Essay

Behind Closed Doors

Scientists' and Science Communicators' Discourses on Science in Society. A Study Across European Research Institutions[1]

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Abstract Public Engagement (PE) is a marginalized field within a science institute's 'core business' of doing research. Using interview data from a range of science professionals working in European research institutions, this study addresses fundamental questions about science communication: What role do scientists think they should have in SiS activities? What audience do scientists think they should address? Despite an openess to experiment with PE initiatives, the deficit model remains dominant among research practitioners. The importance of the institutional factor emerges, namely research institutions failure to recognize SiS activities as an integral part of the research profession.

Keywords scientists; communication; public; engagement; space; evaluation.

Introduction

In responding to the call made by Lévy-Leblond back in the 1990s (1992), recent literature has started paying attention to scientific experts' understanding of the general public (Besley and Nisbett 2011; Davies 2008; Young and Matthews 2007; Burchell 2007), emphasising a need to engage with these often-neglected questions: how do scientists perceive the public? What do scientists understand by public communication and engagement? But, according to Davies, "little recent work has specifically examined scientists' ideas and assumptions about public communication and engagement, despite the fact that these will certainly affect the ways in which they engage in such activities" (Davies 2008, p. 415).

How scientists engage with the public(s) is related to their broader understanding of so-called "Science in Society" (SiS), a field comprising activities in both Public Communication of Science and Technology (PCST) and Public En-

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gagement (PE), and to the different publics that scientists and communication experts address in their everyday working lives.

"Science in Society" is a locution that has been recently proposed to replace the previous one "Science and Society". The reason for the change lies in the belief that speaking of "Science in Society" would better address the need to overcome a "diffusionist" conception of public communication of science. This last conception was centred on the belief that science was too complicated for the public and, consequently, there was the need for a mediation capable to make science understandable to non-scientists. These are some of the ideas underpinning the diffusionist conception, and in particular: "the notion of the media as a channel designed to convey scientific notions, but often unable to perform this task satisfactorily due to lack of competences and/or predominance of other priorities (e.g. commercial interests); the public as passive, whose default ignorance and hostility to science can be counteracted by appropriate injection of science communication; science communication as a linear, one-way process in cui the source context (specialist elaboration) and the target context (popular discourse) can not only be sharply separated, but only the former can influence the latter; communication as a broader process concerned with the transfer of knowledge from one subject or group of subjects to another; knowledge as being transferable without significant alterations from one context to another, so that it is possible to take an idea or result from the scientific community and bring it to the general public"(Bucchi 2008, p. 58). Often the diffusionist concept is referred to as "deficit model", although the latter more aptly refers to the second term of the previous list (Bucchi 2008), giving PCST the task of filling the gap of scientific culture that characterizes contemporary society. The weaknesses of the diffusionist conception and the necessity of overcoming it have been widely reaffirmed by the numerous criticisms of the deficit model. Those criticisms call for a relationship between science and society based on dialogue and engagement with citizens seen as active interlocutors and worthy of consideration (Funtowicz and Ravetz 1993; Gibbons *et al.* 1994; Lewenstein 1995; Michael 2002; Nowotny *et al.* 2001; Wynne 1995). That is why the locution "science in society" sounds more appropriate than "science and society". Science and society should not be interpreted as two separate entities to be related assuming that the first one should transfer something to the second, rather one as part of the other in an equal relationship. This is also the reason why to understand how scientists see their potential interlocutors and how they envisage the interaction with them is particularly relevant for research in the field of Science and Technology Studies.

In considering those issues, one should keep in mind that scientists are not isolated when they carry out research activities or when they interact with the public(s). In both cases, their attitudes and the actions they take are highly influenced, for better or worse, by the motivations and resources coming from the research institution to which they belong. The organizational culture of scientific institutions, therefore, cannot be overlooked when seeking to understand the approach scientists have toward SiS activities as a whole. Similarly, one should not forget that scientists, in so far as they belong to a certain institution, may find

themselves working side by side with other professionals such as those who are engaged in communication and/or public relations (PR).

At the same time, one should be able to analyze what public(s) is (are) addressed by researchers and science communication experts, given that "in the area of science communication, as in any area, it is firstly important to ask who the public is. The public of course includes the informed, educated, interested and engaged populations as well as naive, uninterested and poorly educated groups" (Turney 2006, p. 38). Nevertheless the most common tendency still seems to be that scientists consider "the 'public' as a passive entity with 'attitudes' or 'understandings', but not as a bumptious technoscientific actor" (Haraway 1997, p. 94), even though the willingness and capacity of the public to become actively involved in technoscientific practices have been largely recognised (Funtowicz and Ravetz 1993; Epstein 1996; Irwin and Wynne 1996; Callon *et al.* 2001; Jasanoff 2004; Bucchi and Neresini 2007). The general public is neither completely uninterested in science - especially when it senses its relevance for everyday life - nor unable to actively contribute to science development, either by means of taking part in the process of doing scientific research, or by getting involved in the initiatives of PCST (Felt and Wynne 2007).

There remains much to be done in order to understand how scientists conceive that part of their professional commitment that has gained increasing relevance under the pressure of the public, the media and politics. Furthermore, the increasing demand of public communication and engagement seems to conflict with the traditional requirements put forth by the scientific community in terms of laboratory work, exchange with colleagues, writing up of peer-reviewed papers.

1. From deficit to engagement: which public and which role for the scientists?

According to available literature, the prevailing conception of the public among scientists is the so-called "deficit model". In this respect, the scarce scientific culture and the strong disinterest that characterizes lay people constitute the basis of unfavourable attitudes toward science (Brossard and Lewenstein 2010). Those attitudes might foster irrational behaviour - such as the rejection of GMOs or the belief in horoscopes; additionally, they might render the study of science and prospective careers less attractive to young people. The latter attitude deprives research institutions of necessary resources (Sturgis and Allum 2004).

This dominant perspective emerges in a straightforward manner from the detailed review recently presented by Besley and Nisbett, in which studies show that "scientists believe the public is inadequately informed about science topics" and that, at the same time, "is uninterested in becoming more knowledgeable" (2011, p. 4). They agree with Davies (2008) that "these findings reflect, a traditional 'deficit model' of science communication" (Besley and Nisbett 2011, p. 4).

