Critical Perspectives on Making Science Public

Selected papers given at the Science in Public conference 2013 at the University of Nottingham

22-23 July 2013

PREFACE

I am pleased to present this collection of papers based upon presentations made at the 2013 *Science in Public* conference held at the University of Nottingham on 22-23 July.

It was lovely to see such a wide variety of presentations at the conference, covering a wide range of approaches to the conference theme. The papers collected here also reflect that diversity. You will find papers exploring fiction, science communication, responsible innovation, case studies and many more. You will also find a wide variety of theoretical and methodological approaches. Truly, this collection reflects science in public in all its forms.

All of the papers are short, intended to reflect the content of the conference presentations. This brevity has another advantage: it is easy to dip in and out of the collection, perhaps have a quick read on a subject outside your normal area. References are listed with each paper to help explore each topic further as desired.

Please note that these papers have not been subject to any kind of peer review. Every paper that was sent to me has been included as written. Note, too, that there is some variety in the appearance of the papers. This is caused by different versions of Word being used, and the use, by some, of software such as Endnote. I regret that my technical limitations prevented me from overcoming these variations.

On behalf of this year's organising committee I thank you all for coming to the conference, and thanks especially to the authors of these papers who took the time to write up their presentations. I hope that you enjoy reliving the conference in these papers and I look forward to seeing you all again next year.

Adam Spencer

The 2013 Conference Organising Committee was:

Beverley Gibbs
Eleanor Hadley-Kershaw
Brigitte Nerlich
Warren Pearce
Harinee Salvadurai
Adam Spencer
Judith Tsouvalis

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Do science centres really engage in dialogue with the public?

Hannah Owen (hannah_owen1@hotmail.co.uk) and Erik Stengler (Erik.Stengler@uwe.ac.uk, corresponding author)
Science Communication Unit, University of the West of England, Bristol, BS16 1QY, UK.

INTRODUCTION

The EU Commissioner for Research, Innovation and Science, Máire Geoghegan-Quinn, said in a statement in April 2012 regarding the Science in Dialogue Conference, that with an increasingly technological world the general public will have difficult choices to make in regards to how science and technology can help tackle our different societal changes. Through education she poses that, “the general public will be in a better position to understand and engage in debate on the most important science issues affecting society.” The statement also expresses how from surveys taken the public wants developments in technological research and innovation to be guided by the principles of trust, integrity and participation (Geoghegan-Quinn, 2012).

This investigation addressed the issue of dialogue between science and society in the context of science centres, to assess whether dialogue is present and whether it is being used in a way to achieve the aims set out through the steady development of public engagement (PE) dialogue strategies. The search was framed to assess whether a two-way flow of information is achieved between the ‘science community’ and members of the public. It sought to identify collaboration between the two areas whereby ideas are considered and shared, rather than a simple transmission of information. Despite fresh efforts to drive dialogue in science into the mainstream it is still something of a specialist activity (Sciencewise, 2012). The question this investigation posed to answer is whether science centres, known for their professionalism and sophistication in good science communication (Nepote, 2007) have sufficiently made the move in re-evaluating their role in public education and the representation of science (Pedretti, 2008).

We have used two science centres used as the focus for research: At-Bristol and Techniquest. Qualitative research methods were used in the search for dialogue. The primary mode of research was observation of the exhibits and the centre in its entirety. And secondary research was through close analysis of the brochures and website contents. The Public Engagement Triangle published by Science for All in 2010 (Science for All, 2010) was used in this research and gave a focus for the search for dialogue by acting as a reference of the level to which engagement was achieved. Three distinct levels of engagement were categorized, ‘Transmit’; simple transmission of information from the science community to the public, ‘Collaborate’; collaboration between the two parties through dialogue and ‘Receive’; information received by the science community from the public.

RESULTS

There is a substantial unequal balance between the styles of exhibits present within the defined science centres. 295 exhibits in At-Bristol and 116 in Techniquest expressed traditional phenomenon-based or interactive 'hands-on' displays. Those characterized as 'critical' that animate the debate of current controversial issues, inviting visitors to partake actively in a two-way flow of engagement are distinctly fewer, with just 9 across both centres. The vast majority of the 9 exhibits were aimed at adults (78%), suggesting that these 'critical' exhibits are not so suitable or easily catered towards children. This is in contrast to the exhibits in the rest of the centre, which are predominantly aimed at children. In fact, At Bristol is strongly marketed as great for a 'family day out' and uses slogans such as "play and get hands-on with science", "watch explosive science shows". Similarly in Techniquest's selection of brochures emphasis was resoundingly given to phenomenon-based experiences, with slogans used such as "What will wow you the most?". The focus on their website was again given to family oriented visits, with main events advertised being 'Toddler day' and 'Summer Term Programmes'. Ultimately no opportunities for 'dialogue' in terms of, a two-way aspect of listening and interaction between the science 'community' and visitor over current contentious science topics, were found in either websites or selection of brochures of each centre.

In terms of exhibits, a significant decreasing gradient from 'Information transmitted' to 'Evidence of collaboration' was found. All used the 'Transmit' tool; two exhibits allowed for visitor input, none gravitated towards 'Collaboration'. One of the two gave the opportunity to leave a comment and read other people's comments via a computer screen. And the other, through a comment board where a visitor can leave comments on a card to be answered by another visitor or staff member.

A measure of the accessibility of the science community through the exhibits was taken. It was found that there was no opportunity for a follow up discussion and no brochures were provided.

DISCUSSION

In the Government's 2004-2014 'Science and Innovation Investment Framework' (HM Treasury, 2004) aims were set out to move forward from public understanding of science (PUS) to facilitating PE. The aims were as follows: (a) government and scientists responding proactively to public priorities and concerns; (b) people having greater confidence in the benefits offered by science; (c) greater engagement with major issues facing society, such as climate change; and (d) careers in science becoming more attractive to both adults and children. Eight and a half years on, this investigation shows that each one of these aims were addressed through initiatives of both At-Bristol and Techniquest, however significantly greater emphasis was placed on achieving (b) and (d) than (a) and (c). The high proportion of exhibits aimed at children in both centres compared to those aimed at adults gives

little chance for (a) and (c) to be achieved and reinforces the focus given to achieving (d).

The distinct lack of engagement surrounding contentious topics can also be related to the heavy reliance both centres hold on using computer displays and other interactive mechanisms. This provides substantial limitations for 'two-way aspects of listening and interaction' (Nepote, 2007) in a 'flow' of discussion; instead the collaboration is static with little or no mobility of ideas between 'the public' and the science community.

In two exhibits visitors are able to have an input, as previously described in 'Results'. This method relies upon visitors returning within a small time scale to receive an answer to their raised question or comment. From survey results taken between 2008-2010 by the Scottish Government through a 'Science Centre Evaluation' the proportion of returning visitors within a given 12 months was 18%, steadily decreasing 'return visits' as time went on, with an average of 63.5% of visits being their first time. This delayed response used as an alternative to face-to-face instant discussion does not allow any realistic opportunity for 'collaboration'; it is not achievable in this context. Upon return, visitors may find their comments unanswered, or answered by another visitor potentially incorrectly, either way failing to achieve the aim of tackling the 'crisis of trust' between the 'science community' and 'the public'.

CONCLUSION

We conclude that science centres do not really engage in dialogue with the public. In reference to the Public Engagement Triangle (Science for All, 2010) the study has deduced that collaboration in sharing and mediating ideas between the two entities is never achieved in the format that At-Bristol and Techniquest offer. The 'receive' tool allowing for visitor input is exercised as a rarity whilst information is 'transmitted' to the visitors through the exhibits.

Through marketing themselves as a place for a 'family fun day out' At-Bristol and Techniquest provoke an expected experience on part of the visitor. In doing so they serve their purpose in achieving the Government aims to build people's confidence in the benefits made by science and encourage adults and children to take careers in science. They are not perceived as a setting to engage in dialogue and discussion over societal concerns in science, which is evidenced in their distinct lack in sufficiently responding proactively to public priorities and concerns or engaging with major issues facing society.

The move has not been made by Science Centres to renew their role in public education and the representation of science; instead reliance has been placed on the traditional method of simply 'transmitting' information. Resulting in a high proportion of traditional 'experimental and tutorial style' exhibits with respect to 'critical exhibitions'. The format and environment in which exhibitions are set simply does not lend itself to the 'dialogue' that such contentious topics require.

RECOMMENDATIONS

The duplicate role in which science centres are attempting but not achieving to balance alludes to the need for a re-evaluation:

Rather than combining a new contemporary aim of public engagement into a traditional format such as exhibitions, that do not meet the requirements, it is recommended to either:

- Provide a setting which hosts adult only events addressing contentious topics in contemporary science in an informal, informative and innovative context, enabling 'issues that matter' to be addressed in a collaborative manner (Dana Centre, 2012).

  Or

- Continue to inspire potential 'science professionals' and to promote confidence amongst the public to the advances in science, leaving 'dialogue' on contemporary science to a more suitable environment.

This conflicts with the current assumption by policy science and society frameworks that Science Centres, such as At-Bristol and Techniquest, through their current means are ideal candidates to engage in 'dialogue' with the public over contemporary science issues.

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Inclusive museums as contributors to social change

Anna Omedes* & Pere Viladot
*aomedes@bcn.cat, Museu de Ciències Naturals de Barcelona, Director.
Museu de Ciències Naturals de Barcdelona, Head of Activities.

The Natural History Museum of Barcelona first opened to the public in 1882 and currently encompasses three venues: the Botanical Garden, the Laboratory of Nature and the Museu Blau. The Museu Blau opened in 2011 with new facilities (workshop rooms, laboratories, conference hall, media library, etc.) and a 3,000 square metre reference exhibition. This exhibition, "Planet Life", makes the museum's 134-year-old collection compatible with state-of-the-art museology, and gives visitors the choice of different paths to understand each issue more deeply.

The Museu Blau has provided the means to redefine the Museum's mission, which is: to generate and share knowledge with the aim of creating a society that is better informed, more connected and more responsible towards nature. This is done by maintaining collections that are the tangible testament of the natural heritage of Catalonia, doing research on biological and geological diversity, and creating experiences that encourage *as many people as possible* to explore, learn, love, enjoy, enter dialogue and participate.

The priority #1 of the Strategic Plan 2013-2017 is "To become a Museum for all the public" through the strategic objective 1.2: "To be an *inclusive museum*, which works to serve everyone and contribute to *social change*". We understand an inclusive museum to be one that has equity targets so that no one is excluded from the enjoyment of its services and activities. Not only disabled or elderly, but anyone who for whatever reason, economic, social, cultural or physical, is prevented from going to the museum or may not receive its benefits.

One of the basic functions of the Museum is to exercise social responsibility, understood as the promotion of actions to go beyond the fulfilment of the objectives of the institution, investing more in human capital, in the surroundings, in disadvantaged social sectors, in relationships with their partners, etc.
Four lines of action are being gradually implemented:

- The Travelling Museum
- Activities for visitors with special requirements
- The Proximity Project
- The Born for Science Project

The Travelling Museum

The Travelling Museum is a project to facilitate taking the Museum to groups of people that for various reasons cannot visit it. Its objectives are very broad: to teach about the Museum; to promote scientific interest, curiosity and desire

to learn; to promote respect and interest in living beings; to teach some basic aspects of animals; to engage its users into a discovery process that promotes collective learning; to provide enjoyment while learning science.

In 2008, the Natural History Museum began a pilot project in collaboration with the Youth Penitentiary Centre to develop educational workshops. A year later, in 2009, a special trunk with drawers and cupboards was designed so that it could contain original pieces of the collections and a pedagogical guide and be used by groups of young offenders on a long term basis for their educational programs. In 2011 two new pedagogical trunks were built and constructions of animals were added to singularize, complement and enrich it, and broaden the offer.

Although the pedagogical guide proposes many activities, the Travelling Museum is an open project and an excellent tool to enhance communication skills of individuals through observation, dialogue, reading, interpretation, etc.

From 2011to now, 1,885 individuals from penitentiary and juvenile centres have been enjoying these materials with a very positive evaluation because that has allowed them to open the field of action to other topics.

In 2014, the Museum will take the Travelling Museum to people admitted to hospital with long-term illness. It will begin with children and youngsters to continue with adults. The aim is that the materials can be used not only as an educational tool to substitute compulsory schooling, but also as a therapeutic one to help healing processes and to relief the state of the patients.

Visitors with special requirements

Persons with disabilities visiting as individuals or in groups deserve special attention in order be able to use the Museum and receive its services. In the Blue Museum, measures to adapt its facilities to the needs of visually, hearing or intellectually impaired visitors have been implemented.

Guided tours of the permanent exhibition *Planet Life* led by specialist staff are offered to enhance the features that may be more appropriate for each disability, such as objects that can be touched or areas where sounds can be heard, etc.

Visually impaired visitors are offered an audio guide specially designed for them to visit the permanent exhibition. Other facilities are a router on the ground to access the information point, a map of the museum in relief and Braille and large characters brochures. The permanent exhibition *Planet Life*, offers 50 real pieces or replicas that can be touched accompanied with Braille text and relief diagrams.

For hearing impaired visitors, there is a magnetic ring both in the lobby and in the auditorium to allow the use of hearing aids. Sign language is offered under request for all conferences given at the Museum.

For visitors with intellectual disabilities, most activities are adapted and in many cases materials prepared from children's activities are used.

The next step will be to prepare several actions aimed at Alzheimer's patients and people suffering from mental illnesses.

The Proximity Project

When the Blue Museum opened in 2011 in the district of St. Martí, one of its aims has been to become not only a museum but also a facility for the district, its neighbours, associations, NGOs, schools, etc.

Some projects are collaborations with social organizations from the district to promote integration of newcomers, cooperation with NGOs working with people with high risk of marginalization, etc. As a result, the museum has become a meeting place for these groups and the place to show their works.

Some of the most successful projects have been carried out with schools from the district, participating in activities linked with some of the Museum's temporary exhibitions. During the academic year 2012-2013 three schools, 22 teachers and over 500 students from kindergarten to high school participated in this project. The students' works have been shown for four months in an exhibition in the lobby of the museum.

We are at present developing a new project with schools around curiosity and desire to explore their neighbourhood, inspired by what drove nineteenth century explorers around the world. Their works will be displayed as illustrated tales in another exhibition at the end of the present school year.

The Born for Science Project

Born for Science is a project to promote science in early childhood. A close contact with the world of science from an early age is an important tool for the development of children into adults involved in scientific decisions and their ethical, moral or economic results.

For children 0 to 6 years of age the Museum has opened the Science Nest. A multidisciplinary team of architects, teachers, educational researchers, educators and museum curators has designed this space to offer an innovative service specifically for these ages.

Children 0 to 6 years are often forgotten in museums, at the most they are offered simplified activities designed for older children. The proposals on which the Museum works in the Science Nest are based on accuracy, singularity, beauty, robustness, versatility, originality and openness. All proposals are based on the principle that every path of scientific research, begins with a good question that needs answering. Thus, in the Science Nest,

what matters is not the right answer, but the formulation of a good question that starts research.

During the academic year 2012-2013, a total of 3,138 students in 126 class groups visited the Science Nest and during 2012, a total of 9,402 children and adults participated in activities for families in it at weekends.

Is There Room For Museology Principles In The Design And Day-To-Day Running Of A Science Centre?

Erik Stengler (Erik.Stengler@uwe.ac.uk, corresponding author), Science Communication Unit, University of the West of England, Bristol, BS16 1QY, UK.
Guillermo Fernández (gfn@tinet.org), Plaça de la Mercè, 10-12. 08002 Barcelona, Spain.

INTRODUCTION

There is a growing feeling in the science centre community that science centres and science museums need to re-invent themselves. After a few decades of success and popularity that coincided with a period of economic bloom, which encouraged public and private investment in culture and specifically in new or renovated science centres and museums, the current economic climate is revealing that the sector has come of age and needs to look after itself and find its place in society.

Before we continue let us clarify that we will not differentiate between the *traditional* science museums, keepers of collections of objects and specimens and the science and technology discovery centres (in short: science centres) with their interactive phenomenon-based exhibits, because we firmly believe that both concepts are on a course towards convergence, as is advocated and predicted by the *Total Museology* of Jorge Wagensberg (Wagensberg 2006, p 33) and shown in practice by Anna Omedes in this panel with her presentation on the Natural Sciences Museum of Barcelona (Omedes, 2013).

Science Centres and museums need now to justify their existence, as it is their survival what is often at stake as a consequence financial struggle. Recent examples include Manchester's Museum of Science and Industry, who was 'saved' from being closed down through petitions and campaigns (Qureshi 2013) and Madrid's Cosmocaixa Science Centre, which is due to close by December 31, postponed from August 31. Even the renowned Exploratorium in San Francisco, just a few months after its opening in a brand new location has faced the consequences of financial trouble and is forced to cut back in staffing by a fifth (Chang 2013).

In order to attract visitors and revenue, science centres and museums have to look for what they can be unique for, and make them competitive visitor choices among a growing range of attractions and activities available.

We have had a closer look at four recently created or refurbished sites, in order to see what their managers have considered important to make them unique and attractive.

SPECIFIC EXAMPLES

The Museum of Mathematics (MOMATH) in New York has chosen to focus on a specific topic like Mathematics. This may seem a challenging choice, but

has science not been one too, when the whole science centre movement began? By choosing a differentiated topic MOMATH has ensured that its offer is not perceived by potential visitors as “yet another” science centre with basically the same content as any other one anywhere over the world. This perception is, in fact, a generalized one and a consequence of many science centre creators not going beyond visiting other centres for inspiration and ending up creating a “clone” science centre to so many others that also used the Exploratorium Cookbook (Bruman *et al.* 1991) as their main source for exhibits of a permanent exhibition.

It is precisely the concept of a ‘permanent’ exhibition which has been challenged by the Science Gallery in Dublin. They have chosen to base their exhibition offer entirely on short-term temporary exhibitions, even if this means to have gaps of up to three weeks between exhibitions. Another distinctive aspect on the Science Gallery is their choice to go beyond Science and focus on interdisciplinarity across science and art, and therein, going beyond the naïve approach of commissioning artists with representations of scientific content, but rather creating an environment where scientists and artists can work together to produce unique outputs that stem from interdisciplinary collaboration (Gorman 2013). Dialogue and creativity two aspects, that have been alluded to in other presentations in this panel (Davies and Stengler (2013) and Owen and Stengler (2013)) that may find in such an environment a particularly fertile ground to develop.

Science and Art are also at the core of the already mentioned Exploratorium of San Francisco, although with an emphasis of human perception as the nexus between the two and as the way to put the visitor at the centre. The Exploratorium is well known for its very popular and useful on-line presence. Their web and all the possibilities it offers from a very appropriate and useful *complement* to the visit, as opposed to the naïve and unfortunately too frequent use of ICT to put up a on-line *replica* of the exhibition, or even sadder, the conception that in order to tick the ICT box all that needs to be done is to offer workstations and/or wi-fi access in the centre’s café.

Also in the same region, the California Academy of Sciences has made a deliberate choice (and investment) to be visitor-centred, too. The figure of about 500 staff members devoted to interact with the public speaks for itself. So does the visitor feedback, in which between 65 and 75% of the visitors rate their experience at or above 9 (out of 10) for its educational value. And although they do have a permanent exhibition area, which includes various different thematic exhibitions simultaneously, every one of those has a very quick turnaround, so it is not really ‘permanent’ at all.
Distinctiveness, being visitor centred, providing added value to the visit, these are all features that overarch these four examples of new or renewed science centres in their efforts to become and remain competitive visitor choices. Gradually also other science centres and museums are searching for and incorporating such ideas. The Cité des Sciences & de l’Industrie in Paris prides itself to offer “What you can’t experience at home or at school” (Cité des Sciences & de l’Industrie 2010) in their children’s area “Cité des Enfants”.

The Center for Life in Newcastle has tried an exhibition without texts, *Curiosity* Zone in the most pure inquiry-based approach, in order to offer a genuine discovery experience (Center for Life, 2013).

Another significant, albeit unintended example is the case of Science Alive! in New Zealand. Following the total destruction of their building in an earthquake in 2011, its staff have managed to keep the science centre running in an award-winning effort to maintain the activities offered to schools and other venues (Stylianou 2013). This is undoubtedly a managerial feat that deserves to be recognised as such, but it can also be a starting point for a reflection along the lines of this presentation. If a science centre can carry on with business (almost) as usual without their own building – is our current approach correct regarding what makes a science centre or museum different from a company offering science shows and activities?

This leads to the main question we wish to address here, namely what is the core business of a science centre or museum? To answer this we may have to refer back to the origins of these institutions as a cabinet of curiosities. Even if the word museum has intentionally been dropped from many names since those beginnings, their core business remains the same, namely museology, a unique and distinctive way to communicate that speaks its own language, the museographic language.

CONCLUSIONS

Science centre creators and managers need to rely on experts that speak this language, in addition to experts in education, design, engineering, architecture etc. Science museology is probably yet to be fully developed, but the way to go in order to ensure that science centres and museums do not lose sight of their primary role in society is to stick to what makes them unique. They do not speak the language of books, movies, the internet or any other means of science communication but have an own specific and unique way which no other venue can offer (Wagensberg 2006, p. 27).

In order to learn from the experience of the past decades and turn it into useful museographic principles, the field of museology has a wide scope for research as part of the wider science communication field. At the same time it needs to be ensured that this research feeds back into the day-to-day practice of those working in the management and on the floor of science centres and museums. Bridging the gap between theory and practice is a recurring challenge for many fields, but perhaps more so for science education and science communication. Conferences like this are a unique opportunities to bring together researchers and practitioners, which we hope will carry on presenting themselves in the future.

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The introduction of Museums and Science Centers in social networks.

Cecilia C. B. Cavalcanti, Communication School of Federal University of Rio de Janeiro. Email: ceciliacbc@gmail.com.

Mônica Schieck, Institute of Biophysics Carlos Chagas Filho of Federal University of Rio de Janeiro

Renata M. B. Fontanetto, Communication School of Federal University of Rio de Janeiro

Abstract: This paper intends to analyze the link between the elements of interactive science museums - versatility, multidisciplinary, interactivity, varied language tailored to the target audience, with competence, creativity, update and innovation through the use of own resources from social networks like Facebook and Twitter.

Keywords: science museums, social networks, Facebook

Introduction

It´s possible to define scientific communication in general as the multiplicity of languages and representations of scientific knowledge found in communication spaces, whether in traditional media, magazines, literature, art, Internet or in science museums. Using as a theoretic reference, Bruno Latour (2012), to analyze how science is represented in these channels, it is necessary to make a correlation between science culture, history, literature, politics, economics, social and daily life cultures. The goal is to place the language of communication resources into the context of technical and scientific cultures.

In this "Information Age", where there is a consensus on the need for greater understanding of science in society, its characteristics, uses and possibilities, Science Centers and Museums are taking on a new social role, emerging as alternative spaces for dissemination of information and education in science and, with the support of new technologies of transmission and diffusion, becoming part of a network of information and knowledge able to reach not only a more diverse audience, but especially to make it a producer of knowledge.

Museums of science, by their origin and nature, have fulfilled a vital role in disseminating science directly in the real world, interacting with the public in a way that requires one’s physical presence. However, some museums of science and technology have been using social networking to publicize their activities and to share topics of scientific culture. The enormous potential to multiply these actions in the virtual environment are generated by the accelerated growth of features and ease of access to the worldwide web.

In this sense, we propose to discuss these mechanisms that allow increasing scientific knowledge of society and lead to a more active participation in scientific issues, either through partnerships between universities and science

centers or in the organization and distribution of information through social nets.

Internet as a communication strategy

The culture of scientific excellency combined with the academic world produced and framed the internet, placing in evidence the capacity of people to “transcend institutional targets, overcome bureaucratic barriers and subvert values established in the process of inaugurating a new world” (Castells, 2006, p.13). The appropriation of the capacity of interconnection through the social networks of all types have led to the formation of online communities that reinvented society and, in the process, “expanded spectacularly the interconnectivity of computers and its reach in the way it is used” (ibid, p.54). In other words, communication has invaded the set of human sciences and the political, social, cultural and economic practices.

It is still, possible to observe that the public life associated with it is found primarily in the Facebook and Twitter instruments capable of boosting social relationships, establish effective bonds with acquaintances or friends and create an individual community of personal interest that links itself to other individual communities. In other words, it becomes possible to link communities with other communities and individuals with other individuals.

