than instructor.

Finally, barriers should be taken down: the course should offer more workshop type / dialogue elements, it should be clear that engagement has added value, the work environment should be more supportive (involve supervisors), and the added value of the public's knowledge about research should be clarified and emphasised.

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23. The challenges of strategic climate change communication in the government workplace context

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Introduction

Global climate change is one of society's greatest challenges. The intrinsic complexity of the science of climate change also makes it difficult to communicate effectively (Nerlich, Koteyko et al. 2010). As Moser (2010) identifies, the challenges in climate change communication arise from myriad unique factors such as 'invisible causes' and temporally and spatially 'distant impacts' that often make audience engagement problematic (p.33). Not surprisingly, confusion and misconceptions about climate change persist in the Australian public sphere (Ipsos 2010). In response, the literature calls for a more strategic approach to communication of the phenomenon. This paper explores what that means within the context of the literature and presents preliminary findings of research that examined factors influencing a practitioner's ability to develop and deliver strategic climate change communication initiatives in Australia.

The concept of 'strategic communication' is a salient theme across a range of disciplines including, but not limited to, health communication, science communication and risk communication (Palenchar and Heath 2007; Cox 2010; Kreps 2012). Several authors provide definitions to describe how 'strategic' applies to communication. Hallahan et al. (2007) define 'strategic communication' as the 'purposeful use of communication by an organization to fulfill its mission' (p. 3). Others distinguish communication from 'strategic' communication by using terms such as 'carefully designed' (Kreps 2012, pg. 379), or 'carefully planned' (Duffy and Omwenga 2002, p. 146). Such descriptions highlight the essence of strategic communication as purposeful, well researched, thoroughly planned and, as is the case with most climate change communication, able to effectively stimulate behaviour change.

Strategic Climate Change Communication in the Government Context

Much of the peer reviewed literature on climate change communication focuses on the audience and various best practices for communicating with them (Moser 2010; Morton, Rabinovich et al. 2011). This growing body of research improves our knowledge of how to connect with various target audiences through applying appropriate strategies and an improved understanding of, for example, how people respond to different messages. However, despite this expanding area of scholarship, the work of the professional science communication 'practitioner' does not appear to be well covered by the literature.

Government Communication Practitioner

Hallahan et al. (2007) identifies six practitioner roles commonly found within an organization.



Practitioners engaged in this study are best characterised by the ‘information/social marketing campaigns’ role described as: ‘employees in...governmental agencies... involved in social, psychological, and physical well being. [Their purpose is] to reduce the incidence of risky behaviour or to promote social causes important to the betterment of the community’ (p.6). Such a role is distinguished from other practitioners who are categorised as working in ‘public relations’ or ‘marketing communication.’

The Study

To explore the perceptions of public sector science communication practitioners actively engaged with the issue of climate change, a qualitative approach was applied to the study. The findings presented here are based on a thematic analysis of mixed method semi-structured interviews with a purposive sample of ten communication professionals employed in a government setting within the geographic confines of the State of Queensland. Interviews undertaken with this sample were structured to elucidate the factors that informed their approaches to the design and delivery of climate change communication initiatives.

A salient theme to emerge from the interviews is that of the ‘Organizational Context.’ This was perceived as a leading factor informing how a practitioner designed and implemented strategic climate change communication initiatives. The theme encapsulates the organizational environment in which the practitioner is employed; in this case, the government workplace. This environment includes internal influences such as an organization’s cultural values, institutionalized practice and policy, and/or external influences such as current legislation and mandates.



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‘...we’re just taking a ‘one size fits all’ [approach]...can’t do it. We have to invest the resources to [research] the target audience...and identify a strategy. And that’s what I mean about strategic communication.’

As one participant expresses above, undertaking strategic communication is not a simple task. Indeed, despite best intentions and perhaps awareness of the need to be strategic, the practitioner reveals utilizing a ‘one size fits all’ approach. Why is that? The analysis indicates that the organisation was perceived to be an important factor affecting their ability to be strategic. The reasons for this, presented below as sub themes, include: ‘day-to-day demands,’ ‘reactivity’ and ‘organisational misconceptions.’

Day-to-day Demands

In practice, practitioners do not work in isolation and are required to respond to the changing demands of their workplace. At times, this is expressed as creating conflict in their approach to communicating about climate change, often imposing a choice between being strategic and keeping up with the day-to-day workload. The following quote from one respondent captures this theme:

‘So you might have a fabulous plan about educating the community about climate change...the reality is, today I can’t do that...And I think you’ll find that any communicator will say that one of the issues preventing them from following a strategy as they had planned it, will be the fact that their day-to-day work gets in the way.’

Reactivity

Another important theme emerging from the data is 'reactivity'. The term is used to describe the piecemeal approach to communication flowing from an organisation's need to react quickly to unexpected demands. As a result, the organisation may meet immediate short-term communication goals, but usually through sacrificing long-term, theory-based strategies. As one participant describes:

'The thing about government is that it's so reactive that you don't get to do all that planning stuff. The timelines are so tight that you've just sometimes got to jump straight into it which I don't necessarily agree with but it's just the way you've got to go.'

Organisational Misconceptions

The data also suggest that an organisation's collective beliefs about communication can profoundly affect its practice. For example, rather than employing a systematic approach to developing communication initiatives based on theoretically informed techniques, a practitioner may instead be bound by internal workplace beliefs about communication, which may be narrow and imbued with misconceptions. As the following participant explains:

'But where we've sat, people have always tended to... want to go straight to product. 'We need an information sheet.' ...You're always trying to get them to go, well, hold on. Yes, it might look pretty...But is that the key communication tool that you want to use? Actually getting them...to...tease out what the problem is. And then decide what's an appropriate tool...'



Discussion and conclusion

This study reveals that practitioners frequently perceive their organisations as having a significant role in determining their capacity to communicate strategically about climate change. Rather than focusing on the implementation of theoretically informed strategies, as advised in the literature, the data above reveal a scenario requiring practitioners to also consider the beliefs, values and norms that define their workplace environment. This highlights that communication strategies clearly cannot be developed in isolation from their environment and exclusively based upon theory, but rather are influenced by other factors such as workplace culture as captured in the 'Organisational Context' sub themes of 'day-to-day demands,' 'reactivity' and 'organizational misconceptions.'

The research presented here responds to a call in the literature for a more strategic approach to climate change communication, and aims to provide insight into the communication practice of professionals employed in a government sector context. This was achieved by conducting qualitative, semi-structured interviews with communication practitioners engaged with the issue of climate change. Preliminary findings reveal that the strategic practice of these communication professionals ironically is often impeded by the organisation itself. Therefore, this study stands to make an important contribution to the literature on climate change communication, as it is apparently the only study that explores and elucidates perceptions of the professional communication practitioner, rather than the more commonly researched angle of the audience.

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24. Contextualising strategic communication of science and technology: persuasion, organization, public relations

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The relevance of strategic communication raises many new questions and challenges for academic researchers who study the public communication of science and technology (PCST). Whereas much effort has gone into situating the production of PCST in social contexts, into grasping the public authority and credibility of science, and into understanding different publics' uptake of science, little research on the institutionalisation, commercialisation, and strategic performances of PCST has been conducted. As academic institutions, research-intensive firms, government branches, science centres and many more organisations begin taking a professional and strategic interest in science communication, understanding PCST in strategic contexts becomes increasingly important to understanding contemporary and future challenges to PCST. In order to appreciate what the shift towards strategic communication means for researchers, practitioners, and publics of PCST, we therefore need to explore how the field of PCST relates to other domains of strategic communication.

Strategic communication of science and technology (SCST), in general terms, can mean communicating scientific and engineering knowledge (including knowledge about the ethical, social and legal implications of S&T) in order to satisfy certain goals. The goals of SCST are heterogeneous, including changing attitudes, facilitating new behaviors, coordinating activities, building social relationships, attracting funding, etc. Making sense of the multifaceted field of SCST, this paper considers three strategic contexts for PCST: persuasion, organisational management, and public relations, each of which defines specific ends, means, and media of SCST.



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SCST as persuasion

Persuasion can be defined as "human communication designed to influence others by modifying their beliefs, values, or attitudes" (Simons 1976, p. 21). The objective of persuasive SCST is to produce some kind of attitudinal change in particular audiences or target groups. To find out whether SCST activities are persuasive in this sense, it is necessary to be able to probe the change in beliefs, values, or attitudes effected. This can be done by means of standardised attitude-measurement techniques such as those explored in Roberts (2008).

There are several approaches to persuasion, three of which include (this section is based on O'Keefe 2002):

- **Social Judgment Theory (SJT)** Attitude change is mediated by the receivers' judgments of the information content, the point of views, and the values being presented. Communication produces two kinds of perceptual effects, contrast or assimilation. The contrast effect occurs when the receiver judges the position advanced to be in contrast with his/her own position; the assimilation effect when a higher degree of similarity is being perceived. The degree of assimilation is positively related to the degree of attitude change.

- **Elaboration Likelihood Theory (ELT)** Attitude change depends on the likelihood that receivers' engage in "elaboration" (i.e. issue-relevant thinking) of the ideas or beliefs being put forward. ELT underlines the correlation between attitude change and the perceived relevance of the communication to the receiver. Moreover, ELT emphasizes the cognitive capability of the receiver to process the information. ELT endorses the notion of "elaboration continuum" from central routes of persuasion (strong relevance and ability) to peripheral routes. Central routes involve a high degree of cognitive processing of the merits of the arguments presented, whereas peripheral ones depend on emotional and/or external factors such as rewards.
- **Cognitive Dissonance Theory (CDT)** CDT focuses entirely on cognitive elements (including attitudes, knowledge, etc.). There is said to be dissonance between such elements if the opposite of one element follows from the other (e.g., the smoker's knowledge of the risk of cancer vs. the cognition of being a smoker). Since cognitive dissonance is an aversive motivational state, persons experiencing dissonance will try to reduce it (stop smoking or stick to the belief that the risks do not pertain to them). Communication is most persuasive when it produces cognitive dissonance reduction.

SCST as organisational management



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Other than being persuasive, SCST, like other forms of communication, builds social relationships. The social (ritual) dimension can be used strategically in research-based organisations to strengthen organisational structures and facilitate social ties. In the organisation management literature, several strategies of organising and communicating can be distinguished, all of which builds on different perceptions of the organisation (this section is based on Conrad & Poole 2012):

- **Traditional** The traditional organisation is conceived as a hierarchical structure with decision-making located at the top level. The role of SCST in the traditional organisation is to enable information about research projects to flow freely, but regulated through the chain of command. Communicating S&T to outside stakeholders is highly specialised and centralised.
- **Relational** The relational organisation substitutes decentralisation and participatory decision-making for hierarchy and specialisation. With respect to SCST, this means that researchers and research teams are free to decide what should be communicated to whom and how. The communication of S&T should aim to build relationships within teams and between teams within the organisation, rather than serve the entire organisation.
- **Cultural** The organisation, whether it is conceived as traditional or relational, builds on values, symbols, etc. The culture of the organisation, however, is neither homogenous, nor harmonious. SCST might be used to promote certain types of organisational culture and to "enculturate" newcomers. Symbolism, storytelling, rituals, visions, charisma, and other forms of cultural "glue" should be part and parcel of SCST culturally conceived.
- **Network** The network organisation strikes a balance between flexible change and structural integration. SCST is seen as a way in which to adapt the network organisation to new circumstances, but also to achieve alignment between dispersed actors.

SCST as public relations

Public relations (PR) is defined as “a strategic communication process that builds beneficial relationships between organisations and their stakeholders” (Corbett 2012). The PR dimension to SCST (PR-SCST) most often refers to communicating research results and projects to various audiences in the general public. More broadly, it includes knowledge transfer, policy advice, student recruitment, and many other activities in which universities engage in strategic deliberations on communicative interactions with other social actors. Depending on the specific goals of PR-SCST, communicative tools and processes will include:

- **Attracting funding** In order to attract funding, universities and other research-based institutions need to promote research excellence and establish a brand identity.
- **Knowledge exchange** The exchange of knowledge between the university, industry, and government requires strategic attention to the communication of research-based knowledge, but also to the accumulation of personal contacts, maintenance of social networks, etc., thus seeking a beneficial balance between the interests of researchers and stakeholders.
- **Recruitment** In order to recruit students, universities will emphasise teaching excellence, but also student life, career opportunities, etc.
- **Social responsibility of science** Besides one-way communicative activities, PR-SCST also includes promoting social accountability by enabling dialogue between the university and members of the public. The social responsibility of science can be enacted through strategic communication by showing the engagement of the university in social and environmental issues on a local and global scale, but also by engaging the public in decision-making about the future directions of research.



From PCST to SCST: a research agenda

The shift from PCST to SCST is more than a shift in perspective. Granted, it entails a shift from looking at what audiences (and scientists) get from S&T communication to seeing how research institutions strategically may adopt specific means to specific ends, but it also paves the ways for a broader and perhaps more experimental approach to S&T communication.

SCST is a multi-level approach to the study and design of S&T communication. Depending on the context, SCST ranges from persuasive interventions through organisational management to the enabling and maintenance of a broad range of public relations. SCST is not only about getting your message across in the best possible way, but also gives attention to the role of S&T information in shaping the organisation and its relations to stakeholders. A certain degree of tension between the different levels of SCST is to be expected and might form the basis of empirical investigation.

Moreover, the SCST agenda could/should be seen as a call for an integrated strategic-experimental approach to S&T communication (Neresini & Pellegrini 2008). The three contexts presented in this paper also define specific contexts for evaluation. Evaluation requires that the goals of SCST be made clear. Persuasion, organisation, and public relations are three different ways of thinking about SCST objectives. Evaluating or measuring the effects of SCST is necessary to understanding the ways in which the strategic objectives are being met, and SCST evaluation might form the basis for increased cooperation between researchers and practitioners of PCST.

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25. Strategic science communication: the value of communication for the performance of the organization

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Introduction

In the past decade there have been many attempts to define 'strategic communication' (Hallahan et al, 2007). In her inaugural lecture as professor in strategic communication in the Netherlands, Noelle Aarts described strategic communication as: 'to organise meaningful interactions to ensure adequate positioning of the organisation in the networks that people form with each other, both within and outside the organisation' (Aarts, 2009).

But how to define 'strategic *science* communication'? In a first attempt to get a grip on strategic science communication, Nielsen in the previous paper relates it to persuasion, to organisational communication to public relation management (Nielsen, 2012). In this paper I will use the definition of Aarts and describe strategic science communication as 'strategic communication within the science and technology domain': communication to ensure adequate positioning of an organisation in the science and technology domain.

The science and technology domain is characterised by the fact that science and technology has high impact on the societal issues. Another important factor is that the knowledge workers in this field, working in R&D departments, laboratories, specialised governmental bodies and knowledge institutes, are granted more authority than in other areas of society. Their visibility implies that their communication can have immediate effect on the positioning of the organisation as a whole. This situation will probably pose specific requirements to the communication department of the organisation.

The question is: does the structure and management of the communication function of organisations within the science and technology domain indeed differ from those in other domains? Do the organisations in various fields pursue similar objectives? And to what extent and how does the communication function contribute to these objectives? In this paper we describe a benchmark study that provides insights into the link between organisational objectives and the structure and management of companies in different domains.

Communication benchmark 2011

The Science Communication section of Delft University of Technology in The Netherlands was commissioned by communications consultancy Boer & Croon to design a benchmark that provides insight into how the communication function of large companies and organisations in the Netherlands is organised, and to find heuristics for the development of the communication function that actually contributes to the success of the organisation.

An important principle in developing the benchmark is that the benchmark should be able to yield measurable results of the success of the communications department and connect



the activities and composition of the communication department with the performance of the organisation. To obtain an insight into causality, we have based our benchmark on the Balanced Scorecard (Kaplan & Norton, 2004). The balanced scorecard considers strategic objectives of an organisation as a series of explicit and testable causal relationships and lists the conditions that will lead to the desired results (Critical Success Factors). These CSFs are characteristics of the organisation necessary for the success of the organisation and therefore of specific interest. Based on literature (Boer & Croon, 2010) we focused on six objectives (see figure 1).

In addition to questions about the objectives and CSFs, we added several questions in our questionnaire about the current structure of the communication function. These questions were related to the communication disciplines that are present in the communication department (such as internal communication, web communication, sponsoring, brand communication, public affairs). The questions concerned the available budgets per discipline, the number of professionals who perform tasks related to a specific discipline, and the occupational level at which the professionals perform.

In early August 2011, some 170 directors or managers of communication departments of Dutch companies and organisations received an email with a link to the online survey inviting them to participate in the benchmark study. 49 of the addressed persons completed the digital survey: a response rate of 26 per cent. In addition, 40 respondents partially completed the survey. Their data are used wherever possible in the benchmark. The data enabled us to compare organisations to a general average but also to more similar companies in peer groups.



Performance of the respondents

The average scores on the Critical Success Factors (CSFs) are placed in figure 1. The spider web can be used to visualise the scores of one organisation related to the average scores (figure 2) and to visualise the average scores of several groups of respondents. One of the outcomes was that the scores of semi-public organisations differed from those of businesses (table 1).



Figure 1 Average scores of all respondents



Figure 2. Average overall CSF scores for the objectives of Company X

The average overall scores on the CSFs as presented in the spider diagram will not provide communication directors and managers with sufficient information about how to develop a communication function that actually contributes to the success of the organisation. A first step is to analyse and interpret the data, to find possible causes to explain poor scores. In the end, the communications director and his team have to decide which (combinations of) causes apply most to their situation. Next step would be to find solutions that fit in the causes and implement them. In this paper we focus on the first stage.

Table 1.

Strategic objective	Benchmark	Semi-public	Business
To play a strategic role in the organisation	4,2	4,2	4,2
To make the organisation communicative	3,2	3,2	3,2
To be accountable to the organisation	4,0	3,9	3,9
To manage and reinforce relations with stakeholders	3,9	3,7	4,0
To timely detect and effectively manage issues	3,3	3,4	3,2
To reinforce the corporate reputation	4,1	3,8	4,2

Possible interpretations

To enable the respondents to interpret the benchmark data several data were combined. Two sets of factors were clearly identifiable and have potentially major impact: the levels on which the professionals perform to achieve an objective and the budget available for the objective.

As seen in Table 1 respondents generally scored high in terms of reputation management and playing a strategic role within the company. This seems hardly surprising, as it appears that to achieve these objectives, particularly professionals with the most strategic (the “highest”) profiles are employed. In addition, to enhancing the reputation relatively much money has been spent.

Communications departments scored much lower on the targets ‘to timely detect and effectively manage issues’ and ‘making the organisation communicative’. If we connect these goals with allocated budgets and job levels, it is apparent that in reaching the goal ‘effective issue management’ relatively many professionals with a strategic profile are involved, but that the allocated budget is relatively low. In case of the second objective we see the opposite. Although the budget is relatively high, there are only few professionals who operate on a tactical-strategic or strategic level. The observed absence of high-level professionals and/or sufficient budget could be an explanation of the lower scores.

The scores on other specific CSFs could explain a relatively poor score in one of the objectives as well. It is for instance striking that in achieving both objectives with the relatively low scores (‘to timely detect and effectively manage issues’ and ‘making the organisation communicative’) the co-operation of communication professionals with the line is essential. This co-operation requires different knowledge and skills than in achieving other objectives:



rather than the expert role, it is mainly the analytical and social skills that characterize the role of the professionals involved.

Strategic science communication

In this paper the Communication benchmark 2011 has been introduced as a means to make the value of the communications function for the organisation visible and measurable.

The benchmark design enables an organisation to compare its communication function with other companies and organisations on the basis of various criteria, provided that there are enough participants in the benchmark. A first tentative step has been set to develop guidelines to interpret the benchmark data and find causes for the scores.

Until now, several research institutes, universities, and hospitals took part in our benchmark. But we do not have sufficient respondents from the science and technology domain yet to compare the data of companies and organisations in this field with those from other domains.

Our hypothesis is that ‘to organise meaningful interactions to ensure adequate positioning of the organisation in the networks that people form with each other’ in the science and technology domain requires a focus and structure of the communication function that differs from other domains. At Delft University of Technology we have started several research projects in order to answer this question.



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26. Panel Discussion: Science Communication in the South East European Region - Overview of the Current Situation and Quality and Accountability of Science Communication

Science communication, access and the quality of science news disseminated to the public are still at inadequate levels in many of the South East European (SEE) countries. This was noted during a UNESCO Venice Office round table on *“Assessing and Disseminating Scientific Information in South East Europe”* held in Maribor, Slovenia in November 2005. Prior to this round table, fact-finding missions were undertaken in many of the SEE countries. The mission results all recognised the importance of increasing political commitment and reinforcing regional cooperation so as to improve public understanding and interest in science.

The PCST2012 parallel sessions organized by the UNESCO Venice Office provided an opportunity for science journalists from Albania, Bulgaria, Croatia, the Former Yugoslav Republic of Macedonia, Greece, Montenegro, Serbia and Turkey to share their best practices in communicating science. It was also an occasion to meet peers and update regional contacts with specialised science media. With the financial support of the UNESCO Venice Office and the Italian Government, the Venice Office provided eight travel grants for selected SEE science journalists to participate in PCST 2012. The sessions, were chaired by Mario Scalet and Rosanna Santesso from the UNESCO Venice Office.

Isabella Susa (Agora Scienza) briefly provided details about training/summer schools on science communication for PhD science students at the University of Turin in Italy. The objective of the training/summer school is to establish a better dialogue between science and society as well as providing a form of tutoring of science communication for researchers and scientists. More details are available at: <http://www.agorascienza.it/en/training/scs>

Susan Schneegans, Editor, A World of Science UNESCO, spoke about “Reflections on quality and accountability in communicating science internationally”, followed by the presentations of the eight SEE science journalists. All slide presentations can be downloaded from <http://www.slideshare.net>

The participants noted that many newspaper editors tended to be sceptical about the level of public interest in science and thus reluctant to publish stories on science. On numerous occasions, science news often appears in an incongruous section, such as that on life and entertainment. Frequently science articles are associated with pseudoscience like astrology. E. Baris Altintas from Turkey and Mico Tatalovic from Croatia highlighted the need for more honesty in the mass media. Some ‘science stories’ are utilised as advertising for alternative health remedies whose effects had been poorly researched.

Tatjana Stojceska from the Former Yugoslav Republic of Macedonia recalled the continual challenge faced by the media in making science more attractive for the public, particularly youth. She suggested that governments finance the purchase of science documentaries produced by renowned broadcasting companies so to air them on national television. Milena Milunovic from Montenegro informed the participants that this type of television investment is successfully being carried out in her country.

It was noted that the media tended to prefer to publish information on national/domestic



research rather than international science, even though news of domestic breakthroughs was rare. Moreover, Julianna Photopoulos from Greece observed that, even though initiatives to promote science in her country were becoming popular, such as science days and festivals or science cafés, these events were not necessarily being reported by newspapers.

It was also remarked that journalists too need training in how to present science stories. Serbian television presenter Ljubica Urosevic mentioned that the Science Promotion Centre established in Belgrade in 2010 offered regular training workshops for media professionals. (Her presentation is published at greater length in the following paper.) Ayelet Baram-Tsabari (Israel) agreed that regional and/or national training for science communicators is an asset.

Maria Grigorova Tcherneva from Bulgaria pointed out that direct contacts and meetings between journalists and scientists are lacking. This mutual mistrust compromises good science journalism and does not generate a democratic debate on the impact of science in society. A proposal to elaborate the preparation of a reference guide for scientists on good practices was mentioned. This could be a useful tool in attempting to bridge the communication gap.

Science journalists also encounter difficulties in obtaining information rapidly about new developments in scientific research. Mico Tatalovic suggested the need for a regional science news agency to dispatch and disseminate press releases. He also recommended inviting ministries to produce press releases on developments related to the research they supported through the research budgets and grants they allocated to research institutes and universities under their supervision.

The informal brainstorming session led to the exchange and sharing of comments and ideas on how UNESCO could further support science journalism in Southeast Europe. The participants unanimously agreed to draft some recommendations to prepare as an annex of science communication needs and priorities to be presented during the next SEE Round Table of Ministers of Science in late 2012. The sessions concluded with the participants responding enthusiastically to the UNESCO Venice Office proposal to create a regional network or national association of science journalists.

Conclusions

Generally speaking, the journalists were critical of the quality of science journalism. They suggested that:

- journalists need training in how to present science stories. Mario Scalet proposed the idea of a summer school for PhD students in communicating science to the public, possibly organised by UNESCO's Venice Office if funding could be identified.
- the need for a SEE science news agency to dispatch regularly press releases/news information on new research.
- the need for governmental support for science television programmes.
- several speakers suggested creating a regional association of science journalists. The UNESCO Venice Office could possibly host this body, at least temporarily. The journalists



would be able to communicate via postings on the site.

- the lack of contact/communication between journalists and scientists can compromise good science journalism.
- The UNESCO Venice Office plans to liaise with the science journalists present at the session to elaborate a series of recommendations for submission to ministers of science and higher education from Southeast Europe at a meeting planned for later in the year.

The designations employed and the presentation of material throughout this report do not imply the expression of any opinion whatsoever on the part of UNESCO concerning the legal status of any country, territory, city or area of its authorities, or concerning the delimitation of its frontiers or boundaries.

The speakers are responsible for the choice and the presentation of the facts contained in this publication and for the opinions expressed therein, which are not necessarily those of UNESCO and do not commit the Organisation.



27. Science Communication in Serbia

Ljubica Urosevic, Serbia

The current situation in Serbia could be described as a wide, rich landscape picture in a very narrow frame. There have been plenty of different activities on S&T communication initiated in recent years but they have not been followed by media at an appropriate level.

Why? Despite the strategic orientation to the development based on knowledge and advanced S&T, the reality is still far from proclaimed goals. Serbia is on its crucial crossroad, passing through a dramatic social transition to democratic society. The strongest public focus is on “hot” political questions: how to develop mechanisms of democracy and ensure their implementation, how to deal with the Kosovo problem. There is a list of serious economic problems: growing debts, undeveloped industry and economy, high corruption. It seems understandable that science and technology are not topics that could draw high media’s attention.

The efforts on building democratic society can also raise the question: does lack of knowledge about S&T lead to a democratic deficit? Is it possible to solve existing problems without the application of scientific knowledge? Is it possible for citizens to participate in the decision-making process in S&T area without basic scientific literacy?



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The EU has redoubled efforts to promote S&T’s development, building closer links with society. But in Serbia, after long years of crisis, science has become apart from the public. It was necessary to encourage bridging that gap to increase not only S&T capacities, but significantly improve its communication. Many specific actions were implemented to increase general “science culture” and to awake interest in science, involving scientists, educational system, informal education.

UNESCO and the National Commission for UNESCO in Serbia have an active role in those efforts, significantly contributing in science activities and their promotion, linking Serbian researchers with international scientific community, disseminating information on science, providing possibilities for contribution in international research projects and activities under UNESCO patronage, supporting Serbian science to play a more active role on the international scene. UNESCO is not only a transmitter of scientific information in two-way direction Serbia-world, but also undertakes a number of initiatives in PCST. From the broad field of those activities, only those recently undertaken will be mentioned.

Under UNESCO patronage were organized: 30th Anniversary of Youth Research Centre Petnica, 100th Anniversary of Serbian film, Day of mother language etc. The UNESCO and L’Oréal joint programme ‘For Women in Science’ was established in 1998 to promote young women researchers, opening the door of science to them and Serbia is among 50 countries providing national fellowships and participating in international contests. Ivana Pešić, doctor of medical sciences, received a prestigious International Fellowship among 140 candidates, inspiring young women in Serbia to follow her example.

On the proposal of the Serbian National Commission for UNESCO, at the Jaroslav Černi

Institute for the Development of Water Resources, in Belgrade was established the regional centre, Water for Sustainable Development and Adaptation to Climate Change, focused on applied research, knowledge transfer, education and strong promotional campaign.

Petnica Science Centre is the oldest and the biggest independent organisation for informal science education and UNESCO has recognised that it is “of huge interest in science education of youth, science networking and strengthening links between science and society”. Petnica organised more than 2,500 programmes for nearly 50,000 students in 15 disciplines. It is also a training centre for teachers promoting new methods in teaching science. Students are coming from all countries of former Yugoslavia. Once a year Petnica welcomes international participants. Fully equipped facilities have been recently completely reconstructed in a €7.6 million investment.

Science is ‘Inn’

The most important step towards better science communication in Serbian society was the founding of Center for Science Promotion (CPN) in 2010. This governmental institution is part of the strategy for the knowledge economy and today is the most significant player in Serbian PCST. Its task is to link and support numerous individual initiatives launched across Serbia and to form a broad platform to spread the culture of science. Its mission is to popularise science, to raise scientific literacy, to encourage young people to choose the path of science, to help scientists to promote their work and to educate media professionals. This has been realised through many successful events (Day of Science, ‘Science is not a Bogeyman’ Festival, Month of Physics, Month of Mathematics), exhibitions (Imaginary, The Big Math, etc.), lectures, workshops, panels (Science and Euro Integrations), publication, web portal Elementarium. CPN’s web site is in the top 50 in Serbia.

In Arguslab, a floating laboratory fully equipped for environmental research, CPN integrated new creativity with old resources, launching a programme for international expeditions, environmental monitoring, education. Another interactive education space is the Scientific Truck, a travelling Centre for Science Promotion. Under a financial agreement with the European Investment Bank, an impressive new building for CPN (10,000 square metres and including a planetarium, interactive exhibitions, laboratories, congress halls etc.) will be constructed soon.

An important activity of the CPN is education of journalists (Colloquium of Scientific Journalism). This is the only case in Serbia providing that kind of training. The Centre also provides financial support to projects on science communication.

In last years, Science festivals have simply “exploded”, attracting thousands of young people. The most popular, Belgrade Science Festival (more than 20 000 visitors every year), initiated from NGO sector (with contribution of CPN) takes place in five locations in the Serbian capital. 300 scientists from seven countries were included in the last festival. Many cities have their own festivals (Eureka Days, GIMFest, Science is not a Bogeyman). The International Researchers’ Night is the most popular event in several Serbian cities.



Serbia participates in FameLab International, a competition taking place in 20 countries for the best new talent in science communication. The idea is to take science out of the classroom and make it fun, and to encourage young people (18-35 years old) studying science or working in science, to share their passion with the general public (every candidate is given three minutes to impress the judges with exciting talks that can be understood by the audience). Organised by the British Council and local partner Serbian Broadcasting Corporation RTS, the final competition is broadcast live.

Belgrade's Museum of Science and Technology has permanent and thematic exhibitions and the Nikola Tesla Museum (unique museum in the world which preserves the original and personal inheritance of Nikola Tesla) is the most visited Serbian museum. In 2003 UNESCO included Tesla's archive in the "Memory of the World Register" as a movable documentary heritage (exceptionally valuable collection: 160,000 original documents, 1,200 historical technical exhibits, 1,000 of Tesla's plans and drawings, 1,500 photographs and photographic plates of original technical objects and instruments etc.) Beside the significant role in providing abundant information to the researchers, the museum has a particular role in promoting Tesla's investigations and his contribution to the development of science and engineering. Since 2006 the museum has published 40 publications and organised over 100 exhibitions in more than 20 countries on four continents, with more than 1.000.000 visitors.

Judging by mentioned activities and numerous other initiatives, the key question for Serbia is not how to inspire PCST activities but how to motivate media to support it.



The silent media

The first victims of sudden media commercialisation in Serbia were culture and science. The most used excuses are: "It is not what audience wants" (without any valuable public opinion research on that issue) or "Expensive production".

TV programmes on S&T are seriously deficient, representing only 4% of total programming of 134 TV stations (6 national, 30 regional, 98 local). The largest percentage of the scientific content (16%) is provided by the second channel of the National Broadcasting Corporation RTS and the lowest (below 1%) by the most popular commercial TV "Pink" (there is no legal obligation concerning content for commercial stations).

The science department of RTS, which exists 45 years and has produced many internationally awarded programmes has reduced its output from 764 titles in 2003 to 310 in 2006. The current situation, with three half-hour formats weekly plus occasional special programmes is better, but far from the old glory.

However, despite the low representation of science in the RTS programme schedule (3,9%), these programmes are the most watched (rating 1.3) of related programmes (Culture: 5,9% of programming, rating 0.7; Documentary: 9.1% of programming, rating 0.7). More watched are only sport (19.8% of programming, rating 1.9) and news (16% of programming, rating 1.6). It clearly denies the thesis of a low audience interest on Science.

The situation in print media is equally problematic. Among 517 registered print publications, only three have special S&T issues!

How to deal with paradox of strong efforts on science popularization and indifference of the media?

The possible ways are: to provide an adequate research on public interest on science and technology in media, to re-establish the Serbian association of journalsits specialising in S&T which has not been active for years; to strengthen endeavours in journalism education and the most important, to enhance networking between professionals, with special emphasis on exchanging methodologies, experiences and best practices on regional and international scale.



28. Participatory Communication on Knowledge Production: Linking Science Shops and Knowledge Debates

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The objective of the PERARES project¹ is to strengthen interaction in formulating research agendas between researchers and civil society organisations (CSOs). To address this challenge of upstream public engagement, PERARES aims to bridge the worlds of Science Shops (which are often university departments doing or mediating research for CSOs, usually performed by students in their curriculum) with that of public engagement activities and dialogues on science ('science' in its broadest sense, including arts, social sciences, humanities, engineering, etc.).

We focus on Science Shops because, as found in literature on public engagement, for many public engagement activities, it is not clear what will happen with the results of dialogues. Moreover, many engagement activities are conducted in a transmission mode of communication. Civil society is positioned as lay citizens, in need of information. In such interaction events, representatives from research have the opportunity to articulate their interests, issues, curiosities, and civil society is put in the role of spectator. They can react and ask questions, but there is a limited opportunity for a window on their 'world', i.e. their worldviews, needs, issues and experiences, to be opened up.

Science Shops work the other way round and start from a societal request, so they start by listening. Issues from society are put on the research agenda, the research is done with various degrees of participation, and results are offered to civil society. This is a form of Mode-2 Joint Knowledge Production.

With support from the European Commission, we are now trying to link existing and novel dialogue forms, discussing science, technology and innovation and their societal impact, to those who can actually perform research on the issues. This would give all participants in the dialogues a clear sense of what is at stake. In the PERARES project, we use various approaches. We are starting new Science Shops in ten regions, to set research agendas on a local level. We are studying the role of higher education institutions and research funders, and their policies, to advance joint research and student learning. We are starting continuous dialogue forms where researchers and CSOs regularly discuss research. We are sitting down with a number of organisations to set agendas of social research; we do so with Roma and Travellers Communities, but also with Women's Aid Organisations to discuss required research on issues of domestic violence.

¹ *Public Engagement with Research and Research Engagement with Society (PERARES)* received funding from the European Commission (FP7). The views and opinions expressed in this publication are the sole responsibility of the authors and do not necessarily reflect the views of the European Commission.



Research in domestic violence was set up by universities in Brussels, Cambridge and Stavanger, together with an NGO in each city. A joint research question was formulated, to 'explore how to overcome the barriers health care providers face in identifying and responding to the issue of domestic violence during pregnancy'. Students in all three cities are involved; the project will also serve as an example of how to set a joint research agenda.

As a novel – and challenging – development, PERARES set up an international dialogue website, with a focus on jointly setting research questions. Participants can discuss which research questions need to be – and can be – answered, which need finance from research funders, and which have already been answered. The steps taken by the moderators are: 1) Make start text for webpage, based on local dialogues between CSOs and researchers; this gives some examples of the type of research questions that could be related to the topic; 2) Invite known members of our network for first responses; 3) Actively promote the debate to a wider audience; 4) Distil potential research questions from the debates. These questions will then be offered to the Science Shop network or be brought to the attention of research funders.

As a pilot for this website, we started a dialogue on potential research questions on five separate nano-technology developments. This focus on separate, specific domains was based on our formative analysis of previous nano-dialogues. From that, we learned that it is important to have this focus on particular applications of nanotechnology with relevance to people's lives, and give ideas of what is at stake. The purpose of the dialogue should be clear, so we described our intentions to have these questions put on research agendas. Finally, we know that dialogues like these are an on-going process of learning and reflection, and they take time.



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The nano-pilot is taking place early in 2012. By conducting interviews, organising face-to-face interactions, and document analysis, we managed to articulate what is at stake in different nano-domains (e.g. nanotechnology in healthcare, nanotechnology and food, nano particles and environmental life cycle analysis). The issues (e.g. uncertainties, dilemmas, possible destabilisations of existing societal practices) served as the starting point for the online dialogues on our website.

The face-to-face discussions worked quite well to articulate research questions. An example was the workshop organised by the Dutch civil society organisation *Leefmilieu* on nano-applications, which we used to draw out research questions. The use of cerium-oxide nano-particles as an additive to reduce the use of diesel fuel in trucks led to the conclusion (based on previously commissioned research by a science shop) that the toxicity is not the main issue (diesel exhaust is also toxic), but that the addition should be studied through full environmental life cycle analysis. This was put as an example question on our dialogue website. We got a response from a professor in environmental sciences who pointed out that cerium was not as scarce as the workshop participants thought, but that this broader analysis of a resource that was used dissipatively was still valuable.

We managed to get some more responses in the web dialogues, further articulating the research questions. Also, people gave links to research reports or stated their views. However, we discovered that it is still a challenge to involve people and organisations in a structured online debate. The moderation is more difficult, has longer lag-times. For Science Shops, work shifts from working with an organised CSO in a face-to-face meeting, to working

with a virtual community which has not previously come together to articulate its research requests, in online, textual communication.

On the more practical side, we made the mistake (though forced by delays in the website development) of testing and improving the dialogue website during the nano-dialogue and not before. Also, even though we do offer translations into English for everyone who wants to contribute in their own language, we knew from the start that we could not translate everything in all EU languages. The fact that we started five dialogues at once also was quite a challenge, though on the other hand it makes the dialogue ‘on nanotechnology’ have more points of relevance for civil society.

We are now trying to distil the articulated research questions and themes so they are available to researchers and research funders to take up. If we manage to get some of these requests researched, we will have proven the concept and we might be able to expand this dialogue website in the future. It will then also be easier to convince participants that it is worth taking the time to participate in the dialogue.

Our next two dialogues will be focused on societal issues, namely the research agenda on Roma and Travellers Communities’ Issues and the research agenda on Domestic Violence. Framing the dialogue from a societal issue instead of from a technological development may lead to increased and easier participation of CSOs and the general public alike.



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Our evaluation of our various approaches will give us more knowledge on the specific features, benefits and challenges of each approach, and will enable us to learn from them, and to use this in managing and planning of the work. Also, our evaluation provides accountability for the project. Our evaluation has the following stages: ex-ante (including a checklist at the project’s start), mid-term (to monitor and if needed modify the project), and ex-post questionnaires. With the latter, we use one form directly at the end of the project (to see if the output and outcomes are satisfactory), and one for a later moment (up to 12 months), to see if we can find long-term impact. We are currently testing these forms.

At the end of PERARES, we hope to have achieved more international co-operation in public engagement with research, have more researchers engaged with civil society in their practices, and have more civil society actors involved in research activities – starting with the incorporation of their needs and concerns in research strategies. We aim to have new cooperative research agendas defined, based on the combination of the knowledge and experiences of both researchers and civil society actors.

29. Communicating environmental issues through the media in Mexico: an overview

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Mexico is a megadiverse country and it hosts cultural and environmental complexities. Under present conditions of biodiversity loss, transformation of natural ecosystems, water supply crisis and climate change it is crucial to increase the effort and quality of public communication of environmental themes.

Currently, environmental issues have not obtained the attention in mass media in Mexico they deserve. Environment and sustainability issues should be crucial in journalistic stories but the topics are not yet considered of relevance at the editorial desk. Scientists are aware of the need to communicate science in a “more action-oriented” way. Universities, research centres and some organisations have increased their interest in establishing communication channels to improve collaborative strategies with other social sectors.

In 1986 the Mexican Society for Popular Communication of Science and Technology was created. In 2004 the Environmental Journalism Mexican Network was formed. These two organisations are active nationwide in their efforts to communicate science and technology to the general public in many ways. Despite the existence of the Network, there is no census or directory of journalists specialising in environment.



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In order to know more about the state of the art of environmental journalism in Mexico, I made a survey among journalists who cover these topics. The objective of this work was to do a diagnostic about the activities and players on environmental journalism in Mexico. These results may help to draw a map of environmental news nationwide.

The survey contained seventeen questions about personal information (gender, place of residence, age, professional career), media where they work, sources of information, topics of interest and specialisation in journalism. The survey was electronically distributed for two weeks at the end of January 2012 using social networks and distribution lists such as Pal-Net list (environmental journalists), Periociencia list-group (Mexico), email list of the National Council of Science and Technology and Facebook Group for Environmental Journalists in Mexico.

Writing green: environmental journalists in Mexico

Thirty-eight journalists answered the survey. More than 60% of them were male and 37% female. Most were aged between 25 and 35 years old, one third of them were above 45 years old. More than 60% had a bachelor degree, 31% had a master degree but only one mentioned they had a certification in environmental journalism.

The journalists that participated in the survey belonged to 31 different national media. Seven

were editors, five were media directors or editors in chief, four were working as freelance journalists, four were writers and three of them were communication officers.

Most of the work in environmental journalism is located in central Mexico. Eleven journalists live and work in Mexico City, while ten of them live in the state of Veracruz, where in 2011 the first postgraduate programme in environmental journalism in Mexico was started at the Universidad Popular Autónoma de Veracruz.

Three journalists work in the state of Mexico, there were two more in the states of San Luis Potosí and Baja California peninsula. Finally, in the states of Sonora, Sinaloa, Michoacán, Guerrero, Guanajuato, Aguascalientes and Quintana Roo, there was one environmental journalist in each state. I had no responses from northeast Mexico, an important area of economic development activity, or from southern states such as Chiapas and Oaxaca, places with a special richness in culture and biodiversity.

In Mexico, at least in environmental issues, most of the journalists work (30%) for newspapers and magazines, 24% focus their work on content for internet such as blogs or news agencies online, 15% said they work in radio, one third of the journalists said they work in diverse media and public relations offices. The rate of environmental news production reported by the professional activity of each journalist was mostly daily and weekly. Seven of them reported they produce news monthly or sporadically.



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There seems to be a lack of specialisation in environmental journalism. The reporters who cover environmental issues cannot work only on these topics. From the total of journalistic contents the reporters produce, fifteen of the journalists that answered the survey said they focus their work on environmental issues. Nine of them reported the environmental content of their work was 30%-60%, and eleven said they produce 10%-30% environmental content.

The main formats used to communicate environmental issues in mass media were journalistic research articles (25 answers), interviews (23 answers), web page content such as blogs (15 answers), content for social networks in brief formats (15 answers), radio programmes (10 answers), television programmes (9 answers), chronicles and environmental capsules (7 answers). It is important to say that journalists can use a wide variety of formats to develop their stories, so in this case the question included answers with multiple choices.

The richness of environmental journalism is its wide variety of natural and social topics giving an interdisciplinary framework. In Mexico the most popular environmental issue is climate change. More than half of the reporters that answered the survey mentioned they were interested in climate change, conservation, biodiversity, environmental politics and water issues. On the other hand, few of them mentioned that they were interested in developing stories on other topics with a new approach like agroecology, urban farming, environment and gender issues, indigenous rights and citizen participation or nature activism.

Participants in the survey reported also that their main sources of information were specialised publications, but they also mentioned information available on internet, interviews with academics and non-governmental organisations, popular science articles and technical reports. None of them mentioned that they based their work on press releases.

Another important information that I was interested in gathering was if they were related to any type of professional network. Most of the reporters that answered this question said they were not related to any network or association. Seven of them reported to be members

of the Mexican Environmental Journalists Network. Few of them said they were related in a some way with some national associations: Asociación de Periodistas de Sinaloa, Red Estatal de Información Ambiental de Veracruz, Television Universitaria, and Sociedad Mexicana para la Divulgación de la Ciencia y la Técnica A.C. Few of them mentioned belonging to the Society of Environmental Journalists (U.S.A.), the Environment Journalists Network (a European initiative to empower and enable journalists from developing countries to cover environment issues) or Red de Periodistas y Comunicadores Ambientales de América Latina y el Caribe.

Science news stories in Latin America are based mostly in foreign research rather than the work of national research institutions (Massarani and Buys 2008). From the 38 reporters that answered the survey, ten of them said that they did not have any link or collaboration with any research institution or university. 27 of them mentioned knowing or at least having known the work of 31 Mexican research institutions, regional and nationwide.

Despite the importance of building and strengthening an environmental journalistic agenda in Mexico, the efforts to communicate environmental issues through the mass media seem to be not enough. There is an important challenge given the present environment crisis in the planet and in Mexico; it is crucial to stimulate the participation of more media in environmental communication. Part of this effort can be focused on the promotion of a more permanent and long-term interactions between academics and journalists in environmental communication.



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30. The Ethics of Reframing: The Case of the Biofuels Debate

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The past decade has witnessed a range of opinions and reports about the potential and use of biofuels as an alternative energy source. The phrase “Food vs Fuel” has hovered over many of the public debates, smothering virtually any nuance, and has led to increasingly entrenched views about its potential role in transition to a more sustainable society. An important drawback of this oversimplification has been the dichotomous framing of a single issue that dominates the debate and has not really contributed to a greater understanding of whether biofuels have the potential to serve society in the shift to a more sustainable way of living.

This simplistic framing fails us miserably in its inability to accommodate the complex set of questions that must be asked and considered regarding any possible response to the complex problem of identifying and developing sustainable energy sources. Serious consideration must engage with the multiple dimensions of both the problem and possible solutions. Consequently, when the public debate becomes stuck on one issue and is reduced to a single question, much is lost in our ability to find appropriate solutions.



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When a possible solution is discussed or framed in such a way that dismisses or disregards scientific developments and technologies, then a major disservice is done to all stakeholders by the continued predominance of a simplistic dichotomous, and scientifically outdated, framing. The almost reflexive response of “fuel vs food” to the very mention of biofuels is now entirely predictable. Yet, while it directs attention to one consideration, in a single phrase, it dismisses all other considerations, some of which are equally critical and, depending on the technology, more relevant (given that some current and contemplated biofuel sources present little or no competition with food sources).

This dilemma highlights the issue of responsibility for public understanding of scientifically informed debates, especially given that the public sometimes is sometimes not sufficiently well-informed to evaluate the merits of various arguments (Nisbet and Mooney, 2007). To be sure, this is not a new concern, but in the context of developing sustainable energy sources, it is a concern that has widespread effect, and one in which considered, well-informed views should be the gold standard.

As a result, what questions we ask and how we discuss the merits of potential solutions become critically important. Even as we recognise each person’s right to his or her own view (as well as *articulation* of these views), these views may ultimately inform policy and will surely inform individual and collective action. Framing has arguably played a pivotal role in the public discourse on biofuels, and given how much relevant information is sidelined by the fuel versus food inquiry, at the very least, civic responsibility requires that we devote some attention to the work of framing and the possible need to deliberately re-frame certain highly important co-opted public debates.

The popular use of a frame, like food versus fuel, is a way of organising ideas and defining a

controversy such that it “resonates with core values and assumptions” (Nisbet and Mooney, 2007). However, as a heuristic, this particular widely-used frame has potentially enormous implications for future policy and practice. This work suggests a normative approach to re-framing, including when (e.g. when current frame results in a disservice to society) and with what goal. Identifying appropriate heuristics that are accessible to the public arguably present one possible strategy toward the re-framing of socially important issues when current framing detracts us from being able to serve our own best interests, through directing the inquiry in such a way that it burdens neither freedom of speech nor fundamental principles of a liberal society such as allowing persons to develop their own conceptions of the good. The biofuels debate provides an interesting vehicle for exploration of reframing and operationalising a normative approach both for its scientific complexity as well as for its polarising initial frame.

Societal perspectives about how we as a national or global society achieve our sustainability goals may range the gamut (see e.g. Asveld et al., 2011). As members of liberal societies, we are all entitled to our opinions and values. We are free to decide what is important to us and which trade-offs are acceptable and which are not. However, policy decisions affect everyone, collectively and individually, and this is equally true regarding the use of alternative energy sources such as biofuels. Because of that, a certain civic responsibility arguably rests with all stakeholders, and particularly with policy-makers, to reach a certain level of engagement with the issues, a critical aspect of which is to ask the “right” questions in order to weigh in responsibly on the issues (see Osseweijer et al., 2011 on stakeholder engagement on biofuels). “Food versus fuel” told the public what to consider in developing an opinion about the desirability of biofuels as an alternative energy.



Reframing should not only seek to open doors to accurate information, but also to empower autonomous and informed perception leading to informed choices and preferences. By contributing to a “re-framing” of the issue of biofuels in a responsible way, we can return empower stakeholders with a way of asking the broad range of relevant questions that the issue may implicate.

Biofuels present an interesting case for this inquiry not only because it presents a possible way of achieving our shared sustainability goals but also because of the different technologies and scientific components involved in their production. That is, in its various iterations, biofuels present substantially different types of issues. First generation biofuels, gave rise to the concerns about food competition. Second generation or “advanced” biofuels present substantial advantages over first generation in this regard in that there are sources and production techniques bypass many of the objections associated with first generation biofuels.

These advanced biofuels are converted from biomass that aims to minimise undesirable impacts, e.g. by utilising less land, producing higher yield crops through genetic engineering, or uses processes and techniques designed to reduce greenhouse gas emissions and involves the use of non-food crops, including crops with capacity to grow on land not suitable for food crops. Most second-generation biofuels aim at sustainability as part of the technological innovation, in substantial part due to the optimised production processes that specifically seek to attend to issues of carbon emissions, land use changes (see e.g. Lynd, 2011), and not compromising food security. In view of this, paradigmatic lenses like “food versus fuel” no longer

serve the debate either as an analytical tool or as a conceptual device capable of facilitating discussion leading to improved understanding of whether and how this technology can serve society.

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31. Getting a Different Dimension: The Orce Man Controversy in Spanish Newspapers

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Introduction

In May 1983, a cranial fragment that seemed to be the “first European” was discovered in Venta Micena site, in Orce, Granada. The publication of this finding had a great impact in Spanish mass media. One year later, the announcement in a Spanish newspaper that the famous “Orce Man” was not a man but a young donkey caused a major controversy. Three years later, Jordi Agustí, one of the discoverers that published a scientific paper arguing that the bone was, in fact, a young donkey, stated in *El País* newspaper: “The scientific debate should have been limited to scientific publications, but the media treatment of the issue has given it a different dimension”.¹

In order to analyse this controversy I will divide this paper in two main points. First, I will show how in this case scientific debate moved to the public sphere. The mass media, particularly newspapers, became the scenario for scientific statements and different situations and “actors” appeared. Science was in a *Different Dimension*.



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Second, I aim to show how scientists used both scientific publications and communication of science in their discourse, blurring the boundaries between established scientific publications and popular media.² In addition, I will also emphasise how communication of science, especially in controversial cases, is much more than a simple way to minimize public ignorance but has “an active role” in the shaping of scientific knowledge.³

To sum up, this case is a unique case to explore science and media relations on one hand and, on the other, to see how science communication, as well as other communication practices, need to be considered as part of the generation of scientific knowledge in order to achieve a complete understanding of these processes.⁴

¹ Original in Spanish: “el debate debería haberse mantenido en las publicaciones científicas pero que el tratamiento periodístico del tema le ha dado una dimensión distinta” Editorial 2/10/1987 *El País*

² Hilgartner put it that way: “The precise location of the boundary between genuine scientific knowledge and popularization is difficult to establish” Hilgartner, S. (1990) “The Dominant View of Popularization: Conceptual Problems, Political Uses” *Social Studies of Science*, 20, 3. 519-539

³ Using Shinn and Cloître: “Expository practices played an active role in the knowledge production process”. Shinn T. and Cloître, M. (1985) “Expository practice: Social, Cognitive and Epistemological Linkage” in Shinn, T.; Whitley, R. 1985. *Expository Science. Forms and Functions of Popularization*. Reidel. Dordrecht.

⁴ More on this in Secord, J. (2004): “Knowledge in transit”, *Isis*, vol. 95, pp. 654-672

Different Dimension

The cranial fragment, called VM-0 by the researchers, was attributed to *Homo sp.* in *Paleontologia i Evolució*, the Institut de Paleontologia de Sabadell journal, by Josep Gibert, Salvador Moyà-Solà and Jordi Agustí.⁵ VM-0 is a 10-centimetre cranial fragment with parts of the parietal and occipital bones. It was called “the Orce Man” in Spanish headlines where it was described as “a scientific revolution”.⁶ Gibert, Agustí and Moyà-Solà gave press conferences, wrote their own newspaper articles and were even preparing a “popular science book” on the finding.⁷ At the time of the first publication of the discovery, the internal part of the bone was hidden because it was still fixed to a calcareous rock. In spite of this, according to the scientists, it had enough characteristics to be classified in the *Homo* genre.⁸

Next year, the internal part of the bone was cleaned.⁹ After the cleaning, an unusual crest appeared. This crest seemed to steer the evidence away from the hominids and bring it close to the Equid family. The discoverers took the bone to Paris where the prestigious French scientist Marie-Antoinette de Lumley examined it and claimed that it was definitely a member of the Equid family, specifically, an *Equus*, a young donkey.¹⁰ So the next day, and only one year after the first publication, the cranial fragment was attributed to *Equus* by de Lumley as reported by the newspaper *El País*.¹¹ A very harsh controversy began that was closely followed by public opinion. *El País* published more than 10 articles on the issue in four days.¹² Polemical headlines such as “The Orce Donkey” appeared, and some journalists and other scientists criticised the researchers for jumping to conclusions.¹³ With the controversy, Josep Gibert, the only Orce Man defender, was marginalised by his colleagues and by institutions that denied him excavation permits and funding.¹⁴

Three years later, in September 1987, Agustí and Moyà-Solà, Gibert’s former colleagues, announced to the press the further publication of the first scientific paper following the de Lumley attribution.¹⁵ In this newspapers article Jordi Agustí identified from within the involved

⁵ Gibert, J.; Agustí, J.; Moya-Sola, S. (1983) "Presencia de Homo sp. en el yacimiento del Pleistoceno inferior de Venta Micena (Orce, Granada)" *Paleontologia i Evolucio*, 1-9, Sabadell.

⁶ For example: De Semir, V. 12/06/1983 *La Vanguardia* p.51. or Aguilar, J., "El hallazgo del Hombre de Orce puede suponer una revolución en en estudio de la especie humana" 14/06/1983 *El País*.

⁷ For example: Agustí, J.; Gibert, J.; Moyà-Solà, S. 21/08/1983 *La Vanguardia*. and Piñol, R. M.15/03/1984 *La Vanguardia*.

⁸ Gibert, J.; Agustí, J.; Moya-Sola, S. (1983).

⁹ Campillo, D. (2002). *El Cráneo infantil de Orce : el homínido más antiguo de Eurasia*. Bellaterra. Barcelona. p.31.

¹⁰ Gibert, J. (2004) p.48.

¹¹ Relaño, A. 12/05/1984 *El País* p.1.

¹² Relaño, A 13/05/1984 *El País*; Arroyo, F. 13/05/1984 *El País*; Editorial 15/05/1984 *El País*.

¹³ Original in Spanish: Gomis, L."El Burro de Orce"16/05/1984 *El País*. For critics, Editorial "Un gran descubrimiento presentado sin reservas" 12/05/1984 *El País*.

¹⁴ Gibert (2004).

¹⁵ Mercadé, J. "Los colaboradores de Gibert dicen que el cráneo de Orce pertenece aun equino" 2/10/1987 *La Vanguardia* p. 40; Editorial, 2/10/1987 *El País*. and Agustí, J.; Moyà-Solà, S. (1987)"Sobre la identidad del fragmento craneal atribuido a Homo sp. de Venta Micena (Orce Granada)" *Estudios Geológicos* 42, 538–443. To publish the main findings of a scientific paper first in the press has been called "science per press conference" in Lewenstein, B. (1995) "From Fax to Facts: Communication in the Cold Fusion Saga" *Social Studies of Science*, 25, 3, 403-436.



scientific community that “the Orce Man” controversy was something different.¹⁶

Due to the early attention to the discovery and to the later controversy, Spanish newspapers became another space for validating scientific knowledge. During the first three years the mass media was the only debate scenario. Later, scientific publications were also important but a parallel “trial” took place in the media, and scientists used it in order to achieve public validation before the scientific validation in scientific publications. Through public validation scientist made their scientific claims stronger for the further scientific debate.¹⁷ In addition, if scientific knowledge validation occurs in the mass media it has to follow media logic, then scientific validation occurs not only in a different scenario but also with different rules, logic, “actors” and steps.¹⁸ Science is then in this *different dimension*.

Blurring Boundaries

In this same announcement, these scientists stated that the bone cannot be a *Homo* because it had a “Coronal Structure impossible in humans”. In turn, Gibert, main defender of the Orce Man, said that the “Coronal Structure doesn’t exist”. A month after, Agustí and Moyà-Solà published a scientific paper in a Spanish journal where they stated that the Coronal Structure “is very easy to observe in an x-ray of the Orce bone”.¹⁹ One year later, Gibert published another scientific paper in the same Spanish journal. Gibert stated, again, that “there is no Coronal Structure in the cranial fragment”.²⁰

This situation shows how scientists articulated their discourse using both newspapers and scientific publications. New scientific statements were published in the media and scientific papers used earlier newspaper reports. Boundaries between communication of science and scientific publications were not clear.²¹ Later in the controversy, also popular science books played a role in the scientists’ discourse.²²

In addition, this also shows how in the Orce Controversy no judge can moderate a scientific controversy because no judge can be outside the dispute.²³ Moreover, using the notion of



¹⁶ Editorial 2/10/1987 *El País* and Mercadé, J. 2/10/1987 *La Vanguardia* p.40.

¹⁷ Bucchi, M. (1996), "When scientists turn to the public: Alternative routes in science communication" *Public Understanding of Science*, 5, pp. 375-394.

¹⁸ Nieto-Galan, A.(2011) *Los públicos de la ciencia. Expertos y profanos a través de la historia*. Marcial Pons, Madrid. p.243-244.

¹⁹ Agustí, J. and Moyà-Solà, S. (1987).

²⁰ Gibert, J; Ribot, F; Ferrández, C; Martínez, B.; Caporicci, R.(1989). "Características diferenciales entre el fragmento de craneo de *Homo sp.* de Venta Micena (Orce, Granada) y los *Equidos*." *Estudios Geológicos* 45:121-138.

²¹ As Hilgartner, S. (1990) points out: “what is communication and what is “scientific” is “a matter of degree”.

²² As Hochadel (2009) states, “popular science books” can be a “battlefield” for paleoanthropologists that write their controversial theories in them. Hochadel (2009) *Atapuerca - the Making of a Magic Mountain. Popular Science Books and Human-Origins-Research in Contemporary Spain*.

²³ As Elisabeth S. Clemens illustrates, quoting Pierre Bourdieu, in her paper on the discovery of the asteroid that caused the K-T extinction: "as the definition of the criteria of judgment [...] is it self in a struggle, there are no judges, because there is no judge who is not also a party to the “dispute”. Clemens, E.S. (1986) Of asteroids and dinosaurs; the role of the press in the shaping of scientific debate. *Social Studies of Science*, 16, 421-456.

“Experimenter’s regress” or “Taxonomist’s regress” we can analyse also the epistemological problem related to VM-0.²⁴ The classification of VM-0 in the *Homo* genre or in the *Equus* genre depended on the presence or not of the Coronal Structure that depended on whether one-million-year-old Hominids had it or not. At that time there was only one hominid skull, from Kenya, of that age and the classification was not determined previously.²⁵ When this happens and there is no consensus, then there are no internal criteria for the, in this case, zoological classification, that allow for a final decision. Then, no act of classification is ever fully correct. This is the Experimenter’s, in this case, “Paleoanthropologist’s regress”.

In September 1995, after twelve years of controversy, Gibert managed to hold an International Conference in Orce. Gibert showed to both scientists and press a little tooth fragment that was found that summer and that was presumably another hominid remain.²⁶ This happened not only before the publication but even before a complete study of the fragment. Gibert showed the fragment in order to achieve both scientific and public validation. The case was once again in all newspapers. Scientists gave their opinion on the teeth fragment and on the former cranial fragment, to the press.²⁷ The opinions were mostly positive. This teeth fragment was never published in any scientific paper.

This example shows how announcing a new scientific discovery to the press or voicing scientific opinions in the press are some of the discourse practices that are part of the construction, generation and circulation of “scientific knowledge”.²⁸



Conclusions

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In March 1985, three Spanish paleontology professors, Jaume Truyols, Jaume Porta and Miquel De Renzi, with no connection to the Orce case, sent a letter to the main Spanish newspapers with a very harsh critique of Gibert.²⁹ They said that scientific hypothesis should be contrasted before any announcement, concluding that for them “that was the difference between a paleontologist and a mere fossil collector”.³⁰ For Gibert, this letter had a “terrible” influence on the Orce research, particularly in the Venta Micena excavation funding processes.³¹

This example provides clues for understanding this *Different Dimension* of science that scientists recognised and the role of newspapers in shaping scientific research. With the case in all newspapers, new “actors”, such as scientists not involved in the case, were capable to

²⁴ Collins, H. M. (1992). *Changing order: Replication and induction in scientific practice*. Chicago: University of Chicago Press. First published 1985, Beverley Hills & London: Sage. And Maerker, A. (2006) “The tale of the hermaphrodite monkey: classification, state interests and natural historical expertise between museum and court, 1791–4” *The British Journal for the History of Science*, 39.

²⁵ Martínez, B. (1993). *El Hombre de Orce. Historia de un descubrimiento*. Proyecto Sur Ediciones. Granada. p.27.

²⁶ F.R.A. 9/09/1995 ABC p.39.

²⁷ For instance: Turbón, Daniel 17/09/1995 *La Vanguardia* p.64

²⁸ Shinn T. and Cloître, M. (1985)

²⁹ De Renzi, Miquel; Porta, Jaume; Truyols, Jaume "Nota sobre paleontologia" 6/3/1985 *Avui* p.10.

³⁰ “Aquesta és la diferencia entre el paleontòleg i el mer colleccionista de fòssils afeccionat”. *Ibid.*

³¹ Gibert (2004) p. 56, 57.

“speak” about the controversy and to do it in very different terms that they would do it in a peer-reviewed publication. These statements also influenced Orce’s excavations that were paralysed during more than 24 years of controversy.³²

So, with the case in a “different dimension”, and with an unsolvable scientific controversy, science communication became more than just a way to communicate science to lay people but was another piece in the construction of the scientific discourse that had a main role in the validation of the different theories in the Orce Man controversy. These new scientific conditions determined how scientific knowledge was shared along scientists and emerged as crucial to understand the generation of this knowledge.



³² Gibert (2004).

32. Framing Controversy: Mass Media's Ethics and Responsibility in Life sciences. Media Coverage of the Law of Sexual and Reproductive Health and Voluntary Interruption of Pregnancy in Spain. *El País* and *ABC* (2009-2010)

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Introduction

The debate over abortion touch the essence of society because is about human life from its beginning (Cayuela, 2006). There are two main perspectives or arguments: those who defend the inviolability of the human being from the conception, influenced by personalism (Sgrecia, 2009), and those who justify its instrumentalisation for the benefit of others, influenced by utilitarianism (Singer, 1979). The arguments can be constituted around three principles: utility, veneration, and democracy (Bauer & Gaskell, 2002).

Medical, legal and philosophical perspectives over abortion have been intensively studied. From media advocacy perspective we find several studies in United States (Ball-Rokeach, Power, Guthrie, & Waring, 1990; McCaffrey & Keys, 2000; Rohlinger, 2002) and another considering cultural differences between Germany and United States (Marx Ferre, 2003). In Spain there are several institutions that publish reports from legal, philosophical and biomedical perspective (Abel, 2008; Bermúdez Merizalde, 2005; Boné, 1991; Calvo-Álvarez, 1997; Casado, 2010; Domingo Gutiérrez, 2010; Gafo, 1982; Roberto Germán Zurriarán, 2009). However, we found very little Spanish literature about the media's role (Navas García, 2008).

In the interpretation of the message, certain characteristics may resonate more in the public, and in this context, we focus on the extensively studied concept of framing (Entman, 1993; Gamson & Modigliani, 1989; McComas & Shanahan, 1999; Nisbet & Lewenstein, 2002; Pan & Kosicki, 2001; Scheufele, 1999). Another factor that may affect the credibility is the use of sources, given that people have various levels of trust toward different types of sources (Brossard & Shanahan, 2003; Hornig Priest, Bonfadelli, & Rusannen, 2003; Peters, Covello, & McCallum, 1997; Scheufele, 2006).

We aim to analyse media coverage of parliamentary debates of Law 2/2010 on Sexual and Reproductive Health and Voluntary Interruption of Pregnancy. Taking into account the more ideological Spanish journalistic context (Timoteo Álvarez, 1992) than other traditions like North American based on the rule of balance (Lacy, Fico, & Simon, 1991; Tuchman, 1978/1983) and the different editorial line of the two newspapers studied – *El País* is closer to social democratic tendencies while *ABC* is more centre-conservative – we can formulate the following hypotheses:

H1: In *El País* there will be more sources “pro” than “con” than in *ABC* about the abortion law and

H2: In *ABC* there will be more sources “con” than “pro” than in *El País* about the abortion law



In order to study in depth media coverage of this law, we formulate the following research questions:

RQ1: How many sources are quoted by article in the stories published and what type of sources?

RQ2: Which are the main genres used in the stories?

RQ3: Which are the main frames used in the stories?

RQ4: Which are the sections where the texts are located?

RQ5: In terms of graphic treatment, how is the issue of abortion portrayed in the newspapers analysed?

Methods

The analysis focuses on stories about the abortion law published in *El País* and *ABC* in 2009-2010. 2009 was chosen as starting point because this law starts to appear in the media in this year and it was passed in 2010. The main modifications were the authorisation of abortion for women of 16-17 years without parents' consent, free abortion in the first 14 weeks and the impossibility of some health staff of being conscientious objectors, which was finally rejected.

The two publications represent the two extremes of the ideological spectrum – *El País* is described as progressive socio-liberal, European and from the left-centre (PRISA, 2008) and *ABC* is known to be a conservative and a defender of Monarchy (Olmos, 2002; Pérez Mateos, 2002). These two papers have the highest numbers of readers among Spanish newspapers (AIMC, 2010). Using the database Mynews we collect all the articles in PDF version with the keyword “aborto” and we analyse an affordable sample following the method of the constructed week (Kayser, 1982; Stempel & B.H. Westley, 1989).¹

The method is a categorical content analysis (Bardin, 1986; Berganza & Ruiz, 2005; Krippendorff, 1990) combined with a practical application of framing theory (Brossard & Shanahan, 2006; Durant, Bauer, & Gaskell, 1998; Nisbet, Brossard, & Kroepsch, 2003) and a formal evaluative one (Canga Larequi, Coca García, Peña Fernández, & Pérez Dasilva, 2010; Kayser, 1982; Núñez-Romero Olmo, 2009). The coding instrument for sources is inspired by one previously used (Brossard, Dunwoody, Dudo, Hillback, & Wijaya, 2007). We also measure the general tone (Van den Berg, Smith, & Van der Veer, 1992) and the direction of opinion of the sources (Harris & Lewis, 1948). The reliability was calculated with a double coding of 15% of the sample (n=59) with the average in all the variables using Cohen's Kappa higher than 0.90. The total sample comprised 387 stories (159 in *El País* and 228 in *ABC*).

¹ There were four coders working, two professors and two graduate students trained in the coding process during two months: Sara Giménez Albiach and José Tamarit Hernández .



Results

Most of the stories were not neutral. Editorial line makes an influence in the general tone of the texts in both papers. In *ABC*, 50% of the stories were against the law and, in *El País*, 52.8% were in favour.

ABC and *El País* show their editorial lines in opinion articles (*El País* publishes 35 in favour and *ABC* publishes 24 articles and 19 columns against). But it is remarkable that there are also informative stories where *ABC* and *El País* depict their editorial lines which should be balanced and with a neutral tone. *El País* publishes 33 pieces of news in favour of the abortion law and *ABC* publishes 50 reports against. Therefore, our results support H1 and H2. *El País* balances more than *ABC*, because *El País* quotes 47 sources in favour and 53 against, but *ABC* quotes 48 sources in favour and 151 against which also supports H1 and H2.

In order to answer RQ1, we found that 45% of the texts (175) do not contain any personal sources and there is one source quoted in 31% of the texts (120). *ABC* published more texts than *El País* with one personal source (37.3%, vs. 22%). Politicians are the most quoted personal source (167 times; 44.7%), followed by religious sources (59; 15.8%), scientists and privates institutions (44; 11.8% each one).

If we calculate the mean value of highlight and present frames,² “Policy and regulatory strategy” has the highest value (1.65) followed by “Ethics& morality” (1.51). The next frames ordained by values are “New research” (1.45) and “Anecdotal personalization” (1.44).

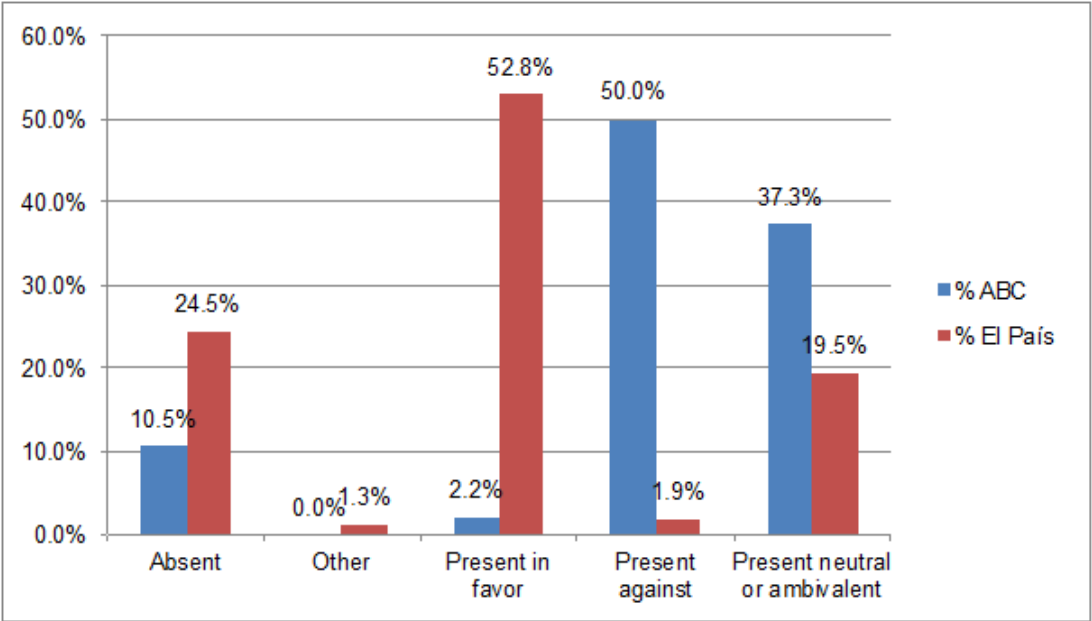


Figure 1: Tone of the stories

² In this calculation, highlight frames rate 2 and present frames rate 1.

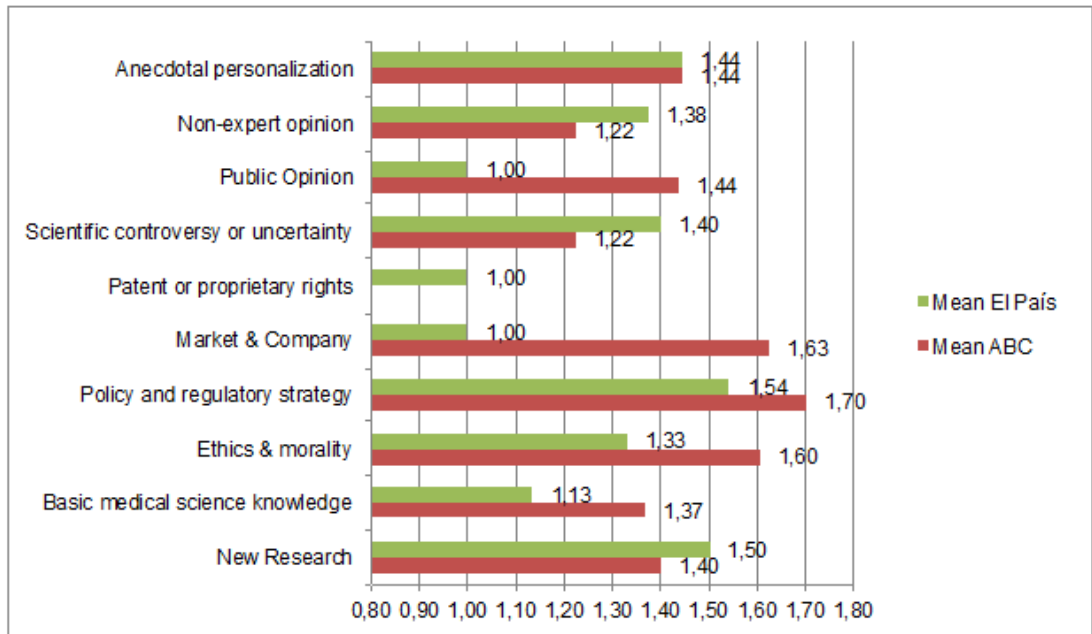


Figure 2: Mean of the frames highlighted and present



Related to sections, most of the stories are published in Regional (20.9%), followed by National (18.3%), Opinion (16.5%) and Society (15.8%). There are many differences between papers. *ABC* places them preferably on National (25.9%), Opinion (21.9%) and Regional (16.2%); although, *El País* places the stories about the analysed law in Society (32.1%) and Regional (27.7%).

According to the methodology for assessing the morphology to answer RQ5, *ABC*'s and *El País*'s stories have medium values: *ABC* has 30.62 points over 100 and *El País* has 30.6 points. If we evaluate the morphological assessment according to the general tone of the texts, we find that *ABC* rates better texts without neutral tone than *El País*.

Conclusion

The data obtained supports H1 and H2 which predicted that *El País* and *ABC* would show a clear position in the debate about abortion law. Therefore, the editorial line has an influence on the general tone of the texts in both papers. It is clear that *ABC* and *El País* show their editorial lines in opinion articles, but it is remarkable that there are also information stories where both papers depict their editorial lines which may be explained by cultural differences of Spanish journalistic tradition (Timoteo Álvarez, 1992). *El País* balances more than *ABC*. However, *El País* shows its position through the use of headlines or leads and *ABC* does it through quotes of personal sources.

There are very few sources quoted per story which depicts a low quality of journalism (Fontcuberta & Borrat, 2006). The most quoted type of sources reflects which spheres are the most considered: policy, science and religion. "Policy and regulatory strategy" frame is

the most present, and the frame “Ethics and morality” is also present or highlighted in more than the half of the sample. Most of the stories are published on Regional sections, followed by National, Opinion and Society which also explains that the issue is framed in terms of policy. According to morphology measures *ABC's* and *El País'* stories have a medium value which means that abortion is not considered one of the top issues in the Spanish media in the two papers studied.

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33. Expert Knowledge and Social Communication of Nanotechnology

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Scientists, Public and Nanotechnology

Nanoscience and nanotechnology is an emerging field of research, development and scientific-technical innovation which is predicted to bring about significant social transformations. (From this point forward we will employ only the term “nanotechnology” to refer to both, although there are certain differences that could be important depending on the objective of each study.) Like all new fields, nanotechnology provokes contrasting reactions: great expectations and equally great fears. The past experience with biotechnology, particularly with GMOs, which revealed the influence of public opinion on the development of a techno-scientific field, has produced special interest in both researchers and social actors.

Briefly, for nanotechnologists the primary concerns are unfamiliarity among the general public and the fear that the reaction to GMOs will be repeated. In general, social scientists have focused their attention on nanotechnology before society has formed an opinion on this issue for heterogeneous reasons, ranging from descriptive to explanatory. In the case of certain sectors of civil society that are involved, concern centres on the risks involved with its potential toxicity to human health and the environment; furthermore, they demand participation in the decision-making process, given that the issues raised transcend merely scientific or technical questions.

Finally, in the majority of society we find that an opinion has not yet been formed on this issue. Two characteristics that stand out are widespread unfamiliarity (despite the fact that ten years have passed since the first public initiatives supporting nanotechnology were carried out), and the predominance of positive attitudes.

Public understanding of nanotechnology in Spain

Although a broad range of studies on public comprehension of nanotechnology has been carried out on the international level (Currall, 2009; Satterfield, 2009; Priest, 2012), none have been carried out in Spain. The only available data come from European Commission Eurobarometer surveys, which provide quantitative data for over a decade on public understanding of nanotechnology in Spain. There are a total of five four-year surveys.

Without going into detail, the results for Spain are in line with the general results, revealing that although Spaniards do not know what nanotechnology is, this unfamiliarity does not provoke a lack of confidence; on the contrary, the results show interest and moderate optimism. Table 1 shows the Spanish data compared to the overall European Union and the United States regarding confidence in 2002, 2005 and 2010.

The table shows that in 2002 the level of optimism was higher in the United States (US) than in Europe. In the following surveys this was maintained, despite a significant increase be-



tween 2002 and 2005 in the European Union (EU). Between 2002 and 2010 optimism regarding nanotechnology only varied slightly in Spain (SP). However, pessimism did increase, while unfamiliarity remains much the same between 2005 and 2010.

This unfamiliarity is confirmed when people surveyed were asked if they have ever heard of nanotechnology before: almost 70% had not heard of it. However, this does not mean that 30% know what it is, but rather that they had simply heard the word mentioned before. Table 2 compares the data for other EU member states. Spain is 22nd on the list, while Portugal occupies the last position.

Table 1. Expectations for Nanotechnology

2002	US	EU	SP	2005	EU	SP	2010	EU	SP
Positive effect (optimism)	50	29	39	Positive effect (optimism)	40	42	Positive effect (optimism)	41	43
Negative effect (pessimism)	4	6	3	Negative effect (pessimism)	5	4	Negative effect (pessimism)	10	8
No effect	12	12	7	No effect	13	8	No effect	9	3
Don't know	35	53	52	Don't know	42	47	Don't know	40	46

Source: European Commission (2005 & 2010) and GASKELL *et. al.* (2004)



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Table 2. Acquaintance with Nanotechnology

Have you ever heard of nanotechnology before?	2010	
	% YES	%NO
Denmark	77	23
Slovenia and EU-27	46	54
Italy	37	63
Spain	33	67
Portugal	21	79

(Source: European Comission, 2010)

Involving experts in public communication

In Spain public opinion is mostly uninformed about nanotechnology, and its research community is not well prepared or encouraged to divulge information about its activity. This is largely due to a lack of communication or mutual ignorance.

This situation concerns some researchers in the field of nanotechnology because they see that in addition to the uncertainty inherent in a wide open field that is only just emerging, there is also uncertainty due to the fact that public opinion has not yet been formed on this area and is therefore highly unstable and variable. Any setback or alarmist or catastrophic information could polarise public opinion and create open hostility toward these technologies. This is why public attitudes, without being determining factors in the road that nanotechnology follows, can clearly have an important effect in one way or another.

When uncertainty exists about the future and people have little information, foresight techniques can be a valid resource to manage that uncertainty. Therefore, we decided to carry out a consultation of researchers in the field of nanotechnology on two aspects, guidance and foresight, in search of a way to manage uncertainty. We chose the Delphi method, which obtains information from experts via various rounds of questionnaires.

The Delphi studies that have been carried out on nanotechnology have focused on technical questions rather than aspects related to public understanding, with the exception of the recent study carried out by Zimmer and others (2010), focused on risk assessment. In contrast to that study, our goal was to consult the experts in order to obtain information that will encourage them to become involved in popularizing nanotechnology to the public.

Our hypothesis is that the risks affecting the future of nanotechnology are not only technical. In an uncertain environment and context, whether (or not) uncertainty is managed is a factor that influences its development, in one direction or the other. We feel that the uncertainty that currently exists regarding the development and future of nanotechnology must be dealt with by providing clear and realistic information to the public.

The questionnaire included questions concerning the principal aspects that condition the creation of public attitudes: Conceptual comprehension of nanotechnology; Current and expected risks and benefits; Regulation; Social participation in decision making; Framing; Communication strategies

The panel of experts was obtained by creating a list of research groups which included around 4000 Spanish researchers. Pre-doctoral researchers and technicians were excluded from this pool and of the remaining names 198 were selected at random to propose participation in the study. Of these, 60 agreed to participate. After the first phase, 48 have sent in their questionnaires.