This is further confirmed by a measured tendency among scientists to attribute responsibility to others for a lack of scientific culture in the lay public; less than one third of scientists think that the problem stems mainly from scientists themselves (MORI-Wellcome Trust 2001). Science communication scholars also think that scientists "hold a deficit model perspective" thinking that the public have not meaningful opinions, even if "the members of the science community remain mixed in their views of the public" (Besley and Tanner 2011, p. 256). The prevalence of the deficit model among scientists, and the resulting tendency to interpret their interaction with the public as a one-way form of communication, however, is not inconsistent with more flexible positions. These may include subjects or situations about which lay people express interest in interacting with the scientists, such as topics or applications of science perceived as relevant to the public (Davies 2008, p. 417). On the other hand, findings from research by the Pew Trust in 2009 confirm that scientists may broadly view the lay population as ignorant, but remain in disagreement about whether or not this is a problem.

Therefore, research concludes that most scientists frame SiS activities in terms of the deficit model, a fact that has consequences related to the way scientists perceive the public(s), and interact with it. This is a typical situation of self-fulfilling prophecy: "false conceptions of the public operate in science policy making and misguided efforts at communication of scientific institutions which alienated the public still further" (Bauer *et al.* 2007, p. 85). The naïve view scientists have of society and its interactions should not be surprising, as they are - like everyone else – obliged to assume some model of social reality in order to be able to interact with it (Wynne 1989). Moreover, scientists are encouraged to take as good models those that are ready at hand, namely those of common sense, such as: communication exchange described using the metaphor of the transmission of knowledge; the lack of knowledge explains the prejudices against science; the 'others' tend to form a homogeneous whole uninterested - or even hostile - towards us even when we are – on the contrary – really engaged in what we do. There is no reason to believe that scientists are immune from the cognitive processes that typically come into play when ordinary people need to get an idea of how social interactions work (Besley and Nisbett 2011, p. 13). The deficit model is the combination of these elements of common sense; this explains, among other things, its persistence, even among scientists. And for these reasons it is crucial to understand what scientists think of PE and PCST, now grouped in SiS. This goal can be declined in a number of issues that address very general questions. First, it should be understood who is (are) the public(s) that scientists address. It is already known that the predominant tendency is to characterize it as scientifically illiterate and with very little interest in filling a knowledge gap. Simultaneously, there is the belief that public perception is pervaded by scepticism, if not outright hostility, towards science. On these premises, it is logical to expect that the public is imagined as a homogeneous rather than as a differentiated entity. The data available confirm that we are heading in this direction. Therefore, Davies (2008) asserts, when scientists think of their interaction with the public they seem to have in mind three main objectives, in descending order of importance:

to form scientifically literate people; to recruit potential future scientists and to arouse interest in scientific research.

The role scientists think they play or might play in SiS activities appears to be much less clear. In this regard some indications come from how scientists view their relationship with media. The conception scientists have of media, in fact, comes into play in building their idea of the public and, therefore, in their understanding of the complex nature of SiS activities. The most recent and comprehensive research on the relationship between scientists and the media is the one conducted by Peters and colleagues between 2005 and 2006. The opinions expressed by scientists interviewed about their relationship with the media are in many ways ambivalent: on one side " 'possible critical reactions from peers' were considered important concerns for 42% of the respondents (while) a similar proportion (39%) found 'enhanced personal reputation among peers' to be an important outcome of media contacts"; at the same time, "when assessing the quality of media coverage of scientific topics in general on four aspects (accuracy, use of credible sources, presence of a hostile tone, and comprehensiveness), scientists on average were neither clearly positive nor negative" (Peters *et al.* 2008, p. 203). However, what is more relevant is the fact that "increasing the public's appreciation of science was the most important benefits mentioned by scientists as an incentive to interact with the media" (Peters *et al.* 2008, p. 204).

When scientists talk about PCST they simultaneously build both themselves and their audience (Davies 2008, p. 427): if others possess little knowledge, they have a lot of it; if they are disinterested and passive, as scientists – as an interested party – they have the task of taking the initiative; if scientists have a lot to say, then the public should just be ready to listen. If the public should be educated to look at science with goodwill, despite the difficulties involved in dealing with the media, then scientists tend to define the public as a subordinate interlocutor, but to look at it with favour. The monodirectionality associated with communication via the media, especially the more traditional ones such as print and television, reinforces the idea of a passive audience, receiving knowledge and information from scientists.

In any case, interaction between scientists and the lay public develops far beyond occasions created through traditional forms of media. There are indeed many ways of being in contact or, to use Beaulieu's concept, co-present. Bearing in mind that being physically located in the same space might not be the same as being ready to interact, as Beaulieu points out quoting Goffman; she defines co-presence as a type of interaction that can take different modalities, such as face-to-face or web-based interaction. The space, therefore, can be a physical location or a virtual one: "Co-presence decentralizes the notion of space without excluding it" (Beaulieu 2010, p. 2). The web space, namely, can foster horizontal ways of being in touch between the lay public and the researchers, thus emancipating the public from a monodirectional communication dynamic.

In this perspective, the contact with the research world that the public can gain through a website is of particular importance and the websites of scientific institutions become a strategic resource. However, direct experience of the la-

boratories, through visits, and of the research centres as a whole, through open days, are still a unique opportunity for interaction between scientists and the public. This is why an institution's organization of space in relation to the presence of visitors who are not scientists themselves can tell a lot about how scientists conceive their relationship with the public and their role within it.

Additional information can be derived from the meaning that scientists assigned to evaluation activities in the context of SiS. Indeed, we are led to consider evaluation as a set of tools – more or less articulated and more or less reliable – through which one can determine whether and to what extent a particular initiative has produced those results for which it was undertaken. However, the way in which evaluation is designed and built can tell a lot about how the promoters of a given initiative think of themselves in the context of its realization. In the case of SiS it is clear, for example, that if scientists ask evaluation to detect only the changes produced in the public – a request which is very difficult to satisfy – or also to detect the changes possibly generated on scientists, the role of scientists is completely separate. While in the second case scientists and the public are imagined as part of a process that sees both of them actively involved, carrying different points of view but both recognized as an equal partner, in the first case, scientists place themselves in a position of relative supremacy, in so far as they assume that only others have to change, hopefully in the direction desired by scientists themselves (Pellegrini and Neresini 2008).