Facebook is, then, an online platform of communication, a “social network” that allows communicate and share with people part of your life. About the Twitter, Santana says that its biggest advantage is the simplicity, “because it is based on short messages, transmission is very quick and objective.” (Santana, 2012)

Specifically on Facebook, there are options to like, share and comment. For each one of these options there is an intrinsic value that each person attributes to the information. While “like” demonstrates that the information is relevant to each one individually, “share” means that the person believes that the information is also valid to someone else. Furthermore, in regards to a Facebook page, the shares increase the visibility of the page, increased to a larger number of people.

Aware of the new communication structures, regulation, cooperation, languages and new intellectual techniques, changes in relation to time and space, the most important thing is the fact that cyberspace form and content are still specifically undetermined. As such, it is no longer about thinking in terms of impact but in terms of projects (Santaella, 2001).

Museums of sciences on Facebook

Facebook as a social network allows its users to create a personal profile and add other users as friends, allowing for the exchange of messages and automatic notifications. As for the fan pages, they exist so that organizations, companies, celebrities, etc. are able to *transmit information to their followers or to the general public that choose to connect with them.*

Manuel Castells (2006) said that the allocation of interconnectivity through social networks, particularly amongst adolescents and young people - target audience of museums - led to the formation of online communities and now

the fan pages, reinventing the company and "dramatically expanding the interconnection of computers, its scope and use." (Castells, 2006, p.54)

Based on the premise that the fan pages are becoming an important mean of marketing information, the staff of Space Life Science Museum (SLS) in Rio de Janeiro is conducting a research on the impact of information shared on fan pages of museums in the social networks. Besides the fan page of SLS, in the week of the 25th of May to the 31st, we also analyzed the fan pages of three other museums (Fig.1).

Fig. 1 – Total of likes – 25 to May 31

Museums	**Likes**
London Science Museum	81.545
Cité des Sciences et de l'Industrie	24.601
Cosmocaixa	26.728

In all of the fan pages, there are more posts about issues related to children's world or language. There were also found three different kinds of posts: about events that have happened or will happen in the museum; important science dates; or Birthdays of scientists with shorter sentences that discuss a question, a curiosity or a polemic. Most posts have pictures or videos.

Specifically, on August 10, 2011 was created a page on Facebook for the Space Life Science[1]. Our main goal was to publicize the event called Saturday Science that takes place on the last Saturday of each month[2].

On January 2, 2013 there were 758 people “liking” the fan page from *Espaço Ciência Viva*. On March 29, after the Saturday Science event - "4th Brain Week - So many emotions ...", when a real-time coverage took place on Facebook, with photos and information, it created a synergy between the physical space and the virtual one. As a result, on the day after the event the number of people who liked the fan page jumped from 1.164 to 1.189. In general, the average daily likes are 4, with most of the people women – 70.8% - with age ranging between 18 to 24 year old.

In May there were 1.500 people enjoying the page. The most liked post during this time was the one about the activities held at the museum, as seen in the fan pages of other museums. Most posts had pictures.

Finally, the most viewed posts, with an average of 300 views in 34 posts in the last week of May, were those related to Science Saturday event. More specifically, the opening module called giant artery.

In July 2011, the profile of Space Life Science was reestablished on Twitter - @ ciencia_viva (Twitter does not have a monthly analysis system. The data were collected manually) – the number of followers was around 200. As of July 11, 2013, it has 1758 followers.

[1] - https://www.facebook.com/museucienciaviva.

[2] - It is noteworthy that due to the school holidays in January and February, the event is not held.

Recommendations:

In this research we noted the importance of recognizing the new mechanisms to increase the scientific knowledge of society, whether through partnerships between universities and science centers or in the organization and distribution of information through social networks.

This dissemination of information in the digital media, coupled with a number of tools available on social networks, has led to the development of interactive horizontal networks that have the ability to connect the local with the global at any time.

It is recommended that a specific strategy for adult audiences, with appropriate language and themes.

Consequently, social networks enable a democratization of access of scientific information, also allowing people to participate more actively in scientific issues.

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Encouraging creativity: novel learning environments in science and technology centres

Authors: Davies, M. J. T., University of the West of England, mel_tudordavies@yahoo.co.uk and Stengler, E., University of the West of England, erik.stengler@uwe.ac.uk

Introduction

Despite the contested nature of creativity, there is little dispute that science, technology, engineering and maths (STEM) subjects are inherently creative disciplines, as they require inquiry, experimentation, analysis, speculation, and draw on the powers of imagination. Since these processes result in new understandings and innovative products, the 'critical' driving forces of the UK economy (Work Foundation 2008), it is not surprising that encouraging creativity within the STEM subjects has long been an aim of the National Curriculum (Hadzigeorgiou et al. 2012). However increasing competition from overseas markets (Work Foundation 2008), and a decline in the number of students pursuing STEM subjects (Schmidt 2011), has meant that there has been a recent renewed effort to allow students greater freedom in exploring the sciences creatively (Hadzigeorgiou et al. 2012).

This has included a movement of creativity-encouraging teaching practices from the classroom into science and technology centres. Being freer from the constraints of the National Curriculum, and uniquely placed in being able to design congenial environments for creativity, science centres have great potential to encourage creativity within the STEM subjects (Ecsite 2008; Bellamy & Oppenheim 2009). Indeed several studies suggest both science centre professionals and visitors feel centres encourage creativity and provide inspiration (Ecsite 2008). To date however little research has been conducted into *how* science centres can promote creativity.

This research project, conducted in collaboration with the University of the West of England and At-Bristol, set out to devise a classification system for the different types of hands-on creativity-encouraging activities, suitable for family audiences, that are available to science and technology centres. Through identifying the nature and potential merits and drawbacks of each activity type, the classification system seeks to provide a means by which centres can assess the suitability of creativity-encouraging activities for their visitors.

Methods

The classification system was designed via a triangulation approach (Denzin & Lincoln 2000). Telephone interviews were conducted with professionals from five UK science centres to identify the types of creativity-encouraging activities they had recently offered, a literature review was conducted to identify the types of creativity-encouraging activities that have recently been offered outside of the science centre sector and the UK, and visitor

experiences of three creativity-encouraging activities in At-Bristol were evaluated to provide in-depth case studies. In total data on 41 activities was collected. Each activity was coded for data extracts of interest before being cross-analysed to allow those showing similar patterns to be grouped.

The Classification System

The classification system generated by this research contains four different types of creativity-encouraging activities: Creative Problem Solving, Open-ended Experiment, Talk, Make and Take and Experimental Art. Before each activity type is discussed, a few common themes found across all classes will be mentioned.

All activity types display Active Prolonged Engagement (APE) features, meaning that visitors decided for themselves what actions to take rather than following a set of instructions, spend extended amounts of time with the activity, and are free to try a variety of actions, with each one building on the last (Humphrey & Gutwill 2005). This can be regarded a strength since studies have shown visitors show greater levels of engagement with APE exhibits than non-APE exhibits (Tisdal & Perry 2004; Tisdal 2004), and they can cater for visitors with a wide range of understandings and motivations (Humphrey & Gutwill 2005).

Further merits are that they all typically allow very active, rather than passive learning (Falk & Dierking 2000), can elicit much enjoyment, perhaps simply by engaging participants in the creative process and allowing them to enter a state of ‘flow’ (Csikszentmihalyi 1996), typically promote team work and family interactions, and have broad appeal. There is also much flexibility in when, where and how each activity type can be delivered.

Each activity type will now be discussed.

Creative Problem Solving

Creative Problem Solving activities require participants to create a functional object that attempts to meet a goal or challenge. Multiple solutions exist for each challenge, and the design is up to the visitor, meaning there can be much variation in what is created. An example activity is the Egg Drop Challenge, where participants must create a protective case that will ensure an egg is not smashed when dropped from a balcony.

As participants design, build, test and modify their creations they go through the process of creative problem solving (DeHaan 2009). This requires the application of a range of creativity, thinking, social and practical skills (Csikszentmihalyi 1996; Howard et al. 2008; Isaksen et al. 2011). Activities can enhance the development of these skills by providing opportunities for testing and/or problem finding, supplying materials that lend themselves to multiple interpretations, and providing example creations or challenges as prompts.

A common goal of Creative Problem Solving activities is to raise awareness of the importance of creativity in engineering and innovation. However evaluation of K'NEX bridge building activity in At-Bristol found such awareness was limited. Whilst this was not a statistically significant finding, it mirrors the findings of other similar schools-based studies (Vind & Kind 2007), and may be down to the ingrained view many young people have of engineering as being a non-creative discipline (Schmidt 2011).

Open-ended Experiment

Open-Ended Experiment activities require participants to carry out experiments for which there are no predefined questions, procedures or answers. An example activity is Bubblology, where participants as young as three are able to experiment with the effect of different shaped bubble wands on bubbles.

As they formulate their own hypothesis, design a procedure for testing it and generate their own understandings participants are able to develop a range of creativity, thinking, communication, practical and numeracy skills (Flick & Lederman 2004). Development of these skills can be enhanced through leaving the scientific method open to the highest possible degree and providing many variables.

This type of activity can intimidate visitors, perhaps because visitors feel they lack the expertise or confidence needed to conduct coherent, in-depth investigations on their own (Allen & Gutwill 2009). This indicates the presence of a facilitator, who can help guide and encourage visitors through the investigation when needed, is important.

Talk, Make and Take

Talk, Make and Take activities are characterised by participants creating purely aesthetic artworks inspired by a scientific topic. While their hands are busy opportunities are presented for discussion about the scientific topic with the facilitator. An example activity is Insect Mask Making, where participants can make masks whilst learning about insect physiology and adaption.

During these activities participants can creatively express their ideas, allowing them to use their imagination, explore their originality and develop practical skills in the given media (Craft 2000).

A common aim of Talk, Make and Take activities is to foster positive attitudes towards making. Frequently they seek to inspire creative confidence and further creativity by allowing participants to display and/or taken home their creations (Cropely 2001). This can also enhance a sense of ownership on the part of the visitors, and help to make memorable experiences (Simon 2010).

Experimental Art

Participants of Experimental Art activities are required to create artworks through the application of a scientific principle or technology. As they experiment with different variables, they are able to instantly generate many different artistic outcomes. By observing the effects of their actions they can raise new questions and experiment further. An example activity is Light Painting, where participants can use different light sources and a camera to create light drawings.

As with Talk, Make and Take activities, visitors can creatively express their ideas, allowing imagination and originality to be developed and self-confidence built (Craft 2000). Experimental Art activities are also well suited to developing skills in the use of specific technologies or pieces of software. They have the potential to encourage further engagement and creativity at home by using freely accessible technology.

Conclusions

Inclusion of some, or all, of the different classes of creativity-encouraging activities identified by this research in the informal learning programmes of science centres has the potential to bring many benefits, from deep engagement and enjoyment, to the development of a huge range of creativity, thinking, social and practical skills. Unsurprisingly some activities also present challenges, such as high barriers to entry and an enduring difficulty in promoting awareness of the sciences as creative disciplines. These are issues that should be addressed in the future development of the activities.

There are no set formulas for activities that will work effectively across all venues, and more research is required to determine the extent to which each class of creativity-encouraging activity can develop its specific skills and understandings. However, the classification system seeks to act as a framework by which science centres can begin to assess the suitability of creativity-encouraging activities for their visitors, and further their creativity-based programming.

By developing their creativity-based programming in ever-more efficient and effective ways, science centres have the potential to become truly unique learning environments, where all members of the community are free to unleash their creative capacities and develop a passion for inquiry-based and curiosity-driven science.

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Improving the visibility of academic research: normative expectations and strategic interests under review

Dr. Martina Franzen (corresponding author) Bielefeld University/ WZB Berlin Social Research Center
Email: martina.franzen@uni-bielefeld.de

Dr. Arlena Jung
WZB Berlin Social Research Center
Email: arlena.jung@wzb.eu

Opening the "black box" of academic research is used to serve two different, in part contradictory goals: to enhance the quality of public participation and to realize the strategic and particular interests of research organisations, research fields and individual scientists. While the first goal is oriented to the normative ideal of a democratization of science, the second is based on a more pragmatic interest in the competitive advantage visibility is assumed to have for research funding. For a long time the public communication of science was set in a rather simple, straight-forward narrative. Safely nested in the 'deficit model' there was assumed to be a clear-cut distinction between experts and lay people. The role of science communication was to educate the public and policy makers and thereby both rationalize and democratize the policy process. By educating the public on science, scholars would increase the credibility of science, turn the public into 'well informed citizens' and thereby rationalize the policy process. Thus, there seemed to be a neat symbiosis between the strategic interests of scientists and their normative obligations to society: Increasing the visibility of science was seen as being both in the interest of scientists and in the interest of the public.

As the myth of a 'clean bright line' separating science from society began to crumble, this narrative slowly disintegrated. Vividly illustrating the role of pragmatic considerations and strategic interests in the scientific knowledge production process, science and technology studies debunked the image of science as a source of objective and certain truth. At the same time, in a context of raising fiscal pressures, increased competition over funding and repeated, highly medialized peer review scandals, public trust in science further decreased. With this partial depletion of the epistemological authority of science the democratic legitimacy of the role of scientists as rationalisers and educators was seriously shaken. Thus, the 'deficit model' was gradually replaced by a 'difference model', in which scientific expertise appears as only one type of a number of specialised knowledge forms pertinent to solving practical problems (Fischer 2009) and Policy programmes shifted from 'Public Understanding of Science' to 'Public Engagement with Science and Technology'.

As a result of these developments the academic questions pertinent to science communication studies have changed. Rather than investigating the degree of scientific literacy, scholarship has turned to understanding the

social construction of science that is both the ‘boundary work’ scientists invest in creating the sacred stories of science, and the factors influencing the public perception of science (Gieryn 1983). Seeing science communication as a two way process has opened the doors to questions concerning the effects of public visibility on the credibility and rationality of science. The institutional demands of making science public confront scientists and their organisations with criteria that seem in some respects incompatible with fundamental scientific norms and institutional settings. With the rise of mass media as a communication form following its own rationality, these contradictions seem to become more pronounced. Given journalists’ proclivity to the dramatic and the negative, more science in the news often seems to mean more ‘bad science’ in the news.

In considering the role of the media in shaping the science-public interface a developing research area conceptualizes the changing relationship between science and the mass media as the ‘medialization of science’ (Weingart 2012). *The central empirical observation* of the medialization concept is that increased media attention to science is answered by an increased orientation of science towards the media. *The central empirical question* is how this co-orientation affects the credibility of science on the one hand, and the scientific knowledge production process on the other. *The central theoretical assumption* is that this question can only be adequately answered if we not only consider the strategic interests but also the different rationalities involved in the co-orientation of science and the media. Based on three empirical studies, we show how the ‘medialization concept’ can contribute to explaining the increasing interest in public visibility in the context of changing normative, cognitive and social parameters from different perspectives.

In a media study the coverage of stem cell research and epidemiology in German newspapers was reconstructed in detailed qualitative analysis (Jung 2012). The research question was, what image of science is created in the media in these two fields. Looking at the implications of the coverage of ‘bad science’ on the credibility of science one can distinguish between three *possible* effects: (1) a loss in credibility, meaning that science is no longer seen as being able to produce objective truth, but rather as being just as tainted with subjective perceptions and particular interests as any other social form of constructing reality, (2) the stabilization of a tension between normative and cognitive expectations, that is of expectations concerning how science *should* actually function and how it *does* function and (3) a re-stabilization of credibility, where for example uncertainty comes to be seen as an acceptable, normal and necessary part of science. What the study showed was that reporting on ‘bad science’ either implied a stabilization of the tension between normative and cognitive expectations or a re-stabilization of credibility. A loss in credibility, as defined above, did not occur. While a re-stabilization of credibility could be interpreted as resulting from the successful boundary work of scientists, the prevalence of the stabilization of a tension between normative and cognitive expectations needs further explanation. This, it was argued, can be attributed to the rationality of journalism. A loss in credibility as defined above did not occur. This, it was argued can be attributed to the rationality of journalism. While a re-stabilization of credibility

could be interpreted as resulting from the successful boundary work of scientists, a loss in credibility would imply a fundamental break with deeply rooted cultural patterns. The prevalence of the stabilization of a tension between normative and cognitive expectations needs a further explanation: Co-ordinating the mutual expectations of different social spheres (Kohring 2005) or put in normative terms binding science to the expectations of its social environment is the democratic function of journalism in modern Western societies.

Although there is a general trend towards more science PR in the higher education sector (Marcinkowski et al. 2013; Peters 2012; Jung/Ruddigkeit forthcoming), there are considerable differences between scientific disciplines in the degree and forms of both media attention and media orientation of science (Franzen/Rödder 2013 in print). The most proliferated press relations activities can be found in biomedicine (Kallfass 2009), having to do with the general interest in health issues that is also reflected by the highest percentage of media coverage compared to other fields (e.g. Suleski, J./Ibaraki, M. 2010; Elmer et al. 2008).

In molecular biology, according to a recent study[3], new findings are publicized by journals, research institutes, funders, publishers and companies. In studying research papers covered by the media, it was found that up to 8 press releases are issued per paper. The individual and organisational interests in media visibility are above all the legitimation of funding decisions and the achievement of competitive advantages. Scientists, journal editors and press officers, however, all disclaim any media orientation of their own, while alleging other actors with the active pursuit of publicity. They agree that the driving force behind increased media orientation is the funding bodies in the new governance of science. (Franzen/Rödder 2013 in print).

What, however, are the implications of medialization on scientific knowledge production? A case study on stem cell research indicates that “serving the media’s demand for astonishing results, scientists themselves tend to overstate the societal implications” and even the scientific value of their findings (Franzen 2012). Hence, the credibility of science is jeopardized by findings published in high-impact journals that turn out to be wrong or even fraudulent. Drawing from the results of an in-depth analysis of publication events in stem cell science, it was argued that, “exaggerated claims can be interpreted as one form of reaction of scientists to public interests, i.e., as an undesirable side-effect of the medialization of science” (ibid., p. 347). From a comparative perspective, such medialization effects occur in those scientific fields in which the *production side* of knowledge remains structurally intangible (e.g. lab sciences) and reviewers are, thus, not able to verify the claims made in scientific publications without backstage passes. Rather, they must trust the authors’ *representations* of the knowledge production procedures and their findings.

[3] This is part of the ongoing project “The production and representation of knowledge under the conditions of medialization”, funded by German Federal Ministry of Education and Research (BMBF) in the program ‘‘New Governance of Science” (grant number 01UZ0909).

Based on these in part complementary, in part contradictory empirical findings one can, we believe, see that more research is needed considering both the rationality of the media and of science, and viewing the science-media-public interface from a comparative perspective. Only then can a coherent picture be drawn, allowing for a better understanding of the causes and the implications of the current push for more 'public visibility'.

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Pride and Prejudice:
Communication of Science from within a Science Institute

Gabriela Frías Villegas
gabriela.frias@nucleares.unam.mx

Instituto de Ciencias Nucleares
Universidad Nacional Autónoma de México

In Jane Austen's famous novel *Pride and Prejudice*, the two main characters, Elizabeth and Mr. Darcy, go through a series of misunderstandings, starting with their first encounter, when the heroine is convinced that Mr. Darcy is proud and superficial. Meanwhile, he thinks that Elizabeth is a silly girl from an ignorant family. At the end of the novel, they manage to leave the misunderstanding behind to fall in love.

I would like to compare the story of Elizabeth and Mr. Darcy to that of the first encounter between several actors that participate in communication of science processes, which is full of misunderstandings and prejudices at the beginning, but where the participants reach agreement at the end. During the encounters between the scientific community and the members of other cultural groups, many – probably contradictory – representations of the world clash. This is due to the fact that many of the discussions that take place are mediated by prejudices. Sometimes, those prejudices are justified. However, most of the time they consist of distorted images of "the other", i.e. anybody who does not belong to their own community.

The journey taken by scientific information, which travels from within the institutes where it is generated to the members of general audiences, can be tortuous. The first actors that meet in this process are scientists and professional communicators of science. Usually, scientists are sure that experts in communication are not going to understand the complexity or importance of their work: they don't trust anyone who is not a scientist to present the results of their research in the media. On the other hand, some communicators of science find scientists to be arrogant, or difficult to approach.

The next encounter that takes place is that of scientists and /or communicators of science with different audiences. Usually, those scientists who are willing to communicate their work during fairs or public lectures are convinced that people will not understand them, even when they prepare their presentations according to the audience they think they will address. Even more worrying is the fact that the members of those audiences believe themselves to be incapable of understanding what scientists or communicators of science will present, even before the event begins.

In the Communication of Science Unit of the Nuclear Sciences Institute of the National Autonomous University of Mexico, we are doing research on the

interactions of the scientific community with different communities. I will use our experiences in this Unit to discuss examples of such interactions.

Communication of Science Unit of the Nuclear Sciences Institute, UNAM

The Communication of Science Unit (UCC) of the Nuclear Sciences Institute (ICN) was founded in 2008. It is located in the National University of Mexico, one of the most important universities in Latin America. In this institute, multidisciplinary research is carried out: Some of the main research subjects include cosmology, particle physics, nanotechnology and astrobiology.

The UCC started its activities with only one person; now it has grown to become a group of professional communicators of science. This Unit is one of the few of its kind in Mexican scientific institutes; its goal is to communicate the results of the research that is carried out in the Institute to different cultural communities. Mexico is a multicultural country, in which a number of indigenous and rural communities coexist with several urban groups.

The practical actions and theoretical research – from the philosophical, anthropological and sociological point of view – that is carried out in this Unit is based on visits to several institutes of scientific research and scientific experiments around the world that house communication of science offices.

Following these studies, the UCC bases its actions on a model of pluralist awareness. In his book *Multiculturalism and Pluralism*, the Mexican philosopher of science León Olivé comments that “it is possible that the world-views of different cultures are incompatible and that the members of those cultures live in different worlds. However, they can still act in a rational way and reach agreement” (Olivé 2000, p. 77). In this context, communication of science does not focus on the scientific topic, but on shared concerns between the communities involved in the communication of science processes, i.e. scientists, communicators (who act as mediators in the process) and different social groups.

Representations of society from the scientific community

Even if scientists are part of a society, their representation of the latter is often as a group of people who are not interested in the advances of science, especially if they believe that science does not bring any benefits to their life. Hence, some scientists are convinced that it is a “waste of time” to create dialogues with cultural groups who are completely unaware of the latest scientific discoveries.

Some scientists are reluctant to share the results of their work with journalists who work for mass media, arguing that they can make scientific work look superficial. On the other hand, the members of a scientific community need public support to carry out their projects, particularly if they require a lot of resources.

Representations of the scientific community from society

In 2009, the Mexican Council for Science and Technology (CONACYT) and the National Institute for Statistics and Geography carried out a survey of "Public Perception of Science and Technology in Mexico". This survey found that 83.6% of Mexican people have "more trust in faith than in science", and that 57.5% of Mexican citizens think that because of their knowledge, scientists have power that "makes them dangerous". These results show that those who are not aware of scientific research can be interested in the subject. However, they might prefer to have a representation of the world based on other kinds of beliefs, such as magic or religion. Individuals also perceive an epistemic asymmetry between their knowledge and that of scientists.

Taking these results into account, it is important to give an impulse to the participation of citizens in scientific debates. I agree with Feyerabend when he states that "citizens have the power to participate in the decisions about the way scientific institutions which work with state budgets function" (Feyerabend 1985, 76). He believes that the main decisions of the applications of science should not be left only to experts. It is important to point out that in contexts in which dialogues between the scientific community and other cultural groups take place, many individuals have a representation of themselves when they face scientific information that can stop the critical exchange of ideas. In particular, many of them do not trust their capability to understand scientific knowledge or to participate in debates about scientific information. Carina Cortassa states the following about this:

> A normal recurrent worry of the public is derived from a correct perception of a high degree of vulnerability of the place he occupies, and of being aware that he occupies a vulnerable position, and realizing his incapability of judging in an autonomous way the epistemic value of the scientific proposition or of the reasons presented on his behalf. In such circumstances, the asymmetry would reduce its options in believing or not believing the things that experts assert. […] However, recognizing that the conditions are not symmetrical implies that the only option the public has is that of blind trust (Cortassa 2010, p. 161).

Hence, one of the main problems between members of the scientific community and other communities is the distrust of the participants about their own knowledge.

Two extreme examples

Recently, the Communication of Science Unit of the Nuclear Sciences Institute studied two extreme examples of dialogues between the scientific community and other communities who are not usually close to science.

The first was the encounter between an elite group of contemporary artists and the scientists of the Nuclear Sciences Institute. This group of artists are part of a cultural center called Laboratorio Arte Alameda, which specializes in contemporary electronic art. The artists approached the institute because they wanted to learn but particle physics in order to create new artistic proposals.