Among the main results of the first phase we would like to highlight the following:

It is clear that the community of experts on nanotechnology has yet to undertake the task of informing the general public about their field.

However, it is quite a difficult and complex task due to various factors. For example:

- It is very difficult to establish basic common principles because the different converging scientific and technological fields and the basic concepts that must be understood by the public are too broad.
- Researchers and the majority of reporters are not trained in the social communication of science and sometimes they are not aware of the different levels of education and other limitations of the public.
- There is too much faith put in solutions involving the mass media (especially radio and television), which are difficult for the scientific community to access or that escape their control, even more so among ICTs. In addition, there is no clear understanding that outreach tasks do not need to be done on the individual level.

Among the positive aspects, we can mention:

- In addition to using the mass media, experts propose actions that depend (at least in part) on the scientists themselves and their institutions, such as speaking at educa-

tion centres and introducing these topics to primary and secondary education curriculums.

- There is a belief that making an effort to communicate with the public will have a positive impact on its confidence in nanotechnology.
- The need to establish new kinds of regulations on nanotechnology is accepted, although there is no consensus on what that should entail.
- And finally, there is some disagreement on public participation in matters related to nanoscience and nanotechnology

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34. CLIMATE SCOPE: using the Google Earth virtual globe for a visual storytelling of climate change

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In our contemporary ‘visual culture’ computer generated visualisations have great potential as a mean to engage people about environmental issues affecting society. Climate change (CC) being a challenging science communication topic the use of visualisation can bring much to lay people’s understanding of its signs and impacts.

The challenge of communicating climate change

For most people, CC is a “far away” problem, something that isn’t tangible and that does not relate to their own life. Compared to other environmental issues climate change has some specific features that make its communication challenging.

Climate is not such a simple concept to understand, people tend to confuse it with local weather, using their personal and limited experience to make general statements. Moser (2010) summarised some of the most evident traits that make climate change “a tough issue to engage with”. The first characteristic is that CC is not visible: anthropogenic drivers of climate change, normally indicated with the rise in greenhouse gases (GHG) concentration in the atmosphere, are not visible to human eyes, and do not produce any immediate physical evidence. A second reason is that climate change impacts are very often distant in space and time: even the rise of GHG emissions doesn’t seem to cause immediate and direct impacts, and those occurring are not spatially related to the source of carbon emissions.

Another lack of visibility is the fact that early signs of climate change are occurring in inhabited areas (Poles, coral reefs or mountains). So most evidence of actual CC remain “hidden” to people, that tend to disregard the issue in everyday decision-making compared to other more compelling needs and immediate demands. The invisibility is also enhanced by the urbanisation of global population that has diminished people’s attention and assertiveness in regard to natural processes thus reducing their perception of eventual climate shifts.

A last trait of CC is its great complexity in terms of the physical and ecological dynamics and the related uncertainty about future scenarios, due to the limits of the state-of-art of the scientific knowledge, has been used by lobbies to foster non-action. Media also contribute negatively by turning the scientific debate into a show where scientists are portrayed as “dualists”, the alarmists vs the sceptics, with the effect of capturing public attention but at the cost of reducing their confidence in scientific findings.

In this context it is important for communicators to give more concreteness and truthfulness to climate change facts, decoding science data in a way people can trust and understand. Pre-



vious research on this topic (Nicholson-Cole, 2005; Sheppard 2005) has shown that meaningful visualisations about CC could help to bridge the gap between what may seem an abstract concept and the real everyday experience, making clearer its local and individual relevance.

The RACES project and the Climate Scope

Communicating climate change was the main aim of the EU LIFE project RACES - Raising Awareness on Climate and Energy Savings. The project was directed to build an awareness-raising campaign to communicate climate change and its impacts in five Italian cities (Trento, Modena, Firenze, Potenza and Bari), underlying local impacts and mitigation strategies.

In this framework, a Google Earth engine tool based on Thematic Mapping API® library, named Climate Scope, was developed for educational and communication purposes. The goal of the idea is to have a powerful geographic viewer to show the physical dimension of current climate changes at the global and the local level, and at same time a tool capable of engaging users in becoming information producers about social dimension of changes through personal content sharing.

Climate Scope features



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Climate Scope is a mash-up merging climatic and environmental global geographic layers (scientific level) available on the web with geo-located user generated content (media and social level). On this basis Climate Scope was proposed to teachers of secondary schools (14-19 year-old students) involved in the RACES project to be used as an educational tool to frame CC as a global and real event taking place nearby. During the project the Climate Scope was arranged with a pre-set of layers considered useful and comprehensive to start exploring CC. Nevertheless the tool can be further customised by any user to show the relevant information to be highlighted.

The information displayed inside the Google Earth project mash-up were twofold: a set of global climate-related layers, showing data-derived maps downloadable from the internet, like Land Surface Temperature Anomaly (NEO-NASA), Vegetation index (MODIS NDVI), European Drought Severity index (ESA); and a set of real-time layers displaying quasi real-time information as Global Cloud Coverage (provided by Xplanet), Sea Surface Temperature Anomaly (CoralReefWatch-NOAA), real time Precipitation Estimate (EumetSat). These sets of layers produced by authoritative agencies and scientific institutions were then integrated with local information formatted as geo-located signposts inside the Google Earth viewer. Depending on the purpose, different kinds of information were added:

- Scientific local data, as for instance historic series of a physical parameter represented by the map layer (i.e. global/local temperature's anomaly);
- Media produced content, like news or video to include information on social impacts of climate change, such as economic loss due to a strong heat-wave.
- Institutional content, showing mitigation/adaptation efforts by local governments to foster people participation at local level;
- Lay people content, like observations of local changing climate (picture or info) or personal stories about community resilience practices and consumptions choices.

Presenting local stories within a geographic environment of global information layers can help individuals to bridge the gap experienced in relating their personal actions to the global context. (Nicholson-Cole 2005; Sheppard 2005)

Climate Scope was conceived to enhance visual communication and to propose a participatory approach using the geo-environment as the cognitive frame to communicate climate change. The visualised mapping of scientific information and beautiful satellite images were used to explain different signals and impacts through colour scales. Visual representations make data more attractive (see Fig. 1 and 2), illustrate the global dimension of changes and finally can engage the public emotionally.

Climate Scope might also be used to foster public participation in science at different levels. Users are invited to become “observer, researcher and producer” of local information, integrating climatic and social data and publishing it. An opportunity to strengthen the collaboration between researchers and lay people or students, new actors of “volunteered geographic information” (Goodchild 2007), an assertive method of collecting geospatial information as opposed to the authoritative method that government agencies employ to collect data. In the new framework of Web 2.0, users may contribute to science generating meaningful contents; citizens become local “sensors” who have the chance to verify eventually the scientific and authoritative sources, adding new information and contributing to keep it up-to-date, realizing sometimes valuable examples of collective intelligence.

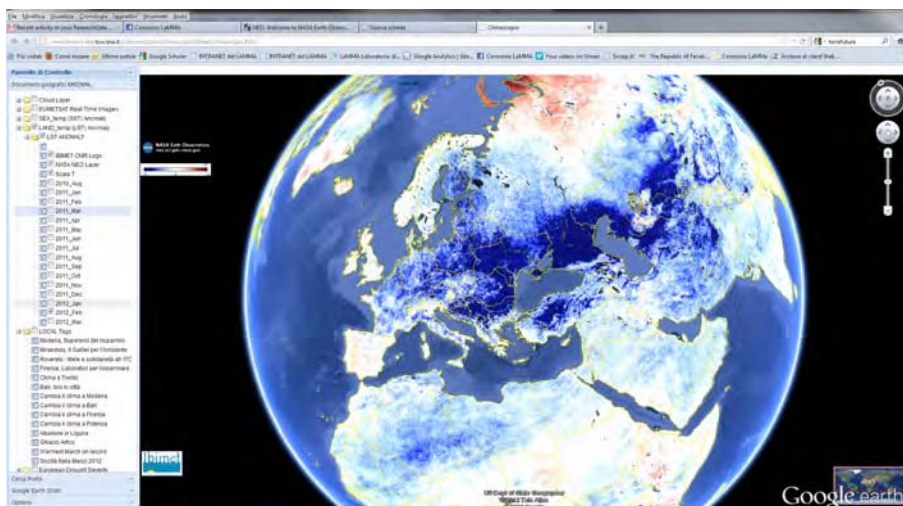


Fig. 1: The Cold Wave of February 2012 as showed in the Climate Scope Layer of Land Surface Temperature Anomaly (NEO-NASA)



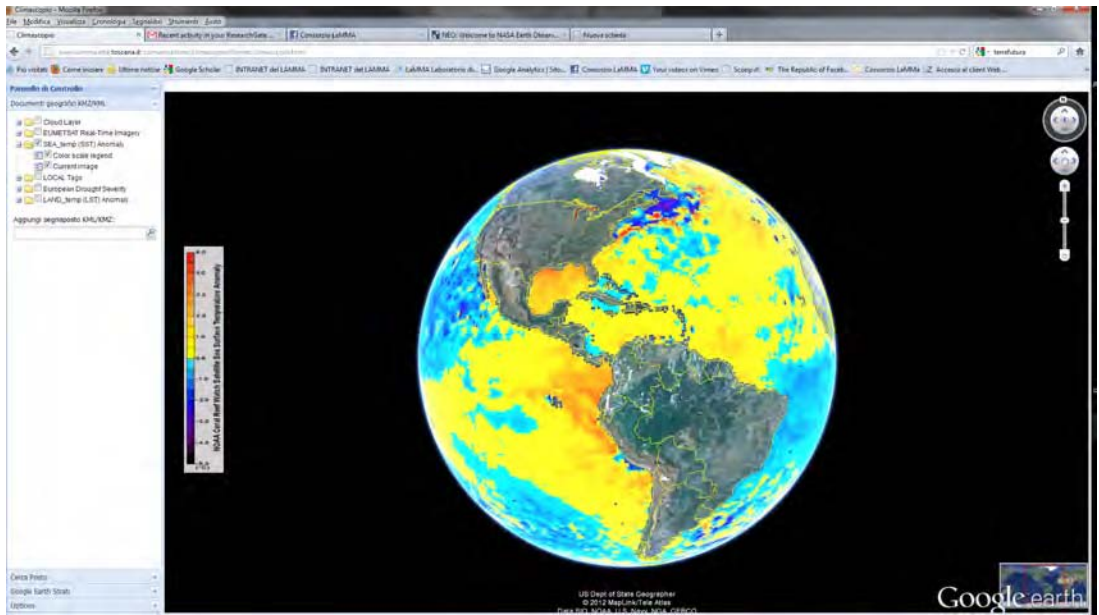


*Fig. 2: Red Spot showing El Nino in the Climate Scope - SST Anomaly layer
(CoralReefWatch_NOAA)*



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Conclusions

Far from being a definitive tool, Climate Scope is a proposal for framing the climate change issue in a way to be effective: where the distant problem can be brought closer, the invisible can become visible; and solutions happen to be true and feasible because they are shared through real personal stories. Overcoming the “deficit model” (considering general public as lacking in science information), Climate Scope aims at being an example of “citizen science”, where lay people knowledge might integrate and give meaning to experts and authoritative knowledge. Further work should be done to evaluate the real feedback from people using Climate Scope as an effective tool to understand and engage with climate change.

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35. Science is ready, serve it! Dissemination of Science through Science Café

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Introduction

“Welcome. Relax. Take a coffee or a beer. The discussion will start in a moment, but don’t be too impatient. We are here to explore, discover and enjoy science and technology”.

A science café is a discussion about some topic in science and technology as scientists do. This does not mean drawing formulas on napkins, but discussing with experts all on the same ground, where the public, and not the experts, are at home.

The purpose of the science café is that of demythologising science communication, removing it from the cathedra and bringing it into everyday life. Often, we consider science communication as a one-way flow of information, from experts to “ordinary” people who simply have to absorb some concept. It is true that much of the technical knowledge necessary to take an informed decision is not everyone’s heritage, and that we often need specific skills to understand advanced topics, but it is also true that the scientific method requires that the participants to the discussion be on equal level, without exceptions. Thus, the concept of science café has to do with participation as well as with science.

A science café is not a conference. Experts introduce themselves and the theme of the discussion, but this part is limited to a minimum. The “engine” of the meeting is always the questions, actions and discussions of the public, animated by a moderator. As D. Dallas, the inventor of modern science cafés says, it is very important to choose a correct venue: “A unique characteristic of the Café Scientifique* is that changing the venue changes the tone and nature of the discussion. In a lecture theater you expect to be lectured to, in a café-bar you expect to discuss scientific matters on equal terms, and that is what people like”. [1]

The European Project “SciCafé”

The authors represent two cultural associations, Caffè-Scienza in Firenze [2] and formaScienza in Roma [3], that organize such events. Those associations participate in the European Project titled SciCafé[4] the Florence one through the CSDC, Centre for the Study of Complex Dynamics, University of Florence [5]. The SciCafé project exploits the notion of networking, the exchange of best practices, and cooperation between science cafés in different cities and regions of Europe, both in their physical vicinities and in virtual space.

SciCafé operates as a vehicle for the promotion of the public understanding of science and of the public debate on scientific issues, focusing specifically on the promotion of a scientific culture at the local level. More specifically, the SciCafé project uses an innovative approach



that crosscuts the boundaries between the already existing initiatives, focusing not only on the improvement of organisers' knowledge on how to develop and maintain a Science Café but also on increasing the motivation of participants to learn and understand scientific issues, which could potentially change their attitude towards science and encourage them to follow scientific careers.

Our activity and goals

Science cafés

In Florence, this activity is carried out by the non-profit association Caffè-Scienza Firenze, formed by academic and CNR researchers, but also many "ordinary" people. As in other science cafés, the public is mainly composed by middle-age, highly educated people.

In Rome, this activity is carried out by the non-profit association formaScienza, founded in 2005 by a group of young scientists. formaScienza is a laboratory of action-research with the aim of exploring new methods to diffuse the idea of scientific thinking as a part of people's basic culture. The activities of the association formaScienza, that include science cafés, deal with the science as a cultural phenomenon, rather than with its specific contents.

Both in Rome and Florence science café each season is composed by seven or eight events which are attended by an average audience of 60 people.

The components of a typical event are: two experts - they should complement each other; a moderator - who animates the discussion; the audience - the participants that ask questions. The experts present the subject (10 minutes each) and the discussion goes on for 1-1:30 hour (10-20 questions). We use surveys to gather information from our audience, mainly their opinions on the single event and suggestions for future topics.

Caffèrenze

Sometimes an interesting theme is not suitable for a science café, mainly because it is too technical and the public may have a few questions to ask. So Caffè-Scienza Firenze launched a hybrid between a science café (café-scienza) and a conference (conferenza) that has been called "cafferenza".

The events take place every one-two months, 4-6 events each season, with an expert, that explain the subject for about one hour, and a moderator, who stimulates the questions from the public. They are hosted in a beautiful library, Biblioteca delle Oblate, in Florence.

Audio and video streaming

In Florence we are collaborating with RadioSpin [6], one of the web radios of the University of Firenze, and both in Florence and in Rome we are experimenting the video streaming service offered by DBC- tv [7], a partner of the SciCafé project, and other independent services.

Radio Moka

Born in October 2010, Radio Moka is a radio broadcast that, through local radio stations, tries to increase awareness of the science café and approaches the general public with scientific issues. The choice of the radio arose from the consideration that this medium, although it is undoubtedly among the most elderly, is the one that may have suffered minor losses with



the advent of Internet users and is still the most acceptable to most people: the radio is still considered non-invasive and reliable. It is based on words, the great primordial communication channel, it can be followed anywhere, anytime and while doing other activities at the same time.

We have experienced two different formats: 45 minutes shows and, currently, 15-minute shows every Saturday morning at 10:00. The programme is written, recorded and edited by two authors of this article (G.P. and F.B.). A typical episode of this second season contains five sections: the preface, an introduction, an interview, a column about physics or chemistry, and finally the next scheduling for the science cafés. We space the sections with music clips, chosen for their relation with the subject under discussion. In order to make the show more appealing, we adopted the classic situation in which one of us is the “teacher” and the other is the “student” asking for explanations.

Junior Science Café, Italian practice

In our experience, the name ‘junior science café’ is used to call simply a science café dedicated to students. In Rome, formaScienza has developed an innovative format of this practice, called ‘Caffè Scienza Junior’ (CSJ), in which students are not only involved as audience of the science café, but are the organisers of the event, under the guidance of one or more tutors.

The steps are the following: first of all, students must choose the scientific theme, starting from their interests and their questions. The team must then decide how to introduce and address the chosen topic, using books and the Internet. Then students need to find two researchers to be invited. In this phase the students learn how the research centres of the territory are organised and how to identify the specific skills of a scientist. Then, students choose readings or film clips related to the theme to be shown during the science café. This is the occasion to connect scientific knowledge with the overall culture. The final event, the science café, is held in a public place, the school or a cafe, a library, etc. One or more students play the role of conductors and moderate the debate between the two researchers and the audience. Students publish all the collected resources on a website, take photos, video and audio recordings of the event and of its preparation.

This approach contributes to present science as a set of alternatives that may be in contradiction, rather than knowledge true once and for all. Moreover, it stimulates students’ participation in the scientific debate, above all developing in students the ability to search and select scientific information that is particularly necessary in a society in which mass-media play a leading role in the construction of the image of science of the citizen.

Conclusions

With respect to “classical” conferences, Science cafés can involve a wider public thanks to its formula. We further enhance this by using “cafferenze” and Junior Science Cafes. Moreover, the audio and video streaming enabled us to reach distant public with an encouraging number of followers. (about 200 people per event, from all over Europe).

* The science café is typically called “café scientifique” in the UK.



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We acknowledge the support from our partners in the European project SciCafé [4].



36. Science Museum On Tour – a new model of outreach

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London's Science Museum is renowned for energetic, high-quality learning programmes that aim to enthuse participants about the creativity of science invention. Science Museum Outreach reached over 140,000 people in 2011/12, part of the total 2.7 million total on- and off-site visits last year.

The Science Museum Group (SMG) includes the Museum of Science and Industry in Manchester, National Railway Museum in York, and the National Media Museum in Bradford in addition to the Science Museum, London. The Outreach team is based in London; as well as travelling the UK their work has recently become increasingly international, with bookings from Ireland, Gibraltar, South Africa and Abu Dhabi in 2011.

The key to engaging a wide variety of people is the diversity of formats. Science Museum outreach includes science shows, workshops, storytelling, teambuilding and communication skills. Each of these formats is based on research, and individual programmes developed by incorporating audience feedback. The process ensures that the events surpass expectations and are pitched at a suitable level that will be appropriate and fun for audiences.

Recently, a new show 'Science Museum- Live On Tour!' has increased access to a wider audience. Originally the majority of outreach participants were children in school, but more recently science museum outreach has enlivened science in venues such as theatres, hospitals, festivals, businesses, libraries, prisons and even weddings!

Underpinning the model of high-impact, commercially viable public engagement with science is the philosophy of providing Life Enhancing Experiences for visitors. The aspiration across the SMG is that experiences are engaging, memorable and inspiring for all audiences.

The demand for Science Museum outreach exceeds existing capacity. This fact together with a high proportion of repeat bookings, commercial success, and positive feedback from press and participants demonstrates the popularity of taking science communication activities directly to audiences who may not be able to visit.

Increasing access to science is not only about physical barriers to accessing collections, but also breaking down intellectual barriers. One teacher commented:

'Presenters were able to convey tricky information in a very entertaining manner'

The emphasis on forming positive associations with science activities can provide immersive experiences for new audiences:

'A thoroughly enjoyable afternoon. Actually forgot where I was'

Audiences that are not currently attracted to science-themed events have been met at festivals; for example the Isle of Wight Festival and Bestival. It has proved beneficial to seek



alternative sites in addition to established science celebrations such as ‘The Big Bang’.

Reflecting on the lessons learnt from analysing feedback, recommendations become clear. It is important to balance education and entertainment in carefully planned sequences so that the ‘wow factors’ are backed up by evidence and development in scientific thinking. One of the outreach workshops develops pupils’ abilities in science communication by sharing the principles behind devising a science show segment. Pupils learn for themselves how to mix comedy with clear visual demonstrations that link to a narrative.

As shows have ventured into new public spaces, presenters have developed subtlety in moderating their style for specific audiences; this has been incorporated into new training for outreach staff. Consequently, the same product can be used with both school and informal audiences, when presenters match tone and adapt content flexibly.

Clearly it is important to match the presentation style to the audience expectations. However, one aspect is apparent for school outreach. Whilst teachers may have to impose a tight rule frame in classrooms, the magic of a Science Museum visit for children is that the show isn’t school. For a short time at least the normal parameters are changed. Science Museum explainers have the license to take more (managed) experimental risks in the name of science investigation than most adults in school would be allowed to, and shows are most memorable when this opportunity is used to maximum effect!



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The unique feature of science museums, as opposed to science learning centres, are their collections. To reflect this, Science Museum outreach will be focusing on incorporating objects into outreach sessions, to physically increase access to collections as well as to expertise in science communication. In doing so, the aspiration is to inspire science literacy around the importance of objects that prompted scientific innovations.

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Science Live on Tour

http://www.sciencemuseum.org.uk/educators/whats_on_for_your_group/events/events_for_schools/science_museum_live.aspx

Science Learning Department Research

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37. Emerging models of engaging children in science

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The following short paper outlines recent innovation of models for directly engaging young people with science and scientists. An outline of our approach to employ new technologies in a multifaceted approach including portable satellite technology, videoconferencing, social media and free-to-use online applications such as Skype and Coveritlive is described. Feedback regarding this work has so far been encouraging but the authors are of the view that this is a fertile area for further research into the effectiveness of this model of science communication and its impact on young people and scientists.

The Natural History Museum (NHM) has a world-class scientific collection and over 300 scientific staff dedicated to furthering our understanding of the natural world and our place within it. As a major visitor attraction the Museum facilitates a wide range of opportunities for young people to learn through active engagement with scientific research and collections. Visitors are able to take part in a variety of face-to-face science communication initiatives including *Nature Live*¹, our flagship platform for dialogue and discussion. These facilitated scientist encounters have involved over 250,000 participants in the past 10 years and evolved to employ a variety of methodologies for engagement with adults and young people.

We are committed to providing opportunities for young people to meet scientist role models and engage with real science in context as a way of raising aspirations and developing awareness of the relevance and application of science knowledge, understanding and skills. A recent innovation in the past 12 months has been the expansion of the Museum's videoconferencing programme, which centres round facilitated discussion between and Museum scientist and school students. Students of all ages and in any location have the chance to speak directly to world leading scientists and to put their questions to those working at the cutting edge of science. The programme provides an opportunity to meet inspiring scientist role models, and the Museum's learning team facilitate the discussion around the relevance and application of the scientists' work.

This expansion has combined the effective use of a number of approaches with satellite communication, videoconferencing and web based technologies (e.g. Skype² and CoverItLive³) to bring young people to the very edge of scientific discovery. Work in this area in the last 12 months (May 2011-April 2012) has involved over 2,000 interactions with young people, including through seven live video conferences and online fora, and has linked to two field projects (Costa Rica and Bahamas) and the collections. This combined approach appears to have enabled wider engagement sustained over a longer period than typical video-conferences.

School students also have the opportunity to see some of the incredible specimens housed at



the museum and find out how they are used in research. For example, in a recent videoconference, a palaeontologist used a real plate from a stegosaurus to elicit ideas from students on why these animals had evolved these spectacular features. For our scientists, the events have been a chance to share not only their knowledge and expertise but also their passion for the natural world with an audience they do not normally come into contact with. We also note that videoconferencing allowed for more precious specimens to be used as risks were reduced. Our scientists have been exposed to the enthusiasm and inquisitive nature of young people and have all been impressed by the questions they have been asked.

Additionally we have also been able to apply this stream of work to programmes for young people as part of a family group. A highlight from this work was that, as part of a two-channel live link to a field site in the Bahamas, a 12-year old was able to ask questions of a local marine biologist about the view from a mROV (mini Remote Operated Vehicle⁴) while also directing the operator in where the mROV should go next. From conversations with the family following the event it was clear that the experience made an impression.

Another key element of this multifaceted approach has been the use of social media to further and deepen engagement. As well as raising awareness through well-established platforms such as Facebook⁵ and Twitter⁶ participants were also able to take part in discussions on the Museum's online forum, Nature Plus⁷. A dedicated schools area, accessed through a restricted log-in system, was created to enable discussion between students and researchers and for students to upload their own images from local experiments. For example, students were able to upload images of lichens from their local park as the lichenologist they had been speaking with though videoconferencing was uploading images of lichens as they were being discovered in a remote field site in Costa Rica. It caused the lichenologist great excitement to see that students were uploading photos of UK species of genera they were seeing in quite a different form half-way across the planet. A further benefit of this (given the time differences often encountered with this kind of science) was that comments and questions posted by students could be responded to overnight so that there were daily developments during the whole field project.

Feedback from the work has indicated positive response from young people involved. A quote from a 13-year-old boy supports this: "It made me think about what a career in science would entail. It really improved my confidence in asking questions to scientists and I'm really glad I got to take part." More broadly this work has raised many questions in the minds of science communication practitioners involved. These questions range from basic questions around the impact of meeting scientists in this way (Seakins, 2011⁸) through to more complex questions around the integration of multiple media for engagement with science. In the spirit of the PCST conference the authors welcome interest from researchers in coming together to explore and further our understanding of these emerging models of science communication with young people.

¹ www.nhm.ac.uk/nature-live

² www.skype.com

³ <http://www.coveritlive.com/> (the coveritlive plug-in was used for the NHM website)



⁴ <http://www.nhm.ac.uk/about-us/news/2012/march/underwater-tropical-twilight-zone-explored-with-museums-rov108768.html>

⁵ www.facebook.com

⁶ www.twitter.com

⁷ www.nhm.ac.uk/natureplus

⁸ A. Seakins, 2011, unpublished doctorate research presented at NHM seminar November 2011

⁹ www.ja.net

The videoconferencing network Jenet⁹ provided invaluable support to all parties. Key to the success of these programmes, beyond the work and dedication of many staff of the Natural History Museum and our scientific/technology partners has been the support of proactive teachers whose role in enabling students to engage so effectively has been critical. Of course this exciting work would not have been possible without the willing participation of the young people themselves.



38. Science journalism as a governance mechanism in medialized societies: a conceptual model of society-level effects of PCST

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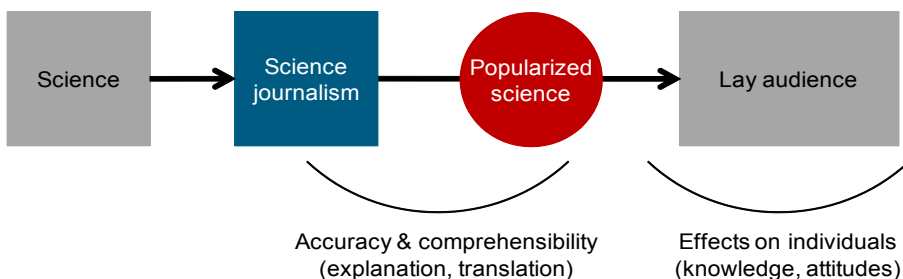
Introduction

Communication models can have several functions: They can be used as models of reality. Such models can be *empirically* true or false. Models can be *normative*, suggesting favored ways of communicating (“public engagement”) or denouncing disliked practices (“deficit model”). Such models carry connotations of “right” or “wrong” in a moral sense. And models can be *conceptual*, i.e. analytically structuring a certain type of communication situation as an object of inquiry. Such models implicitly or explicitly guide research and are more or less useful in exposing challenging and promising research questions. In this paper I am mainly concerned with conceptual models.

The linear communication model, its normative biases and its blind spots

Many reflections and research on science journalism (and PCST in general) are guided by a linear communication model that links science via the mass media (or another “channel”) with a lay audience (Figure 1). This model suggests a number of useful research questions about science journalism. Within the framework of that model scholars have studied the performance of journalism as “translator”, the content, comprehensibility and accuracy of science coverage, and the effects of media coverage on knowledge and attitudes of the audience, for example.

Figure 1: Linear information model of science journalism



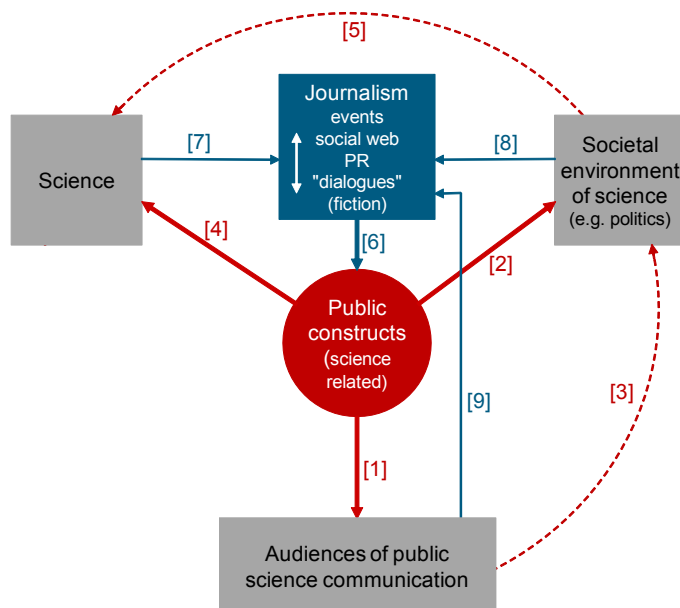
The effects of thinking in terms of the linear model when designing research on science journalism and interpreting the results are two-fold. First, when conceptualising science journalism as “information channel” certain normative expectations are activated that would rather require a critical discussion. Discrepancies between source message and mediated message



come into view as “distortions” only, not as possible adaptations to the needs and expectations of the audience or as manifestations of journalistic autonomy (Kohring 2005). The linear model thus assigns journalists the role of a “messenger” or “translator” rather than “observer”. Second, relevant aspects of the communication process escape attention, such as the dialogical character even of mediated public communication, the function of science journalism as knowledge producer (rather than just disseminator), and society-level effects beyond influences on knowledge and attitudes of the general media audience.

In the following I try to sketch and advocate a constructivist model of PCST that includes the linear model (i.e. the information path from scientific sources to the general audience) as a substructure but puts it in the context of a broader public science communication system (Figure 2).

Figure 2: Comprehensive constructivist model of PCST



Public constructs of science, scientific knowledge and science-related issues

In the core of the model are the public constructs of science, scientific knowledge and science-related issues, i.e. representations of, e.g., scientific findings and theories (“big bang”), science as a social system, research fields (“stem cell research”), projects (“Human Genome Project”), technologies (“agricultural biotechnology”), medical practices (“organ transplantation”), organisations, prominent researchers, and problems such as climate change or the regulation of use of research animals. We find these constructs in tangible form in the content of public communication, e.g. in the stories produced by science journalism, in the exhibitions of science museums or in the messages circulating in Twitter.

Of course, it is not necessary to assume that public constructs of scientific findings, technolo-

gies and issues are clear, consistent and uniform. Often they will be vague, include uncertainty, contradictions and controversy. These aspects will actually be characteristics of the constructs themselves. Some of these constructs will be rather stable over time and implicit in messages across many topics (such as conceptions of science). They might even be considered part of the culture or an issue culture. Other constructs will appear and change rapidly, having a half-life of only days or weeks.

Effects of public constructs of science

As they are public, the constructs will be perceived by the respective audience of mediators of science information [1]. A long record of research on audience reception and effects shows that audience members are influenced by the public constructs, i.e. by the content of public communication. Public opinion on science, technology or science-related issues such as perception of climate change risk, as measured by surveys of the general population, will probably not simply mirror the public constructs but certainly be influenced by them.

However, considering effects on members of the general audience only is a too-narrow view. The public constructs are also perceived by decision-makers and processed in organisations and institutions in the societal environment of science [2]. Along with many other influences and constraints they will enter the decision-making processes in political, economic and health institutions, for example.



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One of the reasons is that the constituency of these institutions – members of the general public as citizens, consumers and patients – will effectively express their preferences formed under the influence of the public constructs and put these institutions under pressure to be sensitive to these constructs in their decisions [3]. However, there is evidence that in our “media societies” public constructs can influence these institutions rather directly. Politicians, for example, will often not wait for voters’ reactions in elections, for evidence of protest or results of opinion polls but will react rather directly on these public constructs (Petersen et al. 2010).

Finally, the public constructs related to science will be perceived within science – by individual researchers, science managers and public affairs departments of universities and other research organizations [4]. Scientists have readily learned that social support of their research depends, among other factors, on public legitimacy, and that media visibility (as long as it is not negative) serves as a universal indicator of social relevance for individuals and institutions outside science. So they are concerned about public accounts of their work and of themselves and adapt their public self-presentation but maybe also their research to the expectations of the media in order to meet the media’s selection criteria, a process now being discussed as “medialization of science” (Weingart 2012). Public constructs may influence the research agenda and other aspects of the research process, perhaps even the interpretation and publication of results. Furthermore, funders of science and science regulators may base their decisions (partly) on the public constructs related to science, as described in the last paragraph, and thus reinforce the media orientation of science [5].

Creation of public constructs of science

Another part of the model describes the creation of the public constructs by “mediators” that have access to the relevant socio-technical infrastructures required to reach the public

[6]. The most important of those mediators (I believe) is still the classical journalism in print, broadcast or online, although its position within the new portfolio of possibilities is challenged (Brumfiel 2009). Largely because of the development of the internet, the quasi-monopoly of professional journalism has diminished thus increasing the technical possibilities of scientific sources – individual researchers and organizational public relations departments alike – to communicate with the public without the involvement of journalism. Furthermore, social media (blogs and social networks like Twitter and Facebook) have developed that operate according to a network logic that differs from the logics of journalism and “one-way” self-presentation of science communicators.

A main assumption of the model is that communicators in science [7] as well as in the societal environment of science [8] are involved in the creation of the public constructs. Furthermore, because of the audience orientation required for effective communication these constructs will also reflect – to some degree – the relevance structure and values of the audiences [9]. In the perspective of the model, public constructs are the outcome of a kind of “dialogue” between communicators from science and its societal environment – a dialogue that includes the audience, at least in a metaphorical sense, through the audience orientation of professional communicators but also, perhaps more and more, directly through social media. In general, the public constructs will be the outcome of the contributions of many communicators from within and outside science, and influenced by the logics of different communication systems (above all journalism, public relations, and social media). The involvement of non-scientific communicators will lead to a social contextualization of science, an integration of knowledge from scientific and non-scientific sources (co-production of expertise) and a combination of different “rationalities”.



The model, its uses and its limits

The model covers the linear communication model described above ([7] → [6] → [1]), but by inclusion of society level effects and interactive relations it also allows to conceptualize an informal science governance mechanism by which “society” (as a shortcut for “societal environment of science”) is involved in the creation of public constructs of science which in turn are perceived within science and inform decision-making about research. Normatively, the model does not encourage socio-technocratic perspectives on communication that consider individual recipients as “targets” (“How do I have to communicate in order to reach the effects I aim at?”) as it stresses interdependencies rather than causal relations. It considers the creation of public constructs and their effects as part of the process of societal self-regulation. It suggests studies about the suitability of the public communication system for inclusion of publicly communicated expertise for policy-making, about its compatibility with democratic values and processes, and especially about the public “negotiation” of the position of science in society.

I do not claim that the model facilitates conceptualising of every possible research question in PCST, but used as a heuristic to generate specific research questions it can lead to a number of innovative approaches. Each arrow and box in the model can be used to generate research questions. Some of these are rather mainstream, e.g. the analysis of communication content (“public constructs”), their individual-level effects [1], and scientists as communicators [7]. But some questions are rather neglected in current research such as the

political effects [2] and repercussions on science [4], the impact of audiences on the production of public constructs [9], or the changes in the system of mediators that generates the public constructs. Regarding the last-mentioned research area consequences of the social network logic for science communication, the future of science journalism within the new communication context, and the interdependencies between the different mediator systems may come into view. Finally, the model encourages a systemic view on PCST, considering the interaction of several linkages.

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39. Reconsidering public engagement in science: developing an analytical framework and a social indicator set for empirical research

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Introduction

Public engagement of science (PES) is a broad notion that covers several dimensions of the social outreach of scientific organisations. Theory development and empirical research is often divided in streams of literature focusing on different aspects of the so-called “third mission” of universities and public research centres. A first stream is related to public communication of science, interested mainly in dissemination practices and the promotion of science culture in society. A second stream focuses on the community engagement of research organizations. It studies the direct action to resolve the practical needs of the surrounding civic society, using knowledge and resources accumulated by universities for special education, health care, social integration and other social services. A third stream is related to knowledge transfer with firms and public administration. Although technology transfer and commercial relationships are not usually considered part of PES, the broader notion of knowledge transfer encompasses other not-for-profit relationships with firms that are useful for regional and local development, such as specialised training for small firms, exchange of human resources, social entrepreneurship and access to scientific instrumentation. On the side of the public administration there are also many possibilities of knowledge transfer, including training and applied research tailored specifically to inform social policies.

Studies on PES have been developed by different epistemic communities, resulting in diversified sets of indicators for capturing some of the above dimensions. In addition, most of the empirical endeavours are designed to measure public engagement of organisations as a whole, or some of their organisational units. Nevertheless, a common barrier for empirical research is that most of the activities are carried out by individuals. Many of them do not report their activities, making evaluations of the real contribution of public research organisations especially difficult. Therefore, it is still needed a comprehensive framework of indicators for PES, together with an operational procedure to capture the real behaviour of individuals and organisations.

The strategy of this paper is to develop a cross-fertilisation of approaches in order to build an integrated indicator framework. After the introduction, section 2 discusses the background ideas to connect public engagement of science with other approaches. Section 3 analyses the three missions of public organisations: public dissemination, knowledge transfer and community engagement. Section 4 proposes measurements for specific activities and discusses the methodological options for empirical research. In the conclusions the possibilities for implementing this framework in specific organisational sites are discussed.



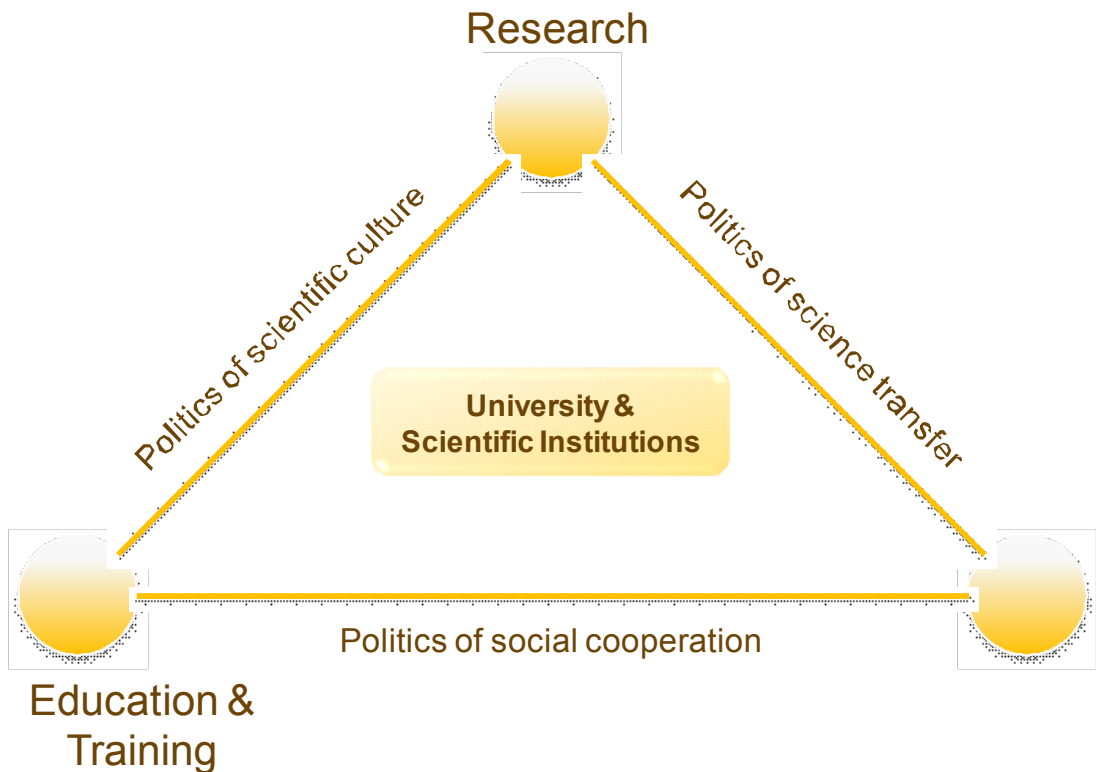
Background

The several dimensions covered by PES can be addressed by the concept of “third mission”. The term has been used broadly since the beginning of 20th century to refer to the enlarged role of universities and has been adapted to different historical contexts. In 1930, philosopher Ortega y Gasset stated in his book, *Mission of Universities*, that, along with professional training and scientific research, universities should incorporate a goal of commitment with society. This mission should pursue “the modernisation of society, encompassing the extension of higher education to the formation of a civic spirit”.

The notion of the socially engaged university was supported by other scholars such as Dewey and has persisted over the years. Nevertheless, the idea of third mission has become more visible when research institutions have become central actors for promoting economic development and well-being. The emergence of modern research systems has given rise to a critical stream of thinking that revises the traditional role of research organizations. Concepts like Mode 2 (Gibbons), Post-academic Science (Ziman) Postnormal Science (Ravetz and Funtowitz) and Triple Helix (Etzkowitz and Leidersdorff) reflect the several dimensions of the transformation of science. A new discourse about the social contract between science and other social domains is demanding more effective links, resulting in an extended accountability of public engagement.

The modern versions of the third mission framework (Molas-Gallart et.al; Laredo) can be used for analysing the several components of public engagement. This notion can be divided into three dimensions as represented in the triangle about the functions of universities consisting in research, higher learning and innovation. The multiple missions can be outlined looking at the sides of the triangle. The above processes are connected closely with the notion of public engagement as used by the epistemic community of the field of public understanding of science. Therefore, a useful exercise for building an indicator framework is for public engagement is to depart from the streams covered by the notion of third mission.





The multiple dimensions of public engagement

The public dimension of knowledge transfer (KT). It covers the practical problems of transferring knowledge between organisations. It seeks to organise, create, capture or distribute knowledge and ensure its availability for future users in organisations different from universities and research institutes. It can be assumed that a public dimension of KT exists when mobilising science resources is undertaken for promoting public goods. Some forms of KT can be considered as public engagement since they imply the use of knowledge to improve public policies. Although some others are carried out with firms, they may encompass a social purpose. The main components are KT for public administration, KT for local and regional development, and social entrepreneurship.

Community and civic engagement. It refers to the links between science institutions and civil society, especially the more disadvantaged communities. This involves attending to the demands for education and extension of knowledge in the local and everyday domain. The main goal is to contribute to the creation of a plural and inclusive policy and the empowerment of communities against social exclusion. The main sub-dimensions are: the extension of knowledge and qualifications, the promotion of citizenship development, and action for social and individual integration

Public communication of science. It implies the communication of science and scientific knowledge to the non-specialist public. It includes the use of appropriate skills, media, activities, and dialogue to produce a personal responses to science encompassing “Awareness, En-

joyment, Interest, Opinion-forming, and Understanding” (Burns). The main sub-dimensions are: social networking, non-academic publications and media appearances, social media and education for science culture.

Towards an integrated indicator system

The strategy for implementing the above dimensions in an operative indicator system is to focus on behaviours that can be measured in terms of activities performed and frequencies for a given period of time. Every indicator can be included either in a questionnaire or in documents that can be placed in a retrieval information system.

Group: Activities related to knowledge transfer

I. KT for public administrations

Applied research

- Collaborative projects between academics and public administrations
- Applied projects to inform public policies

Innovation in public administrations

- Evaluation of public services
- Forecast and planning

Expert advice

- Consultancy
- Participation in advisory committees

Human resources training for public employees

II. KT for upgrading firm innovation

Advanced services

- Consultancy
- Technical services: testing, analysis, calibrations.
- Use of university facilities
- Contract research

Collaborative research

- Collaborative projects
- Demonstration projects

Entrepreneurship with social purposes

- Spin-offs
- Start-ups

Human resources training

- Training of university postgraduates by firms/internships in firms
- Training of firm workers by universities/internships in universities



Others

- Participation in exhibitions, fairs, professional conferences
- Expert advice

Group: Activities related to Public Communication of Science

Social networking

- Conferences and round tables
- Dissemination fairs
- Open doors events at universities and research centres
- Social networks related to ICT

Non-academic publications

Text books

Dissemination articles

Web page content

Movies and videos

- Mass media appearances

- Press articles
- Radio
- TV

- Participation in the education system

- Teaching introductory science subjects in schools

- Teaching dissemination courses in schools



Group 3: Activities related to civic and community engagement

Extension of knowledge and qualifications

- Special training for integration into the labor market
- Long life training and employability of workers
- Higher education for elder people

Citizenship development

- Education for tolerance and integration of minorities
- Education for promoting solidarity values
- Social leadership: participation in public debates, social movements

Social and individual integration

- Participation in community services (health care, special education, etc.)
- Projects to prevent social exclusion
- Projects for promoting sustainable development
- Preservation and integration of local identities in global processes

Operational procedures

Survey instruments. The above indicators can be included in questionnaires for representative surveys targeting individual researchers. Possible questions can be referred to: frequencies (in a given period of time), importance for the workload of researchers, and importance attributed by researchers.

The “pros” of implementing indicators in a questionnaire is that surveys are quick and affordable. They are useful for observing trends, exploring correlations between activities, and studying causal relationships between individual/institutional dimensions and activities. The “cons” are that they do not offer a detailed account of activities. The behaviours considered as “non-desirable” tend to remain hidden.

Retrieval information systems. Standardised CVs and documents can be filled by individuals and organisational units in universities and research organisations. The above indicator framework could be implemented in information technology systems as far as activities are reflected in written documents. Information systems allow accurate and detailed accounts of activities. Registries are valid for evaluations. Analysis can link activities of public engagement with other registries (publications, patents). Nevertheless, information systems are costly and difficult to implement. They may cause “bureaucratic fatigue”. Researchers usually need incentives to fill them. Once established, they are difficult to change and can be subject to path dependency.



Conclusions and implications

Public engagement is a multi-dimensional domain. For detailed and reliable measurements, a cross-fertilisation of different epistemic perspectives and a multi-dimensional indicator system is needed. It may include three main dimensions: Knowledge Transfer, Community and Civic Engagement, and Public Communication of Science. Multi-method and pluralistic approaches combining survey and retrieval information systems are needed to overcome methodological limitations. In any case, it is necessary to consider the barriers to develop indicators in comparison to the availability of data that account for the other missions: formal teaching, scientific research and commercialisation. Public engagement of researchers tends to be hidden not only because of the limitation of empirical observations, but because its legitimacy is less than that of other activities of researchers.

40. Media attention and its repercussions on science: a cross-disciplinary approach

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The medialization of science

The relationship between science and the mass media has attracted the attention of sociologists of science and communication scholars alike. Given the importance of the mass media in framing public opinion in every part of society, media attention can be seen as crucial for science's public support. In times of a presumptive tightening of the "Sciences' Media Connection" (Rödder et al. 2012), the question arises not only if media coverage of science is on the rise but also if science in turn orients itself towards the rationalities of the mass media.

This process of mutual influences and dependencies between science and the mass media has been termed "medialization" (Weingart 1998, 2012). A media orientation may result in press conferences and other staged events, in the occurrence of scientific media stars, in the announcement of research results in the media prior to their publication in peer-reviewed journals, and other changes to science's institutional and epistemic characteristics.

Medialization research systematically investigates structural changes in science towards mass media-related criteria of relevance and locates it on different levels: as changes with regard to the professional role of scientists, as organizational responses and in its resonance in scholarly communication (Franzen et al. 2012). A recent survey article concludes that medialization effects are difficult to grasp and that the interpretation of empirical findings depends to a large extent on theoretical assumptions that makes them in a way incommensurable (Weingart et al. 2012).

Apart from methodological and theoretical constraints it is rather obvious that there are considerable differences between disciplines. Schäfer has addressed this issue; his cross-disciplinary approach (Schäfer 2009) and meta-analysis of medialization research (Schäfer 2012) were focused on the first dimension of medialization, the changes with regard to media coverage. Our complementary aim is to qualify the second dimension, an increasing orientation of science towards the mass media, in that "the interests and values of their publics communicated by the media become an important reference for science" (Weingart 2012)

A cross-disciplinary approach

We therefore proceed on the assumption that it is not science as such that experiences media-related change but that resonance can be observed in various disciplines under specific conditions only. By comparing mathematics, molecular biology and contemporary history, we investigate the implications of medialization in three disciplines that differ in the amount of news coverage as well as in their production and presentation modes of knowledge.



The research question that informs the comparison is: What are the implications of media (or no media) attention for science funding, for research agendas, for universities and the professional self-understanding of scientists, and how do these developments relate to the production of new and reliable knowledge?

Methods

We combine three methodical steps to explore the repercussions on science with regard to discipline-related specificities: (1) a media resonance analysis of original research articles from the top journals in each field that were covered by the German press, (2) an in-depth analysis of medialized papers and their accompanied network of articles and (3) semi-structured interviews with scientists, press officers of research institutes/journals, journal editors in the three fields and science journalists.

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41. Public Communication in Graduate Programmes in Public Health

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Introduction

The focus of this article lies in the presentation of the results of a systematic review and analysis of the existing literature on the public communication of science within the perspective of public health as set out in its post-graduate programmes, these being included, in their turn, in university institutions which, within a broader context, constitute cells dedicated to the production of knowledge, science and technology in knowledge societies.

The limitation of this study to the sphere of public health is due to its inclusion in doctoral research undertaken in the Post-graduate Programme in Public Health of the School of Public Health of the University of São Paulo, Brazil.

Method

This is a bibliographical study and one of documentary analysis. In the discussion of the results the principle of the analysis of the tests of tracking and the diagnostic test, used in epidemiological studies in the field of public health, has been employed. A bibliographical survey of the PubMed database, the most important database for the retrieval of literature in the biomedical field, chosen for its international outreach, was undertaken. Documentary analysis of the articles retrieved was also carried out to verify their correspondence to the original proposal of their being related to public communication within the context of post-graduate programs in public health.

The bibliographical survey was based on the Medical Subject Heading (MeSH) programme, which consists of a structured, controlled vocabulary, produced, maintained and made available online by the U.S. National Library of Medicine, employed as a resource for the indexing, cataloging and retrieval of information and documents and/or articles relating to the health field.

It was sought to identify the MeSH and DeCS terms associated with the theme of public communication and post-graduate programmes in public health. Once in possession of this structured vocabulary, the bibliographical research was undertaken, both by simple and advanced search in the PubMed databases. The documents retrieved during the advanced search were then submitted to documentary analysis.

In order to provide elements for the interpretation of the data obtained during the bibliographical survey the methodological principle of a tracking test and of a diagnostic examination, such as are used in epidemiological studies in public health, was adopted (Pereira, 2005, p.33).



Tracking tests were undertaken, the first with a view to retrieving, on the basis of the established databases, documents related to the theme of public communication. The first was done by simple search. In the second, undertaken by advanced search, each of the MeSH terms related to public communication was conjugated with the MeSH terms related to post-graduate programmes in public health. The documents retrieved in the second phase were submitted to a “diagnostic test”, i.e., in this case they were submitted to documentary analysis to determine which of them actually dealt with the subject in accordance with the previously established criterion.

A second bibliographical survey was undertaken with the data obtained from a control group with a view to determining possible false negatives, undetected in the group tracked.

The terms sensibility, specificity, positive predictive value and negative predictive value, inherent to a tracking test in epidemiological studies, were correlated with the results obtained by the bibliographical research into the databases.

Results

The MeSH terms which were associated with public communication and post-graduate programmes in public health are as follows: Diffusion of Innovation - DI, Mass Media - MM, Communications Media - CM, Information Science - IS, Access to Information - AI, Disclosure - D, Information Dissemination - ID, Health Communication - HC, Information Literacy - IL, Social Media - SM, Education Graduate – EG, Schools Public Health - SPH.



172 Table 1 presents an overall view of the number of documents retrieved whether by simple or advanced search (AS) using each of the MeSH/DeCS terms associated with public communication and the post-graduate programmes in public health. The number of articles resulting from the Documentary Analysis (DA), correlated with public communication in the post-graduate programs in public health, may also be seen.

Table 1 – Articles retrieved from the PubMed Databases

Data Base	Number of Articles Retrieved by MeSH/DeCS Term Simple Search													BA	AD
	DI	MM	CM	IS	AI	D	ID	HC	IL	SM	SPH	EdG	Total		
PubMed	13.640	52.315	202.026	2.804.086	26.463	34.746	11.563	66.227	2.780	6.416	11.226	43.384	3.274.872	237	3

Discussion

The methodology of the tests of tracking and diagnosis (Bonita, Beaglehole, and Kjellström, 2010) was adopted for the analysis of the data collected. The bibliographical research, in accordance with the criterion of the search for articles related to public communication in post-graduate programmes in public health using the MeSH terms, constitutes the group or population tracked. The bibliographical research structured by randomised draw constituted

the control group. As only the PubMed database complied with the previously established criterion, the study of the tracked and the control groups was undertaken exclusively on the basis of this database. Only the basis of the control group, of 241 documents, was composed by proportion in relation to the tracked group.

A sample of the articles of the control group was undertaken, employing the “Random Integer Generator” resource, available on the site www.random.org, for submission to documentary analysis. As the indexing of the articles in the PubMed is highly dynamic and can change from one day to the next, the bibliographical search, both for the tracked group as also for the control group, was undertaken on one and the same day.

It was intended, with the control group, to identify articles which complied with the previously established criterion of dealing with public communication in post-graduate programmes of public health which had possibly not been identified in the tracking test.

When the documentary analysis had been undertaken, as also that of the diagnostic examination of the 241 articles belonging to the control group, no false negative article was identified. That is to say, no document which complied with the purpose of the study was found. This demonstrated that the search system used by the PubMed database is efficient and sensitive in its identification of the truly positive articles or cases.

On the basis of the application of the model of a standard tracking test (Menezes and Santos, 1999) and of formulas used in the tracking tests of the epidemiological studies (Pereira, 1995), it was concluded that in the bibliographical research, both with the tracked and the control group, the resource was more appropriate to measure the degree of sensitivity than their degree of specificity, seeing that the identification of the articles which in fact complied with the established criterion was of 100% and the degree of specificity of the test in detecting articles which did not comply with that criterion was of approximately 51%.

As the purpose of the study was the identification of articles related to public communication in post-graduate programmes of public health, the result of the degree of sensitivity of the same corresponded fully to the original proposal.

Conclusion

The theme of public communication in post-graduate programmes of public health does not thus yet seem to be the object of systematised studies, which points to the need further to develop the study of this theme. One important reason for working on the theme of public communication in post-graduate programs, particularly those of public health, relates to the presuppositions of the modern knowledge society (Bessa, Nery e Terzi 2003, Wagner 2007).

Even though the results presented here are partial in the light of the consideration that they are included in the wider context of a doctoral research project, they close the circle of a study which is already complete. It is to be hoped that they may contribute to the discussion of the questions of public communication within the field of post-graduate programmes in public health, and by extension within the scope of post-graduate programmes in general, in the various areas of knowledge and also within the scope of universities in general, especially Brazilian ones.



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42. Science and technology governance and public acceptance

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Introduction: the debate about public acceptance of science and technology governance

A relevant part of the current debates about public acceptance of science and technology centers on the social acceptability of science and technology *governance* (including decision making, regulation and risk management) (Irwin & Wynne, 1996; European Commission, 2007). In this contribution we will argue, based on survey data, that the relationship between, on the one hand, public and stakeholder acceptance of governance and, on the other, the level of public education, as well as current improvements in science and technology management is still unclear.

We present recent survey data on the public perception of science and technology governance, particularly on the perception of the importance of scientific knowledge and values, precautionary regulation, as well as the role of experts in decision making. The survey's data are particularly relevant due to the relatively limited availability of data specifically about public attitudes towards regulation and decision making (instead of particular scientific-technological applications or overall science and technology).



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The relationship between education and acceptance

Many of the current proposals to improve general public acceptance of science and technology, as well as specific technological applications (for instance, biotechnology) center on the idea that there exists a general lack of scientific culture. Consequently, public understanding of science and technology and general as well as specialized scientific-technological education are understood to be in the need of being fostered. Still following this argument, it is often taken for granted that an increased level of knowledge and understanding among citizens with respect to science and technology would also improve public acceptance of governance and regulatory processes. This argument about the relationship between education and acceptance can be linked to the "deficit model", the notion that public criticism of decision making is the result of a lack of specialized scientific-technological knowledge (Irwin & Wynne, 1996; Millar & Wynne, 1988).

The survey

We will recur here to a recent survey that allows us to question the argument with respect to the supposed link between level of education and attitudes towards science and technology governance. The study of public perception (Fecyt, 2008) was carried out in Spain in 2008. A total of 7400 persons were personally interviewed on 29 questions related, among others, to policy, governance and public funding of science and technology, scientific culture, as well

as science and technology education. The wording of the six questions most relevant to our discussion, as well as the respective percentages of the responses are shown in table 1.

Table 1: Responses to questions about science and technology governance (Fecyt, 2008)

(Percentages of agreement/disagreement with the following statements)	Complete or partial agreement	Neither agreement nor disagreement	Complete or partial disagreement	Don't know
Decisions on science and technology are best left with the experts	67.9	18.0	6.4	7.8
The citizens should assume a more important role in decisions on science and technology	35.7	30.4	24.0	9.9
Scientific knowledge is the best basis for drawing up laws and regulations	37.1	28.7	18.3	16.0
In drawing up laws and regulations, values and attitudes are as important as scientific knowledge	47.8	26.5	11.5	14.1
If it has not been proven scientifically that new technologies can cause severe harm to humans or the environment, it is erroneous to impose restrictions on these technologies	39.1	25.5	23.7	11.8
While the consequences of a new technology are not well known, action should be guided by caution, and the technology's use should be controlled to protect health and the environment	64.7	19.2	7.4	8.6

The response data summarized in Table 1 show that Spanish citizens tend to trust the experts, while being split on the issue of citizen participation in decision making. On the question of the relevance of scientific knowledge and values in policy making respondents are also divided. When it comes to the question of precaution, there is a clear bias towards precautionary decision making.

What makes those data highly relevant to our discussion is that the responses are practically independent of the level of formal education received by the interviewees. Independent of the five levels of formal education under which survey participants were classified (unfinished primary education, primary education completed, secondary education/first level completed, secondary education/second level completed, or university education), the responses to the above six questions do not vary in a statistically relevant way (as a Chi-Square analysis confirms). Any such variations are too small to be of relevance, even in the case of



the first statement relative to expert decision making in which a very(!) slight trend could be observed: with an increase in the level of formal education, there is somewhat less support for expert-based decision making.

To sum up, not only are attitudes towards governance and policy independent of the education received. Even more, the data indicate that any change in the level of scientific-technical education are unlikely to have an important influence on the way people think about science and technology governance.

The implications for policy reform

Data such as these we have presented above question the notion that an increase in scientific culture would necessarily lead to higher levels of acceptance of governance and policy making. But there exist other data that raise even broader questions about the possibility of easy policy reform with the objective of increasing acceptance. Such data are related particularly to public participation and information in science and technology governance (Barnett, Cooper and Senior, 2007; Poortinga and Pidgeon, 2005; Luján & Todt, 2012). The results indicate that neither the introduction of participatory decision making, nor increased scientific-technological education and fostering of scientific culture, nor the adoption of new regulatory frames (like the precautionary principle) are likely to significantly improve social acceptance of science and technology governance.

Policy reform may transform the focus of public debates on policy and governance, but does not necessarily lead to closure. In consequence, more research is needed on the complex relationship between information, participation, trust and acceptance, as well as their respective roles in decision making and regulation of science and technology.



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43. Inspiring a nation to lead the world in science through public engagement? The role of STEM research centres

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Recent research in science communication has assumed a shift from the ‘public understanding of science’ to ‘public engagement with science’, or from ‘deficit’ to ‘democracy’ (Irwin 2006). Evidence of this shift is found, for example, in the European Union-commissioned report that had amongst its mandates (Felt et al, 2007, p.9): ‘How to further the stated EU commitment to improve the involvement of diverse elements of democratic civil society in European science and governance’.

Given that many scientists work in science (more broadly, in science, mathematics, engineering and mathematics, STEM) research centres, it is appropriate to investigate how ‘engagement’ issues are understood in such centres. Neresini and Bucchi (2010) analysed 40 European research centres in terms of their ‘engagement activities’. Their analysis led them to conclude that “it is a culture of public engagement that still seems to be lacking among most research institutions in Europe” (p. 14).



178 Is this the case beyond Europe? The research question this paper examines is: How do Australian STEM centres regard public engagement?

Engagement: The Australian STEM research centre context

We initially examined a number of Australian science research centre websites, with these questions: (1) what, if any, statements the centre made about public engagement; (2) whether the centre had a dedicated science communicator; and, (3) whether the centre had a social science research program which complemented the science program(s).

The centres reviewed were in three groups, funded by one of three funding agencies. The first two are national funding agencies: the Australian Research Council (ARC) and the Cooperative Research Centres (CRC); the third is a group funded by the Western Australian Centres of Excellence program.

We selected 12 research centres; interviews were conducted with the self-nominated communication person in each centre to learn about different interpretations of engagement.

The interviews were semi-structured and comprised 12 questions. To understand different interpretations of communication and engagement, respondents were asked to describe their communication and engagement activities including the types of groups that they engage with, methods used and what this is about. They were also asked to give their opinion about the purpose of the communication from the centre’s perspective.

What did they say?

The interviews suggest that communication about research has become part and parcel of Australian science research centres. Of 12 centres that we have approached, the individuals interviewed included five individuals with an institutionalised responsibility for the communication dimension of the centre (e.g., communications manager/officer/director, community awareness program manager and knowledge exchange manager), five individuals from senior management (e.g., chief executive office, chief operating officer or centre director) and two business managers.

We distinguish four main ways in which the respondents talk about communication. These are connected to discourses of (1) 'communication for funding' (which concentrates on communication in the relationship between research organization and funding organization); (2) sender - receiver/ innovator - end-user relationships; (3) communication ability (scientists as 'bad communicators'); and, (4) 'public education'. We will illustrate these discourses by means of pertinent quotes, and we will reflect on how these categories relate to models of science communication. Interviewees are identified below as R1, R2 and so on.

Not surprisingly, the self-nominated communication person adopted a 'communication language':

At the CRC program level we were also questioned about money put into non science areas... proportion of money going into communication activities (R1).

I'm the second person who has been in this role, the aim or goal there was that they get... communication [side of things happening so that they could get the] tick in the box when ARC came to review us. Not necessarily the first thing that they think of... ARC's expectation that there is some kind of communication, this centre has made sure that they satisfied that by employing me (R2).

Another respondent emphasized the importance of discovering 'context' to make the outcomes of research usable:

... really important to realise that unless you put your research into context and that you have a dialogue with the practitioners so that they understand the research and they under the practice so you can work out ...(R5)

The governance of the STEM research centres, from a business point of view, is often organized rather well, with professionals in communication engaging in the business communication. They are particularly doing well in cases where there is sufficient funding for this kind of task, which seem to be more the case for centres funded by the Australian Research Council (ARC) and the Cooperative Research Centres (CRC) than for those funded by the Western Australian Centres of Excellence program.

However, most of the professionals that we have interviewed expressed concerns about the communicative abilities of the researchers working in their centres. In the majority of the interviews, there was a quite pronounced distancing of the persons responsible for communication and the researchers, whom they viewed as 'bad communicators'. This may be a form of silent resistance on the part of the researchers rather than them necessarily being 'bad communicators'. Some of the communications people acknowledge this:

There was definitely a lot of resistance from scientists to be more involved in actually



having to participate in adoption there is no reward for them... (R1).

Generally their [researchers] personality type not suited, not comfortable, their organisation doesn't support and often actively blocks it... real issue in terms of communication... the key thing is bringing the researcher alive... they are incredibly passionate... if you can tap into that you can make a difference...I think the disjunct between research and practice is the biggest obstacle (R5).

This has demonstrated the importance of making a distinction between the people responsible for communication in a STEM research centre and the researchers themselves, to assess whether the researchers echo the business model type of interaction or whether their approach to communication is rather different.

Science communication 'as engagement' is different from communication 'for business'. Although more research is needed and generalizing is always risky, it seems safe to conclude that science governance in Australia seems to be much more about the latter than the former.

This 'business communication' theme was manifest in a number of sub-themes, among which were:

- Communication as instrumental to selling;
- Communication happens at the end of research (output); and,
- Separation of users and providers of knowledge.

Under-pinning these themes were the following

- Institutional fixes (e.g. communications person) instead of communication being embedded;
- Scientists/ researchers perceived as 'bad communicators';
- Legitimacy derived from economic development (commerce department) not public good; and,
- "Government is not involved": question of relevance to policy or implementation.

Conclusion

Our findings suggest that, in Australia at least, the approach of the science centres in our sample is dominated by a business model of communication with the following characteristics: communication as instrumental to selling; communication happens at the end of research (output); and, separation of users and providers of knowledge.

This business model of communication is consistent with a 'deficit model' identified in much science communication research. This model has been widely criticised by 'public engagement with science' researchers, who have proposed 'dialogue' models of communication, in which citizens work actively with science knowledge, as well as drawing on knowledge which is specific to a local context. Even more recently, a 'co-creation' model of communication has been proposed, in which research agendas are co-created by interested publics and scientists (Bucchi, 2008).



Communication in science centres thus legitimises the 'deficit model', and so is at odds with the 'public engagement with science' research agenda of the past decade. We stress here that our analysis is based on the views of the person designated as most responsible for communication.

Finally, we can legitimately ask, what is the significance of this situation? Clearly, if we believe interested citizens have the right to participate meaningfully in decision-making, as many public engagement with science researchers claim, the continuing dominance of deficit models of science communication will not permit this. We are currently investigating the views of communication and engagement held by research funding bodies (Palmer & Schibeci, 2012) and scientists (Schibeci & Williams, 2012) to see whether deficit models dominate in those two instances.

The inaugural science communication report *Inspiring Australia: a national strategy for engagement with the sciences* (2010) speaks largely in terms of communicating science to the public, but 'engagement' seems to be conceptualised in a rudimentary fashion. We need a clear understanding of what science funding bodies, science centres and scientists think about engagement if we are to move further away from a deficit model of communication to a more inclusive and effective approach.

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44. Communicating Evolutionary Theory in Francoist Spain: the case of La Vanguardia Española (1939 - 1978)

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Introduction

Communication of evolutionary theory in Spain is an illuminating example of how science communication changes alongside politics. Besides, it is also an example of how an apparently objective and neutral scientific theory can be used as an ideological tool and how its communication plays a key role in it.

Evolution is a concept that has its own imaginary, its own popular set of ideas that go beyond its scientific meaning. Its arrival in Spain in the mid 19th century is really well studied [1] and historians show that it was not only a pure innocent diffusion of scientific knowledge but more an appropriation, and the context of Spain at that time had a central role. That was a context of revolution, a progressive and liberal revolution known as La Gloriosa.

In this context, evolutionary theory was taken by different sectors of the society to champion their causes. Progressives took it because of its idea of constant change and progress. Liberals, because of its idea of the struggle for life and the survival of the best adapted as it offered them an argument to support liberal thinking. In contrast, conservative sections of the society disapproved of evolutionary theory mainly for two reasons: its revolutionary, progressivist and liberal mood and its shock to the Catholic religion. [2]

Thus, evolution, as it entered Spain, was not value-neutral knowledge. It carried an ideological charge that came from its appropriation and it was used and instrumentalised for different purposes. What happened with all this ideological charge after the 19th century? Did it affect the communication of the theory of evolution somehow or promoted any use of it? To try and answer this question, I focused on the Franco dictatorship, a century after the arrival of the theory in Spain.

The context and the source: Franco dictatorship (from 1939 to 1975) and La Vanguardia Española was a good testing ground for two reasons. First, it was a paternalistic, military, deeply Catholic dictatorship. It preserved the values of morality, work, family and tradition. [3] In this frame, the ideas traditionally associated with the theory of evolution in Spain would be presumably considered dangerous for the stability of the regime. And second, the regime itself experienced a series of changes and we could test if the treatment of the theory of evolution changed with them.

La Vanguardia Española is one of the oldest newspapers in Spain. It is also one of the most read in Catalonia. It was started in 1881 and it has been published continuously up to the present, with the sole interruption of the Civil War. Its owners have always had a very good sense of business, and they have always had in mind that their newspaper is an enterprise whose survival depends on the support of the current government as well as on the loyalty of



its readers. So its editorial policy changed somehow in parallel with Franco's regime. [4] What happens then, with the appearance of evolution theory and its treatment in *La Vanguardia Española* during Francoism and the following transition period?

Silence on evolution

From the end of the civil war in 1939, we have to wait until the 1950s to find the first articles mentioning the theory of evolution. Thus, the theory of evolution disappeared for more than ten years from *La Vanguardia Española*'s pages. Until 1964, there were only seven official newspapers in the streets of Barcelona, and they were all related to the regime [5]. With this scene in the Barcelona press, if the theory of evolution did not appear in *La Vanguardia Española* for some political reason, it would presumably not appear in any other official newspaper in the city, and that means an absolute silence regarding the theory of evolution in the official press in Barcelona.

This silence could be a result of the first severe autarchic period of the dictatorship and its recalcitrant censure, which maybe silenced the theory of evolution because of the imaginary associated with it. Moreover, it was in 1950 that Pope Pius XII published the encyclical *Humani generis* which allowed debate on evolution, previously forbidden [6].

Evolution's reappearance

The reappearance of evolutionary theory in the newspaper is always circumstantial: because of a book review, the advertisement of a workshop or a conference report. And it is always discussed alongside religion: until the mid 1960s the theory is always accompanied by a religious bodyguard. Moreover, it reappears always linked mainly to three undesirable actions which lead to a rejection of the theory:

Threatening Catholic faith

This advertisement illustrates the main trend of the newspaper concerning evolution until the late sixties:

"It's been some time since you live this way, turning your back on truth. [...] Since then your will, your sense of duty, your morality and your dignity began to weaken. Since then you are not happy, of course. [...] Do you remember that day when you read something about evolution of species theory and it put into question the divine origin of man ...?" [7]

Here, evolutionary theory is clearly associated with loss of values and unhappiness.

Dethroning man as king of creation

The theory of evolution appears, up to a point, like the one who deprives man from his privileged position in the animal kingdom. And we can find a very strong resistance to accept it, stronger than accepting the theory itself. Juan Arbó, a journalist with the newspaper writes in an article entitled, *Man and his Origin*: "Theories of evolution, of natural selection, they are all valid, except in man". [8]



Leading to an unfounded optimism and fake progress

And we can also find the sense that a foolish and dangerous optimism was emerging from the belief in the theory of evolution: “This unshakable optimism of today’s world is a consequence of the era opened – like Copernicus in his day – by *On The Origin of Species*, a century ago”. [9] Optimism, they thought, that came from the idea that man could improve without effort, that nature without effort led us into progress, and which led to a loss of traditional value, a “progressive optimism that contributed to the thinking that, by natural law, the new, modern, had to be necessarily better than the old.” [10]

Evolution and censorship

Moreover, beyond the official censorship, we can see a sense that the theory of evolution was dangerous knowledge that should be managed carefully or even needed to be censored. This sense was expressed by journalists: “There is a danger that Prehistory and Archaeology give to those who read manuals and popularisation books blunt ideas and illusions about something [the theory of evolution] that is, itself, problematic or more than problematic.” [11] Readers also expressed that fear. We can find a letter to the newspaper entitled “Biological evolutionism” that begins like this: “I refer to your consideration and caution the publication of this letter: I am not a professional sociologist, and therefore, I do not know exactly the impact that this could have.” [12]

**Evolution of the treatment of the evolutionary theory**

All these associations and fears went through an evolution: they are really strong until the second half of the sixties but, afterwards, the emphasis on these links, and with it the rejection to the theory, is weakened or abandoned. Until the mid 1960s the censors are in control of what gets printed, so there is no controversy and every mention of the theory of evolution follows the same pattern: associated with the fall of man from his pedestal, the foolish optimism, the unfounded effortless progress and always accompanied by religion. Afterwards, the controversy between the positions for or against the theory of evolution appears in the pages of the newspaper. Then, all the associations relax and vanish progressively and the theory of evolution starts gradually to appear more and more mainly in the 1970s.

Conclusions

Why do those associations vanish? It could be a consequence of some regime changes and the result of the new press law, in 1966, which replaced the so-called “mandatory censorship” with “voluntary censorship” (even though it was, in fact, far from voluntary). Besides, the association of the theory of evolution with genetics through synthetic theory, the Neo-Darwinism, furnishes the theory with a “more scientific” jargon allowing it to become independent of its ideological charge, and also gives it an aura of modernity that fitted well with the new phase of openness of the dictatorship.

Thus we could conclude that the theory of evolution, in its presence and treatment, in *La Vanguardia Española* during Franco’s dictatorship, seems to be linked to social and political changes and provides an outstanding example of the non-neutrality of scientific knowledge and of the vulnerability of science communication to ideological and political use.

Footnotes

[1] GLICK, Th.F. (1982); GLICK, Th.F.; PUIG-SAMPER, M.; RUIZ, R. (eds.) (2001); NÚÑEZ, Diego i altres (1977); YOUNG, R. M. (1985); Pelayo (1982)...

[2] GLICK, Th.F. (1982); NÚÑEZ, Diego i altres (1977).

[3] PELAI, P. (dir.) i altres (2004).

[4] HUERTAS, J.M. (2006).

[5] HUERTAS, J.M. (2006).

[6] PIUS XII, Encíclica "Humani Generis", (1950).

[7] "Do not turn your back on truth - Comunity meeting for spiritual development." La Vanguardia Española, 24.05.1964, p. 3. Original language: "Hace tiempo que vive usted así, de espaldas a la verdad. [...] Desde entonces empezó a flaquear su voluntad, su sentido del deber, su moral, su dignidad. Desde entonces no es feliz, claro. [...] ¿Recuerda usted aquel día, cuando leyó algo sobre la teoría de la evolución de las especies y puso en tela de juicio el origen divino del hombre...?". "No vivas de espaldas a la verdad – Obra de ejercicios parroquiales". La Vanguardia Española, 24-05-1964, p. 3.

[8] Juan Arbó, S. "The issue of science - The man and his origin." La Vanguardia Española, 31-7-1965, p. 11. Original language: "Las teorías de la evolución, de la selección natural, en todo son válidas, menos en el hombre[...]". Juan Arbó, S. "El tema de la ciencia – El hombre y su origen". La Vanguardia Española, 31-7-1965, p. 11.

[9] M. "Apart". La Vanguardia Española, Bibliographic notes, 03-02-1960, p. 10. Original language: "ese irrefragable optimismo del mundo de hoy es una consecuencia de la era abierta — como Copérnico en su día— por «El origen de las especies», cabalmente ya hace un siglo". M. "Al margen". La Vanguardia Española, Notas bibliográficas, 03-02-1960, p. 10.

[10] Euras, S. "Progresismo - Prosperity and decadency cycles". La Vanguardia Española, 02-12-1966, p. 13. Original language: Un optimismo progressista que "contribuyó a que los hombres pensaran que, por ley natural, lo nuevo, lo moderno, tenía que ser forzosamente mejor que lo antiguo". Euras, S. "Progresismo – Los ciclos de prosperidad y decadencia". La Vanguardia Española, 02-12-1966, p. 13.

[11] Caro, J. "Cultural characteristics of our time.", La Vanguardia Española, Let us return to..., 2-06-1966, p. 57. Original language: "Existe el peligro de que la Arqueología y la Prehistoria den a los que leen manuales y libros de divulgación ideas e ilusiones tajantes sobre algo que, en sí, es problemático o más que problemático". Caro, J. "Características culturales de nuestra época". La Vanguardia Española, Volvamos a..., 2-06-1966, p. 57.

[12] Buetas, E. «The biological evolutionism.» La Vanguardia Española, Letters to "La Vanguardia Española", 22-10-1966, p.30. Original language: "Remito a su consideración y prudencia la publicación de esta carta: No soy un sociólogo profesional, y por tanto, desconozco exactamente las repercusiones a que ello pudiese dar lugar." Buetas, E. "El evolucionismo biológico". La Vanguardia Española, Cartas a «La Vanguardia Española», 22-10-1966, p.30.



45. Between the Regenerative and the Renewable: Patterns in the Media Beautification of Technology and Science, from Stem Cells to Wind Farms

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Public knowledge of issues related to biotechnology and wind energy is heavily influenced by news coverage, as most citizens have little first-hand knowledge about research related to biotechnology and wind energy. As is well known, both biotechnology and wind energy encounter considerable resistance. The beautification of biotechnology in the media has attracted considerable attention among specialists in Science Communication and Science, Technology, and Society. As a result, we know about the presence of patterns in, for example, the use of the metaphors employed in order to promote a whole range of biotechnologies, from genetically modified organisms to cloning. Several STS scholars have argued that textual and visual mechanisms of media beautification of biotechnology have been developed in response to widespread public concern about biotechnology, which frequently took the form of open resistance to biotechnology. This is also connected to ongoing discussions regarding the risks and ethical issues associated with biotechnology.



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We know much less about media strategies that have aimed at the beautification of another defining technology of our era, that of wind farms. Noticeably, wind farms are by now, also, a technology that faces considerable resistance. Wind farm installation has raised great waves of resistance in local communities due to the serious impact it has on the environment, the landscape, the biodiversity and the economic life of communities (e.g. negative impact on prospect of development of tourism).

This is why central to our paper is a comparison between the way stem cells and wind farms have been portrayed in the media. This comparison is based on primary research in several of the most popular Greek e-newspapers and other news blogs and websites.

Between the Regenerative and the Renewable

Stem cell research is a hot topic in the press. It has been constantly in the news for several years: not a week goes by without the announcement of a new and ‘amazing’ advance. Reporters tell us that we are constantly on the verge of a revolution in medicine due to developments in stem cell technology. The central rhetoric in the beautification of biotechnology in the media is the idea of regenerative: that bio-scientists reorganise life at the genetic level so as that biotechnology will offer enormous possibilities in order to remould life on Earth. GM technology is presented as a green revolution that regenerates agriculture and solves the problems of the poor and world starvation. The GMOs crops are supposed to be durable, more productive and nutritious.

The announcement of the human genome sequence in 2000 by the Human Genome Project was heralded as correcting the “*Book of Life*” so as to rewrite the genetic code without errors.

Stem cells research and technology promise us regenerative therapies which have been demonstrated (in trials or the laboratory) to heal broken bones, bad burns, blindness, deafness, heart damage, nerve damage, Parkinson's disease, and a range of other conditions. Stem cells are presented as self-renewable, totipotent, renewable¹ and reprogrammable. In short, the stem cells are presented as capable of regenerating the human.

Wind energy technology, dominated by a version of it known as 'wind farms' or 'wind parks', is being promoted as aiming at the reduction of CO₂ emissions. As this technology is being developed, great social, economical and enterprise benefits will supposedly emerge. Yet, wind farms are also met with resistance. The central rhetoric in the beautification of wind farms is the idea of renewable energy. The concept promoted is mostly about wind as an everlasting energy source that provides energy without any destruction of resources. Thus wind energy is mostly characterised as renewable and clear. Since this kind of energy is supposed to be renewable (unlike fossil-fuel-burning technology), the aim is to produce large amounts of wind energy. A significant part of the wind farm rhetoric assumes that their development will result in new jobs creation and economic growth. Within this context, wind energy is considered to be a more or less magical solution, which could save the planet and at the same time create huge economic growth.

Method and data

As we know, millions of citizens read media news daily. The media beautification of a given technology is mostly based on the construction of certain media frames regarding this technology. The media beautification of technology is also based on the deployment of certain metaphors.² Moreover, it is based on the use of certain pictures.³ In the context of our research, we have examined the media beautification of stem cells and wind farms on the basis of a representative sample of articles from the most popular Greek e-newspapers and other news blogs and websites. The key-words that we were used were "stem cells" and "wind farms".