Finally, as noted at the beginning, scientists do not work as isolated individuals, but rather within organizations that make research possible and at the same time affect their activities. Here, then, the way in which scientists thematize the relationship with the scientific institutions to which they belong becomes an additional perspective from which to derive useful information on their role. Scientists can interpret their contribution to initiatives of communication and public engagement as part of their institutional role as researchers, attributing to this task a role more or less consistent with the activity of research strictly speaking. This attribution, however, will depend significantly on how research institutions define SiS activities: are they a mere appendix to delegate the task of interacting with the public or, conversely, a major component of their organizational culture to which all are called to contribute?

Depending on the response, the role of scientists in SiS activities will obviously be defined very differently. Within the general issue concerning the meaning they attribute to communication with and involvement of the public we can therefore identify some more specific questions, which can be summarized as follows:

1) Which audience do scientists address or think they should address?
2) What role do scientists have or think they should have in SiS activities?

This second question can be divided into three more specific questions:

a) Which kinds of interaction do they prefer, direct or mediated? And how does the interaction influence the organization of space in research centres?

b) What do they understand about evaluation of SiS activities?
c) Which value do scientists believe research institutions assign to SiS activities?

In order to answer to these questions the present study uses data coming from extensive fieldwork undertaken as part of a broader research project in which a set of interviews with researchers and communicators working in leading research institutions in various European countries. Choosing institutions where SiS activities are not minimal, allowed us to compare the opinions of scientists engaged in research with those of their colleagues only or mainly engaged on the front of SiS.

2. Methodology

This article stems from a broader research project which consisted of two different phases. During the first phase (2006-2008), the largest European scientific research institutions were surveyed in order to map and analyze their SiS activities. The second phase (2009-2010) centered on the actors involved in such activities; they were asked to be interviewed about the meaning assigned to PCST and PE by their research institution. A sample of researchers and communication practitioners was selected for interview from among those working at the research institutions already surveyed in the first part of the project. Two main criteria guided the sample selection: a) the importance of SiS activities in the research institution; b) the size of the research centre, which was calculated by considering the number of staff employed rather than the budget of the institution, because this latter parameter varies considerably according to the research field.

Because there are differences in SiS activities, due to the research fields of the institutions, 6 of the 12 selected work in biomedical sciences and 6 in advanced physics. Finally, the institutions surveyed are distributed across several European countries: the United Kingdom, Germany, Portugal, Sweden, the Netherlands, Romania and Italy. The number of research institutions surveyed is not sufficiently large to constitute a representative sample with which to depict the current situation of biomedical and physics research organizations at European level. Nevertheless, we can identify a number of common trends that help us highlight the interviewees' perceptions of SiS without widening the gap between the scholarly understanding of SiS and its concrete understanding among scientists and communication experts.

Four different professional profiles were interviewed at each research institution: the head of communication/PR, the director (if not available, a manager with an executive role), a senior researcher, and an early-career researcher. Each interview was scheduled to last between 40 and 50 minutes. The common language among all participants was English and so this was utilized in the face to face interviews. The population sample therefore consists of 48 individuals belonging to different professional groups: 24 researchers (equally distributed be-

tween early-career and senior), 12 professionals in charge of communication and engagement activities, 12 with top-level managerial responsibilities (directors of research centers and/or deputy directors). One-third of the interviewees are women, with a large majority belonging to the category of communication professionals. But only one woman was interviewed among the 12 top-level managers, reflecting the well-known under-representation of women occupying senior positions in scientific organizations (Blickenstaff 2005; Probert 2005).

Comparative analysis is limited to scientists and those professionals involved in communication and PR activities. While working on the data from the interviews, in fact, we realized that the major differences were between those two broad categories. We also detected some differences between women and men, between biomedical and physics research institutions, between junior and senior scientists, but the differences noticed are not relevant for the purposes of our research questions.

The face-to-face interviews were conducted using a semi-structured grid prepared by the researchers on the basis of the questionnaire used in the first part of the research project. The interview grid is structured around the following main topics: range of concrete activities implemented by the research institution and regarded as S&S; the interviewee's perception of the role of media in science communication and his/her conception of the public(s); the interviewee's attitude to the relationship between science and society (science and territory, science and publics); the interviewee's opinion on the purposes of science communication; the use of evaluation and feedback tools. Clearly, these topics give an idea of some of the issues addressed, without representing all the themes encountered in the course of the face-to-face interview.

While designing the interview grid, we did not to use the expressions 'public engagement' or 'science in society' in our questions so that interviewees would not be conditioned by them. From this we determined that the vast majority of the scientists and communicators surveyed did not use the term "engagement" when describing the range and type of science communication and PE activities that they undertook. Almost none of the researchers and communicators used the expression "science in society", instead preferring the locution "science and society". For this reason, in what follows we prefer to use the term "S&S" instead of "SiS", an expression that might look more appropriate from a theoretical point of view – as we have seen in the introduction – but less adequate for describing the positions of the interviewees.

All the interviews were transcribed using a slightly modified version of the standard conventions of transcription (see the legend in the annexes for details). Their content has been analyzed in order to identify key themes and concepts (Silverman, 2001; Flick, 2002). We look at the themes and issues discussed in the conversation samples selected with the aim of bringing out what scientists think about their involvement in PCST and PE activities. Therefore, the interviews were transcribed and then analyzed identifying parts relating to the research questions.

3. Science and society: the scientists' point of view

The research centers considered by this study fall into two main categories:

1) institutions where S&S activities are managed by the communication-PR department/office;
2) institutions where the organizational unit responsible for S&S activities operated separately from the one dealing with PR and communication.

An institution of the first type tends to promote a conception of S&S closer to a deficit-oriented model, while one of the second type is more inclined toward a dialogue-participatory model. The former collapses S&S into the public communication of science in general, whereas the latter generally takes primary and secondary schools as the main targets of its S&S activities with an organizational unit – department or office – dealing specifically with education and outreach activities.

In both cases, however, there is a general lack of awareness of the existing different models for pursuing public engagement and science communication. This can be regarded as a gap present in the research centers at institutional level. S&S activities were enacted without being part of a broader strategy capable of profoundly influencing the structure of the research center itself. In fact, "it is particularly important to establish whether the commitment to public engagement takes the form of an extension of the range of activities undertaken by research institutions – adding extra tasks without altering their overall structure and underlying rationale – or whether a more profound process of organizational change is actually in progress" (Neresini and Bucchi 2011, p. 65). This is especially the case in research institutions where there is no department or office specifically devoted to S&S, but only a PR and communication office.