The UCC organized a short course on particle physics for artists called “The cosmic recipe”. The result was very positive, since the artists had confidence in their capability to understand a new subject and found the lecture exciting, and stimulating. The lecturer was fascinated to answer questions from the “most engaged students” he had ever had.

As a result of this short course, the artists presented several proposals. In particular, the Mexican artist Ale de la Puente presented a performance in an art and science show called Kosmica, entitled “Cooking and the big bang”, based partially on the Nuclear Sciences Institute course.

A contrasting example is that of the habitants of the rural communities near the gamma ray experiment HAWC. Most of the members of these groups have only a basic school education and their only contact with science is through the experiment. The interaction of the rural communities with the scientists is filled with misunderstandings: people sometimes think the experiment is dangerous, or that it will use all the water in the zone. Moreover, even if the scientists try to explain what they are doing, the general audiences are convinced that they are not able to understand how the experiment works.

After studying such cases, there are many open questions that we would like to address in the future: is it possible to found Science Communication Offices in research institutes that are not based on the deficit model? How can Science Communication intervene to create better interactions between the public and scientists?

Conclusions

We are convinced that scientific communities, with the mediation of communicators of science who are experts in theoretical studies and practical actions, should encourage dialogues and learn about the concerns of the members of society who are in contact with scientific experiments or institutes. On the other hand, members of society should demand to be included in the debates about the implications of science and technology. In this respect, it is crucial that institutes of scientific research create Communication of Science Offices in which representations of science and scientists are recognized by all the actors involved in the communication process.

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Evidence-based policy or policy-based evidence? Striking the balance between responsible and impactful communication of environmental research to policy-makers.

Franca Davenport, franca.davenport@uwe.ac.uk, Science Communication Unit, Faculty of Health & Life Sciences, University of the West of England, University of the West of England

1. INTRODUCTION

In theory the call for **evidence-based policy** (EBP) is a positive one, allowing scientific research to provide an objective, valid and reliable knowledge base on which policy can be formed (Funtowicz, 2006). In turn, this can improve public trust and encourage greater **public engagement** with both science and policy. This is particularly valuable in the **environmental arena** where there can be scepticism and misunderstanding of research.

However, some have challenged EBP, suggesting that in reality it does not work to the principles on which it was founded (Holmes & Clark, 2008). Wyatt (2002, p22) has proposed the term may be adopted as "convenient shorthand" whilst Nutley (2003) suggests that "evidence-aware" or "evidence-informed" may be more realistic descriptions than "evidence-based" (p. 3). A recent report by the JRC and AAAS (2010) posed the question of whether it is policy-biased evidence or evidence-based policy.

Considering the complexities of both environmental research and environmental policy-making, a linear pathway of impact from scientific findings to policy is unlikely. Owens et al. (2006) described the transfer of knowledge to policy as "a continuum of influence ranging from clear and immediate impacts to long term, subtle processes in which problem definitions and modes of thinking change".

As such the pathway can become complicated, involving feedback loops and reciprocal effects. This is somewhat inevitable but the question is what can be done to communicate science to meet policy-makers' needs whilst still reflecting scientific procedures and processes.

The study investigates the nature of EBP in a project that produces reports on environmental research for an audience of EU and national decision makers. It aims to provide insight on the processes and practices at the science-policy interface to inform better communication of research.

2. METHOD

Using topics targeted for written publications as a framework for discussion, in-depth, semi-structured interviews were conducted with scientists, European policy-makers and science communicators (n = 22). Topics for the publications were often multi-disciplinary and sometimes controversial, such

as bio-electrical systems, sustainable phosphorus and green infrastructure. The data were analyzed using a grounded theory method.

3. ROLES AND RESPONSIBILITIES

Amongst participants there was a general agreement on the respective roles of researchers and policy-makers in the development of EBP. In basic terms, researchers provide information and knowledge, while policy-makers act on this information to make decisions. Both policy-makers and researchers implied science shouldn't be "dumbed down" and, to a certain extent, it was the policy institution's responsibility to employ staff able to apply scientific research.

> I think there are really limits to what one can simplify and of course it's a very aesthetic art to communicate something extremely complicated in an appealing and digestive way. (Policy-maker)

There was acknowledgement of the value of individuals or organisations communicating scientific research to policy-makers. However their role was assigned several labels by respondents (see figure 1.) This diversity of titles indicates the different levels at which science communicators work and the lack of clarity on their responsibilities.

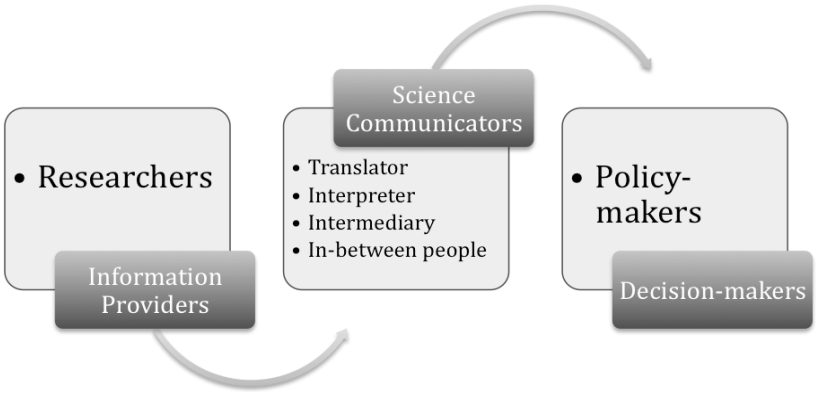

Figure 1: Roles and Responsibilities at the science-policy interface

4. WHEN IS RESEARCH USED IN POLICY-MAKING

Policy-makers report using 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 EU nations or member states).

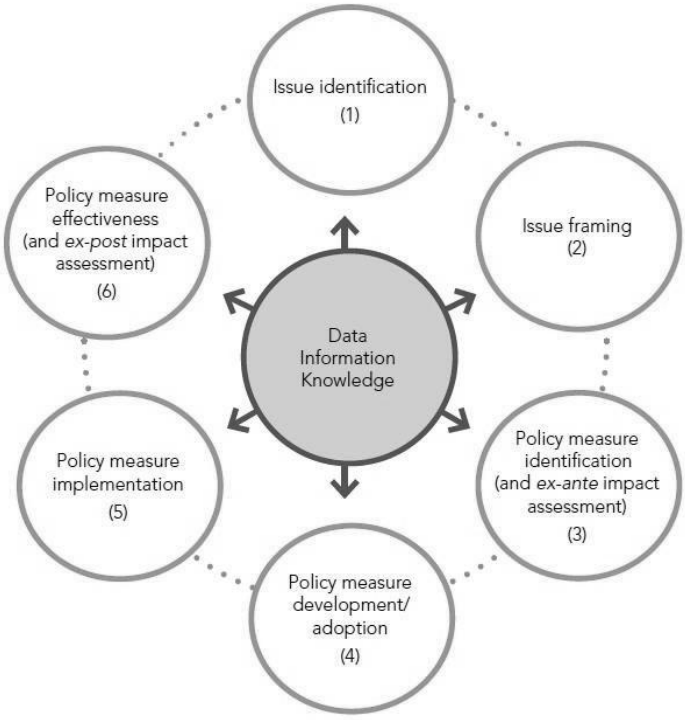

Figure 2: Main stages in the policy cycle, supported by data, information and knowledge. Source: European Environmental Agency (EEA)

To some extent this is in accordance with the European Environmental Agency's (EEA) framework of research in the policy cycle (see figure 2). However respondents suggest it is rarely used at the "issue identification" stage.

> When we draft a communication, when we elaborate it, we always have quantitative data to support it but in fact we know before what we will do. It can happen that we change our mind—that is possible—but it's not the norm. Very often we use the quantitative data only to confirm what we think. (Policy-maker)

Policy-makers report using research to raise awareness and trigger stakeholder consultation but this is more to prioritize a policy area or obtain feedback on a proposed policy rather than put it on the agenda.

Often policy-makers talked about research allowing them to "make a case," or "provide a scientific underpinning" to their work. This begs the question of whether science is used to inform policy choice or support existing policy.

4.0 REQUIRED QUALITIES OF COMMUNICATION

The research indicates that policy-makers expect a lot from the communication of environmental research. As one policy-maker said, they want "a digestible but exhaustive and complete and accurate holistic picture, concerning a specific policy question. . . . And it needs to be objective."

Quantitative data are highly valued, particularly analyses of costs and benefits, and figures that relate to targets. However policy-makers also appreciate data to be placed in a socio-economic context through case studies and practical examples. Often they referred to wanting research that presents choices. This suggests that, although the final decision lies with the policy-makers (usually at a higher level), there is some onus on researchers or communicators to provide an analysis of choices or scenarios.

5.0 EVIDENCE BASE AND THE IMPACT AGENDA

Many policy-makers acknowledged the value of "basic" or "pure" research but admitted there was rarely time to use critical thinking to apply this research in policy making. Often there was a need for research to answer a policy question, which tends to be commissioned from a research institute or consultancy. As one researcher said this reduces the spectrum or "ecology of research", particularly curiosity-driven research which can be valuable for providing overarching theory.

> It is a philosophical issue – is that science anymore? They need information packages that they can use for solving their particular political tasks or to meet their targets that they have agreed upon. (Consultant)

Even if research is not directly commissioned by policy bodies, academia is under increasing pressure to produce impact and policy is one of its main targets. There is a growing motivation to gain policy attention, particularly for new environmental technologies that require start-up funds. This can lead to a so-called "economy of promises" whereby researchers pledge unrealistic outcomes to gain policy support. Some researchers spoke about contemporaries hyping research or spending a disproportionate time on policy engagement. This, combined with the reported tendency for policy makers to rely on a select group of scientists, can mean there is not full representation of different research bodies.

6.0 DEALING WITH UNCERTAINTY

All participants acknowledged the inevitability of uncertainty in scientific research and the need to understand and communicate it better. As one researcher said "very often we're uncertain as to how uncertain we are on these things."

One of the most cited dilemmas was deciding whether to clearly communicate uncertainty and run the risk that results will be dismissed or to gloss over uncertainty only for its discovery to trigger mistrust from policy-makers. This is often an issue with environmental models, which were referred to as "black boxes". Although policy-makers highly value the scenarios and projections produced by models, they often do not understand the processes within the "black box". The discovery of uncertainties and limitations at a later stage of evidence-based policy can trigger disillusionment and distrust. As such the communication of environmental modeling often

involves a decision between stripping away the heavy methodological detail and conveying the limits (and potential) of the model.

> All models have a lot of limitations and potentials which are very much dependent on the data feeding into these models but when these models are presented to policy-makers, who only see for example a map coming out of these models, it needs to be very clearly said what this map does say and what it can't say and what the model can deliver and what it can't. (Policy-maker)

In general, amongst the participants there was a call to deal with uncertainty as a common problem and a common responsibility. This could include using better definitions of uncertainty in terms of identifying sources and implications for decision making (Wardekker et al., 2008). One researcher suggested the need for a better cultural understanding of uncertainty, which could include using less negative language.

7.0 CONCLUSIONS & RECOMMENDATIONS

The research provided insight into several issues around communicating research to policy-makers in the environmental sector. Building on Nisbit's (2009) ethical guidelines on framing science, the current research outlines some recommendations on striking the balance of effective yet responsible communication:

- Be familiar with the processes of research and the policy communities. As much as possible emphasize dialogue and the exchange of perspectives to help ensure concepts and procedures are fully understood.
- Consider and if possible communicate the values that guide a policy decision. In the environmental field a new form of research attempts to integrate natural sciences with social sciences by assimilating stakeholders' knowledge and values into ecological research. As Sarewitz (2013) said, "the boundary between the natural and the social sciences has blurred.…For contentious issues such as climate change, natural-resource management and policies around reproduction, all science is social science" (p. 2). By streamlining values into the scientific procedure this can improve transparency.
- Maintain as much accuracy as possible. There is a need for better definition of uncertainty in terms of its source and its implications (Wardekker et al., 2008). Expectations from research may also need better management.
- Avoid the use of provocative framing or hyping to appeal to policy-makers. Scientific research is open to misuse and there is a responsibility to take precautions.
- Consider different policy audiences and use appropriate forms of communication*.* This study suggests a very general three-tiered classification of audiences: policy officers, policy deciders and politicians (see figure 3). This model provides a means to connect between layers and refer to them for further information. However, the responsibility of deciding what is lost between layers lies with the communicator.

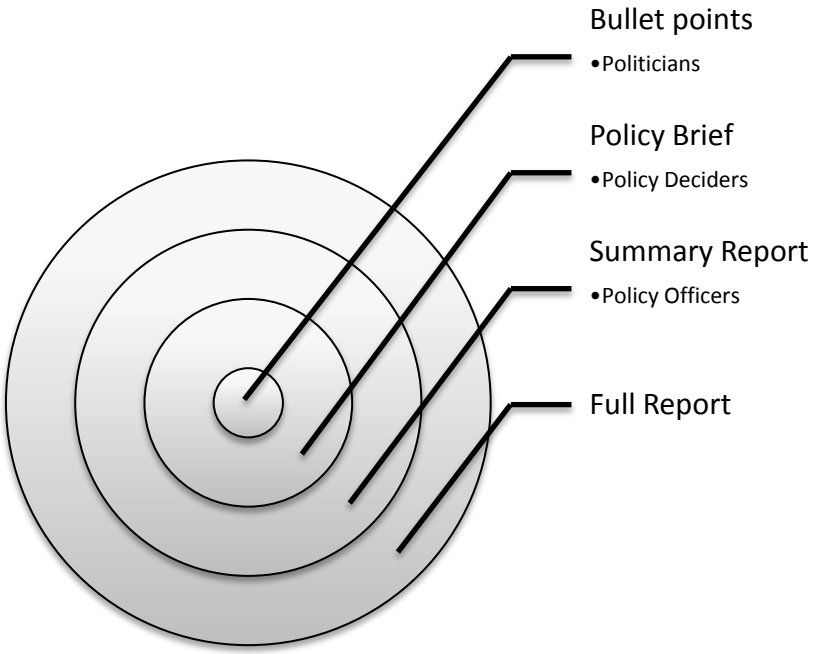

Figure 3: Levels of communication for different policy audiences

- Work within the boundaries of skill sets. This involves being honest about knowledge levels and experience when working as intermediaries, either between science and policy but also between policy departments and scientific disciplines.

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From Truth to Patents: What Kind of 'Knowledge' Guides our Societies?

Aline Guevara Villegas
aline.guevara@correo.nucleares.unam.mx
Nuclear Sciences Institute, National Autonomous University of Mexico

> "…Knowledge is both a new problem and panacea for our times. If we don't have enough of it, we are destined to become 3rd world countries. If we are not yet a knowledge economy, or are not 'in transition' to becoming one, then organizations like the OECD and World Bank are on hand to guide us in the right direction". (Robertson, 2008, p.2)

INTRODUCTION

The previous paragraph presents before us a frightening threat, but also an opportunity that evidently must be taken. There is a worldwide acceptance of the project known as 'Knowledge Society', to the point that almost every nation and region is trying to comply with the requirements and policies established by the OECD and the World Bank. After all, which society would refuse to base its future and viability on such a progressive resource?

By means of their discourses on science, technology and innovation (STI), Science Communication and Education (SC&E) have played an important role in the production and dissemination in the public domain of what 'knowledge' is. Subsequently, we could infer that SC&E have been decisive in the incidence of such a widespread enthusiasm with regard to the Knowledge Society project.

ON 'EPISTEMIC THINGS' AND ON 'PURE CONCEPTS'

Traditionally, SCE has centered their effort to democratize STI by translating expert technoscientific information in lay terms, for the unversed to understand it. This paradigm is commonly known as "deficitarian" (Lewenstein and Brossard, 2010, p.12).

By contrast, in an effort to introduce alternative, critical images of STI in the public sphere that go beyond the mere presentation of scientific information, dialogical paradigms of SC&E seek to produce discursive resources that allow and encourage public evaluation and negotiation regarding technoscientific issues (Guevara, 2013a).

But these apparently opposite paradigms share a common tendency: they focus on what Hans Jörg Rheinberger called "epistemic things": scientific objects built continuously within the context of experimental devices (1997, p. 29). Epistemic things are the material objects of scientific enquiry (including theories and procedures).

There are three levels of characterization of epistemic things, present in SC&E discourses (Guevara, 2013b, sec. 3):

- The first level describes all the 'intrinsic', 'essential', characteristics: what could be considered as the universally, scientifically observable constitution of an epistemic thing.

- A second level of characterization describes all the 'complementary', but still physical descriptions of the epistemic thing, that arise in relation to other scientific objects.

- The third level of characterization is 'contextual': the settings in which epistemic things occur, in *which they acquire reality* (Latour, 1999, ch.2).

When constructing discourses on STI, the deficitarian paradigm of SC&E tends to emphasize the first and second levels, whilst the dialogical paradigm focuses on contextual situations in which epistemic things can be subject to public assessment, because they are inserted in socially shared instances of reality.

Example. Epistemic thing: atoms			
Level of characterization	**Discourse content**	**Where does it take place in *reality*?**	**Can it be publicly assessed?**
First level: intrinsic (essential, universal, "scientifically observable")	Basic constitution (bosons and fermions). and energy-mass equivalence (eV).	It occurs in reality only in scientific discourses (books, documentaries, etc.)	Nothing can be said about it unless you are an expert.
Second level: complementary (in relation to other epistemic objects)	- Chemical properties.	It occurs in reality in scientific discourses (books, documentaries, etc.)	Nothing can be said about it unless you are an expert.
Third level: contextual	In medical devices, in a supercollider, in a nuclear reactor…	Context allows epistemic things to take place, to occur, **to acquire reality.**	**Only realities of epistemic things shared between social groups, can be evaluated.**

But when SC&E speak of epistemic things to the public, that is, when they talk about *something*, they also tell a lot about *pure concepts*, pure abstractions *per se,* that are closely related to those epistemic things: notions as 'uncertainty', 'objectivity' or 'knowledge' are intertwined with atoms, neutrinos or geoengineering issues.

WHAT DO SC&E TELL US ABOUT KNOWLEDGE?

In the present, there is a generalized popular conception of 'knowledge' directly associated with Modernity (Robertson, 2008, p. 3,19; Toulmin, 1992, ch. 1) that has been widely promoted by SC&E, and that can be described in these terms:

• A system of statements acquired through an objective search for the truth about the world.

• That system allows us to establish order over controversies or problems because it is not based on opinions, but in facts.

• Since knowledge has its origin in the truth, It can only lead to progressive development and control over the world and ourselves.

• Knowledge is not controversial because it emanates from an objective search for the truth; polemic arises only when we have to decide the way in which statements or products of knowledge will be applied or used.

• The most effective way we have to produce knowledge is with STI (Robertson, 2008, p. 9,10).

MODERN PREJUDICES AND PUBLIC ASSESSMENT REGARDING KNOWLEDGE

In the very same way that there are not instances of abstract idealizations of epistemic things taking place in reality, the former characterization of knowledge is a modern idealization that has never occurred throughout history (Toulmin, 1992; Daston and Galison, 2010).

Unlike the received modern definition of 'knowledge', and in a similar way in which epistemic things require shared contexts to be subject to public evaluation, any determination of what 'knowledge' is originates in an *a priori* axiological system that can be subject to assessment. That is to say that instead of an eternal, ahistorical system of statements waiting to be discovered by rationality and then applied, the very characterization of 'knowledge' arises within a hierarchical system of values. But in order to establish such an axiological hierarchy, there has to exist a *political project* that precedes and dictates its form and structure[4].

Allow me to present two examples to illustrate the fact that there is a political background behind every definition of 'knowledge', and that this political basis can be traced.

[4] As Stephen Toulmin noted (1992), even the modern project (and therefore, the very definition of knowledge), was preceded by a political project, which he called "the Politics of Certainty", created to put an end to an era of continuous war originated in religious and political dissent and controversy.

a. If we define ‘knowledge’ as:
‘Any intellectual or material resource which provides a social group with cultural cohesion and long-term survival’, probably we could trace this definition back to a political project which tends to establish social and ecological justice as its main value.

b. But if we define ‘knowledge’ as:
‘Any statement, procedure or object that can be owned (patented, published) to become an economical resource, a commodity in the market’, then we can notice that knowledge has to be sold and bought, according to the pressures of supply and demand. We can trace this definition back to a political project which seeks to ensure freedom of the markets for private instances as its main goal. *Then we are talking about a presently existing neoliberal political project* (Robertson, 2008).

Of course, if non-experts try to evaluate specific items of scientific information, it is very unlikely that they can say something that could change the course of scientific research and its application. But when it comes to political determinations on what is considered knowledge and what is it for, it can and must, for sure, be subject to public assessment and discussion.

CONCLUSIONS. NEW RESPONSIBILITIES FOR SC&E

Up to this point, we have seen that citizens want to become members of knowledge societies based on their modern idealization of the concept of ‘knowledge'. Unfortunately, such prejudice makes them establish an *a priori* positive evaluation (since they believe truth is always necessary and benefic at the end) that impedes further evaluation.

To change this situation, science communicators and educators should stop telling modern unrealistic stories, and instead start promoting public decisions regarding knowledge: what will be considered as such, the role it will play in each society, and its relationship with STI. They should tell in their discourses that knowledge (including STI) is a necessary, but not a sufficient condition for us to improve our social state of affairs, because knowledge can only serve our collective purposes in relation to the political path we decide (or not) to take.

But mainly, public assessment is certainly required because there has been a profound philosophical change: the political project in which the actual Knowledge Societies frenzy emerged is not related anymore to the modern idealization on the quest for the truth to solve controversies and improve our control over the world. As Susan Robertson has proven extensively (2008)[5], the present project of Knowledge Societies is, instead, committed to an already existing neoliberal political project. Taken in that way, knowledge not necessarily serves a political axiology that locates social and ecological justice as main objectives.

5 I invite my reader to visit Professor Robertson website, at the University of Bristol, to know more about her research on this topic: http://susanleerobertson.com/publications/

Without a doubt, at the present time, projects of SC&E are being produced in a political quandary between order by social justice, and order by economic efficiency. It is not at the level of expert knowledge that citizens should be capable to decide; it is at the level of specific contexts and politics in which knowledge gets defined, where citizens must decide what kind of order do they want for themselves.

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Greens and Science

Anne Chapman,
acc@chapmanstatham.co.uk,
Green House Think Tank

The Green Movement obviously owes a great deal to science. It is science that has uncovered the threats to our environment of our current ways of living. The impacts of pollution, the threat of climate change, the loss of species, can only be spoken about because of the scientific research that has made them known.

Like scientists, Greens are children of the Enlightenment. Both tend to think that decisions are, or at least should be, made on the basis of rational arguments, by appeal to the evidence. However, Greens are also children of Romanticism. This legacy makes them aware of the limits of science, both in the sense of the limits to its knowledge, and that science is not sufficient to tell us how to live. Science is not enough.

In particular, science should not be the only voice when it comes to decisions about technology: science and technology are not all of a piece, but are distinct, governed by different norms and we should use different criteria when judging them.

It is in this area that Greens have in recent years been accused of being anti-science; in particular in their opposition to genetically modified (GM) foods and to nuclear power (for example, Henderson 2012, chapter 9 and Lynas 2013). Science, the argument goes, has judged that the risks from these technologies are low and that the technologies need to be used if we are to meet our future needs for food and energy. Greens opposition to them is therefore irrational.

A key part of this argument is the concept of risk as it is used in technical risk assessments. Most regulatory regimes require the safety of technologies to be assessed by a risk assessment process whereby possible ways in which the technology may cause harm are identified and their probability estimated. If no harmful outcome can be identified there is no risk; and risks are low if the possible harmful outcome, even if of very large consequence, is considered to be of low probability. In contrast, I argue that Greens, and in fact much of the public in general, consider novel technologies such as GM food, to be risky, because even if we cannot identify what harm it may cause, harm is possible 'for all we know'. It is not a matter of the probability of identifiable outcomes but of what is possible in the epistemic sense, *i.e.* taking into account the extent of our knowledge, and ignorance. Novel technologies where we are relying on (inherently incomplete) theoretical scientific knowledge are risky. Whereas risk refers to an outcome, the riskiness of a situation or technology is inherent in the technology or situation itself. Identification of risk requires prediction: we need to know and be able to predict the probability of the other conditions that are needed for the outcome in addition to the technology. As well as a mussel contaminated with radioactivity from the discharge from a nuclear power plant, we need to know whether people will collect and eat that

mussel, and if so how much, how often, and what other radioactivity they are exposed to; it is not a matter simply of the presence of a carcinogenic chemical in a product, there must be a pathway by which it can enter the human body, and a known probability that once there it will cause cancer. In contrast, the riskiness of something is a property of the thing itself. A chemical can be identified as risky if we know it has the potential to cause harm, or if it is novel (*i.e.* it does not occur in natural systems) and we therefore do not know how it will behave in living systems. We do not need to be able to predict exposure levels and whether harm will actually occur. (For other aspects of chemicals which make them risky see Chapman 2007, p.103-112).