¹ Cooper Geoffrey M. and Hausman Robert E., *The Cell: A Molecular Approach*, Sinauer Associates Inc. (5th Edition), 2009 | Chapter 17: "Cell Death and Cell Renewal", http://www.sinauer.com/cooper5e/sample/Cooper5e_Ch17.pdf

² As Nerlich and Hellsten said the "*metaphors [...] play an important role in the communications between science and the wider society. For scientists, working in the life sciences, metaphors may be indispensable tools for popularizing issues, promoting certain views over others and for making specific scientific programmes legitimate. For journalists, metaphors are part of journalistic routines used for the purposes of popularizing, concretizing and dramatizing issues, in brief for making issues both newsworthy and interesting for the relevant audiences*" (Nerlich and Hellsten 2004, p.257). [Nerlich Brigitte, Hellsten lina, "Genomics: shifts in metaphorical landscape between 2000 and 2003", *New Genetics and Society*, Vol. 23, No. 3, December 2004, p.p.255-268]

³ The photographs condense the journalistic text in an optical representation. Their choice, the way of reception and their content are selected so that they attract and they cause the interest of readers framing a new technology positive or negative. The photographs via their rhetoric aim often in the sentiment of readers and often make us accept or reject a new technology.

Findings

This study is part of a larger research programme, undertaken at our Department. Regarding our preliminary key findings, we here focus on the following points.

1) The beautification of stem cells research and wind farms in the media take place through the use of three common frames: a) *progress* frame; b) *economic prospect* frame and c) *run-away technology* frame⁴.

2) Stem cells are presented as renewable ‘sources’ and not as ‘technology’. A stem cell can produce re-growing of a variety of various lost or destroyed human body parts. The emphasis in the media is placed on their alleged benefits and not on how this will be achieved technically. On the other hand, when the articles refer to economic aspects of the stem cells research the photographs published usually show labs and not stem cells.

3) The rhetoric of the articles is more powerful than the photographs in the case of stem cells. Pictures are used more often in beautifying wind farms than stem cells. In a sense, wind farms and stem cells are the opposite in terms of size. It is common to use settings that contrast a wind turbine to a thermoelectric power generation plant. This is not the case in connection to stem cells.



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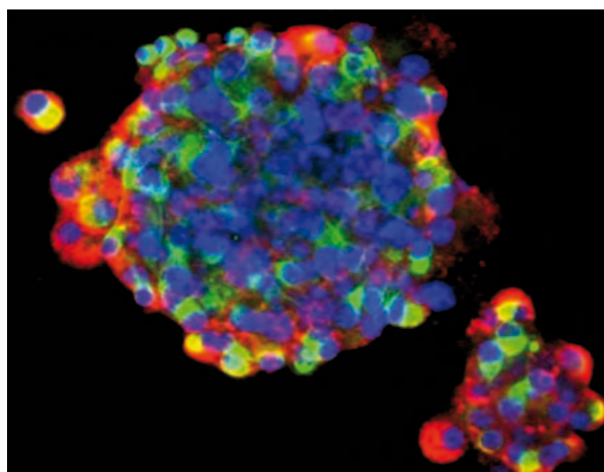


Image 1

(Source: e-newspaper *TO VIMA*, 1/11/2012⁵)

⁴ This framing typology is adapted from Durant, J., M. Bauer & G. Gaskell (1998.), and Nisbet Matthew C. & Lewenstein Bruce V (2002).

⁵ Τσώλη Θεοδώρα, “Αναγέννηση των γηρασμένων κυττάρων. Μια νέα μέθοδος επαναπρογραμματισμού υπόσχεται επανάσταση στην αναγεννητική ιατρική”, e-newspaper *TO BHMA (TO VIMA)*, 1/11/2011.



Image 2

(Source: in.gr, 11/4/2004⁶)

4) The photographs of articles depicting stem cells are usually digital constructions or reconstructions of images. The photographs obscure the complex accompanying technological infrastructure that is involved in appropriating stem cells so as to attempt any kind of regeneration. We have noticed something common regarding the abstract presentation of both technologies through the images accompanying articles. In the case of stem cells, we see colourful abstract images of tiny stem cells under investigation (image 1). In the case of wind farms (image 2), we see an abstract environment with one artefact (one wind turbine and not the whole farm, which actually consists of several of them). The base of the turbine is not shown, and usually only the top part is left in the picture. Also, we don't see the unattractive supporting technological infrastructure (e.g. transmission lines and power stations).

5) Very often, the photos of stem cells depict only one stem cell and not a group of stem cells. Presenting a stem cell in isolation disconnects it from its association to a living embryo so as to leave aside any ethical resistance against stem cells research.



⁶ “Νησί της Σουηδίας αποφασισμένο να έχει καταργήσει το πετρέλαιο έως το 2025”, *in.gr*, 11/4/2004.



Image 3

(Source: *Econews*, 16/02/2012⁷)



Image 4

(Source: *Econews*, 28/03/2011⁸)

6) In the case of wind farms, the beautification through images relies heavily on constructed images. In such images, as mentioned before, we frequently see single wind turbines and not the whole picture of a wind farm (Images 3 and 4). Additionally, very frequently, only the upper part of the artefact is shown and not its base. In this case, it is assumed that there is no interference with the environment and the landscape.

⁷ “Ανανεώσιμες Πηγές Ενέργειας: ισπανικό μοντέλο για τις ταρίφες – Φόβοι για μειώσεις”, *Econews*, 16/2/2012.

⁸ “Ανανεώσιμες πηγές ενέργειας: τίποτα δεν είναι απλό” *Econews*, 28/3/2011.



Image 5

(Source: e-newspaper *Eleftherotypia*, 11/7/2010⁹)

7) In wind energy rhetoric the concept of the renewable is promoted mostly through the use of characterisations as clean energy, sustainable and environment friendly (image 5). The part of the rhetoric relevant to economy is realised mostly by the presentation of a picture of a beneficial revolution, which induces great investments and creates many new jobs. It is very interesting that journalists usually use financial (as opposed to technical terms) to describe the size of a new wind farm project.



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8) As shown in image 5, wind turbines are shown next to windmills, as if the two are equivalent in regards to size and more generally. In reality, a wind turbine is ten times taller. Moreover, a windmill was built locally, by using traditional material. It was lasting for centuries. By contrast, wind turbines rely on synthetic materials, are reconstructed by very few high tech companies world wide, and have a lifecycle of about 25 years. The pictures in the media are chosen so as to create the impression that a wind farm is as attractive as the traditional windmill.

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⁹ Νταϊλιάννα Ντόρα, "Μύλος ...με τις ανεμογεννήτριες", e-newspaper *Ελευθεροτυπία (Eleftherotypia)*, 11/7/2010.

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46. When science and popular culture meet on YouTube: Science in music videos

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On online video-sharing sites such as YouTube or Vimeo one finds a lot of music videos. One tendency that is particularly interesting is that there are also music videos about science, technology and related subjects [1].

Scientific topics and motifs can be found in music videos made by professional artists, for instance about the origins of life [2] or the periodic table [3]. In fact, there is a whole range of music videos dealing with Darwin and the theory of evolution [4]. The band, They Might be Giants, has also created a variety of songs and video clips aimed at children that deal with various basic concepts and ideas in science [5].

Scientific organisations also seem to value the potential of music videos for outreach purposes. For instance, two of the three winning clips of the last Brain Awareness Video Contest organised by the Society for Neuroscience were music videos [6].

Individual scientists and researchers also use music videos in order to gain attention and maybe also to promote a more youthful image. Various institutions and researchers use music videos to promote and advertise their institutions and their research [7-9]. A music video clip from CERN about the Large Hadron Collider [10] has been viewed more than seven million times. This success has led to the production of two further music clips, one about black holes [11] and one about rare isotopes [12]. It is worth noting that the US Fermi National Accelerator Laboratory responded with an own music video [13].

However, it should be stressed that commercial suppliers of scientific and lab equipment also use music videos to advertise their products [14-18]. Another hilarious scientific music video is used to advertise funding opportunities for young researchers by the European Commission [19].

Some educators also encourage their students to share what they have learned in class in form of a music video, for instance in a clip about the “synaptic cleft” in a neuroscience class [20]. This also seems to work with younger children, for example in a clip about water and how it changes its aggregate states [21]. In such instances students are not only forced to learn and digest the content of science classes, but they also have to engage with current media technologies and do some thinking about how the science learned could be presented in an entertaining and understandable way. Interesting sites and blogs in this context are The Rhymeosome [22], The Science Songbook [23] and the website of Mark Rosengarten [24].

Furthermore, lab members and medical staff also use music videos to educate one another about codes of conduct. Or they use them as other hilarious instruction videos. A whole range of music videos have been created to disseminate lab safety rules and general codes of



conduct regarding health, hygiene and other safety instructions [25-30]. Other music videos are made to support silenced scientists speaking out on climate change in Australia [31], advocate theories of climate change [32] and the expertise of climate scientists [33], Darwin's theory of evolution [34-38], or MMR and other vaccinations [39-41]. A special case is Baba Brinkman who wrote a whole feature-length "rap guide" to Darwin and the theory of evolution and was funded by the UK Wellcome Trust to produce some professional music videos in this context [42].

However, opponents of science are able to create and disseminate music videos too, for instance deniers of climate change [43], creationists [44] opponents of vaccination [45-47] and advocates for esoteric alternative medicine [48] also use music videos to advocate their views. Creationists, for instance, are well aware of the potential of video sharing platforms. They are explicitly recommended as helpful tools for 'internet evangelism' [49].

Especially young people and people who do not have great interest in science might encounter topics such as these in media channels like YouTube, and probably less so in carefully edited serious newspapers or magazines. The fact that many of these music videos are very professionally made, often humorous and entertaining make them dangerous propaganda tools from the point of view of science. Social Media such as YouTube, Twitter or Facebook provide arenas for messages and actors that challenge scientific results and that try to confront audiences with anti-science worldviews.



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However, music videos made by young scientists and researchers about their research, work environment and working conditions could also be interesting for practical science communication purposes [50-52]. They allow a glimpse into what life in the lab looks like, what it means to be working as a scientist today and what scientific work actually looks like in practice. Some of these music videos are very humorous and entertaining [53-61]. They allow an insight into the settings of lab work even for people who do not have a great interest in science. Sometimes, they also have a subversive edge, especially if they are shown together with overly positive depictions of science [62]. In general these clips offer authentic views from researchers at the bench and could also be seen as a means to empower them and make their voices heard.

Music videos about science are generally quite short and can easily be shared via online video-sharing platforms such as YouTube or Vimeo [63-64]. Many mobile devices now also make it possible to watch music videos on the go. These developments allow popular music video clips to become "viral" if they are done well. In this sense they have the potential to reach a huge number of viewers if they are entertaining and intriguing. However the opponents of science also know how to use this media format to their advantage. In the current scenario it is therefore likely that we will see more music video clips about science, technology and related issues in the future and that social media are used as arenas for promulgating messages for and against science.

The science communication and education communities would in all likelihood do themselves a favour if they already had these kinds of development on their radar and if they looked beyond the obvious routes of communicating science.

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47. From Text Culture to Visual Culture: Simulation – Interactivity – Virtuality

Susanne Paech, *HYPERRAUM.TV - Founder and Owner*

Technology view

The digitisation of technology in the second half of the 20th century will attain the historical status of a quantum leap for mass communication. Since the invention of printing in the 15th century, the history of mass communication was built on an analogue basis. Also, the first electronic mass media – radio and TV – started in analogue technology. But with the advent of computers, digitisation of the media world began. This changed not only the technology of mass media, but is revolutionising their production as well as their usage up till now.

- business is migrating from locally based publishers to international corporations
- professional media producers are increasingly confronted with technology
- the technical entry barrier is dramatically lowered for professional media producers
- technical border between mass media and individual media is vanishing
- mere reach is out – intelligent targeting is in
- the user enters the scenario as a content producer



The Anthropological Aspect

Evolution has provided humans with a visual sense, which permits a much higher data rate than the ear. The human brain is prepared to receive high data quantities via the eye and to rapidly process them.

This capability was essential for the survival of primeval man. Until today, vision is his most essential sensing mechanism. It is not the image, however, but the word which is viewed as the intellectually most valued product of *Homo sapiens*. Whenever we are reading, we are – as a matter of fact – viewing, but basically we are mentally transcoding spoken words into visual signals.

Moreover, images let us mentally handle control processes in ways that would be far more time-consuming if done by words. Since the age of classical philosophy and literature, our Western language-oriented culture has continually been developed further. The cultural achievement of communicating by the visual channel is still in its infancy. And it was the motion picture only about one hundred years ago, which finally provided a medium for storing reality in motion.

Visual media offer insights that are essential for the development of society in the 21st century: All kinds of interaction, dependencies, feedback loops, elements that can far more easily be communicated by visual than textual means. However, until a short time ago, the technical devices for an implementation on a broad scale were still missing. Thanks to digitisation, they are available now.

Simulation – Interactivity – Virtuality

Communication by visual media is a powerful instrument for the transfer of knowledge. Here we present three methods:

Simulation: Science is using simulation as a successful tool for research. To give an example: Pharmaceuticals are being designed by computer-aided chemistry. Using three-dimensional imagery instead of formulas has greatly advanced this branch of research. Simulation is also very helpful in teaching and training environments and in transferring information to a broad public.

[Visuals: Examples from the TV channel HYPERRAUM.TV]

Interactivity: Digitisation makes communication a two-way process. In modern astrophysics, events out in the universe can be simulated and varied on the PC in a 3D-mode. Such visual results help scientists make considerable advances. But they are also useful for the broad diffusion of scientific knowledge. It isn't only big fun interfering actively with physical processes by varying the parameters, it also aids in the quick and easy understanding of what's going on. In mass communication, this kind of interactivity has so far been impossible for the lack of a suitable back-channel. In these days, when the border between individual and mass media is vanishing, interactivity is getting used more frequently.

[Visuals: Interactive examples from Mathematica demo program by Herbert W. Franke]

Virtuality: Up till now, mass media were limited to distributing their digital experiences in a one-way style. The electronic mass media had a back-channel to offer only for voting, as in the Eurovision Song Contest, or for phone calls (to contact radio stations' programme editors). Real group experience was to be had only in the outside world, in soccer stadiums, concerts, museums. The implementation of virtual realities now lifts simulations and interactive applications in mass communication to a new level. For the first time now, many people can meet in a virtual space to have interpersonal and even interactively controllable experiences.

[Visuals: A virtual museum for science and technology, based on a 3D world platform of the Deutsche Telekom AG]



Conclusion

Adding emotion to the transfer of knowledge can be reinforced by methods like simulation, interactivity, and virtuality. The visual experience can be "beautiful" in an aesthetic sense. And this "beauty" stimulates the use of media, and fulfils an important task in knowledge transfer: the addressee will approach such content in an emotional way. A rapidly growing overflow of entertainment-oriented stuff in the Net means an even harder competition in the field of information media activities. If media want to win and keep the user's attention, one thing is certain: the design of visual media must be done on a professional and state-of-the-art level.

48. Marine microbiology in Malaysia: communicating science through visual arts

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Introduction

Science communication is a form of communication through different media such as books, magazines, television and internet discussing scientific information between public and scientific researchers. The concept of science and communication in the 21st century, however, has been expanded and developed to another level with creative and innovative approaches beyond the conventional media concept. Visual art for example, is among the creative and innovative media with dynamic communication features.

The possibilities of visual arts in communicating science had been proven by previous studies. Among the studies are those by Pauls (2004) and De Regules (2004) who studied the communication between science and art. De Regules (2004) has used art as an intermediate medium to communicate about science and art with public in the science museum exhibition concept. While Pauls (2004) studied art and science communication between artists and marine polar research in Antarctica.

Furthermore, a report from the American Academy of Microbiology (2004), an honorific leadership group of the American Society for Microbiology, speaks about the importance of microbiology research and public literacy of microbiology in the 21st century. The importance of microbiology research is based on the issues relating to the increasing of new microbial diversity and global diseases in the world today. Public literacy of microbiology is based on the issues of public awareness, knowledge and understanding of microbiology. Thus, this paper attempts to visualise marine microbiology research which has been carried out in Malaysia and transformed into works of art, emphasising visual art forms as a platform to present marine microbiology in Malaysia and media for science communication in artistic and scientific contexts.

Methodology

The research project design is divided into three sections as follow:

Section 1: Marine Microbiology Books

In order to visualize marine microbiology in Kedah region, books written by Malaysian microbiologist were used as a guide and reference in the process of developing work of arts. The content of the selected books was analysed to classify the statements and pictures relating to marine microbiology in Kedah water region.

Section 2: Visual Art Forms (Platform and Media)

This section is to find out potential visual art forms to become a platform and medium for



visualising marine microbiology in Malaysia. The selection of visual art forms to become a platform for visualising marine microbiology in Malaysia are based on the objectives and the levels of art and science concepts contained in the visual art forms. A book written by Stephen Wilson (2002), *Information Arts: Intersections of Art, Science, and Technology*, was used as a reference to identify visual art forms convenient to the marine microbiology concepts. The selection of visual art forms as media for visualising marine microbiology in Malaysia was based on the artistic form and content of the artworks. A book called *Prebles' Artforms* (2009) was used as a reference to identify convenient visual art forms to be the convenient media to exhibit the marine microbiology in Malaysia in an artistic way.

Section 3. Art Exhibition

An art exhibition was organised for the purpose of communicating science of marine microbiology in Malaysia to the public. In order to communicate marine microbiology in Malaysia to the public through art exhibition approaches, an art exhibition theme was formulated based on the art and science concepts. The art exhibition theme was described through illustration of the settings and the location of where the artwork was displaying.

RESULTS

Section 1: Marine Microbiology Books

The book selected to describe marine microbiology in Malaysia is *Diatom Marin di Perairan Malaysia* (Marine Diatoms in Malaysian Waters) by Lokman Shamsudin. The analysis was conducted through examination of texts and pictures in the book. Selected statements and pictures from the book are divided into three categories as below:



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Category 1: Location of Sample Collection	Category 2: Microbiology Tools and Equipments	Category 3: Type of Marine Diatoms
The selected sample collection region was <i>The Strait of Malacca</i> . This includes satellite images of the diatom location, map of <i>The Strait of Malacca</i> and Kedah region.	The selected marine microbiology tools and equipments are plankton net, sampling bottles (screw on lids) and microscope.	There are forty types of marine diatoms identified in the <i>The Strait of Malacca</i> according to the statements and pictures from the book <i>Diatom Marin di Perairan Malaysia</i> (Marine Diatoms in Malaysian Waters) by Lokman Shamsudin.

Section 2: Visual Art Forms (Platform and Media)

The selected visual art forms as a platform and media to visualise marine microbiology in Malaysia is *Ecological Art*. This selection is based on the interdisciplinary approaches and the intersections of science and art formulated in the *Ecological Art* concept (Weintraub, 2006). In other words, *Ecological Art* requires both aesthetic and scientific values together. Applica-

tion of Ecological Art can be observed in various media such as drawing, painting, sculpture and in objects such as microscope and sample collection equipments.

Section 3. Art Exhibition

The theme formulated for the art exhibition is titled as *The Science and Art of Marine Microbiology*. The illustration of the art exhibition setting concept can be seen in Figure 1 below:

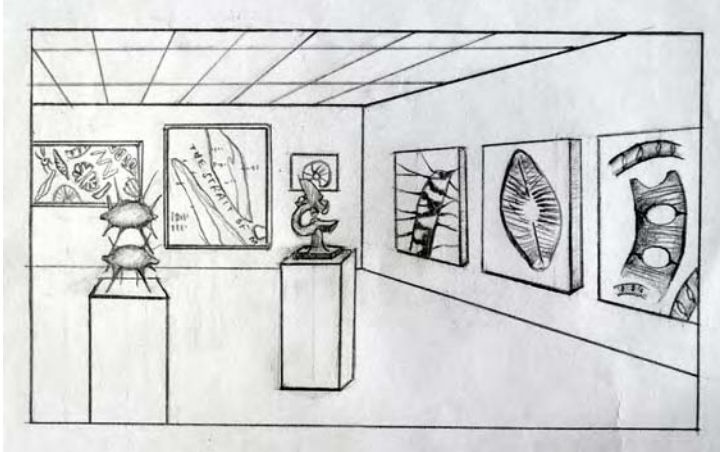


Figure 1: Illustration of 'The Science and Art of Marine Microbiology' exhibition

Conclusion

From the perspective of visual art as dynamic, creative and innovative communication media, the application of Ecological Art as a platform and media to visualise marine microbiology in Malaysia for the public awareness, knowledge and understanding in art exhibition context has the potential to become a science communication medium in the 21th century. *Marine Diatoms in Malaysian Waters* by Lokman Shamsudin has been recognised to be a potential reference in the process of visualising marine microbiology in Malaysia in visual art context.

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49. Meeting scientists halfway between the lab and the seaside: some cases to think about “deficits” and “dialogues”

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This paper is an offshoot of a broader project – a PhD on the Sociology of Science (Conceição, 2011) – which aimed to analyse different models of public communication of science from both a theoretical and an observational point of view.

Empirically, the research focused on the Portugal-based activities of a public programme called *Ciência Viva* (Living Science), which has been operating since 1996 with the overall aim of promoting scientific culture among the general population. It comprises a large and diversified range of initiatives – science learning projects in schools, science centres, and different public dissemination campaigns.

Our goal was to characterise different ways of addressing the issue of the public understanding of science. We employed a typology that evokes different analytical dimensions and was inspired by the proposals and debates presented for example by Bucchi and Trench (2008), Costa et al (2009), Dierkes and Grote (2000), Cheng et al (2008), Durant (1995), Felt (2003), Gregory and Miller (1998), Irwin and Wynne (1996), and Miller et al (2002). Very briefly, among other issues, we considered whether the activities were mainly *educational* (top-down), or were based on some kind of *dialogue* approach; if they were mainly *discursive* (talks) or more *interactive* (hands-on); if science was presented *out of context* or *in context*; if audiences were being contacted *at a distance* or *by direct contact* with the scientists; if they explored a more *spectacular* or *reflective* approach to science. We were thus dealing with the differences between a deficit (one-way or top-down) model of public communication and the new approaches based on the idea of dialogue and public participation; but we were also trying to decompose these models in accordance with various different dimensions; and, ultimately, searching for cases where these different approaches might somehow overlap.

For the purposes of this presentation, we chose to focus on the case of a national campaign called *Ciência Viva no Verão* (Living Science in the Summer), whose activities include a number of innovative features that may offer some interesting illustrations.

Under this campaign, every summer a number of institutions (e.g. R&D units, scientific societies, private companies, etc.) promote free public communication of science events targeted at the general public. These activities usually entail direct contact between the public and researchers or other science professionals, usually in small groups and for several hours. The meetings are quite informal and may occur not just in labs, but also on the streets, at the seaside, in the countryside, or in other settings to which the promoters think it will be easier to attract people during the summer holidays. Demand has been high, especially among family groups and people who are usually interested in this kind of cultural events. According to the annual surveys, most participants are very satisfied.

What are the promoters looking for? And the public? And what tends to happen during these meetings? In an attempt to answer these questions ten case studies were carried out (includ-



ing interviews and ethnography). The chosen cases illustrate three types of event that are quite common in this campaign: scientific field trips linked to geology or biology questions; astronomical observations; and visits to lighthouses or high technology facilities.

Most of the people who conducted these PCST actions were experts in the subjects and tended to be quite committed to the campaign. However, they were far from being specialised in science communication; rather, they were volunteers who felt a sense of responsibility to increase public understanding and awareness of science. They wanted to inform the public and make it more sensitive to scientific issues related to their own work which they believe to be relevant to citizens. They often also wanted to convey enthusiasm about the wonders of science and encourage amateur scientific practices (e.g. astronomical observations or bird watching). Some of them also had some sort of marketing goals, or at least a desire to change public attitudes (e.g. about the environment or certain new technologies).

The public seemed to be looking for two different things: besides trying to learn something about science (they sometimes even brought notebooks), they wanted to have a good time with friends and family or even to meet people (taking cameras and often stopping to chat). They were clearly in a free-choice situation, hoping to combine learning, pleasure and fun.

Because of their wish to learn, they assumed the role of learners and asked for access to some technical information. However, they didn't seem to be entirely interested in all the topics the scientists would have liked to talk about; and since most of them were highly qualified adults (even if not in the specific subject in question), they ended up rebelling against the experts whenever the latter put them in a very asymmetrical or distant position – e.g. when a scientist was just talking without really showing anything or listening to people's comments.

As a result (sometimes after a few bad experiences), the promoters realised they needed to address scientific issues by connecting them with other forms of knowledge – lay knowledge – so that the public can be more easily engaged; and that they should look for those links not only when they chose the topics for the activity, but also throughout the sessions, whenever they talked to the participants.

Of course this may be true whenever science is presented to the public. What is interesting here is that it is the social context of these meetings that is somehow forcing the promoters to adopt new approaches. Because they are in a face-to-face situation, it is quite embarrassing for experts to avoid dialogue or keep using technical terms without trying to valorise the knowledge/interests that the public already have. Moreover, these meetings often take place in a sort of no-man's land (outside labs or conference rooms). Not being subject to peer judgment seems to make it easier for scientists to really establish a contact with the public, by means of shared cultural references. After all, an expert is also a citizen and moves in many social spheres, thus sharing a number of cultural references with non-experts. This exercise might not be easy for scientists, but it's not impossible, and some end up saying they learn a lot about science in society when they undertake it.

During these activities we found three main forms of presentation, often combined: the experts explain something orally; they encourage people to see something; and sometimes they also suggest some kind of experimentation. The public seemed to be interested in all three approaches, but it was obvious that they engaged even more when they observed things directly or did some kind of practical work.

Interestingly, some of the promoters were concerned that people might feel they were being treated like schoolchildren if they were asked to do experimental work; but many partici-



pants seemed to like this, thinking that learning science by doing would help them not only to understand it better, but also to have more fun. Some even said that, because they were on vacation, they found it appealing to take on other, very different roles from those they played in their daily lives. Having said this, some did tend to react negatively to proposals that just turned the session into a spectacle, without the opportunity for a minds-on experience.

In conclusion, these activities are mainly guided by educational goals – the idea that we are dealing with lay people who must learn or change certain attitudes. This could lead to activities that are clearly oriented by the so-called deficit model; but the face-to-face encounter in very informal contexts between scientists and people on vacation means that the success of these experiences seemed to depend on the ability to establish some kind of dialogue between different cultures, and to provide a practical and contextualised approach to science. Consequently, even if we are long way from activities oriented towards public participation (in a political sense) they somehow end up incorporating some of the concerns of the latest models of the public communication of science.

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50. What Does Quality Mean in Public Engagement with Science?

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Background

What DOES quality mean in public engagement with science? This was a question which we in the Edinburgh Beltane, Beacon for Public Engagement explored. The Edinburgh Beltane is one of six beacons for public engagement which were established in the UK from 2008. The Beacons were “university-based collaborative centres that are working to support, recognise, reward and build capacity for public engagement”¹. The definition of public engagement which has emerged from the Beacons project is expressed in terms of three purposes for engagement: informing, consulting and collaborating².



We would place ‘knowledge’ at the centre i.e. the purpose of public engagement is the sharing and co-creation of knowledge.

Although the Beacons culture change project and indeed our project on quality encompassed public engagement across all disciplines, we believe the findings from our work are relevant and significant for science engagement. It is often the case in universities, certainly in the UK, that science engagement is more established than engagement with other disciplines.

We perceived that in the early stages of Beacons, there had been a focus on increasing the quantity of public engagement in universities without necessarily paying so much attention to the quality. We were reminded of an old comedy series on television in the UK about

a tailor's shop. The title of the series was 'Never Mind the Quality, Feel the Width.' There could be a danger that by increasing the quantity of public engagement without due attention to quality, public engagement itself is not embedded in the culture but instead becomes another perceived hurdle or tick box exercise to be completed without regard to the effect of the science engagement on the publics engaged, on the reputation of the university or the subject or research area.

But what does quality mean in public engagement with science? We considered this question of quality in public engagement from three perspectives: at institutional level, at practitioner, and at activity level. This paper represents our reflective journey and arguments from our own experiences.

Our approach was to gather together practitioners in public engagement to discuss the concept of quality. As a starting point for discussions, in the first workshop (in Edinburgh) we looked at quality and quality assurance in other areas of practice-based, engagement type work. We considered the Quality Assurance process for teaching and learning in universities, the quality framework in Museums in the UK⁴, a funder of UK-wide community based projects⁵ and an organisation which benchmarks informal education in the UK⁶.

The common denominator for each of the frameworks described above is *the enhancement of quality practice through evaluation, with monitoring and review taking place as close as possible to delivery. Each is a process for enhancing the quality of the experience and not merely for generating metrics for external validation.* The concept of evaluation can often been seen as something to add on at the end of a project, as another hurdle to navigate, particularly for those new to public engagement (which is true of many researchers in universities). However the main learning point is that *the process of evaluation should feed back into enhancement of the delivery and be part of a reflective cycle. Evaluation is an enabler of quality engagement.*



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Quality Public Engagement at Institutional Level

So what should we do at institutional level to embed quality public engagement with science and to move away from the perceptions of public engagement being a 'Cinderella' activity which does not have the rigour of teaching and research in universities?

- Align public engagement with university strategy (if public engagement is seen to be contributing to the success of the institution's strategic vision then it is more likely to be viewed as a core area of work and therefore will encourage capacity building.
- have a professional approach with organisation-wide policies and processes e.g. Health and Safety, copyright, ethics.
- demonstrate the value (internally) show how public engagement with science contributes to the strategic vision of the organisation social capital is important and relevant.

Professionalising public engagement as a valued area of practice in a university which generates social capital as a valued output.

What does quality public engagement mean at practitioner level?

We found very interesting parallels between our findings and those of a JISC ^{8,9} funded project outlining Continuing Professional Development framework for engagement. This project identified core personal attributes: honesty, integrity, empathy, together with core abilities: networker, facilitator, reflective practitioner, oral and written communicator, influencer, strategic planner.

Our findings were very similar:

Communications skills

Publics – effective engagement skills

Internal – influencing (being an ambassador, encouraging and enabling others to participate)

Leadership – being able to make the case for public engagement and secure funding and time

Management skills (networking and collaborating)

Effect project and people management

Building and contributing to a supportive network and collaborative projects.

Attitude (respectful, reflective and proactive)

Respecting colleagues and audiences and their background and experiences/sources of knowledge

Reflective – learning from the experiences and changing practice appropriately and innovatively

Proactive – reflection in practice, recognise and respond to opportunities, risk assessment/analysis

These parallel projects identified core skills and a clear set of behaviours for effective science engagement and an ethos of practice which encompassed a 360° vision, i.e. not blinkered or constrained.

What defines quality public engagement practices at activity level?

We have summarised our findings as a set of guidelines and indicators.

Guidelines for quality in PE activities

- Use the process of evaluation as a planning tool while embracing and valuing the unexpected.
- Ask the who, where, why, what, when questions before designing an activity.
- Identify the community to be engaged and define the purpose of the activity.
- Work with the community to develop the engagement i.e. listen I would argue there is another deficit model which is characterised by NOT listening to audiences, stakeholders.



- Identify resources and additional expertise required within and beyond the institution.

Indicators of quality in PE activities

- Evidence of legacy beyond the activity for engager and ‘engaged’ which could be knowledge, different way of thinking, behaving.
- Continued relationship with community/audience
- Good feedback and word-of mouth recommendations

The primary author’s own experience as a public engagement practitioner, and as a trainer and enabler for researchers to become involved in public engagement is that although there is potentially an infinite number of different methodologies and approaches possible in science engagement there are generic guiding principles¹¹ which underpin effective science engagement. These sit alongside cornerstones of effective practice. These guiding principles are:

- Accuracy in the representation of the science or issue
i.e. whether you are informing about an aspect of science or discussing issues arising from the implementation of science, an accurate representation is essential. The model/description may be simplified but analogies and comparisons should be accurate, and the relative importance of information should be transparent.
- Neutrality: Public engagement is the sharing or creation of knowledge, not PR.
- The engagement is considered from the audience’s perspective. If one is designing a presentation, a workshop an exhibit, think what might be interesting from the audience’s perspective not what you as a scientist find interesting. If it is a consultative or collaborative activity think about the points of common interest and goals.
- Clarity of purpose
- Enriching experience (net gain for all participants)
- Creativity

The cornerstones of effective practice are as follows:

Professionalism (respectful behaviours, consideration of legal constraints, ethics)

Flexibility (teamwork, resourcefulness, adaptability, imagination, problem-solving skills)

Reflective practice (evaluation used as a tool for continual improvement)

Quid pro quo (collaborative working, belonging to a community of practice)

I would add to these: vision – seeing the bigger picture, strategic thinking.

Conclusions

Public engagement revolves around knowledge. Quality in public engagement with science can be defined in terms of key guiding principles and behaviours in practice. Achieving qual-



ity is an ongoing process rather than a goal and the aim is one of continual improvement through reflective practice. Public engagement practice is a learning journey for each practitioner.

Quality practices should be embraced by both new and experienced practitioners alike. What emerged very strongly from our project, from concurrent work and personal experience is that there is certainly an ethos in public engagement practice which is perhaps not always evident in other areas of academic work in universities. Quality is an enabler and should encourage a 360 degree perspective of the engagement experience and of behaviours. We can all strive for Quality, Honesty and Beauty in science engagement.

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51. The role of researchers in Danish News Media

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Introduction

On average Danish newspapers contain one hundred articles per day where research is mentioned and in about 15-20 of these, a Danish researcher from the social sciences, humanities, natural sciences, or health science is quoted. In fact such simple observations have, until recently, been used as pretext for *not* taking science communication seriously in Denmark. This project has the aim of analysing the status quo in Danish news media Science Communication. This is done using quantitative content analysis of Danish news media combined with a survey of journalists and researchers.

The main research question is “Which role do researchers play in Danish news media today?” This question is subdivided into four questions according to which this paper is structured: The first question is “What characterises the stories that researchers contribute to?” The second is “What characterises the researchers who contribute?” The third is “What characterises the journalists who quote them?” While fourth and final question is “What characterises their cooperation?” The term ‘researcher’ includes researchers from social sciences, humanities, health, technical, and natural sciences.



- 212 For a period of four months, the Danish printed press was combed for articles quoting a researcher. A total of 640 items were selected and coded for 11 variables. Having coded an item, the research assistant would call the journalist who wrote the article and ask a series of questions related to both the experience of the journalists and the cooperation with researchers – both in general and related to the particular newspaper article. Then the research assistant would call the researcher quoted and ask a series of parallel questions. A total of 362 interviews with journalists and 342 interviews with researchers were carried out.

Findings

The newspaper articles share many similarities with an average news article. In fact 50 percent of them were coded as hard news stories. This observation led to testing to what extent the researchers comment on day-to-day news events or provide background material for journalistic news stories, rather than to present scholarly achievements.

In 84 percent of the articles, the role of the researcher was to comment on news events, and the main topic of the story was not research. So judging from newspaper articles alone, Danish researchers may be very active in communicating to the press, but their role is to comment on news events. This corresponds with findings in Hansen & Dickinson (1992).

Only three percent of the researchers quoted were from private companies; this may be because objectivity of researchers working in the medical industry, for example, is frequently brought into question by media in Denmark. This finding corresponds both with Verhoeven (2010), Bubela and Caulfield (2004), and Tanner and Friedman (2011).

Table 1. Main topic of news item by role of researcher

		Is the role of the researcher to comment on news events?					
		Yes		No		Total	
Is the main topic of the item a research project?	Yes	20		90		110	
	No	516		12		528	
	Do not know	2		0		2	
Total		538		102		640	

The data reveals that social scientists are most frequently cited, followed by the humanities. However, as only 19 and 16 percent respectively of university researchers in Denmark are social scientists or from the humanities, they are highly overrepresented in news media. One explanation for this is that the daily news is more likely to be related to social sciences and humanities than to 'hard sciences'.

Table 2. Sampled researchers classified by faculty

	Frequency	Percent
Humanities/Theology	169	26,4
Social Sciences/Law	288	45,0
Health Science	74	11,6
Natural, Technical & Agricultural Science	90	14,1
Other	19	3,0
Total	640	100,0

*Table 3. Research experience (MA not included) in 5-year intervals*

	Frequency	Percent
1-5 yrs experience	35	15,4
6-10 yrs experience	43	18,9
11-15 yrs experience	40	17,6
16-20 yrs experience	24	10,6
21-25 yrs experience	25	11,0
26-30 yrs experience	19	8,4
31-35 yrs experience	22	9,7
36-40 yrs experience	16	7,0
41-45 yrs experience	3	1,3
Total	227*	100,0

**N=227 some researchers were interviewed several times. The figure above is based on individuals*

The most media activity is found among researchers with less than 15 years experience. According to Ståhle (2006: 58), the age distribution of Danish researchers does not vary significantly. Therefore the age distribution of Danish researchers quoted cannot be explained through the age distribution of the researchers. Rather, it may be explained through the course and duration of an academic career.

First of all, they are not science journalists. A comparison between the membership list of the Danish Association of Science Journalists and the bylines of the news items sampled, revealed that only very few names occur on both lists.¹ Secondly, these journalists quote researchers quite often. 80 percent of them claimed that they used a researcher at least once a week. Thirdly, they are very young: 65 percent of the journalists in this sample have less than ten years of experience.

Table 4. Journalistic experience

	Frequency	Percent
Trainee	34	15,2
1-5 yrs experience	69	30,9
6-10 yrs experience	41	18,4
11-15 yrs experience	19	8,5
16-20 yrs experience	19	8,5
21-25 yrs experience	24	10,8
26-30 yrs experience	12	5,4
31-35 yrs experience	3	1,3
36-40 yrs experience	2	,9
Total	223*	100,0

**N=223 some journalists were interviewed several times. The figure above is based on individuals*

At first glance it may seem surprising: Communicating science in journalism is considered difficult and therefore an area that one would expect to be covered by experienced journalists. However, as 84 percent of the news items in this sample do not communicate research then this may not be very surprising after all. That young Danish journalists turn to university researchers, may be explained by the character of local journalism training: About half of the Danish journalists have earned their journalism degree at a university (Lund & Petersen, 1999; Terzis, 2009). Here they have familiarized themselves with researchers from social sciences and humanities.

Finally, this study confirms the findings of a series of recent studies, concluding that working relations between journalists and researchers have improved considerably over the recent years and are, in general, quite good (Gascoigne & Metcalfe, 2010; Hargreaves & Ferguson, 2000; Peters et al., 2008; Roche & Muskavitch, 2003; Valenti, 1999; Weaver, Lively, & Bimber, 2009). However, journalists evaluate the relationship in slightly more positive terms than researchers. This conclusion may be drawn from two variables in the data set:



Firstly, the journalists with more than 5 years experience were asked whether they considered researchers to have become more professional in their dealings with journalists. Secondly, Researchers with more than five years experience were asked the inverse question.

Less than 20 percent of the researchers found that journalists had become increasingly professional, while 68 percent of journalists thought researchers had become more professional in their dealings with media. This is also reflected in the fact that 30 percent of the researchers had received training in dealing with journalists, while only approximately 6 percent of journalists had received training in communicating science.

Preliminary conclusions

Based on this data, it seems safe to conclude that quite a small group of relatively young social scientists and researchers from the humanities are very active in contributing to Danish news media. Their role is to act as expert sources where they comment on news events.

The journalists use the researchers in order to obtain compensatory legitimacy for their news stories. It is the journalist who set the agenda for the meeting: He decides which researcher to contact, on which topic the article will be, and within which frame it is to be presented. Finally, judging from the articles in the sample, the journalists are not very interested in writing about scholarly achievements. One obvious reason for this might be that he knows very little about research and especially about how to communicate scientific achievements to the public.



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52. One way science journals can support good science journalism: Science journals should give reasonable notice of publication of science papers

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I now know a few words of pigeon “journal-speak”. And publishers are picking up the science journalist and press officer vernacular. It’s true and I’ll provide some evidence.

For too long and too frequently I may have kept in touch with a scientist and the journal with whom they are publishing over days, weeks or months, tracking the progress of a paper to publication only for that paper to suddenly appear online. With not a smidgen of notice.

“Some journals have a timetable as rigid as the Japanese bullet train!” I would cry. “How come others are as capricious as British trains confronted with leaves on the line?”

“And if they have no set timetable, can’t they at least be fitted with brakes so they can stop at press officers’ and science journalists’ desks and be redirected to worldwide fame?”

Without that stop, they head straight to the scrapyards like poor Old Slowcoach in Thomas the Tank Engine, however loud an announcement I make.

Giving a bit of notice allows a science journalist to scrutinise a paper before it goes public and to prepare a story that gives it its proper place in the wider world. With enough notice, I might want to film and edit a video as well as write a press release. Or organise a press briefing.



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Sometimes, a journal editor appears to understand this and to have the will to provide notice. But even then they may be unable to control the publication process so the paper shoots all the stops, crashing beside Old Slowcoach.

Tom Reller, head of global corporate relations at Elsevier, said at the PCST2012 panel on journals and journalists that I chaired: “We can see these issues bubbling to the surface more often and are now grappling with best practice.”

At the moment, he can ask publishing staff to tag an article, tracking its progress to online publication. They can get advance notice of when it might be published to within 24 hours’ accuracy. This helps because it at least provides time to prepare whatever press activity best fits. Or with articles in some journals he can request the production process shifts to manual, and brakes sufficiently to provide a few days’ embargo.

At *Nature*, I have noticed publication speeding up too. The supersonic Ruth Francis was apologetic that the advance notice she is able to give is contracting. But even a few days’ notice can be sufficient when combined with an in-house system between scientists and their press offices to keep track of publication.

Tom also said that he can feed back to his portfolio of journals why science press officers bang on about wanting notice. It helps science journalists write a good story and it in turn can benefit authors. Author relations are the lifeblood of a journal. Press coverage can help improve the understanding of controversial science, it can help push citation rates, and it can help scientists make new research and industry contacts.

Here's my other bit of evidence that our pigeon grasp of each others' languages is sufficient for us to be firm friends...

Eric Merkel-Sobotta from Springer described how the amount of information being generated by science publishers has grown by three to five per cent every year for the last 200 to 300 years. Publishers will not throw three to five per cent more resources at press coverage.

But Eric will feed back to the International Association of Scientific, Technical and Medical Publishers, a body of which I had never before heard, but which he chairs, that advance notice of online publishing helps support good science journalism. He is happy to receive a compelling summary of "ideal rules", which can include other issues raised by science press officers, and which I am happy to coordinate.

The editors of upcoming new open access journal eLife will also be inviting comment over the summer as they build their embargo policy. I have talked with them about putting something on Stemptra when they are ready.

So you don't really need to know the language of journal "workflows" and publishers need only know the basics of the science press officer world. Do get in touch if you want to build on the momentum. We might never have the efficiency of the Shinkansen but we can keep our stock out of the scrapyard.



53. Professionalisation in Science Communication: reflections on competences perceived by PCST2012 participants as required in their work

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Introduction

What are exactly the competences that science communicators need to acquire? It seems that most curricula in Science Communication (SC) did not make competences explicit (Hong & Wehrmann, 2010). SC-students cannot grasp where exactly they are heading to, while employers do not know what to expect from SC-graduates. In the meanwhile, SC-researchers try to understand the field as a whole, and promote new ways of looking at the relationship between science and society. Dialogue, deliberation, participation; this is what SC-researchers pressing ask from SC-professionals. But does that reflect reality?

There comes the freshly graduated SC-student, starting a first job. This graduate may feel helpless on the first workday already, for dialogues are not part of the daily business at all! The employer might think *"What the ..(..), this science communicator cannot even write ten good articles per day!"*. Unfortunately, this is reality. Time to rebuild bridges.



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PCST-session on professionalisation

During the PCST2012 panel-session on Professionalisation. Working Towards Competence-based Science Communication Career Models for Science Communication Students and Curriculum Developers, we took the step to enrich theoretical thoughts about *What is science communication as a profession?*, with the visions of those that work in the field on a daily basis. We wanted to give SC-students more clarity on the SC-field and -education, give SC curriculum developers insights on which competences to educate, and provide SC-professionals acknowledgement for the great variety of tasks that come along with working in the field.

Prior to the conference, we asked 30 colleagues in the field (varying from researchers, to science centre content developers, journalists, and strategic advisors) in a short survey, *What knowledge, motivations, skills or personal traits do you need in your daily practice?* We derived these questions from the four elements of Spencer and Spencer's vision on competences (1993), and gained from this survey preliminary insights on SC-competences required according to SC-professionals.

During the PCST-session, our panel introduced Spencer and Spencer's vision on competences, and stressed the need to map competences perceived by science communicators as 'required and useful to work effectively in the field'. Two panel-members also inspired the session's participants with competences they experienced themselves as needed in their daily practice.

After the panel's introduction, we made our session's participants brainstorm in three groups about the same questions we asked in the survey. Around thirty enthusiastic students, PhD's,

and SC-professionals with a variety of jobs (from science center employees to strategic advisors) worked together. The groups came-up with lists of competences they perceived as relevant in their work. One group focused on skills, another group on motivation, and the third group thought about skills, motivation, knowledge and personal traits of science communicators all at once. Thoughts were shared in plenary by means of five-minute elevator pitches.

The panel session delivered us a lot of data about skills, knowledge, personal traits and motivation perceived by SC-professionals as required in their work. We felt the urge to make sense of it. So we transcribed, analysed, summarised, discussed, and came to several commonly agreed findings, conclusions and possible implications.

Competences of science communicators

Summarising the visions of our PCST-session participants, SC-professionals need to have the following specific knowledge, personal traits, skills and motivations:

- Knowledge about: science (history, trends, methods, the culture), communication models (psycho-sociological fundamentals), people (*What characterises my public or my stakeholders? What do they need/want?*), and (mass-) media (*which medium to use when?*).
- Personal traits like: curiosity (broad interest in people and topics; from the level of science up to societal scale), socially engagement (be a networker, connect with people, easy small talker), flexibility (adapting to context, like chameleons), and creativity, (develop innovative solutions to (unforeseen) circumstances).
- Skills in: Socialising and interpersonal communication, story-telling (about researchers themselves and their work), writing, teamwork, using (mixes of) media, planning, and budgeting.
- Motivations to: learn and reflect continuously, take (and be ready for) action, be missionary, striving towards a higher goal, such as a good science-society relationship, and democracy.

On top of this, participants of our PCST-session mentioned in their pitches that the competences themselves (as given above) are not unique, but the sum of the competences is what makes a science communicator. Also, one brainstorm group identified a cyclic relationship between- and in advancement of personal traits, motivation, knowledge, and skills of the science communicator. Last but not least, the elevator pitchers emphasised a shift from one-way communication to more interactive two-way communication in SC-practice, asking for good interpersonal and facilitation skills.

Reflecting on ‘what makes a science communicator?’

Our interpretation is that we can derive several conclusions from the list given above:

- A *science* communicator might be different from *general* communicators for having knowledge about one or more scientific disciplines, and the world (that is hidden) behind science such as methods or culture. General communication professionals may not necessarily be knowledgeable about that.



- A generic interest in science should really be part of the science communicator's personal traits.
- The science communicator needs to be motivated to strive for higher goals such as democracy or a 'good science-society relationship', in which science is a serious party in every day's society and society is an important part of/in science.

These interpretations, call for SC-curricula that help students to identify and experience the benefits of a good science-society relationship. Attention for reflexivity in curricula is required. Since competences on the levels of motivations and personal traits can be rather invisible (Spencer & Spencer, 1993), SC-curricula that aim to work on personal traits or motivations of SC-students might need to communicate extra transparently about that.

The above listed SC-skills may seem comparable to a *general* communicator. But these skills still make science communicators different from (other) scientists. Science communicators know how to communicate effectively, either verbally, written or visually, especially when interacting with other people. This fact confirms that SC-curricula should definitely offer practical trainings on these skills, and thereby help SC-students to thoroughly experience the theoretical (communication) models they learn about.

Further thoughts

Previous research emphasised that each element of science communication is to be found in other domains, but that their total sum creates the uniqueness for what science communication really is (Van der Auweraert, 2007). SC-practitioners' visions shared during our PCST session on 'competences required in the field' make us able to confirm that. But it evokes critical thoughts. Are these insights new? Is this list of competences useful for SC-students, curriculum developers, or SC-professionals? Are we not just talking 'just' about generic (post-academic, communicator) competences? Are we really talking about *competences* here? Or merely activities? Final judgments are up to readers, but we provide one thought below.

Van der Auweraert defined the SC-field by eight building blocks (2007): content of SC, approaches to SC, levels of SC, domains of SC, collective motives to perform SC, SC-effects on public, functions of SC, and the overlap of SC with other disciplines. Comparing Van der Auweraert's SC building blocks with our insights based on this PCST session, the knowledge, personal traits, skills, and motivations we found can be placed quite well within these building blocks.

However, the variety of our PCST session participants shows that the span of the field is broadening. Van der Auweraert's building blocks may, therefore, need expansion. SC-professionals can work as science (communication) researchers, executive professionals, or strategic professionals. Executive professionals have practical tasks like science promotion or science-society knowledge exchange facilitation, while strategic professionals enable other's to communicate, based on their strategic advisory or plans. The amount of 'science' as part of communicated content seems to vary within those different SC working fields. Besides 'content of SC' focused on science and technology itself (Van der Auweraert, 2007), communication about topics like research themes, R&D strategies or the science culture, also belong to the daily practice of some SC-professionals.

With this highly explorative study on SC-competences, we hope to have refreshed some in-



sights in SC-practice. May it help SC-theorists to grasp the real nature of SC-professionals' work in the 'field', and vice versa!

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54. 150 years of earthquakes in Italy between memory and oblivion: which communication strategies?

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Communication, Memory and Oblivion

There is no memory without communication, so memory is a problem of communication and who attends to communication should worry about it. At the same time memory is something qualitatively different from communication because memory is subject to biological and cognitive constraints. This makes the memory-communication relationship something complex, an interdisciplinary field difficult to explore and define.

By summarising and simplifying things, we can say that while the roots of memory are in bodies, communication is a process that concerns the social sphere (Bartoletti, 2007). There is no unitary definition of memory because it is dynamic: a process of memory that remodels itself in function of the present, taking into account primarily the reference context and the passage of time. The concept of memory is not absolute; in order to be grasped in full, memory needs to be considered in its inseparable connection with oblivion. So when we talk about memory we are actually talking about a continuous process between memory and non-rememberance (Ebbinghaus, 1885). Ebbinghaus, who is considered the father of scientific psychology had already questioned the relationship between memory and oblivion in relation to learning processes.

In absolute agreement with the pioneering studies of Ebbinghaus, communication regarding earthquakes, or other phenomena associated with them such as tsunamis, tends to fall as abruptly on the web or on social networks. Japanese researchers have tried to gauge interest in the earthquake and tsunami that struck Japan in March 2011, observing by the count of tweets how this abruptly declined (Isoda and Claster, 2011).

Each memory type has its own oblivion

Individual. Individual memory has been a privileged object of study in psychology. In particular regarding trauma, psychoanalysis has provided a great contribution with its research and definition even at an unconscious level. This form of oblivion is defined by psychoanalysis as repression, in that our consciousness does not permit access to contents deemed undesirable or painful.

Collective and social. According to the definition of the historian Pierre Nora, collective memory is “memory, or set of memories, more or less conscious, of an experience lived or mythologised by a community of living persons, of whose identity the feeling of the past is an integral part”. The term “collective memory” was used for the first time in 1920 by Maurice Halbwachs in opposition to the concept of individual memory. Collective memory is shared, transmitted and also built by the group or society. Collective memory is subject to oblivion



and, according to experts, collective oblivion has a strong influence even at the individual level.

According to Namer, it is possible to distinguish the collective memory of individual groups from the social memory, understood as the intersection or the product of the reciprocal dynamics of the different collective memories in a society, or as the set of traces of the past virtually available. Since collective memory is a selection in each case (more or less voluntary) of the past, his study can be set alongside the one on mechanisms of oblivion production, which occur both in the practice of censorship in the explicit forms of occult manipulation exercised in commemorations and different selections of the past preserved and reproduced institutionally (Yerushalmi, 1990).

The sociologist Alessandro Cavalli talks about the social construction of oblivion. For example, the earthquake in Friuli has brought a cancellation, a removal of the adverse event, and memory has turned to rebuilding and continuity with the pre-disaster past. In the case of the earthquake in Belice, however, there was commemoration, celebration, exaltation of the adverse event.

Mediated. This is a form of memory that is built through the mass media. Increasingly we witness earthquakes and disasters that we do not live in directly or in first person, but to which we have access through the mass media. In this case, oblivion is extremely sharp, as we have seen in the examples that relate to the web.



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Transactive. This covers the most recent studies on memory, and concerns a type of memory that does not refer to human beings as such but to a memory “separated” from the subject using external media technology. This paper refers to new technologies and changes in the mode of storing or forgetting in the Internet age. It is a form of memory that already contains oblivion within itself, because people remember not the contents but only the path to recover them.

Memory Disasters

In recent years several studies have been devoted to the study of memory concerning natural disasters. Many studies suggest that it takes three generations after a disaster for a population to stop taking precautions – after the last person who experienced the disaster first-hand has passed away. This makes perfect sense in a culture whose history is transmitted orally, like the ancient Aleutian Islanders of Alaska. Archeological records show that Aleutian villages would relocate repeatedly to higher ground after a tsunami, only to move back to the coast about 100 years later. This is true also for elephants: during droughts, older females lead younger elephants to distant water holes they remember from droughts of their youth.

What are the differences between orally transmitted memory and the memory transmitted today through schools or the media? Some researchers, such as earthquake expert Costas Synolakis, think: “Communal memory of rare disasters is worse in more developed societies because knowledge now is passed on in schools, movies or the internet, leaving no time for oral history or reliance on the elders to learn about the world.” So the memory limit of human beings seems to be that of three generations. Is it possible to overcome it?

Towards a transgenerational memory

In *The Ancestor Syndrome*, Schuzenberger (2004), therapist and analyst with over forty years of experience, provides clinical examples of his psychogenealogic approach to psychotherapy. We are mere links in a chain of generations, and we often have no choice and become victims of events and trauma already experienced by our ancestors. The book contains interesting case studies and examples of “genosociograms” that illustrate how patients have developed seemingly irrational fears, psychological or even physical difficulties by discovering and trying to understand the parallels between their life and that of their ancestors. Is it possible to apply the reconstruction of individual psychotherapy to a level of collective memory and find a way to access information of past generations?

Communication strategies

A precise answer to the above question does not exist yet. Over the centuries humans have developed techniques and procedures to leave a trace of their past. Rites and rituals are a case in which the analogue aspect is predominant, along with the social and interactive ones. The rituals in communication meet two important aspects: the affective and the symbolic ones and appear as a set of signs that, however, do not provide the code that allows you to interpret them fully. They appear on one side as having sense, on the other as having no apparent sense at all. Their limit is all here, because the link between the ritual and the memory of a specific event is largely lost or dismissed in a set of tracks. Even regarding commemorative days of environmental disasters there is a lively debate about their usefulness.

Memory processes and celebration, may, as some scholars believe, be functional to oblivion, that is, to processes of collective removal (Tota, 2001). Another strategy to remember concerns the possibility of the establishment of building identity cards. Many townships of EU countries have for some years been requiring the preparation and periodic testing of the state of efficiency of structures and buildings reported in a separate booklet. This booklet has been designed in relation to numerous disasters due to acts of pure negligence on the part of those granting building permits who, without checking the actual condition of buildings, have authorised resizing works on the structural parts of the buildings or other types of works that have altered their stability.

The idea of writing a book or compiling a record on the history of the building will have a certain effect in terms of safety and will eventually make the work of relevant bodies in issuing clearance more streamlined and quicker. But the issue remains an open one. How should we store the buildings’ ID cards so they may become part of a nation’s cultural heritage and not lie forgotten in an archive somewhere? In a more strictly communicative and informative direction we have tried to develop strategies that could mark the succession of earthquakes in a specific area, using an idea by Carl Sagan. By compressing the time on a time scale of a single year we have represented 1,000 years of earthquakes in Italy from the year 1000 to present. Then on an even smaller time scale, one day, we brought together 150 years of Italian earthquakes.

This work represents only the beginning of a process that should aim to identify effective strategies and methods for transmitting a memory of disasters that can exceed the limit of three generations. Because having memory of a disaster means giving an instrument of knowledge to future generations to help build a more secure area.



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55. Hunting rumours in earth sciences: understanding their origin for debunking and turning them into something useful

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Introduction

Rumours in social, economical, political and scientific communication indicate news, presumably true, that circulate without being confirmed or made evident. Planet Earth seems to be the elected place to give rise to frequent rumours about impending catastrophes. In this work we analyse some rumours related to Earth sciences and we give ideas on how turning them into something useful for communicating Earth sciences to the general public.

Since ancient times there are stories handed down orally and assuming each time new meanings. These stories are supposed to be true but nobody take into serious consideration to verify them, since rumours have different social functions. One is important for our planet, according to the following definition: rumours involve a group communicating in chains of transmission in order to make sense of some situation, event or issue, so as to help us to cope with anxieties. (Rosnow 2001, quoted in Hook, Franks & Martin 2010).

Since there are so many aspects of Earth still completely unknown, people try to find explanations to cope with the fear for the future. Very often natural hazards cause death and destruction even in countries where the fight against them have had excellent results. The recent earthquake in Japan (2011 Tohoku earthquake) showed that an earthquake could always surprise any studied attempt to contain a tsunami. Disasters may happen, but rumours very often exaggerate reality.

As a science communicator I believe that rumours are already popular, so in debunking them we convey science to a broad public already interested in the subject. A more personal approach is that rumours are also appealing from a narrative point of view.

In the following paragraphs I report some examples in Earth sciences. The first two cases show how we used them to organise public events of science communication. The third case maybe not a real rumour, but can be used to popularise the Earth atmosphere. The fourth case shows how sometimes what it is supposed to be a rumour is indeed just a prejudice.

2012: the end of the world according to the Maya

It is the rumour of the year: the impending end of the world as foreseen to happen on 21 December 2012 in the Maya calendar. Others say that it will simply mark the beginning of a new Era. The causes are an alignment of the planets in coincidence with the next solar maximum. The Earth's collision with an object such as a black hole, or an asteroid or a planet called Nibiru. Astronomers and other scientists have rejected it, and even the Mayanist scholars have denied that in any Maya account this prediction of an impending doom exists.

Nevertheless, a lot of communication has been produced about it. In Italy 550 books have been written about this topic. Three billion websites talk about it. There is also a movie by



Roland Emmerich, 2012, which is the 38th in the worldwide list of highest-grossing-films. In it there is a funny cartoon done by one of the characters, a radio presenter, Charlie Frost, who in two minutes summarises the Maya prophecies. On the NASA website it is possible to find FAQs and the answers given by scientists on this same subject.

To transform a rumour into an opportunity for science education, science communicators should consider when is the right moment to use it, how to do it and where. Here we give an example of how to do it. During a public event that our Institute (INGV) organises every year, called “Open Science”, we organised a lab dedicated to 8-9-year-old children called “Let’s play to the end of the world”. The aim was through a playful approach promoting the knowledge of our planet to minimise the risk coming from natural hazards. The event started with an introduction to the day in the institute’s main hall where we showed a brief history of the universe following the Sagan method: from the big bang to present times in one-year scale. We then divided the students in four groups: volcanoes, earthquakes and tsunami, solar storms and magnetic field.

We asked students to imagine catastrophic events taking inspiration from a cartoon, the Xmen: Cyclops (volcanoes); Phoenix (earthquakes and tsunami); Tempest (solar storm); Magneto (earth magnetic field); Secondly, we invited them to write two stories: one for volcanoes, earthquakes and tsunami and the other for solar storm and earth magnetic field. After a break we asked the students to transform the stories introducing the anti-characters (i.e. for Tempest, Anti-Tempest) and according to some elements encouraging prevention and mitigation of natural hazards. Finally, we asked the students to tell the stories and their transformation. A rapid feedback at the end of the day suggested that the event was appreciated by almost all the students that loved to imagine what will happen to the Earth but also what can we do to protect themselves from catastrophic events.



Rome 11 May 2011 Earthquake Prediction

It is also important to choose the right moment to debunk a rumour. Some colleagues organized an Open Day the exact day of a catastrophic event predicted for the city of Rome (C. Nostro et al. 2012). Even if the seismic history of Rome suggests that no catastrophic event ever occurred in the past centuries, some inhabitants decided to live the town on the 11 May 2011 since a catastrophic quake was predicted for that day apparently by Raffaele Bendandi a self-trained scientist of the last century. Indeed even the prediction was wrongly attributed to him.

Before the Open Day, some pre-events took place as a press conference on 9 May. While a video to answer the question “Earthquake in Rome on 11 May?” was already uploaded in the INGV Terremoti YouTube Channel since 14 April. The Open Day was based on a traditional programme: meet the INGV scientists; visit the 24-hour earthquakes monitoring facilities and the permanent exhibits; lectures on the theme; 24-hour broadcasting of the day from the INGV YouTube Channel; distribution of gadgets, books, brochures and informative material to the participants. Some results based on a preliminary media analysis including press clips and the daily statistic views of the INGV Terremoti YT Channel revealed the effectiveness of the chosen timing.

Haarp conspiracy a rumour? How to use it to popularise the Ionosphere

The web is full of data about the supposed Haarp conspiracy. Is it a rumour? We are not able

to answer, since it is a complicated issue but we can start to shed a light by posing the right questions and using them to explore a lesser-known part of the planet.

Some say that Haarp facility provoked artificially the 2004 Sumatra tsunami and also the Sichuan earthquake. Some videos on YouTube show the so-called EQL 30 minutes before this earthquake. Concerning Haarp we can pose all this questions: what is the ionosphere? What is EQL (Earthquake Light)? How can study and monitoring of the ionosphere improve the reliability of communication and navigation systems? Can the Haarp facility really influence the ionosphere to the point of provoking a natural disaster? And last but not least: can men use a scientific facility for military purposes in secrecy? In this way we can at least learn that the ionosphere is the highest part of the atmosphere, how it is used by modern technology for communication system (by satellites). We can also learn the science behind the beauty of Aurora borealis and so on.

Earthquake prediction by animal behaviour: a prejudice rather than a rumour

Can animals sense earthquakes? In the past it has been often considered a rumour, but in 1975 the Haicheng earthquake was predicted also observing the snakes' abnormal behaviour. A milestone was the book of Helmut Tributsch, *When the Snakes Awake*, that narrated the successful prediction. Nevertheless, it was an isolated episode since no other earthquake has been predicted with the same precision in the following years. After the 1995 Kobe earthquake (Japan), Prof. Motoiji Ikeya collected in a volume (Ikeya 2004) the lab experiments he did to understand the phenomenon of unusual animal behaviour before an earthquake. Today there are researchers of different disciplines all over the world investigating this particular field of study.



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Conclusion

As we have seen in the last case, what was thought to be a rumour, a legend, is now a research field. Rumours can be dangerous sometimes because they make people behave irrationally even if they help people to cope with anxiety. On the contrary, we can use our creativity to communicate science debunking them. Debunking a rumour at the right time can also make the difference and contribute to successful science communication.

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56. “We decided to change the visual vocabulary”: Medical illustrators navigate their clientele

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Medical illustration is a centuries-old field of practice best-known for its contribution to anatomical and scientific atlases. In North America the first school was established at Johns Hopkins in 1911, and the professional association, the Association of Medical Illustrators, had its first annual meeting in 1946. Today medical illustrators work in a variety of areas: textbook, courtroom, educational, museum exhibits, health communication websites, and commercial contexts. This paper focuses on the work of these illustrators in science marketing for the pharmaceutical industry.

My initial question was, How do professional medical illustrators discuss quality, honesty and beauty in their work and with their clients, and how might these perspectives influence their practices as a form of public communication? Findings quickly revealed that as a descriptive term, “accuracy” was more often used than either of the terms “quality” and “honesty.” Accuracy – the quality or state of being correct or preciseⁱ – was also intimately linked to beauty. These terms embodied medical illustrators’ descriptions of the richness in their visual culture across academic and commercial contexts.



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In practice, medical illustrators ally themselves with science and contemporary science data, distancing themselves from commercial marketing such as lifestyle images. Illustrators emphasise the Mertonian norms of scienceⁱⁱ and the anatomic norms of beauty and accuracyⁱⁱⁱ even within what might be interpreted as the compromised practices of advertising.

Methods

Twenty-eight members and past members of the Association of Medical Illustrators who had worked on pharmaceutical contracts between the 1950s and 2000s agreed to participate in semi-structured interviews. The illustrators’ responses were transcribed verbatim. Qualitative research software (NVivo 9) was used to facilitate the process of iterative comparison and inductive coding techniques to identify themes and insights.

Findings

Unprompted, medical illustrators used the terms “accuracy” and “beauty” to describe what they strove for across their academic and commercial work. They spoke of accuracy in a variety of ways: 1) as best vetted by those with science expertise; 2) as dependent on accurate data; 3) as an inspiration to visual work; and 4) as intrinsic to beauty.

1) Accuracy was described as best reviewed by those with science expertise. Medical illustrators requested “experts” and “scientists” to scrutinise or collaborate on visual processes and results:

“... A lot of times I’ll write a script and there will always be with every animation we do there is always an expert on hand.” (Wooster)

“Our artist ... he constructed the structure here, and this is actually based on proteins databank data, and we actually conferred with the scientists, who solved this crystal structure.” (Georgia)

Even in commercial contexts, medical illustrators presumed collaboration with practitioners in science and medicine. Image descriptions of the supporting science in turn supported the products sold—these science stories also required accurate data.

2) The accuracy of the images was dependent on authentic digital data and support from scientific literature. Péro explains a client scenario where copious data was rendered operational:

“... in this case the challenge was to, first of all gather the requisite data, the accurate data, from the literature, to decide, there are way too many pathways and proteins in human cancer to claim to put them all on one poster ... It’s ridiculous the complexity is beyond belief ... Thousands, thousands and thousands of proteins, and hundreds of pathways. So the question was, can we identify what are, let’s say, the key 15 pathways that account for the majority of mutations and cancer types? Well that was task number 1. Task number 2 is that within each one of these pathways there are many many proteins, which are the key nodes of communication. How do I identify those? And that was also hard.” (Péro)

The care taken to translate an appropriate story to the intended audiences as based on complex data meant data had to be depicted in ways potentially not seen or attempted before. Science communication became a means to “change the visual vocabulary” of how molecular science was represented:

“... one of the things that we looked for was a means to use real data, in this case using data that was being collected by the protein databank, to be able to depict things differently.” (Nell)

By “differently” Nell is contrasting previous image work not based on science data, with the new “more accurate” visualizations that are accessible. Nell continues:

“And so one of the things that was an argument I was always having ... was [why make] ... this stuff so dumbed down when you could do it in a way that’s not only more elegant, but also describes the science more accurately.” (Nell)

For Nell and Péro, achieving a story as based on complex research and accurate data was the inspiration needed to communicate science itself.

3) Accuracy was an inspiration to communicate science. Illustrators felt “strongly” that their work be connected to a professional science context:

“Yeah if it’s not accurate don’t talk to me and I actually feel very strongly about that.” (Storm)

Throughout the interviews, an emotional adherence to ideals of accuracy was apparent. The focus on striving to presented current and ongoing science to a variety of audiences not only made science more “accurate” but acknowledged the intelligence of those audiences. Susan continues:

“I started talking and said ‘you know we probably need to give for more detail, in



order to cover the territory that they are questioning.’ So the project evolved into something a little more detailed, a little bit more complicated, than what they had originally asked for, but in the end the client, the agency and the client, were both satisfied.” (Susan)

These previous descriptions of collaborations with traditionally-defined science experts, using actual science data and thinking of audiences as capable of understanding complex science, were also connected to interpretations of beauty.

4) Without accuracy, images created by illustrators were not considered beautiful:

“To have inaccuracies it doesn’t honour the beauty of the biology, pharmacology and the physiology and the disease state... It’s not just physical beauty but it’s the intelligence beauty of how the body works and it’s you know it’s sometimes I think that’s the magic of what I do. That you reveal the beauty, not only the beauty of the molecular side of biology and the body but the beauty of how clever medical systems are how clever you know the whole organism is as a whole and I mean even in signal transaction the way in which a cell manages its energy. ... I mean it’s magic and it’s not just the beauty of it, it’s intellectual magic of the science and inaccuracies for me are unacceptable.” (Storm)

“My philosophy is that I want to show the science as accurately as possible. But the aesthetics are so critically important to everything I do.” (Aude)

“... the illustrators motivation is often to do something informative, accurate, hopefully beautiful.” (Hank)



As seen in these quotations, illustrators’ perceptions of beauty were compromised by work they deemed scientifically inaccurate. The medical illustration community, in part responsible for creating the visual culture of science for professionals, had strong views about the roles of images. Images embodied the aesthetic of medical illustrators, was based on the “intellectual magic of science” as well as the “beauty of how clever medical systems are.” These interests were those used across illustrative work for commercial contexts.

Summary

Selling the science behind pharmaceutical products is a valuable strategy – it has been used in marketing contexts with physicians for over 60 years.^{iv} Medical illustrators acknowledge the complexity of scientific advertising, and as a professional community seek out and guard the rigour of science and medicine through close collaborations with those specializing in these areas. While working on commercial topics, by allying themselves with science and contemporary science data, illustrators distance themselves from the commercial marketing environment while at the same time still working for it, putting emphasis on a vision of science as defined by scientific and medical research rather than commercial products. Primarily interested in representing an accurate and beautiful material world, and appreciating the abilities and interests of all audiences, medical illustrators protect and promote their centuries-old collaboration of scientist-artist even within commercial contexts.

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ⁱⁱ Robert K. Merton worked within the sociology of science to create the Mertonian norms, or, the goals and methods of science: Communalism, Universalism and Organized Skepticism (CUDOS).

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^{iv} In 1938 Ciba Pharmaceutical Products, Inc. hired Frank Netter, a commercial artist trained as a surgeon. Netter later illustrated ten volumes of The CIBA Collection of Medical Illustrations. Mahoney, T. (1959) *The Merchants of Life: An Account of the American Pharmaceutical Industry*. New York: Harper & Brothers. p. 236.



57. Artists on the Galapagos Islands – how can artists communicate the challenges facing a world heritage conservation site, the conflicting interests of scientists, the local population and eco-tourists, and connect with environmental matters nearer home?

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The Gulbenkian Galápagos Artists' Residency Programme evolved out of ten years of the Calouste Gulbenkian Foundation's pioneering programme to encourage encounters between the arts and sciences. Poet Ruth Padel, Charles Darwin's great-great-granddaughter, introduced me to the director of the London-based Galapagos Conservation Trust (GCT). What could they do to draw attention to the importance of the scientific research and conservation activities being undertaken on these distant islands?

Having attended a day hearing about the British Antarctic Survey's 20 year artists' residency programme, I suggested an experiment. As more and more artists were taking a serious interest in the politics of environmentalism, we might offer them a chance to explore the complexities somewhere right out of the ordinary. Scientists, in particular, can be sceptical about the idea of artists rushing in for a quick engagement with knowledge accumulated over years. But artists, too, develop their work over years, nurturing abiding passions, accruing intellectual ideas and honing unique aesthetic practices. In productive art/science encounters the two trajectories intersect, subtly affecting each other's sensibilities.

The Galápagos are located around the Equator off the Pacific coast of Ecuador within whose territory they lie. They have historic associations with Britain because it was during a visit on *HMS Beagle* in 1835 that Darwin noticed that there were variant species of mocking birds on different islands. It was this pivotal discovery that led to the publication of *Origin of Species*, published in 1859. In the centenary year, 1959, the Ecuadorian government declared 97.5% of the archipelago's land area a national park and the Charles Darwin Foundation was founded as a scientific and conservation research facility. In 1978 UNESCO recognised the islands as a World Heritage Site.

Today the islands present a microcosm of a situation that exists at all heritage sites, one where there are huge conflicts of interest – between the animals and plants whose natural home this is, the scientists who are urgently researching them, and a host of invasive creatures which include plants, animals and people, challenging the notion of a pristine biodiversity. The islands have attracted many Ecuadorian people seeking some kind of a living in this inhospitable territory and the Ecuadorian Government must find a balance between supporting its people and respecting the integrity of the park. And among the temporary inhabitants of the islands are tourists, beguiled by the thought of close encounters with wild creatures, but whose visits must be carefully managed by the conservationists.

All GCT-sponsored journeys are carbon-offset but we thought that if we sent artists to record in inventive ways the conflicting interests of the place, it may deter the rest of us from actually going ourselves. But essentially we hoped their record would help us make connections



between Galápagos' challenges and those nearer home – a synergy between the local and the global.

In selecting the artists we had to be convinced of a compelling reason for each visit, an existing reputation, perhaps related to a love of the natural world, of history ancient and recent, and particularly a fascination with the ways in which human culture interacts with nature. They were offered a week's boat tour of the islands, guided by a naturalist, and alongside a small party of other tourists. After that they would stay for a couple more weeks in the basic accommodation normally used by scientists visiting the Charles Darwin Station from where they could pursue their own interests. The artists' visits took place in 2007–2011. The individual residencies were brief - as Darwin said of his own visit, *"It is the fate of most voyagers, no sooner to discover what is most interesting in any locality, than they are hurried from it"* but they presented the artists with a wealth of ideas, *"Enough material for a lifetime!"* as artist Marcus Coates exclaimed.

The visits have resulted in a touring exhibition to Liverpool, Edinburgh and Lisbon with discussions for extended displays, hopefully in South America; There is also a publication and interactive website.

Marcus Coates's visit transformed the attitudes of scientists and local people alike. One of his first projects was to make a television programme in which he appeared in a rudimentary cardboard costume as a Blue Footed Booby, one of Galapagos' iconic birds. He went round interviewing people from the perspective of a bird: *Some of you have more territory than others. Why is that? Why do you feed your children with the spoon?* There was an immediate delighted response. The project placed humans alongside animals within the overall concept of biodiversity and the scientists felt that local people suddenly understood what they were doing, demonstrated by an increased interest in research participation.

For another piece Marcus commented on the fetishistic language of advertising and glamour in environmental photography, *"I spent many days with the giant Galápagos tortoises, probably the most iconic and photographed species of the Islands. In a bid to investigate our relationship with these creatures I attempted to compete with their exotic appeal by buying the most glamorous outfit I could find in the Galápagos and supplanting myself in their breeding enclosure to be photographed alongside them. As an exotic attraction myself, I assumed my glamour would be in equal demand, but most of the tourists photographing the tortoises demanded that I move well away from what they mistakenly called the 'turtles'"* (see Figure 1 below).





Figure 1: Marcus Coates, Galapagos Fashions/Iconic Species 2008. Digital pigment print. Photography by Elke Hartmann.



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Kaffe Matthews made music from the routes taken by hammerhead sharks as they trace the magnetic map of the Earth while night-time hunting out in the deep: a 3D, sculptural, multi-channel composition. Her fearless underwater swimming attracted respect from people who usually regard the sharks as a dangerous menace. She adds: *"In July 2011, the Galápagos National Park seized seven illegal fishing boats found containing the remains of 379 sharks, their dorsal fins removed. Shark fin soup demand continues to create inflating prices. Here in Hackney, London, small actions are worth it. After a year of repeated asking, my local dim sum restaurant has taken shark fin soup off the menu".*

Jyll Bradley worked with local people to create gardens using native species; children's book illustrator Alexis Deacon chose not to take a camera but drew what he saw and has since created a graphic novel inspired by Galapagos creatures; Paolo Catrica made evocative photographs of the streets and houses built by local people from a mixture of materials reflecting their modest desire to be part of the land; Alison Turnbull made abstract paintings inspired by collections of moths and butterflies – she also discovered a rare species of moth and liaised between Ecuadorian entomologists and the Natural History Museum, London. Jeremy Deller made a film of cock-fighting, a favoured local sport (though since ended by public referendum) – an ironic comment on the survival of the fittest in the location which stimulated Darwin's evolutionary thinking. These and other examples may be found on the website www.artistsvisitgalapagos.com

There were many positive outcomes from the residency programme:

- an increased status for environmental matters when reflected through art, some of which has featured in solo or groups show internationally; work bought for private and public collections, some winning international art prizes;

- positive interactions between scientists and artists – both in order to communicate to the wider public but also
- encouraging scientists to be more self-reflective;
- some new discoveries, notably Alison Turnbull's entomological investigations;
- greater involvement for local people in conservation activities – greater pride in the land, enhanced education, participation in citizen science and increased interest in careers in science;
- new ways of linking Galapagos matters with conservation interests in other countries, for example Liverpool-based friends of the Galapagos Conservation Trust are working with elderly people in the city to create a new native gallery at the Bluecoat Gallery;
- capacity building for Galapagos – plans for a long term artist education exchange programme between the Galapagos islands and Scottish island groups;
- greater awareness for all concerned of the complex interaction between science and culture in a biodiverse world.

Curator Greg Hilty: *Humans are not just privileged consumers of the natural world but active and therefore responsible participants in it; art is a central human and therefore natural behavior.*

Felipe Cruz, Director of Technical Assistance at the Charles Darwin Foundation for the Galapagos Island: *I have seen the project make a very positive impact on the scientists. The work that the artists have done has complemented our education work beautifully and I hope that the project helps people everywhere understand the fragility of the islands and the balancing act that goes on between the human and wildlife populations.*



58. No Place for Ugly Mathematics – Communicating Mathematics through Literature

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“Why are numbers beautiful? It’s like asking why is Beethoven’s Ninth Symphony beautiful. If you don’t see why, someone can’t tell you. I know numbers are beautiful. If they aren’t beautiful, nothing is.” (Paul Erdős)

Many mathematicians would say that one of the reasons for their fascination for mathematics is its beauty. Godfrey Harold Hardy writes in his book *A Mathematician Apology* (Hardy 1940): “A mathematician, like a painter or a poet, is a maker of patterns ... The mathematician’s patterns, like the painter’s and the poet’s must be beautiful; the ideas like the colours or the words, must fit together in a harmonious way. Beauty is the first test: there is no permanent place in the world for ugly mathematics”.

For Hardy, being a mathematician is in first place being an artist. However, this is certainly not what most non-mathematicians think of the subject: their view is coined by a bad attitude towards mathematics resulting from bad school teaching. In a nutshell, mathematics to them is in first place a technical process and has nothing to do with beauty.

According to Paul Erdős, the beauty of mathematics does not seem to be accessible to everyone. He argues that everybody has to “see” it on his or her own. But there are successful attempts to bridge this gap. Authors of popular science books on mathematics try to give an insight into the manifold connections between mathematics and beauty and even more between mathematics and culture by referring to the close relationship between mathematics and art.

For example in his *Why Beauty Is Truth: A History of Symmetry* (Stewart 2007) Ian Stewart shows the beauty of mathematics by describing the fundamental concept of symmetry in the historical evolution from ancient times to the present. Not only is it a fascinating story about a mathematical adventure, it’s about the fascination of mathematicians with mathematics. This personal view brings to life the beauty in the concept of symmetry. Ian Stewart argues that the power of mathematics lies in the remarkable fusion of the human sense for patterns (“beauty”) and the ability to apply mathematics to the laws of physics, which are the criteria for truth in the physical world. The physicist Eugene Wigner calls this *The Unreasonable Effectiveness of Mathematics in the Natural Sciences* (Wigner 1960).

This seems to be surprising correlation, especially if you consider that some mathematical results found their way into application hundreds of years after their discovery respectively invention.

In the late 1980s readers of the *Mathematical Intelligencer* were asked to evaluate 24 mathematical theorems for their beauty. They were also asked for criteria what make a theorem beautiful – that a theorem has to be surprising was one of them (Wells 1990).

Another way to create such surprise is to describe the appearance of numbers where one



wouldn't expect them, like Mario Livio did it in his book *The Golden Ratio: The Story of Phi, the World's Most Astonishing Number* (Livio 2002). Since the ancient Greeks artists, architects, mathematician and others have been fascinated by the "Golden Ratio" (known as "Phi" or the "Divine Proportion" as well). In the words of Mario Livio there "exist a few special numbers that are so ubiquitous that they never cease to amaze us" (Livio 2002: 2). For example the number "Pi", the ratio of the circumference of any circle to its diameter, which is a "star" in many popular science books as well.

But for Livio, "Phi"¹ is even more fascinating because you find it in such disparate things as the spiral shells of mollusks, Salvador Dali's painting "Sacrament of the Last Supper" or the petal arrangements in roses. And it is a rich source of myths and legends: It is said that Leonardo da Vinci used the "Golden Ratio" in the Mona Lisa and even that the creators of the Pyramids employed it.