However, it would be wrong to conclude that most of the research centres surveyed are exclusively deficit model oriented and that S&S is mainly understood as being the communication of scientific content to the general public. In some cases, the deficit model has been superseded by individual initiatives that put dialogue, debate and engagement into action. These initiatives are often undertaken because of the particular circumstances (social, geographical, economic) of the area in which the research centre is located, even if they are generally promoted by individuals wanting to implement particular activities for communicating science.

3.1. Who is (are) the public(s)?

From the data analysed it becomes evident that interviewees attempt to address different audiences. However, the segmentation is often poorly developed, since/because neither communication practitioners nor scientists seem fully aware of the need to differentiate their activities according to the group and stakeholder targeted.

Very few interviewees seem aware of the need to shape each S&S activity according to different segments of the public. Despite this lack of attention to the existence of many different publics, some interviewees show that a number of research centers made efforts to engage various kinds of atypical publics (i.e. politicians, particularly gifted children, persons aged over sixty-five, and so on) which do not belong among the categories most often targeted by S&S.

Contrary to what might be expected, the category of politicians and decision-makers is overwhelmingly understood as privileged in bridging the gap, or enabling mutual understanding, between scientists and the public, although not vice versa. Politicians are often seen as mediators between scientists and non-experts. Some interviewees explicitly mention politicians as one of the publics to which their research institution addressed its communication policies: according to this view, scientists must "convince" politicians (who in their turn will convince the voters) of the goodness of investing public money in research because they (politicians) are the people who can influence public opinion. In the words of a junior researcher:

> To receive funds, to get students to buy equipment and instruments or simply to have a pay check to go on simply doing what you do , you have to convince someone somewhere, and not directly the public (again, perhaps put this in the direct contact section, scientists long for a direct contact with the public but seek for a direct contact with politicians as mediators between them and the public, politicians need to respond to the public an= but someone who responds to the public, and this is a link between the public and the researcher. (JR, male, id10, biomedicine)

In this case, it is clear that in the view of scientists PCST and lobbying are blurred, although the pressure on politicians to get public funds to support research should be confined in an area quite distinct from PCST.

Only in one case does the public itself request and delegate scientists to study certain phenomena, exerting influence on the management policies of the research institution itself. In this particular case, the politicians do not act as intermediaries; on the contrary, it is the public that enable researchers to reach politicians in an attempt to affect policy-making. In another case, the interviewee recalls the important role played by the research centre in terms of policy-making and its ability to attract the attention of those who decide on specific issues:

> Prevention becomes a key element for the sustainability of the National Health Service (xxx)= we had an important role in raising public awareness on rare diseases.
>
> (D, male, id11, biomedicine)

Overall, however, politicians are an audience to be reached directly, either as part of decision makers who control research funding, or as intermediaries in the relationship with the general public which remains rather undifferentiated.

3.2. The scientists' role: reaching the public through direct or mediated contact

All interviewees emphasize the importance of direct involvement between the public and scientists. The S&S activities most frequently cited as examples of successful ways to engage the public are those in which direct contact takes place between researchers and the public, such as visits to laboratories, lectures or conferences: "Human beings do not want distance learning (x) screens" (SR, male, id9, biomedicine). The S&S initiatives cited, in fact, are primarily guided tours of laboratories, educational workshops conducted within or close to schools and open days. All these activities make it easier for the public to contact researchers, indeed often sharing the same space with them: "there is no substitute for having real scientists involved in public engagement. Professionals are mainly helpful as mediators or facilitators, but they cannot deliver authentic access to real scientific practice, or the latest expert findings" (Turney 2006, p. 88).

Research institutes active in the biomedical field stress that people should be more involved in matters concerning their bodies and their health. This is hardly surprising because biomedicine, more than physics, has been directly involved in research connected with health issues, sometimes inducing both scholars and the general public to re-consider and re-think notions of personhood. Science in this case seems literally able to touch the public in their bodies. Interestingly, interviewees use the word "touch" both in its literal and metaphorical meaning. In fact, they refer to the way a scientific concept can touch the public in the sense of reaching the audience's interest and imagination, and to the way can touch the public as something that is felt through the body, via a bodily feeling or sensation. In this second case, the word "touch" has a literal meaning being an actual contact between the body and then concept. For example, all four of the interviewees working at the same biomedical research centre recall a conference organized on the topic of the stomach. The evening did indeed touch many people: "in your daily life you do not think of having a brain= but you are <u>always</u> in contact with your <u>stomach</u>" (SR, male, id9, biomedicine). In this context, direct contact means the possibility to experience a scientific concept with and through the body. Many interviewees at physics research centers, on the contrary, propose the public interest in the origins of the universe as a means for scientists to touch their audience.

The main opportunities for direct encounter between scientists and the public are open days and visits to laboratories. Besides activities planned with schools and universities, open days and visits to research institutions are two key events where the general public – not solely youngsters – can meet scientists in their working environment: "the visitors' appreciation of an encounter with 'science in reality' or, in other words, of authenticity as the crucial quality of the visits also seems to interrelate with visitors' views that the visit programs are seen as a kind of demonstration of the research centre's openness to the public" (Neresini *et al.*, 2009, p. 24).

Opportunities to access and visit laboratories are crucial for communicating with and involving different audiences, whilst open days do not seem particularly significant in engaging the public, even though they are certainly the most popular means by which research spaces and activities are available to all those interested. In particular, although at least half of the interviewees consider open days important for communicating research and enabling encounters between scientists and the public, open days are considered rather expensive and their effectiveness has to be demonstrated with suitable evaluation tools. Notwithstanding the large amount of energy and money invested in the organization of an open day, there is no certainty about its results in terms of PCST and/or PE. In fact, whilst the majority of interviewees describe open days as occasions that people "like a lot" (HC, female, id3, physics), there is no agreement on numbers or on the ability to attract audiences not already involved in scientific research. For example, the head of communication at one of the research institutions says that "4,000 visitors a year are a significant number of visitors" (HC, male, id12, physics), whereas the director of the same institution stated that "the numbers are very low" (D, male, id12, physics).