Technical risk assessment tends to consider probability and size of harm together, as if the two were commensurable: a low probability of a large amount of harm comes out as equivalent to a high probability of a small harm – they both give the same number of 'deaths per year'. But high impact/low probability outcomes are of much more concern that low impact/high probability ones. Events that cause some harm, but are not catastrophic can strengthen a system (Nassim Taleb has coined the term antifragile to describe this sort of system (Taleb 2012)). High impact, catastrophic events wipe it out.

Nuclear power is obviously risky. It is not a matter of the number of people it has or has not killed but the fact that it requires elaborate safety systems and armed guards at nuclear power stations. There is also the massive unknown of how we are going to keep safe, for centuries, all the radioactive waste it generates – and the cost of this (£1.6 billion of public money is currently spent each year at Sellafield, dealing with the UK's legacy of nuclear waste, at a time when the UK's public finances are under severe pressure. Estimates of the total costs keep rising – House of Commons Public Accounts Committee 2013). Plus the scale of consequences if things go wrong: it is not a matter simply of individual lives but of the destruction of whole communities through their exclusion from the place that they called home. Genetic engineering is risky because it is attempting to engineer a system we have only very partial knowledge of. People are aware that organisms grow, reproduce and spread. There is a fear that once a genetically modified organism has been released into the environment it will not be possible to get it back, should we latter discover that it is not as benign as we originally thought.

If we are going to use risky technologies, technologies that are meddling in things that we only half understand, there need to be very good reasons for doing so. This is the second strand of Greens' objection to these technologies: that they are not essential to meeting real human needs (as opposed to corporate interests). There are other, lower risk ways of generating energy without adding to greenhouse gas emissions (see, for example, the Zero Carbon Britain report – Allen *et al* 2013) and GM technology is not the best way to solve the problems that need solving in the food system (Tudge 2012). In both areas we can do a lot to reduce waste and share would what we have more equitably.

Finally, our choices about technology help to construct the world that we live in. Technology helps to determine the possibilities for human life, and the relationships between people and the organisations they create, as well as the impact that human living has on non-human nature. For Green Movement, more than any other political force, technology is political. Nuclear power is a large scale, centralised, inflexible way of generating power, owned by large corporations or state-owned companies and guarded by armed security forces. The scale of the hazards associated with it legitimates authoritarian enforcement of rules, which in turn erodes civil rights (Beck 1992, p.80). In contrast renewable energy generation can be decentralised: owned by individuals and small communities, increasing their economic independence. A common concern with genetically modified crops is the role of the large corporations who develop and own it, and retain intellectual property rights over the seeds that they sell to farmers. Arguments about genetically modified crops are part and parcel of arguments about who has control over the food system and the nature of farming. Do we want large scale, capital intensive agribusiness, or small scale mixed family farms? These are arguments about the type of world a technology brings into being. They are not ones that scientists who work on nuclear power or genetic engineering have any particular expertise in. They are properly matters for public political debate.

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Showing public value: factors supporting researchers' attitudes to open science

Ann Grand (ann2.grand@uwe.ac.uk), Science Communication Unit, University of the West of England, Bristol.

Funders – notably in the UK, EU and USA – are increasingly pressing researchers to make research outputs openly available. While an open access policy may be a driver, my research suggests that many publicly-funded researchers acknowledge that public funding carries an obligation to make their results publicly available. Additionally, making research more open has the potential to support two-way communication and widen participation. Increasing participation by making research open not only draws on these new participants' skills and expertise but also enables re-use and re-purposing of research outputs, increasing return and enabling researchers to validate its 'public value'.

PUBLIC VALUE

The notion of 'public value' was first outlined by Moore (1995), as means of drawing an analogy for the public services with the development of shareholder value in private companies. Moore emphasised three aspects of performance for public agencies: delivering actual services, achieving social outcomes and – importantly – maintaining trust and legitimacy. The public value approach has since become an established means of assessing the degree of success of public service organisations (Talbot, n/d).

'Open science', defined by Nielsen (2009, p. 32) as the sharing of 'everything – data, scientific opinions, questions, ideas, folk knowledge, workflows and everything else as it happens' is an emerging approach to research practice that potentially allows active projects to be open to anyone to follow, analyse or contribute to. Although practised by relatively few researchers (Research Information Network, 2010), if current trends continue and increasing numbers of people become 'digital residents' – individuals and groups who see the Web as a place to develop an identity and belong to a community – (White & Le Cornu, 2011) the expectation that the Web is the space where information is created and communicated will surely become more common.

SCIENCE IN PUBLIC

The protocols of research – novel work, scrutinised by peer-review and validated by publication – have supported sharing, trust and civility (Shapin, 1994) among researchers for over 350 years. While this etiquette serves the research community well, in the pre-Internet era the difficulties and costs of accessing research outputs ensured that such access was mostly confined to a privileged few. Open science advocates contend that the new ways of working made possible by the development of the Internet and Web-based technologies and tools will enable researchers to re-espouse the values of 'openness and community that were supposed to be the hallmark of science in the first place' (Waldrop, 2008). However, others remain wary, concerned that putting raw information in public view may create grounds for criticism

and concern and increase rather than lessen controversy (Jasanoff, 2003; Irwin, 2006). Furthermore, the technologies of openness – blogs, wikis, etc. – are seen by some as a 'waste of time or even dangerous' (Research Information Network, 2010, p. 5).

The development of open science practice has parallels with attitudes towards PEST. Although the scholarship and practice of public engagement extends back to the mid-twentieth century (Snow, 1965; House of Lords, 2000; Bauer, 2009), many researchers remain unengaged. Davies (2008) argues that some researchers persist in perceiving science communication as difficult, dangerous and framed within an over-arching context of one-way transfer. Researchers may be concerned that their work will be misunderstood or misquoted (PSP, 2006). Others believe they lack the requisite skills and training (Poliakoff & Webb, 2007) or that their participation in PEST might mean they are taken less seriously by their colleagues (PSP, 2006). Nevertheless, longitudinal evidence (Wellcome Trust, 2000; Burns, et al., 2003; PSP, 2006; Burchell, et al., 2009) suggests the majority of scientists express a positive attitude to participating in activities that promote PEST. Some motives are personal – such as enjoying the challenge of PEST activities or taking the opportunity to develop new skills, while others are more outward-facing: acknowledging the importance of communicating with a wider public, the desire to disseminate research outputs more widely or the urge to further a career (Poliakoff & Webb, 2007).

OPEN ACCESS

Recently, notably in the UK, the European Union and the USA, other ingredients have been added to the communication mix. First, funders are obliging researchers to make research outputs openly accessible (Wellcome Trust, n/d; EPSRC, 2013; National Science Foundation, 2013). In mandating open access, funders seem to be governed both by motives of accountability and the drive to enhance the value and return of research. Improved access to research outputs is seen as serving multiple communities – researchers, educators, students, clinicians, patients, businesses and the public – as well as increasing the benefits of research. Houghton et al., (2010) judged that over the 30 years following the implementation of an open access mandate, the economic benefits could be between four and 24 times the cost of the basic research, depending on the archiving model used. Second, funders aspire to maximise the impact of research, for example by researchers engaging with a variety of communities, with public engagement embedded throughout the research process and conducted by the researchers themselves, as part of their legitimate activities (Research Councils UK, 2009).

THE PUBLIC VALUE OF OPEN SCIENCE

While researchers may be compelled to openness by the extrinsic stick of policy, my research suggests that they may also be reacting to an intrinsic carrot of responsibility. For many, being open is a welcome duty; simply the proper way to conduct research:

> *It feels right. Ethically, it feels like the right thing to do (researcher 1)*

This ethicality is engrossed with a sense of accountability:

> *… with the current financial situation, showing public value – value to the public in general, rather than just to your students – I think is important (researcher 2)*

> *We have paymasters; that is, the public […] 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 (researcher 1)*

Researcher 1's comment also illustrates the possibility that people other than the researchers can make use of research data; that openness can, as Researcher 3 suggests, increase the return that can be obtained:

> *What a lot of public money to spend on gathering the data, out of which a single piece of research has been done. That data might actually support all sorts of other enquiries and it's such a waste of that resource not to make it available to people (researcher 3)*

Re-using and re-purposing datasets is one way of allowing researchers to increase public value. However, while many recognise the value of making data available, open practice raises issues of data ownership and how established systems for reward and recognition can be adapted to acknowledge the value of such contributions:

> *Who owns the data? If everyone's putting their data into a melting pot, who owns it? […] I can see how this would help science perhaps but not necessarily the scientists (public 1)*

Also, requiring researchers to make data, writings, images and more available could add to scientists' workload or take time away from their 'real' work:

> *… if I'm in my office, I feel guilty blogging. So a lot of it's done in my personal time. That's partly because there's a lot of time demands, doing science … even if I could say it was a core part of my job, I'd still find it hard, finding time in my working life to put time into that (researcher 4)*

Openly sharing research outputs could help breach geographical, institutional and cultural boundaries and support richer communication, connections and collaborations. Particularly, open collaboration and dialogue can support not just one way communication, from academic providers to members of the public but also contribution by unconventional participants, including amateur scientists, citizen and civic scientists:

the fact they've got all these amateur … amateur but interested people watching means they [professional scientists] *might discover something they wouldn't have spotted themselves (public 2)*

… there would be a chance that a member of the public could do the analysis. And if they saw something before the scientists did, that would be a big bonus for everyone (public 3)

If you allow them – the audience, the community – if you allow them to surprise you, then they will (researcher 5)

Both professional researchers and members of the public recognised that open practice may sustain new collaborations and allow new participants to make novel discoveries.

CONCLUSION

Many researchers acknowledge that being in receipt of public funding carries an obligation to make the results of that research publicly available. Open science has the potential to support the communication of research-in-action and the sharing of the complete record. Furthermore, open science can support not just one-way communication from academic providers to members of the public but also sustain new communities, such as amateur, citizen and civic researchers. Increasing participation by making research open to multiple collaborators not only makes use of and values their skills and expertises but also, by allowing re-use and re-purposing of research outputs, adds to knowledge, increases return and enables researchers to demonstrate the 'public value' of their work.

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Communication and engagement practices at CERN

Jamie Dorey

The Open university
E-mial: jamie.dorey@open.ac.uk

ABSTRACT

The production and sharing of knowledge and information between interested parties is fundamental to successful scholarship, be they other scientists, media professionals, stakeholders, or members of the public. Like many other big science projects, the Large Hadron Collider (LHC) at CERN requires major international collaboration, significant public funding and assistance from a multitude of outside organisations. These factors create an extra imperative for openness and transparency when it comes to disseminating its work. The operations of the CERN press office play a crucial role in promoting the work carried out at the LHC and in developing opportunities for public engagement with high-energy physics. This work is complemented by the independent activities of CERN scientists who engage with the broader scientific community and with members of the general public. Analyses of CERN documentation regarding public engagement policy and interviews with CERN engagement professionals and researchers have been carried out with the aim of identifying the values that underpin CERN outreach and engagement policies and the motivations of individual scientists.

INTRODUCTION

The operations of the CERN press office play a crucial role in promoting the work carried out at the LHC and in developing opportunities for public engagement with high-energy physics. This work is complemented by the independent activities of CERN scientists who engage with the broader scientific community and with members of the general public.

My Current study aims to explore how CERN research becomes public in an era of digital scholarship and what implication digital technologies have on academics and media professionals. The focus will be on how CERN researchers and professionals use digital technologies to communicate their research and engage with audiences.

This paper will outline some of the work done to date. It will discuss some examples of the values and attitudes that underpin public engagement at CERN that have emerged from a number of interviews carried out with CERN researchers and those involved with public engagement.

CERN

CERN was established in 1954 (CERN, 2013a) and is made up of distinctly separate users spread out across many countries. Over 10,00 scientists from over 600 universities carry out their research at CERN (CERN, 2013b).

The organisation of CERN is nicely in line with what Mintzberg (1985, p.160) would describe as an 'Adhocracy', that is an organisation that works in a complex and dynamic environment, with unique and complicated outputs. These outputs require experts from many different fields to form multidisciplinary teams. Coordination of such organisations is 'semi informal' with little direct supervision and standardisation. No single person is able to dictate, with decision making distributed among managers and non-managers. Such an organisation survives only if the members share the same values as to the role of the organisation. This can be difficult with such a wide variety of cultures in numerous institutions that are all so geographically dispersed. The Large Hadron Collider is the jewel CERN's experimental programme, but is nevertheless just one component of a very varied research infrastructure. It's 4 main detectors ALICE[6], ATLAS[7], CMS[8] and LHCb[9] all have their own strategies for communication and engagement, furthering CERNs complexity.

Before its shutdown earlier this year, the LHC was producing around 15 petabytes (15 million gigabytes) of raw data each year[10], all of which needs to be stored, organised and analysed. For this the appropriate information technologies need to be in place to allow the most efficient handling, sharing and networking of data, while appropriate communication technologies need to be in place to allow effective communication, collaboration and engagement. And it has been the development and implementation of digital technologies into research and academia that has brought forward this new form of scholarship, 'digital scholarship'

DIGITAL SCHOLARSHIP

The work of Boyer (1990, p.12) and his defining of 'scholarship' provided much of the groundwork for the conceptualisation of digital scholarship. Boyers concept of scholarship focused around four main elements that are all connected and interact with each other to various extents. The four elements are:

1. Discovery: The production of knowledge
2. Integration: Linking specific discoveries to a wider context
3. Application: Engaging with those outside of the original context
4. Teaching: Extending knowledge

[6] ALICE – A Large Ion Collider Experiment (Accessed 12/02/2013) http://aliceinfo.cern.ch/
[7] ATLAS – A Toroidal LHC Apparatus (Accessed 12/02/2013) http://atlas.ch/
[8] CMS – Compact Muon Spectrometer (Accessed 12/02/2013) http://cms.web.cern.ch/
[9] LHCb – Large Hadron Collider beauty (Accessed 12/02/2013) http://lhcb.web.cern.ch/lhcb/
[10] CERN: Taking a loser look at the LHC. (Accessed 01/02/2013). http://lhc-closer.es/php/index.php?i=1&s=3&p=12&e=0

A simple way to think of digital scholarship then is that it is concerned with technologies that support all scholarly practices, including discovering, analysing, publishing, and sharing research information.

Digital technologies therefore provide opportunities to extend research and teaching practices through formal and informal publications Scanlon (2013), while new forms of open access and open peer review have implications for openness and transparency within academia. There is also potential for digital scholarship to not only have direct benefits on academia, but to also impact on society through this increase in openness and dialogue through such things as citizen science initiatives (Pearce 2011, p2)

(Weller 2011, p.50). We have also seen in the debates surrounding climate change how digital technologies can allow the public and interested groups to evaluate research first hand and help shape the nature of public debate (Holliman 2011, p2). Yet, despite numerous acknowledgements of the potential benefits that digital technologies could bring as a scholarly tool, there is limited empirical evidence as to the impact technology has actually had on scholarship. This is where my study fits in.

From studying strategic documentation produced at CERN, I identified three broad themes through which 'Digital Scholarly Practices' could be explored. These are Communication, information and engagement. For the benefit of this paper, I will talk a bit about the engagement strand of my research.

CERN ON ENGAGEMENT

CERN has a long standing history on the openness of their research. Their original commitment to form collaborations and allow openness comes from their 1954 Convention (Amaldi, 1955), where in Article II.1, it states:

'*The Organization shall provide for collaboration among European States in nuclear research of a pure scientific and fundamental character, and in research essentially related thereto. The Organization shall have no concern with work for military requirements and the results of its experimental and theoretical work shall be published or otherwise made generally available.'* (Amaldi, 1955, p.4)

This statement is clearly quite broad and could have been interpreted in different ways. There is no indication as to what 'made generally available' would mean in practice, How this policy of openness would be enacted? The other key part of the statement is the word 'results'. In general physics research only gets made available in its final, peer reviewed form. How then have digital technologies, which offer the possibility to make all stages research open, impacted on this general practice? There is also limited reference within the convention as to who results should be made available to. Within CERNs convention, there are only 2 groups specifically mandated for. These are the high energy physics community and CERN member states.

Despite this, CERN also has a number of broader non-mandated audiences they attempt to engage with through various means. From my interviews, I was able to group these into 4 general categories, but there is some variation between experiments as to who they targeted. This is summarised in table 1.

Table 1 Non-mandated audiences and how they are engaged

Category	Forms of engagement	Comments
General public	Group visits Social media	Highly valued group. Broadly defined as adults who are not scientists but have some kind of interest in science. When it comes to the use of social media, twitter and Google hangouts are the preferred choice of individual scientist.
High school students	Visits Special events (researchers nights etc.) Video links	The majority of engagement targeting students involves them going behind the scenes to see scientists in action. This seems to be an attempt to dispel some of the myths and prejudices of what a scientist is and does.
Media	Tailored visits Interviews with spokespersons and senior members	Identified as the most significant group by CERNs communication team, although less valued by individual scientists.
VIPS	Tailored visits	Again another highly valued group amongst senior scientists as they can influence funding.

WHY DO CERN SCIENTISTS ENGAGE

From the interviews I also established a number of reasons why scientists choose to engage with the public and the value they place on such interactions.

The reason people first take part in such activities is simply because of personal enjoyment. As public engagement is not required by CERN, such

activities are left to those who have an interest in public engagement and enjoy doing such work. It was felt that scientists at CERN have begun to come round to the need to communicate to the outside world, and there is added excitement about what is being done at CERN.

One thing that came up in almost every interview was an awareness that as a publicly funded organisation, the public deserved to know what was being done with their money. This also would help also increase support for the work and help maintain funding. The public were seen as important by many as they were the ones who could influence political decisions regarding the value of such research.

Something that raised its head a few times was the feeling that the public understanding of science is to low, and the LHC gives scientists an opportunity to improve this. Although not a widely held opinion, it was thought the visit service lacked any real science content which made it ideal for the public as they wouldn't be able to understand anything too in-depth anyway.

The final reason that came up on multiple occasions was the desire to change the image of scientists and make science more accessible. This is especially true of high school and younger audiences but also the public in general. Many of those interviewed believed the public still had quite a negative view of scientists and wanted to improve this.

However, choosing to do public engagement work can also have negative consequences. The time demands are often off putting and the rewards seem minimal. There also a fear held by many of not being able answer specific question or saying something incorrect. Outreach was seen as an add on to the CV, but not something that was going to make a scientists stand out as an active researcher.

CONCLUDING REMARKS

While a more detailed account is not possible in the framework of this paper, I have begun to outline some of the values that underpin engagement practices at CERN. As is the nature and organisation of CERN, with many different experiments and departments having their own communication functions, both internal and external communication at CERN can often be quite fragmented. With each experiment having their own messages they want to get across to various audiences, it is difficult for CERN to present a united message. Yet scientists are united in their acknowledgment that CERN has as a publicly funded organisation a responsibility to communicate their research. While that is a widely held opinion, there are numerous other values held by scientists that impact on their willingness to engage. We have also seen how digital technologies, especially the use of social media, have been utilised by those at CERN to put these values in practice. The use of video links to the control room allows scientist to reach distant audiences and change the views they hold of scientists. Social media allows direct interactions between scientists and publics, allowing scientists to not only explain what is happening with their money, but to also increase scientific knowledge amongst the public. Further

research is being carried out to explore how digital scholarship has impacted on other areas of communication, such as the work of the CERN press office. Examining how significant events at CERN been communicated online will allow me to explore the products of communication, while continued observation of the CERN press office would allow me explore communication as a process.

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What would the public want?

Ash Choudry,
ash_choudryy@yahoo.co.uk
www.nottinghamscience.blogspot.com

Introduction

Whilst universities have long been comfortable in their central roles of research and teaching, they also have a more public role, in influencing public culture and seeking to engage with a more non-specialist community.

It can be challenging for universities to fulfil this latter role, especially in terms of reaching out to the communities immediately around them.

Fortunately, the UK's relatively strong civil society means that there are many organisations who can act as "force multipliers" and help universities engage with their localities.

This presentation looks at the three aspects of university-community engagement

1) Examples of good practice,
2) What happens when wider society engages with universities,
3) Suggestions on what could be done better.

Examples of good practice – May Fest

"May Fest" is an annual event at which the University of Nottingham throws open its doors, laboratories and lecture theatres to the community. It's an outstanding event, with something for all ages and all levels of interest and offering an interesting and interactive insight into the research undertaken by the different university departments.

Two examples of how community organisations can be a powerful "force multiplier" can be found in the shapes of Berridge Junior School and the Islamic Centre.

Berridge Junior School, Hyson Green, really went the extra mile in promoting the event. Staff talked to the pupils about the event and gave each child a flyer to take home. The efforts by the school are particularly important as it has a catchment of relatively disadvantaged children and pupils new to the UK.

The Islamic Centre, Curzon Street, made an announcement to their congregation (of some 1000 people) before Friday prayers, encouraging them to attend and take advantage of May Fest. Later a senior member of staff told the author that they and their family had attended May Fest and that the event had been "really great".

Examples of good practice – Public Lectures

Nottingham is blessed with a number of organisations who deliver science related public talks throughout the year (examples being the University of Nottingham, Nottingham Trent University, Café Sci and the East Midlands Materials Society).

These events are a great way of gaining an insight into current research efforts without having the information filtered by a headline seeking media. One aspect that is perhaps particularly worth noting is the Café Sci format which involves a short 20minute talk, but a long, 60minute, discussion afterwards. As a general rule, the discussion is at least as interesting as the actual talk and universities may wish to consider moving towards this model in some of their events.

When the public engages – Finding out Information

The author wondered how easy it was for the general public to find out about public science lectures that universities were holding, To try and investigate it an ad-hoc group of friends and work colleagues were asked to search the websites of 6 East Midlands universities to see if they could find information on any future science related events. There was only one rule – the participants could spend a maximum of 2 minutes on each university's website. That might not seem long but, on the internet, 2 minutes is forever.

The results showed that:

i) None of the sites were sufficiently easy to use that all participants could find information.

ii) There was variability in results for each university, with some participants being successful while others struggled to find the information they were seeking.

iii) There was one East Midlands university where no-one could find any useful information.

Some of the comments participants made are shown below (from a variety of participants and relating to a variety of universities).

"Half a dozen available (look good too!). Good descriptions etc.",
“Excellent. Events on homepage…lists science related public lectures”.
"Only globalisation and economics lectures listed”,
“There was only one event in the list.",
“Horrible, frustrating format ”,

The difficulties many people were experiencing in finding out what events were scheduled has a number of adverse effects on the impact public lectures can make. In particular, people are simply unaware that events are taking

place, and the lack of a clear web location for forthcoming events makes it hard for supportive
community organisations to effectively promote public lectures.

Ironically, the evidence is that there is a huge appetite for science learning in Nottingham. For example, a "Star Gazing Live" event attracted thousands to Wollaton Park on a cold, dark night to see the stars.

One final point regarding lists of forthcoming events is that universities sometimes have a "silo" mentality, with each department having its own list of events on a different page. This makes it hard for people who have an interest in more than one subject from keeping track of what public events are in the pipeline.

When the public engages – Asking for change

Given that public lectures are held for the benefit of the public, it seems reasonable to take the view that the public should be able to engage with universities on their subject matter and how they are publicised.

The authors experience has been that in some cases universities respond very quickly and positively to requests for small actions whereas in others it can take multiple emails and calls over a period of years to get a relatively simple task done.

The author believes very strongly that members of the public who take the time to engage with universities are a rare and precious resource, especially if they are young adults undertaking their first activity as active citizens. As such they should be treated with respect and have their questions answered promptly and with a spirit of meeting their needs (if practical), not have their requests kicked into the long grass.

What could be done better – What would the public want?

Imagine you are a member of the public who is keen on learning more about the topic of a public lecture. Or a blogger who wants to report on the key points of a talk. What could the speaker do to help you get the most out of the event?