In the above-mentioned survey of the *Mathematical Intelligencer*, the theorem that the number of primes is infinite was among the top 3. Another high scored theorem was that every prime number of the form $4n + 1$ is the sum of two integral squares in exactly one way. Besides surprise, simplicity, brevity and depth were also mentioned as important criteria for the beauty of a mathematical theorem. The primes satisfy all these requirements. In particular the combination of simplicity and brevity enables deep insight into the beauty of mathematics without requiring any special knowledge. For instance, the theorem that the number of primes is infinite can be carried out in a few, easy understandable steps.

In addition, primes hold some unsolved mysteries as well. The patterns behind them are impossible to grasp. We cannot predict when the next prime number will occur.

In 1859 the mathematician Bernhard Riemann gave a hypothesis which was an important step towards shedding some light on the order of these mysterious numbers. But the so-called "Riemann hypothesis" remains unsolved. This doesn't add up, when you consider the \$1 million prize on offer for solving it. The "Riemann hypothesis" is one of the Clay Mathematics Institute Millennium Prize Problems.

But it goes without saying that prime numbers are best suited to illustrate the beauty of mathematics by telling a thrilling story, as was shown by Marcus du Sautoy (2003) in *The Music of the Primes. Searching to Solve the Greatest Mystery in Mathematics*.

These are just a few examples of the many bringing the beauty of mathematics and its relationship to art and culture to life. Contrary to Paul Erdős, transferring mathematics into the language of literature is a way to make the alleged elusive beauty of mathematics comprehensible. Even more it sheds light on aspects of mathematics, which are not noticeable in the context of "pure" mathematics. For this reason, popular science books not only provide insights for non-mathematicians, but enable mathematicians to get a better understanding of their subject.



¹ which is equal to $(1 + \sqrt{5})/2$

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59. Partnering with Science Facilities to Promote Science Communication through the Performing Arts*

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Our present National Science Foundation (NSF) grant works with research facilities in the U.S. to develop science communication to the general public through the performing arts. A previous NSF grant supported us in partnering with colleges and universities to do the same. The concept of promoting science communication to the general public through the performing arts has been developed, tested and proven effective at the Graduate Center of the City University of New York's series *Science & the Arts* for more than ten years (<http://web.gc.cuny.edu/sciart/>).

In the current grant we develop ongoing relationships with senior scientists and staff at the following NSF research facilities: the Homestake DUSEL facility in Lead, South Dakota and the LIGO installations in Livingston, Louisiana and Hanford, Washington for the purpose of developing a model for bringing science and arts activities to primarily rural localities that may have limited numbers institutions of higher education and arts organizations and, in the process, strengthening the relationships between the NSF facilities and the surrounding communities and the greater regions. It should be noted that each facility has a distinct minority community (Homestake – Native American; LIGO Livingston – African American; and, LIGO Hanford – Hispanic) to which we reach out collaboratively to develop science-arts programmes of particular interest to those communities.

The Homestake DUSEL (Deep Underground Science and Engineering Lab) facility, a unique research endeavour funded by NSF is located in Lead, South Dakota. In collaboration with the University of California Berkeley and the Lawrence Livermore Lab, in four brief years Homestake has gained a reputation as a world-class research facility in the fields of astrophysics and astronomy. In addition, with its "Deep Science for Everyone" Lecture Series, and scholarship and other educational activities, Homestake already reaches out to high schools, colleges and the broader community as part of its commitment to provide science education to the schools and citizens of SD and the region.

We have met with faculty, staff and students in the science and arts departments at Black Hills State University, the South Dakota School of Mines, and the Oglala Lakota College. Also, we have identified a number of community arts organizations for collaborative activities: Black Hills Community Theater, Children's Theater Company of South Dakota, Black Hills Dance Theater, the Black Hills Playhouse at Custer State Park and the Black Hills Symphony Orchestra. We have met and shared materials with all of the above organisations and are working with them on science-theatre collaborations.

The LIGO (Laser Interferometer Gravitational-Wave Observatory) facility, located in two separate installations – Livingston, Louisiana and Hanford, Washington – operates as a single labo-



ratory. By means of its research into the nature of gravity, LIGO is an important tool in the fields of physics and astronomy.

We already have visited and shared materials with Louisiana State University (LSU), a prime collaborator with LIGO, Southern University, Tulane University and other colleges and community colleges in the region as well as regional academic and community arts organizations (e.g., LA Art & Science Museum, Pennington Planetarium & Space Theater, Baton Rouge Center for the Performing Arts, the Swine Palace of LSU, and the Baton Rouge Little Theater, etc.).

Additionally, we have visited and sent materials to the Director of the LIGO facility in Hanover, Washington. We are working with LIGO Hanover in creating and supporting new outreach activities in science and arts through new collaborations with Washington State University, Evergreen State College, and other educational institutions. We also met with LIGO and leaders in community arts organisations such as the Mid-Columbia Symphony, the Academy of Children's Theatre, and the Mid-Columbia Ballet.

To initiate the project, we visited each of the sites for approximately five days. On these visits the project Principal Investigator, physicist Brian Schwartz, gave a major public presentation to audiences that included science and arts teachers, students, and the general public. We then held scores of meetings to establish working relationships with scientists and staff at the facilities, discuss with senior personnel the interests and needs of the scientists and community, meet with appropriate leadership in the science and the arts from local educational institutions, and most importantly meet with community leaders and arts organisations.

We continue to work with the facilities and local science and arts leadership to develop ideas and help in the development of plans for specific science and arts events at each location. A key component of such joint-local collaboration will be the 'ownership' of planned activities by the communities and NSF facilities, rather than the imposition of any plan of activities upon them. In order to get the science-arts programming off to a good start, we have identified some possible initial programming which will set a tone and standard for the local programming: one-person performances that bring to life science personalities such as Richard Feynman, Madame Curie or a one-person show on the trials and tribulations of a woman getting her Mathematics Ph.D. degree.

In the area of science and theatre, one series of programming could specialize in targeting a specific audience – young girls. We encourage the presentation, over a period of time, of a series of plays that feature women scientists (or were written by women). These could include *Thread of Life* by Rita Nachtmann (about crystallographer Rosalind Franklin); *Remembering Miss Meitner*, by Robert Marc Friedman (about nuclear physicist Lise Meitner); *Love and Chemistry* by Jean-Noël Fenwick (about the chemist and physicist Marie Curie), and *Schrödinger's Girlfriend* by Matthew Wells (about a mythical woman and quantum mechanics). All of these plays have been performed before and were well received by both science and general audiences in the *Science & the Arts* series at the Graduate Center.

We also have identified science-related plays about members of various ethnic groups. These plays include *Red Pumps at Ground Zero* by the Latino author Allen Davis about neuroscience and the World Trade Centre incident; *World Set Free* by Bryn Magnus about urban Chicago Black teenagers and their interaction with scientists involved in the construction of the nuclear reactor under Stagg Field at the University of Chicago; and *Miss Evers' Boys* by David Feldshuh, which tells the important story about the Tuskegee Experiment on humans



and the lives of those who were part of an experiment which they did not understand.

Currently we operate a web site for the *Science & the Arts* programming at the Graduate Center. It contains:

- A listing of *Science & the Arts* performance groups (or individuals) that we have presented during the past ten years. Many of these groups will have recently performed a science related program and should be able to repeat or modify the program for an interested group in their location.
- An annotated listing of copyrighted and public domain materials especially for the stage. We have access to an inventory of more than 200 plays which have a STEM theme many of which are unknown to both the science and the arts community.
- The web site hosts digital podcasts of many *Science & the Arts* special events including an international conference we held on science and the performing arts consisting of more than 30 presentations (see www.sciartconference2010.com).

In the past decade the marriage of science and the performing arts has emerged as a powerful tool in the national movement to advance knowledge and understanding in both fields. This includes plays such as *Copenhagen* and *Proof*, dance performances focused on science themes (e.g., *Genome*, *Ferocious Beauty*), and musical-science performances, including opera (e.g., *Doctor Atomic*). This strategy of the combining science and theater through public-focused seminars and performances was initiated by us in 2000 with the opening of the play *Copenhagen* in New York and expanded nationally as the play went on tour.



More recently, in 2008, Professor Schwartz collaborated with the Metropolitan Opera in producing and videotaping for the web a series of science symposia in collaboration with the New York premiere of the John Adams opera *Doctor Atomic*. For the past ten years, we have produced the series *Science & the Arts* at the CUNY Graduate Center in mid-town New York. (See: <http://web.gc.cuny.edu/sciart>) The enthusiastic responses of the hundreds who attend each presentation indicate that the performing arts are able to make science accessible, relevant and exciting to new and diverse, non-science audiences in ways that provide both scientific content and significant artistic and entertainment values.

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Our proof of concept, established over four years of written post-performance surveys by members of the audiences, has demonstrated firmly our appeal to audiences in which a significant fraction are more interested in the arts – dance, theater, music – than in science. Thus, we are reaching beyond the typical audiences who are attracted to *NOVA* science programmes on television, science museums and science lectures.

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60. The professionalisation of the explainer: a European perspective

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Explainers, pilots, facilitators, mediators, educators; whatever their name is, these professionals have an essential role in science centres and museums (but also in outreach activities of universities and research institutes); they are the human, direct interface with the public, and therefore have a huge impact in the success of the communication of their institutions (Bevan and Xanthoudaki, 2008; Rodari and Xanthoudaki, 2005; Tran, 2006; Tran and King, 2007).

A key factor determining the quality of their work is training, but training schemes for explainers are very often, all around the world, very short and practice-oriented, mainly aiming to empower explainers to repeat activities' storylines developed by others. Very often the initial training consists only in the shadowing of senior explainers, and it does not include reflections on theirs and museums' practices, nor any theoretical/methodological input regarding informal learning or science communication issues. Besides a few, praiseworthy best practices, training schemes for explainers are far off the standards of the training practices for more developed professional families.

Usually the correct development of a training scheme follows precise steps as in Figure 1.

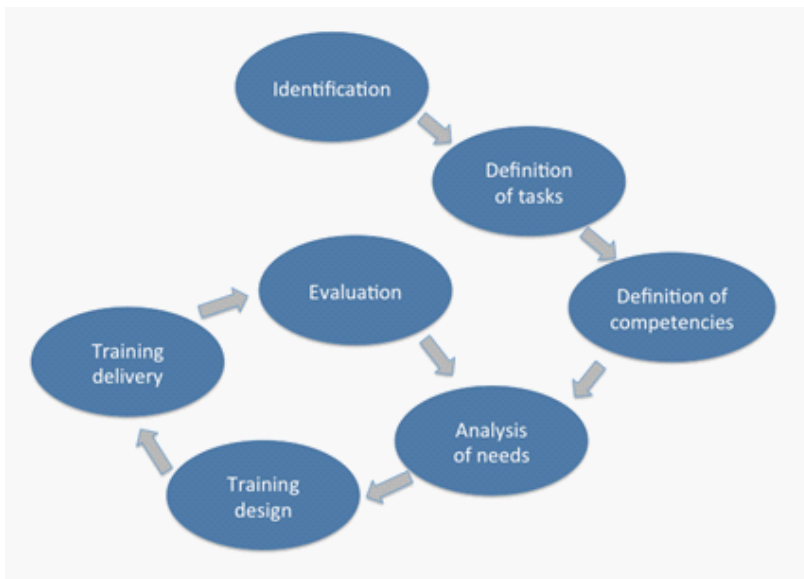


Figure 1: Training scheme development process

A professional family should be identified, and its work tasks listed. Then a dictionary of the competencies related to the tasks has to be prepared. When this background information is ready, a specific community can be tested in order to identify training needs. On the basis of this analysis a training scheme is designed. The training evaluation can feed the process again, so to develop new and better training schemes.

In the case of the explainers, however, those standard procedures are not possible: the identification of the explainers' professional community and the definition of its tasks and competences is still work in progress, in which action, research and practice merge, together with a few international studies (Bailey, 2006; Love-Rodgers and Kelly, 2001; Tran 2008a).

THE group, the Thematic Human Interface Group is a working group of Ecsite, the European network of science centres and museums, dealing since 2007 with the professional development of explainers. Different international projects funded by the European Commission (e.g. Dotik, Pilots, Feast) have in recent years undertaken actions or research, aiming to understand explainers' role and status in museums and science centres, and support their empowerment. Surveys on their demographic profiles, roles and training needs have been carried out, training courses at a European level have been organised (and carefully evaluated) and many international seminars have been held to exchange best practices and to discuss pro and contra of different training schemes (Richard and Barrett, 2011; Rodari and Merzagora, 2007; Rodari and Merzagora 2009). What can THE group's experience and that of the related projects tell us about the state-of-the art of explainers' professionalisation?



The explainers are a very diverse professional family, with a huge variety of profiles and roles, and work in institutions with very different organisational internal structures. In some institutions, for example, people who design activities and people who deliver them are different. In others, the same people are in charge of everything, from the visitors' reception to the materials development and maintenance. In general, we can say that their work is defined by a continuum, in which every institution collocates in different way representing its own identity, mission and cultural context (for a more complete analysis of this issue see Aubouin, Kletz and Lenay, 2010). The continuum goes from activities at the backstage of museums and science centres, thus totally hidden to the visitors, to activities that become the institution's public face.

As for the public programmes, a shared typology of the activities held in museums and science centres, still does not exist; on the contrary, the choice is based on the identity, strategies and priorities of each institution, and this means often limitations in the 'transferability' of programmes from one institution to another. In the case of EU-funded projects, a lot of time is spent just in order to understand which features characterize the different activities in the different institutions: guided tours, facilitation on the floor, science shows, science adventures, demonstrations, workshops, labs, debates, discussion games.

In general, explainers are engaged in a range of roles and tasks, that can be collocated on a continuum, that goes from the explainer as facilitator of visitors' personal experience (debates, inquiry-based activities etc.), to the explainer as actor delivering performances in front of a mostly passive, but deeply engaged, large audience.

Neither is it easy to define explainers looking at their age, backgrounds and careers. The

Pilots project survey, coordinated by Unverscience, deepened and confirmed the results of the previous Dotik survey, focusing also on the variety of ages and careers (Rodari and Merzagora 2009; Richard and Barrett, 2011). It is true that many explainers are very young people, students who use this profession to sustain their academic career, but there are also large groups of senior explainers, to whom this work is their loved profession.

However, a sense of community can be found in explainers coming from the most different institutions and of all ages and backgrounds, as has been testified by a few studies (Bailey, 2006; Rodari and Merzagora 2009) and during the international training courses organised by THE group and the related EU-funded projects. For example, it is amazing to see how drawings developed by explainers coming from different countries and asked to draw in different moments and locations represent the typical explainer in the form of a fantastic animal. The drawings are indeed surprisingly (or not?) very similar! (Figures 2, 3,4).



Figures 2, 3, 4: The explainer has a lot of hands in order to perform a lot of tasks and use a lot of different instruments; s/he has plenty of creative ideas; always smiling, s/he knows how to deal with different, sometimes critical, situations, etc.

Considering the variety and complexity emerging in all aspects of explainers' work, it is easy to understand that a process of professional development cannot be simple nor obvious. Should we opt for a complete training of explainers, this should cover a wide range of competencies:

- Knowledge, that comprises general knowledge (such as learning and informal education theories and methods, but also science and technology topics) and local (institution mission, vision, organisation, etc.);
- Communication and relational skills, comprising a large range of competences that specifically characterise the explainers' job; competences linked to a macro-dimension of the explainers' activities (such as how to communicate science, how to facilitate learning, how to engage different kinds of visitors) or to a micro-dimension of explainers' activities (how to use questions as learning tools, how to manage emergencies and conflicts, etc.);
- Personal and working skills, such as voice and body control strategies, skills for flexibility and open mindedness, ability to work in a team, problem-solving, etc.

Besides these competences – that we may call since decades the evergreen of museum educators – new areas of expertise are building up in the last years, in line with the evolution of museums' and science centres' missions (Czajkowski and Hudson, 2008; Henry, 2006; Munley and Roberts, 2006). For example, explainers should now be able to contribute to the policies or strategies for better community integration, for example making the museum more accessible to different kinds of people with different needs and cultural, religious or social backgrounds. They should also be able to tackle controversial issues and to facilitate debates on ethical, economic, social impacts of science and technology.

Is it possible to organise all these competences in a standard professional development scheme, applicable to all institutions? Is it possible, even more, to design and propose a standardised higher education level course of studies? The discussion is open (Bevan and Xanthoudaki 2008; Tran & King 2007; Tran 2008a; Tran 2008b).

What THE group has been doing in recent years can be certainly considered a contribution to the process of professionalisation. With a bottom-up approach to the problem, many European institutions (and some extra-European; see Massarani, Rodari and Merzagora, 2008) organise international training courses in which sharing of experiences and knowledge gradually leads to an international learning community, still very fluid in practice, but with a growing awareness and reciprocal knowledge.

The advantages of this approach are many. An increasing number of explainers and heads of explainers are gaining the feeling of being part of a community; they are aware of debates and trends inside the museum and science centres community; they are able to meet people from all over the world and share practices and reflections; they are acquiring new skills and competences. In particular, through the participation of Ecsite – the European network of science centres and museums – conferences, with seminars and talks focusing on their work, are giving explainers external recognition of the importance of their role and contribution to their institutions' mission.

A 'hard' interpretation of the word professional development should, however, lead to the hypothesis of a unique training scheme, offered by higher education institutions, recognised all around the world. Is this feasible, but is it also desirable? This hard approach presents, as viewed in the international debate on the issue, not only advantages but risks as well.

The advantages comprise a stronger external recognition of the explainers' profession, and surely better career opportunities for practitioners. At the same time, to require something like a diploma for explainers, presents, at least in the present situation, not negligible risks:

- To lose the variety of people now acting as explainers, including young secondary school pupils as well as retired people, with all the richness this diversity offers (Martin and Tames, 2008; Vakevainen, 2005);
- To lose the variety of practices created by institutions with different histories and cultures; a variety that is able to produces new formats continuously;
- To stop change, meaning also change in thinking about what it means to engage people in science: from the public understanding of science we moved to the notion of scientific governance and citizenship; the communication of science is changing fast in a fast-changing world: would an institutional course of studies be able to quickly adapt to the future changes?



- To reduce the distance from school educators. Many universities and higher education institutions do not have (with perhaps the exception of UK, USA and Canada) updated competences in informal learning; institutionalisation of explainers' training inside academies would risk bringing their profession too close to that of school teachers, losing the incredible innovation of explainers' informal approach (Gomes da Costa, 2005).
- To exclude the explainers from the definition and the development of their own role. In the actual bottom-up approach, the process of definition of their role and profile they see themselves as proactive actors (Motto, 2008). **Would this role be guaranteed if universities and other higher education institutions take the lead?**

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61. Mapping Variety in Scientists' Attitudes towards the Media and the Public: an Exploratory Study on Italian Researchers

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The paper outlines the results of the first exploratory survey on the attitudes of Italian researchers to their interaction with the mass media and the general public, and conducted at two interdisciplinary research institutions. Building on the methodology of the key international study in this field, the paper offers the opportunity for interesting comparison to be made with results from other countries. The findings point to a significant variety in scientists' attitudes towards the media and the public, which relate to different patterns of engagement in relevant activities, as well as to different models and conceptions of the science/media/public interaction.



Methodology

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The study used an adapted version of the questionnaire developed by INWEDIS, an international project on researchers' attitudes to communication and the mass media, which has already involved 1534 scientists from five countries (Germany, France, Japan, UK and USA – see Peters et al. 2008; Peters, 2009; Peters, 2012). The data collection was conducted by Computer-Assisted Web Interview on a population of 584 researchers working at the Edmund Mach and Bruno Kessler research foundations. The survey was conducted between May and June 2011. The response rate obtained was 50.5%. The sample consisted of 295 cases.

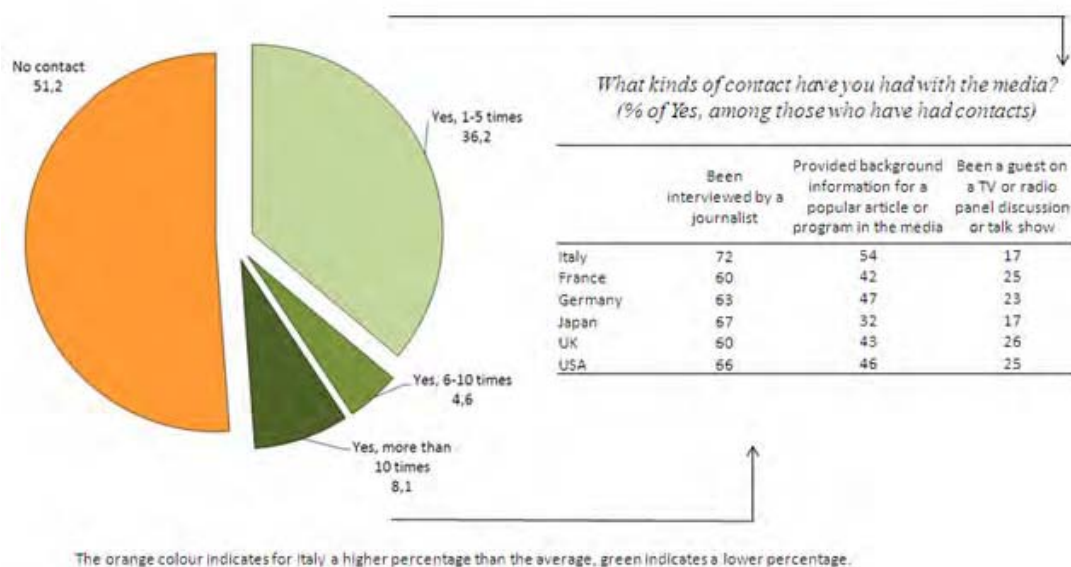
Results

Data analysis shows that interaction with journalists is more common than might be thought but is less common in Italy compared with the other countries covered by the international survey. Some 49% of the Italian researchers have had at least one contact with a journalist in the past three years. The most frequent form of interaction is an interview or a request for information for an article or programme, while only 17% of the respondents personally participated in a television or radio discussion. The frequency of contact with the media is associated with the scientist's position within his/her institution of affiliation and his/her level of productivity: among the senior researchers, in fact, more than 70% have experienced contacts with the media.

The majority of scientists consulted by the mass media believe that journalists have asked appropriate questions, and that they have been able to convey a message to the public. But only around one in three believe that they have been properly listened to, and that their research has been explained well. In practice, only 47% are satisfied with their last citation in the media – a percentage lower than those of the other countries surveyed.

Four interviewees out of ten believe that all their contacts with the media have had positive effects on their careers. In fact, after their appearances in the media, 42% of respondents have been contacted, apart from relatives and acquaintances, by fellow-scientists and other journalists, a practice more common in Italy than in France, Germany, Japan, the United Kingdom or the United States.

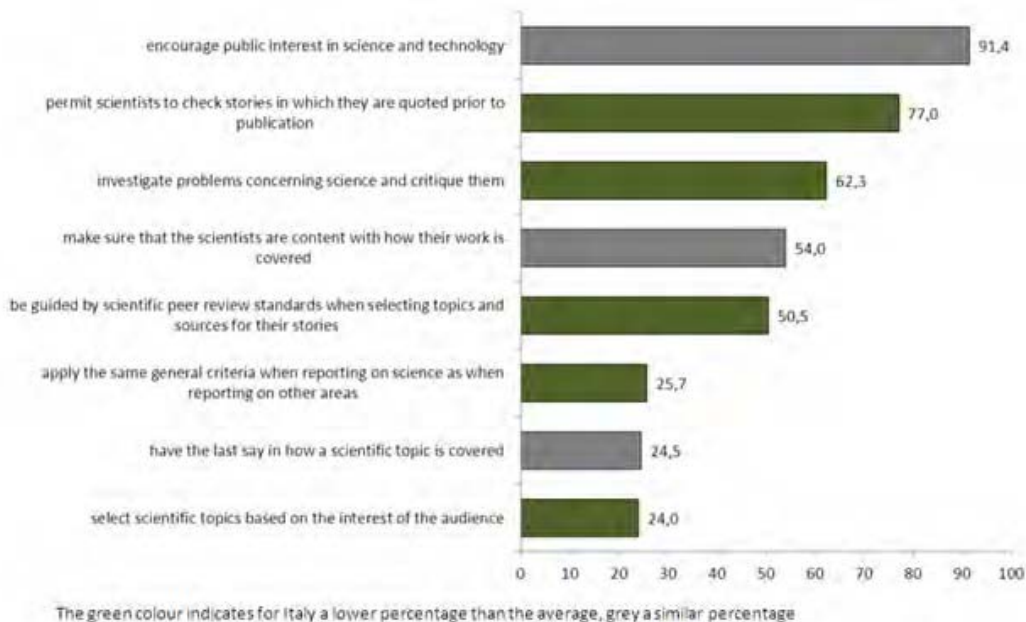
Figure 1. In the past three years, have you had professional contacts with journalists from the general mass media face-to-face, by phone, or by mail/fax/e-mail? (%) Source of international data: H. P. Peters et al. (2008), Science Communication: Interactions with the mass media, in Science, Vol. 321, No. 5886, pp. 204-205.



Whether or not the scientists have had relations with the media, according to the researchers at the two foundations covered by the Italian survey, the three main factors that may induce a scientist to refuse interaction with the media are the risk of misquotation, the unpredictability of journalists, and the possibility of negative publicity. For 73% of the interviewees, in fact, scientific topics are inaccurately expounded in the media; only a minority believe that journalists use credible scientific sources, and that the scientific information furnished to the public is sufficiently detailed.

According to the majority of the Italian researchers interviewed, journalists should encourage public interest in science, and address and criticise its problems. But journalists should also let scientists check the articles in which they are quoted before publication, and verify that they are satisfied with how their work has been treated. Journalists should not apply to scientific topics the same criteria that they use to treat other subjects. They should not have the last word on how to communicate a scientific argument. And they should not select scientific themes solely according to the interests of the public.

Figure 2. People differ in their expectations of how journalists should report on science. Please indicate your agreement or disagreement with the following statements about what journalists should do. Journalists should... (% of Agree)

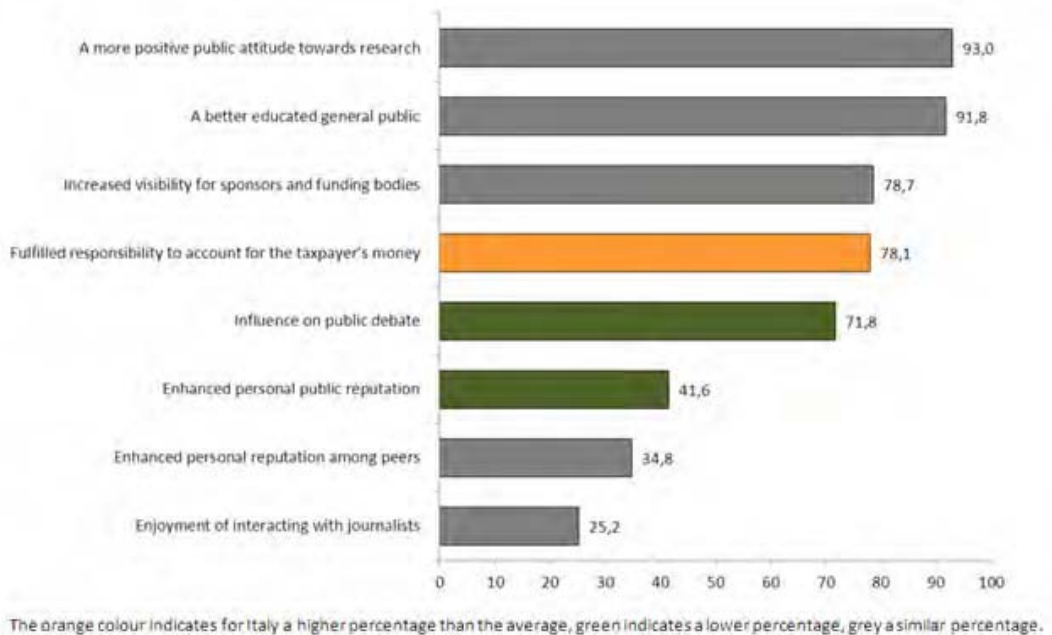


The survey shows that the relationship between scientists and the media is ambivalent: researchers are highly critical towards journalists but they recognise the importance of the public communication of science, and at times allow themselves to be influenced by the media in their research work.

More than the 90% of the interviewees consider it necessary to accept contact with the media in order to improve the education of the public and make its attitude to research more positive: if the public were more informed about science, they would have a more positive attitude towards research. Moreover, according to eight interviewees out of ten, public communication of the results of their research makes it possible to increase the visibility of the bodies funding their research, and to fulfil their responsibilities due to the fact that they were spending taxpayers' money.

Moreover, because the interviewees expected positive or negative publicity from the media, a not-negligible percentage of them (around three in ten) admit that they had brought forward or delayed a scientific publication, selected or avoided certain collaborators, presented or not a paper at a conference, selected or avoided particular research questions or sources of funding. The findings also point to a significant variety in scientists' attitudes towards the media and the public, which relate to different patterns of engagement in relevant activities, as well as to different models and conceptions of the science/media/public interaction (Bucchi, 2008).

Figure 3. How important to you personally are the following possible outcomes that make scientists feel more positive about contacts with the media? (% of very and somewhat important)



The following five types can be identified on the basis of our data:

1) *It's important to communicate, provided I am not in charge*; 2) *Let's discuss it*; 3) *Let me explain it in my own terms*; 4) *Oh, no: I have to communicate!*; 5) *Leave me alone, I have to work!*

The first group (*It's important to communicate, provided I am not in charge*) consists of those respondents who have not had contacts with the media and have not participated in public communication of science activities in the past three years, but have taken a training course on communication techniques. The researchers belonging to this group dislike the public communication of their work; they are unwilling to have contacts with the media, although they have a positive opinion of the latter; they believe in the social importance of public communication of science, and they have similar feelings about different models of interaction with the public. This group represents 18% of the sample, mainly junior researchers aged under 30. who have published at most 10 scientific articles.

Belonging to the second group (*Let's discuss it*) are researchers who have had occasional contacts with the media and had engaged in at most five science communication activities in the past three years. The members of this group have not attended a training course to learn communication techniques. They are willing to communicate their work, and they consider it important to do so. They expressed a neutral attitude towards the media. They are uncertain whether the deficit model or the dialogue model should be used to communicate science; in fact, when they communicate, they have the participation model in mind. This second group

comprises a further 18% of the sample: they are mostly researchers aged between 30 and 40 years old, no longer in junior positions, with 25 published articles at most.

Table 1. Summarising researchers’ attitudes: A typology

	Type 1	Type 2	Type 3	Type 4	Type 5
Contacts with the media	-	=	+	=	-
Public communication of science activities	-	=	=	+	-
Attending training courses	+	-	-	+	-
Deficit model	+	=	+	-	=
Dialogue model	+	-	=	-	=
Participation model	+	+	=	=	-
Judgment on the presentation of science in the media	+	=	+	=	+
Personal enjoyment of public communication	-	+	+	=	-
Social relevance of public communication	+	+	+	-	=

The typology was constructed by carrying out a two-step cluster analysis after recoding the variables and constructing additive indices. The variables related to patterns of public communication of science have been summarized in an index after principal component analysis.

The symbol - indicates that the majority of the researchers belonging to the group indicated the lowest mode of the variable (eg. no contact, no activity, disagreement), the symbol = indicates that the majority of the researchers have shown the average mode (eg. occasional contacts, uncertainty), the symbol + indicates that the majority of researchers have marked the higher mode (eg. frequent contacts, more than five activities, agreement, positive judgement).

The third group (*Let me explain it in my own terms*) consists of those respondents who have not taken a training course on communication techniques but have had frequent contacts with journalists. They have been engaged in up to five public communication of science activities in the past three years. The researchers in this third group find it correct to expound scientific topics to the public; that it is important to communicate science; and that it is enjoyable to do so personally. They express uncertainty as to whether the dialogue or participation model should be used; they believe it necessary to use the deficit model to communicate scientific facts and models to a non-specialist public. 16% of the sample belongs to this third group: pre-eminently senior researchers the apex of their careers, having published numerous scientific articles.

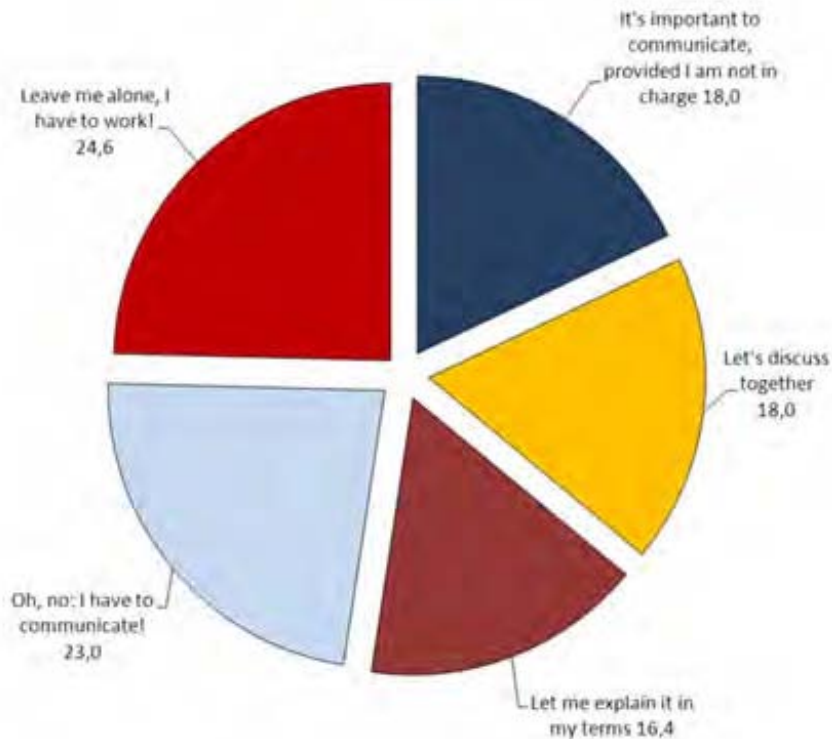
The fourth type (*Oh, no: I have to communicate!*) includes respondents who, like the researchers in the second group, have had occasional contacts with the media but, unlike them, have engaged in up to ten public communication of science activities in the past three years and have attended a course to learn communication techniques. Despite their active collaboration, members of the fourth group do not particularly enjoy communicating their work to the public and do not believe that it is important to do so. They express a neutral attitude towards the work of journalists. They disagree with the deficit model of science communication, and they are uncertain as to whether both the dialogue and the participation



models should be used. This fourth type describes 23% of the sample: interviewees with this profile are midway through their careers; they are mostly aged between 30 and 50 years old, and have published a maximum of 50 articles.

The fifth group (*Leave me alone, I have to work!*) is composed of interviewees who have had no contacts with journalists; have not engaged in any public communication of science activities in the past three years; and have never attended a training course on communication techniques. The researchers belonging to this group express a positive opinion about the work of journalists but they do not wish to have anything to do with it. They do not believe that it is socially important to communicate science. They are uncertain as to whether a deficit or dialogue approach should be used; but they certainly do not consider the participation model appropriate. This fifth group is the largest one in terms of size: 25% of the sample can fit into this type; their features are somewhat similar to those of the members of the first group, junior researchers aged under 30 who have published 10 articles at most.

Fig. 4 The distribution of types (%)



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62. Variations of scientist-journalist interactions across academic fields: results of a survey of 1600 German researchers from the humanities, social sciences and hard sciences

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Introduction

The interactions of scientists and journalists have been a research topic since many years. By means of surveys of scientists scholars have analysed the frequency of contacts with journalists, the scientists' assessment of these contacts as well as perceptions, motivations, beliefs and attitudes relevant for public communication. Mostly, these surveys included only "scientists" in the Anglo-Saxon meaning of the term, i.e. on researchers from natural sciences, life sciences and engineering. In a previous study (Peters et al. 2008), we had analysed the interactions between biomedical researchers and journalists comparing the situation in five large democratic knowledge societies (USA, Japan, Germany, United Kingdom and France), and looking for cross-cultural differences (but finding remarkably few). In a recent online survey of German researchers we focused on cross-disciplinary differences and included 16 disciplines not only from "science" but also from the humanities and social sciences.¹ The paper presents results of this survey and provides evidence of clear-cut differences in the science-media interface between academic fields.



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Methods

The 16 research fields used in the study were selected based on the list of academic disciplines used by the German Research Foundation. From each of the five main categories "humanities", "social sciences", "natural sciences", "life sciences" and "engineering" we selected three fields at random (with some constraints in order to avoid the selection of fields too similar). We added the field "communication research" as a fourth social science discipline because of our own particular interest in it.

¹ The survey of scientists is part of a collaborative project that also includes surveys of journalists and public information officers of research organizations as well as content analyses of newspaper articles and press releases. The project is supported by a grant from the Volkswagen Foundation. Principal investigators are Alexander Görke (Free University of Berlin), Matthias Kohring (University of Mannheim), Frank Marcinkowski (University of Munster) and Hans Peter Peters (Research Center Jülich). We gratefully acknowledge the technical support in conducting the online survey by our colleague Gisela Deegen.

In the sampling of researchers from each field we used the same approach as in the previous five-country study, where we selected study participants based on their authorship of relevant scientific publications (Peters et al. 2008). Taking into account the different publication habits of researchers from different fields, we collected about 475,000 data records about authors and co-authors, editors and co-editors. This was easy for fields in which researchers publish mainly in peer-reviewed international journals that can be accessed through literature databases, but very time-consuming for social science and humanities fields where German-speaking journals and books still play an important role in scholarly communication. For each field, a list of researchers who had published more than once in the field in a two-year period was produced and – if necessary – a random sample of 350 researchers was drawn. (For neuroscience the sample size was 1000 in order to allow an individual analysis of that field.) Missing email addresses were searched online.

Using the SoSci Survey system,² we prepared an online questionnaire that took about 20 minutes to complete and emailed invitations to 5940 researchers in May 2011. After five email reminders the overall response rate (excluding non-working email addresses from this calculation) was 33.7%. Excluding respondents who indicated in two initial filter questions that they were not part of the target population, we got exactly 1,600 usable responses.

The questionnaire included questions on the perception of media coverage, expectations towards journalism, preferences related to communication, perceived expectations of organisational management and peers, perceived costs and benefits of media visibility, consultation requirements before media contacts, frequency and outcome of media contacts, perception of the characteristics of the own area of research, repercussions of media orientation on research, as well as some basic socio-demographic (e.g., age and gender) and work-related questions (e.g., type of research organisation, management position, number of publications and funding sources for research).



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Results

In this paper we focus on four dimensions of the science-media interface, expecting systematic differences between the 16 academic fields:

- Interdependency between academic fields and journalism
- Demarcation of inner-scientific from public communication
- Demarcation of scientific knowledge from everyday knowledge
- Professionalisation of interactions with the media

The empirical results are presented in a straightforward and consistent way. For each of the four dimensions we have selected two empirical indicators. Their average values or proportions are shown for each of the 16 academic fields by bar charts (Figures 18, appendix). In each chart the academic fields are rank ordered from highest to lowest indicator value, and to make it easier to grasp the message of the charts the academic fields from the humanities and social sciences are colored red, those from «hard sciences» (natural sciences, life sciences and engineering) are colored blue.

² See <https://www.soscisurvey.de>.

Interdependency between academic fields and journalism: To measure the strength of interdependency, i.e. how relevant the media are for the academic fields, we used the reported frequency of interactions with journalists and the reported frequency of repercussions on decisions about research and scholarly publication of research as indicators. The number of researchers with frequent media contacts varies greatly between the research fields. Researchers from humanities and social sciences are much more likely than researchers from hard sciences to have frequent contacts with journalists (Figure 1). This is only partly – if at all – the effect of a stronger media interest in the humanities and social sciences; mostly this reflects the extremely disparate size of the research communities. Media interest in fields with large research communities (such as biology and neuroscience) is simply spread over many more researchers than in the smaller humanities and social science fields.

Other factors, such as the typical size of research groups and projects, also play a role. However, the density of personal experience with the media is a factor *per se* relevant for the orientation of an academic field towards the media. The repercussions indicator is based on a question asking respondents, e.g., whether they have “chosen or avoided certain research methods” or “used or avoided certain kinds of wording in scientific publications” because of anticipated media response. If at least one of a list of eight such possible effects was acknowledged, the indicator value was defined as “true” for that particular respondent. Again, this indicator shows clear differences between the academic fields with a tendency of fields from the humanities and social sciences to show more responsiveness to anticipated media coverage than fields from hard sciences (Figure 2).

Demarcation of inner-scientific from public communication: Two indicators are used to determine how the academic cultures in different fields distinguish between scholarly and public communication, i.e. motivate researchers to engage in public communication only after the research has been completed and the results have been subjected to inner-scientific quality control. The first indicator is based on the perceived effectiveness of the so-called Ingelfinger rule, i.e. the policy of scientific journals not to accept manuscripts for publication when the research has already been covered by the public media.

Figure 3 clearly shows that this rule is still effective in the hard sciences (with the exception of mathematics), but much less so in the humanities and social sciences (with the exception of psychology). The second indicator refers to the readiness of researchers to provide information about ongoing and unpublished research to journalists. This indicator perfectly separates the humanities and social sciences from the hard sciences (Figure 4). While researchers from hard science are reluctant to share information about ongoing and unpublished research this is much less an obstacle for researchers in the humanities and social sciences.

Demarcation of scientific knowledge from everyday knowledge: The indicators of this dimension describe the relationship between the respective academic body of knowledge and general knowledge. To what degree is the knowledge produced in the academic field believed to be part of the knowledge everybody is normatively expected to have, or considered specialist knowledge? And how relevant is it to the issues that dominate the public agenda? The first indicator is based on the respondents’ (dis)agreement with the statement “Research in my research area is part of general education”. Figure 5 shows that especially the three academic fields from humanities (plus communication science) assume that their academic knowledge should be shared with the general public, i.e. not be considered knowledge only specialists are expected to possess.



The second indicator is based on a survey question about the content of the latest encounter with a journalist. The answers show that knowledge from humanities and social sciences is more often demanded by the media as “expertise” – not because it represents a scientific advance. When talking to researchers of these fields, journalists are interested in comments on topics of the public agenda in the first place, while they more often inquire about research and research results when covering hard sciences (Figure 6). An exception to that pattern is archaeology; it is of course plausible that this field is not considered a source of topical expertise by journalists.

Professionalisation of interactions with the media: This dimension is understood as the degree to which the “who” and “how” of interacting with the media is regulated by the organisation (e.g. university) and by norms of the scientific community, and is not solely at the discretion of individual researchers. The first indicator is based on the affirmative answers (“always” or “in some cases”) to the question about whether the researcher has to consult the “unit responsible for press relations” before talking to a journalist. With the exception of mathematics, consultation with the public information department is more often required from researchers in the hard sciences than from those in the humanities and social sciences (Figure 7).

Another question presented seven “conditions” which may make it acceptable for colleagues that a researcher talks about scientific topics in the media, such as “The scientists have an excellent scientific reputation” or “It is a serious medium with high-quality science reporting”. The second indicator counts the conditions the respondents thought to be important for acceptance of their media contact by their colleagues. Researchers in the hard sciences perceive more normative expectations of their peers to be relevant than researchers from the humanities and social sciences (Figure 8). This indicates a stronger control of media contacts in the hard sciences than in the humanities and social sciences by professional scientific norms.

Conclusions

Compared to the hard sciences academic fields in the humanities and social sciences are characterised by stronger interdependency with journalism, lower demarcation of inner-scientific from public communication, lower demarcation of scientific from everyday knowledge, and lower professionalization of interactions with journalists. When ranking the 16 research fields by aggregated (standardised) values of the eight indicators, the academic fields of history, philosophy, communication studies and law form the “humanities/social science” end of the scale while materials science, neuroscience, biology, chemistry and veterinary medicine represent the “hard science” end. The other disciplines show either moderate indicator values or represent mixed cases (e.g. archaeology and psychology).

We interpret our findings as pointing to two ideal types of science-public interface: *Public communication as the “outskirts” of science communication*, where the interested attentive public is partly (and mostly in a listener role) included in scholarly communication, and *public communication as popularisation*, where the arenas of inner-scientific and public communication are clearly separated and the audience is informed by science specifically reconstructed for the public. The outskirts type of interface dominates in the humanities and social sciences while the popularisation type dominates in the hard sciences. This picture is simpli-



fied, of course, as it ignores existing special communication arenas for amateur scientists and professional users of scientific knowledge, for example. Furthermore, different research areas within one academic field may have different kinds of relationship with the media. Empirically, we therefore find mixed forms.

One may speculate about the reasons why academic fields have developed different kinds of interface with the media. Very briefly, we would like to mention three possible and interdependent explanations: differences in *comprehensibility*, *relevance* and *power*. Hard sciences are more often characterised by esoteric knowledge and epistemic practices than humanities and social sciences. This has consequences for the comprehensibility of scientific publications for laypeople, for example. Furthermore, research topics of the humanities and social sciences more often refer to situations and developments that are part of the everyday world (moral and legal problems, political decisions, social change, the economy), making the construction of relevance for a broader lay audience easier than in the hard sciences. And, finally, the hard sciences have a quasi-monopoly in generating knowledge about their research objects while the knowledge of the humanities and social sciences often competes with knowledge from practitioners, other professional observers such as journalists, or everyday knowledge of laypeople. This monopoly in defining truth may be a power resource for hard sciences in their relations with the media, but less so for the humanities and social sciences.

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Figure 1

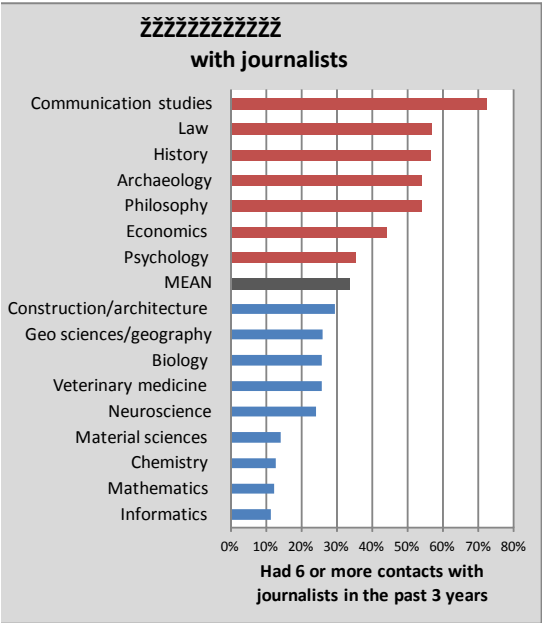


Figure 2

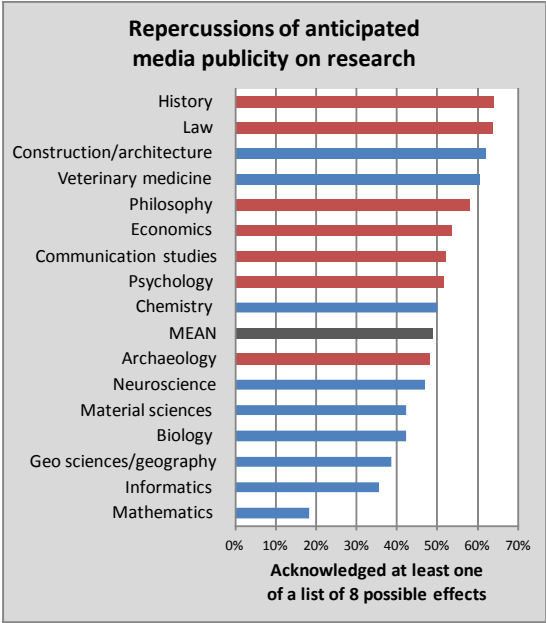


Figure 3

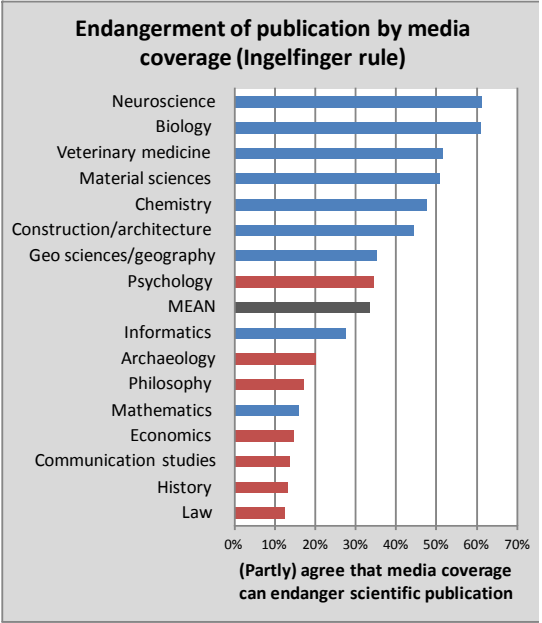


Figure 4

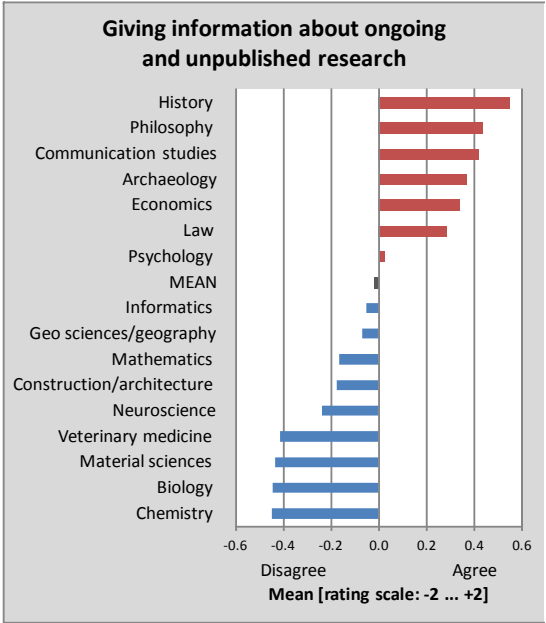


Figure 5

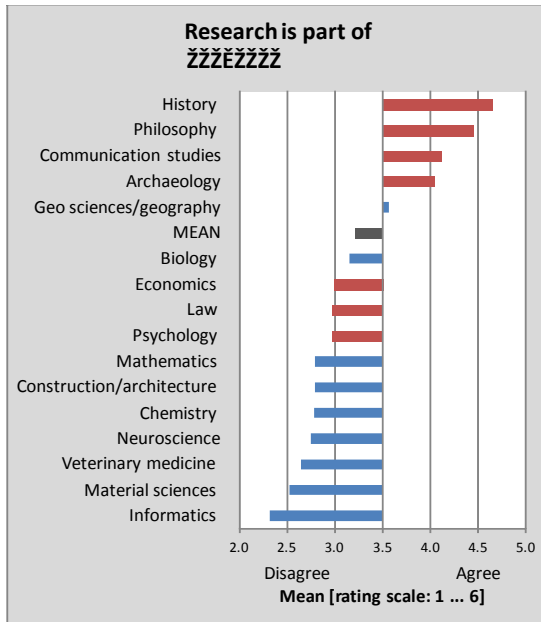


Figure 6

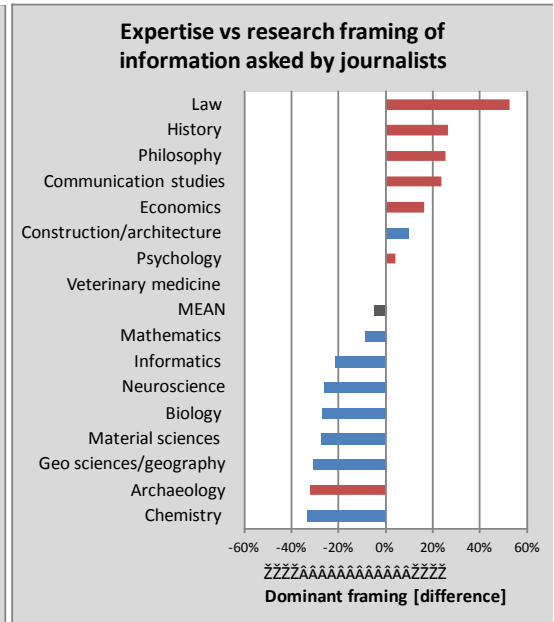


Figure 7

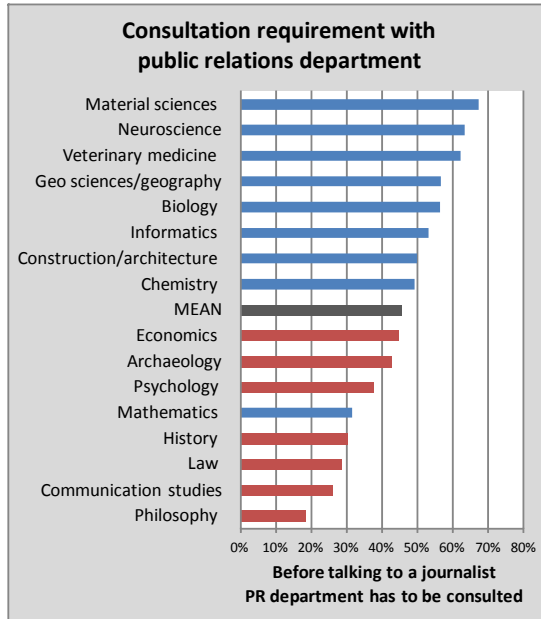
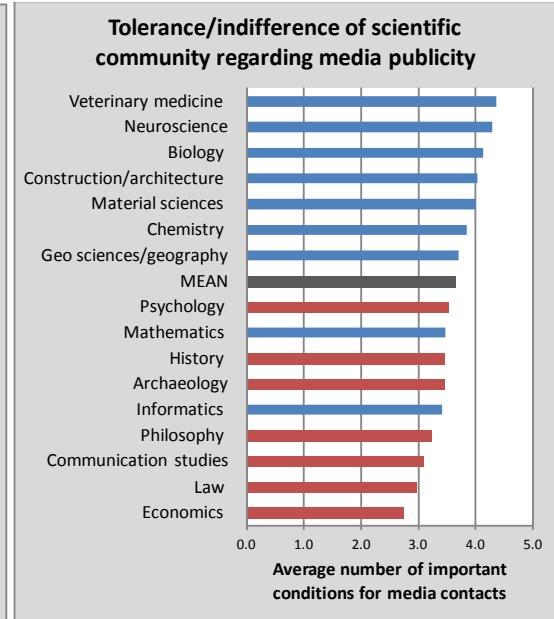


Figure 8



63. Science Communication E(value)ation: Understanding Best Practice

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Understanding best practice evaluation is paramount to the problem of determining best practice science communication; however, the problem is fundamentally one of determining which features of science communication might be usefully considered. Such features are often discussed by researchers and practitioners within debates about models of science communication. In particular, many researchers and practitioners debate the appropriateness of a model of “engagement” or participation for describing and evaluating science communication activities. While some have suggested that science communication models have evolved, others contest that progressive models are merely reincarnations of old ones—particularly in practice. Nonetheless, a sense remains in science communication circles that science communication activities modelled by notions of deficit and dialogue are less desirable than ones modelled by engagement.



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It is our understanding of modelling, and its resulting influence on evaluation practice, that is central to what I'd like to discuss here. I will argue that it is our misapplication of these models of science communication that is hindering the development of effective evaluation practices, and that a new view, or perspective, of the features that make up these models is needed.

Transmission view of science communication

One way of modelling communication is to take a linear, or transmission view of communication in which an idea originates with a sender, who sends it via some medium to a receiver, and the receiver does something with that message. A common metaphor used to describe this view is one of transportation; during the 19th century, the word “communication” referred to the physical transportation of messages (usually in the form of letters or telegrams) in the same way that one might refer to the transportation of goods or people (Carey 1989).

It seems that for some time now—at least since notions of scientific literacy and public understanding of science were ascribed to communication deficits—a linear view of communication has served as a useful way of describing and prescribing the processes of science communication. To date, science communicators continue to plan and assess their efforts according to various elements of a transmission view of communication.

A transmission view of communication has some obvious advantages: it is relatively simple to understand, can be generalised to different kinds of communication, and

its results are easy to quantify. The focus is on disseminating knowledge and ideas, which makes it relatively easy to evaluate—“good” science communication in this view refers to effective message transfer (e.g., Was the message received in the way that it was intended, and did the receiver do what was expected as a result?). For science communication, the expected outcomes as a result of message transmission have been regarded as a change in knowledge, understanding, attitudes or behaviour.

However, a transmission view has proven to be both ineffective and insufficient for planning and describing our latest conceptions of science communication. As a result, there has been a movement in science communication to shift away from viewing communication as the transmission of information, to a notion of communication as “engagement”. And engagement much more resembles what communication theorist James Carey described as a ritual view of communication.

Ritual view of science communication

Another way of modelling communication is to take a ritual view. In Carey’s ritual view of communication, the focus is not on imparting information (as it is in the transmission view), but on shared understanding of meanings in a cultural context. Rather than concentrating on whether or not the message is received, a ritual view is concerned with elements such as when and where the act of communication takes place, the roles of (and power relations between) the people involved, and the intended purpose of the communication. Essentially, a ritual view offers a way of describing this new standard of science communication that is aspired to – communication as the “representation of shared beliefs” defined in terms of “sharing”, “participation”, “association”, and “fellowship” (Carey 1989). The question for science communication now becomes: what does this new phase of evaluation look like?

It is apparent that retrofitting old evaluation techniques, which are suited to transmission views, into this new form of science communication is insufficient. For example, demonstrating an improvement in the publics’ knowledge, understanding, or attitudes about science is more reflective of our ability to persuade than it is of their engagement experience. And it makes sense that current evaluations models are not working because the transmission view is a characteristically different view with what might be considered characteristically different “units”. To understand the benefits of engagement, a new mode of evaluation—to fit our new model of communication—is desperately needed.

I suggest that instead of emphasising the old units of “knowledge, understanding, attitudes or behaviour”, the way forward lies in featuring values in the evaluation process. In evaluating science communication, the fact that values are an inextricable part of evaluation has largely been ignored. A values perspective allows for a broader perspective, provides a more genuine descriptive (rather than prescriptive) account, and encourages a progression from linear models of science communication to more multidirectional models.



Advantages to a values perspective

Allows for a broader perspective of the evaluation process: In normative, transmission modes of science communication evaluation, the focus is on the evaluation itself as a product. Essentially, evaluation is represented by all the activities that go into it (e.g., gathering and analysing data), and the production of a report or document based on measured objectives, indicators, etc. However, there are a wide variety of other features of evaluation that tend to remain invisible, or separate from the broader picture of science communication evaluation.

In a ritual or value-focused evaluation framework, it is necessary not only to look at the values in the product of evaluation, but also the values in all the other inputs that shape how the evaluation is produced. In other words, the values that shape an evaluation are not “contained” within the evaluation itself—they come from stakeholder documents (e.g., policy and funding documents, evaluation guides, research publications) and sources of data (e.g., emails, interviews, focus groups, informal conversations, questionnaires/surveys, observations). Therefore, an examination of the values in an evaluation document must also examine the values that framed how the evaluation came into being. This provides a much more diverse and richer collection of data for understanding the bigger picture in evaluation of engagement than the reporting of objectives, indicators, etc.



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Allows for a reflection on how things are, not how they should be: In a normative, transmission mode of science communication evaluation, there is a tendency to regard “value judgements” (e.g., speculative statements) as subjective and therefore inadmissible. It is easy to criticise these judgements and argue that the person who wrote them does not have sufficient evidence or that their justifications are invalid, and that the key to improving evaluation is to provide more training, knowledge, or understanding of evaluation.

In contrast, in a value-focused mode of evaluation we can take a broader view of how people are valuing activities and look at that same judgement in light of the other inputs in the evaluation process. Each of the inputs reflects decisions made by a person (or people) about what “things of value” to include and exclude and how to support and frame their arguments. For example, evaluators may explicitly or implicitly make decisions about data to collect and make statements of value based on what they think funders or participants value. With a values perspective, we can look at them and discuss how the evaluator, or the person writing the report, appears to be assuming values on behalf of other people. And that assumed value is guiding how the evaluation is carried out. In other words, instead of closing the dialogue about what is happening in evaluation by saying that it is incorrect, we can reflect on the processes and try to understand the evaluative influences at work.

Thus, instead of looking to improve evaluation by providing some remedy for insights that can be supported with formal, objective evidence, it is more important to recognise that evaluation happens around values. Values can be expressed explicitly,

but they are also assumed, imputed, and justified in particular ways. However, values cannot be eliminated in evaluation—even wanting to minimise them, by endorsing objectiveness, is a reflection of values.

Allows for progression from linearity: The tendency for evaluation to appear linear makes it appealing to try and describe the flow of how values should happen in discourse. For example, one could argue that the “push” side of the information flow (e.g., advice from governments, policymakers, funders, and researchers) feeds into how evaluators collect information from the “pull” side (e.g., parents, children, participants, etc.).

However, in practice, it is less clear where the values used by the evaluators come from. For example, evaluators may draw on funders’ values as equally and prevalently as they may draw on participant values, and ultimately put them forward as their own values.

As the ritual model predicts, values are everywhere. Evaluators and researchers are struggling with them because they do not recognise them as values. A values perspective encourages us to see that our attempts to model evaluation in a linear fashion are failing; just as we tried to make science communication modelled in a linear fashion and decided to move on, now we have to do the same thing for evaluation.



Conclusion

In summary, a “values” perspective not only fundamentally changes how you examine evaluation, such a view is necessary if science communication is going to move on from linear models of communication where there tends to be a desire to eliminate values. The field needs to acknowledge that values cannot be eliminated—because evaluation is about demonstrating the way people value.

I suggest that if science communication is to move into an engagement paradigm, or model of science communication, a shift in thinking is required. Successful science communication can no longer be judged by its adherence to a transmission model of practice, but must move on to a ritual model of both science communication and its evaluation. Best practice evaluation, therefore, should not attempt to eliminate values, but embrace them, make them transparent, and make use of them.

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64. Understanding Science Television’s Audiences: an analysis of viewer rates in 10 European countries

Markus Lehmkuhl, Tuomo Mörrä, Christina Karamanidou, Kristina Boyadieva, Yvonne Cunningham, AVSA Team, Audio-Visual Science Audiences project

This paper attempts to map the factors that influence the viewing habits of audiences of television’s science programmes in 10 European countries (Austria, Bulgaria, Estonia, Finland, France, Germany, Greece, Ireland, Spain, Sweden). It became quite obvious during our research project that a key to understanding audiences is to understand the interplay between supply and demand, between the structural characteristics of TV markets and the actions of individuals. The audience choices are dependent on what is broadcast by television companies but on the other hand the audience choices and respective ratings influence the decisions made by broadcasting companies. In the vocabulary proposed by Anthony Giddens (1984) in his theory of structuration, human agency and social structure constitute each other mutually. In Giddens’ theory this is called the duality of structure.

The interplay between structural characteristics of television markets and the aggregated actions of individuals as expressed in audience ratings have not roused much interest among media scholars. Although the various influences on media production have been illustrated in a number of models (Webster & Wakslag 1983, Rosengren 1994, Schweiger 2007, Shoemaker & Reese 1995, McQuail 2010) we are not aware of studies that combine the viewing habits with the determinants of the choices made by channels. This is what we seek to do in our research.

We will first present an overall picture of the audience rates of different programme types in 10 European countries (table 1).

Programme type	Average viewing rate (%)
Information	1.9
Popularisation	1.2
Edutainment	1.3
Advice	1.9
Advocacy	1.0
F-value (3.56)=	1.2 n.s. (n=210)

Table 1: Average viewing rates by programme types



In summary, information programmes refer to science news programmes, popularisation programmes are predominantly documentaries, edutainment programmes mix educational and entertainment elements, advice programmes give audiences advice especially on health and healthier living, and advocacy programmes refer to environmental programmes which advocate the need of environmental protection.

On average, each programme in our sample reached about 1,3 percent of the whole population in ten European countries. This accounts for about 300,000 viewers for each programme. The differences between the rates of programme types are slim and the low F-value indicates that significant differences among the rates of different programme types could not be found. This means that there is no evidence that different-sized audiences can be related to different programme type preferences.

Our next table shows how the audience shares of science programmes are divided between the different age groups (table 2). The table shows that the share of young people is clearly lower and the share of 50+ audiences is clearly higher than their share in the whole population.

Age group	Average share (%)	Share in population	Difference
14-29	11	24	-13
30-49	28	33	-5
50+	60	43	17



Table 2: Comparison of audience shares of science programmes (n=210) with their share in the population

Our samples do not allow cross-country comparisons but we have not identified any single country in which the audience share of young people comes close to their share in the whole population. The share of young audiences is between 7 basis points (France) and 15 basis points (Greece) lower. Even the share of audiences between 30 and 49 is mostly considerably lower than their share on the whole population. Only in Austria and in Ireland the shares of middle-aged audiences approached their share in the whole population. In other words, audiences of European science programmes are relatively old.

Table 3 explores how the shares of young viewers can be divided between different programme types.

Program type	Share of viewers 14-29	Standard deviation	Number of programmes
Information	9.6 %	6.2	10
Popularisation	11.1 %	10.4	115
Edutainment	15.8 %	11.1	43
Advice	8.5 %	7.6	24
Advocacy	10.9 %	8.8	18
F-value=2.25 n.s			

Table 3: Average share of young viewers (14-29) by programme types

Although the average share of young audiences who have watched edutainment programmes is almost twice as high as their share among the audiences watching advice programmes, the differences are not significant. This is certainly due to the low number of cases in some of the categories. According to our findings there is no convincing evidence that the low shares of young audiences concern specific programme types in particular.

Science programmes as a whole appeared not to be very attractive to young audiences. Every single science programme type reached considerably lower shares of young people compared to their shares in the whole population. Differences are more apparent among the older audiences (table 4).



Programme type	Share of viewers 30-49	Standard deviation	N
Information	22.3	6.1	10
Popularisation	28.0	9.4	115
Edutainment	34.8	13.0	43
Advice	20.1	11.2	24
Advocacy	31.7	12.2	18
F-value= 7.7			

Table 4: Average share of viewers in the age group 30-49 by programme types

Edutainment programmes got significantly higher shares than other programme type categories (except advocacy programmes). On the other end advice (health) programmes got significantly lower rates than other programme types except information programmes.

Differences in programme type preferences were also more obvious among viewers older than 50 years than among the young audiences. Edutainment programmes got significantly lower shares than all other programme types while advice (health) programmes got significantly higher shares than other program types with the exception of information programmes. These findings indicate that programme type preferences are of lower relevance for young audiences than they are for older age groups.

However, even among the older age groups significant differences could only be found in the viewing of edutainment and advice programmes. Program type preferences did not seem to explain the differences of the audiences attracted by information, popularisation and advocacy programmes. It is clear that audience preferences for contents are just one and insufficient factor in understanding the logic behind the audience figures.

We finally present the way we put programme type preferences into to the wider context of other factors that may influence programme choice behaviour (table 5). We calculated three regression models in which the shares of audiences went in as dependent variable while viewer availability, channel preferences, viewer awareness, programme type preferences, and specific programme type preferences went in as independent variables.

First of all, we could not identify content-related factors that would increase the probability to reach higher share among the young audiences. Instead our findings suggest that channel preference is the most important factor when explaining the differences of the shares among the young science audiences. Of certain relevance are also young viewers' availability and their awareness of what is provided. The probability of reaching young audiences increases if science programmes are scheduled outside peak hours and on big channels.

Conclusion

Our analysis suggests that the preferences of young people regarding science programmes are not as clearly interpretable as they are among the older age groups. At least interpretation is not possible at this level of classification of program types. Maybe the media uses of young people are individualised to an extent that interpretation of aggregated actions is difficult – if not impossible. Or maybe they do not have, as a group, specific, science-content-related preferences.

Whichever explanation is true, the consequence is the same: young audiences as a group, as a mass audience cannot be targeted by science contents in television since their preferences are unclear. On this level of analysis their audience shares can only be linked to the structural factors like the preference for commercial channels, the awareness of what is offered, and young viewers' availability to the programmes.



Predictors		14-29	30-49	50+
Viewer availability				
	weekdays/weekend	excluded	.12	excluded
	off peak/peak h.	-.12	excluded	.17
Channel preferences				
	public/private	.33	.20	-.34
Viewer awareness				
	Market share channels	.17	excluded	excluded
Programme type preferences				
	Edutainment	excluded	.13	-.20
	Advice	excluded	-.25	.23
Specific programme type preferences				
Frequency	regular/not regular	excluded	.25	-.18
Topic	natural/social sc.	excluded	excluded	excluded
	variety of topics	excluded	excluded	excluded
R²		.16	.24	.33

Table 5: Stepwise multiple regression of programme choices by age groups (n=220)

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65. Audience judgements on TV science programming in five EU member states

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Engagement with science through audiovisual media is, at least to a certain extent, an active rational behaviour of audiences, which have two analytically different expressions: *selection of science content* in audiovisual media and *reception of science content* in audiovisual media. The aim of this paper is to discuss what motivates different audiences to watch science programmes on television, and to compare results and analyses between different European countries. Data was obtained by carrying out 40 focus group discussions; these took place in five European member states: Germany, Finland, Greece, Bulgaria and Ireland.

Results

Table 1 shows the categories into which motives of engaging with science (through media use) are classed. Categories and classification were taken from Katz and Gurevitch (1976: p. 220)



Table 1: Classification of motives for engagement with science (through media use)

Referent Resource & Mode	Self	Peers	Society	Tradition, Culture	World
Cognition (acquiring, increasing knowledge, understanding)	x			x	x
Affect (increasing/acquiring emotional experiences)	x				
Integration (rising social status, trust, stability)	x		x	x	
Interaction		x			

The following list gives motives for engagement with science as expressed in the focus group discussions.

Cognitive motives

- Expanding the limits of individual worlds by getting insights into completely unknown worlds
- Enrichment of known worlds by unknown scientific explanations
- Increasing understanding the world around
- Increasing understanding of self

Affective motives referring to self

- Becoming fascinated
- Becoming surprised
- Becoming inspired to search for further information
- Avoiding the feeling of wasting time
- Increasing ability to unwind from daily routine (self)

Integration

- Becoming orientated to the world in the future (world)
- Becoming orientated to behave rationally (self)
- Formation/confirmation of own identity (self)
- Rising social status (peers)
- Gaining expertise which will be requested by others (peers)

Interaction

- Gaining interesting things to talk about (peers).

In focus group discussions, motives did not appear clearly distinguishable one from the other. The statements by participants indicate that different motives are strongly connected with each other. The perception that science provides new information is crucial for understanding the motivation for engagement with science by participants in all focus group discussions. The motive of increasing knowledge about the unknown is generally connected with other motives.

The next section is a more qualitative description of selected motives for engagement with science as expressed by participants in focus group discussions.

Cognitive motives connected with cognitive arousal and integration

German participants expressed views that science (or science programmes) provides insights into completely or largely unknown phenomena: this is why participants liked science and/or science programmes. Statements were sometimes accompanied by remarks like “getting fascinated”, “getting impressed”; “getting inspired to go deeper into a subject”. Some German participants found that science provides explanations for well-known phenomena; this was why participants liked science programmes especially.



Learning about the unknown is also connected with the adjustment and/or development of individual world views by new scientific findings. Florian, 39, when asked what prompted his interest in science responded by saying: “The acquisition of understanding, of insight – for me, personally. In the best case to also create a new conception of the world”. Some German participants liked science because it orients them in different areas of everyday life and new scientific findings influence every day routines and habits.

According to *Finnish participants* new knowledge helped them understand how things work and new ideas helped them to understand themselves and other human beings as well as past and present societies. In a group composed of students of upper secondary schools practically everyone replied to the question by saying how science could help them personally in orientation in life or in becoming a better person. “When you learn more you can understand bigger entities and how things are linked with each other.” (Iiris K., group no. 3).

Bulgarian participants talked about education and knowledge the most and described their interest and engagement with science as an internal need they felt. The reasons they gave were, among others: “an opportunity to gain knowledge of the world”, “need for knowledge”, “need for information”, “teaches you something new”, “to know who we are and where we came from”, “We can learn from these shows what can be expected in the future in various areas of science and technology, what will happen in the future”, “to get facts and information on different topics”, for example: “Only in shows like these you can see the progress that mankind has made, what is the newest thing in different spheres of science. More or less we must be informed”.

In *Greece* older participants added the dimension of education or information. This was done exclusively by the 50+ group. Participants liked science because of the fact that “you learn something” [Rosa, 54] and “get informed about problems” or “learn about the unknown you would like to understand better” [Aristidis, 61].



Cognitive motives connected with other affective motives

This combination did appear less often compared to other combinations, it was explicitly mentioned in discussions in Germany, Bulgaria and Ireland. In Germany, Martin, aged 32 said: “It’s also a pastime activity, to be quite trivial. When I switch on the TV there’s quite some bullshit on and these programmes (science programmes) stand out against the other ones by letting time fly by rapidly. They’re also quite interesting even if you don’t derive any personal utility from them and just watch them to relax and to learn something about a topic you’d never heard of.”

Bulgarian participants mentioned entertainment and recreation as contributing to their interest in science and science programmes. Specifically, they mentioned that it: “helps you unwind from the daily grind”, “pleasurable intellectual effort”, these programmes, according to participants, are more interesting than most of the entertainment programmes and talk shows shown on TV (“We prefer them to the Turkish soap operas, which have flooded television”).

Watching science programmes, particularly blue-chip documentaries rather than more entertainment-based formats, was perceived by Irish participants as being a worthwhile activity. Participants said that they enjoyed watching high-quality programmes. One 16-year-old

male student said he liked to watch such programmes because: “It gives you a break away from all the reality TV. It gives you interesting stuff that is real”.

Summary

The focus group discussions illustrated that participants engage with science by choosing to watch science programmes on television. They are motivated to watch these programmes because of:

- (a) the perceived personal functionality of science (in media)
- (b) the perceived characteristics of the medium that transmits science content
- (c) their perceived personality traits (curiosity)

In this paper we focused on the first two aspects. The results obtained show that participants often did not draw a clear line between motives for their engagement with science and motives for engagement with science through watching science television programmes. Mixing up content and media was most clearly observed in Finland and Germany; both these countries have an estimated (comparatively) high number of science television programmes.

All in all, no meaningful differences with regard to motives for engagement with science across the different European countries studied were observed. There was not enough evidence to allow us to link differences in science programmes offered in a country with the expectations of participants in that country, which in turn could be linked to cultural differences or the like. Our findings suggest that participants, who claimed to be interested in science and claimed to use science in media frequently share very similar views across European borders.



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66. Risk communication: already there in 18th century?

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In the context of the PCST2012 session on *Risk communication*, I presented original research on a French astronomer and populariser, Jérôme Lalande, who wrote, in 1773, a paper on comets and their unstable trajectories. My presentation aimed to add an historical prospective to risk and risk probability communication, which is still today a highly debated issue and which started to acquire importance already in the 18th century, because of the increasing capability of science to make accurate previsions.

In his *Mémoire sur les comètes*, Lalande stated that a comet could come close to the Earth, thus producing catastrophic events. He didn't make any forecast, he simply showed that only sixty paths were well known, out of the infinite number of tailed stars: consequently, the mathematical and the physical impossibility of an impact with the planet could not be demonstrated. He was supposed to give a lesson on his work at Paris *Académie des sciences*, so he announced the day and the time to his public on the *Gazette de France*, as he was used to do. When the *Académie*, due to lack of time, cancelled his lecture, people thought he had been censored, in order not to reveal an imminent apocalypse. Rumours and fears spread out.

As the police ordered, Lalande published a popular version of the *Mémoire*, titled *Réflexions sur les comètes qui peuvent approcher de la Terre*, in order to clarify the scientific contents, but it did not help. The panic did not stop: instead, it soon reached French provinces and other European cities; several newspapers propagated the story, and many intellectuals commented on it.

This single episode is particularly representative of the period, characterised by a new dimension of the relationship between scientists and the lay public. The more science became specialised, the more the distance from the public increased, as regards the language, the concepts and the field of studies.

As we read in a remark contained in *Académie des sciences'* official records for 1773, this short-circuit was likely due to the gap between the meaning of 'unlikelihood' in common sense and its mathematical, physical meaning.

*'...Mais si on calcule la probabilité que cet évènement aura lieu, on la trouve si petite, et la probabilité qu'il n'aura jamais lieu est si approchante de la certitude, qu'on peut en employant ce mot impossible, dans le sens du langage ordinaire, et dire hardiment que la rencontre d'une Comète avec la Terre est impossible, et que nous n'avons rien à craindre de ces Astres.'*¹

Discussions of this kind closely resemble the recent debates on risk and risk probability communication, particularly those concerning high-energy accelerators or natural catastrophes.

¹ Grandjean de Fouchy, J. P., ed., *Histoire de l'Académie royale des sciences avec les mémoires de mathématique & de physique tirez des registres de cette Académie*, Imprimerie Royal, Paris, 1773.



What happened in 1773 is similar to what happened in 1999 in relation to Brookhaven's Relativistic Heavy Ion Collider: the Nobel Prize-winner Frank Wilczek declared that the collider could produce *strangelets*², thus possibly converting the entire world into a new type of matter. He labelled his suggestion as not impossible as well as not plausible, but the damage had been done: the London *Times* headlined 'Big Bang machine could destroy Earth' and rumours about the end of the world spread out.

With all the due differences and considering the cultural and historical distance between these two episodes, there's at least one significant analogy: the distance between specialised language and common sense, with common sense translating the scientific term *not impossible* into *likelihood*. Even if every day people *translate* science concepts, sometimes changing the significance too, problems emerge particularly when these concepts concern the risk produced either by technology or by nature. For instance, when scientists talk about the *tunnel effect* probability, they never say it is equal to zero, but none of them actually thinks that a pen could get through the desk:

In quantum mechanics, there is a probability that this pen will fall through the table. All of a sudden, it will be on the floor. Because it can behave as a wave, it can go through; we call that the "tunnel effect"... If you calculate the probability that this happens, it is not identical to zero. It is a very small probability. But it never happens. I've never seen it happen. You have never seen it happen...³



However, when Frank Wilczek declared that the probability of strangelets being generated during the experiments was not equal to zero, people got into a panic. As Jos Engelen said during an interview,

CERN officials are now instructed, with respect to the L.H.C.'s world-destroying potential, not to say that the probability is very small, but that the probability is zero⁴.

The communication of probability has to deal with many language obstacles, because of unusual terms and complex calculus: although most of the time the public's difficulty in understanding such terms does not clearly emerge, when we talk about probability of risk we do realize how many related issues need to be discussed.

So the point is not how do we communicate probability (which is still a good question, but not of prominent importance here), but how do we communicate risk probability, science uncertainty and the existence of different degrees of knowledge?

It seems that Lalande decided, whether just wishing to feed the rumours or guided by a precise idea of popularisation, to explain his conclusions using 'science' terms, like *not impossible*; on the contrary CERN officials deliberated to previously translate the same term to *impossible*, in order to avoid any other short-circuits.

Then the central question we would like to ask is which is the way to proceed, Lalande's or CERN's. Should science always 'translate' – and if so, who should be in charge, researchers or

² Form of matter that might exist at the centre of neutron stars.

³ Engelen Jos, interviewed by Kolbert Elizabeth, *Annals of science*, New Yorker, May 14, 2007. At the time, Jos Engelen was scientific director of CERN.

⁴ Kolbert E., *Annals of science*, New Yorker, May 14, 2007.

journalists? – or should we just spend more time in education and in explanation of its own language and issues?