The main reason for criticising open days is their explicit spectacular dimension (a word frequently used was "magic") often proposed to the people taking part in them:

> Science is often seen as something that can provide all the answers (x) what scientists are classically trained to do is to look for alternative explanations (xx). Talking more about the methodology, the rational, give people a greater understanding of what science cannot tell you. (JR, male, id7, physics)

Researchers seem particularly worried about this aspect, but some of the communication practitioners interviewed also asked "what is the value of an open day?" (HC, female, id6, biomedicine). Again, "openness is about allowing people to interact ((articulating words)) rather than opening for a day" (D, male, id6, biomedicine). Furthermore, some interviewees note that open days tend to always attract the same audience, generally represented by people already interested in science, whereas occasional initiatives designed to reach other, more specific, audiences may be more successful:

> There are always the same people, families and so on at the open days, we should make effort to attract new visitors" (JR, male, id5, physics); "the photographic competition was successful because it really managed to involve new people , I mean not the same we already saw during the open days. (HR, male, id3, physics)

In contrast to open days, educational activities are regarded as essential. This may stem from the predominance of the deficit-transmission model of science communication. The interviewees see training and teaching activities as important for three main reasons: first, as one of them points out, educational activities are gratifying for researchers because they can "confront them with a new and fresh vision" (SR, female, id2, biomedicine). Second, these initiatives enable

highly-specialized scientists to contextualize their research in a broader setting: "scientists sometimes lack the overall picture" (JR, male, id7, physics) and thereby "remember why I chose ((laugh)) this caree:r" (JR, female, id1, physics). Finally, young researchers can decide whether they want to continue with research or to engage in science education and communication. This latter option indicates that research and science communication are perceived by interviewees as two separate activities requiring different skills, and which cannot be undertaken simultaneously – a belief that we will investigate later.

3.3. Space as medium

The concrete space of the scientific laboratory has always been represented by the media as a fascinating and mysterious place capable of attracting the lay public. According to this imagery, the doors of the lab are kept closed in order to protect the research undertaken inside. To gain access to this space means to gain access to knowledge, to share (sometimes to steal) knowledge with those who produced it – the scientists. The curiosity and the strangeness of the equipment often present in the laboratory drives visitors as an interviewee explains: "It's the curiosity of going inside hidden spaces, it's the possibility to see odd things. Like the machines we have in the experimental lab" (SR, male, id12, physics).

In the words of the interviewees, however, "space" is used also to denote those rooms devoted to visitors of the research institution. The availability of spaces suitable for welcoming the lay public (a visitors' centre, a dedicated area, or even a simple lobby) is regarded as essential for a fruitful engagement with the public. Most of the interviewees, whether scientists, communication officers or directors, were aware of the role space played in creating a fruitful exchange between scientists and the public. In one case, for example, the research centre has neither an obvious entrance nor a hall for welcoming visitors. A senior scientist stresses that it is always necessary for someone to "accompany" visitors, whereas if there were a reception room with posters, brochures, and other illustrative materials, the visitor would not need a guide to feel comfortable and would start understanding the general kind of research undertaken at the institute.

The notion of space is too often dismissed in discussions on how to engage the public, or it is defined only in terms of the presence of a museum within the research center. By contrast, the interviews demonstrate that the particular organization of space can empower and emancipate the visitor.[2] The head of communication at one of the research organizations, for example, stresses that the centre in question has a space specially designed to welcome visitors with tables and chairs arranged in a circle to encourage horizontal interaction between scientists and audience: "it is important to have a space where people can feel comfortable

[2] A contemporary theoretician who has closely examined the role of space in emancipating people is the French philosopher Jacques Rancière, especially in his *The Politics of Aesthetics* (2004).

in (x) even just a simple room with chairs in a circle" (HC, female, id6, biomedicine). Researchers and visitors sitting around a table can enable an exchange between the two actors where the roles are not already assigned and kept static.

The lay public can emancipate itself from being passive receptors of a message or knowledge transmitted by those who know (scientists) and those who do not know by sitting side by side with scientists in the same room or by gaining access to spaces that are normally kept closed. A research institution can question traditional roles assigned to researchers and visitors not for the purpose of turning visitors into scientists but with a view to empowering them, assigning them a role in dialogue and exchange with scientists. This can be done, for example, when spaces of play and experimentation are maintained, such as the open-days or the photographic competition organized by one of the research institutions surveyed. In this second case, the photographs of the lab taken by the lay public became a sort of neutral territory, an area of interest not completely monopolized by either scientists or non-experts, an area in which the public(s) enters. The photographs taken by participants showed a reality of the space of the laboratory very much different from what one would expect, a photographic representation that thwarted people's expectations. Furthermore, through photography, participants gained access to previously inaccessible spaces. As the head of communication explains, that competition furnished an alternative image of the spaces of the laboratory, spaces that were not "clear", "empty", "ordered", "glossy" as is often the case with corporate communication campaigns, but instead more truthful about the real life of a laboratory – messy, creative, full of objects, wires and busy people.

In one case, an interviewee described the transformation of the research laboratory into a television studio where two episodes of a popular television program were recorded. This moment in the history of the research institution, is remembered as being:

> particularly funny creating disarray and amusement (xx) those people came fore by with the crew , there were cables everywhere ((amused moving the hands to convey the sense of mess)) , their cables with ours, a <u>total</u> mess = we even got involved a school class from Turin who was just visiting us by chance. (HC, male, id12, physics)

Space plays an even stronger role when the interaction between researchers and the public(s) gives rise to misunderstandings and controversy. Assigned roles and possibilities can sometimes also be inadvertently thwarted. Presenting research findings or new technological instruments in front of a specific audience is sometimes highly influenced by where the presentation takes place. One interviewee gives an example of a lecture held in the research centre to explain to a female audience the future installation of a diagnostic instrument. In this case, there was a clear gap between the words used by the researcher to describe the project which were reassuring about the technology, highlighting the fact that it was safe and user-friendly, and the physical reality of the space where the meeting took place: "what people saw at that time were steel tubes, rather messy ca-

bles everywhere" (D, male, id12, physics). As a consequence, the interviewee remembered, one of the women said: "You don't want to put a woman in here, do you ? ((mocking the gestures and facial expression of those women)) It's far too dangerous" (D, male, id12, physics).

Scientists, however, can also have contact with the public in a mediated way.