Minimum jargon.
Some subjects are relatively easy to explain to the general public – e.g. engineering, physics (strangely) or geography. Others are much harder and susceptible to the early onset of jargon – e.g. electronics, chemistry, biology. Perhaps a good rule of thumb is to pitch a talk so that a bright 16yr old could understand it. Another suggestion is that any terminology or acronym that is never heard outside of “work” should not be used without explanation.

To listen and not have to take notes.
Public lectures are almost always jam packed with fascinating information – but listeners often take notes frantically in case this they are unable to find the

data again afterwards. It is suggested that presenters put their slides online – and tell the audience they have done so at the beginning of the talk.

To find more information easily .
When the general public tries to look up references, they very often hit a pay-wall. One way around this is for universities to have information on their own websites (ideally with a note allowing bloggers and students to use the images themselves). CERN does this very well.

What could be done better – Engagement with communities

Based on the authors experience as a volunteer in a number of organisations, the following are some useful points relating to building long term relationships with local communities:

i) Engagement and building relationships takes years.

ii) Getting to know, and work with, supportive stakeholders (community workers, youth workers, bloggers) is absolutely key. Universities should be prepared to react in a practical way to community suggestions, not just offer platitudes and invitations to events.

iii) The enthusiasm for engagement with universities is generally not at the top of community organisations – but rather about half way down, at the coal face, with younger volunteers and youth workers.

iv) Key stakeholders can pass on supportive messages to thousands of people, with a greater authority than the academic institution has – particularly important for BME and economically disadvantaged communities.

v) Genuine engagement involves institutions talking to their local communities and asking “what lectures do YOU want us to hold, what aspects of our work are YOU interested in"

A genuine engagement with local communities offers much for both sides, academics are exposed to the big questions that they perhaps do not usually consider in their detailed day-to-day research; while the public gain a better understanding of the time taken to develop technologies and what kind of people are doing the developing.

What could be done better – A closing challenge

Dear reader, can you say, hand on heart, that your institutions have a central list of public lectures, that engaged members of the public are responded to and that copies of public lectures are available online?

If not, can you commit to trying to improve the situation at your institution?

Obstacles to the Expansion of Science and Technology for Socioeconomic Development in Africa, focusing on Ghana

Yao-Martin Donani (epxyd@nottingham.ac.uk)

Faculty of Engineering and Institute for Science and Society (ISS), University of Nottingham

ABSTRACT

Science and technology are fundamental for industrial development in a society. Ghana, like most sub-Saharan African countries, does not have a strong technological base, hence, Ghana embarked on a policy review with a global perspective to promote science and technology for the benefit of the public. The policy review (United-Nations-Conference-on-Trade-and-Development, 2011) however, appeared to have isolated the traditional institution, which consists of the culturally minded mainly rural population, as no framework for dialogue was found. This study therefore aims to better understand the situation through a multidisciplinary approach using mixed research methods to explore and analyse both the traditional and formal sectors in Ghana to identify the factors that could explain the situation and propose a model for technology development as the way forward.

INTRODUCTION

The subject of socio-techno-economic development in Africa for the benefit of its public is seen as a very difficult topic in view of its technological chronic stalemate and nature of evidence starved historic pattern of technical change (Davidson et al., 1965, Austin and Headrick, 1983). Also, the resulting complexity of Africa's 'foreign imposed' State formation (Herbst, 1997, Kieh-Jr, 2007, Davidson, 1992, Herbst, 2000, Chabal, 1994) and analysts' observation of the economic impact of the technology lag shows Africa remains the poorest continent in the world (Acemoglua and Robinson, 2010, Lall and Pitroballi, 2002) despite huge influx of capital intensive technologies over several decades (Akubue, 2000).

Some scholars have argued that the lag in Africa's techno-development trajectory results from a lack of adequate infrastructure (Juma, 2011b), inefficient institutional framework (Acemoglua and Robinson, 2010) and a seeming 'backward' orientation of Africa's cultural practices (Austin and Headrick, 1983). The authors' position provides insight into the African scenario as a point of departure for discussion. However, their perspectives seemed skewed, reflecting their own 'invisible ethnocentric' (Chevalier et al., 1992) cultural backgrounds not adequately representing the Africans' perspective, the very people their studies are concerned with. What this study aims to do differently is not to draw conclusions from speculations and assumptions, but to solicit Africans' perspectives through a micro-ethnographic study (Wolcott, 1990) in Ghana using a multidisciplinary approach (Sachs, 1992) to understand the cultural variances inherent in the Ghanaian society for a more realistic description.

The study found that both sectors exhibited a strong quest for industrialisation describable as ‘a sense of commonality’ cutting across cultural, social and ethnic barriers despite the strong cultural conservative stance of the traditional sector (Beall and Ngonyama, 2009) and the formal sector’s interest in developed countries (Chevalier et al., 1992).

AFRICA’S LAG AS PERCEIVED BY SCHOLARS

Scholars like Davidson and his friends, and Edgerton have shown how some Africanist authors claimed Africa had no history of its own (Davidson et al., 1965) and never invented anything (Edgerton, 2008) and is hence, technologically backward.

These assertions have been found not to be correct as scholars have now established that Africa has its own history, State empires (Englebert, 2002, Davidson, 1991, Davidson et al., 1965, Beall and Ngonyama, 2009) and three stages of technological development though failing to adopt the wheel and the plough (Austin and Headrick, 1983).

Africa’s technological trajectory is however historically rudimentary, but today, Africa embraces modern technologies and economic growth (BBC-News-Africa, 2013). Nonetheless, in spite of the growth, Africa remains the poorest continent in the world (Acemoglu and Robinson, 2010) and its growing economy is described as fragile (Aryeetey, 2008) as it lacks requisite technologies (Juma, 2011a) to add value to its primary produce. Some scholars blame this lag on institutional failures (Acemoglua and Robinson, 2010), while others see the African culture as the cause (Austin and Headrick, 1983). Thus, Juma (2011) perceives the provision of infrastructure as solution to the lag.

With the provision of infrastructure, the question that comes up is; who should provide the needed infrastructures? Who maintains them? To what or which cultural mainstream and ideology will such infrastructures be designed to suit and deployed? For several decades, infrastructural provisions have been made to Africa (Akubue, 2000, Price, 1975), but the results are disappointing (Sachs, 1992, Sagasti, 1979) as these infrastructures do not derived from Africa’s cultural setting for its sense of ownership and heritage, thus, leading to poorly maintained and dilapidated infrastructures noticed in Ghanaian rural schools and hospitals.

Similarly, the institutional argument seems to miss the fundamental question of what stimulus, drive, impetus, or catalyst is needed to create the institutional framework? There seems to be a fundamental misconception by the scholars to presume that institutions working efficiently in a particular culture and geographical location should perform with that same measure of efficiency when ‘imposed’ in a different cultural setting. Such expectation should be considered as a flawed; institutions are culturally dependent (Hofstede, 1984), evolving as a product of society just as technology is shaped by society (MacKenzie and Wajcman, 1985, MacKenzie and Wajcman, 1999) Institutions therefore do not develop in vacuum; they must have relevance to a cultural ideology and setting, as culture is formed and

influenced by the people in discussion and factors that surround them, hence, the notion that African cultures account for its lag should be discarded.

THE TRADITIONAL AND FORMAL SECTOR COMMONALITY

Authors like Austin and Headrick (1983), using a dialectical approach, suggest that technological development is only possible in Africa when the cultural mindset of technologically advanced countries is adopted by Africans. Such claims are described as ethnocentric (Chevalier et al., 1992) for their parochial nature. Taking cognisance of advanced countries like China and Japan which have retained their very distinctive cultural descriptions different from those of their 'technology parent' countries (ibid) attests to the invalidity of such claims. It can however be observed that, industrialised countries posses a feature describable as monoculturalism, or a near monoculturalism, where, if language classification is used as the bases to differentiate cultures (Lewis, 2009), it was observed that most industrialised countries have a 'commonality' of monoculturalism, i.e. having a dominant language. This is not the case with Ghana. According to the ethnologue of world languages (ibid), Ghana has seventy-nine living languages excluding their dialects and each language constitutes its own culture defined by the tribe, implying; seventy-nine different cultures, each maintaining its distinctive identity and resisting any form of tribal domineering leading to potential conflicts (Boafo-Arthur, 2006, Odotei and Awedoba, 2006). These cultures do not integrate or harmonise. Monoculturalism is identified to be a major cultural feature of industrialised countries; however it should not be seen as a condition to develop industrially, it can, nonetheless, be used to emphasise the need to identify 'that sense of commonality' in a mixed cultural setting like Ghana. This study is not advocating for a consolidation of cultural variances into a single cultural framework like flattening of the cultural landscape, as demanded by early post-colonial African leaders (Herbst, 1997), but seeks identify a 'sense of commonality' cutting across all language, cultural, ethnic and racial barriers to a point where all cultures, traditional or formal, meet symbiotically.

WHERE CULTURES MEET

The traditional sector, though culturally divided (Davidson, 1969) and conversative, it is not immutable (Beall and Ngonyama, 2009) as it demonstrates the willingness to embrace modernisation. The formal sector, which holds the seat of government, on the other hand, seems more focused on building relationship with the developed world (Chevalier et al., 1992) at the expense of the traditional sector. As a resutl, no framework for dialogue on science and technology development in Ghana between the two sectors was found in the policies drawn (Government of Ghana, 2010, Ministry-of-Environment-Science-and-Technology, 2010, Republic-of-Ghana, 2011, The-Republic-of-Ghana, 2011, United-Nations-Conference-on-Trade-and-Development, 2011).

A common quest in both the traditional and formal sector was identified to be the craving for industrial development. Thus, having found a common interest that cuts across all cultures of both sectors, a framework for the manufacturing of technology with cultural sensitivity and secured market for

value-added production is proposed as a vehicle for technology deployment in Ghana (applicable in other African countries).

CONCLUSION

Differences in the African cultures in both the traditional and formal sectors were found in this study to converge at a point of technological needs defined by the quest for industrial development. The concept of development was found to be a recent phenomenon to the African cultural genome.

The traditional sector being conventionally conservative now embraces modernisation thus, sending a strong signal to the ruling class and seat of government power to reconsider its conventional approach of focusing its relationship with the industrialised world and sidelining the traditional sector. This wakeup call is seen as vital to the expansion of the application of science and technology in Africa, focusing on Ghana for the benefit of the population.

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Practices and images of public communication by Italian scientists over the years

Alba L'Astorina*, lastorina.a@irea.cnr.it **(c**orresponding author), Sveva Avveduto**, Loredana Cerbara**, Adriana Valente**

*Science Communication and Education Unit, IREA – CNR

**Science Communication and Education Unit, IRPPS – CNR

Introduction

The research presented here is part of the activities undertaken by the Science Communication and Education Unit of Cnr[11] which aim is to *promote and observe* the relationship between science and society. *Promoting and observing*, for our group, means both studying, planning and testing science communication and participation methodologies, as well as monitoring some key aspects through the social research. Results are then used to re-think new ways and methods of communication and interaction between science and society.

During these years we've been capturing the different views of the public of science, focusing each time on a different segment, such as young people or students and teachers at school and, more recently, the scientific community. Whereas public is a traditional focus of Public Understanding of Science (PUS) scholars, over the past few years a growing number of them have been focusing on scientists as main
subject of investigation. Key questions that start to be answered include: What kind of languages and practices do scientists choose when engaging in science communication activities? What images of science and publics do scientists refer to when reflecting on science communication? What are the main motivations behind scientists' engagement in communication of science? What the main obstacles?

As Cnr, we run a total of three studies focusing, in different ways, on Italian scientists' understanding and practices of science communication to the public. We concentrated our studies on the Cnr community, observing it from an inside perspective, "immersed in the social life of our respondents", paraphrasing Collins' "participant comprehension" (Collins, 1983). In recent years we started a collaboration with the University of Torino[12], which is still ongoing, so as to broaden our observatory and evaluate possible differences between researchers from different disciplines at university and research centres such as Cnr.

[11] The National Research Council (Cnr) is the most important and the biggest public organization of this kind with a total of employees of about 8,000 units[11]. Research activities are characterized by an interdisciplinary approach in the team group that combines curiosity-driven with applied research; multidisciplinary studies covering all areas of scientific and human knowledge; geographical distribution all over Italy through a network of institutes aiming at promoting a wide diffusion of its competences throughout the national territory and at facilitating contacts and cooperation with local stakeholders and organizations.

[12] Agorà scienza is an Interuniversity Centre located in Turin,http://www.agorascienza.it

All surveys have been published and presented in national and international meetings and we refer to our articles for details concerning methods and results (Valente, 2011; Avveduto, Cerbara, L'Astorina, Amorese, Agorà Scienza, Valente, 2013). In this paper we will only briefly reflect on some key continuities and discontinuities that characterize the Cnr researchers and try to make some confrontation with analogous international surveys on the topic.

Findings

Starting from the overall result, we can say, in line with similar international surveys (De Chevigné, 2000, Jensen, 2008, Albero, Esquinas, Rochas, 2011, Ecklund 2012, Kreimer, 2011), that public communication of science has clearly entered the framework of activities scientists have been experiencing over the last years.

The variety of practices is very wide and the most popular include education, participation to public conferences, festivals and other events. Considering that the public of such events is often the school, this shows an evident interest of researchers towards education. The result is steady in all Cnr surveys where researchers also state that students are, among other categories of public, the ones the researcher find it "easier" and more "useful" to communicate with.

The relationship between scientists and the media is instead considered complex and manifold and many international surveys on the topic report scientists mentioning journalists as the main responsible for a number of misunderstandings that determine public perception of science (see a review of such studies in Besley & Nisbet, 2011). Also Cnr researchers share a critic relation with media; however they seem to acknowledge the difficulty to "conciliate a reliable and precise information with a clear and independent one", as European citizens suggested in a survey of some years ago (Eurobarometer, 2007). Researchers also consider the advisability for both – researchers and journalists - to be involved in the public communication, according to own different roles and skills.

Although we registered a general "declaration of interest" towards public engagement, communication of science is mostly experienced as a voluntary activity that is, in most cases, practiced with no funding, no specific human resources and without any sort of training. The result is coherent with analogous surveys in Europe, where the public engagement reveals to be still based on the goodwill of individual scientists and confined to episodic initiatives, neither recognized nor rewarded by the research organizations (Neresini, Bucchi, 2011) leading to the conclusion that the policy of science communication and the debate that surrounds these issues have found their way into researchers' practices of science, while they have not yet entered the governance of science realm.

As far as the image of science is concerned, Cnr researchers seem to share a complex and very articulated one. Popular images of a science separated from our society, considered as the "only source of true knowledge" coexist

with images where science is embedded in its local and historical context becoming the result of a precise time and place. Furthermore, science is inscribed in the funding allocation, meaning that Cnr researchers are clearly aware of the contingent nature of research. Perhaps that might be a peculiarity of the Cnr, whose relationship with the industry has represented an important parameter since its foundation. However, we denote some resistance to change and abandon some convictions and certainties that traditionally were used to secure the image of science as unquestioned and unproblematic (Funtowicz, Ravetz, 1999).

Reflecting over the relation between science and the public, it emerges that a number of traditional and widely discussed views about public continue to persist among researchers at Cnr. In many international surveys the public is considered as “not informed”, “irrational“ and “emotional“, only “interested in the sensationalistic aspect of news“ about science, “not able to understand the complexity“ of some scientific topics. Again the media are considered responsible of this situation being not able to correctly inform the public. Also Cnr researchers consider the public “not enough aware of what the scientists do”, or of “what are their efforts in carrying out their research activities”, and maybe “not even much interested in science”; however the trust scientists feel from the public is considered high. This result reminds to previous Cnr surveys on science and the young people (Valente, 2006; Valente, Cerbara, 2008) where doubts on the independence of science and on the risk connected to the use of some science and technology results were expressed by the respondents. In the same surveys, however, scientists were also described as the most suitable to inform the public and to decide on some technological and scientific applications.

As the role of the public in the political process concerns, Cnr researchers do not feel it easy to relate to stakeholders and policy makers and show a marginal interest for participation practices such as public dialogue and debate. The public is considered as a “valid actor for the construction of new knowledge”, however, researchers do not trust the public as being actively engaged in the decision making process and more in general, in the governance of science.

Although some researchers declare to be ready to “learn from the public”, most of them view engagement as chiefly about dissemination, as a means for “increasing knowledge” or “combating the public’s unfounded fears about science”, rather than dialogue. Last findings are in line with Besley and Nibet, 2011, Davies, 2008, Burchell, Franklin and Holden, 2009, and AMORESE, 2010, which indicate that scientists are not always comfortable in situations where they meet directly with the public such as public debates, and sometimes regards these as stressing and threatening circumstances. However, in recent times, Italian scientists engage more and more with the citizens, due to the cyclic and major cuts to research and education from the Italian government, in order to draw the attention of public opinion on the importance of science for society and to ask for support. Such events, even if marginal, are described as “more positive and enjoyable” by researchers, as they imply not conventional channels, such as the Web, museums, squares,

theatres, the natural scenario where researchers carry out their studies; an informal language in order to relate to a broaden public. What is here on stake is not only the results of research, but rather experience, passion, that is, the cultural and social dimensions of science.

As a final consideration, we can say that surveys indicate that Cnr scientists communicate science through a multiplicity of ways according to different settings. We suggest that the latter cannot be enclosed in fixed models of science communication circulated amongst academics (deficit/dialogue model), and on the contrary include a variety of activities, opinions and forms of communication that can play a different role in the future of science communication and need to be better explored.

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How is diversity of opinion represented through public debates?
The case of the French GM-Food Controversy

Elodie BRULE-GAPIHAN
elodiebrule@univ-reims.fr
University of Reims Champagne-Ardenne

As GMOs' representations depend on the parties involved in discussions, representing general interest is a tricky process regarding the strong opposition between protagonists. One of the means chosen by the French government has been to integrate the lay public in debates.

Until now, four initiatives have been taken. The first public debate occurred in 1998; it took the form of a conference of consensus, named Citizens' Conference. In 2000, the persistence of GM-field destructions led the government to organize another national conference organized by the Committee of Wise Men. Three years after, crop destruction campaigners still remained an important issue to tackle as opposition between volunteer reapers and scientists had been getting stronger and stronger. A fact-finding mission, named Parliamentary Commission, was therefore implemented. In 2007, the status quo being maintained, GMO activists (either they were for or against GMOs) expected a lot from the coming French President Election, and they mobilised themselves in order to make their expectations hear. By consequence, a conference on environment, named the Grenelle Environment Forum, was set up just after election.

Notwithstanding the organisation of national debates, GMOs' opponents continued to demonstrate (by destructing GMO crops, making press conferences…), justifying these actions by a deficiency of debate. Each demonstration was made "to nourish the debate", to show different points of views on GMOs. The leader of the volunteer reapers explained "the aim of our network is to ban GMOs, and for doing this the question has to be publicly asked, in order to have it publicly debated". For him, until 2007, there would not be a public debate yet; this remark shows how different the opponents' expectations were on debates compared to those of promoters.

Considering this difference, this paper aims at first analysing the nature of these differences in activists' expectations, and then the organisation of public debates themselves, in order to understand how the lay public is integrated. This analysis will mainly focus on two public debates presented above: the Citizens' conference and the Parliamentary Commission for two reasons. Firstly, they were both organised by the same parliamentary committee. Secondly, all information needed for the analysis is easily available.

PROTAGONISTS' EXPECTATIONS AROUND PUBLIC DEBATES

Among all debates, the Citizens' conference retained attention the most. For GMO opponents, this conference remained without any effect, except "the fact to inform citizens", but this information was considered to be inadequately

covered by the press. Moreover, the Citizens' Conference was viewed as a means to influence GMOs' acceptability and to open the GMOs' market, but not a public debate. For GMO promoters or neutral organizations[13], this conference was not satisfying either since it occurred too late: discordant points of view had already been covered by the media, and mistakes on communication made by seed companies.

The parliamentary commission was more appreciated. According to one representative of the association "France Nature Environment", this commission was "a real debate" since many interests were represented. But he deplored having been censored himself. Notwithstanding, the nature of debates and the increasing participation of citizens on the internet were evidence for opponents of an important citizens' mobilisation against GMOs. For them, the main problem related to GMO lied on public scientific agenda; the question was: who decides the kind of research that will be done?

Beyond criticisms around the organisation of public debates, it soon seemed obvious for GMO promoters that the main question was in fact: "which kind of society are we going to build?" Debates after debates, they ended up considering that dialogue would never be possible. They first expected to find solutions to develop their products, but they soon realised that the opposition would always be strong. With the increasing number of reapers, they considered dialogue with opponents would not be possible anymore, and that no compromise could ever be found. Some GMO opponents shared the same feelings; "the debate became so radicalized, and arguments from each side so simplistic that dialogue was not possible anymore".

In fact, expectations around public debates were not the same for promoters and opponents. For promoters, debates had to help them work. They needed information to find how to conform to stakeholders' expectations. They expected a work plan. On the contrary, for opponents or majority of them, debates were a means for citizens to express their opinion on GMO's, which could not be nothing else than a GM-food refusal. In May 2004, opponents published a book whose title reflected this conviction: "Civil society against GMO, arguments in favor of public debate". The debate was seen as an opportunity for citizens to make their choice on the society they wanted to build. Opponents considered GMOs were above all else a political choice, and not a technical choice: "As soon as you consider GMO as a technical need, you cannot discuss it anymore; it is a way to bypass the debate".

Beyond activists' expectations, the following section will develop how public debates are composed, and how the general public is integrated in these initiatives.

REPRESENTATION OF DIVERSITY IN PUBLIC DEBATES

The table 1 compares the composition of membership for the Citizen's conference and the Parliamentary Commission. We can observe that

[13] Neutral organisations were composed of scientists, politicians, technicians, downstream industries and others (like insurers, lawyers and journalists).

proportion of neutral organisations had increased, and among them, scientists and technicians[14].

Table 1: Evolution in composition of Private Auditions in 1998 and in 2005

				Neutral			
	GMO-Promoters	GMO-Opponents	Neutral	Scientist[15]	Politician	Technician	Other
Citizens' Conference	0,26	0,18	0,56	0,24	0,03	0,11	0,18
Parliamentary Commission	0,09	0,14	0,77	0,40	0,14	0,23	0,00

Moreover, GMO opponents seem to be more auditioned than GMO promoters. However, as this Commission was divided in private auditions, private roundtables of experts, and public contradictory roundtables, we can observe (table 2) that GMO promoters were overrepresented in private roundtables of experts, and less represented in other debates, whereas GMO opponents were represented more in contradictory roundtables. Going further, GMO opponents interviewed during contradictory roundtables belonged to organisations whose position is quite moderate. In addition, one of them took part in three different controversial debates: on environment, health and economic issues. He has been therefore counted three times for the statistics.

Table 2: Representation of participants' positions on the Parliamentary Commission of 2005

	GMO Promoters	GMO Opponents	Neutral
Auditions[16]	0,09	0,14	0,77
Roundtables of experts	0,31	0,21	0,49
Contradictory Roundtables	0,16	0,27	0,57
Total	0,18	0,21	0,61

Finally, five themes (detailed in table 3) were covered in controversial debates. GM promoters were more represented for economic issues, but they were totally absent in debates around public information. GM opponents were more represented for legal issues, and less in debates on health issues.
Table 3: Representation of participants' positions in Controversial Debates of the Parliamentary Commission of 2005

[14] People working on ministries to give support on regulations
[15] If scientists can be considered by some activists to stand one-sided position, scientific deontology implies neutrality; then I classified all scientists as neutral.
[16] Sometimes, these auditions gathered more than one person. Here all people, either they were interviewed alone or not, were counted.

				Neutral	
	GMO Promoters	GMO Opponents	Neutral	Technicians	Scientists
Sanitary Issues	0,10	0,20	0,70	0,50	0,20
Environmental Issues	0,18	0,27	0,55	0,09	0,45
Legal Issues	0,17	0,33	0,50	0,25	0,08
Economic Issues	0,33	0,25	0,42	0,08	0,17
Media & Public information Issues	0,00	0,27	0,73	0,09	0,18

Apart from the representatives of organizations directly involved in the development of GM crops, the four public debates presented in this paper initiated the representation of the general public. This representation changed with the time (table 3). For Citizens' Conference, a panel of 14 people, randomly chosen, enabled to show "how informed citizens can reasonably speak about a complicated topic"[17]. This aim symbolises the underlying belief that GM opposition is based on misunderstandings and erroneous perceptions about GMOs. As described in the conference's report, countries which higher GM opposition are also those where general knowledge on GMO is described as being erroneous (according to a survey).