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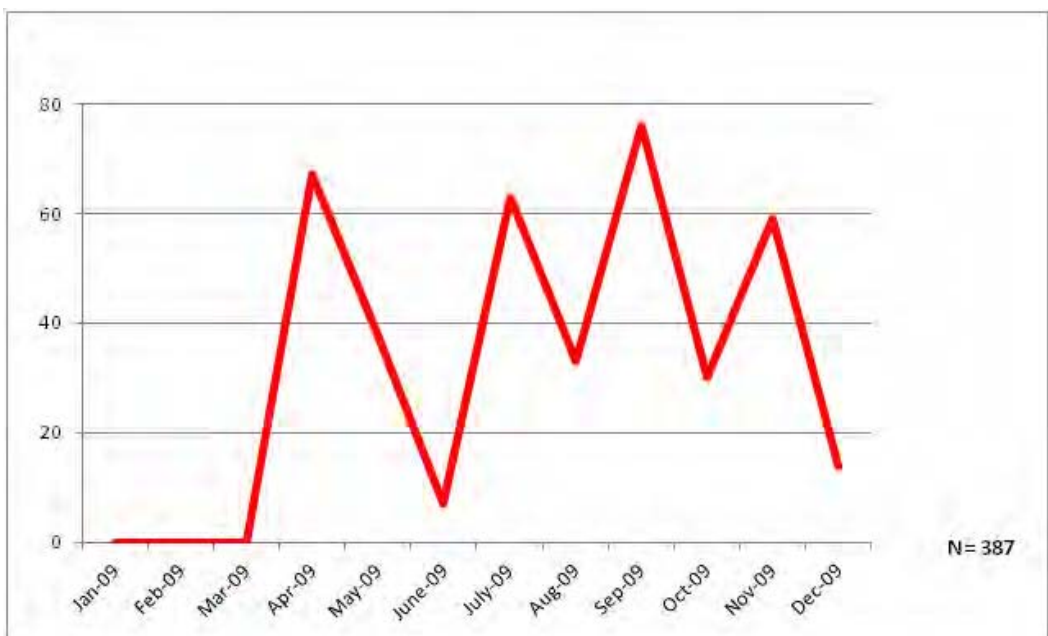


67. Actors in public representation of risk: a comparison using the Observa Science in the Media Monitor

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In this paper I compare two different stories, two alarm cases namely the 2009 pandemic and last year's Escherichia Coli alarm. Alarm cases could be useful to investigate relations between actors in the public communication of risk and its definition, because an alarm is a moment of re-negotiation and re-definition of a situation that is changing. I have chosen them because of their potential threat for European health system. For this comparative study I have worked on Italian newspapers using the Science in the Media Monitor (SMM) tool apparatus, realised by Observa –Science in Society, an independent, non-profit research centre in Vicenza, Italy.¹ SMM is a system of media monitoring that works downloading directly from the main newspaper sites.² The SMM research team is able to investigate Science and Technology media coverage and also particular stories, as in this case.

So here, we start comparing the coverage of the two stories.

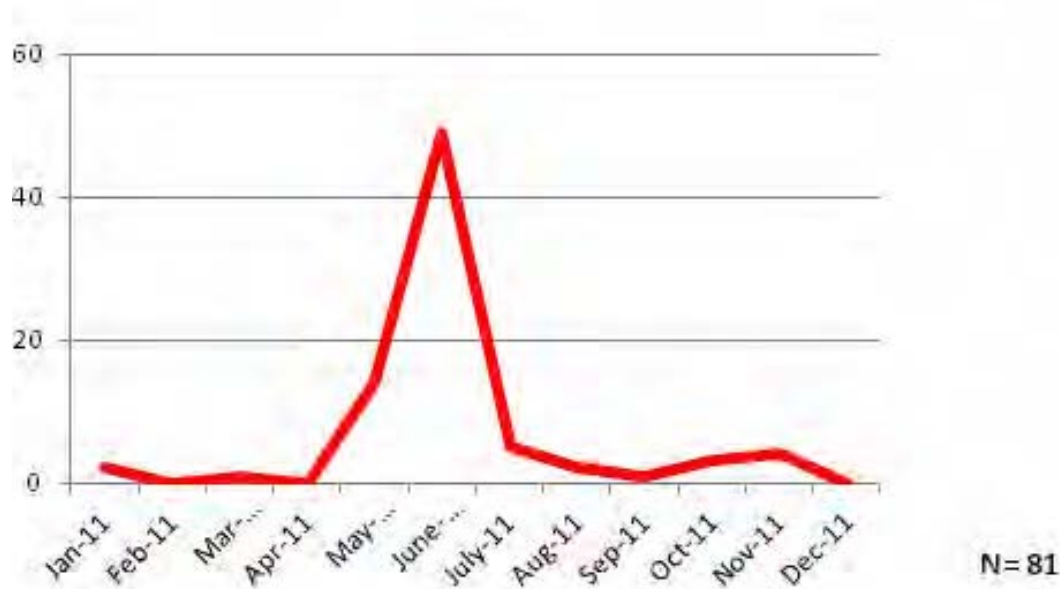


Graph 1 - 2009 - A(H1N1) Pandemic Flu daily news coverage

¹ See <http://www.observa.it/mediamonitor.aspx?LAN=ENG>

² The SMM starting from 2011 is monitoring six national newspapers: Avvenire, Corriere della Sera, Il Giornale, Il Sole-24 Ore, La Repubblica and La Stampa. Before the monitoring was concentrating only on four of them. For this analysis I have chosen to work only the original four newspapers, so excluding Il Giornale and Avvenire.



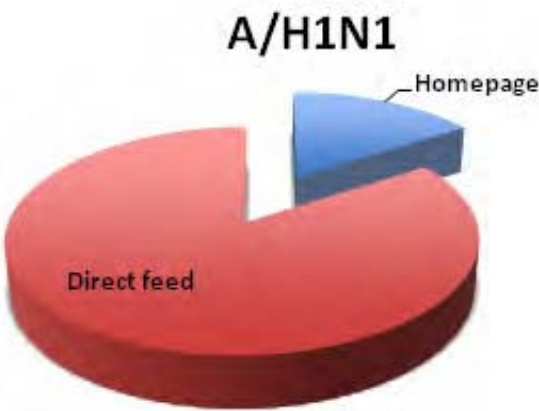


Graph 2 - 2011 - Escherichia Coli daily news coverage



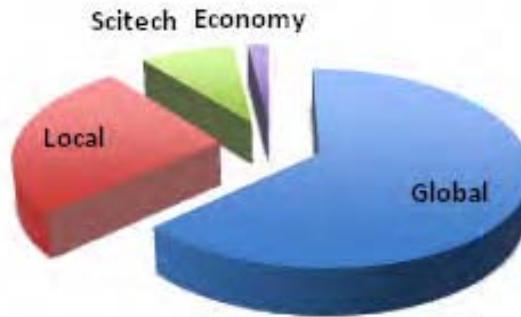
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As is evident from the graphs the two stories had a completely different coverage on the Italian newspaper. In 2009 we individuated four peaks of articles (April, July, September and November) while in 2011 we recorded only a single peak approximately between May and June. Consequently, we found two different corpora, with two different extensions. In 2009 all the coverage was about 387 articles, while in 2011 it was only 87. But we are able to compare the two stories taking into consideration the first phase of the alarm: the outbreak. That means to investigate the phase where it is not clear what is going on, what people should be scared of and, consequently, which solutions should be adopted in order to avoid any kind of damage. Analysing the composition of the two corpora it is possible to compare the patterns adopted by the Italian daily press.



Graph 3 - 2009 A (H1N1) corpus composition

In 2009 we can see that the majority of the articles were coming from direct feed section; only a small part of them has been published in the homepage. Considering the inner composition of direct feed 2009 corpus, it is possible to note that the largest part (63%) was from the foreign news section, while less than 10% were coming from science and technology section.

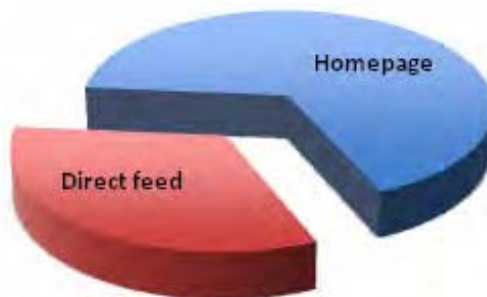


Graph 4 - 2009 A (H1N1) sub corpus composition

As shown in graph 5, in 2011 we found the reverse situation for the Escherichia Coli story.

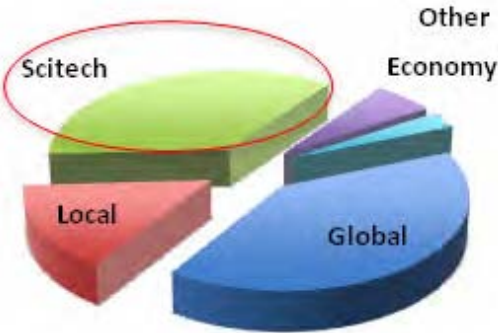


Escherichia Coli



Graph 5 - 2011 Escherichia Coli corpus composition

The majority of the articles of the outbreak was published in the home news pages of the newspapers monitored. A first statement is that the two alarms were completely different in the importance given to them by the newsmakers. Escherichia coli in 2011 was basically considered a greater threat to European and Italian population compared with the earlier one.

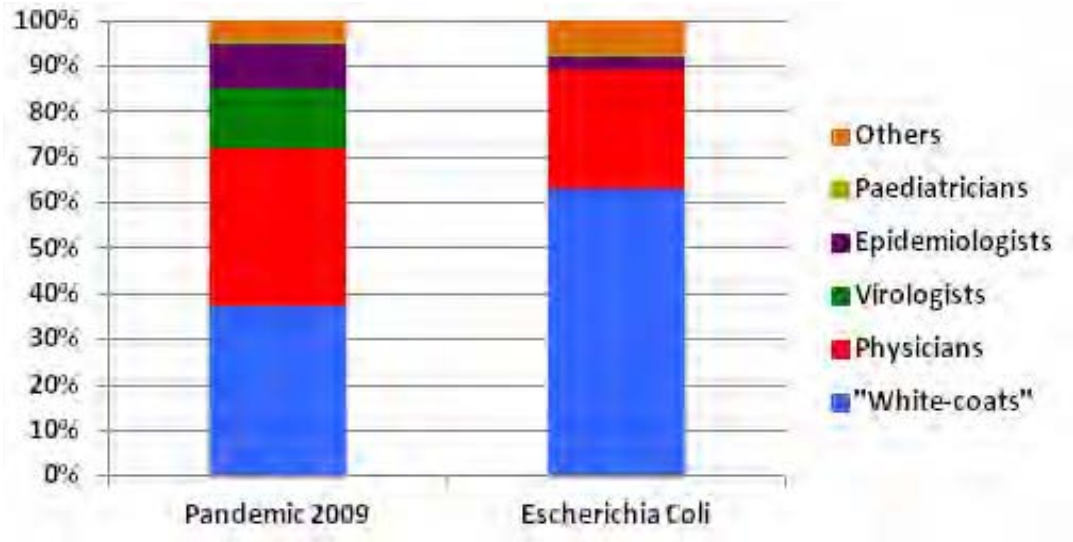


Graph 6 - 2011 *Escherichia Coli* sub-corpus composition

Again in the pie-graph the inner composition of the sub-corpus is analysed: what emerges is the growth of articles coming from the science and technology sections. This fact suggests that actors belonging to the scientific world are supposed to be more represented in 2011 alarm narration than in 2009. But this statement must be investigated more in depth.



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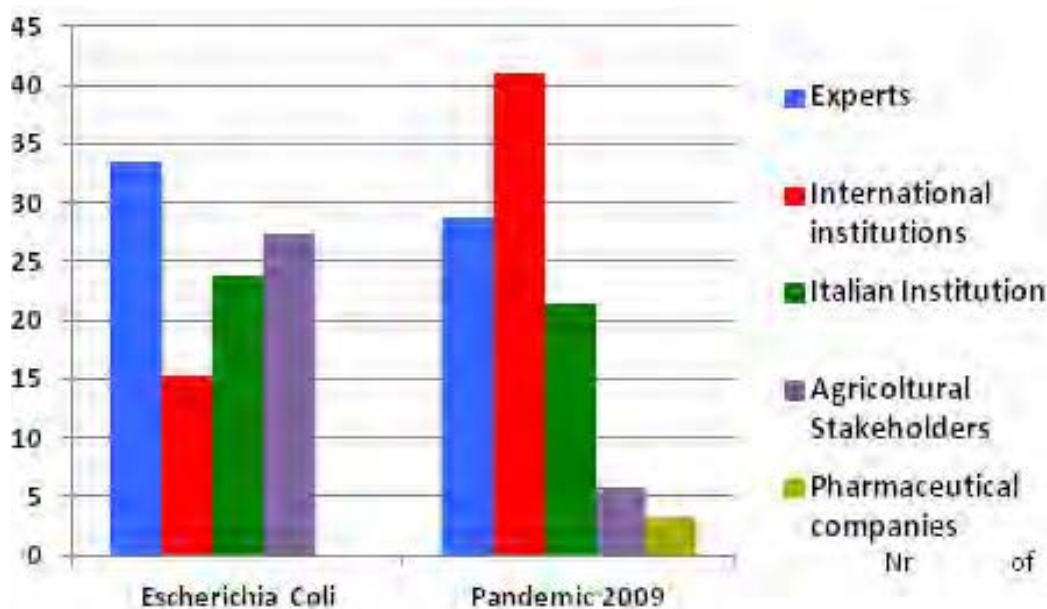


Graph 7

Here we have a direct comparison of the experts’ presence in the two cases. The categorisation described here, has been made starting from the frequency of nouns and words referring to scientists following the kind of specialisation mentioned in the articles. I would like to stress the category of “white-coats”, the one in blue. This category is the sum of every quota-

tion referred to experts or scientists with no particular specialisation. This means that this category is the sum of all the quotations not referring to a specific expertise attribution to the experts quoted. So it includes quotations as like “researcher/s”, “experts of the minister” or “scientists”. This category in 2011 strongly dominates the public representation with more than 60% of share. In 2009 the percentage of “white-coats” was still high (more than 30%), but if we add to them category of physicians, another category of the scientific world with no specific expertise according to the two issues, again the percentage of no specific scientists or experts raises, more than 70% in this case.

We could then consider that the representation, in the cases compared, is widely dominated by images of an undifferentiated scientific world, with just (at least, apparently) a single task: to solve the problem, immediately. This is typical when scientists take the role of expert: as Helga Nowotny brilliantly stated (2003) “Scientists become experts when they have to answer to questions that they have not chosen”. So we have here a sort of delegation to a general expertise for problem solving that reveals a general attitude in the public discourse: you are the experts and you have to solve the situation. We are supposed to think, according to this analysis, that the world of science is invested with a totally not discussable authority. The state of art of controversies studies is not confirming this hypothesis; in fact, scientists and experts are more and more flanked by other categories of actors in the media public sphere. These categories of actors are mainly coming from other parts of the society such as economics and politics.



Graph 8

As shown in graph 8, experts have to share the stage with political institutions (International and Italian ones), pharmaceutical companies and also agricultural stakeholders. In both cases



analysed here, experts are not the absolute majority. International institutions were more cited than general experts in 2009, while in 2011 their level was lower. This fact does not mean that scientists are more important in media representation; looking at the other stats I would rather say that the babel around the alarm object has been more chaotic in 2011 than in 2009. In fact we have not found a main voice, but a multiplicity of actors' claims. As it was for the BSE alarm (Bucchi 1999) we had a public media sphere extremely crowded by a lot of actors and their own opinions.

The Codacons³ asks the Italian health authorities for “urgent measures” such as a ban on cucumber import from all European countries in order to guarantee citizens health from the infection caused by the killer bacteria. *Escherichia Coli* has caused at least 276 infections and 10 deaths in Germany and a lot of cases in other countries. It is also essential, states the official note, “to control strictly all fruit and vegetables coming from Spain and Holland to Italy”.

Corriere della Sera 27th May 2011

“Coldiretti⁴ reaction: “Vegetables and legume that Italy exports to Russia have a market of 4.4 millions Euro per year. The embargo stated by Russia is a unilateral and generalised measure is completely awkward. It can foster both alarmism and the economic damage for blameless Italian producers. This psychosis spread European-wide has already hit fruit and vegetables exportation, causing 20 million Euros of loss in a single week”

La Repubblica 2nd June 2011



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These two fragments show how complex the situation could be. Two different actors are talking about the same object, but they are proposing new instances around the object at the same time. In the first extract we can see that are concerned about their health and asking for more strict controls; in the second one, producers are stating that the loss of some extreme measures can cause huge losses, also labelling it as a “psychosis”.

The complexity of our society, where a growing number of actors have the opportunity to express concerns about the same issue, as in techno-scientific controversies (Callon et al. 2001, Venturini 2010, Lorenzet 2011), has become a fact and this analysis confirms it.

In the comparison I have proposed, the focus was centred on the actors' categories trying to infer the relations between them starting by their presence on the newspapers and then concentrating on their discourses.

³ Italian national federation of associations for consumer defence.

⁴ Italian national federation of agricultural producers.

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68. Communicating Science Through Music: A Case Study from Mathematics and Biology

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Introduction

Music touches our hearts, makes us tap our feet and sparks vivid memories. Neurobiological studies indicate that music arouses feelings of euphoria and craving¹ and activates neural pleasure and reward pathways, similar to those that are activated with food, drugs and sex.² Although science itself has not traditionally been a subject or source of inspiration for music, the beauty of the natural world has. And, as scientific inquiry seeks a deeper view of the natural world's inherent beauty, music can be an emotional medium through which science as a process and as a human endeavor can be communicated and illuminated. It is with these ideas in mind that NIMBioS created the Songwriter-in-Residence Program to encourage the creation of songs involving concepts of modern biology and the lives of scientists who pursue research in biology.



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Music is often used a pedagogical tool for teaching science and math. Music has been used with some success, particularly for young children, as a tool for learning scientific concepts, such as cellular physiology,³ the scientific method, photosynthesis, among many others. Recollection of textual information is greater when presented through song.^{4,5} In the case study described here, the NIMBioS Songwriter-in-Residence program encouraged the creation of non-instructional songs with the idea that the songs created by the songwriters would help popularise science itself.

Method

NIMBioS Songwriters-in-Residence were chosen based on their ability and experience to compose, produce, and perform live songs; their interest in making connections in music between general audiences and science; and their experience touring. The songwriters, who received a stipend, were required to be on-site at NIMBioS a minimum of three days per week during the month-long residency. While at NIMBioS, the songwriters interacted with resident and visiting scientists and scientific staff at NIMBioS, attended workshops, tutorials and other NIMBioS events of their choosing to help inspire their music. By the end of the residency, the songwriter was expected to have written, composed and produced several songs with copyrights shared among the creator, any scientist(s) involved in the songwriting process, and UTK.

The program was organised under the auspices of NIMBioS using support from UTK's James R. Cox Endowment Fund. Full details about the program, a list of the resident songwriters, and audio recordings of the songs from their residency are available at <http://www.nimbios.org/songwriter>

Evaluation

The program's objectives were evaluated using a variety of online analytic tools to determine the "reach" of the program and to assess audiences and usage. A survey of scientists and scientific staff present during the songwriter program found an unintended benefit of the program was that those who interacted with the songwriter began to think more deeply about how to break down language barriers inherent in communicating with lay audiences.

Google Analytics was used to analyse usage of NIMBioS web pages related to the songwriter program for the period of one year, from the initial call of applications, September 16, 2010, until October 10, 2011. NIMBioS web pages related to the songwriter program (N=11) received 3,197 page views and 2,572 unique page views. Visits peaked during the month of May 2011, when songwriter Kay Stanton was in residence and when a radio story about the songwriter program aired nationally.

In terms of video viewership, the most viewed segment, "NIMBioS Combines Math and Biology with Music," included an interview with and performance by January 2011 songwriter-in-residence Jay Clark; as of October 2011, the video had received 2,242 views. Another popular video was "Science for the People" with November 2010 songwriter RB Morris (347 views).

The program also reached audiences through the NIMBioS blog and social media channels. Fifteen blog posts related to the songwriter program appeared on the NIMBioS blog (<http://www.nimbios.org/wordpress/>). NIMBioS social media channels, including Facebook and Twitter, were used to cross-promote the program. As of October 2011, NIMBioS had 568 followers on Twitter, 175 Facebook fans, and 40 blog subscribers. In addition to the national radio feature about the songwriter program, the program received other national media coverage in Science magazine, and locally in print publications in Knoxville, TN, and in Athens, GA. It was also featured on the NSF-supported Sing About Science & Math website (<http://www.singaboutscience.org/>).

All of the NIMBioS songwriters were interviewed and performed individually during their residencies as guest artists on a local television and radio show called Studio 865. The songwriters also played publicly at various venues in Knoxville. They reported that they also played their NIMBioS songs at other public performances on national and international tours following their residencies.

As a final evaluation tool, a survey was emailed after the conclusion of the program to 106 postdocs, staff, and other scientists/researchers who were at NIMBioS while the songwriters were present. In addition to assessing the value of the program to respondents, the survey was designed to elicit views on science outreach to the public in general. Seventy-nine percent of the survey respondents said they interacted with the songwriters-in-residence program in some way whether interacting directly with the songwriters (59%) or simply listening to the songs online (74%). The analysis showed that those who interacted with the songwriter began to think more deeply about how to break down language barriers inherent in communicating with lay audiences. Twenty-five respondents indicated they discussed their work, research, or other scientific research with one or more of the songwriters. Of those, 68% indicated they had to think carefully about how to communicate their research or scientific topics, while nearly half (48%) indicated changing the way they talked about their research or scientific topic to improve communication with the songwriter.



One respondent said:

“Having songwriters at NIMBioS was a very stimulating, thought-provoking experience for me. It was tremendously beneficial to think about science from the perspective of how to communicate with the public, using songs or otherwise. I found myself reflecting on the changing role of science through history and of public perceptions of science; how public perceptions affect policy with respect to science; how science is integrated into a person’s world view; also how the increasingly specialized vocabulary and methods of science hamper public understanding, and how the same dynamic hampers collaboration between mathematicians and biologists.”

The full survey and its results can be found in a separate report available online at http://www.nimbios.org/ifiles/songwriter_fullsurveyresults.pdf.

Conclusion

We can conclude the NIMBioS Songwriter-in-Residence program met its goal to communicate to the public the excitement and wonder of science and mathematics, which can be measured using various online analytic tools. One can only speculate whether this communication resulted in a greater appreciation for science and math or enhanced public perception of trust in science, even though the qualitative portion of the survey offers some insights. Future research could include a qualitative assessment via focus groups comprised of non-scientist audiences who have listened to the songs or viewed the videos.



- 290 An unexpected benefit of the program was that, in interacting with the songwriters at NIMBioS, the researchers were prompted to think more deeply about communicating with the public: the importance and ways to break down the language barriers inherent in talking about specialized fields of science. The problems scientists face in communicating with the public are also mirrored to some degree in communications between the various fields of scientific expertise: mathematics and biology, theoretical and applied science, laboratory and field work, modeling and experimental research. The NIMBioS Songwriter-in-Residence program was an innovative way of blending the arts and science by bringing scientists and musicians together to use the language of music to communicate science and the lives of the scientists who pursue it.

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69. Esa on Rainews: a new format for scientific communication on television.

Space as a source of weekly news

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Introduction

From May 2000 up to the end of June 2012, in the framework of an informal agreement between ESA/ESRIN and Rainews (the Italian public all-news television channel), I have been participating and coordinating 450 episodes of a science programme dedicated mainly to science *in* and *from* space. Each episode was rerun 3-5 times, for a total broadcasting time of about 30,800 minutes, which means about 513 hours in total, more than 42h 45minutes per year, 3h 40min per month.

Given the all-news characterisation of the broadcasting channel, every episode is a cultural challenge which pushes us to re-think the concept of news itself: what is a piece of news? And how you can cook an hour-long science programme starting from a not so clearly defined piece of news?

Although this outreach activity began as an experiment, the ESA interviews have become a regular appointment. As a result of twelve years of uninterrupted collaboration, we recently got to the 450-episode mark, with news about science *in* and *from* space: this is now seen by Rainews as a rich source of news.



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What is ESA

The European Space Agency (ESA) is an international organisation with 19 member states. ESA is funded by the financial contribution from the agency's member states [1]. After its foundation in the 1970s, whilst it was focusing on science and technology goals, ESA got into a total lack of communication to the general public. Something started to change at end of the 1990s, when the ESA Science Programme Communication Service based in ESTEC (NL), promoted a major survey in the countries which at that time were members of ESA to investigate awareness of the continental space agency. The survey was conducted in June and July 1998. The results were obvious but also chilling: only 12% could recognise without help that ESA was the European Space Agency; by contrast, more than 50% knew what NASA was. [2] This led to a new, stronger strategy of target-driven communication and in October 2000, the new ESA web portal was launched [3, 4]. On May 2000, the collaboration ESA-Rainews was launched as well.

What is Rainews

RaiNews was born in 1999, as the first Italian all-news television channel of RAI, the Italian public broadcaster. In November 2006, when the Italian journalist Corradino Mineo became

head of the channel, the latter turned to a new graphics, similar to BBC World News. Moreover, with the spread of digital terrestrial technology, Rainews achieved a rapid increase in audience and share.

Rainews is now a free digital and satellite channel, which broadcasts digitally 24 hours a day, 7 days a week. It can be watched from Europe, and from parts of North Africa and Middle East. It also broadcasts live on the web and makes use of Facebook and Twitter; it also has its own YouTube channel, an on-line archive of videos, and so on. The audience for Rainews is mostly young people and adults of medium-high culture [5].

The first era of the collaboration

At the beginning of 2000 there was a sort of “informal agreement” between the ESA/ESRIN Communication Desk (headed by Simonetta Cheli) and Rainews (Director: Roberto Morri-one):

- ESA provided Rainews with an expert – like a science journalist with a solid scientific background, so that he could talk about a number of subjects with a good competence.
- ESA also provided videos and news through the ESRIN site.
- Rainews broadcasted live interviews to the ESA science journalist and other ESA staff.
- The collaboration was totally free: there was no exchange of money between ESA and Rainews.



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From the very beginning, it was obvious that the live interviews could not be top-down academic harangues, but warm and friendly chats. During the first period, each interview was broadcast live on Thursdays at 5:12 p.m. and lasted only 5-6 minutes; it was rerun 3-5 times a week. The programme had no title, but we used the ESA logo as an “ESA corner on TV”. From May 2000 to December 2006, 263 different interviews were broadcast, giving an estimated total broadcasting mean time of about 20 minutes per week. For a full report of those years, please see [5].

The SPACELAB era

In 2007 we entered the second phase: the SPACELAB era. At first, interviews grew from 5 to 20 minutes, then they developed into a real programme about 30-60 minutes long. Rainews designed a logo and a graphic theme for the programme and we began to invite 1-3 other guests, besides myself. I also started to write text for short documentaries we use during the programme. SPACELAB is planned and anchored by Rainews journalist Marco Dedola.

In its 60 minutes formula, which is broadcast in prime-time (from 9:30 to 10:30 p.m.), SPACELAB is divided into 5 segments: a. science news from the world (5 minutes); b. in-depth discussion with 1 or 2 studio guests (20 minutes); c. channel advertisements (5 minutes); d. space news from the world (5 minutes); e. second in-depth discussion with 1 or 2 studio guests (20 minutes).

SPACELAB is still focused on ESA activities, but it places them in a very rich context. By way of example, we can analyse the episode broadcast on 14 June 2012. It was the last one before the summer holidays, so it was focused on oceans and seas.

The first discussion was about the status of the Earth's oceans and seas. The studio guests were an oceanography expert and a climate expert. This part was enriched with a 3-minute short documentary about ocean observation from Space by means of satellites and, in particular, the ESA ones: Envisat, ERS 2, SMOS, and GOCE. The latter is a satellite developed for the study of the terrestrial geoid, but its data have strong implications for the oceanic circulation model.

The second discussion was about oceans or seas in other Solar System bodies. Namely we talked about Mars and its disappeared oceans with a scientist working on MARS EXPRESS, then we talked about the icy Jupiter Moons with a scientist working on JUICE, the first L-class mission of Cosmic Vision 2015-2025 selected by ESA. Finally, I talked about water on the Moon and the methane-cycle on Titan.

As you can see, we talk about ESA activities a lot but in a much wider way than in the past. Thus, SPACELAB has become a real magazine about science and, above all, about space: astronomy, earth observation, human spaceflight and so on.

From January 2007 to December 2012, a total of 187 different episodes were broadcast four times each. SPACELAB is live on Thursdays, then it is rerun 3 times from Friday to Sunday.

The challenge

Our challenge is to consider space as a weekly source of news. It cannot be helped: a piece of news is the same old story. First you target a specific audience, then you try to imagine what their tastes and habits are and finally you define as a piece of *news* something that you guess will be to their liking, as a departure from their everyday life. In the example we analysed, the point of departure was "OK, folks, summer is coming"... which is not *breaking* news, of course – but news nevertheless.

As far as space is concerned, news is – of course – a scientific discovery. But you cannot report on 450 scientific discoveries. Most of them are improvements instead of actual discoveries, and improvements are a common part of continuous evolution, which is the exact opposite of breaking news.

Some examples: the first launch of an astronaut aboard the ISS is a piece of news; the landing of the lander Huygens on Titan is a piece of news. The 58th cargo flight to the ISS is not a piece of news. Whenever we have no real news, we identify a theme and we ask ourselves: what can space science tell us about this? Experience shows that space science can tell something on a very high number of topics, as long as you change your point of view. It is not a matter of space science but a matter of culture. A good example of this approach is an episode broadcast in May 2012, when we talked about how the 4 FITS digital format, created by astronomers to archive astronomical data, is actually helping the Vatican library to digitalise and archive its precious manuscripts.

[1] <http://esamultimedia.esa.int/multimedia/publications/ESA-Presentation/>

[2] Sandrelli, S., Talevi, M, "ESA: un nuovo orizzonte per la comunicazione scientifica", *Giornale di Astronomia*, 2000



[3] ESA's gateway to space, in ESA Today n.8

[4] www.esa.int

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70. Science and Celebrity Studies: Towards a Framework for Analysing Scientists in Public

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Introduction

In 2006, Oxford University Press published a collection of essays on the life and work of writer and evolutionary biologist Richard Dawkins. The book called him “the world famous author . . . [who] has come to play a prominent role as a leading public intellectual.”¹ This discourse of fame has been used by commentators and journalists to describe other scientists active in the public arena. *The Daily Telegraph* called Cambridge cosmologist Stephen Hawking “the world’s most famous living scientist.”² *The New York Times* called American astrophysicist Neil deGrasse Tyson “a space-savvy celebrity.”³ *Nature* called Oxford professor Susan Greenfield “a celebrity neuroscientist.”⁴

But what does it mean for a scientist to be a celebrity? How does a scientist become a celebrity? And how can a scientist be analysed as a celebrity? This conceptual paper addresses these questions by proposing a theoretical framework for analysing scientists in public, a framework grounded in field of celebrity studies. It outlines the core characteristics of celebrity in general and then applies these characteristics to science in particular. It then demonstrates how these characteristics are present in the media portrayals of the lives of selected high-profile scientists.



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Science and Celebrity Studies

Celebrity is a useful concept for analysing public figures because it has come to be “a key site of media attention and personal aspiration, as well as one of the key places where cultural meanings are negotiated and organised.”⁵ Historian Janet Browne examined Charles Darwin as an 19th-century scientific celebrity, arguing that celebrity was an interesting area in which to “think about the manufacture of scientific identities.”⁶

¹ Graften, A. and Ridley, M. (eds.). 2006. *Richard Dawkins: How a scientist changed the way we think*. Oxford: Oxford University Press.

² Bowater, D. 2012. Stephen Hawking: Women are a complete mystery. *The Daily Telegraph*. 4 January. Available from: <http://www.telegraph.co.uk/science/stephen-hawking/8993228/Stephen-Hawking-Women-are-a-complete-mystery.html> [Accessed 4 January 2012].

³ Martel, N. 2004. Mysteries of life, time and space (and green slime). *The New York Times*. 28 September. Arts/Culture, p. 5.

⁴ Nature. 2004. Popularizer Greenfield is blackballed by peers. *Nature*. 429, p. 9.

⁵ Turner, G. 2004. *Understanding Celebrity*. London: Sage. p. 6

⁶ Browne, J. 2003. Charles Darwin as a celebrity. *Science in Context*. 16(1/2), p. 176.

The Visible Scientists (1977) by Rae Goodell identified a new type of scientist that emerged on the U.S. public stage in the 1960s and 1970s. She argued that these scientists, including astronomer Carl Sagan and anthropologist Margaret Mead, used mass media to influence public opinion and science policy, at a time when new communication technologies were reshaping social and personal life, and the mass media was becoming a venue for the public contestation of scientific issues.⁷

For Goodell, these scientists shared five media-focused characteristics: they had a *hot topic*, were *controversial*, were *articulate*, had a *colorful image*, and had a *credible reputation*. Goodell used the terms visibility and celebrity as synonymous, but, since her book was written, the analysis of celebrity has been an emerging academic field, with a range of writings from different perspectives on the subject – thereby decoupling the ideas of visibility and celebrity. Graeme Turner's *Understanding Celebrity* gives a three-part definition of celebrity. He defined it as:

*A genre of representation . . . ; it is a commodity traded by the promotions, publicity and media industries that produce these representations and their effects; and it is a cultural formation that has a social function.*⁸

Breaking this definition down into its constituent parts, as follows, reveals more about the central features of celebrity.

1. First, celebrity as *a genre of representation* means that there is an intense personalisation in an individual's media portrayal. The individual is portrayed as unique, distinctive, and coverage attempts to describe their authentic nature. There is a merging of their public and private selves in their representations. This intertextual representation occurs across various media.⁹
2. Second, celebrities are *commodities*. They become commodities to sell their own books, broadcasts, and cultural products. Also, they can promote another commodity, such as a book or television show or magazine, their name serving as what Andrew Wernick called a promotional booster for these products.¹⁰
3. Third, a celebrity's *social function* involves the way celebrities represent something more than themselves, supplying what scholar Jessica Evans called "a human dimension to the public world, personifying or personalizing things that may otherwise be quite abstract."¹¹ Scholar Sue Holmes said celebrities with lasting popularity have a "deep, structural relationship with the ideological contexts of their times," meaning that their image becomes a means of working over useful questions of their times.¹²

⁷ Goodall, R. 1975. *The Visible Scientists*. Boston: Little Brown and Company.

⁸ Turner, 2004, p. 9.

⁹ For detailed discussions of celebrity, see: Dyer, R. 1988. *Stars*. 2nd edition. London: BFI Publishing; Evans, J. 2005. *Celebrity: what's the media got to do with it* IN: Evans, J. and Hesmondhalgh, D. (eds.) *Understanding Media: Inside celebrity*. Maidenhead: Open University Press; and Marshall, D. P. 1997. *Celebrity and Power: Fame in contemporary culture*. Minneapolis: University of Minnesota Press.

¹⁰ Wernick, A. 1991. *Promotional Culture: Advertising, ideology and symbolic expression*. New York: Sage.

¹¹ Evans, 2005, p. 6.

¹² Holmes, S. 2005. 'Starring . . . Dyer?': Re-visiting star studies and contemporary celebrity culture. *Westminster Papers in Communication and Culture*. 2(2), pp6-21. p.12.



Characteristics of Celebrity Scientists

Based on these ideas from celebrity studies, I argue that there are five salient characteristics of famous scientists. As I outline these characteristics, I will illustrate how these characteristics are present in the lives of selected scientists that have been described using discourses of fame.

1. The scientist's represented images feature a blurring of their public and private lives

The point at which someone becomes a celebrity is when media coverage moves from reporting their public lives to describing their private lives.¹³ Stephen Hawking is a strong illustrative example of how this principle can be applied to a scientist. As well as his scientific work being reported, his former wife wrote a book about their life together, *Music to Move the Stars* (2000), that featured intimate details of their emotional and romantic lives. Also, there was media coverage of his divorce and second marriage. For example, *Vanity Fair* explored the police investigation into a series of apparently suspicious injuries that Hawking suffered during his second marriage.¹⁴

2. The scientist is a tradable cultural commodity

Communicating with broader audiences through trade publishing or commercial television involves the branding and marketing and promotion of the scientist as author or presenter – often involving cross-media promotion. For example, Richard Dawkins's book *The God Delusion* (2006) was released around the same time as the television documentary *Root of All Evil?* (2006) was aired on Britain's Channel 4.



3. The scientist's representations feature the tensions and contradictions inherent in fame

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The Visible Scientists noted that high-profile scientists had an "overrated credibility with the public."¹⁵ This is also a pattern in the representation of scientific celebrity: the tension between public profile and scientific status. As an example, the scientific output of Oxford professor Susan Greenfield has been criticized. In one case, an anonymous scientist was reported in *The Observer* newspaper as saying: "A lot of what she says does not pass muster academically. Britain is very strong on neuroscience and compared to the leaders in the field, she is simply not in the same league. She is never cited in research papers."¹⁶

4. The scientist's public image is constructed around discourses of truth, reason and rationality

The fame of various professions is tied to different discourses. David Marshall in his book *Celebrity and Power* (1997) said the film star is constructed around discourses of individuality and freedom, the television star is constructed around discourses of familiarity and widespread acceptability, and the popular music celebrity is constructed around discourses of authenticity.¹⁷ I argue that celebrity scientists are constructed around discourses of truth,

¹³ Turner, 2004.

¹⁴ Bachrach, J. 2004. A beautiful mind, an ugly possibility. *Vanity Fair* [Online]. June. Available from: <http://www.vanityfair.com/fame/features/2004/06/hawking200406> [Accessed 20 November 2008].

¹⁵ Goodell, 1977, p. 202.

¹⁶ O'Hagan, S. 2003. Desperately psyching Susan: sexy or serious? *The Observer*. 7 September. Review, p. 5.

¹⁷ Marshall, D. P. 1997. *Celebrity and Power: Fame in contemporary culture*. University of Minnesota Press: Minneapolis.

reason and rationality. And they are different from other types of celebrities in that their public image has epistemological and ideological dimensions. This can be seen, for example, in the way Hawking is described. A recurring pattern of representation presents his mind as existing outside his body, in another realm where knowledge is found.¹⁸ *Time* magazine said: “Even as he sits helpless in his wheelchair, his mind seems to soar ever more brilliantly across the vastness of space and time to unlock the secrets of the universe.”¹⁹ This representation underscores the claimed “epistemic exceptionalism” of science.²⁰

5. The scientist has a structural relationship with the ideological tensions of their times

Famous figures that have lasting popularity are emblematic of the socio-cultural tensions of their times. Neil deGrasse Tyson, an African-American astrophysicist who directs New York’s Hayden Planetarium, is an illustrative example of this idea. His autobiography frames his life and career partly in terms of how he came of age in post-1960s America. He described how he became an astrophysicist in spite of NASA, which, in its early years, was sending white astronauts into space while poverty grew in inner city black communities. He wrote about how he dealt with racial stereotypes involved with being a black man who did not occupy a public role as an athlete or entertainer, and about how he became a public expert in a topic that had nothing to do with race.²¹ These issues were tensions of his time reflected through his image.



Discussion

This framework is proposed as a way of analysing prominent scientists in public as celebrities. These characteristics are likely to be present, to a greater or lesser degree, in celebrity scientists. Some of these characteristics are likely to be more prominent at different times over the course of a scientist’s individual career. Future work might examine the lives and careers of particular high-profile scientists, in different countries, to examine how these characteristics play out in individual scientists’ lives. This work could illuminate how the fame of scientists, like the fame of other figures, sits at what historian of fame Leo Braudy called “the crossroads of the familiar and the unprecedented, where personal psychology, social context, and historical tradition meet.”²²

¹⁸ See also: Mialet, H. 2003. Reading Hawking’s presence: an interview with a self-effacing man. *Critical Inquiry*. 29(4), p571-598.

¹⁹ Cited on the back cover of Hawking, S. 1988. *A Brief History of Time: From the big bang to black holes*. London: Bantam Books.

²⁰ Christidou, V., Dimopoulos, K. & Koulaidis, V. 2004. Constructing social representations of science and technology: The role of metaphors in the press and the popular scientific magazines. *Public Understanding of Science*. 13(3), p. 358.

²¹ For a full discussion, see Tyson, N.D. 2004. *The Sky is Not the Limit: Adventures of an Urban Astrophysicist*. Amherst: Prometheus Books.

²² Braudy, L. 1997. *The Frenzy of Renown*. 2nd edition. Oxford: Oxford University Press. p. 16.

71. (Panel Discussion) What do science and art activities bring to science communication?

Saeko Okada, RIKEN, Japan; **Isabelle Boscaro-Clarke**, Diamond Light Source, UK; **James Gillies**, CERN, Switzerland

The images of cells or biological tissues stained by the highly-developed microscope and staining technique, the colorful graph containing various data, or the image of stereo structure of the proteins or polymer molecules – these scientific data look like modern art. In fact, science is art.

Also, the artistic products inspired by science let people know by intuition the substantial story of science, the secret of nature and how attractive the outlets of scientific research could be. They may raise much interest in science.

Recently, some research institutes and universities are introducing such Science and Art activities as an effective means of science communication, since they can convey to people the secret and the beauty of nature by intuition and inform how attractive scientific research can be.

Three research institutes, Diamond, RIKEN and CERN shared their Science and Art activities: why and how they started these activities and organised them, how they are doing them, and what kind of effects those activities may bring to the general public. They exchanged the information and discussed with the floor about how these kinds of activities could be improved to contribute towards better science communication.



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Designs for Life

Over 100 members of the Oxfordshire Federation of Women's Institutes (WI) gathered together at Diamond Light Source (synchrotron facility) in November 2007 to mark the inauguration of one of the largest art/science projects in the UK. The innovative collaboration, 'Designs for Life', resulted in the production of 30 textile art panels depicting some of the 'dangerously beautiful' viruses and diseases such as HIV, breast cancer and Alzheimer's, that are to be investigated as part of biosciences research undertaken at Diamond.

Under the guidance of a local textile artist, the ladies involved produced a piece of striking textile art using a variety of techniques including patchwork, quilting, hand and machine embroidery. The artwork was viewed by Her Majesty the Queen at the official opening of Diamond Light Source in October 2007, before it was installed in its final position in November 2007, having reached the end of a tour of venues around Oxfordshire during which it was seen by thousands of local residents.

The project was launched in 2006 when groups from Oxfordshire WIs visited Diamond to talk to scientists and learn more about the health-related research possible at the light source. As part of the visit, a 'mock' peer review session prompted discussion and debate surrounding

the prioritisation of such research and led to the identification of a number of priority topics to be incorporated into the artwork – including breast cancer, flu, malaria, HIV, osteoporosis and asthma. By the end of the project, over 1000 people had contributed at least one stitch to one of the panels, including a number of Diamond staff and scientists.

Isabelle Boscaro-Clarke, Diamond's Head of Communications says: "Diamond is extremely grateful to all the members of the Oxfordshire WI who contributed to this exciting project. The initiative has been a fantastic success and reflects Diamond's commitment to working with the local community to promote a better understanding of the science we carry out. This innovative fusion of science and art is now on display in the Diamond House atrium, where staff and visitors are able to enjoy its intricate stitch work, stunning colours and thought provoking source material, and this for years to come."

The project inspired another art and science initiative, the world's largest diffraction pattern, a 2.7-metre squared textile piece inspired by diffraction patterns and the 3D structure solved of an enzyme called Serine Racemase which plays an important role in the fight against pain and neurodegenerative disorders such as Alzheimer's disease. Launched in November 2008 by the UK Minister for Science, the pattern travelled to a number of countries, gathering cross-stitches from over 5,000 people through direct attendance at festivals and indirect contributions via a web interface online contributions.

The final pattern was unveiled at Diamond Light Source by Nobel prize-winner Prof. Venki Ramakrishnan who said, "Diffraction patterns allow scientists to visualize the molecules that make up the world around us, including those in the human body. Knowing the structures of the molecules of life is also an important part of our effort to discover new medicines. It is great to see a creative way to communicate what this valuable technique is all about. The completion of the world's largest diffraction pattern is wonderful because it has allowed people who are interested in science to take part directly in imaginative science projects. It is also extremely beautiful and I'm sure visitors to Diamond will enjoy seeing it, and learning about the science behind it, for many years to come."

The Designs for Life project was a collaboration between The Oxford Trust, Diamond Light Source and the Oxfordshire Federation of the Womens Institute (WI), with funding from the Wellcome Trust. The world's largest diffraction pattern was a collaboration between Diamond, the Oxfordshire WI and Evotec.

SciArt@RIKEN

The Japanese research institute, RIKEN, is promoting intensively to raise its visibility to public. It also regards the activities to contribute culture as important enough that it sets these kinds of activities as one of the five managing policies. Science and Art activities can satisfy both objectives.

Starting from a one-day exhibition accompanied by an open lecture in 2006, RIKEN has been promoting these activities till now. In 2008, RIKEN held Science and Art exhibitions in the centre of Tokyo twice. The galleries were located in the downtown surrounded by shops and many young people (mostly in their 20s and 30s) who were not so familiar with science in their daily lives stopped by. The exhibits were enlarged images of scientific data made like paintings, shoes with images of cells or bones printed on them and a video. The shoes were



created by undergraduates studying media art at Joshibi University of Art and Design, who were inspired by the scientific images RIKEN had provided. The video was the one which had been already created by the assistant professor of the university before the exhibitions. He created the story of life circle of artificial volvox as he imagined it.

Many of the visitors said that those scientific images were unexpectedly beautiful and they wanted to see more in a larger space. Also they said they would like to know more about the scientific stories behind the images and the products. Thus, these exhibitions gave good opportunities to let people know the world of science. At one of the galleries, a science café was held. Participants enjoyed the intimate and casual talk with the researchers and seemed to have felt science much closer.

In 2009, RIKEN invited a Japanese calligrapher, Souun Takeda, as a guest speaker to the open cross-talk events held by RIKEN. He talked with RIKEN's researchers about their research and their lives as scientists, and after the talk, he drew the calligraphy which expressed the message he received from the talk. The calligrapher succeeded not only to make the complicated scientific stories plain but also gave the strong impressions to the participants to have connected science and art.

In 2011, a graphic designer inspired by the RIKEN's Science and Art exhibition in 2007 organised much bigger exhibition commemorated the 100th anniversary of a well-known Japanese painter, Taro Okamoto. The exhibits consist of three parts: the first part consists of the photographs taken by the world-renowned photographer Eiko Hosoe and paintings drawn by a Japanese painter, Takashi Shinozaki. The photographs are of artists who led Japanese art in the 1960s, including Okamoto. The paintings are the ones created being inspired by those artists in 1960s, and also contain the sense of wonder of life. The second part consists of Science and Art products created being inspired by science. The third part consists of the installation based on the scientific images created by the graphic designer and the producer of this exhibition, Akira Mabuchi. This exhibition opened in October 2011, and according to the internet survey, this event seemed to have increased the sense of confidence to RIKEN.



Great art for Great Science

CERN's engagement with the arts goes back a long way. It was first formalised at the end of the 1990s through the 'Signatures of the Invisible' artists residency project, which brought 12 visual artists from five European countries to the lab to seek inspiration for their work. Signatures led to exhibitions in Europe, the USA and Japan. Since then, CERN has been open to visits from artists and writers from all disciplines and has recently sought to formalize its engagement with the arts again.

In 2011, the lab launched the Great Art for Great Science initiative. A new residency programme, Colide@CERN, is the cornerstone of CERN's Great Art for Great Science initiative, and has been launched under the patronage of artists who know CERN. In the words of one of the programme's patrons, Mariko Mori, "CERN is leading our future vision for our human civilisation to understand what we are. CERN's challenge to discover the truth of our existence with revolutionary science provides inspiration to artists and creators everywhere." Mori is one of the most radical and feted rising stars of the international arts world, using cutting-edge technology and materials to create strikingly beautiful visions for the 21st cen-

ture in sculpture, painting and video, drawing inspiration from her interests in art and science. In 2012, Collide@CERN welcomed its first two artists in residence, the German digital artist Julius von Bismarck and the Swiss danCer and choreographer, Giles Jobin.

CERN's engagement with the arts is motivated by two concerns. One is to ensure that arts projects carried out in CERN's name are of the same high standard as the lab's science. The second is guided by CERN's policy of engaging with all areas of society. We live in an age increasingly dominated by science and technology, yet in which there is a dangerously widening gulf between science and society. Great Art for Great Science is part of CERN's contribution to closing that gulf, and thereby equipping society better to deal with the science and technology based challenges the modern world brings.



72. Neuroscientists' media interactions and their repercussions on research

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The concept of 'medialization' implies that the media logic increasingly influences various spheres of society, including science and research. The sociologist Peter Weingart (2012) and others have suggested that scientists are increasingly affected by the way how the mass media represent their research and are interested in shaping their public image. In the 'medialization of science' context, scientists and researchers have to take into account how journalists cover their scientific work. In this sense, many scientists are aware that (positive or at least non-negative) coverage of their research is generally beneficial for them.

The focus of our project¹ is not only on the "negotiation processes" between journalists and their scientific sources in the construction of media images of research, but also on the possible repercussions of these media images on communication strategies and decisions on scientific research, thus contributing to the governance of science. For this project we use the multidisciplinary field of neuroscience as a case study and we compare the social context of neuroscience in Germany and the United States. The project investigates the thesis that public communication of neuroscientific research has possibly steering effects and repercussions on neuroscientific research.



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Empirical approach

The project consists of various empirical approaches. The first one is a quantitative content analysis of 2 x 400 media stories about neuroscientific research in US and German print and online media. This study investigates the public representation of neuroscience research. The focus is on the social contextualization of neuroscientific research. Furthermore, we investigate the scientific sources and (competing) sources from other societal fields that appear in the coverage. Moreover, the evaluation of neuroscientific research and attempts to gain influence on that research via the media are analyzed.

The second survey uses semi-structured interviews with neuroscientists. 50 explorative qualitative interviews with neuroscientific researchers in Germany and the US regarding their

¹ This research project is a collaboration of researchers from the Research Center Jülich in Germany and the University of Wisconsin-Madison in the United States. The research was supported by a grant from the German Federal Ministry for Education and Research (BMBF).

perception of public images of neuroscience and its public communication are conducted. The neuroscientists have been selected from various research fields (basic research, applied medical research and applied non-medical research). One focus in the interviews is on whether and how media coverage of research has an influence on the decision-making processes of the researchers. A second focus is on the goals and publicity strategies of neuroscientific researchers in relation to the mass media.

The paper presents some preliminary findings from research that is still ongoing.

Contextualization of neuroscience in the media

The content analysis of German and US media coverage of neuroscience reveals that various aspects, topics and methods of the neurosciences are represented in the media. Most often, neuroscience topics appear in the media in the context of science, but they also often appear in the context of health, health care and everyday life (Figure 1). Biomedical framings play a particular prominent role in the coverage of neuroscience in all three contexts (this is also the case in other science news coverage, see Bauer 1998). For instance, if basic research is covered in the media this often relates to the question how these findings could potentially contribute to medical applications. Healthcare stories then often refer, for instance, to current treatments and therapies and what can be done e.g. concerning neurodegenerative diseases. News stories from the everyday life context then, for instance, offer advice how to stay mentally fit or how to boost or optimize cognitive capacities.

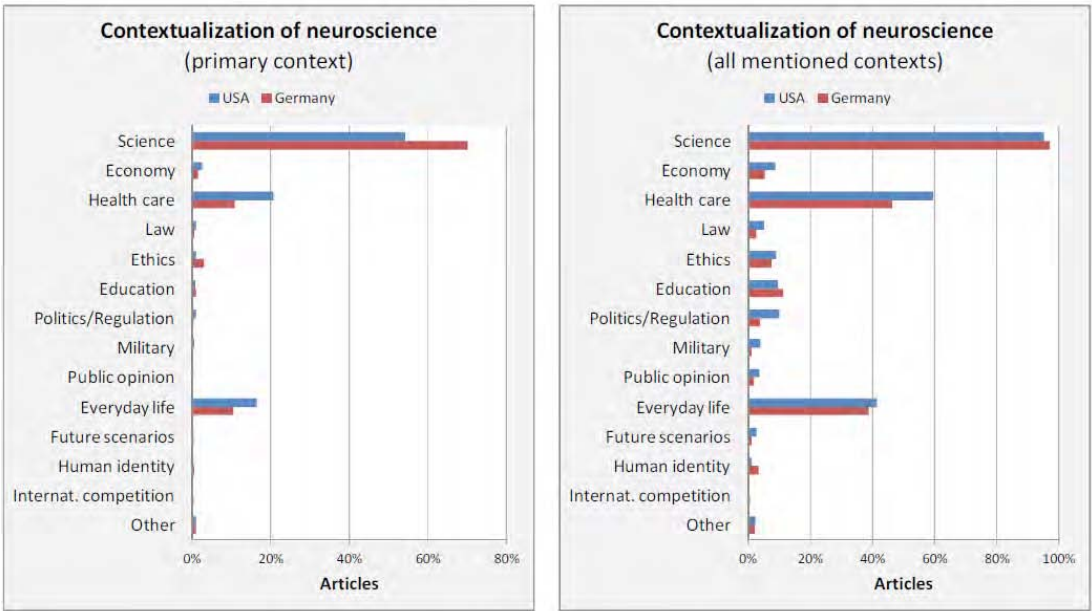


Figure 1

Preliminary findings from the interviews with neuroscientists

In general, the media do play a role for neuroscientists, but they do not see it as their prime task to interact with the media. Typically, interactions with the media are channeled through press offices. It is only rarely the case that scientists approach the media themselves. However, neuroscientists mostly assume that high-ranking publications will be marketed by the public relations departments through the production and dissemination of press releases. Here we notice a division of labour: scientists do the research and publish for a primarily specialist audience, university and other PR professionals disseminate results to non-specialist audiences. The following quote is typical:

"I think that press and all the stuff will come alone by itself if you are in the right track."

Overall, media coverage is seen as beneficial. These benefits, however, vary, for instance:

- Economical benefits (fundraising)

"...there was once an article about our work on the New York Times and some person from California called me and expressed interest. Flew out on his private jet and, you know, spent two hours talking to me and gave me a check for a quarter of a million dollars."

- Career benefits

"And they seem to have seen all these stories that were written. And, I have seen that I have been invited to give much more talks, to give seminars, and now I'm starting to be offered positions. [...] I'm being solicited for positions. [...] I received an email recently from a book publisher, from Springer, and she wants me to edit a book. [...] And from what I read that she also saw all this coverage."

- Recruitment of patients

"...we are currently doing a study about X and there was a film on TV about a special treatment where I also appeared. This TV film had an enormously positive effect on us so that we could conduct this study successfully because after the film has been broadcast many patients called that wanted to participate in the therapy and we could easily recruit them for our study. This was a very positive side-effect of this TV film."

The way neuroscience is portrayed in the media has an effect on the self-portrayal of neuroscientists. Neuroscientists, even if they are basic researchers, often adapt to the medical contextualization of neuroscience in the media, for instance:

"I think the public perceives it as being very disease oriented. This is I think what the public cares about, the public health impact. A lot of scientists are in science, because they love science. They love making these basic research discoveries. But in the end, the general public, they don't really care if I understand how the brain works. They care if I understand how you can fix it when it's broken. So [...] it depends on the audience, but in press releases it's always always disease relevant."

The adaptation to medical framing can cause problems for the researchers and have unintended consequences. It can lead to high expectations about applications that cannot be met



by basic or clinical researchers. Most of the interviewed neuroscientists state that results of their research in the media should not be oversold and that is not beneficial to raise unrealistic expectations, especially about medical progress. A possible self-corrective mechanism is medical ethics and the “hard to deal with” questions and requests from members of the public that react to media coverage about neuroscience, for instance:

“They think this is a huge breakthrough even though of course this is basic science. It’s not clinical, right? So, but then these patients get excited. They email me. Say: ‘How can I begin treatment? My mother is sick,’ you know, this kind of stuff. So, how do you deal with that? It’s obvious just say: ‘Look, I’m very sorry, you know, I’m not a physician. This is all basics science: very far from the clinic,’ [...] What’s worse is the phone calls. I’ve gotten like just people cold calling me and, you know, telling me ‘Oh, I had this episode.’ I mean, I’m not a physician, right? I have a PhD. So, I have the people basically thinking I’m a neurologist. It is basic science.”

Preliminary conclusion

In the interviews we find the awareness that media orientation can have benefits for neuroscientists. We also find evidence that scientists adapt their self-presentation to the dominant media framings of neuroscience (medical context and/or everyday relevance). Scientists are also aware of possible negative consequences of media exposure. For instance, scientists whose research involves animal experiments often chose to stay out of the media spotlight to avoid public accusations and discussion.

However, (in contrast to our initial expectations) no direct evidence for strong steering effects on research has been found. The media is likely to play an indirect role in science governance; it might influence funding and policy decisions of relevant societal actors. Our ongoing research is focusing on these processes and interactions.

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73. Rethinking the scholar: openness, digital technology and changing practices

Eileen Scanlon, Institute of Educational Technology, Open University, UK

Overview

This presentation discussed the current landscape on scientific publication, and the route from 'analogue' to digital scholarship (Borgman, 2007; Holliman et al., 2009; Weller, 2011). The Digital Scholarship project was used to reflect on potential changes to academic practice.

Traditional routes to publication are well known. Primary literature is about establishing priority, including printed text (Montgomery, 2009), and the peer review process (Wager, 2009) and tends to be searched by indexes (Gartner, 2009). 'Alternative' routes to publication have emerged including pre-print servers (e.g. arXiv), open access journals, open review (e.g. JIME), open repositories (e.g. ORO), popular science books, or 'festschriften'. Other sets of communication opportunities include press conferences, and news and current affairs media, with further possible forms of publication including 'secondary' and 'grey' literature, email and online forums, social media and networking, podcasts, audio downloads and web video. Figures in this landscape of publication include academic journals, scientific institutions, 'big science' projects, higher education institutions, industry, news media, magazines, NGOs and scientific citizens.



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'Analogue' towards digital scholarship

The American Council of Learned Societies Commission on Cyber-infrastructure for the Humanities and Social Sciences defines digital scholarship as creating collections and the tools to use them and comments that while it is surprising that these should be counted as scholarship, 'research has always required collections of appropriate information, and throughout history, scholars have often been the ones to assemble those collections, as part of their scholarship.'

Unsworth (2000), again focusing on the tools that scholars need in the digital age, describes seven scholarly primitives or some basic functions common to scholarly activity across disciplines, over time that such tools would need to support. He describes these as discovering, annotating, comparing, referring, sampling, illustrating and representing and discussed the ways in which computers could support these activities. Digital information is efficiently stored, searched for, and retrieved. It facilitates digital archives, curation and informatics. The research process makes use of digital scholarship, includes requirement for training (e.g. in information literacy). It enables the use of automated and personalised updates on funding calls, facilitates searching for collaborators, electronic submission and review. What do these possibilities mean for the activities of contemporary digital scholars?

Cozzini (2008) discusses how the American term cyber-infrastructure used in the Borgman et al. report (2008) is equivalent to the European e-infrastructure and goes on to discuss

the contemporary prospects for e-Science. These were first introduced in United Kingdom by John Taylor, then Director General of the Office of Science and Technology in the U.K as follows:

In the future, e-Science will refer to the large scale science that will increasingly be carried out through distributed global collaborations enabled by the Internet. Typically, a feature of such collaborative scientific enterprises is that they will require access to very large data collections, very large scale computing resources and high performance visualization...."

As a practising e-scientist Cozzini has a good perspective on the reality surrounding this vision of the future He writes (p.2)

"Many national and international projects around the world are now carrying out research and innovation activities that transform the vision of e-science/ e-infrastructure and Grid computing into reality. The first waves of such initiatives came mainly from the natural sciences, where large volumes of data are involved in research and modern simulation approaches require huge amount of raw computing power. High energy physics, astronomy, meteorology, and computational biology are just a few areas where the new paradigm has been applied with considerable success. (....)

"Scholarship Reconsidered" was produced by Boyer in 1990 reflecting on higher education; he developed an extended notion of what it means to be a scholar. He identified four functions of scholarship: discovery, integration, application, and teaching. Pearce (2010) identifies for each of these functions a changed set of practices, Open data, Open publishing, Open engagement and Open education. These changing set of practices were investigated in an Open University project exploring digital scholarship (Pearce et al. 2010).

The Digital Scholarship (DISCO) project conducted at the Open University 2009-10, interviewing 22 academics in higher education about their teaching communication and publication practices. The interviews took 40-60 minutes. They were semi-structured with a set of questions to investigate how new technologies available to academics were being used and how this was influencing their scholarly practices. Either face to face, telephone or Skype were used. A number of themes were identified which are reflected on below: openness, engagement

Reflection

The impulse towards openness is an important part of the changed landscape for the digital scholar. Burton has described the open scholar as *"someone who makes their intellectual projects and processes digitally visible and who invites and encourages ongoing criticism of their work and secondary uses of any or all parts of it--at any stage of its development"* (<http://www.academicrevolution.com/2009/08/the-open-scholar.html>). Although the interviewees recognised some of this impulse, many had reservations about working in such an open fashion.

Some interviewees described their use of open educational practices. McAndrew, Scanlon and Clow (2010) argue that it is not just the research landscape for academics is changed but also that of their teaching practices. It is not only the academic who is potentially who changed here but also the learner: *'The idea that learning is less about transmission, or in-*



deed less about knowledge, and rather about how to operate at personal and society levels has resonances in the current striking change in learning environments. In these emerging more-open environments the user gains the ability to personalize educational resources in the widest sense. When this personalization is combined with social networking enabled by technology, the learner can start to set a customized learning agenda.'

Philips (2011) and Poliakoff and Webb (2007) have discussed the dialogic turn in research practices and the implications of this for public engagement. The interviewees were reflective about the ways in which communicating online had changed their practices, in terms of networking with potential collaborators to developing activities engaging the public using blogs.

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74. Walking the ethical tightrope between science and policy: responsible communication of scientific research to policy-makers

Franca Davenport, *Science for Environment Policy, University of the West of England*

Introduction

There is increasing recognition that policy-makers need to be provided with the latest and best scientific evidence to ensure policy is better informed. However the dialogue between science and policy is not straightforward, nor free of conflict (JRC and AAAS, 2010). Researchers may feel a lack of reception from policy-makers for their work, whilst policy-makers may fail to identify relevance in research unless it is highlighted for them (Stone, 2002). This emphasises the importance of good communication and the role of knowledge brokers in this field (Holmes & Clarke, 2008).

Science for Environment Policy (SfEP) is a weekly electronic news alert targeted at policy-makers across the EU. It disseminates environmental research to 14,000 subscribers and is financially supported by the European Commission. The project has recently expanded to include two new publications that cover emerging, multi-disciplinary and sometimes controversial areas of research such as Biodiversity and Health, Plastic Waste and Green Infrastructure. As such, they require communication of research that is accessible to policy-makers but also faithful to its scientific roots.

An action research project was initiated to develop these multifaceted publications and explore the process of responsible science communication to policy-makers. The metaphor of an 'ethical tightrope' is used to describe the experience science communicators can face when finding the balance between communicating research in a format that will have an impact on policy, whilst maintaining its scientific objectivity and meticulousness.

The research used the new SfEP publications as a platform to conduct in-depth interviews with both scientists ($n = 6$) and EU policy-makers from DG Environment ($n = 6$). Participants were asked about the use of research in policy-making, the qualities that make research valuable to policy and the advantages and disadvantages of using a professional science communication service.

Results

Policy-makers appear to use research at several stages of policy-making from informing new policy (e.g. green papers, communications, etc.) to supporting the implementation of existing policy (e.g. technical guidelines for Member States) (Davenport et al. 2010). To some extent this agrees with the European Environmental Agency's (EEA) framework of research in the policy cycle (see Figure 1), which proposes research is used in issue framing, ex-ante impact assessment, policy development, implementation and ex-post evaluation. However, unlike the EEA framework, the responses in this study suggest that research is rarely used in the



‘issue identification’ stage of the policy cycle. As one policy-maker said, “It is very rare that science will dictate the policy cycle. The policy cycle exists and then you are looking for the science to feed into it.” Policy-makers do report using research to raise awareness and trigger stakeholder consultation but this is more to prioritise a policy area over others rather than put it on the agenda.

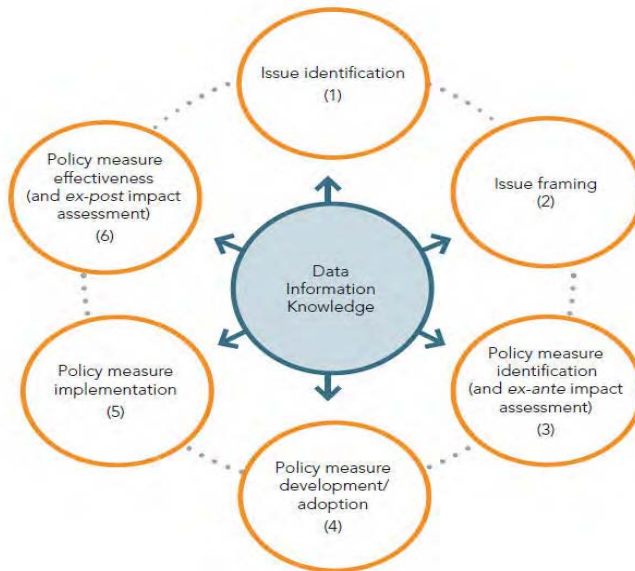


Figure 1: Main stages in the policy cycle, supported by data, information and knowledge. Source: European Environmental Agency (EEA)

The interviews indicate that policy-makers expect a lot from science. As one interviewee said, they want “a digestible but exhaustive and complete and accurate holistic picture, concerning a specific policy question... And it needs to be objective”. Policy-makers want research to be accurate and robust. They want to be sure that research uses proven methods and that the findings are supported by previous research.

Quantitative data is highly valued, particularly efficiency measures, costs and benefits and figures that relate to targets and risks. However, they also appreciate data to be brought to life through relevant case studies and practical examples. A number of respondents mentioned that they want a scientific underpinning of their work, which begs the question of whether science is used to support existing policy or to inform policy choice. Across the board policy-makers want research that can be understood and applied in a short amount of time.

The researchers in the sample tend to see science as performing a watchdog role over policy. As one interviewee said it should have ‘a permanent control on how policy is doing its job’. In the field of the environment it does this by producing models to inform decision-making, developing indicators and targets to measure good environmental status and providing pragmatic research on practical programmes. They believe policy-makers want research that is accurate, reliable and relevant, providing key results and quantitative data.



The researchers also appreciate that policy-makers require an understandable, accessible message. This recognition of the need for accurate, quantitative and accessible data is in line with the policy-makers' responses. However, the scientists in the sample also believe policy-makers would prefer science to be without extreme results or large amounts of uncertainty and that, for science to be influential, it should fit the current policy agenda and policy drivers as well as the legislative policy cycle.

Amongst both the scientists and policy-makers there is awareness that the process of adapting research findings or the research process to meet policy needs could involve several potential risks. These are explored in the following section.

The balancing act of communicating science to policy-makers

Below is a preliminary list of possible risks that could be encountered when communicating scientific research to policy-makers and some general suggestions on how to minimise them.

- *Taken out of context* – Figures can be quoted out of context, research findings generalised or the message can be altered along the communication chain. For example research on Green Infrastructure has shown that eco-ducts or green bridges improve wildlife movement, but this result has sometimes been interpreted as indicating an improvement in biodiversity, which is not necessarily the case. This risk could be reduced by greater participation and collaboration between scientists and policy-makers. Co-creation and co-ownership of knowledge would hopefully result in a shared responsibility for its application.
- *Selectivity* – By striving to make findings quantifiable science communicators may highlight one part of research at the expense of other. More feedback is needed from policy-makers on how science is used to give researchers and communicators an insight on how to frame quantitative data.
- *Handling uncertainty* – If uncertainty is communicated it can be used to deny the implications of scientific research, especially if they are costly. However, without proper communication of uncertainty, science can be misinterpreted or used too 'certainly'. For example there is a high level of uncertainty around the toxic impact of micro-plastics (miniscule pieces of plastic) and this uncertainty is mainly because it is a new area of science and difficult to scale laboratory findings to a global level. However, although the findings are accompanied by a degree of uncertainty, they still need consideration by policy-makers. The message from both policy-makers and researchers is that neither can shirk the responsibility of communicating or hearing about uncertainty. There needs to be better ways to communicate and define uncertainty, both in terms of where it is produced and what impact it has on results. Again this requires more dialogue.
- *Taking action* – Along similar lines there is a risk that action may be taken before all the relevant science is known but, if it isn't taken, then the situation may worsen, especially in terms of climate change and biodiversity loss. This means science communicators have to be careful about how they convey the importance of findings and severity of problems. They need to relate it to previous research findings and to research in other academic disciplines.



- *Getting caught in the middle* – Science could get caught between policy sectors and, as one policy-maker said, used as “a power instrument”. This in turn can mean scientists may start playing different roles such as facilitators and mediators or, in extreme, lose objectivity and become more like lobbyists. As such there is a need to be aware and explicit of the roles people are playing: scientists need to remain scientists and policy-makers need to remain policy-makers. To ensure this occurs, it may be appropriate to use knowledge brokers or science communicators in meetings with policy-makers and scientists.
- *Missing important questions* – In situations when public opinion is ahead of science there is the potential for policy and science to be too driven by public opinion. This could mean that science misses out important questions. For example, Green Infrastructure and the notion of connected green areas is a concept that seems intuitively right and is understood by the public, but the supportive science is not that strong. It could be that important questions are not asked because it just seems “the right thing” to do. More collaboration is needed from an early stage, in particular to ensure that the appropriate policy questions are in place from the start. This may require dialogue between different policy sectors. As one policy-maker said: “We are aware of importance of integration – the theory of it – but there’s still an enormous inertia to get it into practice.”



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75. “It feels like the right thing to do”: ethical perspectives of open science

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Context

The demand for public access to data is increasing. Governments are committing to making information freely available to their populations – ‘Open Data’ initiatives exist in the USA, UK, Australia, New Zealand, Norway, Italy and elsewhere. Such initiatives support governments’ agendas for transparency, participation, engagement and collaboration (Orszag, 2009; HM Government, n.d.; Dept. of Internal Affairs, 2011). While the extent to which such initiatives have succeeded is debated (The Economist, 2012), the principle is widely endorsed.

Funders increasingly support the premise of unfettered access to research outputs (Wellcome Trust, n.d.; Research Councils UK, 2009; OpenAIRE, 2011; National Science Board, 2011). Significantly, the audience for such research outputs includes ‘potential users in business, Government and the public sector, and the public’ (Research Councils UK, 2009). Researchers have, likewise, long acknowledged a responsibility to communicate the results of their research and the social and ethical issues that arise from it to the wider public (PSP, 2006; Kreimer, et al., 2011; Bauer and Jensen, 2011).

Open science, an approach in which the entirety of an investigation – questions, data, methodologies, results, models, published outputs and more – is made available online as it happens (Nielsen, 2009), emerged as a practical means to support multi-site and multi-national collaborations. However, it also embodies a philosophical approach to the conduct of science; a means by which researchers can capture an authentic record of their work and thus maintain long-established scientific standards for ethical research, truthfulness, honesty, validity and repeatability.

Open science has, therefore, the potential to support ethical practice in three senses: first, that it allows researchers to meet commitments to be open about their research; second, that it is a way of offering evidence that research is being conducted in an ethical way; third, that it is ethical in itself.

Data gathering

The data used in this paper were collected from thirty semi-structured interviews with members of the public and professional and amateur researchers and public engagement practitioners, and from three case studies, chosen using a typographical matrix approach (Denzin & Lincoln, 1994) to support purposive selection. A grounded theory approach was



used for the data analysis, with categories developed through constant comparative analysis. The research protocol was approved through the University of the West of England's research governance system.

Findings

Researchers recognised that practising open science offered a means through which they could meet commitments to make the results of their research accessible; indeed, to open the entire research process. Practising open science potentially offers a full record, rather than one that gives the appearance of including only the results that successfully support the hypothesis:

Knowing things that don't work out is just as important as knowing those that do
(member of the public 1)

Open practice thus allows observers – members of the public or other researchers – to scrutinise research questions and methodologies and compare raw data with published outputs, allowing them to verify that research was conducted ethically. Interviewees also suggested that practising open science can be ethical in the sense that it is an appropriate way to conduct research:

It feels 'right'. Ethically, it feels like the right thing to do. (professional researcher 1)

Researchers expressed a personal responsibility, arising from the direct link between themselves and the people who paid for their research, that receiving public funds obliged them to be accountable and responsible:

Because the vast majority of the money that I get comes from the public purse, I do need to respond to what the public want ... to provide information to them, access to data so they can do with the data what they will. (professional researcher 1)

For both researchers and members of the public, open science has the potential to support engagement by providing a sense of the context in which research is conducted. This could support public engagement in discussion of the implications of issues in current science and technology:

It's got to be about distilling the implications [of the research], so that public policy can be steered in an informed way. (member of the public 2)

While participants were largely positive about open science, they recognised certain practical issues. First, they foresaw possible conflicts between openness and ownership:

How do we protect our intellectual property when almost by necessity we're having to share it with the rest of the world? How do you ensure that the benefit for the clever bit of work you've done comes back to —? (professional researcher 2)

Cribb and Sari (2010) suggested that while systems such as patenting and copyright certainly support innovation, they are time-consuming and expensive processes that may cost more than they return. Likewise, the National Science Board noted that 'policies that restrict open communication and exchanges squander human talent and deny American science and engineering the benefits of openness and excellence' (National Science Board, 2011, p. 1). Open communication could be a new model for innovation:



If knowledge and information are key to the knowledge economy you have to accept the argument that you will become commercially more competitive by taking an open approach (professional researcher 3)

Some participants expressed concerns about the quality of openly-accessible information. Metzger (2007, p. 2078) noted that when ‘nearly anyone can be an author [and] authority is no longer a prerequisite for content provision’, conventional imprimaturs of quality, such as peer-review, university accreditation or journal reputation may either be lacking or not well-understood. Assurances of quality are, nevertheless, desired:

We do need to know about the quality of that data; some write-up about its quality assurance and how it was got. It’s all very well saying ‘let’s just open the doors to the data’ – I just want it to be done responsibly. (amateur researcher 1)

To make their way with certainty through unsigned data, non-professional participants may need to develop skills in interpreting research data and judging its quality:

Unless you have the skills to access it and the skills to sift it and use it in interesting ways, some of it’s going to be redundant. (professional researcher 4)

To support users in developing these skills, participants suggested there is a need for information to be richly mediated, commented and annotated:

[Information] is only ‘available’ if it means something; it’s not ‘available’ if it’s just there but means nothing or there’s no map to navigate through it in some way or no support to find your way through. (professional researcher 5)



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Open science, because it offers a complete reflection of the research process, can provide such a context, enabling users to set published results against raw data. Openness enables a wider audience to scrutinise work closely and carefully and supports interactivity and dialogue among members of the research community, be they professional researcher or private individuals.

Conclusion

Adopting an open science approach will not be without difficulties, worries and complexities. Open science can be a harsh spotlight under which to work, revealing flaws and inconsistencies, as well as rich information and first-hand evidence. However, it can also be a way of working within a supportive community, whose experiences and expertise extends beyond the conventional. Adopting an open science approach and using it to capture an authentic record of research supports long-established concerns for high-quality research, truthfulness, honesty, validity and repeatability – and ethicality.

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76. Scientists and Journalists - the Taiwanese Case: results of a Survey of Biologists and Neuroscientists on their Experience with and Attitudes towards the Mass Media

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Introduction

In Western countries the relationship between science and the media has been extensively studied because media coverage of science is expected to increase the scientific literacy of the public and also public support for science (EurekAlert! and the American Association for the Advancement of Science, 2006; Wellcome Trust/MORI, 2000). Compared with Western countries, there are relatively few of such studies in Asia.

The study presented in this paper contributes to closure this research deficit. An online survey was conducted to explore the current relationship between scientists and journalists in Taiwan. The questionnaire comprises various aspects of the science-media relationship, including opinions on the public and public communication, perceptions of the media, and the interviewees' experiences with the media. The questions match those used in a German survey of researchers, thus enabling us to compare results across countries. Selected results serve to provide an overview of current media contacts in Taiwan, in terms of the frequency and evaluation of these contacts by scientists, and to address cross-country differences in beliefs about public communication of science and expectations of how a scientist should behave during media contacts.

Methods

For the survey, 723 Taiwanese biologists and 821 neuroscientists were selected from the database Science Citation Index Expanded on the basis of their authorship of publications in international scientific journals. The survey was conducted in August-October 2011. After an invitation by email, we emailed 4 reminders to the selected scientists. 129 biologists and 151 neuroscientists participated and completed the online questionnaire. The response rate is 21%. The German data is taken from a survey of biologists (n=89) and neuroscientists (n=254) who were surveyed in the context of a more comprehensive study of German researchers (Peters et al., 2012, in this volume). As we are interested in a comparison between countries, we do not distinguish between the groups of biologists and neuroscientists in this paper but present an aggregated analysis.



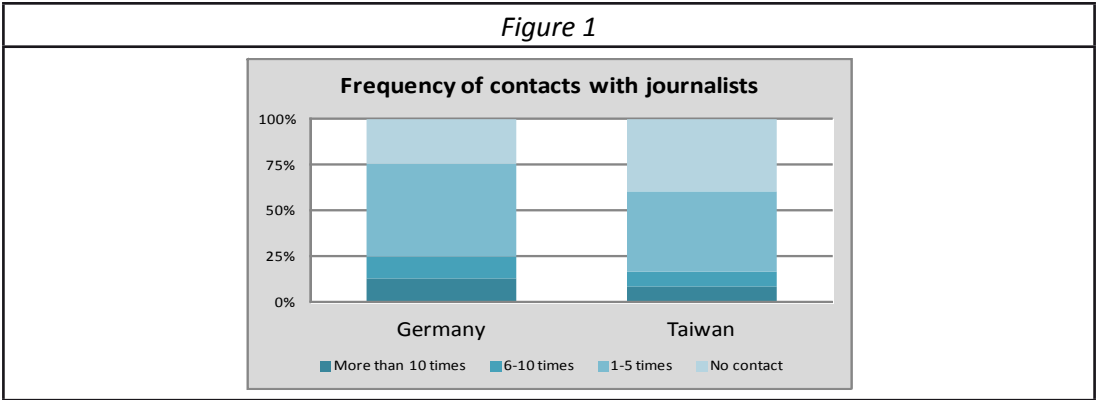
Results

Current relationship between scientists and the media in Taiwan

Congruent with surveys in other countries the Taiwanese researchers reported many contacts with journalists. Scientists who had contacts with journalists mostly evaluate these contacts positively, are satisfied with their outcome and agree that public visibility benefits their careers and increases the chance of getting research funding. Optimistic beliefs about the effects of public communication are prevalent among surveyed scientists: They believe that the increase of the public’s knowledge about science will enforce positive attitudes about and public support for science.

Cross-country comparison: media contacts

Compared with the German survey results, the frequency of media contact is considerably lower in Taiwan than in Germany (Figure 1). About three quarters of the German scientists said that they had at least one contact in the past 3 years, whereas only around half of the surveyed Taiwanese scientists reported such contacts.



Cross-country comparison: beliefs about public communication and attitudes to the public

German and Taiwanese scientists hold similar beliefs about the effects of public communication of science (I1-I2 in Table 1). In both countries most agree that successful communication about science with the public will lead to more positive attitudes towards science and technology and ensure political support for science. Regarding the item whether it is the function of public communication to fill the knowledge deficit, the Taiwanese scientists show more agreement than the German researchers.

Table 1: Beliefs about public communication (I1-I3) and attitudes toward the public (I4-I5)

	Germany	Taiwan	Difference
I1: Greater knowledge on the part of the public leads to more positive attitudes toward science and technology	1.38	1.34	0.04
I2: Positive public visibility ensures political support for Science	1.30	1.19	0.11
I3: Public communication about science primarily serves to fill the general population's knowledge deficit	0.48	1.02	-0.54**
I4: The public is not well educated enough to really understand scientific findings	-0.12	0.81	-0.93**
I5: The public's ability to make judgments is sufficient to allow it to participate in decision-making on research policy	-0.57	-0.90	0.33**
Mean values of a 5-step scale ranging from -2 ("completely disagree") to +2 ("completely agree"); ** differences are statistically significant (t-test, $p < 0.05$)			

Opinions about "the public" of German and Taiwanese scientists are different; the latter take a more critical view toward the public (I4-I5 in Table 1). The Taiwanese scientists are clearly sceptical about the public's ability to understand scientific findings, while the Germans neither clearly agree nor disagree. Although both the German as well as the Taiwanese scientists disagree with the idea of the public's participation in decision-making on research policy, the latter show an even stronger disagreement with that item.



Cross-country comparison: interactions with journalists

Most expectations of what scientists should or should not do during media contacts differ significantly between the countries (Table 2 below). Compared to their German colleagues, the Taiwanese scientists show a more reserved approach to the media: they tend to refuse playing along with journalist rules. In contrast, the Germans seem less stringent in applying scientific norms to the public communicating of science and seem more prepared to present their work in ways that meet journalistic expectations, for example to explain scientific knowledge in understandable terms.

The only item in Table 2 which shows no significant difference between Taiwanese and German researchers is whether scientists should share controversial information with the public. Taiwanese and German researchers both show reserved attitudes in this respect. German researchers are more open to speak about misconduct of researchers or controversial research practices, however.