3.4. The media and the web

Media in general, and more specifically television and newspapers, are largely dismissed by interviewees as ineffective means to engage with the public. They are perceived much more as communication tools useful to advertise scientific findings, but often at the expense of correct interpretation. This is hardly surprising, given that other studies and reports have shown that scientists have a generally negative view on the quality of news coverage of scientific issues (Peters *et al.* 2008). Some interviewees explicitly use the word "quality" when discussing the role played by media in science communication. The presence of the research institution in the media arena does not seem *per se* to assure the quality of scientific communication, which seems instead to depend on the capacity to develop and maintain good relationships with journalists or PR officers. At the same time, the majority of interviewees regard the quality of the scientific information conveyed by the media as rather more important than its quantity.

Another indirect means to reach the public is the World Wide Web and its related modalities: sections of the research organization's website dedicated to the public, newsletters, interactions with existing social networks, scientists' blogs, and so on. But in the majority of cases, the website of a research institution is not a medium privileged over print and television. Only in one case does the website play a crucial role in providing real-time information, and it does so for people seeking information in special circumstances such as natural disasters. One respondent stresses the importance of the website for reaching the audience of fellow scientists, and considers the website a communication channel of limited effectiveness compared with visits: "there are obviously special cases to be displayed on site of ((name research institution)) as highlights of research, but I think the most important thing is visits by people"(JR, male, id3, physics). Direct contacts therefore seem to ensure the quality of the relationship between scientists and the public: "stronger contacts for a smaller number of people" (SR, male, id12, physics). In only a few cases interviewees working in communication and PR departments call for greater use of the Web, as well as for its renewal, especially in terms of design and social networking. Only one research centre of the twelve surveyed gives the Web a prominent role in providing researchers and science communicators (also those working at other research institutions) with materials to engage the public: "we support researchers to do communication that we do not tend to do ourselves" (HC, female, id6, biomedicine). It is therefore easy to conclude that the Web and social networks are still in their infancy as

means for PCST and PE by those who run communication offices at scientific research institutions.

The preference for direct contact should not be interpreted, however, as an instance of a participatory model for reaching the public(s). It can be deficit-oriented, hiding the will to control what kind of information is released and the reaction of the public, without trusting science communicators and journalists as mediators.

3.5. Evaluation

Despite the lack of agreement on what outcomes should be sought in terms of communication and public engagement, all the interviewees personally involved either in research or specifically in PE and PCST state that the outcomes of S&S, i.e. the long-term impact and effectiveness of those activities, should be detected, measured and evaluated. Furthermore, outcomes, not outputs, are a means for interviewees not to waste resources in terms of budget, staff and time:

> To have at our disposal feedback and evaluation tools might be important to understand what we do and how we can improve what we do. (HC, female, id8, physics)

> I would like to have more feedback (xx) it is really difficult to evaluate how it goes. (SR, male, id6, biomedicine)

> We need to have reliable indicators that would allow us not to waste resources. (SR, male, id12, physics)

> Evaluation is a very interesting topic , it's good that you work on that because we need to get better (xxx), there is so much money spent in this field , blasted into papers that are not read , that don't have an impact at all. It's much more important to analyze what really is working and functioning (xx) so to analyze the impact and the long-lastingness of information that you pass on. (D, male, id4, physics)

In referring to evaluation during the interviews, some interviewees explicitly use the word "quality" in conjunction with terms such as "engagement" and "interaction" referring to the need to measure the impact of efforts undertaken by research centers to engage with the public: "Depth of engagement, quality of engagement and quality of interaction are key factors to measure the success of S&S activities" (HC, female, id6, biomedicine); the majority of interviewees, however, introduce the word "quality" when talking about the personal capacity of scientists to know their own topic thoroughly and be able to explain it to the general public: "Quality means knowing what you are talking about and making it understandable" (D, male, id11, biomedicine).

On considering types of evaluation and feedback tools, the interviewees seem skeptical concerning quantitative methodologies like questionnaire-based sur-

veys. They prefer focus groups or other - not further specified - qualitative methodologies applied to evaluation: "Questionnaires are excessively used nowadays in our society (x) they don't give anything back to me (x) they are so reductionist in interpreting reality" (SR, male, id5, physics); "Questionnaires are too didactic, too rigid, focus groups are better" (HC, female, id6, biomedicine); "Focus groups . a more interactive evaluation would be more interesting" (HC, male, id11, biomedicine). This distrust of quantitative research methods is coherent with the interviewees' opinions concerning the need to evaluate the quality of S&S activities rather than measure the general level of agreement of participants.

Insistence on the importance and necessity of evaluation seems, however, to conceal different meanings. On the one hand, evaluation can be seen as an opportunity to re-think what has been achieved or to think about what has been not considered from the outset; it can also enable reflection on the meaning that scientists and science communicators attribute to S&S activities, to their roles as professionals, and to the role played by their research institutions. On the other hand, evaluation is often evoked as a tool primarily intended to measure the impact of S&S activities upon an addressee, which is the public(s).

In this second case, the change of perspective envisaged by interviewees regards the public alone, whilst scientists and communicators are extraneous to processes that they too contribute to creating. A conception of evaluation focused on the idea of the impact on a (passive) public and determined by the joint efforts of (active) scientists and communicators may reinforce the bases of the deficit model (Neresini and Pellegrini 2008). Nevertheless, the two meanings attributed to evaluation as illustrated above should not be understood in purely oppositional terms. In fact, evaluation of the impact exerted by S&S activities can be used for reflexive analysis of how resources have been employed (efficiency); on the other hand, reflexive evaluation (the re-thinking of PE and PCST processes in light of the initial goals) may remain trapped in the deficit model if those objectives are not dialogue-oriented; nor are they able to engage all the actors involved, including scientists and communicators.

Despite these ambiguities, the interaction between scientists and public(s) may encourage self-reflexive processes. This is perceived by most of the interviewees without relevant differences among the various categories (junior and senior researchers, communication practitioners, high-profile managers/directors of the research institution) and across the two scientific areas surveyed (biomedicine and physics). S&S activities therefore become opportunities for researchers and communication practitioners to rethink their roles.

