Science Centers and Public Participation: Methods, Strategies and Barriers

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Abstract

Science centers and museums are currently experimenting to strengthen the participation of the public in two-way conversations between the public and the institution. Eventually, these activities will lead to a stronger role of the public in the decision making process of the museum. We analyzed the current situation faced by science museums in Europe in light of the recent discourse on public engagement with science, and we identified the main barriers and obstacles that prevent actual decision making of the public within the institutions. Finally, suggestions for solutions are discussed.

Keywords: public engagement, science museums, science centers, public participation, governance

1. Introduction

Science centers and museums (referred to as SCMs in the rest of this article) have traditionally played an educational role offering their visitors opportunities for informal science and lifelong learning, and they are usually recognized as important players in the communication and dissemination of science to the larger public. The last decade however has been characterized by an increased professional interest in and development of activities where participatory techniques engaging the public directly with scientists, researchers and policy makers are the key components of many public programs and exhibitions (Davies, 2009, 2011; Lehr et al., 2007). For example, projects like "Meeting of Minds" or "Polka" (I. Anderson et al., 2007; Parisse-Brassens, 2009) involved several SCMs where formal policy statements in the field of neurological and genetic research were formulated and subsequently brought to the European institutions. "Open labs" on the museum floor provide researchers a place to conduct their doctoral and post doctoral research in open view of the public (Meyer, 2011). Increasingly popular are also the "science live" programs, where the public serves as subjects for a wide array of scientific experiments. Currently such programs are running at the Science Museum in London, Science Center NEMO in Amsterdam, Science Gallery in Dublin and other locations.[1] On a more general level, the international field of science centers has formally resolved to "further promote dialogue between scientists and the general public so that public opinions on science and technology can be heard and incorporated into decision-making processes."[2]

SCMs aim therefore to be a direct link between the public and the "doing of science", where the

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[1] More examples can be found at http://www.ecsite.eu/activities_and_resources/projects (accessed 6 January 2012)

[2] As mentioned in the 2011 Cape Town Declaration, endorsed by all the science center networks worldwide. Available online:

http://www.ecsite.eu/sites/default/files/news/CAPE_TOWN_DECLARATION_FINAL.pdf

(accessed 6 January 2012)

museum is in a key position to manage the interactions of the public with the stakeholders involved in the current practice of science (Bell, 2008; Chittenden, 2011; Chittenden, Farmelo, & Lewenstein, 2004). As a result, SCMs are effectively entering the field of science governance by shaping the relationships of the public with other stakeholders, by enabling the public to form images of science governance (Felt & Fochler, 2008, 2010), and by allowing the public to be directly involved in research activities, many of these of a controversial and innovative nature (Chittenden et al., 2004). Furthermore, SCMs perform another critical function: They enable scientists, researchers and other stakeholders to shape and negotiate their own images of the public. SCMs have become places where the "understanding of the public by scientists" takes place (Lévy-Leblond, 1992), thanks to the interactions between scientists and the public that they build and facilitate.

At the same time SCMs are under pressure to develop new strategies to engage and involve the public in the development of their activities and programs, in order to strengthen their social relevance and become meaningful players in the dialogue between science and society (Rodari & Merzagora, 2007). SCMs are therefore currently developing new methods to share the traditional authority of the museum with the public and to achieve a more transparent epistemological process (Cameron, 2008, 2010). The transparency of such epistemological process, it has been argued, cannot however be achieved without a clear role of the public in the governance of the museum (Bandelli, Konijn, & Willems, 2009). The present paper focuses on how SCMs see this role of the public and on the methods and strategies they employ to open up their decision making process to the public.

Even if an increasing number of SCMs are thus becoming interfaces between science and society, there is so far little evidence that these crucial roles are effectively communicated or negotiated with the public. The extensive literature on visitor and museum studies has traditionally focused on

the relationship between museums and their public, with little attention so far about how public participation in the governance and decision making process of SCM affects the larger domain of science policy. At the same time, science technology and society (STS) studies concerned with the public participation in science policy have usually confined the role of museums to the domains of education, dissemination and communication of science, leaving a gap about the role of SCM as platforms to support public participation in science policy.

The present paper aims to fill this void, analyzing the mechanisms of public participation in the governance of SCMs from a perspective of public participation in science policy (see Figure 1). "Governance" is a term that lends itself to multiple definitions and interpretations (Jordan, Wurzel, & Zito, 2005). In this paper however the concept of governance is used to describe the structures and processes where decisions and policy making take place, both at the institutional level (as in the governance of SCM) and at national or international level (as in the governance of science). Our focus in the following is mainly on the governance at the institutional level.