Conclusions

About half of our surveyed Taiwanese scientists reported contacts with journalists in the last three years. This indicates that media contacts with scientists are not rare occasions, and moreover, that issues about public communication of science or social engagement will tackle scientists in Taiwan sooner or later. Congruence with a previous survey in other countries (Peters et al., 2008), the relationship between scientists and the media in Taiwan is not as problematic as might be assumed. Our survey results show that Taiwanese scientists, according to their own judgment, have a good relationship with journalists.

Both German and Taiwanese scientists have positive attitudes towards public communication of science, but in many respects they have either contrasting or gradually differing attitudes toward the public and take different positions in interacting with the media. Although Taiwanese researchers perceive a larger problem of comprehensibility than German researchers (see I4, Table 1) they are less prepared to communicate in a way that might help to solve that problem (see I2, I5, Table 2). Beyond that, Taiwanese scientists generally seem to be more reluctant to adapt to the media. A possible explanation might be that the frequency of scientists' media contacts is higher in Germany than in Taiwan. This may make it easier for the German scientists to cope with media norms, such as to explain their research in a comprehensible way.



Table 2: Expectations of how scientists should act with media contacts

With media contacts, scientists should...	Germany	Taiwan	Difference
I1: use their expertise to criticize political, economic, and other decisions affecting society or make practical suggestions for action	0.99	0.09	0.90**
I2: relate their research to the everyday experience of the media public	1.30	0.61	0.69**
I3: communicate their results and expertise in an entertaining manner	1.03	-0.31	1.34**
I4: play along if journalists are not only interested in scientific results, but are also interested in them personally	-0.26	-0.37	0.11**
I5: use catchy phrases that can be quoted verbatim by reporters	0.74	0.14	0.60**
I6: not share internal scientific differences of opinion with the general public	-0.18	-0.09	-0.09
I7: if asked, speak openly about problems, such as misconduct on the part of researchers or controversial research practices	1.00	0.23	0.77**
Mean values of a 5-step scale ranging from -2 ("completely disagree") to +2 ("completely agree"); ** differences are statistically significant (t-test, p<0.05)			

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77. Lost in transition? Science in the Croatian Newspapers

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Science communication in Croatia remains immersed in the deficit perspective. The media are, according to scientists, to blame. They are discontent with the quantity of media science coverage, with what the media perceive to be a science story and the way in which they present it, and they think media coverage of science is declining. Media science is, they say, simplified and the information is neither precise nor complete – particularly information about scientific method.

The media landscape in Croatia dramatically changed after the political changes at the beginning of 1990s, followed by economic and social transition. The first privately owned newspaper appeared in Croatia in 1987, but only after political changes we witnessed a boom in the media market. Privatisation of the media included the launch of the new privately owned media, the hybrid of the “private initiative within the state or public ownership” and the transition from state or public into private ownership (Jergović, 2004). The method and the nature of this transition are still not clear or investigated due to the lack of reliable data, but a growing number of media, a failing industry, and the decline of the economic standard led to the struggle for advertisers and readership, and has resulted in commercialisation of newspapers and an overwhelming sensationalistic approach in all fields, including science.

Even when treating a topic of scientific discussion or a conference, media coverage of science in Croatia is often based on anecdotal impressions. In an attempt to analyse current media science coverage, I will use here the results of a study detailing the science coverage in five main Croatian daily newspapers.

Croatian newspaper coverage of science

Here I will present the results of content analysis of science coverage by five leading Croatian newspapers over a period of three years, from 2009 until 2011. Our sample consisted of 994 articles published by five leading Croatian newspapers: Jutarnji list, Večernji list, Novi list, Slobodna Dalmacija and Vjesnik, between 2009 and 2011. As we can see in Table 1, the number of articles published within the analysed period is more or less constant and it is around 6 articles per day per all newspapers, and about 1 article (1,26 articles) per day per one newspaper.

In the first two years there was a significant difference (as shown in Table 2) between the only Croatian quality newspaper, Vjesnik, and the rest of the newspapers, which more or less incline to tabloidisation in the selection and in the style of the presentation of the news. While the difference between the frequencies of the newspapers’ science coverage in the first two years was obvious, it was not the case in 2011 (see tables 2 and 3).



	2009	2010	2011
The average number of articles per day:			
all newspapers	6.62	5.78	6.58
The average number of articles per day			
and per newspaper	1.32	1.16	1.32

Table 1: Frequency of articles

Newspaper, 09-10

	Observed N	Expected N	Residual	Chi-Square	P (signific.)
Jutarnji list	116	151,4	-35,4	271,199	<,000
Novi list	145	151,4	-6,4		
Slobodna Dalmacija	91	151,4	-60,4		
Večernji list	77	151,4	-74,4		
Vjesnik	328	151,4	176,6		
Total	757				



Table 2: Frequency of newspaper articles in 2009-2010

Dailies, 2011

	Observed N	Expected N	Residual	Chi-Square	P (signific.)
Jutarnji list	36	47,4	-11,4	9,941	<,005
Novi list	46	47,4	-1,4		
Slobodna Dalmacija	38	47,4	-9,4		
Večernji list	57	47,4	9,6		
Vjesnik	60	47,4	12,6		
Total	237				

Table 3: Frequency of newspaper articles in 2011

Vjesnik published about half of all science stories in 2009, but the frequency started to decline: in 2010 to 39 % and in 2011 only one quarter of the articles about science was published there, as seen in Figure 1.

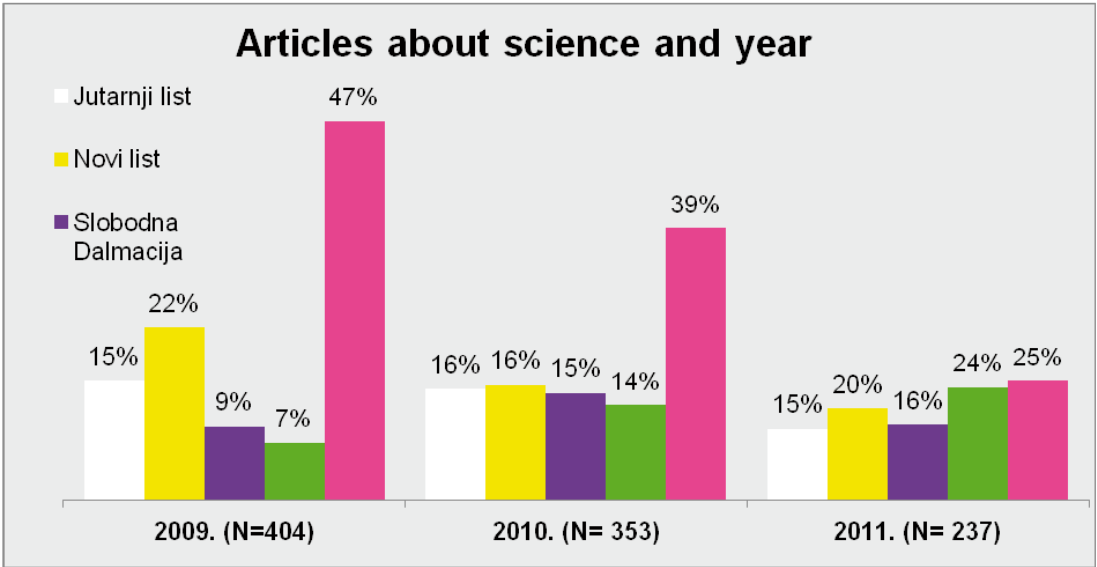


Figure 1: Frequency of articles

Scientific field

Croatian newspapers cover a whole spectrum of scientific fields, but there are certain significant differences in the scientific fields covered. The majority of science stories usually come from medicine. Medicine takes “the lion’s share” of coverage (Suleski & Ibaraki, 2010). In the UK half of the science items on BBC broadcast news deals with medical science (Mellor et al., 2011). The same is the case in Croatia. Nevertheless, interest in biomedicine is slightly declining. Biomedicine was the main subject of 40 per cent of all articles in 2009, and about one third in 2010 (see Figure 2). The decline continued, and in 2011 only 29% of articles deal with biomedical sciences.

Fields outside of health and medicine usually have very small appearance rate (Suleski & Ibaraki, 2010). Surprisingly, Croatian newspapers show a substantial interest in natural sciences, which were the subject of almost one third of articles during the analysed three years. Again, if we compare our results with the BBC survey by Mellor et al., we see that only about 5% of the science items on BBC broadcast news dealt with physical sciences. In 2011 in Croatia natural sciences are even more interesting than biomedicine. There is also increasing interest in technical and social sciences.



News Topics

When science becomes news, it is mainly because of scientific results. From time to time it is also something that we coded as 'other': book presentations, anniversaries and similar.

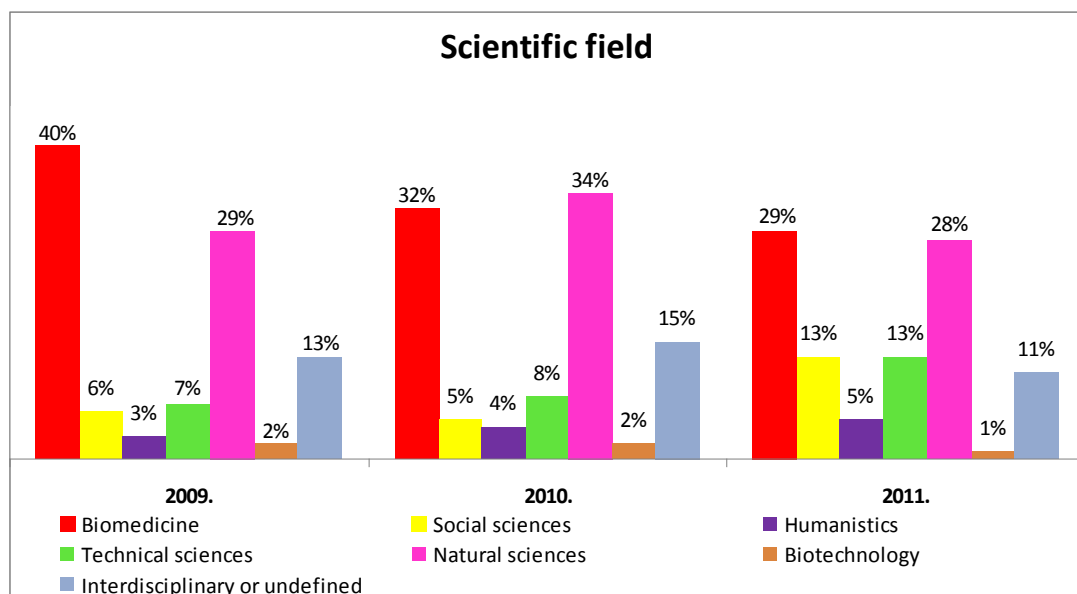


Figure 2: Science fields covered

News topic

	Observed N	Expected N	Residual	Chi-Square	P (signific.)
Research or project	560	165,7	394,3	1319,441	<.000
Scientific events	41	165,7	-124,7		
Outreach activities	24	165,7	-141,7		
Portrait of scientist or event	139	165,7	-26,7		
Other	219	165,7	53,3		
Undefined	11	165,7	-154,7		
Total	994				

Table 4: The coverage of different news topics

Scientific events (conferences, workshops and similar) and outreach activities are of almost no interest for our dailies, and have a small chance of becoming news. Other events or topics, like book presentations or anniversaries, as well as scientists themselves, attracted more attention.

Although there is a difference in the newspaper's coverage of various news topics (see Table 4), newspapers tend to cover different news topic in a similar manner, as we can see in Table 5. Also, there is little difference in the range of topics covered between years.

News topic * Newspaper Crosstabulation									
Count		Newspaper							
		Jutarnji list	Novi list	Slobodna Dalmacija	Večernji list	Vjesnik	Total	Chi-Square	P (signific.)
News topic	Research or project	86	77	70	87	240	560	43,264	<.002
	Scientific events	3	14	7	3	14	41		
	Outreach activities	2	10	4	3	5	24		
	Portrait of scientist or event	24	32	17	13	53	139		
	Other	34	56	29	28	72	219		
	Undefined	3	2	2	0	4	11		
	Total	152	191	129	134	388	994		

Table 5: News topic and newspaper

Distribution and prominence

The majority of scientific articles (at least 69% in 2010, and at most 79% in 2011) is published in sections like 'Life' or 'Entertainment'. The rest is published mainly in supplements on science (between 8 and 22%). Since science sections in the analysed period existed only in Vjesnik (the only broadsheet newspaper which in the meantime ceased publishing due to financial problems). Only a minority of the articles about science are published in science sections. Other sections rarely include science news or stories.

Science is not ghettoised in science sections and supplements, but it is extremely rarely published together with politics or economy. Science stories are also not prominent; only about 5% of all published articles are announced or reported on the front pages on the newspapers. Science becomes salient in rare cases, mainly on the last page. That is the case with 10%-26% of articles. But this prominence is not necessarily good: in Croatia, the last page is reserved for unusual and weird events or phenomenon, and science stories are published there because they contain unexpectedness or peculiarity as the news value and not because of science per se.



Type of news report

Around 9 out of 10 articles are written as news or news reports. We found only a few commentaries (7% at most, in 2010, which is shown in Figure 3), maybe because of the prevalent routine of translating, underwriting or downloading the articles from various sources. Also, there were only 4%-9% interviews. The majority of articles are written in a positive or neutral tone.

Conclusion

The media coverage of science is not, if judged according to number of articles published, in the declining phase. Although science is moderately interesting topic, it still 'fills' newspaper pages, scientific results particularly. They became news more often than scientists or scientific or outreach events, which are of very little or almost no interest for our newspaper. Surprisingly, the results of 'Croatian' research project are the topic of only 6.2% of all articles about scientific results. But, when they become news, than the media coverage is usually prominent and bombastic, particularly about researchers who use media aggressively (Jergović, 2009). Further studies should investigate this phenomenon in detail.

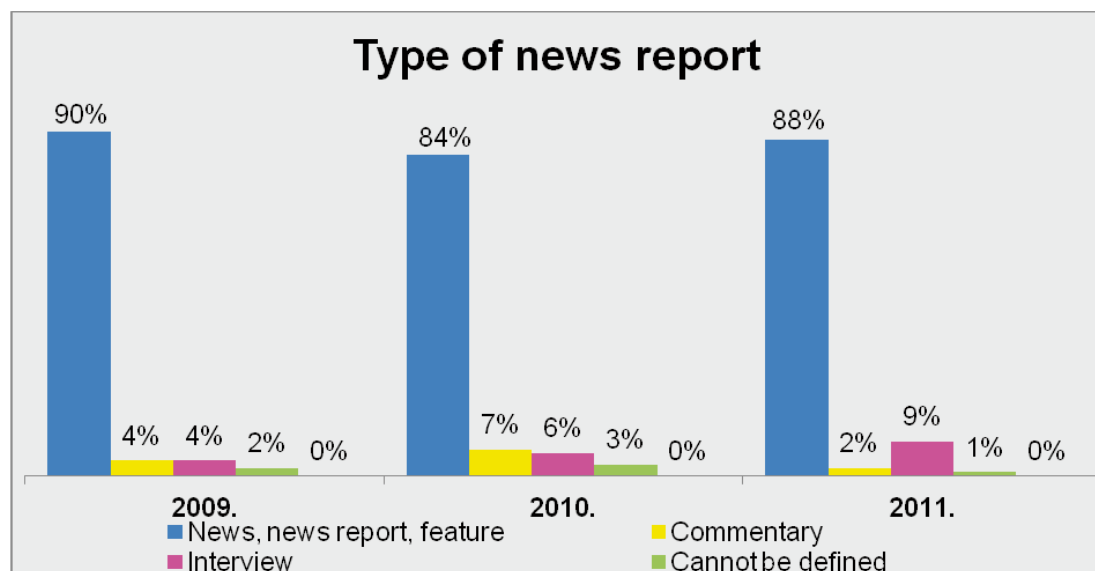


Figure 3: Type of news report

When it is a news story, science is covered in a descriptive manner and mainly in positive or neutral tone. Science news are in the majority of cases not prominent. Science is not ghettoised in science sections or supplements, but in our case it is ghettoised in sections like 'Life' or 'Entertainment'. This can indicate that the social value of S&T is undermined, which has been shown in our previous research. Reasons for this may be, various: from political, social or economical, to those deriving from the general media situation. Transition in the media was seen at the beginning as a positive evolution, in line with the democratization of the whole society. Now, sometimes our press media, if judged according to its science coverage, look more like lost in transition.



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78. Social responsibility in news – case study on the Hungarian interpretation of a “sensitive” scientific story

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First of all, a little correction to my title. What I will write about is not a real scientific news, but rather a scientifically inaccurate misinterpretation of an actual technical accident.

A small French settlement, Marcoule became well-known worldwide last September. The French and English TV channels broke their broadcasts to report the news of the accident that happened that morning. News portals also wrote about it almost immediately, for example BBC wrote: France nuclear: Marcoule site explosion kills one. In the early afternoon the first news and articles were published in the Hungarian online media as well, the first ones mentioned an explosion in a nuclear plant, and a possible radioactive cloud headed for Hungary.

Let's see where the accident really happened and what has really happened?

The Marcoule nuclear site is located in the Gard department of France, in south-east France. The Marcoule nuclear facility does not house any active nuclear reactors. There were three first generation French UNGG reactors operational, all of which has been shut down already. And there was also a fast breeder reactor, the Phenix prototype, which was operational from 1974 until 2009. This is the largest scientific and industrial site in that region. According to the official news website of the International Atomic Energy Agency (IAEA), the accident on 12th September 2011 in fact happened at the CENTRACO nuclear installation located in Codolet, adjacent to but separate from the Marcoule nuclear site [1].



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What really happened?

The blast occurred in the morning when a furnace exploded at the plant that treats nuclear waste. A fire broke out after the explosion, but it has been brought under control. “According to initial information, the explosion happened in an oven used to melt radioactive metallic waste of little and very little radioactivity,” said the Nuclear Safety Authority in a statement [2]. One person died, while another was seriously injured. Three more were hospitalised as well with less severe injuries. As mentioned above, the Hungarian online media wrote about an explosion in a nuclear plant, and a cloud headed for Hungary, which has very little in common with what actually happened.

Why are we so sensitive for that kind of news?

Mainly because of Chernobyl. The International Atomic Energy Agency (IAEA) introduced a scale in 1990, the so called INES Scale – the International Nuclear and Radiological Event

Scale – in order to enable prompt communication of safety-significant information in case of nuclear accidents. The scale is intended to be logarithmic, similar to the scale used to describe the comparative magnitude of earthquakes.

There have only been two events to date which were rated level 7 (major accident) on the INES Scale: the first was the Chernobyl accident in 1986, the second was the Fukushima accident in March 2011.

Chernobyl and how a radioactive cloud moves

Even if this accident was closer to Hungary, our country was lucky, because it got less radioactive fallout than some Western European countries. Contamination from the Chernobyl accident was scattered irregularly depending on weather conditions, and the main part of the radioactive fallout avoided us.

In 2005 the IRSN – Institute for Radiological Protection and Nuclear Safety – modelled the atmospheric dispersion of caesium-137 across Europe following the Chernobyl accident. As we can see from the simulation, the radioactive cloud [3] does not tend to move in a certain direction, but has a rather unpredictable, swirling motion. Therefore it cannot be stated that the cloud moves in a definite direction.



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After the accident of Chernobyl, it was communicated that such a thing cannot happen again, but 25 years later another severe disaster occurred: Fukushima. The earthquake in 2011, the following tsunami and the sequential damages (and explosions) done to the Fukushima nuclear power plant, presented a serious danger again. On many occasions it was referred to as a “second Chernobyl”.

It was just half a year after Fukushima, when we heard the news about Marcoule, that an explosion happened in a nuclear reactor.

And another reason, why we (Hungarians) are so sensitive for this kind of news: We also have a nuclear power plant in Hungary, the Paks Nuclear Power Plant. This is the first and only operating nuclear power plant in Hungary, it's operational since 1982 and consists of 4 reactors. Altogether these produce more than 40 percent of the electrical power generated in the country. They are planning new blocks and the extension of service lifespan.

What's more, we too had an accident in 2003 (an INES level 3 event). Actually, the accident that happened at the Paks nuclear power plant did not occur during the normal operation but was due to a technical problem during maintenance. Although, the accident didn't happen inside the reactor, the common people don't necessarily understand the difference.

Are nuclear reactors the same? Of course not!

There are different types of nuclear reactors:

- RBMK a class of graphite-moderated water cooled nuclear power reactor, a generation II reactor, built up to the end of the 1990s (Chernobyl consisted of 4 reactors of type RBMK-1000)
- BWR boiling water reactor, uses demineralised water as a coolant and neutron moderator (Fukushima Dai-ichi Nuclear Power Plant consisted of 6 BWRs)

- PWR pressurised water reactor (Paks Nuclear Power Plant, Hungary consists of 4 PWRs)
- and many more types ...

But for the public all nuclear reactors of different types and of different security levels are only the same: a hazardous nuclear reactor, which is nearly synonym of “atomic bomb”.

Considering the case of the Marcoule accident, and its interpretation in the Hungarian on-line media, we can see several serious problems, like: translation faults; misuses of technical terms; contradiction between the title, the text of the weblink, the keywords, the header and the content; taking information from other sites uncritically; mixing the information from different sources and from different dates and times, not separating them appropriately; not updating the article in time and in an adequate manner; etc. The following link shows some examples for these problems [4].

Some final thoughts

This is not a unique case. It is not unique in regard of the subject, the country and the different news portals. It's very likely that cases such as these have occurred many times on many portals and probably will again. The reason I felt it important to present this, is to notice these problems, inconsistencies and to speak about the arising difficulties.

There are situations, when we don't have at our disposal all-encompassing information on the details. For example, when the location of an accident is inaccessible (at that moment), or we don't know where it exactly happened, what exactly happened. We must find the balance between being as fast and detailed as we can and creating uncalled-for panic.

Nowadays it can be of great importance for public information communication to be as factual, detailed, professional and free of unfounded (not necessarily sensationalist) presumptions as possible. It is just as important that the occasional mistakes are corrected appropriately with a clear indication that there has been a correction. In addition, it doesn't matter if the reason is negligence, incompetence or to increase the attendance (of the site), it is ethically impermissible to allow misleading, sensationalist pieces of information abusing the reader's personal or territorial involvements to see the day of light and spread in the media.

These inaccuracies – depending on the subject – can create social tension, fear and panic; if not, they will discredit at least the given medium and the information communication. If they are not rectified clearly, pointing out what were the errors, what were the presumptions about a possible danger that proved to be wrong, they can be the cause of tension between people who read two different versions of an article, or even compel a reader to accuse the portal with the concealment of facts. Of course concealing facts can be as dangerous as providing information without sufficient background knowledge.

What I hold important is to highlight the phenomenon, the practices with which these sites are written and re-written, and to emphasize that this can be problematic in a number of different ways.



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79. A question of quality: Criteria for the evaluation of science and medical reporting and testing their applicability

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Introduction and method

The evaluation of quality in science journalism and science communication has often been focused on the question of accuracy. But opinion on what constitutes accuracy may be different among scientists and journalists. This may be one reason why the acceptance of purely scientifically based advice for better science reporting is low among journalists (e.g. Oxman 1993). However, in recent years different monitoring projects emerged, which try to judge the quality of medical reporting on (new) treatments, tests and procedures. These attempts use a set of defined criteria which focus on questions like: Is the magnitude of the benefit reported? Are the associated risks and costs mentioned? What is the quality of the sources (studies and experts)? But also: Is there a second opinion mentioned and does the report go beyond a press release?

Mainly based on the work of Moynihan (2000), the Australian “Media Doctor” started as the first of such projects in 2004 (www.mediadoctor.org.au) followed by a monitoring in Canada and Hong Kong as well as in the USA (www.healthnewsreview.org). In November 2010 the German Medien-Doktor – The German HealthNewsReview (www.medien-doktor.de) started as the first European project in this tradition. However, the 10 criteria used in the other countries were extended by three purely journalistic criteria such as actuality and relevance of the topic, quality of presentation and journalistic accuracy. These criteria were implemented in a journalistic review process which is developed alongside scientific peer review, however, by working with reputable science journalists as reviewers (instead of mainly scientists or physicians). This pure “science journalistic peer review” may be regarded as another innovation in our project.

Results

After the evaluation of the first 120 stories (using 10 plus 3 criteria by at least two reviewers each) there are about as many highly ranked stories as stories with poor quality (0-star-stories: 11; 1-star: 19; 2-star: 27; 3-star: 27; 4-star: 28; 5-star: 8). In 35 cases the newly introduced three purely journalistic criteria were the reason for a downgrade of 1 star; in one case the new criteria justified an upgrade. Comparing the results (based on the international 10 criteria) with the US HealthNewsReview project only one major difference can be identified: in the US-project 14 percent of the evaluated stories (n=1729) got a five-star result whereas in the German project only 6 percent (n= 120) were ranked in this category.

Although the star ranking may be used as a first and rough indicator of the overall quality of different stories the individual results for each single criterion may be more interesting. According to our reviewers’ judgment the most frequent failed criterion was an appropriate discussion of the available *evidence* for a presented scientific result (75 percent of articles rated “not satisfactory”). Similar results were found for an adequate presentation of *benefits*



(74 percent “not satisfactory”) as well as for the discussion of *risk and harms* of a medical method (73 percent).

In many cases it was also criticised that the journalist did not cite independent experts (63 percent). However, journalists seem to have fewer problems with explaining the real novelty and availability of a therapy or diagnosis (29 percent each), to investigate beyond a given press release (24 percent) and to avoid “disease mongering” (12 percent “not satisfactory”). Among our newly introduced purely journalistic criteria actuality, relevance and/or originality of the chosen topics were criticised rarely (15 percent “not satisfactory”; all values rounded to full percent.)

Although these results are preliminary, some suggestions can be made on how to improve reporting on medical sciences by comparing them with the data from the US and Australia (Schwitzer 2008; Wilson 2009). In all three monitoring projects the criteria “benefits”, “harms” and “evidence” are considered to be among the worst reported objects, (with the exception of “costs” in the US (negative rank 1) and the Australian projects (negative rank 2).

Interestingly, the criterion “costs” was more often fulfilled in German health news than in stories from the other two countries. We had expected that the German journalists could consider this information as less important for the individual patient because the German health system is known for its rather extensive coverage of costs, at least in comparison to the US. However, all comparisons between the countries are limited as we imply here a similar judgment and application of the given criteria by the reviewers in the different countries.



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As a means of internal quality assurance we evaluated the consistency of judgments of different reviewers in our project (already after n=70 stories with at least two reviewers each). In 77 percent the reviewers’ judgments for the same story was identical or differed by only one star. For 23 percent of the stories the rank differed by two stars which was also the maximum difference; there was no judgement of a story that differed by more than two stars.

Conclusion and perspectives

Our method seems to be appropriate to sharpen our picture of strengths and weaknesses of medical reporting in the mass media. Therefore, it helps to specify the needed improvement in the education and permanent training of journalists reporting on science and medicine. Some cases of stories evaluated in the project are already used in our own journalism training. Furthermore, the project provides access to best practice examples for the journalistic as well as for a broader community (patients, medical doctors, science communicators).

As the project has gained remarkable acceptance among journalists and mass media (e.g., nomination for the journalistic Grime Online Award; among the awards for the “journalist of the year” of the medium-magazin; integration in the standard curriculum for (other) journalism training programmes in media houses such as the German Press Agency (dpa); wishes from several mass media to be evaluated by the Medien-Doktor team for consultancy) it also promises a sustainable impact on the self-control and reflection of journalists dealing with medical issues.

This does not necessarily mean the exact adoption of our criteria but already the awareness raising of the need or existence of any quality criteria. This may be illustrated by a reaction of a journalist to our evaluation of one of her articles:

“I have decided for myself to establish my own small check list oriented to the Medien-Doktor criteria (however with different weighing of some criteria) and to evaluate my own articles by using them before submitting. This is my personal step for an improvement of the reporting.”

Based on our positive experiences with the project Medien-Doktor for medical reporting we are developing now criteria for a quality monitoring in other fields of science reporting such as on environmental issues.

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80. Science Agora: The History, Evolution and Evaluation of Japan's Leading Science Communication Event

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Introduction

Science festivals are opportunities where everyone enjoys science, while the role of each festival defines its particular target audiences. To name a few of European [Ref. 1] and many other examples nowadays, Edinburgh Science Festival started in 1989 and continues to demonstrate the cultural value of science across the whole city. Cheltenham Science Festival, from 2002, features science among existing festivals on music and other artistic activities. British Association Festival of Science, on the other hand, rather puts emphasis on communication between scientists and educated individuals with remarkable media exposure. At an international level, European Science Open Forum is a biannual science festival circulating across the European continent. Also known is the American Association for the Advancement of Science Annual Meeting in the United States where Family Science Days serve for local children and their parents next to sessions about sometimes controversial issues related to science joined by renowned US and international participants.

Science Agora in Japan has been playing a leading role as one of the largest science communication festivals in the country. Since its inception in 2006, it has continued to represent Japan's most current activities by inviting competitive proposals nationwide. While more than a hundred individual programs welcome their targeted audiences, the event as a whole is for everyone in society at all ages, irrespective of background. Unlike academic meetings, so-called lay audiences can enjoy hands-on activities offered by professional science communicators, research institutions or groups joined by leading scientists; and unlike ordinary festivals, serious discussions on societal issues closely related to specific scientific topics are held among a spectrum of stakeholders to exchange opinions.

Such festivals, often multifaceted, potentially make unique impacts as a whole compared to the situation where individual activities are held at different sites on different days. It is true that single local activities contribute to the respective geographical areas; however, having those practitioners gather in one place and exchange skills and know-how is of equal or even greater significance. In this paper we position Science Agora as a model case and, by reviewing its success as well as identifying remaining challenges, evaluate potential contribution of science festivals for quality science communication.

History: The Event Side

Under the organization by Japan Science and Technology Agency, a major national funding agency, the last six years saw a steady growth in statistics describing the event side of Science



Agora [Fig.1]. Compared to the first event in 2006 that called for a show-up of pioneering science communicators, the sixth Science Agora event in 2011 recorded six times higher daily attendance of more than 3000. Attendees were exposed to various individual programs, the number of which almost doubled to 194 within the six years. Even exhibitors, mostly serving for their guest attendees, enjoyed opportunities to interact with hundreds of other presenting groups or individuals as potential future collaborators.

#	Year	Date	Place	Attendance	# Programs	# Parties
1	2006	Sat-Mon, Nov. 25-27	Tokyo	1700 (estimated)	100	83
2	2007	Fri-Sun, Nov. 23-25	Tokyo	2959	94	124
3	2008	Sat-Mon, Nov. 22-24	Tokyo	6109	123	138
4	2009	Sat-Tue, Oct. 31-Nov. 3	Tokyo	8705	147	141
5	2010	Fri-Sun, Nov. 19-21	Tokyo	5934	145	146
6	2011	Fri-Sun, Nov. 18-20	Tokyo	7057	194	183

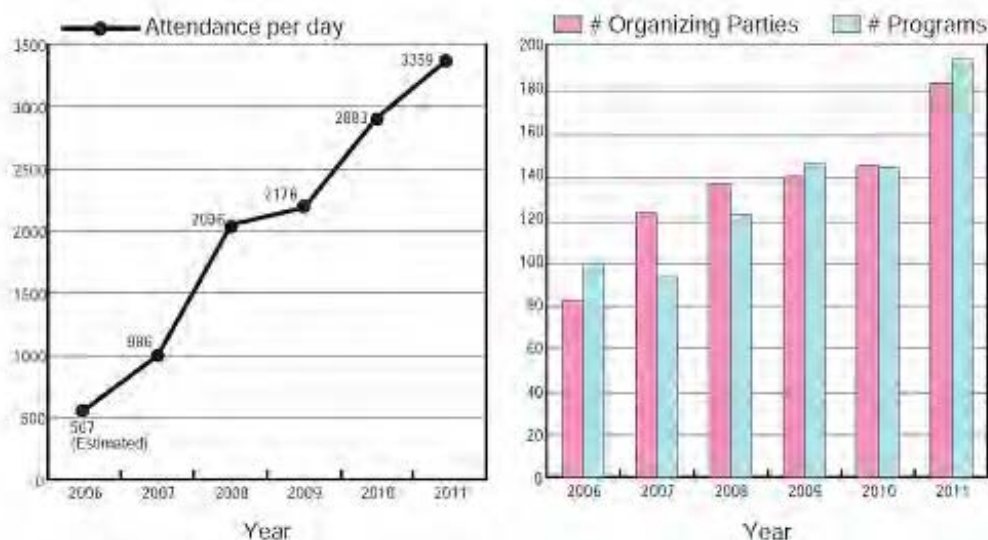


Figure 1: Science Agora event statistics. The daily average of attendance (bottom left) and the numbers of organizing parties and programs appeared (bottom right) demonstrate a steady growth of the event. [Cited from Ref. 2]

Science Agora has so far taken place in Tokyo. The venue is located in the area called Odaiba Waterfront, on the east side of the capital city, where a national science center (Miraikan) and other research and government institutions offered a festival place for assembly.



Evolution: Interaction among Participants

It is appropriate to identify Science Agora as an annual multifaceted event that has continued to serve as a hub of science communication activities. Recently, on the list of individual programs, names of local science festivals can be found in addition to those of traditionally participating science museums and academic institutions nationwide. Although further analysis has to be made, it is reasonable to think that the pool of exhibitors reflects increasing diversity in Japanese science communication activities, and that such activities are reaching critical mass for the formation of local science festivals at specific cities.

Table 1: Examples of local science festivals introduced at Science Agora 2011

Program #	City, Prefecture	Presentation format
Ma-42	Hakodate, Hokkaido	Booth
Ma-43	Mitaka, Tokyo	Booth
Ma-75	Nagoya, Aichi	Poster
Ma-76	Shizuoka, Shizuoka	Poster



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Diversity can also be found when we look into the professional roles of individual participants. Scientists and engineers tend to serve as speakers, panelists and demonstrators; school teachers bring their students to have them experience science in an informal setting; museum staff and science volunteers put ideas into practice in front of children and adults; and journalists, media people and policymakers join discussions on controversial issues related to science and technology. The biggest advantage of such diversity is that it offers to all these participants so many random opportunities to learn better ways of science communication as well as to identify key issues of interest when they just wander around; in other words, anyone can enjoy the place based on their own curiosity and knowledge background, which eventually results in an on-site personalized tour.

Considering the situation mentioned above, we could say that Science Agora has evolved to a “meta-festival” that showcases representative, quality science communication activities [Fig. 2]. Science festivals have at least two functions: one is to host excellent science communicators who directly interact with their intended audiences (a communicator-communicatee relationship), and the other is to offer a venue for networking among science communicators exchanging skills and know-how. The point is that the latter function of Science Agora could now involve participation of local festival coordinators, who learn and bring back their experience to their own festivals.

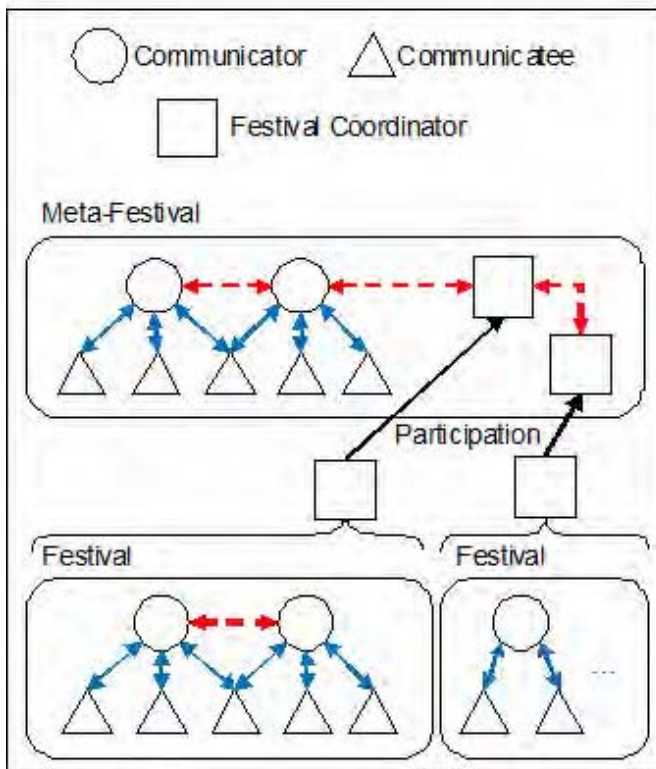


Figure 2: The meta-festival concept. Even at a festival, exchange of skills and know-how (red dashed arrows) occurs in addition to multiple communicator-communicatee interactions (blue solid arrows); but at a meta-festival, participation of festival organizers introduces added quality in that they get ideas for improving their own festivals.

Evaluation: Challenges and Opportunities for Quality Science Communication

Now that Science Agora has evolved to a meta-festival, it has to continue to be an attractive model for local festival coordinators. Then, in what aspect can it achieve the best improvement?

As Japan's science communication policy has been shifting to more engaging, dialogue-based, bidirectional schemes [Ref. 3], Science Agora is expected to take a leading role for its materialization. Considering this expectation, combined with the current meta-festival position, it would be important both (1) to enhance quality of individual science communication practices at Science Agora, and (2) to enhance quality of interaction among science communicators, festival coordinators and other practitioners in a broad sense, thus helping them get more effective feedback on their own activity.

There could be room for improvement. More positive interventions (e.g. providing more effective expert comments during and after peer review) would be a possible solution for the enhanced quality of individual practices. Strategic distribution of booths, posters and parallel sessions would increase probability of successful networking. Agenda setting would guide people's attention to the overall theme of the event and catalyze fruitful discussions.

But altogether, a big challenge is to establish strong “science producers” responsible for the grand design of Science Agora as a whole, whose skills and know-how would eventually benefit every festival coordinator as their role model.

Under the guidance of science producers, whether they are talented individuals or an experienced team within an organization, Science Agora would further be able to contribute to quality science communication both at and above an individual program level. The long-term goal would be to realize the situation where self-directed, locally-unique “agoras” ubiquitously take place year-round, offering accessible places to citizens, experts and communicators for informal education and discussion.

Conclusion

Science Agora has been reflecting Japan’s most current science communication activities. Following its success as one of the largest science festivals in the country, it now seems to move into the next phase where it has to show a model for local science festivals. The strategic grand design is expected to be drawn up and suitably materialized by strong science producers, who may well be a possible role model for science festival coordinators at every level.



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81. Science goes to Hollywood: students' choices and the impact of science fiction

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In the international context, several studies have attempted to understand the reasons why young people choose scientific degrees. Kotte states that their attitude towards science generally develops between 10 and 14 years old.¹

Gender studies focused on the relationship between science and the young present key elements for analysing young attitudes and behaviours, especially in the transition phase between secondary and tertiary education.² With regard to that, it is important to consider the social as well as individual context for young people, by distinguishing at least two main dimensions: a) opportunities and first hurdles; b) socially constructed beliefs and the social representation of science.

The first dimension includes both the student's family and socio-economic context. The family, the school and the other places where the socialising process develops are all influential in shaping their identity and therefore in defining their individual choices. The family environment is a *milieu* which can encourage opportunities/hurdles in choosing a school curriculum; likewise, school is the place where they live. If family provides patterns which foster or hinder particular experiences, such as undertaking a certain study course and acquiring gender stereotypes, school provides a *network* of opportunities which allows students to have access to or to be excluded from specific social groups or future job careers.

The second dimension referred to is the set of social images, beliefs and representations about science and technology, which are learnt from the social contexts one belongs to. The influence exerted by the media in their different guises contributes to stretch scientific imagination. These mechanisms play an important role in shaping the individual's opinions as well as choices.

Some aspects of the media influence were studied within the Iris project (Interest and Recruitment in Science), an international research project promoted by the European Union under the Seventh Framework Programme, addressing the challenge that few young people (women in particular) chose education and career in science³. The aim of the research project is to know the paths followed by young people to approach science at the university with special attention to gender differences. The project, coordinated by the University of Oslo, involves five countries: Denmark, Italy, Norway, United Kingdom and Slovenia. We will now analyse some impacts of the mass media from the Iris data, which, together with the information conveyed by social networks, contributes to the building of social representations young people have of different disciplines and, thus, influences their academic choices.

¹ D. Kotte, *Gender differences in science achievement in 10 countries*, Frankfurt, Peter Lang, 2009.

² G. Guedet, *Investigating the secondary-tertiary transition*, in «Educational Studies in Mathematics», 67, 2008, pp. 237-254.

³ <http://iris.fp-7.org/about-iris/>



There are numerous media contents that can, in a direct and indirect way, influence the choice of study of boys and girls. For both, in the first place there are the books and popular science magazines; television broadcasts of popular science have influence especially on males and fiction film or television science are preferred by females.

In recent years science fiction has been a popular genre and some series have been recognised internationally as the most viewed, e.g. CSI, NCIS, Numbers and others. We can take into consideration the narratives of two of these series, CSI and NCIS, trying to connect their message about roles and identity of scientists to the motivations proposed by students in the Iris project for the choice of a scientific degree.

The narratives of CSI and NCIS: roles , gender and research questions

CSI squad has a family structure: Catherine Willows and Gil Grissom are mother and father of the team. Catherine is a single mother, an ex-dancer who pursued a bachelor of science degree in medical technology. She is very interested in scientific evidence from an holistic point of view, her main question studying a case is “why?”, with a specific curiosity and interest on the context in which the crime took place.

Gil Grissom is an entomologist very strongly based on scientific knowledge. He is very familiar with experiments, he likes to test hypotheses using experimental methods and is very focused on evidence. His main interest is on “who” and “how much” somebody profits from a crime.



- 344 What is very important for our comparison of students' views is the different approach to problem-solving of the two characters. The two approaches are very similar to the preferences expressed by students where females pay particular attention to the meaning of the scientific activities and males to technical aspects.

The NCIS force has a patriarchal structure: Leroy Jethro Gibbs is the father and the boss and there is a smart young forensic scientist, Abby Sciuto. Narratives of Abby propose particular values about science activities. She has a strong passion for science and she is always fascinating by the discovery of new features regarding the cases.

Leroy Jethro Gibbs is a typical marine, a white male devoted to a strong discipline. He stresses the importance of getting to the point, to be clear and faster. Frequently they are engaged in a lively debate where Abby demonstrates passion and scientific rigour while maintaining her originality and trying to fight the stereotype of a submissive woman.

In these particular science fiction messages we can see some similarities with male and female motivations for science studies. In a sense it seems that this fiction reinforces some attitudes expressed by the students. First of all they transmit intrinsic value where terms as passion and pleasure underline the emotional sphere but also the rational attraction for the subjects and their practical application. Here we can find a difference between males and females, where female are very interested in the whole knowledge and meaning of scientific disciplines.

In the Italian qualitative data of the Iris project, we find frequently references to aspirations and ambitions from females that indicate an aspiration for a particular role in the society. This concerns career objectives and lifestyle, but also the social role the students intended

to perform. Males are more attracted and motivated by practical and laboratories activities, especially for gaining a distinguished status. Females offered reasons which more closely concerned mankind, the environment, and nature, with a specific connotation of “taking care of others”. While male students mentioned issues regarding the exploitation of science and technology for the betterment and development of society, which were often described in general and abstract terms, female students mentioned the relevance of science’s impact on everyday life and the importance of working in groups when doing research.

Conclusion

Young people, with particular differences between males and females, are attracted by television series that use science and technology. These TV shows can help to preserve and transmit gender stereotypes, but they can also propose different roles for male and female scientists, offering new ways of defining identity and then also the possibility to implement the motivations of young people wishing to follow careers in scientific study and research work.

The use of forensic science in solving crimes involving the audience offers certainties that are sometimes beyond the real possibilities of the investigation. The presence of scientists in the investigation, however, brings science to the general public, particularly young people, making it more attractive and interesting, offering new opportunities and possible career options.



82. Sensationalising the Female Pudenda: An Examination of Public Communication of Aesthetic Genital Surgery

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Introduction

In this paper, our preoccupation is to highlight the trend toward sensationalising or commercialising female genitalia through medicine. We examine the public communication of aesthetic female genital surgery particularly in the Internet and pose the following questions: How honest, safe, fair, balanced, or ethical is public communication of aesthetic female genital surgery in the cyberspace?

Two theories can be said to be at work concerning the public communication of aesthetic female genital surgery: (a) value-expectancy theory and, (b) elaboration likelihood theory.



Related Literature

Whitcomb (2010) demonstrates that existing representations stress the differences and ignore the potential similarities that exist between female genital mutilation (FGM) and female genital cosmetic surgery (FGCS). Female genital cosmetic surgeons tend to justify aesthetic genital surgery by describing the female genitalia as “irregular, misshapen, large, enlarged, fat, abnormal, problem, excess, deformed, asymmetrical, jagged, not smooth, and flabby”. For these reasons women’s feelings towards their genitalia are said to cause “embarrassment, loss of self esteem, lack of confidence, and self-consciousness.” Before genital surgery, women’s vulvas are more likely to be described as, “stretched, sagging, loose, aging, old, relaxed, gaping” whereas, after aesthetic genital surgery, the vulvas are described as “tightened, youthful, younger, renewed.”

Johnsdotter and Essén (2010) state that “genital modifications take place in a sphere where biology, medicine and cultures are intertwined” (p.29). Latham (2010) observes that cosmetic surgery is increasingly popular in the UK – moving up from 10,738 operations in 2003 to 34,453 in 2007. These operations are done in private clinics in response to patients’ request for aesthetic enhancement of their bodies and not for medical reasons.

Dorneles de Andrade (2010) observes that cosmetic surgery among others are forms of body modification that have parallels with the discourse on female genital mutilation and should be considered to have an analogous function in the reproduction of social and gendered objects. This view tallies with that of Plowman (2010, p. 113) who echoes the argument that “much of the success of female genital cosmetic surgery is because its promoters created the problem – that the privacy of this part of the body can foster anxiety, playing on the long standing cultural taboo surrounding female sexuality – which was then sold to women alongside the solution of surgery.”

Method

This discourse is hinged on ideas, facts, and data gleaned from the textual examination of aesthetic genital surgery. Printouts from the following top websites obtained between the months of January and March 2012 formed the bases for the discourse: Manhattan Centre for Vaginal Surgery; Plastica.ca; Millsmedical.com.; Urogyn.org; Courthouse Clinics.com; Labiaplasty Surgery.com; Clinic of Plastic Surgery; Drmatlock.com; Wellness Kliniek.com; Cosmetic Surgery2.com; and Altermd.com. A Google search for “top cosmetic genital surgery sites” we conducted on 4th October 2011 yielded 8,870,000 results. These eleven (11) sites mentioned above were purposively selected. These sites owned by aesthetic female genital surgery clinics in the United States, Europe, Canada, and Brazil.

Findings

In summary then, from the examination of the communication of aesthetic female genital surgery on the Internet as illustrated above, the following can be said to characterise the public communication:

- 1) With regard to *decency*, it can be said that the public communication of aesthetic genital surgery in the Internet is characterised by graphic details of the female genitalia to the extent that a few websites warn visitors that the images could offend their sensibilities. Most websites offer no such caution. This sort of display may border on prurience.
- 2) In terms of *ethics*, most of the websites bear characteristics that tend toward unethical practices. There is evidence of soliciting for clients, offering of loans and freebies, giving incomplete information, fueling insecurities about vulva aesthetics, and advertising of physician credentials, skills, and services.
- 3) Concerning the *quality* of information, accuracy is sacrificed. The impression the websites give is that aesthetic genital surgery is desirable even if there are no medical indications. Again, one gets the impression from the websites that there is an analogous relationship between the much despised female genital mutilation common in third world countries and female genital cosmetic surgery common in the developed world.
- 4) A focus on *honesty* indicates that it may not be the welfare of the women folk that drives the female aesthetic genital surgery industry but financial fortunes for plastic surgeons, the fashion and modeling industry, the pornographic magazine and film sectors as well as the new-age view of the pseudo-feminine aesthetic.
- 5) In examining *balance*, it is apparent that there is a lot of lopsidedness in the communication of aesthetic female genital surgery. The testimonials are more often than not positive, praising the virtues and benefits of genital surgery to the woman, applauding the skills and services of genital surgery experts and down playing on the risks, complications, and potential harm that aesthetic genital surgery may cause.
- 6) Furthermore, the public communication of aesthetic female genital surgery is characterised by *sensationalism*. A lot of hype surrounds the issue not only in the Internet but in the press, the broadcast media, cable and satellite systems as well as



in public conversation. The media tend to offer cosmetic female genital surgery as entertainment. The more scientific and correct view is that female genitals come in various lengths, widths, colours and shapes and if they are not damaged by trauma such as occur in vesico-vaginal fistula, difficult and multiple births or old age, there is absolutely no need for surgery or a “designer vagina.”

- 7) In relation to *cost*, the communication of aesthetic genital surgery in the Internet loudly indicates that though the procedures are touted as simple, requiring local anaesthesia, and an outpatient treatment, the cost seems too high, prohibitive and tends toward financial exploitation. The websites show that aesthetic female genital surgery ranges from 350 to 6950 euro or between 1,850 and 10,500 US dollars. That might be seen as a waste on needless surgery.
- 8) On the positive side, considering *language*, it could be said that the communication of aesthetic female genital surgery is characterised by simple-to-understand diction though some difficult terms e.g. “protuberant,” etc. are used. Generally speaking, a person of average education can read and understand the language.
- 9) Similarly, in terms of website/webpage aesthetic, it can be said that the postings use good aesthetic. The colours are inviting, the photographs (apart from those that show graphic anatomical details of the female genitalia) are alluring – beautiful, smooth female faces, well nourished bodies, etc. (though this is make-believe) and the typography appropriate. However, some of the websites carry too much information as to make the pages cluttered.



348 The textual examination above of the communication of aesthetic female genital surgery has been corroborated by several other scholars. Arroba (2003) sees it as fallout of the patriarchal system which is based on the control and appropriation of women’s bodies. Blanchard (2010) notes how the female genitalia are described as “too big, too small, too narrow, too wide, too high, too low, too flabby, and too wrinkled.” Lee (2011) gives statistics on how big the designer vagina business is. Bates (2010, p.1) states that cosmetic labial surgery has been at the centre of escalating controversy pitting critics against proponents in a battle of words over ethics, and concludes that “doing such procedures and advertising them with photographs of purportedly “attractive” versus “unattractive” genitalia constitute a violation of the ethical relationship gynaecologists have with their patients.

Conclusion and recommendations

There is no better way to end this discourse than doing so in the words of Goodman (2009, p.159) that patients and others need to know and take note of the ethical principles of autonomy, non-maleficence, beneficence, justice, and veracity. In view of the online sites examined in this article it is clear that there is glaring non-compliance. We recommend that media regulators take a more than cursory look at the communication of aesthetic female genital surgery online to ensure that they conform to journalistic standards of honesty, truth, accuracy, fairness, balance, quality and decency. Similarly, medical regulatory authorities should closely monitor the practice and communication of aesthetic female genital surgery to encourage it to operate in accordance with medical principles and ethics. In doing these, the quality, honesty, and beauty in aesthetic female genital surgery communication would become the ideal that we all desire.

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83. The bodily construction of medico-scientific expertise: medicine and bodies in Italian talk shows

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Introduction

This presentation aims at analysing a new phenomenon inherent to the process of public (re-)construction of medical and scientific expertise. More specifically, I intend to point out the increasingly salience played by the body as a source of medical and scientific authority within the context of visual media representation.

Hans Peter Peters (2008: 133) writes: “The analysis of how scientific expertise in the media is constructed is an urgent research field”. I intend to approach this topic in a cultural and qualitative way, by combining studies of science and technology communication with an analysis of visual medical culture as well as the qualitative study of television programming and, more specifically, of talk shows. My first assumption is that *medical and media technologies are representational tools that produce meaning at a specific moment*. Several theoretical and historical overviews of the intersections between medicine and culture, as well as other cultural investigations of medicine’s visual culture, have shown that viewing instruments and techniques, especially the motion picture, have played a crucial role in the emergence of a distinctly modern mode of representation in Western scientific and public culture. This research has pointed out how the ethics of seeing could affect the framing of medical issues. According to Hugh Crawford (1998: 42), “(medical movies and documentaries) underscore the troubling epistemological relations of optical technologies and people – of looking, looking through, and being looked at. Such relations seem transparent... but they are instead fraught with complexity and produce by their very transparency an unacknowledged and overdetermined way of viewing and acting in the world”.

This representational mode, geared to the decomposition and reconfiguration of bodies, is usually associated with the regulation and control of the body, the modifiability and perfectibility of the body in combination with the medical knowledge. I would like to apply this analysis to the construction of scientific expertise, which, as studies of science and technology communication have demonstrated, is radically different from a transparent translation of scientific knowledge. In this sense, it would seem very useful to shift from the analysis of medical movies and documentaries to *general communicative spaces where implicit conceptions about science and society surface more neatly*.

This observation led me to analyse talk shows, which, according to the numerous cultural commentators of this TV genre, are a peculiar form of public sphere based on conflictual situations, where diverse social groups discuss, negotiate and dispute (Livingstone and Lunt 1994). One of the recurring oppositions on which this TV format is constructed is the opposition between experts and lay people. In this sense, I think that STS-oriented research on the construction of the role of scientists as public communication experts may be complemen-



tary to a qualitative research on talk shows focused on issues of voice, expression, and other features of the performative reconstruction and deconstruction of scientific expertise.

The Bodily Reconstruction of Medico-Scientific Expertise in Italian Talk Shows

With this methodological and theoretical background, I analysed two seasons of the two most important Italian “talk shows of social and political debate”, *Porta a porta* and *Matrix*. Both have a similar, typically Italian, format in which topics of general interest, such as political issues, murder cases, national events (such as San Remo song festival or the Pope travelling outside Europe), social and lifestyle tendencies and, of course, science and medicine, are debated by politicians, journalists, celebrities, witnesses, and, of course, scientific and medical experts.

These formats are very popular in Italy and run in the time slot just after prime time on 3 or 4 days a week on the two most important networks (RAI 1 and Canale 5) of the two Italian dominant TV companies RAI and Mediaset. Different from other talk shows, they are oppositional but very polite, the cast is heterogeneous, but also well aware of TV behavioural rules – for example, there are very few lay people, since their role is usually played by celebrities.

Let's look at a couple of examples of the crucial role played by the body in the public *re*-construction of scientific expertise. The first is drawn from a show devoted to cosmetic surgery and diets. An obese journalist takes part in a week-long medical weight loss treatment in a very prestigious and expensive clinic. In this short documentary we see the journalist having a medical examination, exercising, hanging around in swimsuit and a bathrobe. He reports his physical feelings at the dining table in front of a very light dinner, when he checks his weight and so forth. Afterwards, he appears in a collar and tie speaking about diets more as an expert than as a patient.

The second example regards the effective construction of scientific authority in a discussion on “euthanasia” through the indirect exhibition of the body of one physician who is at the same time affected with lateral amyotrophic sclerosis. Here are two passages: the introduction and a later clear-cut disagreement.

BV: Mario Melazzini is the head of oncological day hospital of Maugeri Foundation Maugeri of Pavia, but for five years he has also been affected with amyotrophic lateral sclerosis. What does this mean?

MM: Well, good evening first of all. This means being a prisoner of your own body. Amyotrophic lateral sclerosis is a neurodegenerative disease which acts upon the motoneurons, i.e. the brain cells which send impulses to voluntary muscles, and hinder their work. All that is voluntary is inhibited, from very simple hand movements to more complex movements which allow swallowing, the articulation of words, breathing. Practically, someone affected with amyotrophic lateral sclerosis, if not adequately supported, will die in 3, 4 years in 85% of the cases.

BV: Excuse me, excuse me, Dr Melazzini. What chance do you have to get better?

MM: Zero, nowadays.



BV: May I ask you, may I take the liberty of asking you, since you are a physician and know your situation better than anyone else...

MM: ... sure...

BV: ... how many more years may you live?



Figure 1. In corpore vili: A journalist in a weight loss clinic

In this introduction, the physical condition plays a crucial role, as in the next one, where the authority of Melazzini stops an argument between two politicians for and against euthanasia.

BV: Your argument is that feeding is not therapeutic obstinacy...

LS: That's the point. Feeding, eating, doing ordinary stuff... like a child, a person who is not able to do it...

MC: Certainly, it's natural, with a tube stuck down your throat!

LS: Well, eating is natural, breathing is natural, drinking is natural...

MC: ... you should have asked Welby¹: that was his question: "Is really natural having your throat punctured?"

¹ Piergiorgio Welby was a political activist who, affected severely with muscular dystrophy, in the last three months of his life led a political battle for the right to die, inaugurating the debate on euthanasia in Italy.

LS: ... Welby wouldn't suffer, it won't hurt much...

MC: ... that was his question!

MM: Excuse me, Honourable Santolini, Melazzini wants to answer Cappato... please.

MM: Pardon me, I would like to make some remarks and reflections (hhh)², we should not forget that even those, who are called by my colleagues (hhh) cases or patients, are first and foremost human beings and individuals like (hhh) Giovanni Nuvoli, who I had the pleasure and the honour to meet last Sunday (hhh). Well, it is important to be clear on the meaning of the words (hhh), otherwise it seems that people who have a tube in their throat, and it is not a tube, it is a simple (hhh) probe in the trachea which allows people to breath and live; (hhh) is sometimes done consciously, on others it is imposed, (hhh) but what is demonized is this technology...



Figure 2. The introduction of Melazzini.

² Breathing.

The Scientific Authority of Bodily Authenticity

To conclude, I would like to stress the importance of the body in scientific public discourse and especially in the construction of medical expertise. This is particularly clear in Italian talk shows of political and social debates, since they are a format that is very close to the public sphere, especially when they speak of medicine. How can we read this media phenomenon? To put it crudely, *authenticity* is replacing *authority* in the television public sphere, especially when a decision about biotechnology is warranted (Brown and Michael 2004). As these two cases show, in TV public spheres the body is a valuable source for the rhetoric construction of a authenticity, or, in other words, for making scientific expertise seem warmer, more concrete and less detached.

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84. Modeling social networks response to scientific information

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Social networks

Human societies, with their social interactions between individuals and organising structures, are examples of dynamic complex systems for the properties of which the network approach and mathematical modeling have turned out to be crucial in understanding their behaviour and how they change with time.

One of the interesting phenomena in a society – describable as a social network – is the process of opinion formation among people. Previously we have developed a model for opinion formation based on co-evolving social networks: the degree of agreeing with a single issue changes the structure of the network and *vice versa*. However, these two mechanisms evolve with different time scales. Opinion changes on a fast time scale (transactions) while the network exchange links with a slow time scale (generations). The dynamics of transactions are based on two main processes: one-to-one interactions, and an attitude parameter describing the personal reaction to the overall opinion (1). The rewiring mechanisms to obtain new acquaintances are taken from network sociology studies, and are basically of two types: *focal closure*, if one prefers to link to agents with the same attributes, or more commonly, a *triadic closure*, which means that one is more likely to make new friends from the friends of your friend.

We have extended this model to study the spread of scientific information among people under the influence of public science communication, such that during the process people may adopt it as truth, or reject it. The key ingredient is to consider the information available to all individuals as an external field, an external action that can influence individual decision-making processes (2). A good example of this situation is how much scientific and technological knowledge determines the public engagement with polemic issues that affect society.

Public Science Communication

Scientific literacy is not the only parameter involved in forming opinions. The attitudes of individuals depend on their cultural, educational, and environmental differences. In order to understand the public perception of science and technology many science communication models have been built (3), but there is still controversy between the so-called “scientific literacy model”, which assumes that knowledge increases the public acceptance of scientific research, and the “contextualist” approach, where social values and attitudes are also relevant.



A remark should also be made on cognitive models (4). Many of these are based on the cognitive miser model, where citizens are supposed to collect only as much information about the topic as they think is necessary to reach an opinion (4). Often the news, reported in different media, is the main component for the opinion formation process. There is also a deeper cognitive process that requires that the individual can overcome epistemological obstacles (5).

The goal of this contribution is to present a mathematical model where each citizen has a personal opinion that is related not only to his or her scientific knowledge but also to the cultural background and that is likely to change through one-to-one interactions. There is also an attitude parameter where the influence of friends, relatives and colleagues are included. Finally, there is also an external influence mostly due to the media.

Modeling social networks

All the details of our model can be found in reference 2. Here we are only presenting the main results that we think could be useful for the science communication community. In the model each agent has a continuous bounded state variable that quantifies the conviction of a fact. When it becomes +1 we consider it as expert knowledge while -1 means a fundamentalist opinion against a scientific fact, as it could be for instance against Darwin's theory of evolution. When the parameter has a value around zero, we are dealing with ignorance. When an agent reaches +1 or -1 it stops changing links within the network. We find that agents stubbornly opposing scientific facts form tightly connected communities, which are not completely isolated because there are ignorant agents who bridge different groups of society. This suggests that scientifically sound concepts are more difficult to acquire because opposing individuals are very well organised. We have also observed that there is a critical value beyond which the dynamics slows down and a complete agreement in the social network is not reached.

We have compared the results of our model study to actual data on scientific perception surveys carried out in two different populations, from Europe (Eu) and from Mexico (Mx) (7) in order to analyse their peculiarities. Although the Mexican survey follows the methodology of the Eu survey, the multiple-choice answers are different. In the Mx survey the answers are: totally agree, tend to agree, tend to disagree, totally disagree and do not know, while in the Eu survey there is an extra possibility: neither agree nor disagree. We excluded the do not know and neither agree nor disagree and normalised the agreement and disagreement percentages, n^+ and n^- .

Then we selected 15 equivalent statements and use our judgement to order them from fallacies to obvious facts. They do not follow the same pattern of percentage of agreement because, as expected, there are cultural differences in specific questions. However, in questions only related to scientific knowledge the results are quite similar due to similar human cognitive processes and the globalised information we all have access to. For each survey we have used their resulting agreement fractions in science-related questions to adjust them to our external parameter. We could infer that a more sceptical society has a symmetrical response in the limits of strong positive and negative influences and favours divided positions under weak external influence.

A comparison between model results and a real opinion formation is beyond the possibilities of this model but it is an interesting task for the future. We have also shown that current



surveys are not enough for probing the intertwined relationship between social communities and opinion, but only measure the averaged results emanating from the social dynamics. We suggest that these surveys could be greatly improved by integrating data over time and keeping track of the details of the network topology.

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85. Honesty in communicating science to politics in the (pre) modern era: how can an advocate scientist stay true to his two allegiances at once?

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Introduction

We want to present our attempt at the application of Latour's concept of factish (2009) to grasp the question of honesty in public communication of science in a political arena.

From Public Understanding of Science to Factish

My colleague and I are critical criminologists. We have a very strong tendency towards the hermeneutics of suspicion and tend to see hidden forces everywhere.

When we started studying the Canadian DNA databank, we thought there was a lot to criticize: loss of privacy, stigma, function creep... The DNA databank is a matching device that automatically compares the DNA profiles of convicted people to any new profile collected on a crime scene. One could see the databank as a repository of suspects of actual and future crimes.



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As critical criminologists examining the political debates surrounding the inception and expansion of the databank, we were doomed to disqualify the DNA scientists that were consulted by the elected officials. We reproached them to have a political agenda and promote a technology, we believed, was leading us on a dangerous slope.

In retrospect, when we started working on genetic identification, we amalgamated at once all the paradigms that traversed Public Understanding of Science in the last 30 years (Bauer, 2009)

We thought that:

1. Politicians have a knowledge deficit regarding genetic identification; they have little training in science and can't ask the right questions nor sift through the answers to distinguish the false from the true (science literacy: public deficit knowledge).
2. Their lack of knowledge is inversely correlated to their attitude. Politicians have tremendous faith in science. They need to develop a more sceptical attitude toward science (public understanding of science: public deficit attitude, realist agenda).
3. The government genetic experts have a deficit of legitimacy when it comes to explaining the science of genetic identification. Their job depends on the implementation, expansion and the appearance of success of the databank (Science-In-Society, trust deficit, expert deficit).

Then, we became dissatisfied with the predictability of our own findings and our struggle between two extremes reflexes: purification and complete fusion. On the one hand, we denounced the blurriness of science and politics. We were driven by the modernist imperative:

keeping culture (politics) apart from nature (science), to avoid contagion of one by the other. On the other hand, we were asking that politicians become scientists.

None of those positions correspond to what was happening in reality. Our view couldn't account for the "messy actualities" that were taking place when politicians and DNA scientists talked.

Factish. Beyond facts and beliefs

Factish merge fact and fetish. A fetish is a fabricated object that gains the autonomy of a god invested with significant power (DNA identification). In the modernists' eyes, a fetish is 'a screen on which we have projected, by mistake, our fancies, our labor, our hopes and passions' (Latour 1997, p. 66). In his anthropology of the iconoclastic gesture, Latour says that "Iconoclasm is an essential part of what it means to be a critique" (1997, p. 66), a breaker of idols and fetish.

We, critical thinkers, invent the notion of people being manipulated by fetish. We want to break the spell of the fetish and separate the facts from the beliefs: "[B]elief after belief, the critique has devoured everything it could, including science and rationality...so many things have been criticized, so many beliefs debunked..." (1997, 65) that we are left with a field of ruins (Ideas¹).

Facts are fabricated too and, like the fetish, it is because of their fabrication, that they are autonomous. Facticity shares simultaneously the realist and constructivist epistemologies and therefore the realm of fact (truths) and construction (beliefs).



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Equipped with the notion of factish, we tried to come to terms with the crude distinction between facts and beliefs and, rather than doubting the politicians and the scientists, we decided to describe how they succeed at communicating. Like Latour suggests: "What if we listened exactly to what is said by practicing scientists without adding or subtracting anything" (1997, p. 74).

To do so, we analyzed an allocution given to the Canadian Senators by the top administrator of the National DNA databank who is also a scientist and director of the national research service. It takes place in 2009, during the review of the laws pertaining to the DNA databank. Avoiding assuming flawed or conning social actors, our question aimed at describing what they say, not unveiling anything: How does an advocate scientist, who is also a leader in a governmental forensic service, explain to the politicians and decision-makers of his country the genetics of identification and the national DNA database, while respecting both the imperatives of scientific honesty and his political mission?

Seeing factish in action

It is at the operational and methodological levels that we encounter a daring challenge: how do we SEE factishes at play in an interaction? How can we empirically locate the movement from fact to fetish and back?

We settled on three ways to see this movement:

¹ <http://www.cbc.ca/ideas/episodes/2009/01/02/how-to-think-about-science-part-1---24-listen/>

1- The seams: the explicit merges of nature and culture

The simplest and the one we took long to figure out is what we called “the seams”: all the instances where the scientist explicitly displays his concrete alliances with social actors that participate in making science and making science robust. Examples:

- Association with other laboratories:
“We have actually joined together worldwide with a number of different laboratories to pick out 13 to 18 to 16 different markers. I call them “loci.” In reality, they are specific pieces of LEGO blocks that allow us to identify individuals”.
- Association with the courts of law:
“This is the big difference between us and many research scientists or people working in clinical diagnostics. Our samples are the twilight zone of samples. We do not know where they come from, how long they have been there, or what environmental insult they have been exposed to. Therefore, our techniques have to be very robust; they have to be valid and reliable. Believe me, we have to be able to present these in a manner in which people understand them and accept them in a court of law.”

It is through such associations that science gain robustness. It is because it is socially fabricated that it is powerful. All the relationships that are threaded participate to the creation of powerful facts.

2- The use of pronouns: the different “We”

The speech addressed to the senators is a WE speech (The pronoun is used a total of 137 times in a little more than 20 pages of text) and seems quite inclusive at first glance.

What is interesting is the polysemy in the use of this pronoun. There are at least six main “We” in this allocution:

- we: the scientist and the Canadian people
- we: the scientist and the senators
- we: the scientist and his international colleagues genetics scientists
- we: the scientist and the Canadian DNA specialist
- we: the scientist and the crime scene investigators working in the front line
- we: the scientist and law enforcement community

Through polysemy, it is possible to identify the way bridges between nature and culture are laid. The scientist bears multiple identities and mobilizes them. He is the spokesperson of these communities. He is the obligatory passage point for the network he is proposing. The heterogeneity of this network participates in making DNA identification necessary and solid science.

3- The switch in designated audience: reinstating the great divide

The scientist opens his speech with a clear will to popularize science. It is shown by his use of metaphors, images and the use of props. About mid-speech, the scientist switches to technical jargon and the level of complexity in his speech increases. He is reinstating the great divide between culture and nature. While the first half of his speech makes DNA identification both understandable and powerful, the second half makes it technical and mysterious. It leads to the impression that the developments and implications of the science are for



scientifics only. While he gives us a glimpse at the magic, he asks to be left alone to produce even more magic.

Conclusion

Seen through the modern imperatives, one can think the scientist has fallen from science into politics. On the other hand, we argue that the speech under study is exemplar of an unavoidable movement between the realm of fabrication and adoration, a transition that is imbedded in scientific communication. This case illustrates how communication takes place, at the border of two social spheres and how a liminal character (the advocate scientist directing a forensic service) reconciles the imperatives of his plural allegiances.

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86. Science-policy interfaces from a communication perspective

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Introduction

Science-policy interfaces encompass the relationship between scientists and other actors who are actively involved in policy processes. This relationship is deemed desirable since the interaction between scientists and other policy actors allows for exchanges, co-evolution and joint construction of knowledge that is assumed to result in more robust and more legitimate policy decisions (van den Hove 2007). In reality, however, the interaction between scientists and other policy actors is problematic. One of the reasons can be associated with the traditional role of scientists in policy-making: scientists traditionally participate in policy debates indirectly, as chief scientific advisors, through membership in expert advisory committees or through preparation of written scientific reports. They are often not present when policy proposals are discussed in stakeholders' policy forums. Consequently, there is a lack of direct communication between scientists and other policy actors what contributes to two problems.

First, the underrepresentation of the scientific community in stakeholders' policy forums causes scientific data to be sometimes neglected by policy-makers. Policy-makers are busy people, and therefore rather prefer direct face-to-face communication instead of reading long scientific reports (Weiss 1989; Sorian and Baugh 2002; Lavis, Robertson et al. 2003; Brownson, Royer et al. 2006). Second, the lack of direct involvement of scientists in stakeholders' policy forums sometimes results in misinterpretation and/or misuse of scientific claims. A number of case studies have demonstrated how arguments supported by scientific claims were selectively used by different policy actors to advance their own interests (Nelkin 1975; Martin 1988; De Greef 2004; Maasen and Weingart 2005; Gottweis 2008).

Against this background, this paper speculates about potential re-organisation of science-policy interfaces to facilitate more active involvement of scientists in stakeholders' policy forums, and thus enable direct communication between scientists and other actors involved in policy processes. The paper builds on a premise that the active participation of scientists in stakeholders' policy forums is a necessary condition for enabling exchanges, co-evolution and joint construction of knowledge which is important for achieving more robust and more legitimate policy decisions.

The paper is divided in two parts. In the first part, the evidence pointing towards the possibility to consider a re-organisation of science-policy interfaces is provided from literature and



public surveys as well as from some real-life examples. The second part of the paper points out the research gap which currently exists in the available literature regarding facilitation of active engagement of scientists in policy-making.

Re-organisation of science-policy interfaces: the evidence from literature, public surveys and real life examples

The proposal to involve scientists more actively in policy debates is not a new one. The possibility of involving scientists actively in policy debates has been long discussed by scholars in environmental science, public policy, life sciences, conservation biology, sociology as well as in science technology and society studies. The well-recognised framework which addressed the advocacy role of scientists in policy debates was proposed in the late 1980s by French political scientist Paul Sabatier. The advocacy coalition framework focused on policy change over time and its particular interest was in the role policy analysis plays in policy change (Sabatier 1988).

As a part of the advocacy coalition framework Sabatier suggested that each policy system has a subsystem which is represented by actors who are actively concerned about a policy problem or an issue. He articulated that these actors come from different backgrounds and he considered scientists as being one of the groups which are likely to participate in these subsystems because scientists possess special skills and knowledge.

The concept of epistemic communities proposed by Peter Haas in the early 1990s also touched upon the advocacy role of scientists, although such a role for scientists was not articulated directly. The epistemic community was defined as a network of professionals with recognised expertise and competence in a particular domain. Haas assumed that what bonds members of an epistemic community is their shared belief in the applicability of particular form of knowledge (Haas 1992). The epistemic community approach focused on the process through which consensus is reached within a given domain of expertise and what influence epistemic community can have on policy-making.

Kelly Moore also studied the advocacy role of scientists in policy-making. She closely examined three public interest scientific organisations which emerged after the Vietnam war in the United States as a response to a disagreement among scientists about the danger of atomic fallout. The objective of these organisations was to demonstrate scientists' social responsibility as well as to address misconceptions about science which were presented to public by non-scientific interest organisations (Moore 1996).

The literature presented above suggests that scientists are likely to engage in policy-making through membership in advocacy coalitions or through creation of scientific organisations when they share beliefs or concerns about certain political developments. Some real-life examples illustrate that this possibility also exists at the EU level.

Public Research and Regulation Initiative (PRRI) is an organisation of scientists established in 2006 with an objective to involve public sector scientists in regulatory discussions regarding green biotechnology. PRRI offers a forum for public sector scientists to be informed about as well as to be involved in the international discussions and negotiations relevant to biosafety where PRRI believes that these can influence the conduct of scientific research. Today more than 300 scientists are actively involved in PRRI (www.pubresreg.org).



Sense about Science presents another example. Sense about Science is a scientific network which shares concerns about the presentation of scientific claims to policy-makers, journalists as well as general public(s). The organisation is active in a number of different scientific domains and has more than 5,000 members today (www.senseaboutscience.org).

Additionally, the Eurobarometer surveys from 2005 and 2010 indicate that scientific organisations in general and the public sector researchers in particular are perceived by European publics as best qualified to explain the impact of scientific and technological developments on society. There is even a slightly increasing trend with regards to trust in these institutions between 2005 and 2010 (Eurobarometer 2005; Eurobarometer 2010).

Research gap

Despite the supporting evidence described above, the current literature on science-policy interfaces is limited mostly to a question whether an active involvement of scientists in policy-making is desirable or not. Limited empirical research exists which examines concrete cases on how scientists can actively engage in stakeholder policy forums and which communication strategies are suitable to facilitate communication between scientists and other stakeholders involved in policy debates. The authors have therefore started a project focusing on the identification of typology of involvement of scientists in the EU policy debates with a particular focus on different communication strategies used by scientists and their effectiveness in facilitating the integration of science into European policies and regulations. The results are expected to show best examples and identify conditions which are necessary to be met for desired scientists' involvement in policy.



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87. **New(?) actors in science communication: the role of scientific associations**

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The history of science shows us that scientific societies, and their members, were among the earliest communicators of science – cf. the public lectures and the scientific demonstrations performed in these institutions, in the early modern science, when the distinction between scientists, other intellectuals and amateurs was still rather tenuous (Ben-David 1984; Dear 1985; Rasse 2000).

This situation has changed with the professionalization and specialization of scientific production and science education. The number of scientific associations has grown substantially and their disciplinary specialisation has also increased. Many of these new associations were of an essentially professional nature and were more focused on providing services to their own members than to the public. Even if some of them kept some science communication activities for non-specialists, this became a less important task (Rilling 1986; Schofer 2003).

More recently, institutions such as the Royal Society and other similar associations have played a decisive role in launching the movement for public understanding of science, showing concern about the relationship between science and society, and willingness to work in this area (Bodmer, 2010). Yet it seems that most studies on PCST tend not to pay a close or specific attention to the activities undertaken by scientific associations.

What is the role that scientific associations are now playing in this area? To what extent communication with non-specialized publics is among their aims? If so, what kind of activities are they carrying out?

This paper is part of a broader ongoing research project concerning Portuguese scientific associations. It is a two-year project financed by the Portuguese Foundation for Science and Technology (PTDC/CS-ECS/101592/2008) and based on several methodologies. For this presentation, we use data from a survey of the Portuguese scientific associations, and in-depth studies of twenty four associations (including interviews to directors, document analysis, ethnographic observation at events and surveys of members).

We took into account different types of associations. For the purposes of this paper, we are only considering the disciplinary scientific societies (whose members are, in general, researchers or other professionals in a particular subject) and the science communication associations, more oriented towards society (generally, more diverse in terms of membership, even if some of them also are directed at a specific field of knowledge). We are thus excluding other associations (such as professional associations of scientists), since their participation in public communication of science activities is less frequent.



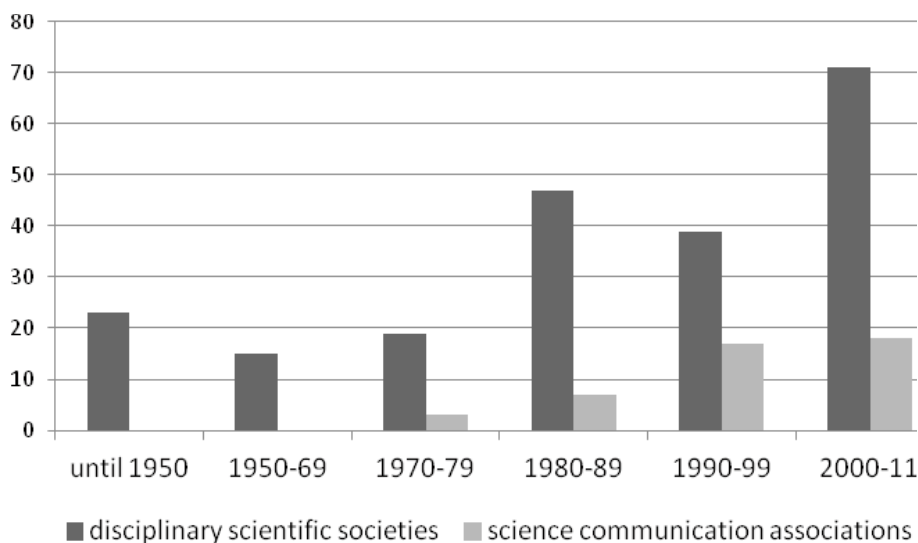


Figure 1. Scientific associations in Portugal: year of foundation

Fig. 1 shows the number of associations created in each period. In general, the number of associations has been growing in Portugal, particularly in the last decades. But, more interesting, most of the science communication associations have been created recently; they are clearly part of recent dynamics in the field of science.



As we might expect, these associations are the ones that most frequently engage in activities of public communication of science, either in events directed to the general public or to young people (fig. 2). Nevertheless, many of the discipline-oriented societies are now also engaged in the effort to promote public understanding of science. But what exactly are these two types of associations doing in this domain?

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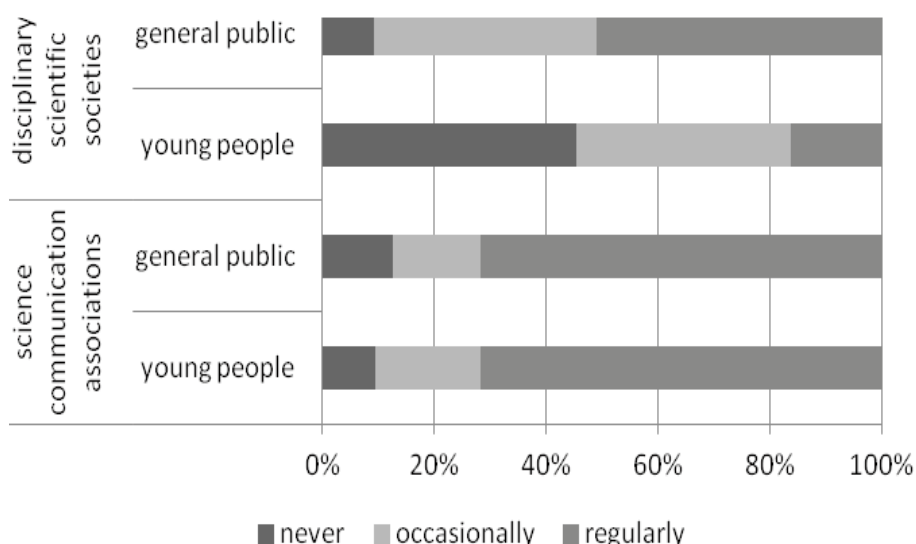


Figure 2. Frequency of PCST activities, for youth people and for the general public, by type of association

One form of public communication of science, carried out by all types of associations, consists in media contacts. Most associations try to respond to requests from journalists in search of researchers who are willing to comment or support the production of science-related news, even if they often complain about the treatment that the scientific issues end up having in the media. Some associations also send press releases of their own accord.

Another relatively common practice in disciplinary scientific societies – and often a more proactive one – is the organization or the participation of some members of the associations in public talks, directed at schools or aimed at adult audiences. Many of these events are only occasional but, in some cases, they are becoming more regular – connected, for instance, with particular celebrations, such as the International Brain Awareness week.