For the Wise Men Committee, the general public was represented by 120 people of whom a majority was students. Their role was to question experts. No one represented the general public for the Parliamentary Commission, and information is missing for the Grenelle Environment Forum.

The role of the general public is mainly a role of observers, at best of questioners. Their role in influencing the general discourse on GMO is quite minor, and their participation has been easier thanks to new technologies such as the Internet.

CONCLUSION

In this paper four public debates made on the GM culture and consumption controversy have been described. For each of these debates, the general public was differently represented. But, despite these initiatives to integrate the general public in discussions around technology choices, their role still remains secondary. But, as controversies go with diversity of opinions, they have at least to be contradictory to be accepted.

In this case, discourses have become more and more technical. Promoters were interviewed in their main competencies' field, but not the opponents. In addition, the diversity of GM opponents has decreased. Regarding these observations, public debates on controversy seem to be a means to get politicians back in the front place, and to highlight moderate positions.

[17] Quotations of the depute in charge of the Parliamentary Commission made by the journalists Catherine Vincent the 14th of February

Geoengineering and (un)making the world we want to live in

Rusi Jaspal
De Montfort University
rusi.jaspal@cantab.net

Brigitte Nerlich
University of Nottingham
brigitte.nerlich@nottingham.ac.uk

Geoengineering promises to alter global climate patterns and thereby avoid the potentially catastrophic consequences of climate change. Implementing various types of climate engineering options is a huge, but still mainly speculative, technological problem (Royal Society, 2009). It throws up immense political, governance, social and ethical problems. However, we should not forget that it is also a linguistic problem. As I. A. Richards (1965) stated in his *Philosophy of Rhetoric*, a "command of metaphor plays a role in the control of the world that we make for ourselves to live in" (p. 155). This means that we make the world we live in by the language we speak in it, especially through the use of metaphors. Metaphors make us see one thing in terms of another and encourage us to act in specific ways according to this new way of seeing. What does this mean for geoengineering? What language is emerging in the context of geoengineering? How might people respond to such language?

To explore these questions, we undertook two studies as part of a larger ESRC-funded project considering climate change as a complex social issue. In the first study (Nerlich & Jaspal, 2012), we examined a small body of articles published in trade magazines between 1980 and 2010, with the majority being published between 2006 and 2009. In a second follow-up study (Jaspal & Nerlich, 2013), we analysed a small sample of articles published in UK national newspapers between 1 January 2010 and 15 July 2013. Overall, the coverage of geoengineering lags far behind coverage of other geoscientific developments, such as carbon capture and storage (Nerlich & Jaspal, 2013) and fracking (Jaspal & Nerlich, in press), for example.

The findings of our first study indicate that those trying to promote geoengineering use a series of powerful metaphors circling around one master-argument, namely that if emissions continue to rise we face global catastrophe and geoengineering might be the only option left to avert it. The three main conceptual metaphors supporting this master-argument were:

(1) **The planet is a machine** *(car, heating system, computer)*, which manifested itself in scientists' and journalists' claims that geoengineering can 'fix' the planet, that it can be used to manipulate the planet's thermostat and so on;
(2) **The planet is a body**, which manifested itself in people talking about building a sunshade for the planet or applying suncream, sunblock or sunscreen to it; and

(3) **The planet is a patient**, which manifested itself in talk of applying medical treatment to the planet of curing the planet's addiction to carbon and so on.

The overarching argument was that the earth was seriously/catastrophically broken/ill and could only be fixed/healed by geoengineering.

Just after we had carried out the first study, the SPICE[18] project (which aimed to assess the feasibility of injecting particles into the atmosphere in order to manage solar radiation) was launched and attracted some media attention, especially after it was cancelled. We imagined that the language used to talk about geoengineering might change after this event. When we looked at the UK press coverage, we found a pronounced difference between right- and left-leaning newspapers. *The Times* and *The Daily Telegraph* (right-leaning) still displayed some of the optimism we had found in the trade magazines (and the scientists who were quoted in them), while *The Guardian* and *The Independent* (left-leaning) focused more on potential threats posed by geoengineering. *The Times* and *The Telegraph* constructed geoengineering as a last option in the war against climate change, as a palliative and a silver bullet (linking back to the conceptual metaphors used in the trade press). They also, and more importantly, began to normalise geoengineering, either by comparing it to sci-fi but pointing out that it was becoming a reality, by linking it back to successful experiments in cloud seeding, or by comparing geoengineering to everyday activities we take for granted, such as stepping into our cars. There was a suggestion that geoengineering had already been in progress for a long time, which served to minimise the uncertainties usually associated with it.

By contrast *The Guardian* and *The Independent* focused on the threats posed by geoengineering and argued that it distracts from climate mitigation - what others (e.g. Hale, 2012) have called the moral hazard argument - and by pointing to many uncertainties, both scientific and social. Some articles also framed the technology as 'fascist', which served to negativise it further and discourage engagement with geoengineering. This contrasts strongly with the normalising discourse emerging within the more right-leaning press.

Readers of press articles about geoengineering are confronted with a wide range of linguistic and metaphorical arguments and framings. These need to be thought through in terms of the world they might want to live in or be forced to live in terms of individuals and communities. This is not easy, as this technology is highly speculative, would be a global enterprise and would have very uncertain and unpredictable local impacts. As a means of understanding how people might respond to complex social and linguistic constructions of geoengineering, we have drawn upon Identity Process Theory (Breakwell, 1986). This social psychological theory argues that we need to maintain appropriate levels of particular "identity principles" in order to construct a positive identity:

[18] http://www2.eng.cam.ac.uk/~hemh/SPICE/SPICE.htm

• **Continuity** – thread connecting past, present and future and, at a group level, survival;
• **Self-efficacy** – control and competence over one's life and future;
• **Self-esteem** – a positive self-conception;
• **Distinctiveness** – differentiation from relevant others.

It is likely that metaphors which construct geoengineering as a danger to the human species could threaten people's sense of *continuity*, while those that normalise geoengineering could in fact safeguard our sense of *continuity* over time by denying that anything would change. Metaphors that depict geoengineering as the only means of regaining control of the planet's climate could bolster people's sense of *self-efficacy*. The notion that we are supporting a technology that could benefit our planet may help us to derive a positive self-conception, enhancing feelings of *self-esteem.* Our analysis of the press coverage exhibits the complexity of media representations of geoengineering. Although particular newspaper outlets may have a vested interest in representing geoengineering in positive or negative ways, journalists may be less aware of the impacts that media reporting can have for the aforementioned principles of identity. Ultimately, this may be pivotal in determining how the public engages with the issue of geoengineering.

It appears that we are more likely to endorse or embrace phenomena that provide us with high levels of these principles and to avoid or deny things that jeopardise our feelings of continuity, self-efficacy and so on (Jaspal, Nerlich & Cinnirella, in press). Thus, the metaphors which make us view geoengineering in terms of either threats or benefits to these principles are clearly important in shaping our perceptions and, ultimately, our future engagement with geoengineering at both individual and group levels. This is no trivial matter. As the sociolinguist Suzanne Romaine (1996) once argued, "it matters which metaphors we choose to live by. If we choose unwisely or fail to understand their implications, we will die by them."

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Mirror mirror, on the wall:
Fairness and justice in geo-engineering discourses

Duncan McLaren, Lancaster Environment Centre

Introduction

Geo-engineering appears an increasingly credible response to climate change. Yet geo-engineering discourses rest on speculative appraisals and scientific imaginaries. Frames within such discourses form cognitive triggers. Dominant narratives provide simple but potentially dangerous heuristics, while information 'framed out' is rarely considered.

This paper explores how geo-engineering has been framed in efforts to communicate to the public through the media, and to understand public positions through deliberative engagement. It aims to assess the extent to which issues of justice are considered or excluded.

Climate change is a key domain in which justice considerations should influence public policy. Yet as climate geo-engineering is emerging as a legitimate option in climate policy, issues of justice appear to be being largely overlooked, if not actively excluded.

Geo-engineering in the media

Media reviews highlight some common and evolving discourses and narratives. Those with the most salience include 'climate emergency' or 'catastrophe' (Nerlich and Jaspal, 2012; Buck 2012), 'scientific ambivalence' (Scholte *et al* 2013) and 'naturalism' (geo-engineering as a process with natural analogues) (Anselm and Hansson, 2013).

While Scholte *et al* (2013) find some opening up of a diverse set of discourses between 2006 and 2011, others find single dominant narratives. Nehrlich and Jaspal (2012) – assessing a longer period ending in 2010 - suggest that a dominant 'argument from catastrophe' closed down debate. Anselm and Hansson (2013) also find a hegemonic 'climate emergency' discourse before 2011, supported by storylines of 'political failure' and 'cynical industrial fatalism'. Such narratives construct a frame of 'political realism' in which mitigation remains inadequate.

Nehrlich and Jaspal find persistent use of technical and medical metaphors which suggest that geo-engineering would be practical. Anselm and Hansson also report a form of 'technological optimism' in analogies of geo-engineering and 'natural processes'. Buck consistently found geo-engineering framed both 'catastrophically' and 'managerially'.

Overall, media frames typically imply that geo-engineering would be practical and controllable ('technological optimism'); contrast it as a climate response with continued insufficient mitigation ('political realism'); and describe the decision as one to be made in the face of potentially catastrophic climate change ('emergency deployment'). While all the media surveys also report

opposition to geo-engineering and various forms of ambivalence, in the periods concerned these positive frames appeared dominant.

Justice in the geo-engineering media coverage

Justice does not appear in the media analyses as a significant topic. Searching the review articles for terms such as justice, fairness, equity, distribution, winners and losers, gains and losses reveals virtually no mentions of the concept, never mind discussion of its salience. It is as though the proposals were emerging on a 'clean sheet' where impacts of and responsibilities for climate change were not distributed and contested. In this respect the media coverage of geo-engineering research and proposals strongly reflect a 'rich country' framing of the wider climate debate.

Justice is not entirely absent from the media analyses. Only Buck (2012) explicitly reports on a justice heading, finding reference to justice concerns in just 12% of print media articles and about twice that proportion of internet articles, and noting that: "*even when it was present, it was rarely the dominant frame*" (p176). In other analyses it is often hinted at, especially in procedural forms related to governance, but never takes centre stage. We can therefore add 'a clean sheet' to the dominant framings.

The media surveys reflect a process in which discussion of geo-engineering has been normalised and justice excluded, regardless of the particular frames mobilised and the degree to which those frames are contested. Justice might be actively introduced by new discourse coalitions, but it may be better considered by more deliberative approaches to public engagement.

Deliberative engagement on geo-engineering

Several UK based studies have undertaken and reported on more deliberative forms of public engagement.

The Royal Society commissioned four public focus groups in 2009 (Shepherd et al 2009). Perceptions of geo-engineering techniques were generally negative, but complex and technique-specific. A range of objections were raised, including ethical ones, and procedural justice concerns over transparency and vested commercial interests featured strongly alongside concern over environmental impacts.

In early 2010 the Natural Environment Research Council in the UK convened a large scale public dialogue involving dozens of people in multi-day events in multiple locations around the UK. Arguably this 'Experiment Earth' process unintentionally reproduced the main media framings found above. It suggested, at best, reluctant support, conditional upon "*increased mitigation activities*" (Corner et al 2012, p457). Facilitators introduced 'emergency framing', 'political realism' and a comparative concept of 'naturalness' which strongly conditioned relative acceptability (Corner *et al* 2011). The use of technical experts and information also tended to sustain 'technological optimism'. However, ethical issues were also deliberately explored and ideas of both international and intergenerational equity featured in the conclusions:

"*The long term-consequences ought to be considered, as should the voices of those in the developing world*" (Corner *et al* p17).

Further public engagement dialogues were specifically conducted around the SPICE project (Parkhill and Pidgeon 2011). The research team actively sought to avoid the framing problems identified in Experiment Earth. Various concerns with stratospheric aerosol injection (SAI) were raised including distributional justice concerns such as the uneven distribution or inequity of the impacts, and the moral hazard for mitigation. The engagement also revealed concerns for procedural justice with emphasis being put upon transparency and participation for local communities in the vicinity of the test bed, alongside calls for greater transparency by the research councils.

Separately, Macnaghten and Szerszynski (2013) carried out seven homogenous focus group discussions focusing explicitly on the kinds of world that deployment of SRM might bring into being. Their participants typically rejected the view that SRM was likely to remediate the climate, expressing fears of unpredictable effects and (procedural justice) concerns about being the 'guinea pigs' for such an experiment. Even so, this study did not bring justice concerns explicitly to the fore. Three reasons might be suggested why. First, the scale of potential impacts suggested makes the stakes so high that distributional issues might appear insignificant. Second, highlighting inherent uncertainties perhaps acted to limit the space for consideration of consequences for justice. And third, the homogeneity of panels may have suppressed consideration of difference.

Implications and conclusions

The power of narrative is also an issue of justice. Those who construct the narrative and set the frames determine the scope and terms of any debate. Different perspectives and epistemologies are not admitted, or at least not on equal terms.

Framings of 'technological optimism', 'political realism', 'emergency deployment') and a 'clean sheet' have surrounded geo-engineering. These easily combine to normalise discussion of geo-engineering, making support for geo-engineering research, and potential future deployment, appear rational. They also tend to exclude questions of justice from the frame, with significant implications.

If the current generation postpones mitigation in the belief that geo-engineering is a reliable form of insurance against dangerous climate change, we would underweight the risks of failure, and transfer them - in the event of underperformance of geo-engineering - onto future generations with no opportunity to undertake adequate mitigation.

The 'emergency deployment' framing places decision makers on the horns of a dilemma (where neither choice is fair or ethical). And procedural issues such as transparency and public participation may be side-lined in 'emergencies'. Moreover, it downplays the distributional implications, implying such a large-scale problem that 'we are all in it together'.

‘Political realism’ not only normalises consideration of geo-engineering, but also underpins rejection (by geo-engineering advocates) of the idea of moral hazard. When there is ‘no progress on mitigation’, they ask, ingenuously, ‘how could it be made worse if we explore geo-engineering?’ Yet where engagement processes have weakened the ‘political realism’ frame, attitudes to geo-engineering have tended to be more sceptical (and moral hazard significant).

Political realism also rebuts any prospect of radical emissions cuts, denying ‘climate justice’. Similarly ‘a clean sheet’ excludes consideration of processes of underdevelopment, past responsibility for dangerous emissions and the role of vested interests in climate policy.

Deliberative engagement studies have only partly surfaced and explored such assumptions and frames. ‘Technological optimism’ and ‘emergency deployment’ have been challenged and examined in several studies, but ‘political realism’ and the ‘clean sheet’ have been much less thoroughly addressed, with the ‘clean sheet’ framing remaining largely hidden.

Three reasons might be suggested why justice still does not feature strongly in public engagement on geo-engineering.

- Facilitators and researchers unconsciously frame it out.
- It isn’t salient for participants, in that biggest potential losers (future generations) are not present.
- Subconscious priming guides participants within “public engagement in science and technology” to respond in scientific ways.

In Snow White, the mirror revealed the ‘fairest’ of all. In public engagement the mirror is a dark glass into which we peer when trying to understand public discourses and developing opinions on emerging technologies. To make it effective we must ask more questions about fairness and justice, challenge framings, and develop deliberative processes that can help answer those questions, not just with respect to the present generation, but also looking into the future.

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Lessons learnt from the SPICE field trial

K.A. Kuo, kan26@cam.ac.uk, University of Cambridge Engineering Department, Trumpington St, Cambridge, CB2 1PZ

ABSTRACT

The SPICE (Stratospheric Particle Injection for Climate Engineering) project began in late 2010 as one of two UK-government-funded research projects on geoengineering. The aim of this project is to reduce the technical uncertainty surrounding the use of stratospheric aerosols for solar radiation management. The SPICE research brief involved computer modelling, laboratory testing, and an outdoor field trial, which attracted significant public attention and was later cancelled due to lack of governance structures and intellectual property issues.

The primary lesson learnt from the SPICE field trial was that the physical scope of the trial could not be disentangled from the wider purpose of geoengineering deployment. The trial was a test of technology, designed to collect data on the movements of a tethered balloon under varying wind conditions, and as such was environmentally benign and did not involve climate manipulation. Both public and stakeholder engagement indicated widespread acceptance of the trial as an engineering test with minimal risk. However, it was the purpose of this trial, as a possible first step towards geoengineering deployment that raised significant concerns.

This entanglement raises three important issues:

1) The context of technological research is critical when making science public, and future applications cannot be ignored by scientists and engineers.

2) Engaging in the issues surrounding geoengineering research is reliant on transparency and accurate communication.

3) Any proposed future governance structure will need to address the blurred boundaries between research and full deployment.

INTRODUCTION

The Stratospheric Particle Injection for Climate Engineering Project, or SPICE, is one of two UK-government funded projects on geoengineering or ‘climate engineering’. We are a team of about 30 scientists and engineers, from a number of UK universities, who are looking at the feasibility of injecting reflective particles into the stratosphere to produce a global cooling effect. Current work involves computer modelling and laboratory studies on three aspects of climate engineering using stratospheric aerosols: the chemistry of candidate reflective particles; the technology needed to transport these

particles to the stratosphere; and the effect the particles will have on global and local climates.

Back in 2010 when it began, the SPICE project proposed a 1km outdoor field trial to investigate tethered-balloon technology (Figure 1). This “testbed” would be a 1km off-the-shelf hydraulic hose held up by a helium-filled balloon. A small volume of water was to be pumped through the hose and sprayed out underneath the balloon. The purpose of this test was to measure the motions of the tether and balloon in varying wind conditions, for use in validating computer models. These computer models would then be used to investigate the stability of a 20km tethered-balloon system, paying particular attention to the large drag forces produced in the jet stream. The testbed would have had no environmental effect, and was not considered to be a field trial of geoengineering *per se*, as it did not involve any form of climate modification. Indeed, this same test could have been legitimately proposed as part of, say, a meteorological research programme, without raising any debate. It was the context of this research, not the proposed activity, which was to become significant.

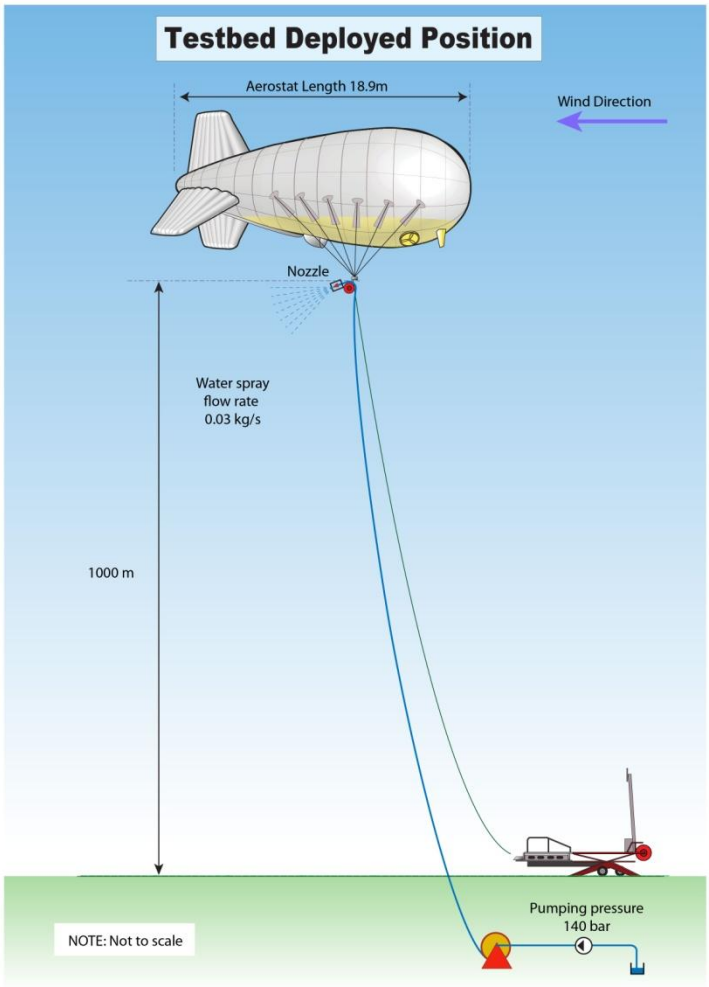

Figure 1. The proposed testbed for investigating tethered-balloon technology. (Copyright reserved, Kirsty Kuo, University of Cambridge).

TESTBED MANAGEMENT

To manage the preparation and delivery of the testbed, a stagegate process was implemented by the funding bodies. An expert panel was appointed to give an independent recommendation on whether the testbed should go ahead. The panel included representatives from the areas of responsible innovation, public engagement, media communications and engineering. The SPICE team was asked to demonstrate five criteria:

1: The testbed deployment is safe, the principal risks have been identified and managed, and are deemed acceptable.

2: The testbed deployment is compliant with relevant regulations.

3: The framing of the project (nature, purpose) for external communication is clear and advice regarding this has been obtained.

4: Future potential application(s) and associated impact(s) have been described and mechanisms put in place to review these as significant information emerges.

5: Mechanisms have been identified to understand wider public and stakeholder views regarding these envisaged applications and impacts.

The stagegate panel also considered the findings of the public engagement exercises carried out by Karen Parkhill and others, as part of the IAGP project (Pidgeon, et al., 2013).

The SPICE testbed team was made up of scientists and engineers, for whom dealing with risk management and compliance is a daily activity. But we had little expertise in addressing issues of communication, future applications and engagement. There were no resources in SPICE for this, and we relied heavily on the guidance and advice of various press offices and social scientists. The public engagement activities had highlighted the need for widespread dissemination of information on climate engineering and the testbed. It was clear that communication of the SPICE project was a hugely important aspect of engaging with geoengineering, and a communication plan was developed to facilitate this.

The SPICE communication plan had three aims:

1. To ensure the purpose and nature of the SPICE project is clearly communicated;
2. To inform stakeholders about the progress of the SPICE project;
3. To promote discussion of geoengineering in the wider scientific community.

The overall communication approach was centred on positive, pre-emptive interaction with national media outlets. To equip the SPICE team, a programme of extensive, tailored communication training was undertaken. We undertook scenario planning exercises that considered the strength and

positivity of any media response to the testbed and the SPICE project. A variety of media framings were considered, and plans for local community consultation and a national press release at the British Science Festival were implemented.

DISCUSSION

As expected, the SPICE testbed launch attracted much media attention, and the majority of media reports were factually accurate and promoted widespread, balanced discussion of geoengineering. In terms of what it set out to do, the communication plan was accomplished. However, there were still outstanding issues relating to stakeholder engagement, governance and intellectual property. These issues delayed the testbed past its original launch date, and ultimately led to the decision by the SPICE team to cancel the testbed (Watson, 2012). It became clear to us that despite the negligible environmental impact of the testbed, going ahead with it would set a precedent for outdoor geoengineering tests. The testbed would be perceived as a political statement of intent, and there was no governance structure in place that could manage this escalation of geoengineering research.

There are three important issues that we have become aware of as part of our SPICE journey:

Firstly, the context of technological research is critical when making science public, and future applications cannot be ignored by scientists and engineers. No experiment can be considered to sit in isolation from the wider focus of the research programme. The purpose and applications of the research (the question of why?) may be equally, or even more, important as the research methodology (the question of how?) in the minds of the public.

Secondly, engaging in the issues surrounding geoengineering research is reliant on transparency and accurate communication. For the public to be informed and to promote discussion of the advantages and disadvantages of geoengineering requires presentation of the current state of knowledge in a readily understandable form. Given the early nature of geoengineering research, and the uncertainties involved, this may entail more direct engagement between research scientists and stakeholders than is usual in other research areas.

And finally, any proposed future governance structure will need to address the blurred interface between feasibility studies and full deployment. There is a continuum in technology development that spans from computer modelling to full deployment, and discussions on geoengineering governance tend to focus on prescribing regulation by delineating this continuum into discrete stages (e.g. Parson and Keith, 2013; SRMGI, 2011). However, the SPICE project has illustrated this continuum is very strongly intertwined by the purpose and applications of the research, and proposed governance structures will need to address this.

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The Source of Magic

Sean Wilcock
s.wilcock@leedsmet.ac.uk
Leeds Metropolitan University

INTRODUCTION

Science fiction writers once promised us the shiny future of jetpacks and robot butlers, what Gibson (1981) summarised and critiqued as the Gernsback Continuum. This is the rational future, as discussed by Westfahl (2008), amongst others.

Fantasy is a related literature, containing both literary/genre works and folklore such as tales of Elfland. Elfland sits alongside our own world, inhabited by ethereal creatures which have magical powers. If a mortal strays into Elfland, he is liable to wake up with an ass's head, or find that a single night has passed to him, but a century has passed outside.