In this respect, it becomes evident that S&S activities are not highly regarded by scientists in comparison with research. Some interviewees, in fact, think that carrying out S&S activities makes it possible to pursue a career in science communication rather than in scientific research: in this case only those who realize that they are not particularly good as scientists might decide to dedicate themselves to science communication and public engagement. Many of the science communication practitioners interviewed describe themselves somehow as 'unfulfilled scientists': that is, they realized that they would rather continue their

careers within the communication field, either because they felt themselves unsuited to the lifestyle required of a scientist (too long working hours, flexibility which is difficult to combine with a family, etc.), or because they felt they were not good enough as scientists:

I realized I was not going to win the Nobel Prize (xx) ((laughing))= I was not as goo:d a scientist as I wanted to be. (D, male, id6, biomedicine)

From this point of view, S&S activities might sound like the negative counterpart in defining the researcher's professional identity.

4. Deficit model, but…

The variety of positions that emerged from the interviews clearly indicates the impossibility of incorporating into a single definition the expression "science and society". However, there is one point on which all interviewees, both senior and junior researchers and communication practitioners, seem to agree without exception: the requirement that S&S should communicate the results of research work to the public. The frequent use of terms like "duty" and "responsibility" sometimes goes together with the awareness of the role of science in advancing society and in particular:

We do good science and we want to bring society forward (x) showing humanity that we gather new knowledge" (HC, male id4, physics) or: "we have three tasks (x) to undertake research, to teach new researchers and to disseminate science. (D, male, id11, biomedicine)

However, the relationship between science and society weights much more on the first term in the expression:

Society needs science, society lives with science, science is a tool for society. (…) the other way around is probably not obvious? There is a direct need from the society's point of view to have science, to understand science, to make it more accessible. Whether science needs society I don't know (x) well, in principle obviously we need society otherwise we wouldn't exist (x) nobody would finance our research? But the impact is less obvious. The public needs to understand science. (SR, male, id4, physics)

But researchers, in contrast to communication practitioners and directors of research institution, tend to ask the public to be more active, to demand the right to be both informed and involved by scientists.

In only one of the twelve research centres the interviewees define S&S as "the capacity to promote and facilitate debate" (HC, female, id6, biomedicine) without considering the transmission of knowledge as one of its primary tasks:

To facilitate a debate without taking it personally and being able to see the others' point of view ? is not something that comes naturally (xxx)in this sense we have a course which is called (x) 'science and society'. So now science communication is now science and society.

How do you engage and involve your audience and offer opportunities for interaction and debate? (D, male, id6, biomedicine)

Certainly, other research organizations have researchers and communication practitioners who understand S&S as a participatory-dialogical relationship: these, however, are exceptions that do not represent the institutional policy adopted by the research centre as a whole.

In some cases, the emphasis is on the transmission of knowledge in order to bridge the gap between science and society: "S&S means the overall aim to bridge the gap between scientific research and society" (HC, male, id5, physics), trying to disseminate scientific contents so that they are accessible:

Complexity is not understandable (x)((shaking head)) it needs to be reduced (x), it is important that the outside world understand what we are doing" (D, male, id4, physics). Again: "we can provide updated scientific information (x.) it is really difficult to translate these data into something understandable = unfortunately , it is not written in the statute that we must undertake public understanding of science. (HC, female, id7, physics)

Interviewees frequently used the word 'translate' to describe the communication task. This reveals the persistence of a transmission-oriented concept of communication that, unavoidably, relegates the public to a subordinate – if not entirely passive – role.

In other cases, a specific S&S activity means at the same time stimulating the curiosity of the public by providing information and urging it to ask questions and decide: "to awaken in the listener the desire to discover (xx) to offer opportunities for people to form an idea (x.) have a basis to decide" (SR, male, id5, physics); "You have to hit people in the head" (SR, male, id9, biomedicine). The conceptual movement enacted thanks to S&S activities incorporates an emotional, a cognitive and a social moment: it starts off from the desire to know, the possibility to formulate an idea, a concept around an issue to move, then, to forming a decision, to take a position. In one case in particular, the term 'debate' was explicitly used to state that all the activities called S&S coincide with "the capacity to promote and facilitate debate" (D, male, id1, physics). The interaction between scientists and the public, even when its purpose seems only to remedy a shortage of scientific knowledge in the public, may thus become a tool for 'empowerment' which turns the public into an active player.

As a consequence, the experiences and activities cited by the interviewees as examples of S&S do not fit neatly into any of the existing theoretical models of science communication and public engagement. Actions whose main goal seemed initially to be the transmission of science and the filling of the knowledge gap between scientists and the public could then become projects that fostered dialogue and participation as well. According to several interviewees, especially researchers, the transmission of scientific knowledge is essential in so far as it enables the public to develop adequate awareness of its responsibility to form an opinion about technoscientific issues. By contrast, scientists often regard S&S as compris-

ing communication activities that recall the deficit model of transmission from the experts to the general public.

Although the large majority of the research institutions surveyed enacted strategies of public engagement in science that were deficit and transmission-model oriented, even in those cases there were signals of more differentiated, complex, and multifaceted attempts to engage the public with science. These may have been minority discourses, but their presence is nevertheless encouraging (Davies 2008). Moreover scientists and even communication practitioners may not be fully aware of the potential novelty of the activities that they implement and the approaches that they adopt, such as, for example, role-playing in S&S activities, nor aware of the impact of controversies in challenging transmission/deficit-based models of science communication, or of the relationship between gender issues and S&S. The main theoretical models describing the science and society relationship – referable, in general, to the opposition between deficit/transmission model and participatory/dialogical one (Bucchi 2004, 2008; Brossard and Lewenstein 2009) – are certainly useful for understanding what research centres do under the heading "science and society" and how they interpret their role in this context. However, these models do not accurately reflect the variety of orientations and activities actually implemented by the various scientific institutions. Furthermore, different approaches often co-exist within the same institution and within the same subject, even if one model tends to dominate the others and determine the types of S&S activities implemented.

Furthermore, the research centers are engaged in an intense search for new tools, strategies and activities able to ensure or enhance the long-term impact and effectiveness of science communication and PE. The problem is that this apparent dynamism of tools is not matched by an equal dynamism of objectives: the long-run goal, in fact, remains that of communicating scientifically sound contents to those who, not being scientists themselves, are believed to be in need of becoming more scientifically-informed. In this regard, the situation of leading research institutions across Europe appears to still be characterized by the deficit model, despite some isolated cases where a dialogic and participatory-oriented model is in place.

Scientists, as well as communicators, tend to have a generic understanding of the public as a largely undifferentiated entity from which only two categories can emerge: those of students and politicians. In the case of students, it is evident that they are perceived as "young, still in the learning phase" and this confines them to a subordinate position; in the case of politicians, they are more often recognized as interlocutors if only because they are often seen either as decision-makers who determine the availability of important resources for research, or as a mean to communicate with the general public.