Figure 1. Context and focus of the present study: Public participation in SCM policy with outcomes that influence science policy and governance.
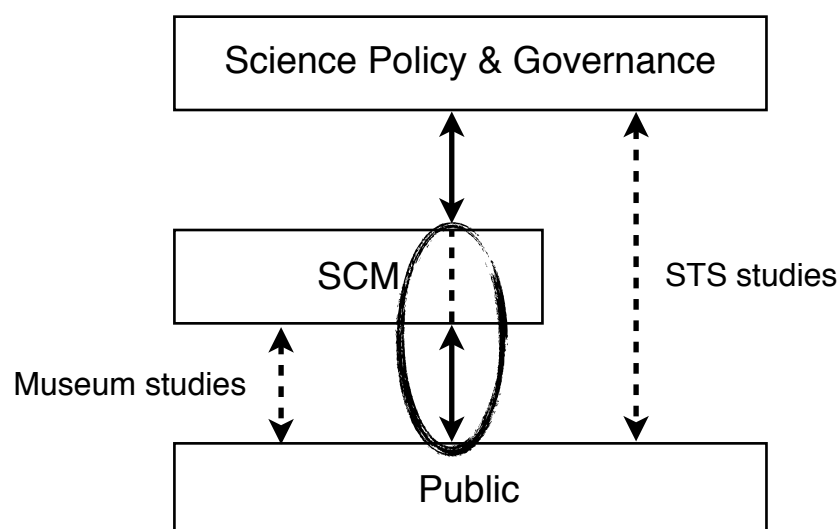
Note: SCM = science centers and museums; STS = Science, Technology, and Society.

It seems that SCMs advocate (and in fact implement) two-way communication between the public and the various stakeholders involved in the governance of science but it is still unknown to which extent the same two-way communication is implemented between the public and the museum itself. For instance, to what extent are the research experiments performed on the museum floor negotiated with the public? Are the public's ideas and concerns about the content of the programs taken into account? How are the dialogue events and the "scientific citizenship" they help to establish (S. R. Davies, McCallie, Simonsson, Lehr, & Duensing, 2008) constructed? How do museum publics enact themselves during such events (Michael, 2009)?

These are some of the questions that need to be addressed in order to understand how SCMs perform their role as "facilitators of engagement" between scientists and the public (Greco, 2007; van Dijck, 2003). There is no doubt that SCMs are good platforms to bring science to the public but we still don't know if the opposite is actually true. That is, whether SCMs are able to include the public's voice in their activities and, therefore, in the science they construct and present. Science currently plays a critical role in the governance of SCMs. In many cases science institutions are among the founders of science centers; the boards and trustees include scientists and representatives of scientific institutions; many directors are scientists; scientific advisory boards are either a permanent feature of SCMs, or are set up when a new program is developed. Thus far, however, there is little evidence that the public plays any role in the governance and in the decision making process of SCMs – at least not in the same structural and formal way. Public participation becomes effective when it is an identifiable and structural component in the decision making process (Caron-Flinterman, Broerse, & Bunders, 2007) and in the governance of the institution. Moreover, it should be an on-going activity, not an ad-hoc exercise; participation should not be switched on only when it is convenient to the organization. It has to allow for unpredictable outcomes and real consequences, and lead to some degree of power-sharing among the parties involved (Seifert, 2006).

Nowadays, SCMs have all the potential to be "level playing field" actors in the governance of science, that is, at the same level as research organizations, patients' associations, industry, government and NGOs, etcetera. However, little is known about the mechanisms used in SCMs to make sure that the various stakeholders not only get equal opportunities to be heard, but also that these mechanisms are transparent and adequate accountability systems are present (Macdonald, 1998, 2002, 2010). It seems therefore that regardless of the "participatory turn" of the last decade in the science and technology studies (Jasanoff, 2003), in their actual operations SCMs still suffer from structural obstacles, which prevent them to effectively implement public engagement and participation. As Chittenden puts it, science centers and museums still represent a system which is "ephemeral and unpredictable" (Chittenden, 2011, p. 1552).

Within the field of public engagement with science, there is a critical discussion about the existing gap between the public and science, and the resistance of certain science structures to accept and acknowledge the difference that public participation can bring to methods, processes and assumptions (Delgado, Lein Kjolberg, & Wickson, 2010; Wynne, 2007). SCMs can be instrumental therefore in increasing public access to science and make public contributions to science governance more visible and meaningful.

If the public is involved in a structural way (i.e., participation becomes a regular, ongoing and integral activity in SCMs), we need to address the position of the public in the decision making process of the institution. Does the public remain an informant, or does this structural involvement lead to situations where the public is not only a full-fledged stakeholder, but also holds decision making power? How can we define the level of this involvement? In the present paper, we address the question of how open are SCMs to public participation in their own governance, analyzing the current state in Europe in view of their methods to involve the public in their decision making

process and governance.