Fantasy stories generally do not have any explanation of how magic works or where it comes from. Gandalf never explained how entropy was reversed so he could return from the pit in Moria. I believe that in the West we have created an infrastructure of magic, an electronic Elfland, but there is more to it than superficial resemblances between programming and spells. What really matters is our relationship to that world. Furthermore, there is nothing that says that magic has to be supernatural in origin; it merely has to be beyond normal human inspection/comprehension. This paper explores the new incomprehensible Elfland that is being created.

UNUSABILTY AS MAGIC

The online environment can be chaotic and unpredictable. Internet based technology always changes, in an almost runaway spiral that makes it hard to follow (think of Facebook and its ever changing security defaults). Businesses constantly come up with new techniques, such as Co-ercive Monetization (Shokrizade, 2013) where the user is convinced to buy credits etc in a game, often without realizing it. It's not just individual sites that may (or may not) become unusable, but the way the different systems/sites work causes problems for users, as discussed in Nielsen (2011).

LANGUAGE AS MAGIC

In fantasy, magicians can often only remember a handful of spells and keep them on aged, curling yellow scrolls. How many passwords can you remember, and where do you store those you can't remember – on an aged, curling yellow Post-It note?

The name of God is often taboo and written ambiguously – YHWH instead of Yahweh. Rumpelstiltskin's name had power over him. On the internet, people are often anonymous or use pseudonyms. The username/password combination is a powerful new 'true name'. Identifying information becomes the essence of the self; identity theft becomes theft of part of the soul (or ka).

MAGIC BY DUALISM

The secular soul is all the information about one's self or 'the algorithm' that summarises all that you are (Salt and Threadgold, 1998). The software (the soul/algorithm) is pure concept that runs on physical hardware (the brain/computer): the ghost in the machine. The migration of our world online leads to the ultimate in Thatcherism, removing any need for physicality, for manufacturing or physical content, turning everything into an immaterial service. Sterling (2005, quoted in Doctorow (2005)) posited 'Spimes', objects which are part-real world and part-virtual. Think of a car that has its most vital details (MoT certificate, recall updates) stored in an online database. *Human beings are now Spimes with user id, password etc* and amenable to magical influence. I propose 'khat' and 'ka' for the real world and the data/immaterial parts of the Spime, drawing on Ancient Egyptian terminology for the physical body and an aspect of the soul.

MAGIC BY NON-HUMAN AGENCY

Systems were once relatively simple and staffed by humans. Now, we have longer supply chains with automated sections which are often not amenable to inspection. Human systems, such as legal and governmental proceedings, *are* more amenable to inspection and validation. Where is the equivalent of Hansard for the algorithm that denied you credit? You can't appeal to a mortgage algorithm's sense of shame.

MAGIC DUE TO GLOBALISATION

Different jurisdictions mean different laws, terms of service etc. EG Which libel laws apply – strict UK laws or more lenient US ones? This is like having different gods in different cultures. Which gods do we worship, which pantheon holds sway here, and how do we appease them?

MAGIC DUE TO FUNDAMENTAL LIMITATIONS

Godel's Incompleteness Theorems and Turing's Halting Problem both say that we can't predict what will happen with formal (computer) systems. Chaos theory tells us there is a sensitive dependence on initial conditions, aka the Butterfly Effect. Imperfections in algorithms can lead to the ludicrous situation where a textbook can be algorithmically listed on Amazon for literally millions of dollars (Eisen, 2011).

THE GODS AND NON-HUMAN ENTITIES

Today, you use our magical talisman to commune with the god Tesco, and he sends one of his minions to your home with a bountiful cargo of 'crops'. From a solipsistic viewpoint, you have cast a spell and your desires have been met. However, who understands the supply chain that creates the magical objects we use? What happens when the magic goes wrong, as it often does

somewhere along the supply chain of djinns and daemons? You eat horsemeat burgers.

According to Frazer (1890/2003: chapters 3 & 4), a god is any entity bigger than yourself which you have to appease and which is incomprehensible. That could apply to any large organisation. I also consider a god to be anything which provides or maintains what I call 'the infrastructure of reality' or 'the infrastructure of existence'. Believers of the Abrahamic religions say that Jehovah, God or Allah created the universe in which we live. Doesn't that accurately describe the set-up on the internet and the web, with the various networking companies, giants like Facebook creating a new social reality and Google its indispensable utilities? Remember, though, all gods eventually ask a price. You must appease the new gods by granting access to information about yourself: your likes, your favourites, your friends etc. You could call this your soul or your spirit (ka), as it is a non-corporeal part of you that has value to yourself and others. We do call the crime 'identity theft', and in a religious or spiritual sense there is nothing as unique an identifier as your 'soul'.

FRAZER ON MAGIC

Frazer (ibid) says that there are two principles of magic:

> "…first, that like produces like, or that an effect resembles its cause; and, second, that things which have once been in contact with each other continue to act on each other at a distance after the physical contact has been severed. The former principle may be called the Law of Similarity, the latter the Law of Contact or Contagion."

If you think of the Google cache and the NSA's PRISM project, where what you have done in the past can be linked to every other thing you have done, you can see that the Law of Contagion works – at least in some big database. Frazer (ibid) also states,

> "PERHAPS the most familiar application of the principle that like produces like [Similarity] is the attempt which has been made by many peoples in many ages to injure or destroy an enemy by injuring or destroying an image of him, in the belief that, just as the image suffers, so does the man..."

This image now includes the internet persona or representation of the person, not just a wax doll, which can be attacked more easily. Think of the recent Lord McAlpine case (BBC, 2013), where unfounded attacks were made via Twitter on the public perception of a man, and his reputation was very nearly ruined. Identity thieves use data to create simulacra of people to pass very simple Turing Tests and gain access to their bank accounts. Amazon's 'People who bought this also bought that' recommendations work by similarity.

Dualism + Random access to data + Automated processing => Frazer's two laws of magic.

CONCLUSION

The state of mind: enforced non-rational ways of interacting with the environment	The situation: an unbridgeable gap between people and technological environment
Unusability	*Non-human agency*
Dualism	*Gods and non-human entities*
Language	*Globalisation*
	Fundamental limitations

Table 1: The human mind versus the technological environment

The physical world is well understood, but the online world is truly alien. If the online Elfland makes us behave non-rationally by unusability, dualism and the magic of names, and if there is a gap between ourselves and this environment that we cannot bridge, then I believe we are in a mental state where historically our only sensible response has been to start appealing to the 'gods' for help – unless we can tackle one or both of these two categories: the state of mind or the situation.

My conclusion is that to understand the present and near future, we should look to the fantasy of authors like Jack Vance, Michael Moorcock, Ursula Le Guin etc, and not so much to science fiction. The rational, 'Star Trek' consensus future will not come to pass if we are living in a world where human beings are spimes, the human mind is conditioned to accept a non-rational environment and the laws of magic really work.

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Producing a Public Image for the Human Genome Project: Comparing the Greek to the International Experience

Constantinos Morfakis, cmorfakis@phs.uoa.gr, Department of Philosophy and History of Science, National and Kapodistrian University of Athens, Greece

The Human Genome Project (HGP) was heralded as one of the most important scientific events of the twenty-first century. In this context, June 2000 saw the triumphal announcement of the completion of the human genome ‘‘working draft’’. The HGP coverage by the media resulted in considerable public attention. This key international scientific project has actually been communicated as an exemplar of science leaving academic laboratories to make contact with new spheres of social needs (Costa 2003).

The purpose of this paper is to present a review of the first results of a study that focuses on the public image of the HGP, as produced through the most popular Greek newspapers. We consider the media framing of the HGP, emphasizing the role of the metaphors used in Greece, in order to shape this public image. We pay special attention to metaphors that depicted a close interaction between biotechnology and information technology. We do so based on the study of a series of selected photographs, sketches and drawings, which were used so as to produce a specific public image for HGP. Throughout the paper, we aim to compare explicitly the Greek and the international experiences producing the public image of the HGP.

What then is the rhetoric with which the HGP and the sequencing of human genome are presented? The analysis of publications showed that the most popular Greek newspapers presented the HGP as a technoscientific fact, a revolution in the field of bioscience and biotechnology. The dominant rhetoric and the media framing of HGP in Greek newspapers highlighted the usefulness and benefits that will result from this field of medicine and the treatment of diseases, and general self-knowledge of human. While references to economic and ethical considerations are not absent, which sequencing of genome affects, the dominant news rhetoric produced for the HGP remain those of technoscientific progress.

Moreover, comparative research showed that the media coverage of HGP in the most popular Greek newspapers generally follow the standards of the media coverage in the international press. Similar to the international press the Greek newspapers show: a) the announcement of the completion of the human genome “working draft” in 2000 combined with a media fanfare being presented as a scientific revolution and promising medical advance, b) the quantitative analysis showed that the most popular newspapers internationally continuously increase the articles on the HGP, starting in 1990 and reaching its peak in 2000 and the Greek newspapers follow this bell curve coverage, and c) the linguistic metaphors used for the sequencing of human genome over time tried to promote a public euphoria, which emphasizes the projected benefits for care and medicine, although concern about the social and ethical aspects of the discovery were also reported.

However one of the most significant differentiations that we detected relates to the fact that the Greek newspapers overemphasize contribution, however minor this is, of Greek scientists in achieving these important technoscientific breakthroughs. One of the most striking examples is the projection of Greek origin Aristides Patrinos, one of the three in charge of the HGP. While the international press is dominated by the figures of Francis Collins (Director of the US National Human Genome Research Institute – NHGRI) and Craig Venter (founder of Celera Genomics) the Greek newspapers overemphasize the role of Greek origin Aristides Patrinos (Dr. Patrinos worked at the US Department of Energy – DOE. His accomplishments include the launch and management of DOE's portion of the US Global Change Research Program and his contributions to the international effort known as the HGP).

To be more specific, using the framing typology for biotechnology by J. Durant, M. Bauer, and G. Gaskell (1998), which is enriched by Matthew C. Nisbet and Bruce V. Lewenstein (2002, p.359-391), an analysis of the publications of Greek newspapers showed that the dominant framing of the HGP and the sequencing of human genome, includes the following media frames in order of importance: a) the frame of techno-scientific progress and the utility derived from it, b) the frame of ethical concerns, risks, and public accountability and c) the frame of economic outlook and competition.

Another important point highlighted by the survey is that linguistic metaphors and rhetorics used by reporters, and by extension the public perception of the HGP and the sequencing of human genome, in a great degree, is largely harboring a genetic determinism. An extract of article in a Greek newspaper demonstrates this tactic: “The exact mapping of the sequencing of the three billion nucleotide bases that make up human chromosomes will answer with certainty the question, which genes are responsible for 4,000 hereditary diseases, paving the way for their treatment” (*TO VIMA,* 30 January 2000). This practice, however, created false image about the role that the genome plays in forming the human being. We observe that genetic determinism is stronger when the articles are written by journalists when the authors though are scientists they use expressions that balance the role of the genome in the formation of a human being.

Also, the image on the genome, as shaped by the articles of the most popular Greek newspapers highlights the close interconnection and parallel development of Biosciences and Informatics. In one of the related specials in a Greek newspaper, about the relationship of biotechnology and informatics we read the following extract: *“*The completion of the first phase of the Program for the Human Genome Project opened wide the way for the longevity of one of the most successful collaborations in decades: the cooperative computing and biology showed once again, which scientific and technological issues will dominate in the near future” (*TO VIMA*, 28 August 2000).

This can be perceived also through the changes in the public image of the bioscientific laboratory. Specifically, looking on a long term the photos published in newspapers we observe the transformation of the bioscientific

workshop from the classic laboratory (image 1), with microscopes, pipettes, vials and test tubes in modern laboratory (image 2) with last generation computers proccessing data analysis in high speed and automation of analytical procedures and handling of the genome. In a feature article of 2000 we read: *"*To date, scientists, performing experiments in vitro, (in the glass, in the test tube) and in vivo (animal), were seeking a gene and the protein resulting from this. Today, when the genome sequence of all genes is known (or at least will be soon), biologists perform experiments in silico (with the aid of computers). The bioinformatics, the science that resulted from the marriage of biology and computing, developed in parallel with the evolution of the human genome project and is now a prerequisite for the development of biology as a whole*" (TO VIMA*, 9 July 2000)*.*

Το ανθρώπινο κύτταρο ήταν πάντα «ο μεγάλος άγνωστος» στα βιολογικά εργαστήρια του κόσμου

Image 1

(Source**:** Anon, 1986. Solution to 'eternal mystery' of life. Incredible scientific conquest in the study of cell. *TA NEA,* 23 February p.38.)

Image 2

(Source**:** Soufleri, J., 2000. The revolution in biology. For the next 200 years there will be no biologist whose work is not affected by the results of the human genome project. *TO VIMA,* 4 June p.58)

In addition, the dominant linguistic metaphors on the genome identified in the articles of the most popular Greek newspapers are those of the genome as a code, map, language, and the book of life, and which were used in order to emphasize the positive benefits that will result from the sequencing of human genome. These linguistic metaphors have been adopted largely in articles of the international press (Nerlich, Dingwall and Clarke 2002, p.445-469; Nerlich and Hellsten 2004, p.255-268; Calsamiglia and van Dijk 2004, p.369-389; Doring 2005, p.317-336; Hellsten 2005, p.283-297).

Finally, the analysis of the illustrative material, such as portraits of bioscientists, photos from the 2000 announcement on the sequencing of human genome, series of digital compositions and sketches on the most popular Greek newspapers, proved that it plays an important role in shaping public perceptions on the analysis of the genome (image 3-6). The illustration material creates strong emotions, causing strong impressions and often combines images already been imprinted by readers from other sources, such as cinema, literature of science fiction and public culture.

ΤΟ ΜΕΛΛΟΝ ΤΟΥ ΑΝΘΡΩΠΟΥ ΕΙΝΑΙ ΕΔΩ

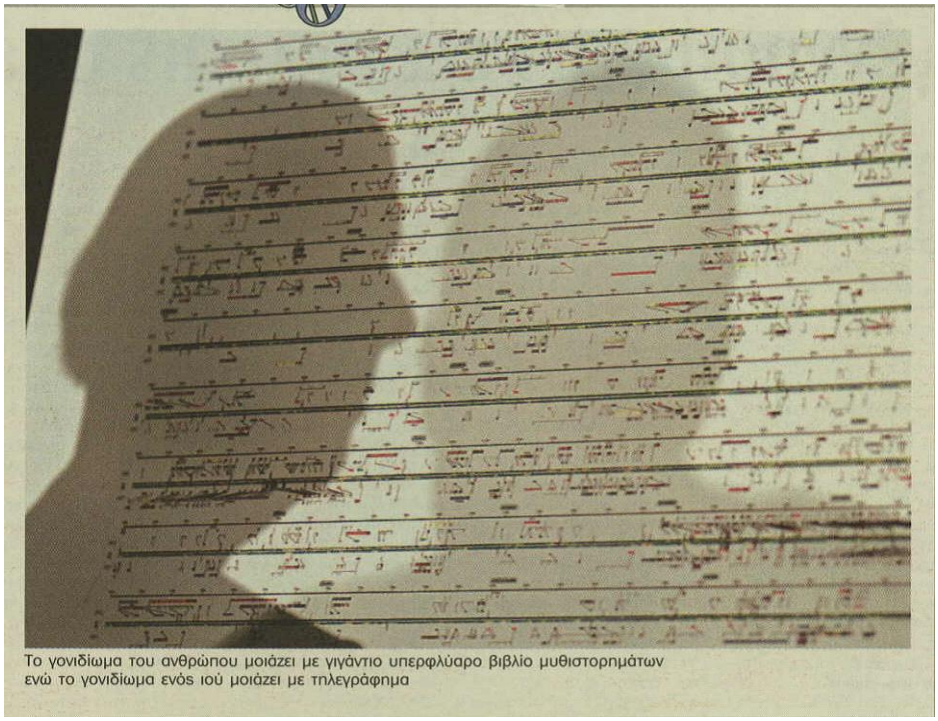
“Ο άνθρωπος διαβάζει τη γλώσσα που χρησιμοποίησε ο Θεός για να δημιουργήσει τη ζωή!..”

Τι είπε για την ανακάλυψη ο πρόεδρος Κλίντον

Ο αμερικανός πρόεδρος **Μπιλ Κλίντον** (στο κέντρο) έχοντας δίπλα του τον **Φρανκ Κόλινς** (αριστερά), επικεφαλής του κρατικού προγράμματος «Ανθρώπινο γονίδιο», και τον **Κρεγκ Βέντερ**, πρόεδρο της ιδιωτικής Celera Genomics Corporation, ανακοίνωσε χθες στον Λευκό Οίκο ότι ολοκληρώθηκε η αποκωδικοποίηση του DNA. Στην τελετή παρενέβη με δορυφορική σύνδεση και ο βρετανός πρωθυπουργός **Τόνι Μπλερ**. Ακολούθησαν κατά τη διάρκεια της ημέρας ανάλογες ανακοινώσεις και σε άλλες χώρες – Βρετανία, Γαλλία, Γερμανία, Ιαπωνία και Κίνα – οι οποίες συμμετέχουν στην έρευνα. Οι συνέπειες «του σπουδαιότερου χάρτη που κατασκεύασε ποτέ ο άνθρωπος» στην Ιατρική, στη Βιολογία αλλά και στη Φιλοσοφία θα είναι τεράστιες.

Image 3

(Source**:** Anon, 2000. The future is here. What he said about the discovery President Clinton. *TO VIMA*, 27 June p.1)



Το γονιδίωμα του ανθρώπου μοιάζει με γιγάντιο υπερφλύαρο βιβλίο μυθιστορημάτων ενώ το γονιδίωμα ενός ιού μοιάζει με τηλεγράφημα

Image 4

(Source**:** Tsaftari, A., 2003. The grammar of DNA. *TO VIMA,* 2 March p.152)

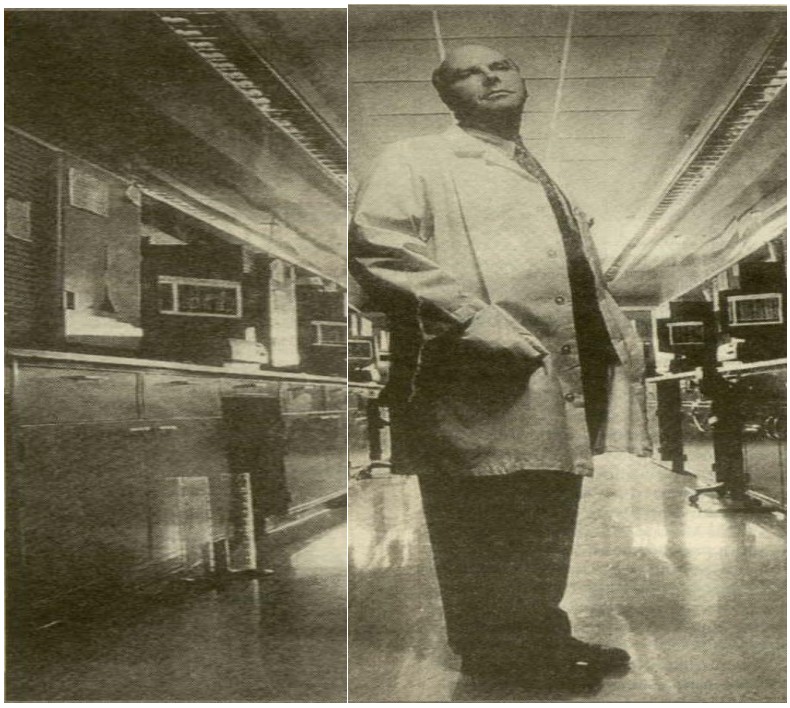


Image 3

(Source**:** Galiatsatos, P., 2000. Craig Venter. *TA NEA,* 22 April p.178-179)

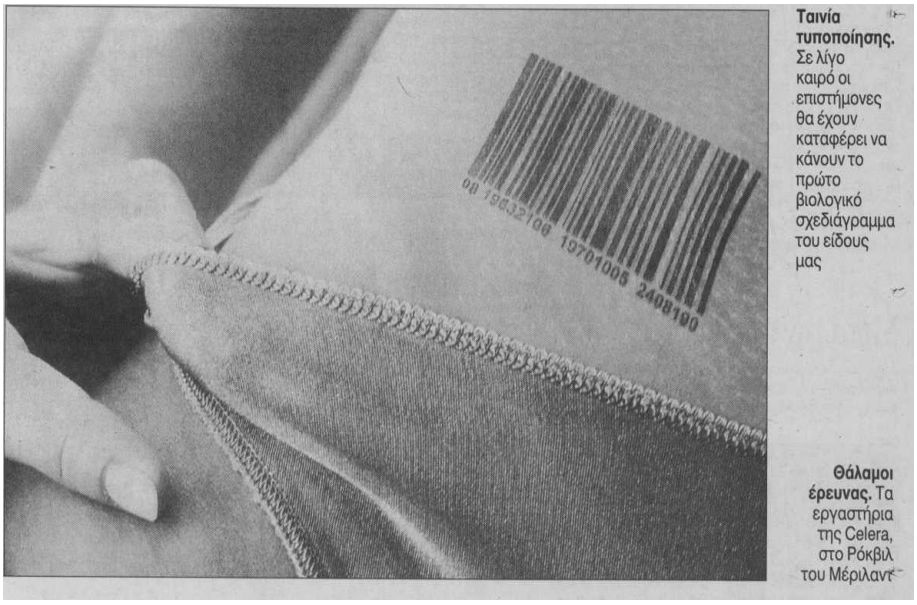


Image 6

(Source**:** Anon, 2000. In the footsteps of the genetic code. *TA NEA,* 24-25 June p.77)

In conclusion, the public image of the HGP in the most popular Greek newspapers is a reproduction of the relevant public image of the international press: the HGP and the sequencing of human genome is a revolution in the bioscience. This reproduction is largely due to the fact that the most popular

Greek newspapers prefer to republish articles on science and technology from the international press. Furthermore, there are relatively few specialized in science journalists engaged, who can produce and publish their own in-depth articles. Finally, minor variations in the public image of the HGP are mainly due to the adjustment of foreign publications in the local cultural context.

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‘Responsible Research and Innovation’: Construction of a new European value?

Stevienna de Saille
Research Fellow, Making Science Public
University of Sheffield

The re-framing of the Lisbon strategy of 2000-2010 as the Innovation Union initiative (2010-2020) brings a number of ideas developed through the Science in Society programme into the centre of European politics. One of the most recent developments has been the emergence and operationalisation of 'Responsible Research and Innovation' (RRI) as a discourse to further Lisbon’s unfulfilled promise to make Europe ‘the most competitive and dynamic knowledge-based economy’ in the world by 2010 (COM(2005) 24 final). While RRI supports the Innovation Union’s attempt to produce deeper integration through completion of the European Research Area (ERA), it is also tasked with promoting upstream engagement of a wider range of stakeholders as part of Lisbon's commitment to more transparent and inclusive governance. As such, it has the capacity to be an innovative form of upstream engagement in policy-making in its own right. However, its transformative potential has also been mediated by its origination within a context of severe economic crisis.

Drawing largely from European Union (EU) publications -- including technical reports, directives, historical summaries, newsletters, and informational brochures aimed at the general public – the paper presents the results of a scoping study outlining the conditions in which RRI is being developed and deployed under the rubric of ‘European values’. Does the incorporation of a demand for social benefit increase or lesson the tensions inherent in policies which tie allocation of public research funds to increasing GDP as the dominant measure of economic health? Is RRI truly a new (or even truly European) value, or – like ‘green business’, ‘sustainable development’, ‘ecofriendly’, and other previous buzzwords – is it simply promoting business-as-usual by a more attractive name?

METHODOLOGY

This paper forms part of the background research for a subproject on understandings of RRI across the spectrum of stakeholders engaged in UK research around the 'Grand Challenge' of healthy aging, which is part of the Leverhulme project *Making Science Public*. Although drawing on several decades of work on public engagement with technological governance, as an EU policy concept 'RRI' is relatively new. It was therefore decided to do a scoping study of documents contributing to its emergence, rather than a traditional literature review. As Arksey and O'Malley (2005: 21-22) have suggested, this may be more useful when breadth, rather than depth, is required to examine the 'extent, range and nature' of a new or ill-defined area.