Concerning activities for young people, some discipline-oriented societies also organise competitions (such as Mathematics Olympiads). More rarely, they explore other forms of collaboration with schools, for instance supporting activities for experimental learning of science.

In the case of the science communication associations, the picture is slightly different. Although almost all of them also participate in that kind of activities (and, as expected, they tend to do it more regularly), here we also find some other forms of public communication.



Some of these associations invite the public to participate in astronomical observations or in scientific field trips (for instance, for bird watching). So, they are exploring more interactive (hands-on) ways of bringing science to citizens.

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A number of those events are related to research projects carried out by these associations, which explore new modes of production and dissemination of scientific knowledge, closer to the ideals of “citizen science” (Boney et al 2009; Clark 2001; Conrad and Hilchey 2011; Greenwood 2007; Hartman 1997; Leach et al 2005) and “open science” (Hetland 2011; Jankowshi 2007). Some of these projects have strong local roots; others are part of national or international initiatives.

For instance, one of the associations we studied, in the field of astronomy, has been carrying out, for several years, a teacher training program that aims to give the opportunity to young people to do astronomical observations via the Internet. As a result, these students (mainly from secondary schools) may collaborate in collecting information for databases that are used either by professional astronomers or amateurs. Another association promotes the participation of volunteers in tasks related to bird census and engages local communities in conservation projects.

Since most of these socially oriented associations have among their members both amateurs and professional scientists (in some cases people who have not found a position in other public or private research centres), they seem to be in a more favourable position for developing this type of innovative approaches, which are based on a fruitful combination between research practices and opportunities to improve citizen engagement with science.

To conclude, in general we may say that all types of scientific associations recognize the importance of public communication of science, and that many of them are becoming active players in this kind of efforts.

For the discipline-oriented societies this is not completely new, although we found good indicators of their growing commitment to these tasks. Nevertheless, they tend to adopt more traditional (deficit model) forms of public communication of science (Conceição 2011; Trench 2008). Most of them opt mainly for discursive, top-down approaches (lectures, in which experts are supposed to talk to and inform the laypeople), even if some are already becoming more aware of the need for finding new spaces for dialogue with citizens, such as science cafes, for instance.

In the case of science communication associations, we consider them new actors in the PCST field, not just because they tend to be more recent, but also, and more importantly, because at least some of them are trying new ways of reaching the public, with activities based on learning-by-doing approaches, that sometimes lead to citizen science practices. In a way, they may be closer to the spirit of the early days of scientific societies.

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88. **The FoodUnique Network: a Nordic interdisciplinary model for effective communication and adoption of human sensory perception-based healthy eating strategies**

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Attempts to increase public awareness of healthy eating practices in the Nordic countries and beyond seem not to have led to significant changes in patterns of food purchase and consumption (Norden, 2006). Much is understood about nutrition through science, and the relationship of nutrition, diet and health is communicated ubiquitously. However, the question remains, why obesity and non-communicable diseases remain a significant problem in society as a result of detrimental eating habits (WHO, 2011).

From a policy perspective this question is a core focus in the Nordic countries as displayed by a plan of action on health, diet and physical activity focused on healthier food to result in a better quality of life (Norden, 2006). On a global scale this issue is also of core interest to the World Health Organisation in terms of combating the propagation of poor diets and its effects on health and non-communicable diseases (WHO, 2011).

In this paper we present a Nordic perspective which advocates a consumer-driven or in broader terms a society-driven strategy in food perception research, to develop and propose healthy foods which can be tolerated and adopted into the diet in the long term from a human sensory and acceptance perspective (see Dijksterhuis & Byrne 2005).

Food and health research needs to investigate the role that innovation in foods and new basic research technologies could play in counteracting the continuing rise of food-related health problems (see Grunert et al. 2008). Innovation must include sensory-acceptance-focused healthy food development aimed at formulation and reformulation processes with a view to enhanced dietary adoption. With respect to more fundamental research and technologies this must be focused on gaining greater insight and understanding of the mechanisms underlying eating behaviour with respect to personal food identity and culture.

From a research perspective these issues are focal areas of the Pan-European multidisciplinary FoodUnique research Network (www.foodunique.eu). FoodUnique is group of key interdisciplinary research partners (20+), encompassing Location, Identity, Perception and Well-being researchers overseen by the WHO and FAO, aimed at “researching, understanding, defining and promoting the benefits of food uniqueness for healthy eating”. FoodUnique’s interdisciplinary research structure (Figure 1) is driven by the applicability and context of its research, which is synergistically integrated with the key impact stakeholders, policy-makers, SMEs, branch organisations, consumer bodies and the public through focused research initiatives.



FoodUnique's mandate is to focus on the view that to enable delimiting of nutritious unique European food it is fundamental to know the importance of genetic and environmental factors on the phenotypes of the products that reach consumers. This knowledge can help producers choose the optimal combinations of varieties and locations to obtain products that will satisfy the sensory, consumer and health demands of the market. Thus, promoting sustainable agriculture and rural development, particularly in territories across the European Union where unique food is strategically and scientifically under defined and lacking in utilisation in a health promoting context, namely the Nordic countries.

This paper is presented by a partnership led by FoodUnique which is tasked with coordinating Nordic input to the European FP7 Capacities project INPROFOOD, "Towards inclusive research programming for sustainable food innovations" (www.inprofood.eu). The aim is to foster dialogue and mutual learning between industry, academia and civil society, already in the earliest stages of the research processes – directed towards developing innovative approaches (technical and social) for dealing with the food and health challenge. 18 partners from 13 European countries have joined forces in INPROFOOD to address this hugely ambitious task during three years of intensive activities.

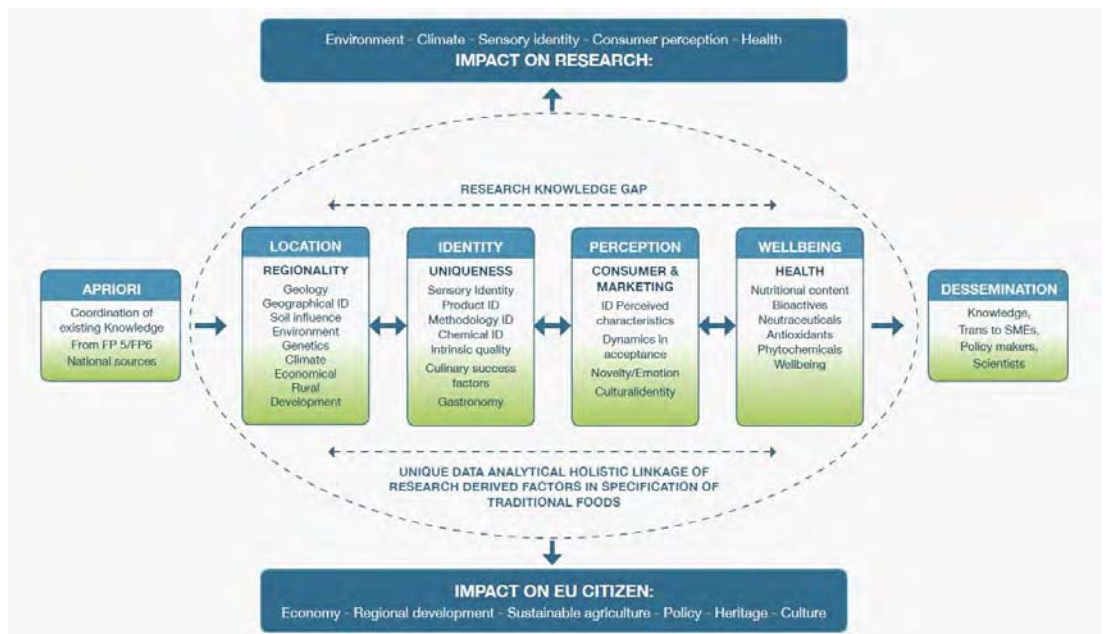


Figure 1. Bridging the knowledge gap in the definition of unique food identity re healthy eating

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89. Developing methods for selecting participants for adapted European Awareness Scenario Workshops with stakeholders concerned with food technology and health issues

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In its Green Paper *Inventing the Future Together*, among other documents, the European Commission commits itself to experimenting “with new ways of involving society at large in the definition, implementation and evaluation of research agendas” (European Commission 2007). Although all calls under the Framework Programme are open to all stakeholders, the flagship initiative on setting up research agendas in technology development, the European Technology Platforms, have seen very little significant participation of others than companies and research institutions. To rectify this situation, in 2010 and 2011 the European Commission started funding projects on research programming involving a broader range of views, knowledge and experience. INPROFOOD is one of these projects.



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Promoting the idea of societal engagement in research and science policy has become a mainstream activity in science policy. Various methods are applied more and more frequently in different variations and combinations, e.g. consensus conferences, world cafés, public online consultations, scenario workshops, and many more. Roughly, one can distinguish between methods that involve citizens and those that involve “stakeholders”, which both have their pros and cons: citizen usually are less biased by special interests and contribute freely on the issues at stake. This advantage is a disadvantage at the same time: outcomes of citizen consultations and deliberations can be quite vague and general as they lack the long term reflection on the topic that stakeholders so often possess.

Stakeholders, on the other hand, usually do have a vivid interest in a broad range of topics, in everything that impacts on their work. From stakeholders we can expect well-founded opinions based on background knowledge and lived experiences, which they are also able to express pointedly. CSOs lobby for certain policies and are used to discuss their perspectives even in the media. Again, all these advantages are disadvantages at the same time: The strong interest of organisations can undermine a free exchange of ideas and lead to negotiating organisational interests instead of societal ones. While in citizen involvement there is a standard of selecting participants randomly from defined areas (frequently taking account of characteristics like sex and age), in stakeholder involvement questions of selection, accountability and legitimacy remain widely open (see Abels 2009).

European Awareness Scenario Workshops (EASWs) are a promising way of involving a broad range of different perspectives and experiences into INPROFOOD, although the method needs improvement to mitigate some of its weaknesses. The classical EASW described by Andersen and Jaeger (2007) and on the FLEXIMODO website was developed by the Danish Board of Technology and further developed in EU projects such as FLEXIMODO in the 1990s.

The classical EASW is a meeting on options for solving a problem policy-makers face. Each meeting lasts for one to two days and is guided by a facilitator. Four proposals for solving the problem, each one informed by a different group of actors, serve as a starting point. Four local groups of actors with different knowledge, perspectives and experiences – policy-makers, business representatives, experts on the workshop topic such as scientists and urban planners, and citizens – all participants, who do not usually come together in such a heterogeneous setting, name barriers to implement these scenarios, jointly develop their own proposals, and propose steps for realising them in homogeneous “role” groups and “theme” groups composed of all actor groups and plenary sessions. Finally, the results of the interactions are documented in a descriptive manner.

As INPROFOOD deals with the sensitive topic of policy-making in the field of health and food research, the EASW approach is adapted in order to respond to frequently perceived shortcomings of stakeholder involvement in general and also on scenario methods.

As it is not yet clear if EASWs would yield similar results if they were repeated with the same structure but different individuals, in 2012 and 2013 INPROFOOD will conduct three series of 13 EASWs each, 39 in total, with 16-24 participants in each workshop. During each series there will be no information flow between the partners so as to avoid any influence on each other.

It is a central weakness of stakeholder involvement that organisations are selected and invited more or less arbitrarily and then regarded as representatives of vaguely defined groups of citizens (see Reed et al. 2009). Such an unbalanced involvement can not only jeopardise the credibility of public engagement, but might also impact on the CSOs landscape, e.g. by creating hierarchies between NPOs. Hence, the planned EASWs imply an elaborate procedure to reach a transparent and broad involvement of organisations. Online databases of possible organisations will be compiled by using credible sources and then the participants will be selected randomly with a public procedure.

The more thought is given to stakeholder involvement, the more challenges emerge. One example is the question of defining stakeholders. Usually it is decided on an ad hoc basis which organisations are included (see Reed et al. 2009, Coccossis et al. 2006). The planned EASWs aims at a more systematic approach, but there are almost endless options to split stakeholders into sub-stakeholders in relation to characteristics that might impact on deliberation: They could be arranged by either broadly or narrowly defined topics, by decision-making structures, by characteristics of the members (institutions, concerned individuals, fundraisers, etc.), by type of activities (consultation, charity, advocacy, personal support, etc.). When it comes to CSOs, even grouping by size is not as simple as it seems: Should it be determined by the number of its members, employees or volunteers?

CSOs are a much too diverse group to be subsumed in one stakeholder group. Additionally, there is increasing concern about industries maintaining pseudo-CSOs in order to influence potential consumers and public opinion. The planned EASWs define three stakeholders according to funding, decision-making and membership:

- a) NPOs without any ties to or substantial funding from industry or political parties
- b) Public authorities including organisations with strong relations to the government, such as chambers, ministerial agencies, etc., also if they are legally organised as NPOs



c) Organised business, such as industrial associations as well as organisations maintained by SMEs. To this category also belong NPOs funded or managed by enterprises.

Although seemingly obvious, the distinction between these three groups can be blurring, too. And in the different regions of Europe the same stakeholders are only partially comparable, because they are embedded in different national situations, laws and cultures

Although a huge effort will be made to adapt and improve the EASW approach for INPRO-FOOD, some limitations of the method cannot be eradicated. As participating organisations are not representative in any statistical sense, no generalisation on nations can be made, and thus no comparison between countries is possible. More importantly, all issues of accountability, representativeness and legitimacy will prevail.

Hence stakeholder involvement should be used with caution and not for decision-making, but as source for new ideas and concepts emerging from bringing together people with various different backgrounds and perspectives. Promising results and new ideas could be then investigated by in-depth research before they are incorporated into policy making.

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90. Short Chains and Long Tails: Raw milk distributors and E. Coli O157 in Italy: errors to be learned from a risk communication perspective and policy making suggestions

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Following Reg. CEE 1411/1971, the Italian law 169/89 forbade distribution of raw milk, apart from milk sold directly by farmers in the farm. However, in recent years, due to regulatory changes at the EU and national level, it has been made possible in Italy to sell raw milk from automatic distributors. Legislative foundations rely on the “Hygiene Package” (4 EC Regulations on food safety requirements), in particular Reg. 853/2004 EC (whereas 24, and art. 8, which gives liberty to Member States to allow or not the sale of raw milk, under strictly ruled hygienic conditions). Furthermore, Section 9 of the Reg. 853/2004 EC set rigid hygienic requirements.

Over a short period, about 1,100 milk distributors appeared on the Italian landscape (2004-2007), for a market share of 4%-6% of milk sales, equal to 80,000 litres of the 1,230,000 litres total sold daily. This event was perceived as allowing savings for consumers: the price per litre was about 20-40 cents less than that of traditionally distributed milk on the grocery channel (1 euro raw milk, versus 1.20-1.40 euro in the supermarkets)

In 2008, a media crisis broke out starting from the daily *Il Riformista*, and the issue gained the agenda of national and local press/broadcasting, resulting in a prolonged “food scare”. The raw milk was blamed for several cases of a disease due to the *Escherichia Coli* strain O157 bacterium, which is highly pathogenic and with possible fatal consequences for children.

Conditions of production, storage and transport of raw milk have been accused of lacking respect for hygiene requirements, and most of all, of the lack of the pasteurisation procedure in place as a general mean recognised to avoid bacteria. As an immediate response, the Minister of Health ordered by an urgent decree, to state in red characters letters in front of the distributors and with a defined size, “*raw milk: to be boiled before consumption*”. However, reconsidering the necessary aspects of an appropriate risk management cycle (risk assessment, risk management and risk communication), it is possible to consider that the framing of the issue was neither evidence-based nor legally confirmed.

It implies both aspects of lack of good journalism in place (absence of a tradition of “fact checkers” charged to assess and filter data); of good science (not sufficient data or “smoking gun” to establish a link between injuries due to E. Coli O157 and raw milk consumption); and of a juridical basis too. Mirroring this with the sociological framework of the theory of Niklas Luhmann, there was a cumulative and contemporary default of several sub-systems (Science, Law) resonating with the public sphere. In particular, the so called “Legnago case” (a child was thought to have Emolitic Uremic Syndrome/ E.Coli O157 from raw milk) was clearly denied by the competent health officials investigating the issue. However, the *media mismanagement* was out and not possible to recall due to the autonomous life of the communication arena.



The article in *Il Riformista* was published on 3 December 2008 and the urgent decree from the Minister of Health was legally binding from 8 December. The lack of time for an appropriate risk assessment and adequate stakeholder engagement, even if were not required enough from a public health point of view, was due to specific interests. It is also doubtful if the measure had any real value; mostly, Emolitic Uremic Syndrome is linked to undercooked bovine meat, and hence called the “hamburger disease”: but on meat packages there is no compulsory indication such as “cook it for at least 120 seconds at 72° C “, and sales of crude meat are not forbidden.

Differently from an ideal risk assessment process, departing from evidence, following with media re-balancing and stakeholder engagement and eventually resulting in a policy output, in this case the media framing produced immediately a policy output and only in the end a fair degree of risk assessment. The cause-effect relationship was so far inverted.

In the end, what stands out is that this was not “evidence-based” policy making. There was no “smoking gun”, as frequently happens for zoonosis, neither evidence or settled opinions on a number of issues linked to the case. But it was *effective*, meaning that an over-conservative response allows for food safety. This is the approach generally used when there is not enough data, in order to better protect vulnerable sub-groups of the population. However, the approach was not efficient. Policy-making requires a cost-benefit analysis of the options in order to improve the protection not only of public health but also of economic interests at stake (when legitimate and protected). The emergency procedure created by the media crisis did not allow to take into account all the relevant factors, and no other policy options have been properly considered and balanced.



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In particular, the available evidence shows that the frequency distribution of the infected cases (EUS) follows a typical “*long tail*” shape (i.e. a limited number of subjects up to 5-7 years old accounting for almost the 90% of the infections).

These preliminary considerations could be useful in order to address properly the issue, learning from other policy-making sectors and experiences. In fact, efficient policy-making requires *not general* but *selective* actions (i.e. targeted to specific population groups), and there is not here a “one size fits all approach”.

This research was useful in order to advance suggestions from Coldiretti to the Italian Minister of Health to redress risk communication at the points of sale (distributors) of raw milk. These were focused on better targeting of more vulnerable age groups (*long-tails* learning) and on the need for better *framing*, with more emphasis on *consumers’ responsibility*.

91. Media coverage of organ transplantation: towards a contextualized model of communication? The case of the Swiss French-speaking press

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Introduction

In many countries including Switzerland, the mass media and the print press in particular constitute the most significant source of information on organ transplantation for the public (Morgan *et al.* 2007; Schulz 2008). In a context of acute organ shortage, how the mass media cover organ donation and transplantation is of major importance.

Science coverage in the mass media has been largely debated. The concept of “medialization” points out that mass media communication has shifted from a science-dominated model to a contextualized model of scientific communication (Gerhards and Schäfer 2009). Following Schäfer (2009), medialization is characterized by three main dimensions: 1) “Extensiveness” states that media coverage of science has increased over time, in quantitative terms; 2) The “controversy” dimension argues that media coverage of science has become more controversial, insofar as authority of experts discourses is no longer taken for granted, but questioned, or even challenged by journalists who do not act merely as transmitters of science to the audience, but hold an active and critical stance; 3) “Pluralization” means that media reports reflect various perspectives in society, in particular that “actors other than scientists have started to appear in the media when it comes to science matters” (Schäfer 2009: 478).

The aim of the present contribution is to examine to what extent coverage of organ donation and transplantation can be said to be in line with the medialization trend. We assume that media coverage follows a contextualized model of communication since organ transplantation is highly charged with emotions, and raises strong moral, societal and ethical stakes (Sharp 2006). Moreover, it can be claimed that media information about such a sensitive topic should foster public debate and help citizens to form their own opinions by conveying balanced arguments and various perspectives (Nisbet and Goidel 2007).

The study

This study draws on a quantitative content analysis applied to a corpus of 376 articles dealing with issues of organ donation and human transplantation (Hammer 2012). These articles are taken from the Swiss French-speaking general press, including three daily papers and two weekly magazines, covering a period of ten years (1998-2007). Before examining successively dimensions of extensiveness, controversy and pluralization, findings of a thematic analysis are presented.

¹ Twenty-eight articles (8%) could not be classified under one of the four main scenic domains.

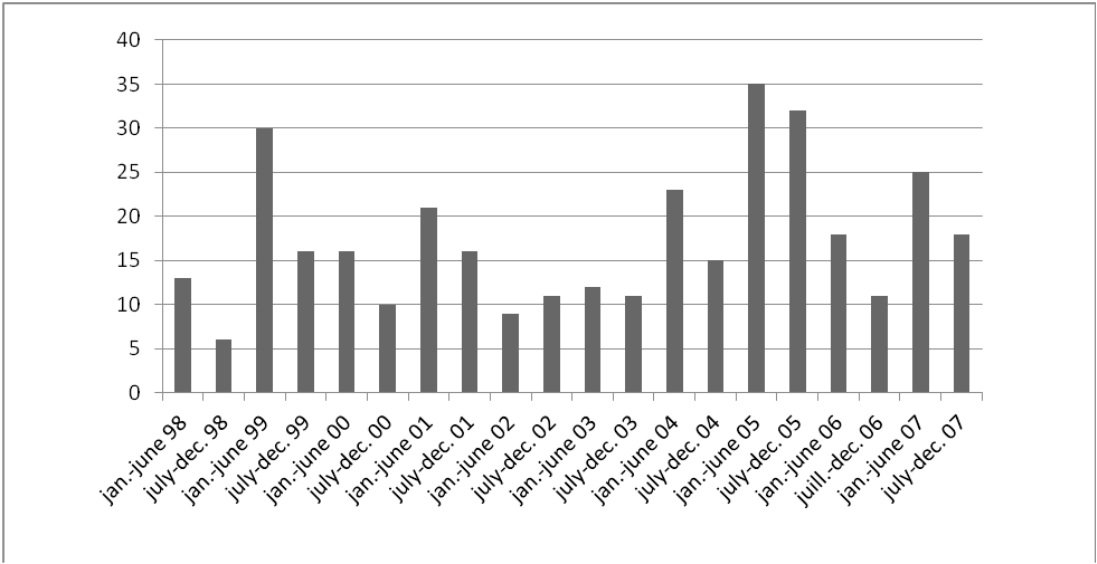


Through a thematic analysis, four “scenic domains” were distinguished, referring to the main framing orientation of each article of the corpus (Charaudeau 2008). The first scenic domain, called “scandals and affairs”, focussed on events that carried a negative connotation and that were likely to arouse public indignation, such as black markets for human organs or cases of medical errors (n=60; 16%). The “medicine and science” scenic domain included articles covering technical and scientific discoveries, as well as medical breakthroughs regarding transplant procedures and surgical innovations (n=65; 17%). As to the “politics” scenic domain, it addressed transplantation at the legal and political level. These articles mainly covered discussions about organ donation regulation in the context of the implementation of the Swiss federal law on transplantation, which entered into force in 2007 (n=95; 25%). Finally, the “public awareness” scenic domain, the most quantitatively important one (n=128; 34%), included articles aiming at increasing readers’ level of knowledge. They chiefly addressed organ shortage, the organization of transplant medicine in Switzerland, and how a transplant is concretely performed. At the same time, these articles supported donation of one’s organs and attempted to raise awareness of the public about organ donation as a social problem¹.

Extensiveness

Looking at the number of articles over time, media coverage of organ donation and transplantation did not increase between 1998 and 2007. Figure 1 shows that there is no linear trend, neither upward nor downward. Instead, media coverage was characterized by peaks and troughs, and this irregularity applied to each scenic domain. More than nine articles out of ten were identified as being directly motivated by a particular event. This proves that media coverage of organ transplantation is closely tied to scientific and political developments, and other news.

Figure 1: Number of articles on organ transplantation by semester (1998-2007)



Controversy

Regarding to what extent content of media coverage was marked by controversies, we examined all statements in favour of organ transplantation, as well as critical statements, by focusing on the “public awareness” scenic domain. Statements of legitimation were found to be present in 95 articles (74%) out of the 128 articles of this subcorpus. These statements pertained to four main kinds of arguments: 1) The medical legitimacy (61%) highlighted efficacy of transplantation on patients, by emphasizing organ donation as a saving life procedure or as a procedure that significantly enhances quality of life; 2) The technical legitimacy (30%) valued transplantation as a surgical and scientific procedure; 3) The moral legitimacy (30%) valued organ donation as a praiseworthy gesture, emphasizing human qualities such as courage, altruism or solidarity; 4) Finally, the economic legitimacy (8%) referred exclusively to the fact that a kidney transplant is much less expensive than dialysis.

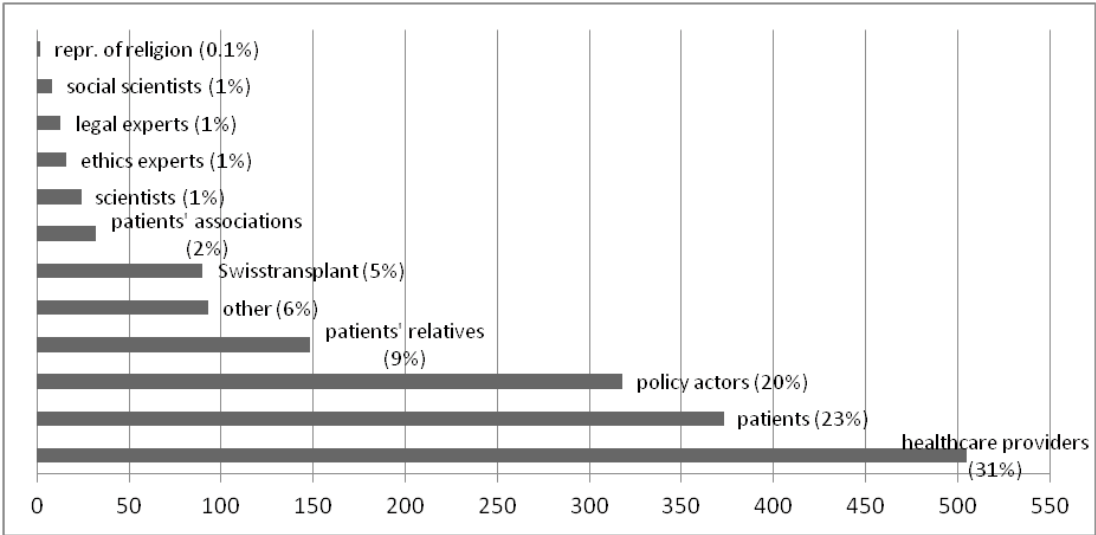
Compared to the 95 articles containing at least one positive statement, only 25 articles (20%) contained one or several statements giving a less positive or less consensual picture about organ donation and transplantation. Interestingly, these challenging statements mostly referred to specific controversial issues such as ethical concerns about living donation and face or hand transplant. As a result, the amount of statements valuing organ donation was much higher than critical statements.

Pluralization

Who did journalists refer to when writing about organ transplantation? In order to assess pluralization of actors, we counted a total of 1,622 statements in direct and indirect discourse pertaining to a series of 12 actor groups. Several noteworthy comments can be made when examining the distribution of the number of statements (Figure 2). As might be expected, the strongest actor group was healthcare providers, which included mainly transplant surgeons (31%). More surprisingly, patients (i.e. transplant patients, patients on waiting list or living donors) ranked second with almost a quarter of all statements. No more than 3% of statements came from specialists in social and human sciences at large (social scientists, ethics and legal experts). Finally, the general public was almost inexistent, with only 11 statements distributed in 4 articles (0.7%) (not shown in the Figure 2).



Figure 2. Number of statements by actor group



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Space for words on organ transplantation was therefore not pluralized, since three actor groups (healthcare providers, patients and policy actors) accounted for three-quarters of all 1,622 statements. Moreover, it must be stressed that physicians’ discourses and patients’ emotional stories (including patients’ relatives and patients’ associations) moved in the same direction: they all supported organ donation without almost any criticism (Amey and Hammer, 2010). In addition, actor groups carrying potential discordant discourses or debating points of view, such as social scientists and ordinary citizens, were almost absent.

Conclusion

Over the decade considered, the print media coverage of organ transplantation does not fit in with the trend of medialization, since it was not extensive, was little controversial in its evaluations and only partially pluralistic in its actors. As a result, the media representation was characterized by a positive portrayal of transplantation, dominated by medical and moral frames supporting organ donation. Our analysis therefore shows that media coverage of organ transplantation does not follow a contextualized model of communication. In other words, media content cannot be considered as encouraging public debate and as reflecting various perspectives on the topic. In particular, one can argue that print press does not help citizens to form their own opinions based on a variety of points of views. However, further research should investigate to what extent and how media content shape people’s attitudes towards organ donation.

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92. Depictions of users in stakeholder board meetings in plant science

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Scientists engaged in technology development are expected to incorporate the views and needs of users and stakeholders to ensure that new technologies are adopted. This study focuses on the discursive devices stakeholders in Dutch plant science employ when they talk about prospective users of technology. For this study eight meetings of a stakeholder board that advises government on what plant research should get funded, were analysed with the help of discursive psychology.

Depending on the topic discussed participants in the stakeholder board depict prospective users of technology as either emotional or as rational. Hypothetical dialogue with rationally acting users is invoked when stakeholders discuss the possible continuation of a research programme. In contrast, in problem talk the dominant discursive construction consists of a statement about users' negative emotional disposition towards technology followed or preceded by a reported dialogue between technology developers and users. With these dialogical constructions of users, stakeholders in plant science demonstrate – among other things – that they take user engagement seriously without necessarily doing something with the concerns of prospective users.



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Increases do as a new technology, stakeholders are involved in the development process of technologies via advisory boards: the underlying assumption is that the stakeholders' participation in these boards will result in technologies that will be adopted by prospective users. Although many user engagement activities are organised it is rarely investigated how participants in deliberations about (plant) technology development discursively engage with prospective users' experiences and views (e.g. see Leach et al. 2005).

This study seeks to partly address this gap in the literature by providing insight into how portrayals of users of new plant technologies are made relevant in plant science. The situated uses of reported dialogue between developers and users are discussed in order to depict users as either emotional or as rational (see Tannen (1989) for more on reported dialogue).

Data and methodology

Twenty hours of talk-in-interaction of a stakeholder board connected to research programmes in plant science were analysed with discursive psychology. Discursive psychology studies talk-in-interaction as a participants' resource to conduct a wide range of social actions that serve different purposes such as stake and interest management (Potter, 1996). In discursive psychology participants' responses to earlier speakers are investigated: a response of a former speaker sheds light on the uptake of an utterance such as: "the dishes are dirty". If the response to this utterance is that the addressee goes to the sink to do the dishes the analyst may conclude that the utterance "the dishes are dirty" is not treated as an observation but as a complaint that requires corrective action from the addressee. Discursive psychologists

also employ the rhetorical principle: actual accounts of events are compared with alternative versions of the same events to uncover the performative functions of actual accounts.

Uses of different portrayals of users with help of enacted dialogue

In the data stakeholders did depict users in two different ways: they are portrayed either as rational actors or as emotional beings. Prospective users of technology are depicted as rational when participants discuss the future of research programmes. Stakeholders achieve this by producing hypothetical dialogue – speakers enact a dialogue with users that may take place somewhere in the future (e.g. see Myers, 2000).

In contrast, when stakeholders discuss problems with field tests of technologies they depict users as emotional beings with dispositional statements such as: *they find that scary*. These statements are preceded or followed by enacted dialogue between users and technology developers.

To show what these different depictions of users achieve discursively two examples are discussed below. The first fragment demonstrates the uses of depicting users as rational beings with the help of hypothetical dialogue. The second fragment discusses the uses of depicting users as emotional beings with the help of enacted dialogue (see the appendix for the meaning of transcription symbols).

Fragment 1: the user enacted as rational being

2	B4:	The first question that the farmer asks is (q) ↑ WHAT now? (q) (.)
3	S8:	Yes=
4	B4:	=So you probably need to say (q) ↑all right then, this initiative is finished (0.8)
5		but in the programs eh we continue with phytophthora (q) (.) cause otherwise
6		it becomes a story like eh (q) ↑ oh the problem has been solved (q) =
7	B5:	=yes EXACTLY=
8	B4:	=when everyone is flooded with phytophthora ((a plant disease)).
- (Bx= representative of breeding company; Sx= scientist)



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In this fragment representative of industry B4 is talking about farmers' possible uptake of the news that a research programme in disease management is ending although the plant disease phytophthora is not yet under control. Given that this news is not yet made public one may conclude here that the dialogue enacted in this fragment is hypothetical in nature.

The dialogue in this fragment (lines 2,4,5,6 the text in between q's) seems to inoculate plant breeding industry's stake in the research programme; after all, if the government does not pay for the research than the plant breeding industry will have to pay for it. With the help of reported dialogue B4 presents the continuation of the research programme as users' rational demand and presents himself as an advocate of farmers instead of as the businessman he is with a vested interest in the research programme.

Fragment 2: The user enacted as emotional being

1	S11:	Another issue that keeps coming back
2		is eh the accumulation of agrochemicals eh

- 3 because last year was of course a dry spring=
 4 C2: =yeah
 5 S11: eh or yes dry first part of the season
 6 that the syste:ms advised longer spraying intervals
 7 (0.3)
 8 eh two (.) three weeks
 9 →S11: .hhh and that many people still also consider scary (.) eh
 10 eh they say (q) yes but then I do not keep spraying
 11 and then I keep- the protection eh level goes down ((against dis-
 ease))
 12 and I need to keep spraying those agrochemicals (q)
 13 because the level of protection builds up (.) eh
 14 and when the weather changes then I have
 15 at least a reasonable protected crop eh (q)
 16 whereas we always say eh .hh (q) yes (.)
 17 you need to spray at the right moment
 18 and then your crop is protected just fine
 19 what you did before that↑ does not matter (.) (q)
- (Sx= scientist, Cx= civil servant)



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This fragment is part of a discussion about how users' dispositions towards decision support systems in disease management inform their use of the technology. The discussion takes place after a major outbreak of phytophthora. S11 voices two concerns of users: the accumulation of agrochemicals and the length of spraying intervals of agrochemicals for crop protection against phytophthora (lines 1-8).

S11's utterance in line 9 is an example of a dispositional statement; *and that many people still also consider scary* is a claim about users' emotional disposition towards the decision support technology. It suggests that users of the technology in general do not dare to implement spraying intervals that are longer than usual; they routinely spray once a week for crop protection whereas the decision support system advises spraying intervals of two, three weeks (line 8). The dispositional statement in line 9 is followed by enacted dialogue with farmers and breeders on the one hand and experts on the other hand in lines 10-19.

Why does S11 use an assessment of a past event – a major outbreak of the plant disease phytophthora – to claim that users' judgment is clouded by emotions? S11's framing of events inoculates the alternative reasoning that given the outbreak of phytophthora the efficacy of the spraying advice provided by the decisions support systems should be questioned. Moreover, with the reported dialogue S11 resists a possible counterclaim that he as a scientist is inclined to label non-scientists as non-rational beings. Also the enacted dialogue shows that S11's judgement is not rooted in prejudice but in experience. Finally, the enacted dialogue shows that technology developers do try to involve users in technology development although the outcomes of the developmental process may suggest otherwise.

Concluding remarks

This paper has shown that stakeholders in Dutch plant science employ enacted dialogue to depict users as either rational or as emotional. Different depictions of users with the help

of various forms of enacted dialogue serve different discursive ends. In the data enacted dialogue with users is always used to provide evidence that stakeholders do engage users in technology development. Generally stakeholders portray users as rational or emotional to manage their stakes and interests or to account for choices in technology development. Depicting users as emotional is also a way to justify why new technologies do not always function optimally.

The research reported here is part of a bigger project which is supervised by Prof. H. Te Molder, Prof. B. Gremmen and Prof. C. van Woerkum. The research is funded by the CSG Centre for Society and the Life Sciences.

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Appendix

Adapted from Jeffersonian transcription (Jefferson, 2004):

.hhh	a hearable in-breath, the number of h's is an indication of length
(x.x)	Pause of x.x seconds
(.)	Micro pause, less than 0.2 seconds
↑word, ↓word	Onset of noticeable pitch rise or fall
wo:rd	Colons indicate the stretching of the preceding sound
<u>word</u>	Emphasized speech
WORD	Speaker is talking louder
((text))	Transcriber's remarks
=	No pause between words or turns
(q) text (q)	constructed speech or constructed dialogue

93. Science communication initiatives in developing countries: global information network on crop biotechnology

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Introduction

The International Service for the Acquisition of Agri-biotech Applications (ISAAA) is a not-for-profit international organisation that shares the benefits of crop biotechnology to various stakeholders, particularly resource-poor farmers in developing countries, through knowledge-sharing initiatives and the transfer and delivery of proprietary biotechnology applications. ISAAA has an information network composed of the Global Knowledge Center on Crop Biotechnology (popularly known as KC) and 26 Biotechnology Information Centers (BICs) or country nodes located in Africa, Asia, Latin America, and Europe. It is probably the only one of its kind in the world today.



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With its global mandate, the KC critically scans global and regional developments and analyses issues and concerns that affect developing countries. This information is transformed into prototype science communication strategies that the BICs adapt for their clients specific information needs to advance a broader public understanding of crop biotechnology. The network uses an array of multi-media communication approaches, networking and various interpersonal formats.

The information network has enabled policy-makers, scientists, academics, media practitioners, farmers, and other interest groups to participate in a transparent and science-based discussion and debate on the technology. Country case studies of how they have operationalised science communication are documented in the book *Communication Challenges and Convergence in Crop Biotechnology* (Navarro and Hautea, 2011). Experiences are presented on how countries have addressed communication challenges by introducing innovative approaches, building capacity for science communicators, and integrating efforts among public and private sectors in knowledge-sharing initiatives. Lessons learned are forwarded on how best to contribute to a better appreciation and understanding of biotechnology despite its being a perceived controversial topic. Countries demonstrated that it is not a case of Science *then* Communication but Science Communication.

Science Communication Challenges

Biotechnology has been touted as a powerful and promising technology with a range of economic, social and environmental benefits. James (2011) highlights the fact that biotech crops have become the fastest adopted crop technology in recent history with over 16 million

farmers from 29 countries worldwide growing them. Yet while benefits continue to be documented and the potential for next generation crops with direct gains to consumers is being talked about, the technology continues to be a magnet for debate and diverse viewpoints. Issues beyond the realm of science have made the technology a recurring and contentious public concern. In addition, “drama” in the form of protests, uprooting of field trials, and anti-biotech scenes through the use of exaggerated scare tactics from civil society groups have attracted media attention and public outcry despite negative and inaccurate messages. This scenario highlights the importance of science communication and its role in facilitating an environment that allows for greater awareness and understanding, and eventually the adoption of new technology.

Global Biotech Information Network

In September 2000, ISAAA established the Global Knowledge Center on Crop Biotechnology in response to an urgent demand from senior policy-makers in developing countries for an entity that would make authoritative information available to facilitate and support transparent decision-making processes regarding crop biotechnology. They noted that “the scarcity of current authoritative information and knowledge regarding food biotechnology crops represents a major deficiency that denies policy-makers and scientists access to the vital knowledge needed to make well-informed decisions”.

The ISAAA Southeast Asia Centre was designated the hub of the KC. Along with the core KC, three initial Biotechnology Information Centers (BICs) were established in the Philippines, Thailand, and Malaysia. Today there are 26 BICs in Asia, Africa, Europe, and Latin America. The BICs are at the forefront of responding to science-based information needs, and in promoting and advancing a broader public understanding of crop biotechnology in their respective countries.

In 2011, ISAAA documented the science communication initiatives of eight countries in Asia and Australia in a book *Communication Challenges and Convergence in Crop Biotechnology*. The book highlights the unique experiences that these countries encountered in shepherding innovations from the laboratory to greenhouse trials, confined trials, multi-location trials, and finally to the farmers’ fields. As in the case of other regions, public acceptance of crop biotech continues to be an issue of concern. Public and private sectors both realise that the environment demands a degree of sensitivity to public opinion as an unfavourable attitude towards the technology will hamper its development and potential for commercialisation.

Role of Media

The public relies on mass media for what it knows about science in general and crop biotechnology in particular. An understanding of how media “defines” biotechnology is therefore crucial to public understanding and policy development. A study in the Philippines on the use of metaphors and cartoons in crop biotech articles and graphical forms shows that during a period where the technology was abstract and little information was available, writers and cartoonists used the negative tone, preferred the fear appeal, and tended to exaggerate portrayal of objects and people. However, once media practitioners were introduced to science-based information and sources, a significant decline in negative articles was noted.



They were able to negotiate meanings with authoritative sources resulting in clear discussions of scientific perspectives.

Identification of Key Publics and Champions

Champions among the key stakeholder groups (policy-makers, scientists, academics, regulators and the media) need to be identified and nurtured to advance the cause of the technology. These are people who are well-informed, have high credibility in the community and are able to influence peers. Key stakeholders will enhance efforts to strengthen debates and discussions essential for decision-making.

Strengthening Availability and Access to Information

Information overload and lack of information are both problems faced in developing countries. Internet availability and the new media have increased access to information but lack of translations and simplified formats, to ensure understandability by nontechnical audiences, hamper their use. The availability of new media forms needs to be explored in the light of different information-seeking behaviour among potential audiences.



Conclusion

390 The various information needs of stakeholders in developing countries have given rise to many innovative communication strategies in getting them to better understand and accept the technology. These include fashion shows in Malaysia where designers “define” biotech through clothing; use of cartoons and animation in India and the Philippines; and portrayal of biotech products through mascots and plays in China. Increasingly, the intensified use of strategies and channels highlight efforts in the public engagement of science. Countries are able to share their experiences and lessons learned in communicating crop biotech.

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94. How and why scientists communicate with society: the case of physics in Italy

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Introduction

The general aim of the survey is to investigate the activities of public engagement of researchers, their attitudes, motivations, obstacles in communicating with different publics, in order to get a picture of the “Science in Society relationship” in Italy from the scientists’ view. This project focuses on the scientific community of Italian physicists, a highly structured community with a long history, popular to the Italian public (also for the numerous Nobel prize-winners), which Fermi opened to an internationally acclaimed reputation. As in the past, often today physicists are the protagonists of public debate on science and technology (for example about nuclear energy but also climate change etc.). Moreover, the Italian scientific community of physicists has been characterised by a long tradition of science communication activities.



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Methodology

The study was performed on scientists and researchers in physics working in Italian universities and the main Italian public research centres, CNR - Consiglio Nazionale delle Ricerche, INFN – Istituto Nazionale di Fisica Nucleare and INAF – Istituto Nazionale di Astrofisica. The population consists of 2,350 university researchers, 1,500 CNR, 830 INFN and 650 INAF scientists. Data were obtained from two CAWI surveys (Computer Assisted Web Interview) sent to all members of the population. The data have been merged for this analysis. The number of complete answers is satisfactory: 468 from university, 620 from CNR, 174 from INFN and 297 from INAF for about 30% overall average coverage of the total population.

The distributions of the main characteristics of the respondents by gender, age, geographic distribution, specialisation and position are in line with the distribution of the population, and so our data describe pretty well the Italian situation. 78.5% declare they have been involved at least once in some science communication in the past three years.

Analysis

Answers to three questions are presented in this preliminary analysis.

- a. We know from current research that school, festival and old and new media are most influential on public opinion about science matters. But how do the scientists

themselves communicate?

b. Science communication is expected to be an organised activity diffused within the scientific community. What is the state of the art?

c. Public opinion trusts the scientists as communicators of science. But do the scientists feel this social responsibility?

The following chart shows the distribution of science communication activities carried out by Italian physicists.

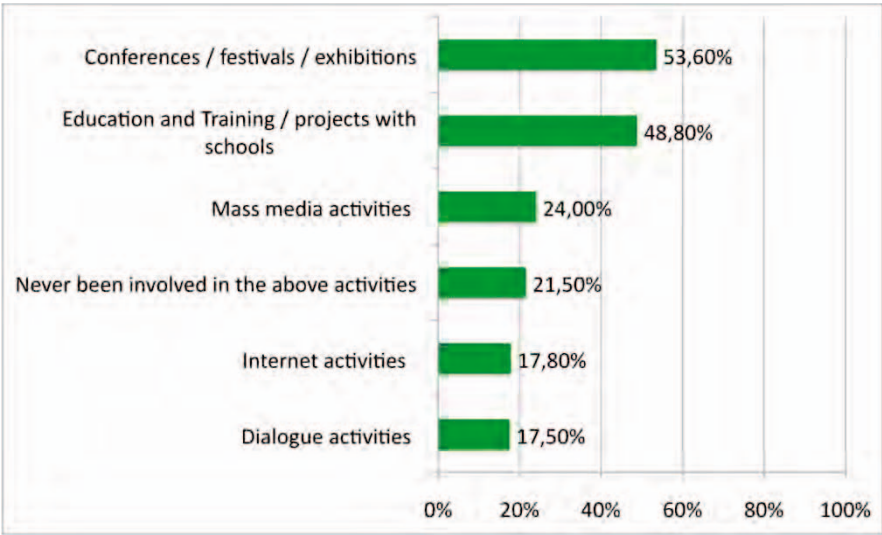


Chart 1: Type of activities in science communication (Multiple choice question)

Some details on each type of activities in Chart 1:

EDUCATION:

- high school 59,20 %

MEDIA:

- publishing industry 69,9 %
- Tv, radio 54,3 %
- press conference 54,2 %
- press release

WEB:

- forum - Social network: 32,6 %
- blog – 28,2
- newsletter 26,1%

EVENTS:

- conferences 48,1 %
- festival 45,9 %

DIALOGUE WITH:

- citizens 52,4,6 %
- policy makers 41,40 %
- businessman 43,7

Table 1: Focus on type of activities



Italian physicists privilege direct communication with audiences of public lectures, conferences, exhibitions and festivals and with school students. Face-to-face communication is the favourite, the use of mass media follows (in particular TV and radio), web instruments (sites, blogs, social networks) are still a niche. Only few of them communicate with business people and policy-makers. Summing up, the traditional communication, such as conferences and school talks, wins over new media and dialogue with stakeholders.

Science communication is an essentially no-profit activity; 56.9% of their activities are not financed and for 83% of them the participation is voluntary. From the data emerges an intensive engagement of individuals emerges in several roles (organiser 47.8%; participant 85.2%; spectator 67.4%).

The members of the scientific community of Italian physicists pay attention to the professional skills needed to improve their communication: 89.4% of them state that they care for the language using simple terms, anecdotes, examples, selection of themes; 63.5% care for the interaction with the society and prefer interactive media; 38.6% try to raise emotion and bring direct evidence on the work of scientists. Only 34.7% affirm that “just a bit” of experience is needed to communicate with people and 5.30% think that physics communication is not possible without a specialist language, and that the researchers need only their scientific competence to communicate science to a lay public.

A serious problem is identified by the respondents. They need greater recognition of these activities by their own community: i) universities don't invest enough to organise their communication (36.8%); ii) there is no real interest of their community in communication activities (35.7%); iii) careers don't benefit from science communication activities (34.9%). Other problems are less important: 27.5% consider ignorance, prejudice and lack of interest of the public to be a problem; 25% have difficult interaction with journalists. Finally 19.2% don't believe that science communication activities bear real social value. The scientific community should better evaluate and have a higher consideration of this kind of activities, so much undervalued and should invest in training courses (that for the 82.9% could be very useful).

We compared the data of Eurobarometer, *Science and Technology*, 2010 with data from our CAWI on two issues: Do scientists put enough effort in science communication? Who are the best qualified to explain the impact of S & T developments on society?

More than half Europeans (including 52% Italians) feel that scientists don't put enough effort into informing the public about new developments in science and technology. We asked the same question to the Italian physicists. The answer was the same; the scientists don't put enough effort in informing the public.

Chart 4 gives the answer of the Italian physicists about who is the best qualified to explain the impact of S&T developments on society, among scientists, medical doctors, associations, consumer organisations, journalists writers and intellectuals, politicians and industry. Close to two out of three Europeans and 90.2% of physicists believe that scientists are the best qualified to explain the impact of science, but it is interesting to note the important role and responsibility that researchers attribute also to journalists and communication specialists.



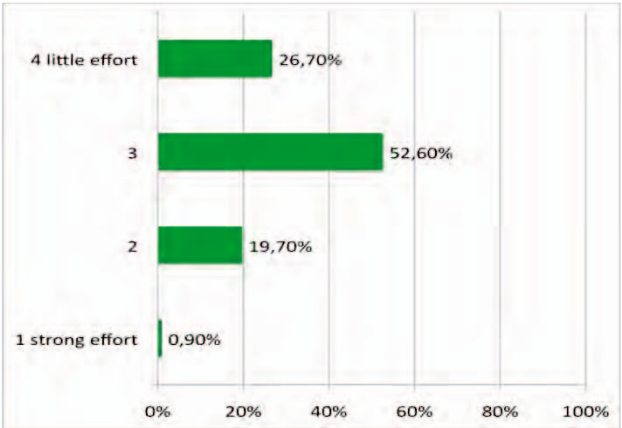


Chart 2: Do scientists put enough effort into science communication?

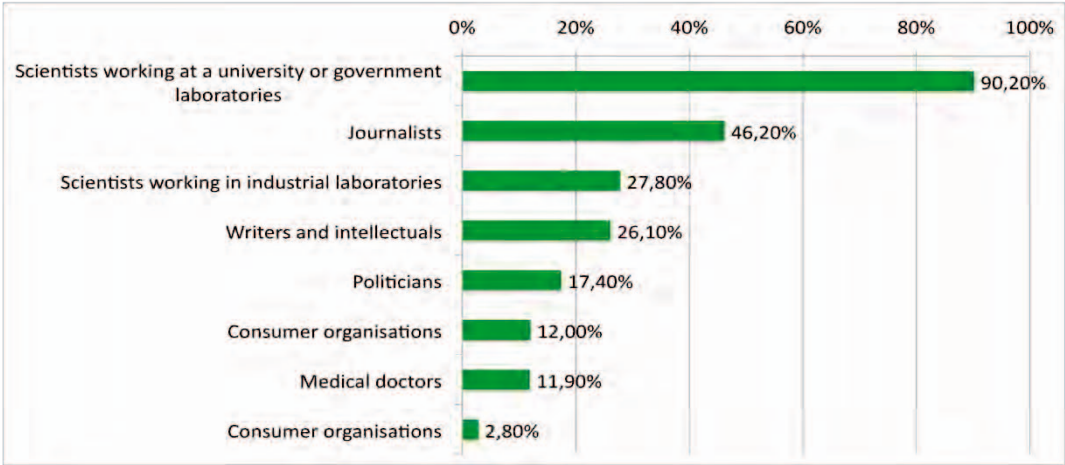


Chart 3: Who is the best qualified to explain the impact of S&T developments on society? (Multiple choice question)

In conclusion, if we compare our survey with Eurobarometer data on the same questions, we find agreement between the findings of scientists and citizens on: i) the scientists don't put enough effort in informing the public; ii) the scientist are the best qualified to provide science communication. Society calls for a major effort to scientific communities to communicate science and to explain the impact of S&T developments. The demand for scientific knowledge is growing steadily and the researchers' believe that not enough is being done.

But why should scientists communicate? 55.7% of the respondents are involved in science communication activity to give people the tools to create personal opinions, 44.3% to encourage a social climate in which science can develop, 43.5% to give people the tools to

evaluate the policies of research. 36.6% believe that an engagement with society is a public responsibility of research institutes and researchers and furthermore 15.3% affirm that it is an interesting and rewarding activity. Only 0.7% declares that there isn't a reason why researchers should engage in communication activities.

Italian physicists are looking for a favourable social climate to improve science and technology development, in which they could meet and dialogue with a public opinion in a "knowledge society"; the public should be given the means to choose science policies and the science community carries the responsibility to inform society. Our general conclusion is that they believe that science is a public good. Public happiness and private happiness can coincide thanks to an honest communication of science but more collective recognition is needed for this activity.

The point of view of scientists in science communication is important to study new ways of raising social awareness about scientific research. As already mentioned this study of the community of physicists is a pilot case and we are currently starting a more extensive research on other Italian scientific communities and new phenomena like institutional dissemination and fund-raising or science communication in conflicts and decision making. Data will be triangulated among Computer-Assisted Web surveys on a panel of Italian researchers, qualitative techniques and specific case studies.

An important output of the project will be the production of guidelines about initiatives to be taken from universities and research centres to promote and enhance the dialogue with society, i.e. the "third mission" of the university.



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95. European scientists' public communication attitudes: scientists' views and experiences and the institutional, local and national influences determining their public engagement activities

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The present empirical research seeks to contribute to the qualitative analysis of scientists' public communication attitudes and the influence of external bodies affecting their public engagements activities. The research was carried out between May 2008 and May 2009 in five European research centres involved in nanotechnology and materials science: Fritz Haber Institute (FHI), Berlin, Germany; Centre d'Elaboration de Materiaux et d'Etudes Structurales (CEMES), Toulouse, France; Instituto per lo Studio dei Materiali Nanostrutturati (ISMN), Bologna, Italy; Centre for Materials Science and Engineering (CSME), Edinburgh, United Kingdom, and Donosti International Physics Center (DIPC), Donostia-San Sebastian, Spain.

The study included face-to-face interviews with 112 scientists and 9 national and local Public Relations and Press Officers of the relevant institutes, as well as observations of the public communications activities and interactions occurring in the centres. The results of this study covered five categories of information: What public engagement means to scientists; Audiences and activities; Barriers to science communication; Training and demand; and Incentives for science communication. Some of the key findings obtained were as follows.

Findings

The amount of scientists' participation in public engagement activity varied by centre: 95% of scientists at the FHI (Germany) had participated in some public engagement activity; 90% of scientists at CMSE (United Kingdom); while 54% of scientists at CEMES (France); 50% of scientists at ISMN (Italy); 31% of scientists at DIPC (Spain). The level of scientists' participation was clearly associated with levels of institutional support: public relations and press officer; positive policies to the activity and some funds. The major form of scientists' participation was in institutional open day events, engaging with policy-makers, working with teachers and schools, and secondarily writing for the general public.

Most of the regular events at the institutes studied were the result of local or national government policies in education and in the development of science and technology, like national science festivals and open doors events. Other public science communication activities were generated by external contacts through different initiatives, invitations and inquiries from schools, associations related to science and technology, and the mass media. In the centres without public relations and press officers (ISMN, Italy; DIPC, Spain) or those with very limited offices and a low profile (CEMES, France), the scientists' participation was low, and most of the scientists' participations were consequence of external inquiries (invitations) and some scientists' personal initiatives or contacts; also the Directors of the centres took direct charge of some activities to promote the visibility of their centres and research, mainly through



posting news on their websites (ISMN, Italy; and DIPC, Spain); establishing direct contacts with journalists and hiring external public relation offices (DIPC, Spain) for certain public events.

Scientists expressed in their own terms that knowing people would be interested and having invitations to participate would encourage them to get involved in public science communication activities. Also they noted how easy or difficult it is to get involved in these activities when having invitations (or not having) invitations, contacts and support. The quantitative research identified that there was a strong agreement between scientists from FHI, Germany (73%); CEMES, France (69%) and ISMN, Italy (70%) that grants for engagements which covered staff time as well as other costs would significantly encourage scientists to get more involved in science communication activities with the public. Meanwhile, scientists from DIPC, Spain (82%) and CMSE, United Kingdom (75%), stated that the fact that such activities brought money into their department was a major incentive.

On the subject of communications departments at the institutes, researchers recognised it is necessary to have a professional in charge of these activities because they themselves would not be doing that work. However, respondents also expressed doubts about current practice because they considered that these departments are often poorly structured and without experts in charge, who are able to understand scientists' needs; and that a communication department tends to spend a lot of money and there was also a suspicion that 'recognition' of this activity could damage scientific research.

Public communication of science means for scientists the promotion of scientific work, the scientific process and nature of science, and its limits and implications in culture and society. Scientists highlighted that if society is better informed about science and becomes aware of it, this may support favourable funds and public policies for scientific research. Also, participants pointed out the relevance of paying attention to public doubts about their subject in order to gain support for their research and promote their position in society. The results show that scientists' position on public communication of science is pragmatic: they consider that promoting the scientific work and the role of scientists in society contributes to ensure funds and better resources, working conditions, staffing levels and higher student numbers.



Conclusions

The level of scientists' participation varied in accordance with the degree of necessity (for example as a result of personal interest or the need to deal with problematic situations) and the level of the support available (for example of government, of other external bodies and institutional policies). The results show that scientific structure has been influenced by external bodies, which have "pushed" the scientific community to establish 'mechanisms or structures' in order to answer the former's regular demands for public communication of science. In addition, these external bodies have positively influenced scientists' attitudes to public engagement through supporting and promoting regular participation. In Figure 1, we present three main factors which influence and determine scientists' participation in public science communication activities.



Figure 1: Factors influencing scientists’ public communication



96. Why should I choose a STEM PhD?

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Introduction

This paper highlights some results on the priorities and considerations that determine the process of choosing to become a STEM PhD student in Slovenia. The research reported in this paper has been undertaken within the IRIS project, which is funded by the European Community under the Seventh Framework Programme (Grant Agreement No. 230043). The focus of IRIS is on disciplines that are challenged by low recruitment and low female participation. Research shows that women in general have lower self efficacy and perceive a higher costs associated with studying STEM; they identify less closely with the STEM disciplines and the scientists associated with them; women have different interests (IRIS, 2010).

This study had therefore two main objectives: (a) to identify which priorities male and female PhD STEM students in Slovenia have for their future careers, and (2) to identify different important factors that influenced their choice of studying a STEM PhD. The detailed analysis is still work in progress and the final results will be presented in the future.



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Theoretical background and international statistics

According to International statistical data (Global Education Digest, 2010) “the largest level of gender imbalance exists in the engineering, manufacturing and construction field of study with 36% of female PhD graduates, although in North America and Western Europe as well as Central and Eastern Europe, women outnumber men significantly among both the Bachelor’s and Master’s degree graduates in general across other fields of study”. The statistics confirm (Education in Europe, 2008) that “in all countries, women easily outnumber men graduating in the fields of education, humanities and arts, social sciences, business and law and health and welfare. Male graduates prevail in the fields of science, mathematics and engineering, manufacturing and construction where only 32% of women graduates at the tertiary level of education (ISCED 5 and 6)”.

The gender imbalance in Slovenia is very similar to international statistics mentioned above; 65% of men and 35% women are studying natural sciences, mathematics and computer science and technology and construction in Slovenia.

Social influences

Students from young age (and males in particular) often hold stereotypical views about STEM topics and activities as a typical male thing to do (Greenfield, 1996, 1997; Jones, Howe & Rua, 2000), also in the Slovenian context (Dolinšek, 2008). Young people, females in particular, often perceive science as difficult, uninteresting, unimportant, passionless, boring, or leading

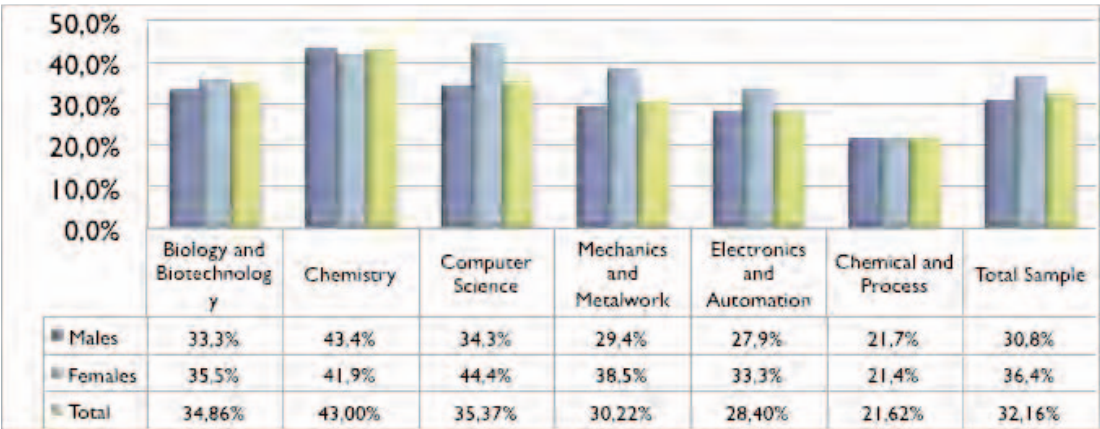
to an unattractive lifestyle (Jones et al. 2000; Eccles, 2009) and their overall interest in science starts to decline after elementary school (Brotman & Moore, 2008).

Moreover, many females believe that the research careers are incompatible with having a family life, which often means they believe they would need to change their personalities to be successful in those careers (Grunert and Bodner, 2011). The concept of science identity is based on how students view themselves and believe others view them as they participate in the scientific endeavours, hence the student’s science identity likely changes and evolves over time (Aschaber, Li and Roth, 2009).

Methodology and research questions

The main data collection method was done on the basis of electronic IRIS PHD Questionnaire (called the IRIS PHD Q). Different constructs from the Eccles expectancy-value model of achievement-related choices (Eccles et al. 1983) are implemented in the IRIS PHD Q, concentrating on the expectation of success and subjective task value. According to the Eccles model the motivation for an educational choice consists of these two main aspects: the student’s expectation of success and the subjective task value he or she attributes to the educational options available. Subjective task value consists of interest-enjoyment value, attainment value, utility value, and relative cost. Possible scores ranged from 1 to 5, with higher scores indicating greater importance. Standard deviations are indicated in parentheses. Gender difference was tested using the repeated-measures analysis of variance (ANOVA).

The questionnaire was completed by PhD STEM students from the University of Ljubljana that represents the majority population of PhD students. The following five STEM faculties participated in the study: Biotechnical faculty, Faculty of Electrical Engineering, Faculty of Chemistry and Chemical Technology, Faculty of Computer and Information Science and Faculty of Mechanical engineering. The target population included all PhD students on study programmes at University of Ljubljana according to the International Standard Classification of Education (ISCED) codes (Figure 1). The sample consisted of 192 doctoral students, 135 male and 57 female students, which represents 32.2% of the whole target population.



1: response rate of PhD students enrolled in STEM studies at University of Ljubljana in 2010/11.



Results and research questions

The study did not identify ethnic, religious or social background of respondents. Following the background information (gender, year of birth, university, PhD programme, previous enrolments) the questionnaire provided quantitative measures of:

1. importance of age period when they developed the interest for PhD study
2. importance of the key persons in choosing the course of study;
3. importance of different priorities for their future careers and importance of characteristics of a career development
4. importance and impact of PhD study on personal life

We will briefly present the most relevant results but focusing on the career priorities and characteristics.

The results showed that the age period 19-27 is the most important for developing interest in research and academics (STEM) identity for both males and females. The key person with the greatest influence on students was the professor/mentor for both, males and females.

Several studies (e.g. Cerinšek et al., 2012) have demonstrated that females tend to seek more interpersonal values in their future careers, such as helping other people, contributing to the society and protecting the environment, whereas males place more value on extrinsic rewards, such as earning high income. Female PhD STEM students in Slovenia seem to have different, more inter-personal career priorities than male PhD STEM students, i.e. they want more than males to work at occupations that allow helping other people, contributing to the society and protecting the environment.



Conclusion

We need to be aware that the gender imbalance within STEM starts at the undergraduate level of study. Regarding the role of the media, the IRIS study on undergraduate STEM students showed (Cerinšek et al., 2012) that among different out-of-school school experiences that were listed, all respondents rated "Popular science television channels / programmes" as most important factor influencing their choice of STEM studies, followed by "Popular science books and magazines" and "Museum/science centres". It is therefore important to notice, that the lack of proper representation of the female scientists' role models in the media might create or affirm the stereotypical beliefs about female scientist in general and even add to female disinterest in STEM studies or in other case, encourage them to consider the possibility to enroll in STEM studies and consequently STEM PhD.

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97. Exploring visitors' opinions: formative evaluation for the 'sustainability gallery' at MUSE, the new science museum in Trento, Italy

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Introduction

This research has been carried on during the development of the new Museum of Science (MUSE) of Trento, Italy, whose opening has been scheduled for July 2013, and concerns a public engagement activity for supporting the project team with information on opinions, interests and needs of target audiences. MUSE will be a science centre of the newest conception, residing in a futuristic building in a city area that used to host an industrial site and is now undergoing regeneration as a new town quarter. Its construction is supported by local funding and the massive building works are in progress since quite a few years. Its development has been complemented with an intense public engagement targeted to the community various actors, as feelings, opinions and expectations of MUSE's potential visitors have been regarded as crucial.

Since 2008 thousands of people have been engaged in a variety of events to share information on the museum development and to collect the public's points of view, and from Spring 2011 citizens and stakeholders could also experience the advances in the work during guided visits to the location and in Internet through a web-cam connection.

Present evaluation research is coherent with MUSE's participatory approach to the museum development and was aimed to support MUSE's researchers and science communicators in their planning of the 'sustainability gallery', an area dedicated to major global environmental issues. Although a relatively small part of the whole exhibition area, the gallery is a pivot of MUSE's communication, aiming to foster the responsible and sustainable decision-making of visitors as citizens. Accordingly, the topics are intended to be proposed with an original approach both from narrative and scientific points of view, being based on the 'planetary boundaries' framework (Rockström et al. Nature 2009, 461:472-475), in order to become aware of the complex relationship between human activities and environmental resilience.

Material and Methods

This evaluation research aimed to feed the 'sustainability gallery' development with information on audiences' perception of the gallery's main topics, so as to enable developers to choose a more effective narrative approach. Evaluation key questions were (i) what potential MUSE key audiences know and feel about sustainability and related global environmental issues; (ii) how the proposed stories/explanations/imaginaries regarding sustainability would



be received by key audiences; (iii) if the points of views of MUSE's potential key audiences would suggest other stories/imaginaries to be effectively used by project developers.

Research consisted in two actions:

1. *State-of-the-art-survey on the public perception of sustainability*, aiming to collect existing information on public attitudes and knowledge about sustainability and environmental issues. This was based on international literature on public perception of science and technology, such as the most recent Eurobarometer studies (Special Eurobarometer 295, 'Attitudes of European Citizens toward environment', May 2008; Special Eurobarometer 313, 'European's attitudes towards Climate Changes', July 2009 and Flash Eurobarometer 290, 'Attitudes of Europeans toward the issues of biodiversity', March 2010), academic papers, grey literature from EC-funded projects and other evaluation surveys held by major international science centres and museums. This latter, thanks to the collaboration with the Natural History Museum of London (survey for the development of the biodiversity gallery and the new Darwin centre), the Science Museum of London (survey on the temporary exhibition Prove-it, on climate changes), the Ontario Science Centre of Toronto (survey for the development of the Innovation Centre) and Universcience, la Cité des Sciences et de l'Industrie of Paris (survey for the development of the Gallery of Innovation).

2. *Focus groups with key target audiences*, aiming to explore the information needs of Trento citizens on the chosen topics. Four focus groups (FG) were carried out at the Museo delle Scienze of Trento on June 2011. FGs were specifically targeted to potential audiences of the gallery, i.e. school teachers (12 participants), secondary school pupils (9 participants) and independent adults respectively of 20-30 years-old (8 participants) and over 30 years-old (9 participants). Each FG lasted 2 hours, was managed by a facilitator with two helpers and one of MUSE's curators who presented topics, idea and constraints of the gallery planning, and was recorded. The FG first three steps were held by the facilitator who started using two sets of cards for collecting information and fostering discussion. A first set of 50 'word cards' presented lexicon of the topics and participants had to sort the cards based on their familiarity.

A second set of 50 'fact cards' presented key environmental issues (climate change, ocean acidification, stratospheric ozone depletion, nitrogen and phosphorus cycles, global freshwater use, change in land use, biodiversity loss, overpopulation, atmospheric aerosol loading and chemical pollution). Participants, in pair, had to choose two of the cards to discuss among themselves and to present to the others the results of their discussion. Interests, feelings, personal experiences, desires of knowledge towards the topics were then shared inside the whole group.

In the FG third step, the facilitator supported free discussion on the all issues that emerged previously, whilst in the fourth and last step the scientific and interpretive approach the project team was developing for the gallery was presented and participants' views on the curators' ideas and proposals were collected. A preliminary FG for 30-50 years-old citizens has been held at Trieste for design testing.



Results

We are reporting the FG outcomes, whilst desk-survey helped to interpret them, allowing us to confirm hypotheses and giving strength to conclusions. Accordingly, even over and above the expected differences due to FG participants' age, education and profession, some common results have emerged.

All the participants stated they had sufficient familiarity – however superficial – with most of the topics, although issues related to water (eutrophication and acidification) were less known. All considered the information on environmental issues and sustainability available in media to be incomplete, erratic and unreliable and they would rather have more data. They complained about the dramatic and spectacular approach used by media to deal with environmental topics and the lack of information about possible and concrete solutions. As a consequence, they stated they felt powerless and depressed, so that somebody even affirmed to prefer ignoring the matters.

At the same time, however, they expressed a need for detailed and critical information on impacts of individual and collective choices and on possible solutions. They asked for more honest and clear information because they felt disoriented and they demanded discussions with experts. Participants, accordingly, never questioned the truthfulness of scientific reports presented by curators during the FGs, and were looking forward with the greatest interest to the MUSE's gallery as a tool for collecting information and an arena (thanks to future museum's programmes) to be involved in public governance of environmental problems.



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The differences among target audiences were more related to the expectations on specific MUSE offerings. Teenagers seemed to be more interested than adults in knowing 'how science works' and focused their wishes more on nature of the exhibitions, such as interactivity, multimedia and new technologies. Moreover, they would wish to find in MUSE a place for being 'protagonists' of the experiences and for meeting and spending pleasant time together. Teachers' expectations seemed instead to be strongly addressed to didactic support, desiring spaces dedicated to school subjects and programmes. Adults showed as the most interested in knowing the connections of environmental issues with their own personal life and responsibility as citizens.

All these expectations seem to match MUSE's project to offer a space specifically dedicated to Earth's environmental major issues ('sustainability gallery') and to locate it close to a space concerning solutions ('wall of the future') and a space designed for discussion and idea sharing ('science and society café'). Moreover, on the basis of FG results, MUSE's curators working on the 'sustainability gallery' design were supported in their choice to avoid catastrophist approaches, to focus on the interconnections among environment, economy and society for sensitizing about complexity, to increase the information by means of audio-video guide and to maintain a trans-disciplinary approach, even this latter seemed to be not fully appreciated by teachers. Accordingly, the 'sustainability gallery' will include the results of environmental research, the awareness of its methods and limits and will show possible environmental solutions also addressed to the individual, with the support of modern technology and public debates.

In conclusion, with this project we wish to propose an example of how a cultural institution such as a science museum can contribute to the dissemination of scientific knowledge based on respect for visitors' backgrounds and expectations. In fact, with this public engagement

activity, whilst enhancing citizens' awareness of what is already available and what is going to be offered in their own town, citizens could actively participate in the process of planning and establishing a scientific centre of noteworthy cultural significance for the whole community, where they are intended to be central actors and not merely passive users.

We expect that MUSE, with this approach, will play an important role in fostering a process of public participation and science and technology governance in which scientists, citizens, stakeholders and science communicators will all be involved in a continuous dialogue.



98. Communication models in science museums: an example of interactive knowledge

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Users want experience over product, as going through it makes people feel enriched in their characters and personalities. This concept, dealing with experiential marketing, is even more valid in cultural and social matters (Kotler and Kotler, 2004). But what can be considered as a good and satisfying experience when we are talking about science and technology communication? Which standards can be evaluated as good-quality when communication is developed inside museums, science centres or exhibitions?



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Contemporary museums can be actually considered as privileged means for communication, playing a central role in making culture accessible to the mass audience, and museology is indeed facing structural changes in last decades. A core question of this renovation process deals with new technologies and their several implications: since we live in a multi-connected era, we actually expect to find a technological element in almost everyday life aspect, both in our professional and in our pleasure activities. Moreover, we expect to participate in dialogue and not to passively receive information. Museums, cultural and scientific institutions are renovating their communication methodology and investigating how new media can be integrated to this purpose and what they should offer (Various authors, 2002).

In the following, some of the several interesting data published in 2010, in a document referring to the use/benefits of ICT tools for cultural heritage institutions in Italy are provided (Various authors, 2010):

- What is your judgement on introducing new technologies?
54% Good 21% Excellent 14% Sufficient 11% Insufficient
- Which impact did it have on the users?
46% High 42% Medium 6% Low 6% Excellent
- What reasons are there to introduce new technologies for valorisation of cultural heritage?

45.4% Diffusion of knowledge – 32.3% Satisfying users' needs – 26.2% Didactic purposes – 10.1% Economic development

It therefore seems that it is not for economic return that cultural heritage institutions are interested in new media but, instead, the intent to offer a more complete experience and, consequently, to yield a good image return. New technologies allow museum curators to

modulate flexible cultural proposals, so as to keep into account that the public is heterogeneous. Since 1969 when Frank Oppenheimer opened the Exploratorium intertwining Art and Science a new conception of exhibition (and communication) was created, aiming “to support a culture of experimentation and collaboration, inspire curiosity and understanding, and stimulate fresh ideas and directions.” Those two separated fields have become a part of a whole method to explore the outside world, and its “hands-on” revolutionary approach still represents an essential heritage for the science centres that came later.

Contemporary ICT, including Web 2.0, fits in perfectly with this interactive approach. A few examples may hint at the general trend, although they definitely do not exhaust the whole range of possibilities of new media/interactive paradigms:

- | |
|--|
| <ul style="list-style-type: none"> • Applications for mobile devices: Rama Tours
<i>(“More than just a digital tour guide, Rama make history come alive like never before by using archival photographs and other images to show you how those places once actually looked”. http://www.crimsonbamboo.com/ramatours)</i> |
| <ul style="list-style-type: none"> • Web 2.0: Google Body, Google Art
<i>(Offering the possibility to create your own gallery http://www.googleartproject.com , http://bodybrowser.googlelabs.com)</i> |
| <ul style="list-style-type: none"> • Museums and exhibitions including new media
<i>(Ongoing exhibition such as “Prints and the Pursuit of Knowledge in Early Modern Europe, Sep 6 2011-Dec 10, 2011” at Harvard Art Museum.
http://www.harvardartmuseums.org/exhibitions/upcoming/detail.dot?id=33226)</i> |



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The actual, modern concept of “Museum 2.0” (<http://www.participatorymuseum.org/>) is something extremely contemporary, not only because it deals with audience participation, but also because it puts audience in the middle of the communication process and not at the end. Specific literature brings several examples of museums and science centres experiencing new media and new communication paradigms (Arends, 2003, 2004; Merzagora, Rodari, 2007) studying their visitors and trying to define appropriate standards about our initial inquiries:

1. What can be considered as a good and satisfying experience when we are talking about science and technology communication?
2. Which standards can be evaluated as good-quality when communication is developed inside museums, science centers or exhibitions?

It seems that *interaction* itself is the way to increase:

1. Communication – from the Museum to visitors
2. Experience – of the visitors inside the Museum
3. Feedback – from the visitors to the Museum

It must be said that scientific museums and exhibitions gain the intrinsic advantage of getting the public involved: visitors can naturally experience an interactive approach during their visit. Nonetheless, there is often the risk of a gap arising between scientific communication

and the general public: if museums fail to set appropriate instruments and models, people could feel uncomfortable and get bored by exhibitions. Developing new media, studying new formats and testing audience responses is a good method to collect data and help reaching higher quality levels in science and technology communication.

What we have done at the University Anatomical Museum of Pisa, in collaboration with the Perceptual Robotics (Percro) Laboratory of Scuola Sant'Anna of Pisa, is to focus on how multimedia applications can improve accessibility and educational aspects. Through questionnaires, we have conducted an analysis of people's experience inside the museum, in order to focus the main aspects/problems concerning the approach to the medical and scientific collections.

What we have ascertained is that, on a sample of 80 persons – very different in education level, age, nationality and gender – 90% of them showed interest in the possibility of interacting with multimedia elements during their visit. On the basis of these results we have developed two interactive applications, based on different objects and different interactive paradigms.

Multimedia format

The term “Information Landscape” (IL) was coined by Muriel Cooper, founder of the Visible Language Workshop at MIT Media Laboratory (Small, 1994, 1996). ILs represent a synthetic 3D environment generated in the computer, with which a user can interact in a realistic manner. The main difference between IL and a conventional virtual environment concerns virtual elements: they are usually structured as geometric shapes on which texts and images are conveniently placed, allowing user interactive experience. ILs are based on principles and metaphors that permit creation of very different worlds: Percro Laboratory has developed a tool to assist the design and authoring of IL (Ruffaldi, Bergamasco, 2005). For the Anatomical Museum of Pisa, we have structured the first part as a corridor where information are placed and perceived from the user in a sequential way, as shown in Figure 1.



Figure 1



The second part of the IL is focused on virtual “rooms” hosting specific objects from the Collection. In every room information about objects are showed; information are distributed in an immersive space, so as to allow the user to loosely visualise and navigate through them. The “Virtual Gallery” (Figure 2) is a sort of multimedia catalogue showing homogeneous objects through an immersive presentation, offering a complementary vision of the exhibition. The basic principle is that of the interactive slideshow, though the pictures are presented as floating in a 3D space in a descending spiral shape. User interaction is limited to the browsing of the pictures and can be achieved by means of standard input devices (mouse, keyboard), or more advanced ones (smartphones, touch surfaces, motion sensors).



Figure 2



Conclusion

The presented interactive tools have been developed in the framework of a PhD research, focusing on the development and the evaluation of interactive formats for scientific museums and institutions.

Our aim is to verify and increase the value of the experience provided by multimedia resources, both for their educational value and for engagement they offer. It is a matter of fact that multimedia play a role in every form of contemporary communication; it is our assignment to study and define suitable models for the undeniable changes our society is facing out.

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99. An Evaluation Framework of Social Effects of a Touring Science Exhibition

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Touring science exhibition in China

Touring science exhibitions were not much funded or widely conducted before the *Outline of National Scheme for Scientific Literacy* was issued by National Congress in 2006, which is aimed at improving the scientific literacy of Chinese citizens by implementing four main activities and four main social projects. In order to implement the Project of Resources Developing and Sharing, which is one of the four main social projects to strengthen science popularisation of China, the China Association of Science and Technology (CAST) conducted several projects since late 2005 to support the museums and science centres who lack money and personnel to develop exhibitions by themselves, especially those in mid-sized and small cities. The touring science exhibition is a way to share resources across China and reduce the cost of creating exhibitions. As a project management measure, evaluation was conducted to measure the social effects of touring science exhibitions. This paper focuses on the evaluation framework of touring science exhibitions.

As a measure to implement the Project of Resources Developing and Sharing, a science touring exhibition's social effects lie in the following 4 aspects: to meet the resource need of science museums and science centres who lack science exhibition, to take full use of a science exhibition, to benefit more people from different places, and to train staff for science museums and science centres of small or medium cities and get more funds from local government or local museums for science communication.

The evaluation objectives, evaluation indicators, evaluation methods and evaluation angles make up the evaluation framework of touring science exhibition. There are 3 first class indicators, 6 second class indicators and 18 third class indicators in this evaluation framework (see Table 1).

Evaluation methods and evaluation angles

Several evaluation methods are adopted to get data and information about the social effects of a touring science exhibition. Call survey and questionnaire are mainly used to get information from the public, and interview is used both in public evaluation and the museum's evaluation. Data collecting is used to monitor the amount of exhibitions, number of visitors, press coverage and so on (refer to Table 1). The so-called evaluation angle is the channel by which to get the evaluation data and information. Due to a touring science exhibition benefiting both local public and the museums, the public and the local museum are chosen to be the two evaluation angles.

An Evaluation Case

This evaluation framework was used in an evaluation of a touring science exhibition, "Energy-



saving, Emission-reduction and Low-carbon life”, carried out in 2010. Due to the limitation of evaluation funding, not all evaluation indicators are carried out in this case. Here are some findings got through evaluation.