Scientists assign themselves a prominent role in the context of the relations between science and society: it is their responsibility to take the initiative, it is they who have something to offer (scientific knowledge), and others have to change. Conversely the public, especially when understood in a generic sense, is defined as a passive interlocutor both to be solicited in order to make it ready to

receive but not to give, and to be observed to see if, appropriately stimulated, it changes knowledge and attitudes in the direction hoped for. Scientists, but not infrequently also communicators, perceive themselves as actors involved in a process that should fall under their control. Therefore, they prefer direct contact with the public, while they somehow distrust mediated contact. The media are seen – often quite naively – as mere instruments of transmission, although inclined to betray the expectations when they simplify or embellish, when they attempt to translate the knowledge that scientists possess.

All this, however, tends to clash with a problem that emerges repeatedly whenever the interest in the relationship with the public and the importance that is attributed to it materializes in a concrete commitment. Scientific institutions, in fact, scarcely recognize SiS activities as part of the profession of scientist, often leaving them to individual goodwill and confining them in marginal sectors. This is why many of the scientists interviewed know little or nothing of what their research institutions do in the field of SiS. On the other hand, the organization of space within the research centers testifies to a general lack of attention to the fact that the same space is used by persons who are not engaged in scientific research work.

5. Conclusions

According to our data, the concrete and everyday practices of staff working on SiS activities at research centers are still regulated by a deficit-oriented model, rather than by a model organized around dialogic communications and strategies of active engagement with the public. With a few exceptions, in fact, most interviewees, regardless of whether they were scientists or communication/outreach practitioners, understood the two terms in the expression "science and society" as being regulated by a top-down relationship.

Despite the prominence of the deficit-oriented model, different practical solutions are at work in the activities of communication and engagement carried out by research institutions. Although this general orientation prevails, it seems that there is enough flexibility capable of fostering more dialogue-based and participatory activities. Furthermore, owing to the research institution's specific sociocultural context, the deficit model is necessarily cross-fertilized with other theoretical models of science communication (the dialogue and the participatory ones, for example), thus fostering forms of public communication and engagement different from those usually associated with science (Brossard and Lewenstein 2009).

The range of activities and strategies described by the interviewees as means to communicate with the public demonstrates that direct contact with the public is preferred to other, more mediated, forms of communication. This is also one of the reasons why the interviewees were generally sceptical concerning the role of the media in reaching the public in a fruitful way. Scientists may not be enthusiastic about the need to consider science communication and public engagement

as part of their research activities, but they are willing to take responsibility for them, especially the former. Scientists trust themselves more than any other actor in creating and maintaining a relationship with the public. According to the interviewees, opportunities to interact with scientists either through direct contact during an open day or through virtual contact via the Web, or through mediated contact via a third actor, are capable of revitalising the scientist/public relationship. This relationship usually becomes stronger when it comes under strain, for example because of a controversial situation in which both actors feel compelled to start a confrontation.

Scientists trust themselves as authoritative interpreters of S&S activities. Simultaneously, however, they perceive their commitment on this matter as an adjunct to their research work, something that takes up time and resources that should instead be devoted to research. On the one hand, therefore, scientists want to be directly involved in the relationship with the public; on the other, this involvement may seriously hamper their work/careers as scientists. This contradictory situation is determined by the fact that while scientific institutions and the organization of research activities do not recognize SiS as part of their efforts, scientists are increasingly required their direct involvement in such activities, both by institutions that support scientific research financially, and by society as a whole. The contradiction just outlined is currently being resolved by relegating SiS activities at the margin of the work of scientists, and by leaving the burdgen to invest in them to scientists' willingness. Clearly, this appears to be a precarious solution which poses serious obstacles to the development of PCST and the PE.

Also for that reason, despite the difficulty of classifying within a single theoretical model both the SiS activities carried out by research centres considered and the way those activities are interpreted by scientists and communicators, without question the deficit model maintains a dominant position. This substantial immobility, however, flies in with an interest in experimenting with new ways of designing and implementing initiatives of PCST and PE. This constant search for new means to achieve the same goal – namely to render the public scientifically literate – is not contradictory and does nothing but provide further validation of the elements suggested by Young and Matthews (2007), that scientists like to maintain a position of control even when scientific knowledge comes into play in the context of everyday life and thus directly implicates other social actors.

From this point of view the fact that scientists give a positive evaluation of their relationship with the media is compatible with their negative judgment towards the way the media talk about science; similarly, the preference given by scientists for the direct interaction with the public is easier to understand (i.e. in those occasions in which the scientists' presence can guarantee the goodness of what is communicated). On the other hand, the persistence of the deficit model is a significant element in the transmission metaphor that underlies the idea scientists have of communication. Consequently, instead of recognizing that communication always has uncertain outcomes, they prefer to place

responsibility for the unsatisfactory results of PCST on media professionals and imagine that the direct interaction between scientists and the public could improve things.

However, if opposing the dynamism of means to the immobility of goals might seem a contradiction at a first look, there is, on the contrary, a real contradiction, because the personal commitment of scientists in SiS activities conflicts with the recognition that they do not have the time, or, rather, that they should take time away from their "real" activities: doing research. Interaction with the public becomes a task to be delegated to others or is a marginal occupation compared to the 'core business' of doing research. In this way the importance of the institutional factor emerges, namely the lack of recognition by research institutions of undertaking SiS activities as an integral part of the profession of the researcher.

APPENDIX: Transcription Conventions:

Punctuation markers are not used as grammatical symbols but for intonation:

. "dot" is used for falling intonation
? "question mark" is used for raising intonation
, "comma" is used for raising and falling intonation
: "colon" indicates that the prior syllable is prolonged
// "double oblique" indicates the point at which a current speaker's talk is interrupted by the talk of another
= "equals" sign indicates no interval between the end of a prior and start of a next section of talk
(xx) "numbers in parentheses" indicate intervals without speech in tenths of a second
_ "underscoring" indicates stressing of a word or of a group of words
() "empty parentheses" indicate talk too obscure to transcribe. Words or letters inside such parentheses indicate the transcriber's best estimate of what is being said or who is saying it.
(( )) "words in double" parentheses indicate transcriber's comments, not transcriptions

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