Museums already interact with several organizations that represent the public, like government agencies, civil society (Janes, 2007) and community organizations. These interactions often affect the museum governance, with seats in the board, advisory groups and similar instances. However, these mechanisms are ruled by formal relationships at the institutional level between the museum and the organizations representing the public, and the interactions they entail are very different from those between the museum and the general public. Access to the museum governance is conditional to some form of "representation" of the public involved – either in the form of belonging to an organization, or bringing the agenda of a specific group to the museum. In addition, several boards co-opt their members, reducing or in fact blocking the bottom-up participation of the public in these structures. This is the "institutional public" in the governance of SCMs.

In the present paper we will focus instead on the public defined as individuals who interact with the museum or science center in their personal capacity, i.e., not because of their institutional roles. In our study, the public may be visitors or users, members or tourists, or "non-visitors" who do not (yet) see the museum as a meaningful and relevant institution. The defining aspect is that we look at how a relationship is built between SCMs and individual members of the public. Participation in the governance requires building trust between the museum and the public – it is arguably not a role for the casual visitor who comes to the museum only once. There are several instances where casual visitors provide input to a museum though: Evaluation studies rely on this, and so do many "visitor voices" projects (McLean & Pollock, 2007). But taking part in a structural way to the decision making process and the governance of SCMs requires an understanding of the issues at stake, which can only achieved with an ongoing interaction between the parties involved. Nevertheless, this relationship can start from a casual visit, if the visitor sees the museum as an open organization which supports and empowers the role of the public in the democratic society.

2. Method

To define the tools and mechanisms for public participation used in SCMs, we used in-depth, semi structured, qualitative interviews with four levels of museum staff: 1) board members, 2) directors, 3) middle staff (managers, content developers, education officers etc.) and 4) floor staff/explainers. Each interview covered three areas:

- Who has decision making power in the museum?

- Is the public involved in the decision making process?

- Are there structural barriers and obstacles to implement public participation in the decision making process of SCMs?

Sample

We identified a theoretical sample (Strauss & Corbin, 1998) of five science centers and museums located in Western Europe (with a geographical distribution from Scandinavian to Mediterranean countries). In a theoretical sample the cases are chosen to fill theoretical categories and to provide examples of extreme situations and polar types (Eisenhardt, 1989). We looked therefore for a broad variety in terms of history of the institution, size, dominance position and competition, exhibition techniques and funding mechanisms. Furthermore, we relied on the availability of additional documents and reports and on professional knowledge of the field to identify the institutions that would fit our purposes most. However, the institutions were not chosen to be representative of the science center field in Europe, nor do they represent "success stories" of public participation.

The institutions in the sample range from small (with less than 10 persons on staff) to very large (in excess of 500 staff members) as well as including very recent institutions (2 years old since opening to the public) to old ones (150 years). Four institutions have collections (either historical objects, specimens or exhibits), while one does not have any permanent collection and organizes only

temporary exhibitions and programs. All the institutions in the sample have a board, which has been either publicly or privately appointed; have one or more levels of staff; and have one or more directors responsible for the management of the organization (when more directors were available, we interviewed those responsible for the public engagement or exhibitions).

In the following, the five institutions selected (and the corresponding staff interviewed) are referred to with fictional names in order to guarantee the anonymity of the institutions and their staff. We named the institutions as follows: The Central, The Metropolitan, The Tower, The Grand, and The Rover.

Data collection

The interviews (in all, 22 in-depth face-to-face interviews of about 1.5 hours each) were collected between September 2008 and December 2009, all recorded and transcribed. In addition to the interviews, other documents were used during the analysis:

- Mission statements;
- Organization charts;
- Annual reports, evaluation reports, press releases and newsletter articles regarding the institutions;
- Related personal communication with the interviewees and other members of the staff.

The data were analyzed with techniques for developing grounded theory (Glaser & Strauss, 1967; Strauss & Corbin, 1998), conceptualizing and reducing the results of the interviews into common categories, and finding relationships across them.

3. Analysis

Our analysis looks at how SCMs organize their decision making process and the contributions from the public, and provides an overview of the current barriers and best practices to include the public in the institutional decision making processes.

In SCMs there are multiple decision making holders: Typically, this power is divided among the board, the director, and the staff (Bandelli et al., 2009). There are limitations to this model, however: For instance, institutions and decision makers will have their own decision making style, affecting how decisions are taken, regardless of who takes them (e.g. autocracy, consultation, consensus, democracy, etcetera). These styles are influenced by the organizational culture of each institution and by the personalities of the people involved in the decision making process. There are also differences within each of the three categories in the model. On the one hand, some institutions have more than one board, for example (with separate responsibilities for legal and scientific issues) and more directors, often with unclear boundaries regarding the decision making power of these bodies. On the other hand, even within the staff the level of decision making power depends on many factors, some formal (such as hierarchical position, or longevity in the institution) and some informal (such as the level of personal trust gained among colleagues, or the person's acknowledged expertise in a specific domain.) Finally, the legal status of an organization is reflected in its governance and therefore in its decision making process. Nevertheless, this model captures the main categories of actors involved in the decision making process, and provides a level of abstraction suitable to be used as an analytical tool to describe an otherwise complex situation. We used this division to analyze the responses of our sample, looking at the role of the board, the director and the staff as decision makers.