Evaluation Indicator			Evaluation Method
1 st class indicator	2 nd class indicator	3 rd class indicator	
need for exhibition resource	local public's need	local public's desire to attend the exhibition	call survey
		local public's motive to attend the exhibition	Questionnaire
	local museums' need	Local museum's desire to import the exhibition	questionnaire, interview
		local museum's motive to import the exhibition	Questionnaire
use of exhibition resource	on-scene exhibition	amount of venues	data collecting
		times of exhibition	
		period of exhibition	
		times of the replication of the exhibition	
	media promotion	amount of media reports	data collecting, supervision on media reports
		ways of media reports	
		influence of media reports	
benefits of exhibition resource	benefits to local public	amount of the visitors	data collecting,
		local public's awareness of the exhibition	call survey
		local public's Satisfaction toward the exhibition	Questionnaire
		the public's gains from the exhibition	Questionnaire
	benefits to local museum	exhibition's influence on staff qualification of local museums	questionnaire interview
		exhibition's influence on local museums' and governments' investment on exhibition	data collecting,
		exhibition's influence on the use of local museums' facilities	data collecting,
		exhibition's influence on the extension of local museums' contents and forms of science communication	data collecting,

Table 1: Evaluation Indicator System and Evaluation Methods of Touring Science Exhibition

The evaluation showed that this exhibition was exhibited by 8 science museums and science centres during March to December of 2010 and about 140,000 people visited the exhibition. The exhibition was reported through newspaper, internet, radio and TV more than 80 times.

Based on 1,681 public questionnaires and an interview with 20 students it was found that:

- (1) Most of the respondents indicated that they got the first chance to visit an exhibition about “low-carbon, energy-saving, emission-reduction” in the recent 2 years, and the exhibition provided an opportunity for most of the respondents to learn and explore;
- (2) The respondents held a positive view of the exhibition; the use of multimedia turned out to be a successful and attractive, hands-on exhibits got a positive appraisal from the public and were in more demand;
- (3) As for the educational effects of the exhibition, it turned out that visitors considered themselves to be more informed by visiting this exhibition, the exhibition promoted the public’s concerns on topic of “energy-saving, emission-reduction, and low-carbon life” and this exhibition was likely to guide most respondents to act a life of low-carbon.

Besides positive findings, the evaluation also indicated what should be done to improve the exhibition, such as to maintain the exhibits in time, to have more hands-on exhibits, to allow teenagers enough time to explore and learn while visiting exhibition.



Conclusion

Touring exhibition is an effective way to improve the sharing of exhibition resources and to support the local museums, especially in developing countries like China, where lots of museums were built within a short period, equipped with hardware but lacking software like funds, qualified teams for exhibition creating and so on.

100. **Science Express Enjoyable triad: expression, perception and public communication of science**

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Introduction

Each day we face challenging advances of scientific and technological knowledge, with the increasing complexity of the universe they represent. How do we handle so many novelties and new modes of survival? We lack time and even media to get to know, for example, the origin and quality of the products we consume. Besides, we are confronted with a great mass of information of different types, sources and quality that many times show uncertainties – like science itself – are contradictory or even wrong (1).

Science in the media is increasing (above all subjects related to biomedicine) (2) but though information flux is really intense, it has worrying contradictions. Public perception of science is controversial. Many people are unaware of basic scientific notions (even directly related to its daily life) but see scientific careers in a positive light; meanwhile their activity generates fears, false rumours and at the same time, enormous expectations of improvement in the quality of life (3). The general public is interested in science and demands more and better information; yet they consume few contents compared to others that have leading roles on TV, radio, newspapers or even the *web* (3)(4).

Science is perceived as a complex kind of knowledge, and citizens face the need of adopting views and taking decisions without knowing the science behind or having enough understanding of new laws and regulations. This controversy leads to the question of “trusting the media” beyond our critical capacity. This is harder now, even for those with a good educational background. We live in a kind of “wild communication era” which is not contributing to solve the epistemological gaps in the public understanding of science. This is the subject of much debate (see for e.g. (11)).

It's a social need to set up strategies to filter the mass of information and elaborate scientific communication policies with this problem in mind. The crucial task really, is to increase citizen's ability to form critical points of view (specially managing trust in sources) in a frame of social awareness.

Social construction of science has emerged and evolved in a cultural, political and economic context and the way in which science is mostly transmitted to the public reinforces previous concepts. Taking the example of exhibitions, Gregory J. Schneider points out that (6) “[...] the mode of display highlights the science that undergirds the thematic science content typically presented.”

More than ever we have to consider this fact from the basis. What is science, how does it work, and which limits and risks does it have? Each person has their own vision and should be able to think of examples of what science is and what is not. But even scientists don't



think equally about this; in fact, we might find many scientists, science teachers, leaders and policy-makers that have barely thought about this issue.

It is worth mentioning we are not even considering the actual problem of “bad science” that is not only done in laboratories, but also transmitted sometimes even without scruples to the public as final truths (5).

Vision

We adopt and extend Schneider’s rhetorical challenge: to achieve a way of conveying scientific knowledge (and its epistemological claims) within and historical process, and to present the complexity of the scientific enterprise as an object of knowledge itself. Before any direct science communication practice (classes, workshops, conferences, hands-on experiences), there should be a reflective introduction to what science is, no matter the format or the length, and a minimal introduction to the philosophy of science. In the case of indirect communicational practices (didactic materials, books and magazines, exhibitions) the texts, images and overall display should carry this questioning message.

By reconsidering the basis, people are encouraged to revise their own visions and concepts and to reflect on the social construction of science and the responsibility it has in producing and reproducing scientific culture, social awareness and responsibility. But how can we tackle the need to go back to the basis? Fortunately, some public engagement practices seek this goal. Some focus on children, e.g. they have to make some drawings (7) (8), answer questions or tell a story. In general they have to draw a scientist in order to see their vision of them. Others combine ideas, also with children (9.) This could and should be done for all ages and professions.

Artistic expression is used to attract the public and show science complexity in exhibitions, as in a take-away photographic exhibition of GM tomatoes (10) aiming to demystify the process of genetic modification, and clarify the debate about this controversial subject. Art and science are making great contact nowadays. It’s an “emotion generating mix”, so we focus on the messages it can and sometimes should give. Emotion-based approaches usually confront the public with fascinating objects and phenomena in order to achieve (through interaction or conversation) the desired response (4). This is really valuable and able to produce good results. However, it leaves behind the previous notions, possible misconceptions and individual associations people may have.

To what extent do emotional messages reach the public and in which way? Top-down stimulation is not enough if we want to inquire social perceptions of science and bring awareness about the real feelings of the receptor. There is plenty of groundwork for how the public conceives not only the scientific ideas, but science itself.

Here I refer to past activities in which we used emotion in a different way: to move the public, awake its interest and provoke reflection; first, about what science is, and second, about what do they have in mind when some scientific topics are just named (climate change, stem cells, nanotechnology, GM crops, synthetic life, etc).

We wonder if it can give a founded response. Which ideas do they associate with science and why? Are they able to express their ideas? The mission is then, to use the emotional approach the other way round and appeal to different forms of expression to arise the sleepy



“knowledge seeking instinct” and vital expression about nature and its phenomena we all have. In this way we expect to get a broad outline about (and possibly identify) the concepts and personal visions public may have about science and controversial scientific topic.

The main objectives of our approach are:

- Promote a personal questioning of science notion within the increasing complexity of scientific and technological knowledge;
- Boost reflection and encourage the challenge of individual expression, experimenting with our perceptions and getting to know more about the world and the circumstances that surround us;
- Identify (and register) possible preconceptions and wrong notions about science and science topics, and determine which aspects can be improved, what points should be taken into account in their communication.

In a glance at activities done in science classes, conferences, etc. we mention the plastic and literary expression workshop, gathering responses to the question, What is science? Participants are told: “Give us a drawing or a word. Don’t think it! Just express”. This can be done on a big sheet of paper (e.g. on a clipboard) also on separate shared out papers, or a booklet. An alternative is the audio recording workshop, in response to the statement, Science is... “Say one word. Don’t think it! Just express.” Here we record the first word that comes to people’s mind.



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The final step is prompting an evaluation debate by the attendees and if possible, science communication professionals, with the guiding questions: How did you feel with the proposal? Do you think it is a good way of revealing “hidden” concepts or ideas associated with science? Does the fact of knowing, sampling and recording these previous concepts and images help improving public science communication? In which way?

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101. **What do you like best about visiting science museums? Young visitors' forum to evaluate science museum offers**

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Science museum is an institution open to the public to promote culture and heritage, and to develop citizen's science skills. Therefore, science museum offers activities for different categories of publics, included children, who represent an high percentage of the visitors. It contributes to develop science literacy in children, by using different approaches to meet their styles of learning and to answer their educational needs and expectations. The paper presents the research we carried out in the Natural History and Archaeology Museum of Montebelluna, Italy. More specifically, we want to present how we assessed background information about children perceptions, expectations and interests regarding science museum. This front-end evaluation activity was functional for the Institution to best answer children's educational needs in order to design a new museum area, and it also helped the Museum to plan new science communication strategies that might be implemented in the new area.



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Inclusive museum

Museum preserves heritage of the identity, the memory and the development of a community. In planning out a project the Museum has to use research strategies where the community can participate in and evaluate it.

In this last half century we conceive an important change in the relationship between the museum and its audience: in the 60s it was considered simple and unidirectional, the museum was self referential in its productions and mostly in dialogue with a certain specific category of people. A cultural elite that the museum staff saw as a reflection of itself, with the same interests, needs and knowledges about the value of the collection (Henning, 2006).

The change of political relationships with users, especially in the last thirty years, has led museum to understand their role in society for the development of the communities whose cultural heritage has been preserved. So museums have been oriented towards inclusive policies, recognizing that their audience is made up of several groups which have different learning needs and expectations, that they wish to express their curiosity and their own observations, which are in connection with exhibitions, collections and activities promoted by museums, according to their own perspectives and their own language. This new awareness to visitors has helped to promote the debate on the interests of the public and the role that museums should play in dialogue with these interests (Message, 2006).

The museums recognizing that the public is made up of many different groups who are able to articulate their needs and make their views known, even through choosing not to visit an exposition, or participate in museum activity. Equally, museum has come to appreciate the

complex relationships that can be established with different individuals, who have taken an active role in contributing to the overall activities of the museum. In order to this perspective the Museum of Natural History and Archaeology of Montebelluna (Treviso Northeast Italy) actually is working. It is an institution deeply rooted in its territory: it studies and spreads knowledge about its natural, environmental and historical-archaeological heritage. It is a culture-producing agency: therefore it is linked to other cultural poles such as nearby Universities, the network of museums, local cultural associations, schools and so on. The Museum fulfils its cultural mission also by carrying out scientific research and experimentation in a variety of fields, such as the natural, historical-archaeological and educational ones. The educational and divulgative activities are the most important and the children from school and families involved in different types of experiences represent the main category of public.

In order to be an inclusive institution the Museum of Montebelluna in the last ten years has focused the attention on the identification of the different types of real and potential visitors, or rather stakeholders, and on the meeting between the bid proposal from the museum and the needs expressed and unexpressed by stakeholders.

Each stakeholder, each public category, has well its own expectations, its needs, expressed or not, known and unexpected, and the museum could relate with them.

The Montebelluna museum has understood that and the first step in this direction was the change of central, self referential prospective to become part of the social, cultural and economical system of its own territory, trying to create opportunities of interchange between stakeholder and museum.



Each stakeholder has his own special interests regarding the museum and the museum, must recognise these interests before engaging in new specific projects.

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According to this “modus operandi” the museum has started deep relations with various stakeholders in the territory, involving them in the new projects, through different action levels: forum, focus group, interviews, questionnaire, personal contacts, selecting opinion leader etc. This has permitted the exchange of experiences, the comparison between museum and people and the spread of ideas.

Only in this way a museum, and the heritage preserved inside, can really be part of daily life of each person, promote cultural and local development.

This is mostly important in natural history and science museums. Actually the gap between science and people becomes each day more wide. Museums are media to deliver of messages about science and the visitors are not just one alone, but there are several different audiences for those messages. So it is necessary develop different communication channels. Each individual has own learning style and he requires specific design in the exposition. The Montebelluna museum has developed strategies aimed at social inclusion about science topics in terms of their educational program and project exposition.

It becomes a place for discussion and debate on the complex issues derived from current research and about the best ways to propose these scientific and natural issues in the exposition or in the educational activities.

The aim of this work is to understand how the children image a new natural science museum in Montebelluna, what and how they want to learn inside the museum.

The young-visitor study to listen to children voices

Science museum is an institution open to the public to promote culture and heritage, and to develop citizen's science skills. Therefore, science museum offers activities for different categories of public and it contributes to develop science literacy in its visitors, by using different approaches to meet their styles of learning and to answer their educational needs and expectations.

Some strategically criteria can be used to evaluate the quality the educational offers: the amount of the aims; the amount of the evaluation elements; the number of used tools; the attention to different public categories.

The Natural History and Archaeological Museum of Montebelluna (TV), of Northeast Italy, uses different techniques to carry evaluation plans questionnaires, interviews, focus groups, observations.

The Museum offers a multitude of activities for different categories of public, included children, who represent a high percentage of the visitors (71%). In 2011, it decided to carry out a visitor study in order to design a new museum area. It asked the collaboration of experts from Department of Education (University of Padova) to joint plan the research project we present on this paper.

This front-end evaluation activity was functional for the Institution to best answer children's educational needs in order to design the new museum area, and it also helped the Museum to plan science communication strategies that might be implemented in the area.



422 More specifically, we want present to you how we assessed background information about children perceptions, expectations and interests regarding science museum, respecting some important pedagogical considerations on working with children.

When researches with children are designed some ethical priorities have to be considered: you have to consider the child as person and you need to promote their participation and their right to be heard, these principles are declared in the Convention on the Right of the Child (UN, 1989). You cannot just to keep information you need from them or manipulate their thinking and their wishes, as marketing does.

Therefore we decided to use a pedagogically research approach, creating an authentic participation opportunity for the young visitors, and occasions to listen to their voices (UNICEF, 2009, artt. 42 & 115) (Fig. 1).

We used a qualitative approach on carry out the method of action-research (Mills, 2011), empiric and interpretative. The action-research method considers actors of a social experience as the ones who can best collaborate to understand experiences they are personally living. Under an the expert guide, they are the ones who can find out solutions to problems about their own practice and they can contribute to produce useful knowledge for the society (Collucci et al., 2008).

Holding those considerations, we created an educational setting where to observe and where to pursue the following research aims:

- 1) understand children's perception, wishes, emotions about museums;
- 2) stimulate children's discussion and cooperation;

- 3) reflect with children upon the characteristics of museums, exhibits, exhibitions;
- 4) experiment some basic phases to build a joint project.

In consideration of the above, we asked a group of children (57 young visitors six to eleven years old) to participate in some forums, where they should express their own ideas about the design of the new museum area. Forum is a popular technique on research with young people and UN used it listening to 400 children and teen-agers in 2002, before the UN Special session on children (UNICEF 2002).

Two types of forum were organized on applying dynamic and interactive techniques from the sector of education, in order to encourage participants in expressing their own ideas about the field.

The Forum type A was named "Thinking about a museum", where children were listened using techniques as circle time and brainstorming (Bezzi & Baldini, 2006). In particular, they answered some questions and children's friendly tools as comics, drawing, collages, writing notes and clipboards (Luperini, 2006) were used to recognize their ideas about science museum. Two group of children participated in the forums: 19 children six to nine years old were involved in the first group; 17 children nine to eleven were involved in the second. Each forum took about 90 minutes and was realized during the third week of July 2011, in the context of a summer camp in the museum.

The Forum B was named "The museum of my dream" and was carried out in two 2-hr meetings. It was always realized in the context of a summer camp in the museum during the fourth week of July 2011. Four small groups of 5/6 children each, six to ten years old, collaborated in four parallel forums. They were involved in a Team Work (Doel & Sawdon, 1999) where they had to design a joint project of the new museum area: the "Dream Museum". The groups were guided by researchers to realize different phases of project plan: ideation; individual creation of exhibits; joint creation of museum routes; presentation of the projects to the community; evaluation of the activities they did.

Discussions were recorded and written out; photos and children's products were collected. The software ATLAS.ti was used to analyze data on coding, analyzing, dividing in families, relating each-other to emphasize some relations (De Vido, 2004).

On the questions "What's the best thing about visiting science museums? What's the less attracting about it?", the analysis of children's answers shows a situation of enthusiasm (Figure 1). Museum is perceived as a place to visit, where you can learn, look, discover, play, realize handcrafts, study, have positive relationships, explore archaeological findings. On the other side, children stumble on also some negative aspects as the privation of visiting or of observing something interesting, the disgust or scaring feeling produced by some finds, the boring experience when someone speaks too long time about the same topic, the obliged activities they have to realize in a place felt as an informal learning site.

The two groups summarised possible offers to public and suggested some useful advice for the museum staff.

The answers to the questions "Who would you like to bring with you to visit a science museum? Why him/her/them?" support the social dimension of the informal learning site (Figure 2). Museum is felt by children as a place of relationship, to visit with the family, friends, class-mates and sport-teams. From the motivations offered by children emerge the idea of



museum as a place where to learn, to discover, to share and to compare different opinions, to co-construct knowledge. A child stated to be interested in visiting the museum alone, in order to study and to deepen the fields he is fond of.

The ingenuous children's answers are connected with the purposes of education, study, enjoyment the current definition the museum holds (ICOM, 2007).

Also the joint museum design of the "Dream Museum" (Figure 3) had surfaced interesting elements the staff of experts considered when the new museum area was projected.

Starting from those and other requests, young visitors provided us with useful information about their perceptions and preferences. Furthermore, they gained a good educational experience where they reflected upon what they do in the museum and upon how they percept the Institution; they thought and expressed their feeling and options; they lived a happy and productive time together; they had a good occasion to cooperate and discuss within a group on building a joint project, useful also for adults.

The research about this topic raised the staff and trustees' awareness regarding their visitors and potential visitors, on considering the point of view of the audience (Comoglio, 2010). It was also a good practice for children to develop their self-knowledge, to trial a social participation experience and to grow their sense of belonging to a community (Watermeyer, 2012).



Figure 1. Visiting science museum: the best and the less attractive things

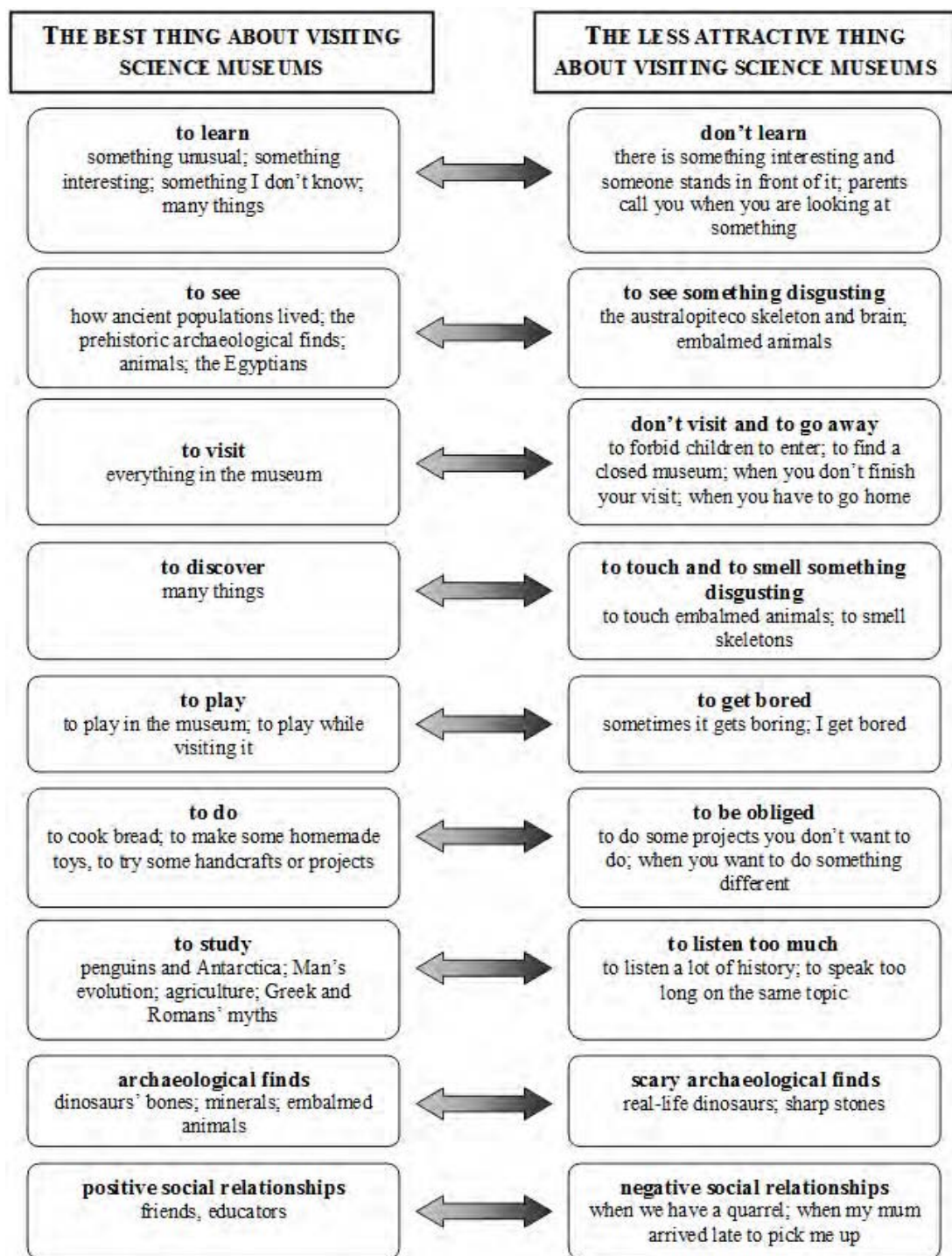


Figure 2. The social dimension of science museum

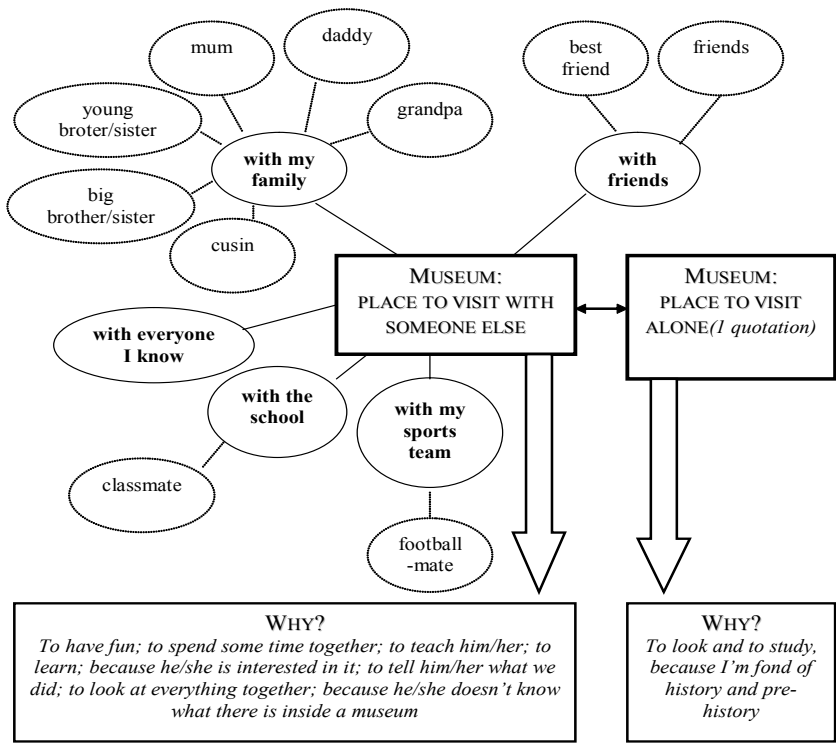


Fig 3. Children present their projects



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102. **Effectiveness of community media in creating health awareness: a case study on a health communication campaign of tuberculosis through community radio in India**

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Prologue

In the developing countries such as India, health especially in the grass root level is one of the neglected areas although the government of India allots a huge budget to health awareness campaigning, such as AIDS, swine flu, bird flu, malaria, leprosy, tuberculosis etc. Health awareness is still a difficult task in the developing countries.



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Tuberculosis is now a totally curable disease. The government of India is providing totally free of cost treatment to all TB patients through the Revised National Tuberculosis Control Programme. In spite of all this, still in India two persons per three minutes, 1,000 people per day, and around 1 million people in two years die from TB. And every year 1.8 million of people are affected with TB (Jnan Taranga, 2011). The reason cannot be overlooked that is lack of proper awareness among the common people especially on tuberculosis.

We cannot deny that community media is the most effective and vibrant communication tool in the developing countries. Here, we can take a small example. The north eastern part of India, consisting of seven Indian states covers 7.7 percent of total Indian landmass. Just in this small region, 357 recognised communities or social group live. Each of them has their own language, own culture and own tradition. The national or regional media may be accessible for those groups but only community media can reach them, influence them, and help them to participate in the nation's development. Dr. Nalini Krishnan, Director of REACH, an NGO based in Chennai, says "Community radio is a very powerful medium that has the unique quality of making an instant connect with local communities" (Ravi, 2012).

TB in India

Tuberculosis is a highly infectious disease caused by bacteria whose scientific name is mycobacterium tuberculosis. The disease is not spread by touching clothes or shaking hands and not even by pregnant woman to her child. Tuberculosis is spread primarily from person to person by breathing infected air during close contact. A person diagnosed with TB should take complete treatment for 6-8 months. DOTS is the most effective strategy available for controlling TB (Dutta, Ray, 2012).

Tuberculosis can be controlled if people are properly aware of it. The government of India

has taken various initiatives for controlling tuberculosis. The first TB control programme was implemented in 1962 but due to various lacunae in the programme, a revised strategy was implemented in 1992 known as Revised National TB Control Programme (RNTCP). RNTCP follows the DOTS strategy for curing the TB patients which is free of cost. The primary aim of the RNTCP is to achieve a high cure rate of 85% among newly detected sputum-positive patients and to detect 70% of such cases (Dutta, Ray, 2012).

India is the highest TB burden country accounting for nearly one fourth of the global incidence. TB is curable with 6-8 months of treatment. The diagnosis (sputum smear examination) and treatment of TB is made available free of cost.

It is estimated that 14 millions of people are suffering from TB in India out of which about 3.5 million are sputum positive. TB kills more women than all other causes of maternal mortality. TB attacks the most productive age group that is 15-60 years, in the country. According to new data from WHO's 2011 Global Tuberculosis Control Report, India's case detection rate in 2010 was just about 60%, of which 73,000 of the new TB cases were already multi drug resistant. Of this less than 3,000 were detected. In order to create a worldwide awareness about TB, March 24 is observed as the World TB Day (DR, 2012).

TB Awareness through Community Radio

With the initiative of REACH, eight community radio stations of different states took part in the TB awareness programme. All these stations broadcast 16 episodes of programmes with a 5-minute feature followed by 25 minutes of discussion, drama, skit, talk, phone-in etc. The episodes contained different themes on TB along with interviews, discussions and sound-bites of renowned physicians, health officers and TB patients.

The topics of these programmes are: TB a problem, how does TB spread, types of TB, symptoms, diagnosis, treatment options, TB and poverty, social impact, stigma issues, India's programme for TB control, drug-resistant TB, TB and HIV, smoking and air pollution, risk for TB, challenges in TB control, cough-to-cure pathway, community participation in TB control and World TB Day (DR, 2012).

Listeners' survey

First Phase

A team from Jnan Taranga conducted a pre-survey in order to have an impression of the status of awareness among the common people about tuberculosis. After the broadcasts, the survey was done again with the same group of people with a few objectives, such as to study the awareness of tuberculosis among the community people, to make the community people aware about TB, to know if the people benefited from the programmes of the community radio station. In brief it can be said that it could experience the real fact of the effectiveness of the CR in the particular area and in a particular case.

In this study, the team has considered the coverage area of transmission i.e. Housefed to Dispur, for research. For the pre-survey research, a total of 200 people were taken as samples of which 110 are general community people residing in Housefed and nearby. The other 90 samples are school and college students. The sample is taken through simple random sam-



pling process. In the first sample, a group of 110 people are considered from all sections of society like employed, unemployed, business persons, housewives, a few business persons (shopkeepers), auto rickshaw drivers, vendors, cobblers etc. In the second sample, 58 college students are considered whereas 32 school students are taken in the third sample. The researchers visited about 72 homes. The researchers put a set of 13 questions to the community people and requested them to listen to the community radio station, Jnan Taranga every Sunday at 4.30 pm to have awareness about tuberculosis. They also told them about the survey after the completion of the broadcast of sixteen TB episodes.

Second Phase

In January 2012, the post survey was started after the end of the TB programmes. The same questionnaires were used with the same sample. The same households were visited and the same people were interviewed. But only 96 respondents among the previous sample were available for the interaction. The results show a positive picture. This time, out of 21 students, 80% of students got to know that TB was actually caused by the bacteria called mycobacterium tuberculosis. 70% of students became aware that TB was not a hereditary disease. 70% students now knew that TB was not a contagious disease; therefore TB patients should not be abandoned by their family and society. 70% of students knew that DOTS was the best way to treat TB. 80% of students learnt that the treatment of TB was absolutely free in the public health centres, therefore the complete treatment is possible even for the poor people.

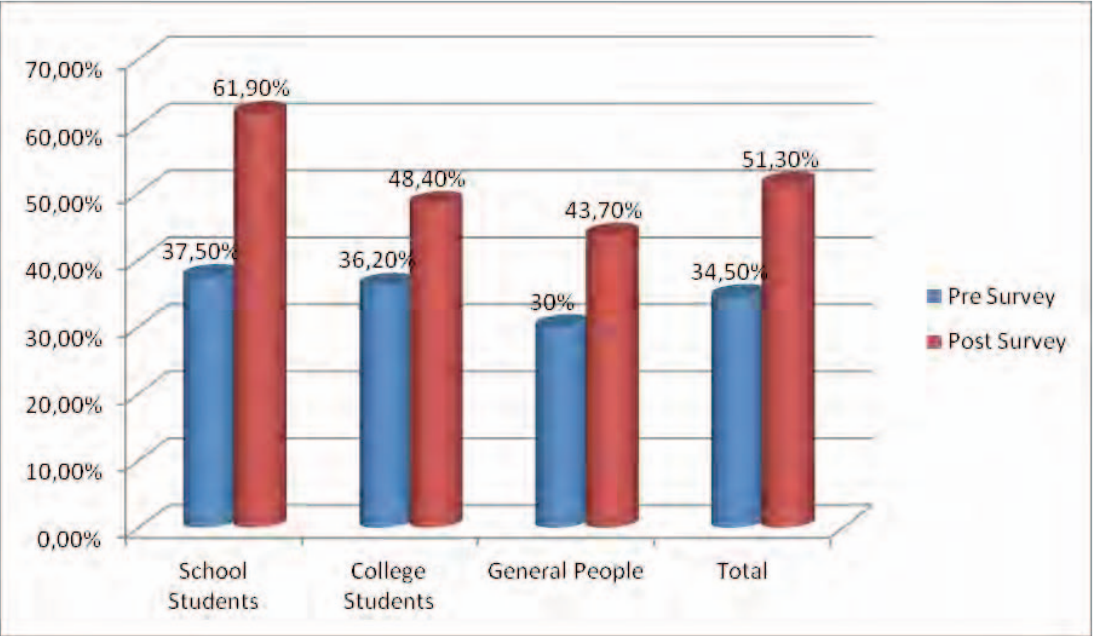


Figure 2: Is TB a contagious disease?

Conclusion

The pre-survey conducted among the common people, school students and college students provided us with varied results. To sum up the results of different questions as provided in the questionnaire, an average percentage was evaluated. The pre-survey resulted in an average of 34.5%.

The post-survey was conducted with an objective of interpreting the effectiveness of the TB programmes broadcast by Jnan Taranga. As a result, awareness about tuberculosis increased to a great extent. Students as well as the common people benefited much from the TB programmes. The percentage of awareness as procured from the post-survey can be mathematically evaluated in an average of 66.2%.

In a nutshell it can be said that the study helped the researchers reveal some important facts. The post survey conducted had a positive response. The TB awareness programmes broadcast by Jnan Taranga had much effect on different sections of people, including housewives, students, vendors, auto rickshaw drivers etc. But here a few challenges cannot be ignored in case of community radio functioning. The coverage area, the quality of transmission, the funding position for running the CR, the frequency allocation, the content of different programmes broadcast and many more problems have still yet to be solved. So to get 100% effectiveness, these problems and issues need to be solved and in-depth research is required for each and every angle.

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103. Social appropriation of science in Peru

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Science and technology provides competitive advantages for building sustained economic and social development of countries, ergo, *human development*, which essentially means to provide the population higher levels of quality of life. Although science, technology and innovation can be used to cause damage, for example, in military technology, promoting human development is inherent to them. There can be no human development without scientific development, without scientists and researchers. The prosperous countries in the world are countries that have kept pace with scientific and technological advance.

It is with these considerations that we locate the role of the *Social Appropriation of Science and Technology*. This has acquired great importance in the world because it is the transmission belt between producers and consumers of science and therefore is an absolutely necessary medium to promote the development of societies in the world. The *Social Appropriation of Science and Technology* is a system of interrelated activities of popularisation of science, technology and innovation, created in order to promote and strengthen the scientific culture of societies. The Social Appropriation of Science and Technology-mission is to popularise science and technology, turning-science –that seems highly specialised and complex – into popular science, so technology and innovation become part of the everyday life, a necessary condition for the steady advance of science and technology, which leads to the progress of humanity.

Without resorting to semantic and etymological discussion of the terms involved, the category *Social Appropriation of Science and Technology* has acquired a rich synonymy. It is known as Popular Science, Popularisation of Science, Scientific Literacy, Science Outreach, Dissemination of Science, Public Understanding of Science, Scientific Journalism, Socio-Diffusion of Science, Scientific Cultural Action, Public Understanding of Science, Public Communication of Science and Technology, etc.

For a country to develop, or achieve gradual and sustained improvement of the quality of life of its population, not only requires the active participation of elite producers of science, technology and innovation and the scientific community, but needs the active participation of the entire society. The *Social Appropriation of Science* leading to the creation of conditions for the popularisation or massification of science and technology as part of national scientific culture is an absolutely necessary condition to promote the development of societies of the 21st century and third millennium.

In the context of Latin America and the Caribbean region countries such as Brazil, Mexico, Argentina and Chile without detracting the great efforts being made in other countries have been promoting for decades scientific and technological development, giving an important place to *Social Appropriation of Science and Technology*, elevating it to the level of the promotion of active public participation in science (Public Engagement with Science). In consequence these countries now have significant levels of economic and social development. Still,



Latin America remains a poor region because it has a low scientific production and has not yet given to Scientific Research and the *Social Appropriation of Science* the importance that it deserves.

In the case of Peru, the scientific culture and the development of science, technology and innovation are just beginning, because the scientific research and the *Public Communication of Science*, or *Social Appropriation of Science and Technology*, are relegated to less important planes. Peruvian universities, instead of playing a leading role, abjure their essential mission of scientific production and Social Appropriation of Science and Technology.

Peru shows itself to be a merely a receiver of science originated in the global scientific large blocks (US, European Union and certain parts of Asia), and Peruvian universities simply transmitters (sounding boards) of foreign knowledge. We cannot avoid saying that *Social Appropriation of Science* is still embryonic. These conditions result in ties of dependency that preclude the country to insert in a globalized world and take part in a sustained manner in the society of knowledge and information.

Our hypothesis is that, even though Peru has some important initiatives for the *Social Appropriation of Science and Technology*, it has not yet established as an integrated national system that is part of the Peruvian scientific culture. It is even unfamiliar for the Peruvian University, from which the *Social Appropriation of Science* should emerge. The gradual institutionalisation of the *Social Appropriation of Science* in Peru is a sustained way to promote science, technology and innovation, and with them the country's development.



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The Peruvian population in general should not be alien to the great achievements of scientific research and scientific elites, but, on the contrary, should interpret and admire them, participating more actively in promoting science and scientific research, and thus contribute to the sustained construction of the scientific culture of Peru. This has to be achieved through the process of systematising the *Social Appropriation of Science and Technology*. Today the development of any country in the planet runs at the pace of science and technology, as is shown by countries in Europe, Asia, North America, Brazil, Mexico, Chile. While Israel invests 4.5% of GDP in Research and Development; Finland, 3.8%; Japan, 3.0%; Korea, 2.7%; United States, 2.54%; Brazil, 1.04%; Chile, 0.57% and Mexico, 0.39%, Peru invests less than 0.11%. This testifies how science and technology are not priorities for state policy and, therefore, a national scientific culture is still incipient.

On the other hand, science and technology does not appear from scratch, but as a consequence of scientific research. In a country like Peru, which downplays science, scientific research is still incipient and prevents the production of science, technology and innovation in terms of the performance and quality that is demanded today. In this context, the universities again acquire importance because, by their nature, they are essentially centres for research and dissemination of science. But in Peru, the universities generally are highly oriented to the professions and the matters of scientific research are not a priority.

In Peru there are efforts and initiatives on the *Social Appropriation of Science and Technology*, however, these are not yet well connected at national level and remain outside the University. We can mention the Programme for the Popularization of Science, of CONCYTEC (National Council for Science and Technology, Peru), led by its Office of Updating and Strengthening of Science that "articulates the work of various institutions (ministries, universities, research institutes, media, NGOs, businesses, arts and cultural centres) that are related with the gen-

eration and promotion of knowledge". We can also find School Science and Technology Fair Programmes, museums, and, though still in insignificant scales, scientific journalism. There is, the Network of Journalists and Science communicators in Peru. But still, there is not an institutionalised national system of Social Appropriation of Science and Technology.

Making science and technology priorities of the national policy of Peru is a necessary condition to promote a sustainable development in the country. We need scientific research, a national system of *Social Appropriation of Science* and that the universities assume their leading roles as producers and disseminators of science.



104. **Opinions of Brazilian students about science and technology, environmental issues and evolution: results of a national study**

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Introduction

This paper presents the results of the international project The Relevance of Science Education (ROSE)¹ on a national scale in Brazil. The project seeks to find young people's interest in science, technology, environmental problems, science classes and biological evolution. About 40 countries participated in ROSE. The ROSE material may illuminate a range of important discussions in the science education community, for example issues such as curricular content versus student's interests, students' disenchantment with their science classes and others (SJØBERG and SCHREINER, 2005; SCHREINER and SJØBERG, 2004). The national data was obtained from 84 schools and 2,365 students from all Brazilian states. Some data of this study are presented here.



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Methodology

The survey took advantage of statistical sampling following PISA-OECD database in Brazil. A sub-sample was designed, selecting randomly a reduced number of schools, which kept a nationwide significance. The ROSE questionnaire consists of statements in which students are asked to report what their interests are, using a four-point Likert scale. Responses range from strongly disagree to strongly agree, with no neutral option. The questionnaire was printed with optical laser personalisation of the answering fields, allowing digital capture of the answers. This allows low level (if any) of misleading data (633,820 items answered).

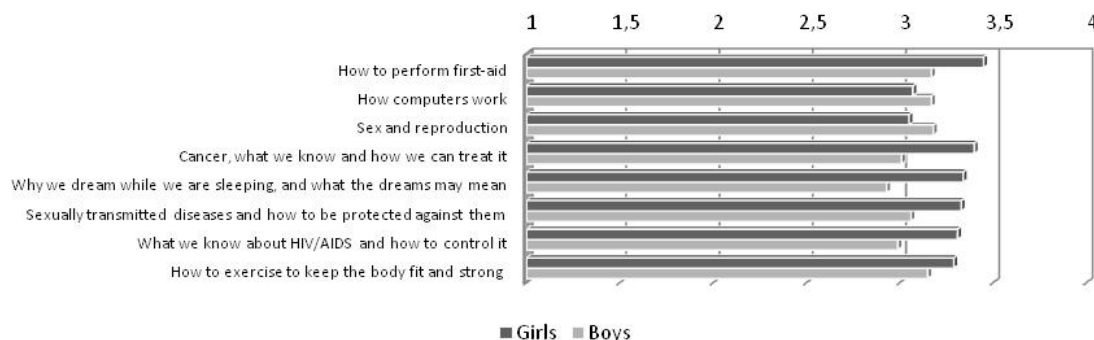
Results

Received questionnaires were 2,365 from 84 schools located in all Brazilian states, and among the respondents, 56.6% were girls and 41.5% were boys. Participants were from 1st year classes of high school, with expected ages of 14-15 years. Young people aged between 13 and 25 years old took part in the survey and the average age was 15.39 years (1.10 SD). Some results of this research can be observed in graphs below.

The science themes which most interest young Brazilians were those related to health: how to perform first-aid, cancer (what we know and how we can treat it), how to keep your body in good physical condition, sexually transmitted diseases and HIV/AIDS.

¹ The ROSE website is <<http://www.roseproject.no/>>.

Items with higher means



Graph 1: Items with higher means between girls and boys.

Among girls, health issues prevailed as the most interesting subject, followed by the meaning of dreams. Brazilian boys were interested in sex and reproduction, how computers work and first-aid procedures.

In relation to the matters of interest, health related issues, fitness and beauty, followed by issues related to environmental protection are the ones that interested most the young Brazilians. Chemistry is the least mentioned subject by Brazilians, both girls and boys. Boys also have great interest in technology and physics, and girls by themes of mystery and unexplained phenomena.



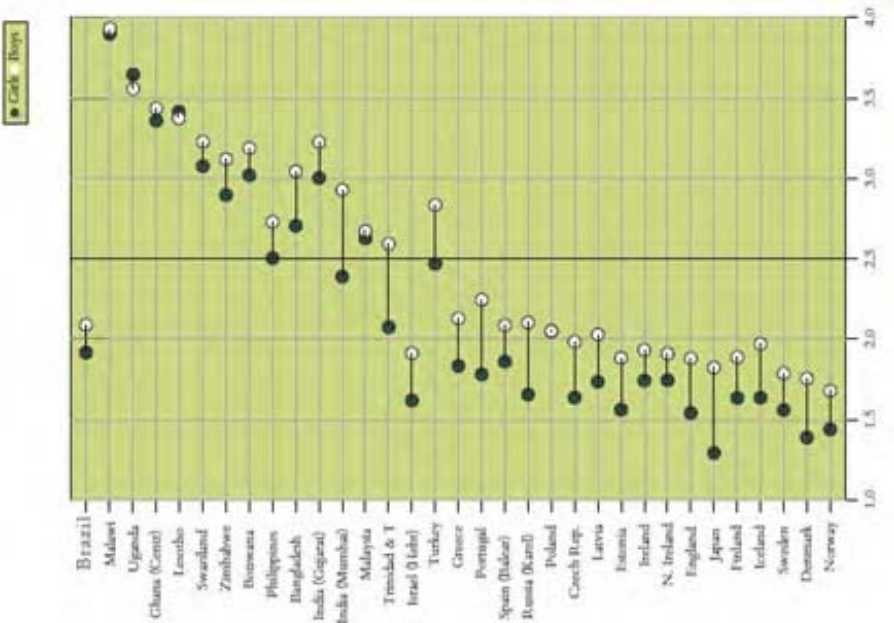
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In relation to future employment, in line with young people from other countries, Brazilians attach great value to issues related to personal satisfaction and pleasure, rather than to manual labour. Working with something meaningful and important and developing their skills are considered by Brazilians very relevant when choosing future employment.

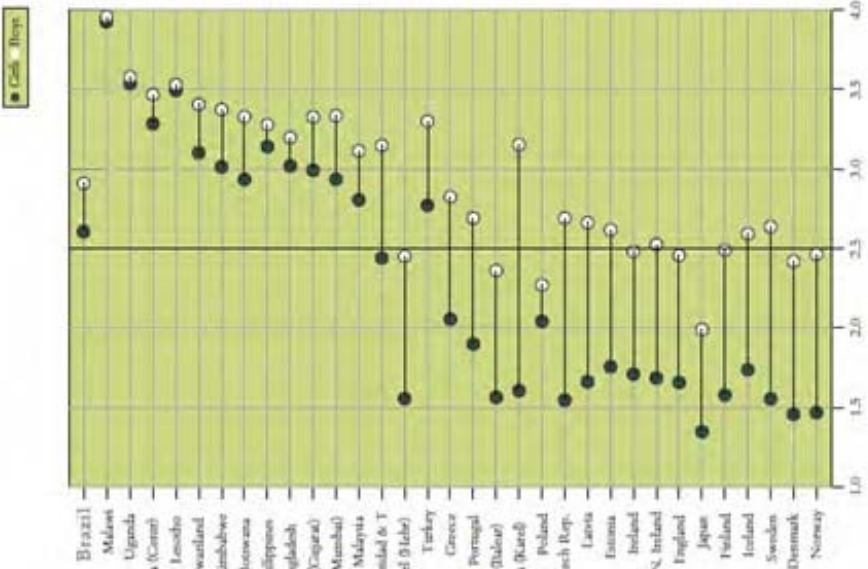
Young Brazilians have an optimistic view about the future, with regard to environmental issues and are motivated to act in a positive way. They also have a feeling that they can influence the environmental issues and that society in general way should be more concerned about them. Girls are more optimistic about the future than boys, and believe that solutions can be found to environmental problems. Regarding the motivation for action, girls are also more willing to sacrifice consumption goods than boys (Graph 2).

International studies indicate in relation to school science that, although male and female students have different perceptions about scientific issues, in general they display a similar lack of interest in the discipline of science. Brazilians do not fit this profile: both boys and girls consider the discipline of science interesting (Graph 3).

Given the statement "I would like to be a scientist", young people in developed countries are less interested in the career than those in developing ones. Young Brazilians lined up more with young people in developed countries, being close to young Greeks and Portuguese. Regarding the statement "I would like to have a job that deals with advanced technology", Brazilians approach young people in developing countries, since they showed more interest than the young people in developed countries (Graphs 4 and 5).



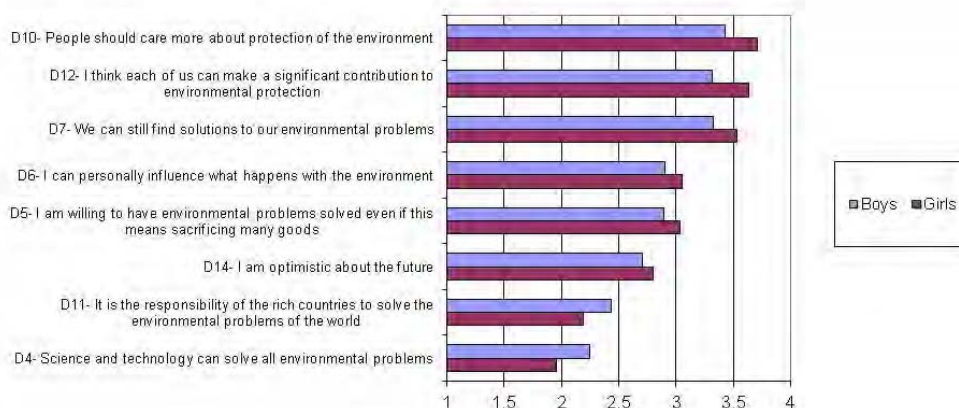
Graph 4: Opinions about the questions “You would like to become a scientist?”



Graph 5: Opinions about the question “You would like to get a job in technology?”



Concerns about the Environment



Graph 2: Girls and boys' concerns about the environment



Graph 3: Opinions about the question "Is school science interesting?"

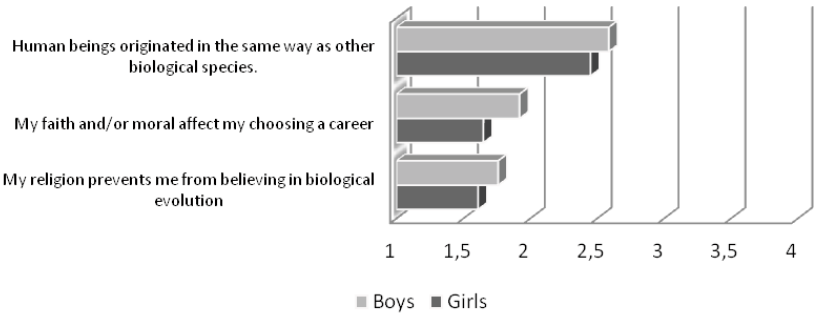


The majority of students rejected the idea that their religion prevents them from believing in biological evolution; however, their religious beliefs prevent them from pursuing a career related to science (Graphs 6 and 7).

Conclusions

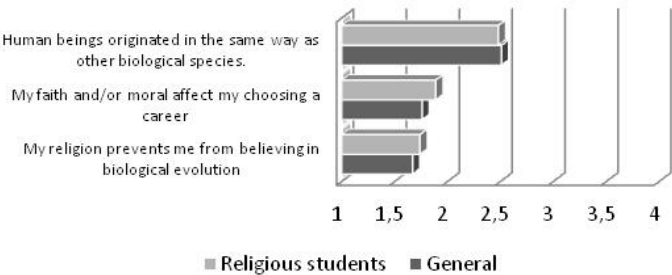
The science themes that mostly interest young Brazilians are those related to health. Regarding future employment, young Brazilians, in line with young people from other countries, attach greater value to issues related to personal satisfaction and pleasure, rather than to manual labour. Young Brazilians have an optimistic view about the future with regard to environmental issues and are motivated to act in a positive way. International studies indicate in relation to school science that, although male and female students have different perceptions about scientific issues, in general they show low interest in school science. Brazilians do not fit in this profile, as both boys and girls consider school science interesting, although they do not consider it easy.

The opinions about biological evolution



Graph 6: Opinions about biological evolution (boys and girls)

The opinions about biological evolution



Graph 7: Opinions about biological evolution (religious students and general)

Given the statement “I would like to be a scientist” young people in developed countries are less interested in the career than those of developing countries. Young Brazilians lined up mostly with the young people in developed countries, being closer to young Greeks and Portuguese. On the other hand, as regards the statement “I would like to have a job that deals with advanced technology”, Brazilians are close to young people in developing countries. Regarding biological evolution, the majority of students reject the idea that their religion prevents them from believing in biological evolution and their religious beliefs do not play a major role for the choice of a future career related to science.

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105. **Design and Evaluation of Intensive Workshop for Making Science Shows**

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The authors work at CoSTEP (Communication in Science and Technology Education and Research Program), Hokkaido University, which is the educational organisation that nurtures science communicators. CoSTEP provides three different yearly learning courses, which are Comprehensive, Selective A, and Selective B. The two “Selective courses” are composed of 27 e-learning lectures and intensive workshops. Selective Course A weighs on designing face-to-face communication experience. Selective Course B weighs on scientific writing.

In this paper, we focus on the workshop of Selective Course A, which was a three-day intensive workshop where participants made science show programmes, held from 26th to 28th of August 2011. There were 20 participants, which were divided into four groups who produced four science show programmes of 20 minutes each.

The authors designed the workshop based on the concept of the “Cycle between Expression, Sharing and Reflection”. Short lectures about general guidance, planning, programme design, writing a press release, designing a flyer, making a manual, and facilitation were given (each of which was in approximately 20 minutes or less). We also made participants do mutual interviews to train in facilitation skills and to promote interaction among them. The other time was used for group works where participants discussed the plan of the programme, prepared and rehearsed for it.

Titles of the science shows are as follows:

1. The Wonderful Feature of Zosteraceae, the Cradle in the Sea
2. Use of Salmon Soft Roe for Cleaning Environment
3. Girls, Be Ambitious! Welcome to the World of Science and Technology
4. Problems and Future of Hokkaido

We introduced several tools to realise the “Cycle between Expression, Sharing and Reflection”

1) Each participant was made decide his/her own learning goal at the beginning. The questions were as follows:

1. What do you especially want to learn in this workshop? Write down your learning goal.
2. How do you think and behave in the workshop to achieve the goal?



3. What kind of role do you try to take during group works?
4. Which part of planning, group works, event preparation, and event operation do you dislike or feel difficult to deal with?
5. Which part of planning, group works, event preparation, and event operation do you like or feel easy to deal with?
6. What do you find or think about, reflecting your study at CoSTEP up to now?
7. What do you especially want to study at CoSTEP from now on?
8. Your promotion comments, etc.

2) Exhibit all intermediate outputs (for example, learning goal worksheets or notes of mutual interviews)

3) Participants reflected on their own activities at the end of each day, wrote down their findings, achievements, and anything to be improved on papers, and they exhibited the papers on the wall to share with each other.

4) Real-time documentation: Our staff took photos of participants' various activities during the workshop and put it on the wall on a timeline with short comments.

5) They evaluated their achievements by themselves at the end of the workshop. The questions were as follows:

1. If you changed your learning goal, describe it.
2. How well have you achieved your learning goal? Evaluate by yourself.
3. What did you realise through the workshop?
4. What is the next learning goal you want to have after reflecting the workshop?

We used online tools for participants to share their learning goals and presentation files for their self introduction, let them put comments on others' presentation, and let them share various outcomes of the workshop.

After the workshop finished, participants answered the questionnaire to evaluate the whole workshop, and necessity and satisfaction level of each of the learning elements. Results were as follows (n=15):

- 1) general satisfaction: satisfied = 80% / relatively satisfied = 20%
- 2) length of the workshop: appropriate = 80% / relatively too short = 20%
- 3) management of the workshop: good = 67% / relatively good = 33%
- 4) learning goal work sheet:
 - good = 47%
 - Writing the goal made me realise it clearer and tackle it more consciously (2 persons)
 - It was useful to reconfirm my purpose and to evaluate my achievement by myself



- relatively good = 33%
 - It was useful because I'm not good at setting my goals
 - It enabled me to realise my goal during the workshop and achievement after it had ended
 - relatively bad = 20%
 - I don't understand what to write
 - I wish I carried the work sheet during the workshop in order to be more conscious about it
- 5) Real-time documentation: good = 73% / relatively good = 27%
- 6) Pre-workshop tasks: good = 93% / relatively good = 7%
- 7) Use of internet during pre and post workshop period: good = 54% / relatively good = 33% / relatively bad = 13%
- 8) daily reflection
- good = 60%
 - It helped me reflect each day (3 persons)
 - I was able to share other members' opinions (5 persons)
 - It encouraged me before I start working
 - relatively good = 33%
 - relatively bad = 7%
 - I couldn't make use of it enough



The results were good in general. However, the programme seemed to have been slightly too intensive for participants to thoroughly experience the "Cycle".

106. **The Journey of Joe the Photon: A Blues Tale**

Sandro Bardelli, Francesco Poppi, INAF Osservatorio Astronomico di Bologna, Italy

Band: Gabriele Coccozza¹, Matteo Correnti², Cristiano de Boni³, Paolo Donati¹, Carlo Giocoli³, Loredana Lovisi³, Federico Marulli³, Fernanda Petracca³, Antonio Sollima¹, Laura Schreiber¹, Margherita Talia¹, Stefania Varano⁴

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Hi,

I'm Joe...

And I'm a photon.

I'm Joe the photon.

I was born in that turbulent madhouse

called BIG BANG....now, I will tell you my story, which started from far away

and in a very remote time.



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Introduction

The show is the dramatisation of the journey of a photon from the Big Bang to the Earth. His voice describes what he encounters during his path along the history of the Universe through the various epochs. The tale is mixed with famous blues songs performed by a band of 14 members, all PhD students or post-docs in astronomy. The songs have been chosen on the basis of connection with the text in terms of argument and rhythm and are intended to rouse the attention of public and to give a break to the narration. Moreover, during the show we projected silent movies with short explanations of the things that Joe is saying. Two short clips from movies (*Annie Hall* by Woody Allen and from the *Simpsons* series) are also part of the show.

Three novels from Cosmicomics of Italo Calvino are read because these are an additional source of dramatised explanations of the various concepts.

For students of a school (secondary level, i.e. college) the ideal thing to do is to have a pre-show or a post-show lecture on the presented concepts to be discussed with experts (possibly the astronomers of the band).

The plot

The show starts with the song Hey Joe to introduce Joe the Photon. On the screen: photons

The Pre-Big Bang epoch

Joe is plunged in the quantistic chaos.

Song: dissonance. Screen: television white noise

Novel: All at One Point

The first three minutes

Particles and photons are strongly interacting each others. Particles and atoms are formed. It is a very “rhythmic” epoch.

Song: Everybody Needs Somebody to Love. Screen: lot of particles and photons colliding.

The dark age



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Music stops suddenly. Joe sees the Cosmic Microwave Background (CMB) in the dark. The rhythm should be slow and repetitive. Song: Somewhere over the Rainbow Screen: Wmap satellite image of the CMB.

Then the dark age begins. It is an age dominated by dark matter. The photons are no more interacting with the matter and are on a straight path.

Song: On the Road Again Screen: Dark Matter maps

The first stars and galaxies

This epoch starts with the novel “At the Day break”.

The rhythm accelerates. Song: Hit the Road Jack Screen: formations of star.

The expansion of the Universe

Joe notes that the Universe expanded a lot.

Screen: first a movie with the cosmic expansion, then *Annie Hall*.

Joe arrives at the Milky Way and at Earth

Song: Sweet Home Chicago. Screen: journey in our Galaxy and around the Earth

Fate of Joe

There are two versions depending on the requested duration of the show.

In the first one, Joe ends his life in one telescope. In the second version, Joe is reflected back by a mirror and realises that he will run for all his life until an atom or molecule will absorb him.

Song: Johnny B. Goode Screen: a running man.

Finale

The finale explains the future of the Universe with the novel *The Light Years*. Then the short clip from *The Simpsons* is presented, ending with the sentence, “Well we hit a little snag when the universe sort of collapsed on itself. But Dad seemed cautiously optimistic”. Just after Homer’s scream, the song ‘I Shot the Sheriff’ starts. On the screen, pictures of famous astronomers of the past and of the members of the band are shown.

Conclusions

The show is tough to offer to a young public, being at the same time a concert, a theatre play and a science outreach lecture. The initiative seems to be successful, in terms of people attending and satisfaction. The main problems are related to the cost of moving 14 band members, instrument rental and royalties. For this reason, the best places for this show are within events or science festivals. We choose to play famous songs rather to write our own royalty-free music, because we are not musicians and composers, and we realised the risk of performing music not adapted to the musical taste of young people.

“The only thing I know, is that I was damned to run, for all my life...to run at the speed of light, because, after all, light is me.”



107. **Reflecting on science made public: a pentagonal dialogue**

Baudouin Jurdant, Joëlle Le Marec, Yves Jeanneret and Brian Trench

with Ana Godinho and Steve Miller on the stage

Characters and cast

Mr Fox, researcher in Science, Technology, Society (Baudouin Jurdant)

Miss Frog, lecturer in Science communication (Ana Godinho)

Dr Wolf, astrophysicist (Steve Miller)

Mrs Bee, biologist and philosopher of science communication (Joëlle Le Marec)

Prof Owl, professor of Literature (Yves Jeanneret)



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We are in New Delhi and we have just listened to a presentation about the need to disseminate science and technology more widely in order encourage people to make more rational life decisions. Enter two people discussing the presentation while a scientist stands there, overhearing the conversation.

SCENE I

Mr FOX

I really wonder what all this science will bring to people. All the more so since we don't know anything about the people to whom we want to bring the enlightenment of scientific reason. Indeed, we could well imagine better communication about GMOs addressed mainly to Rajasthan or Scottish peasants just using good popularisation techniques through local media. But even with this, I'm still sceptical about the real benefits of such information.

Miss FROG

At least, it cannot do any harm!

Mr FOX

I am not so sure about that. In spreading this kind of information, we are unsettling traditional knowledge without actually replacing it with anything. Scientific knowledge is completely decontextualised. It floats in some kind of cultural no-man's land and obstructs local empowerment.

Miss FROG

Precisely! The fact that it is decontextualised gives it an advantage over local knowledge which is very much bound to particular and concrete situations. Decontextualisation is a trump card, a kind of guarantee that the information can be communicated accurately.

Mr FOX

But we cannot understand any information, whether scientific or something else, without taking account of the context in which it is received. This is common sense.

Miss FROG

Well then, that means you don't understand anything about scientific rationality. Rationality is precisely the means for anyone, anywhere, to integrate scientific information into a given situation. The possibility of being rational is always a better standard than cultural contexts. We are rational beings. It is in this that the promise of universal scientific knowledge lies.



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Mr FOX

Even if that destroys local traditions and cultures?

Miss FROG

And you go straight for these high-faluting words! You know as I do that these traditions are full of ridiculous superstitions. We have to get rid of them if we want every human being embody full humanity through the rationality he can bear witness to.

Mr FOX

Do you know that I am myself quite superstitious?

Miss FROG (*surprised, sceptical*)

You?

Mr FOX

Yes, me! I can't actually walk under a ladder and the sight of a black cat, at dusk, crossing my path from left to right, makes me quite anxious. Moreover, I love reading my monthly horoscope in various magazines...

Miss FROG

...and I presume you expect great catastrophes every Friday 13th.

Mr FOX

Not at all. For me it's a lucky day! I try to make the most of it with the Euromillions lottery.

Miss FROG

Ha! That just shows how meaningless it all is: for some, Friday the 13th is a bad day, for others it is a lucky day! It is completely inconsistent.

Mr FOX

But that's precisely what I appreciate in superstitions: they represent what I would call 'light-weight beliefs'. Of course, they are irrational but if human beings cannot dispense with irrationality, they may as well invest it in this kind of belief. Superstitions never led to any crusades, they don't harm anybody and I cannot imagine people fighting for them. If human beings cannot get over believing things, isn't it better that their belief are attached to little things, these little oddities which surprise us and add some spice to the monotony of our everyday lives.



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SCENE II

Dr WOLF (*interrupting*)

What on earth are you saying? This is ridiculous! Superstitions are terribly harmful. Don't you know that they are shamefully exploited by real crooks and cranks who take advantage of people's gullibility. You are defending this swindle which exploits these 'lightweight beliefs' as you call them, to make big profits. This is shameful! I wonder what you're doing at this conference!

Mr FOX

And who are you to attack me so vigorously?

Dr WOLF

Washington WOLF, astrophysicist. But you cannot be serious in your defence of superstition. Think about the racket it represents for thousands, even millions of gullible people!

Mr FOX

OK! Let's talk about this gullibility! Isn't this also the proper business of those popularisers of all sorts who deliver bits and pieces of science in the science pages of newspapers and all sorts of other media. Do you think that you could carry on your very expensive research if you weren't taking advantage of the very same gullibility? The truth is that you'd rather monopolise it for your own benefit. The crooks and cranks that you denounce are just your rivals. Isn't this the real reason you want to get rid of superstition?

Dr WOLF

My dear fellow, you are overlooking something essential: by contrast with our rivals who tell all kinds of rubbish, science popularisers, including myself — I happen to be quite successful with my science programmes on Channel 4 — we tell true stories, we tell the truth...

Mr FOX

... ooooh, yes! Till the moment your theories are falsified ! Theories come and go and very often they differ quite sharply! But that is not the question: whether true or not, aren't your theories appealing to the same kind of gullibility as the one on which your 'crooks and cranks' rely for their business?

Dr WOLF

Not at all, since our stories are true! Hence they're not beliefs any more. They become knowledge, knowledge which has been tested, legitimated, validated by our colleagues. That makes a big difference, don't you think?

Mr FOX

From your point of view, it may make a difference. But have you ever tried to put yourself in the position of a worker who chances on your night-time TV programme after a day in the factory? At best your black holes will trigger some dreams or fantasies in him but it is very likely that he will switch quickly to a football match on another channel. And another thing, look at what is happening in the United States: the candidates in the Republican primaries are openly attacking your 'scientific truths' on global warming, for example. As they are usually presented, scientific statements appeal to the same gullibility or incredulity as superstitions. Scientific statements cannot be true by themselves and in themselves. They only become true in so far as they can be assessed and validated by means that science popularisers make available ... but, as you know, popularisers don't normally make these means available to the general public.

Dr WOLF

If I understand you well, for you, a belief whose content is true has the same value as a belief whose content is clearly mistaken...



Mr FOX

They are both beliefs! The fact that the content of some of them enjoys some kind of scientific legitimacy does not change anything of their status as beliefs. I would even go as far as to say that such a belief might be more dangerous than others. It leads straight to scientism, that is, to an ideology of science as all-knowing, which is no less irrational than any other ideology. It might even be more dangerous to the extent that it is an ideology that is singularly lacking in self-awareness, and certainly in irony.

Dr WOLF

What do you mean? Do you think that religious ideologies are better on this point? What about the fanaticism that seems to affect all religions?

Mr FOX

Good point! But you should note that it is religions based on books that particularly show fanatical tendencies. The traditional oral cultures are much less prone to these faults because they are permeated by some kind of irony, just like superstitions are, at least the way I see them.



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SCENE III

(Enter Mrs Bee)

Mrs BEE

Ha, there you are! I've found you at last! So tell me, what do you think of this last session? *(Silence. More quietly)* Sorry! Have I said the wrong thing? You look like you were having a serious talk! Did I interrupt anything ?

Dr WOLF

This gentleman here whose name I don't even know...

Mr FOX

Fox... ! Caterpillar Fox! *(presenting his white leg)* Here is my white leg!

Dr WOLF

...so, this Caterpillar Fox is asserting some kind of equivalence between popularised science and superstition !

Miss FROG

He is just taking up some of the iconoclastic positions of Paul Feyerabend, physicist and philosopher, unduly despised by academics because of his relativism. He promoted what he called epistemological anarchism.

Mr FOX

He went much further than me on this issue. For him, it is science itself that ought to be accused of irrationality, especially in the way scientists make their choices in the supermarket of theories. But what he criticized most vehemently, and correctly in my view, was the relationship between science and political power. This alliance has given science hegemony over all other kinds of knowledge. In his eyes, that was an abuse. Just as the domination of the church was an abuse in Galileo's time.

Miss FROG

It is precisely this questioning of the power of science and of reason that makes his epistemological anarchism politically relevant. Recent events illustrate this. The acceptance of scientific statements is problematic because it appeals to a gullibility which is fragile and fearful. Experts appear to us as the strongest and that is why we decide to believe them. This is particularly true in medicine and health. Someone who is ill is weak and that makes them capable of swallowing anything. I've just read on an American website the headline, 'Some Asthma Drugs Kill More People than Asthma: Why Is Big Pharma Allowed to Hawk Deadly Pills?' This is exactly the same case as the one we just had in France with the Mediator. You know, this medicine produced by the Laboratoire Servier which has been responsible for more than a thousand deaths in France.



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Dr WOLF

If you're denouncing conflicts of interests I have to agree with you. But the law should take care of such issues. I don't think this has any influence on the public communication of science when this communication is done in good faith.

Mrs BEE

On the contrary, we are at the heart of the problem here and I am afraid good faith is not enough: the abusive alliance of science and power is always present in the communication process we are dealing with in this conference.

Dr WOLF

Excuse me? What do you mean, exactly?

Mrs BEE

Before this alliance and when science had to fight for recognition, it had to pay attention to

the discourses opposed to it. The first scientists had to refine their arguments without being able to rely on a position of strength. The hegemony they now enjoy does not help to speak on equal terms with people. The authority experts enjoy is an obstacle rather than an advantage in their communication with the public. The entanglement of knowledge with power is not good: knowledge can be transmitted quite efficiently but the power that is associated with it cannot be transmitted.

Miss FROG

Actually, power is not the only obstacle to good transmission of scientific knowledge. There is another more subtle obstacle which plays an important role. In science, as in any other field, it is not possible to say everything. Within a given specialism scientists can understand each other very well because they share the same references, they draw on the same know-how which determines their hypotheses as well as their conclusions. The scientific knowledge that is disseminated through newspapers and popular magazines and on TV represents only a very reduced version of that shared specialist knowledge. It represents the tip of an iceberg, most of which remains underwater and invisible. This is what Michael Polanyi, and more recently, Harry Collins identified as tacit knowledge. On the basis of this tacit knowledge scientists weave the relationships and understandings that make their communication with each other so efficient and easy, in spite of their numerous disputes.



Mr FOX

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This tacit knowledge creates bonds between the members of a given community. It can only be learned little by little through the long initiation that universities organise for students who want to go into scientific careers. This knowledge, which is so important for a genuine understanding of science, is no more transmissible to the general public than the power we were talking about earlier. It is knowledge resulting from a very complex socialisation process which is hardly accessible by ordinary people.

Mrs BEE

...we could possibly talk about a real acculturation, couldn't we? Snow would be right when he claimed that science represents a genuine culture in the anthropological sense of the term! For Yves Jeanneret, popularization is a kind of cultural production also.

Miss FROG

This is a different kettle of fish from what we're hearing in France when people talk about "scientific and technological culture", "*culture scientifique et technique*". This expression is most of the time used to deplore the absence of a sufficient scientific knowledge with lay people, which is meant to explain why they cannot be entrusted with the possibility of participating in discussions on the main scientific and technological issues of society. This is how governments end up justifying their dependence on the experts who advise them each time they have to take the smallest decision. "**Culture scientifique et technique**" becomes a legitimate excuse for not taking political responsibility

Dr WOLF

Excuse me! Could you repeat that, please? *(on the side)* It really is a shame to talk that way!
I did not understand a word of it!

SCENE IV

(Enter Professor Owl. He stops and listens with great attention.)

Miss FROG *(emphatically)*

THE LACK OF SCIENTIFIC AND TECHNICAL CULTURE IS THE EXCUSE OFFERED TO MAKE POLITICAL IRRESPONSIBILITY DEMOCRATICALLY PALATABLE !

Mr FOX

Exactly! You don't mince your words, dear Frog!

Dr WOLF

You've added something, there, which, unfortunately does not clear up the meaning of your slogan!

Miss FROG

Certainly! I've added the reference of all references which, frankly speaking, has become so fashionable that it does not mean much nowadays: D-e-m-o-c-r-a-c-y. It rings well! It is with this very word that many inequalities and injustices get justified, especially the inequalities in relation to knowledge. It is with this word that today's science popularisation can raise funds, get science museums built, inspire numerous projects, as long as they are oriented towards the general public. The poor public, a huge reservoir of anonymous ignorant people, manipulated by the big words of science!

Dr WOLF

I cannot stand it any more.

Prof. OWL

May I join you ?

Miss FROG

Why not? We are speaking of these ignorant people for whom popularisers write science sto-



ries in order to get them ready to accept the commitment to science's further development.

Mr FOX

People are not that ignorant! They know plenty of things. But for popularisation to function it has to imagine readers or TV-watchers who are ignorant. This assumption has to be made for the message to be pitched at the right level. Most of the time this is quite explicit. Editors of popular science magazines tell their young journalists: 'When you're writing, assume your reader knows nothing'.

Prof. OWL

Sorry, but do you think that such an assumption, as a basis for constructing messages, makes popularisation a literary genre ? Popular science is a very strange object, because on the one hand it is not exactly literature, and generally speaking it is not considered as science. Popularisation is neither scientific enough to be science and literary enough to be literature. Nevertheless, it is both an incarnation of science, or at least knowledge, and literature, isn't it ? That is the reason why it is so difficult to assess its success or failure.

Mr FOX



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I am not convinced that popularisation could be really considered as part of literature. The great popularisers of the 18th and 19th centuries showed undeniable literary quality. But it seems to me that the didactic dimension of their work condemned them to emphasize content over form. And is it not the inseparability of form and content that makes for success in literature?

Prof. OWL

Do you mean that literature and pedagogy are incompatible? This seems to me highly disputable!

Mr FOX

Who, except for the historians, still reads Flammarion or Raspail today?

Prof. OWL

I do! And I've been very charmed by their style as well as by the originality of the stories they were telling.

Mr FOX

OK! But you must admit that as far as the scientific content of their stories is concerned, today it is better to read Hubert Reeves or Stephen Jay Gould than Flammarion or Raspail!

Prof. OWL

You know, the question **“Is popularization part of literature?” is not a crucial one. Popularisation** is one of the ways knowledge can be textualised and communicated. The topics of the two cultures urges us to adopt an alternative reasoning. According to Snow, culture would be divided in two continents, on one hand literature and culture, on the other science and knowledge.

Mr FOX

But there is a difference between scientific knowledge and other kinds of knowledge! I do not agree with Snow when he advocates for a cultural equivalence between Shakespeare and the Second Law of thermodynamics. There is only one scientific way to know the Second Law whereas the reference to Shakespeare can trigger a great variety of discourses, all culturally legitimate. That's where science becomes some sort of cultural UFO. It cannot be viewed from different perspectives scattered along a cultural spectrum through which it would be loaded with various meanings, each potentially relevant in an open discussion.

Miss FROG

Scientific knowledge leads to an either/or qualification. Either it is scientific or it is not, in which case it does not make sense. Does such an alternative prevent popularization from getting a cognitive purpose?



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Prof. OWL

A purpose, I don't know. But a cultural impact, certainly, of course, as any human activity. The problem is that popularisation is constantly referred to as knowledge which is supposed to be transmitted from science to the public, to be translated from the scientist's jargon in the everyday language of lay people. Popularization doesn't do that. It elaborates a world in which scientific representations and activities, as well as technical and industrial developments do play a role, concurrently with philosophical, political and ethical issues. In their works, Flammarion and Figuiet don't speak only about physics and astronomy, but about urban life, wars, domestic activities, power, industry. And so do Hubert Reeves and Stephen Jay Gould...

Dr WOLF

Dear Prof. Owl, you are eluding the real problem. I agree with you about the way you demonstrate the poetic dimension of popularization. But the point is the way popularizers communicate about science and its results.

Prof. OWL

Dear Dr. Wolf, you are eluding the richness of communication about science. Popularization is the classical way to trap science communicators. Science communication is not so much the explanation of scientific knowledge than the discussion of social issues in which science is a

stakeholder. Many texts are written about health or environment, for instance. Health and environment are not objects of popularization of science. They are public problems which can be discussed by scientists as well as by other citizens. Scientists are not, in general, more conscious of the political and ethical nature of the problem of health. Some are, some are not. And it is the reason why science communication is both literature and knowledge, and it addresses both scientists and non scientists.

SCENE V

Mrs BEE

Your last remark makes me think that popular science has another function to fulfill which quite often is not clearly understood by those involved in producing or by those who are meant to consume it. I've found that idea in Jurdant's doctoral dissertation of 1973, chapter 7, which has just been published nearly forty years later. But it was already touched upon, in a different formulation, in some papers of Terry Shinn. This opens some new avenues of exploration.



Miss FROG

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I want to believe you on that since it seems that, for a long time, we have been going round in circles. We always hear the same old story: science is fantastic! No doubt about that! It gives us an incomparable knowledge of the world of things and a great control on them. Absolutely! So, let's try to give to most people as possible the benefits of it all. Moreover, it is almost free of charge. The simple transmission of scientific knowledge to others doesn't mean you lose any of it. It's a classic case of win-win! Isn't it wonderful?

Prof. OWL

May I object to this argument? The scientist who is giving away his knowledge to people loses the monopoly he enjoyed on it. It is his very status as an expert that is at stake here. And it is not only his own authority as an expert that is at risk, but also his wallet. You must know that the rarer the expertise, the higher its price. But this danger only arises if the expert's knowledge really is transmitted ...

Miss FROG

...which is far from being the case. European surveys, like the Eurobarometer, are quite relevant here.

Mrs BEE

The problem is that when they consider the failures of public dissemination of science and technology, communication specialists think about the availability of the public to receive the information. It is a *faux problème* as the French would say. We have first to recognise that the public is, indeed, available. The general public — one should say “the publics” — still show a lot of respect and a great curiosity for science. They also show real trust in the information that is provided to them as « scientific ». One would almost wish that this trust would be more critical in order to help open real democratic debates about science.

Miss FROG

Communication specialists also blame the imperfections of the messages themselves. Popularisers do not have a very good reputation among scientists.

Dr WOLF

You have to admit that they put out rubbish most of the time despite having reliable information made available to them from serious scientists. Those journalists are hopeless. Recently, a journalist asked me for an interview about dark matter. OK! Perfect! I do my best to explain to him how astrophysicists came to postulate the existence of this dark matter. And then the article is published in the newspaper under the breath-taking headline: “The black holes of dark matter”. In French that is « *Les trous **noirs** de la matière **noire*** »! What do you think of that?



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Miss FROG

The black holes of dark matter, only God can see them! I presume that you burst into laughter, didn't you?

Dr WOLF

Not at all! I was so angry! That journalist better not come back to me again looking for information. It is scandalous! (*turning to Mr Fox*) Hey, you, the great defender of the cranks, don't you find this scandalous? Hey? What have you got to say?

Mr FOX

Bof! It wasn't the journalist himself who wrote the headline. It was certainly somebody else in the newspaper who may have thought this play on words would be funny!

Dr WOLF

...you think this headline is funny?

Mr FOX

The headline is quite interesting! I must say that with such a headline I would probably have read the article if I'd opened the newspaper. And that is the function of a headline: to make people read what follows. You scientists are real quibblers! It is as if you wanted to keep the control of the information that you give away to journalists. You should learn to let it go. Let your knowledge live its own life in the media. As soon as it is out in the public space, your knowledge will be relayed, disputed, distorted, discussed or even corrected through random meetings and debates. That is the best that could happen to it. The only democratic benefits we can draw from science popularisation is something like this: to create discussions and debates to which everybody is invited, without regard to their level of education. Science should be talked about if we want it to survive in the public space.

Miss FROG

Sorry to interrupt you, signori, but you have interrupted Mrs Bee who had something to say on the secretive functions of "culture scientifique et technique". Mrs Bee ?

Mrs BEE



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Thank you, Miss Frog! Men always think they're the only ones who should have a say in these matters. Pure male chauvinism! Anyway, what I was going to say is that we have a tendency to look at the bugs of the communication process and to identify these bugs either in the form of the messages or in the basic ignorance of the general public. But we forget that, historically speaking, the drive for popularisation came from science itself. At the beginning, there was no social demand for scientific truths. So, the question we should be asking is this: what interest do scientists themselves have in the dissemination of their highly specialised knowledge? What benefits do they expect from this whole operation which, apparently, is not directed towards them but towards a public they consider to be ignorant? For them, the public is at the other end of a spectrum from where they are as providers of the most sophisticated form of knowledge.

Mr FOX and Dr WOLF (*together*)

...and so?

Mrs BEE

Scientific knowledge is by definition highly specialised and sophisticated. Researchers have their nose to the grindstone. The small problems they want to solve absorb the whole of their attention and their energy. The only trail they leave behind to help them back out of the maze of their investigations is the method which guides them without them knowing always where it will lead them. The situation is analogous to the writing of computer software: the whole of your attention is required at each step, which means you end up losing the meaning of the whole. All the more so since these steps do not have much sense in themselves. These

experimental biologists who open up rats' brains all day long in order to understand better the effect of this or that drug on the brain and the maturation of the neuronal axes do not have the time or the will to reflect seriously on what they are doing at each moment. They aim to get a result and publish it quickly knowing that if they don't publish they will perish.

Mr FOX

And, as everybody knows, the devil is in the detail.

Mrs BEE

Well said. It is the devil indeed, the nonsense, the absurdity that can only be seen after the event and within a wider vision. In other words, the researcher needs, at certain times, to take a step back in order to integrate all these micro-operations into something broader. And his closest colleagues cannot really help since they are also completely immersed in their own particular scientific worries. When we look at this we can speak about a reflexivity deficit in the functioning of science.

Prof. OWL

As Rabelais said: "Science without conscience is the ruin of the soul".

Miss FROG

A very appropriate quote! But what I always found fascinating in this formula is precisely that we can imagine science without conscience. It puzzles me a lot. Not only it is possible to imagine such a state of science but the history of science can give us terrible examples of this lack of conscience. I am not only thinking about Milgram's experiments on authority, but also at what certain medical doctors and professors did with mentally ill people and jews during the Second World War. At times science can be completely blind to meaning, ethics and social responsibility as if it could be outside social concerns and power.

Miss BEE

And this is where science popularisation could find its main and basic value. As Joëlle Le Marec has been saying, it works as a "reflexivity operator" **for scientists themselves**. Popularisation of science is what allows scientists to better understand what they are doing within the larger frame of society. That is how we could understand Michel Crozon's famous response to the question he had been asked: "Why do you popularise your science?" Michel Crozon was a great high-energy physicist and he was a good populariser of his own research. His answer is worth thinking about: "I do popularisation in order to understand better what I am doing as a scientist". This is an essential function that only popularisation can accomplish.

Dr WOLF

That is some sort of a revelation for me! What you are saying amounts to claiming that we, scientists, only practice popularization as a way to enlarge the dialogue between us. Science



popularization would provide us with various angles or perspectives which would enrich our self-reflexivity. You think that we are not in a position to do that within our own highly specialised communities, so that we use the public (we suppose to be ignorant) as a blank sheet for creating new perspectives on our own work and for viewing it differently from how we usually look at it !

Mr FOX

You've got the scientists' straightforward way of talking. We appreciate that, don't we?

(They all turn silently towards the public)



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Public communication of science and technology is critical in a world thoroughly interwoven with science and technology. The International Network on Public Communication of Science and Technology (PCST) is a network of individuals from around the world who are active in producing and studying PCST.

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- Science theatre directors;
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