Data was initially gathered by using the EU Bookshop[19] as an online search portal, starting with keyword searches for 'responsible+research+and+innovation' and 'european+research+area', and adding supplementary material from the Bookshop, the Europa portal, and EUR-Lex as relevant. A database of 123 documents was created from this process. Of these, thirteen (from 2011-2013) discussed RRI, although only five can be considered formative in the sense of supplying working definitions or concrete recommendations, suggesting that even in the EU, RRI is still extremely ill-defined. The focus of this paper will therefore be contextual rather than substantive.

RRI WITHIN THE ERA

As a solution to the 'European Paradox', or the inability to translate European research into products and services for the market, the Lisbon Strategy (Lisbon European Council 2000) advocated the creation of a European Research Area (ERA) in which there would be free movement of researchers, greater integration of industry with academia, and a rise in research intensity to 3% of each MS's GDP in order to increase Europe's global competitiveness. In addition, innovation was seen as hindered by failures of scientific communication, such as continued public resistance to GM crops. At the same time, the EU was also seeking solutions to a series of crises of political legitimacy, from national votes against the Maastricht treaty in 1992, to the forced resignation of the Santer European Commission under accusations of corruption in 1999. The *White Paper on European Governance* (COM(2001) 428 final), later formalised in the Lisbon Treaty, stated that:

> Legitimacy [of the EU] today depends on involvement and participation. This means that the linear model of dispensing policies from above must be replaced by a virtuous circle, based on feedback, networks and involvement from policy creation to implementation at all levels (*ibid*: 8).

Throughout the 2000s, therefore, there has been considerable overlap in discourse between the need for transparency and inclusiveness in creating policy for governance of risky new technologies (see Felt and Wynne 2007), and policy for governing the EU (see Schmitter 2006). For example, *Rationales for the ERA* called for a 'clear purpose which is meaningful to Europe's citizens and political leaders' to create a 'compelling case for a real shift of resources' (EC 2008a: 4) to increase the STI budget for the next Framework (2014-2020) and stimulate growth of a knowledge economy by completing the ERA.

By the time the Lisbon Treaty came into effect in 2009, the economic crisis was underway and 'innovation' had become the driver for '*a New Renaissance'* in which the (still incomplete) ERA would become a 'beacon of excellence visible across the world', bringing jobs, stability and economic growth (EC 2009: 24). This increasingly singular emphasis on 'innovation' as

[19] <https://bookshop.europa.eu>

the answer to the economic crisis and to global challenges such as climate change, energy, and aging populations -- as well as solving the European Paradox – has now been enshrined in the Europe 2020 policy structure as the Innovation Union flagship (COM(2010) 546 final), opening a space for change in the governance of public funds used for STI.

Although defined differently by different authors in the details, (see Stahl 2012; Owen, Stilgoe, Macnaghten*, et al.* 2013; von Schomberg 2013) there is a general agreement by its proponents that *responsible* forms of innovation should be aligned to social needs, be responsive to changes in ethical, social and environmental impact as a research programme develops, involve the public in decision-making, and promote innovation in accordance with 'European social values'. This builds on years of public engagement projects under the Science and Society (later Science *in* Society) theme of the Framework Programmes, particularly in the field of nanotech. The policy concept, 'Responsible Research and Innovation', however, has a very specific emergence point at the EC, via a workshop hosted by the Directorate-General for Research and Innovation on 16-17 May 2011, which sought to bring members of DG Research together with a carefully selected group of research funders, consultants, and academics, in a creative attempt to address the growing tension between 'innovation' as the provider of jobs and economic growth, and 'innovation' for socially and environmentally responsible ways to provide for Europe's basic needs. Using a number of different mechanisms for brainstorming, consultation, and priority-setting developed under earlier participatory engagement projects, and publishing an informal, photographically-illustrated *Newsletter* (EC 2011) to document the proceedings, in effect the workshop was an attempt to innovate a new form of upstream engagement with the European Commission, which normally meets behind closed doors.

The 2011 workshop was followed by a more comprehensive high-level conference, *Science in Dialogue - Towards a European Model for Responsible Research and Innovation*, which took place in Odense, Denmark in April 2012, during the Danish presidency of the EU. The conference suggested the possibility of an even wider vision for RRI, as a form of two-way science communication which could itself become a European value (scienceindialogue.dk 2012: 27). This idea was developed in the chapter discussing RRI in *Ethical and Regulatory Challenges to Science and Research Policy at the Global Level* (EC 2012a) which suggested RRI as producing European *exchange* value through export as a global ISO standard.

The result of all these discussions were finally 'announced' to the public in a short informational leaflet, *Responsible Research and Innovation: Europe's ability to respond to societal challenges* (EC 2012b), which promised 'a smarter, greener economy, where our prosperity will come from research and innovation…[which] must respond to the needs and ambitions of society, reflect its values and be responsible,' [20] thus reflecting the Commission's attempt to meld both concerns. The leaflet lays out the six 'keys' of RRI as

[20] Drawn from Commissioner Maire Geoghegan-Quinn's speech to open the Odense Conference.

now framed by DG Research: (1) inclusive engagement, (2) a commitment to gender equality, (3) more science education, (4) ethics as shared values reflecting fundamental rights, (5) open access to data, and (6) developing new models of governance. In other words, these correspond almost entirely to the goals enshrined in the *White Paper on European Governance*, and go no further. As such, therefore, these 'keys' are not necessarily specific to RRI or even to STI policy, but are broadly the result of legal changes to governance of the EU in general enshrined in the Lisbon Treaty, and to evolution in the understanding of 'citizenship' (see EC 2013). Additionally, RRI has been welded, through Horizon 2020, to the slogan of 'Smart, Sustainable, Inclusive Innovation' and to Europe 2020's overarching goal of facilitating a 3% growth in GDP. For this reason, perhaps, RRI as an expression of 'European values' has so far been reduced to a requirement for public engagement to encourage acceptance of innovation in Horizon 2020 (where it is mentioned at all), losing its socially and environmentally protective commitments.

In particular, RRI has lost the ability to question the purpose of innovation and to suggest that certain trajectories of research should not be pursued, both key points for those arguing for the development of a framework able to integrate both ethical and market concerns (Owen, Stilgoe, Macnaghten*, et al.* 2013; von Schomberg 2013). It is also unable to acknowledge the inherent conflict between exhortations to increased innovation, and the environmental impact of the increased consumption required to fill Europe 2020's demand for a 3% rise in GDP, or the likelihood of Horizon 2020's commitment to increase 'excellence' through concentrating larger grants in fewer hands exacerbating the gap between a well-funded global elite of researchers and a large pool of precariously employed 'flexible' workers. This may mean that although the impetus behind the 2011 RRI workshop leant towards defining 'responsible' through producing an ERA 'for society, with society, by society' (EC 2011), there is a danger it may instead be used as a tool for legitimising the desire of the European Council to promote growth at all costs.

To sum, although the impetus towards creating an RRI framework was a reflection of 'responsibility' as a moral imperative to make STI policy socially beneficial as well as environmentally sustainable, pressure from other directives has increasingly channeled 'beneficial' into economic concerns. The articulation of RRI as an expression of 'European values' has therefore become normative, aligning a demand for economic growth through high-tech solutions to social problems with the social values enshrined in the *Charter of Fundamental Rights*, rather than supporting more radical interpretations of 'European values', such as strong environmental protection, public ownership of infrastructure and key services, and the maintenance of a welfare state.

To a large extent, this appears to be a result of unreconcilable purposes, a formative tension inherent in the application of 'responsibility' to innovation, which are further complicated by the difficulties of creating mechanisms for public engagement which confer actual involvement in policy decisions in a supranational, multi-institutional structure such as the EU. However, perhaps most important in terms of its call for responsivity and engagement from beginning to end of the innovation process, as presently formulated in EU

policy documents it is unclear how RRI can help the Commission navigate negative findings. As Owen *et al.* (2012) argue, RRI must have the capacity to change the trajectory of innovation, to slow the pace or even cease funding, regardless of the effect on GDP, if it is to be truly responsive to public values and needs. This would be one of the great strengths of RRI, and something that would make it, as a policy framework, a truly European innovation.

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Solar Energy in Future Societies: The pull of 'the local' and the future of photovoltaic technology

Alastair Buckley*[1], Anna Krzywoszynska[2], Matt Watson[3], Prue Chiles[4], Helen Holmes[1,3], Nicky Gregson[2], Jose Maywin[1]
[1] Department of Physics and Astronomy, University of Sheffield
[2] Department of Geography, University of Durham
[3] Department of Geography, University of Sheffield
[4] School of Architecture, University of Sheffield
* alastair.buckley@sheffield.ac.uk

Advancement of technology is considered integral to all routes leading to the decarbonisation of the global energy economy. Future technology promises solutions to climate change and energy security in the face of dwindling fossil fuels and public concern over nuclear energy. Future technology is also seen as central to more efficient generation, conversion and use of energy. The UK energy research council 2013 "route to decarbonisation" discusses "wholesale transformations" enabled by "electrification" (UKERC 2013) in which greater efficiency is the key driver. As part of these technology based energy systems aspirations, solar photovoltaic (PV) technologies have received huge research interest over the last 10 years with new technology promising to revolutionise the economics of PV in order to significantly accelerate deployment. New cell technologies that have lower cost and lower embodied energy are a central component in the energy transformation promise (for example see Espinosa et al. (2012)). In parallel there is a growing understanding and interest in public engagement with emerging technologies before they become materialised and locked into particular deployment trajectories (Macnaghten *et al*. 2005). Such work defines the need for engagement with potential future users of a technology, at an early stage; to understand the issues pertinent to the users and future or existing owners of such technology. In this way full benefit can be gained from a new technology.

Here we discuss the early findings of work to explore the synthesis of solar cell research with the hypotheses that involving "a public" in discussions about future technology use could result in producing 'better' technology. This research project attempts to investigate what 'better' technology would be in a situated context of a particular neighborhood. Working with an interdisciplinary team of researchers we are looking at "how" it could be better, "for whom" and in "what" ways.

The initial research was dominated by finding and gathering "a public" situated in a particular locality. The main event for this was a meticulously planned event, described below, with a large and dramatic physical model of the area describing and exhibiting solar technologies. We then devised a series of collaborative workshops, each time centering around various creative participatory techniques to exchange questions and knowledge. A pre-prepared workbook of inspirational case studies and summaries of the discussions and emerging ideas was sent around a couple of weeks before

the workshops. The overall aim was to bring together the interests of the participants (in the future of their neighbourhood) and of the researchers (in the future of solar energy technology) in order to exchange learning and knowledge relevant for future photovoltaic technology development. Local knowledge is fundamental to understanding both the energy resource of the neighbourhood, and the social, cultural and historical contexts of the use of energy and energy generation technology.

We were clear to all participants that our methodology is a public experiment and may fail.– it is open-ended and formed on the basis of dialogue between scientists and non-scientists, or institutional researchers and 'researchers in the wild' (Callon et al. 2009)The participants to this research were initially recruited through an exhibition and event themed 'Neighbourhood 2050: your energy vision for the future of the neighbourhood'. The exhibition was inspired by *Making Things Public*, an exhibition curated by Latour and Wiebel in 2005. The guiding idea of *Making Things Public* was that objects have the capacity to provoke reactions, and that they can serve as starting points for socio-techno-political debates. We also took our cues from existing literature on energy, particularly in the practice theory vein, to think about energy not as an 'object' but as a key element of life in homes and neighbourhoods. To facilitate conversations as well as non-verbal play, we put together interactive exhibits which approached the issue of energy technology at a number of scales. The uniting theme was the energy future of a particular neighbourhood, and the place of renewable energy technologies in that future.

The participants recruited through the exhibition have since been participating in a series of workshops. The first Workshop was structured around future-oriented scenarios, and included the presence of academics as advisors. In the following workshops, the academics were incorporated into the workshop groups to facilitate knowledge exchange. In the second Workshop, participants were asked to identify their key areas of interest in the context of the energy future of their neighbourhood. This resulted in a creation of five research groups around the themes of transport, education, local food production, local energy generation, and the sustainability of community buildings. Overarching concerns about environmental change, energy sustainability, and the place of renewables were embedded in these projects. However, as the work around the themes progressed in further workshops these macro concerns were sidelined by urgent local issues (such as controversies around particular renewable energy technologies, closure of public facilities, availability of waste heat from local industry, etc.). This also resulted in a desire to see 'real outputs' out of the work done in the workshops – i.e. to effect change in the neighbourhood.

As a result of the strength of local concerns, keeping the future of photovoltaic technology 'in the conversation' is an ongoing challenge. We did not go into the process of engagement with expectations of a 'pure' exchange reflecting Habermasian theory of communicative rationality (Van Oudheusden 2011). It was therefore not a surprise to find that the discussions of groups of participants were shaped by pre-existing knowledge, power relations and discourses, as well as collective group dynamics. Indeed, we took an open

approach to the development of the process, with each workshop shaped by the last and seeking to empower participants in the shaping of the research questions and potential projects. Nevertheless, the extent to which PV continually escaped the conversation has been a key learning experience, for the university research team.

The power of 'the local' felt in our research does not foreclose employing participatory methodologies in the context of 'upstream' engagement. Future technologies will always only find implementation into places, by acknowledging that engaging with emplaced residents is necessary as a part, at least, of understanding the sort of complex and always locally specific networks of social, cultural and political, as well as technical, relations into which a future technology will have to be integrated. Indeed, when asking about the future of technologies and working with a community of interest gathered around the future of a place, we can test the drive to consensus prevalent in deliberative methodologies, and explore agonistic modes of imagining socio-technical futures, in which multiple versions of such futures are explored at the same time, for example.

In relation to solar PV energy generation and solar cells, two examples are explored in this paper. In both cases the context of PV was used by the participants as a tool to achieve discussions about concerns that were both wider (thematically and politically) and more distinctively local (geographically). First, in talking about the requirements of future transport and mobility, solar was used to facilitate discussion of a desire for electric vehicles which could be used to assist the immobile of the neighbourhood to the shops and back. (The neighbourhood is situated on a steep hill with the shops and main road at the bottom of the hill. It also has an aging population and the mobility of these residents is raised often as a concern). The desire for increased mobility was, however, contextualised by desires of certain members of the group to promote particular individual interests such as cycling or rail transport. The power of these individual interests within the research group often became an obstacle to consensus about direction, motivation and action.

Second, a project was constructed around the neighbourhood becoming partly or fully "unplugged" from the national grid. Solar PV was one of a number of sources of energy generation that included wind, hydro, geothermal heat and industrial heat. The barrier to deployment of PV within the context of the neighbourhood appeared unaffected by cell efficiency or cost. The value of PV within the "unplugged" scenario was seen more as a vehicle to engage locally about alternative cultural norms; PV became part of a vehicle to promote particular participants cultural beliefs.

To answer the question about "better PV" then requires a negotiation between the techno-economic arguments for future technology improvement and an understanding of the complex and emplaced relations and pre-existing interests and projects of all the participants.

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Which Publics?
The politics of involving different publics in dialogue around science and technology

Alison Mohr*, Sujatha Raman, Beverley Gibbs

Institute for Science and Society (ISS), School of Sociology and Social Policy, Law and Social Sciences Building, University Park, University of Nottingham, Nottingham NG7 2RD, UK

* Tel.: +44 (0)1158 468151, Email address: alison.mohr@nottingham.ac.uk

INTRODUCTION

How should we understand 'the public' in public dialogue given the dominant assumption within policy-making that the people brought together in these events must constitute a representative sample of the wider population? To improve the prospects for public dialogue and clarify what it can contribute to policy-making, our paper explores 'who or what is the public' to make better sense of why and when public dialogue is carried out.

Our paper, based on a recent report[21] commissioned by Sciencewise-ERC[22] to explore the fundamental question of 'who should be involved in public dialogue and who or what do they represent?', makes a case for why public dialogue can make a valuable and legitimate contribution to good governance in the context of the UK Government's commitment to instituting 'open policy-making'. Good governance, under increasingly complex and contested policy conditions, requires a policy-making process that is open to challenge and improvement from a broader range of inputs. Public dialogue is perfectly positioned to make a valuable contribution to this process.

THE CASE FOR LOOKING BEYOND A REPRESENTATIVE SAMPLE OF THE 'PUBLIC' TO MULTIPLE 'PUBLICS'

In considering the case for looking beyond a representative sample of the 'public' to multiple 'publics', we draw on the example of the 2003 *GM Nation?* public debate commissioned by the UK government as one of three potential strands of 'evidence' (including a parallel economic study and a scientific review) into decision-making on the commercialisation of GM crops in UK. *GM Nation?* consisted of three different tiers of public meetings (regional, local and grass-roots) that attracted thousands of people from across the UK to deliberate the subject. Eminent Harvard-based STS scholar, Sheila Jasanoff (2005, p. 127), described *GM Nation?* as "a remarkable experiment in constructing novel forms of citizen deliberation around an emerging technology". The public meetings were open and attracted a high number of people from environmental NGOs, and other members of the public with an

[21] http://www.sciencewise-erc.org.uk/cms/which-publics-when/
[22] Sciencewise is the UK Government's Expert Resource Centre for public dialogue in policy-making involving Science and technology.

active interest in agriculture, wildlife, biodiversity, food and health (for example, bee-keepers, amateur ornithologists, allotment-holders, etc.). But, because of a dominant assumption within UK policy-making that public dialogue events must constitute a representative sample of the wider population, *GM Nation?* was widely considered a failed experiment – a process 'captured' by a critical, self-selected sample of the public. The point was made, including by the official evaluators themselves, that these people were disproportionately represented at the public meetings (Horlick-Jones et al. 2007). Two national surveys conducted by MORI on behalf of the official evaluators have shown that the majority surveyed were less critical and 'hard-line' on the matter, with relatively little prior engagement or knowledge of the matter. In contrast to the self-selected public of the open meetings, the general public surveyed were assumed to have little or no interest in the subject and thus seen to have expressed 'neutral' views on the matter. So, from a statistical perspective, self-selection was seen as problematic as it distorted the meaning and weight of public opinion, tilting it towards those perspectives that were over-represented in the sample of people who attended the public meetings.

Yet, the idea that we do public dialogue to capture majority public opinion, the desired outcome of a statistically representative sample, has been challenged, notably by social scientists responding to controversy over the representativeness of the public in GM Nation? (e.g., Lezaun & Soneryd 2007; Reynolds & Szerszynski 2006).

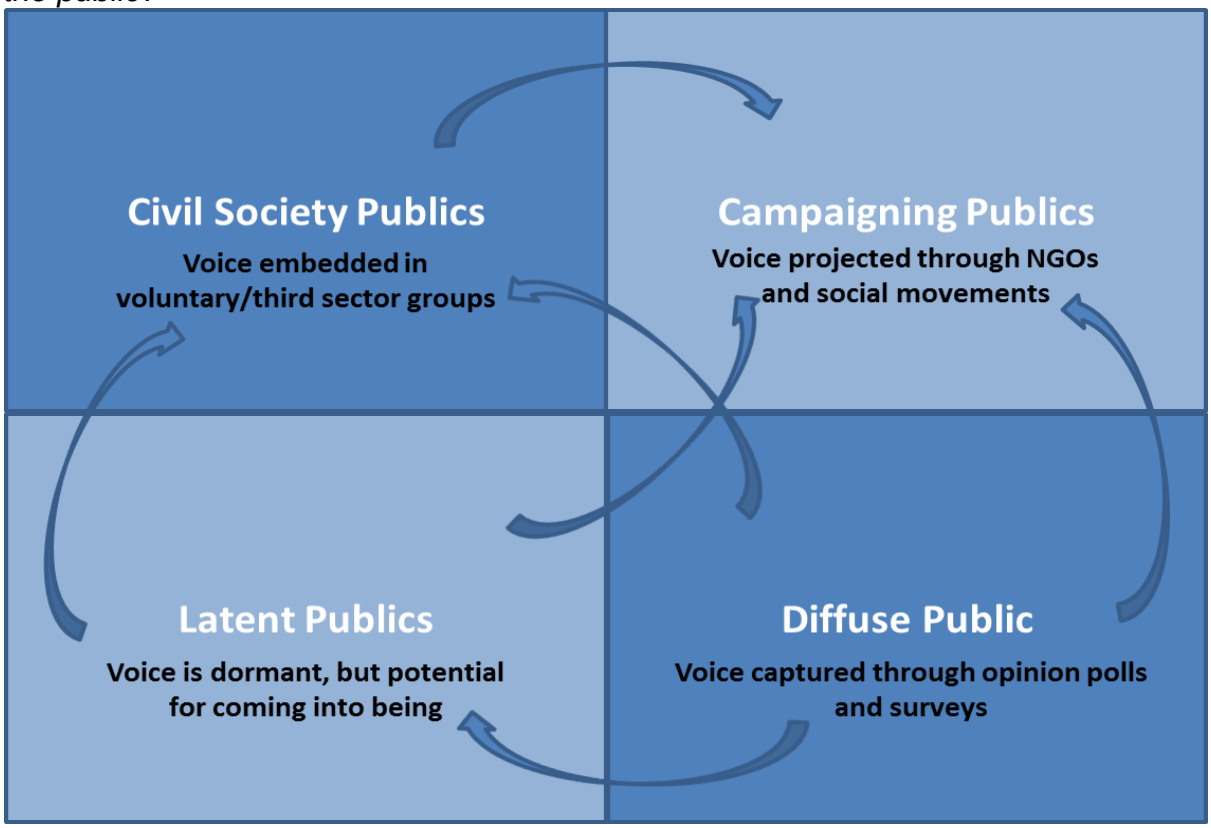
So, why has the criterion of 'representative sampling' as the gold standard for public dialogue been challenged? First, in the context of public dialogue with science, representative sampling methods have known weaknesses when it comes to engaging (rather than studying) the public on 'wicked policy problems'. A wicked problem is a phrase used in policy domains to describe a problem that is difficult to solve because knowledge is still emerging and often contested, where future impacts are uncertain, and where multiple values and meanings of the central issue are still in play. Thus the key facts of the issue and differing value judgments are still open to negotiation. Third, since public dialogues are designed to stimulate a process of engaging with relevant perspectives, rather than simply discovering opinions, there is the potential to produce diverse positions and new insights in the course of discussion (Brown 2004; Burgess and Chilvers 2006).

Finally, applied without awareness of the purpose of dialogue, representative sampling methods can give a distorted picture of the public and the public view. By focusing on majority opinion, substantive arguments about the content of policy, assessments by experts, and how dissenting or minority views (of publics or experts) are handled in the policy-making process, all of which help shape legitimacy, are lost. Representativeness also assumes that 'true' public opinion refers only to a picture of the majority view that has, in the case of public dialogue, been equated with a category of people who were considered neutral by virtue of not having any prior or particular interest or stake in the subject. While representative sampling aims to capture a diversity of perspectives, in the process of translating this into a singular, majority view

for the purposes of reporting and policy-making, diversity, is in fact, lost in practice.

WHICH PUBLICS?

So, if the idea of a *diffuse,* general public with fixed, pre-given views and preferences is inadequate for good policy-making in democratic societies, and where issues are complex and still emerging, *how then should we think about the public?*



Central to the philosophy of public dialogue are democratic qualities such as interaction, diversity and inclusivity. To pursue such qualities in the practice of public dialogue, we draw attention to the idea of plural, dynamic 'publics' that highlights issues of collective or shared interest around which people may sometimes mobilise to articulate a common perspective. In this context, some publics may already be relatively well-organised with a clear voice staked out on the issue at hand (*campaigning publics*). Others may be likewise organised as registered charities, community groups or exist mainly as an internet-based collective, but not specifically engaged with this particular issue (*civil society publics*). Still others may not be part of such organised collectives, so might tend to be seen as atomised individuals in a *diffuse public* – capable of being brought together or mobilised into specific activities either by other civil society actors or indeed, by organisers of public dialogues (latent publics). We highlight that each of these publics might play a role in public engagement for good governance, but in somewhat different ways.

Given what we have argued so far, it might be easy to assume we're arguing there's no such thing as 'the public' or 'a public' in the singular' (cf. no such thing as society!) or that one cannot talk about 'the public interest'. But that's not what we are saying at all, so we want to clarify what the idea of 'publics' is

meant to draw attention to. It is this: that what comes to be defined as the public view (public interest) is the outcome of a process of which dialogue is a part; that this definition can still be challenged especially when it seems to reflect only certain narrow private or individual interests or, indeed when views of the collective interest might not adequately acknowledge constraints, limits or alternative visions. Thus 'publics' allows us to both recognise the need for public input into policy-making and understand that this input can be contradictory and diverse in ways that need to be taken into account.
We conclude by arguing the case for more experimental dialogue processes that remain open to the unexpected inputs that arise because publics act or respond in different ways.

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