What are the current processes of decision making in science centers?

Board: The board provides a general and strategic governance structure to steer the institution rather than acting as an actual decision maker. The board provides the legal framework for

decisions that are already being taken by the institution and has, in fact, more often a role as informant than as decision maker. When it does take decisions, it is usually because of legal requirements. The board sets the "boundaries" within which the institution operates, and confirms (often for legal and financial reasons) the choices that the institution – mainly through its director – brings to its attention.

The role of the **director** as a decision maker on the other hand is much more variegated, and its actual role in the decision making process of the institution varies considerably among the institutions surveyed. Small institutions allow for more democratic processes, whereas staff in large institutions tend to complain about the fact that these processes are often tactical (deciding who does what and when) rather than strategic. The director is seen as a "broker" for the different stakeholders, and the one who can give legitimacy to internal and external pressures. Directors however are not at all the unquestioned decision makers and they can be bypassed in their decisions. The most frequently recurring reasons given are those of internal personalities that do not accept the institutional framework, timeline or protocol for the development of new initiatives; and because of conflicts with the budget constraints and control bodies.

In many respects the **staff** has a weaker role in the decision making process than the board or the director. One common observation across all institutions is the fact that staff decisions are easily overruled by opportunism decided outside of the process: the two reasons most often mentioned are political pragmatism and the influence of sponsors in steering the development of activities and projects. Two situations are reported in which the role of the staff in the actual decision making process is clearer. One is the role of the staff as "gatekeepers" of the contact with the public. When the public is consulted to provide input about a certain activity of the museum, the staff has in fact the power to "frame" this interaction – even if it is not charged with actual decision making power.

Tower-manager-1: What we try to do is to bring to the table what [we think] the visitors need, not necessarily what they [say they] want. And this is an important thing. In the decision making process of the museum we are a powerful influential voice, but that's it, we are an influential voice but we are not making decisions.

A second case reporting a more clarified role of the staff in the actual decision making process is when a member of the staff has an acknowledged "independent" position within the organization. Usually, this means a certain expertise or a role which is well defined and can be carried out autonomously. In this situation the staff is charged with a higher level of trust and their decisions are easily implemented.

In conclusion, it appears that the staff is charged with decision making power only when it has certain skills and competencies to lead a given process. In the other instances, the director acts both as a negotiator among the different informants/stakeholders and as a guarantor of the legitimacy of the decision making process. The board provides mostly a higher level of guarantee and a framework for long term institutional strategies. Of interest is that the decisions of both the staff and the directors are regularly "bent" in order to accommodate other decision makers; this is generally experienced as a frustrating "bypass" of the procedure, because it happens without transparency and argumentation.

Are there methods and strategies to include the public in the decision making processes in science centers?

The interviewees were asked to list the stakeholders of the institution where they work. Table 1 and Figure 2 show the percentage of the answers for each category of respondents (in brackets the number of respondents – 18 out of the 22 interviewees answered this question).

The stakeholders most frequently mentioned are the public (intended as visitors to the science

center), the national and local governments, universities, scientists, and the industry. Teachers and schools follow, together with associations and civil society, media, donors, and the trustees or board of the museum. The results suggest that the SCMs surveyed see as their stakeholders the very same actors that are most involved in the governance of science – notably the government, civil society, universities, industry and the public – which reinforces the view that SCMs have all the potential to be active players in this arena.

As was expected, SCMs are currently still experimenting with strategies and methods to include the public in the definition of their activities and in their decision making. We didn't find any well worked out strategies in this regard, although the work done so far clearly highlights the priorities and the dilemmas faced when the public is included in a more structural way.

One common understanding across all the institutions interviewed is that adults are the key public who can contribute in a substantial way to a more relevant definition of the content and the role of SCMs. The knowledge that the adult public can provide must however fit within the mission of the institution and its responsibility to provide reliable information:

> Rover-director: The whole institution is getting caught up in this sort of dichotomy, which is either they – the public – lead everything you do, and then we don't have any voice, or "we have to tell" – but actually it's a mix, people want to operate within the framework of an organization that they know is a voice of authority. Our responsibility is to provide authenticated information, good quality data, intelligent knowledge, facilitate all those things as well, but also to enable knowledge, experiences, and different perspectives to be applied, to ultimately build on the body of knowledge.

Table 1 - Museum stakeholders as mentioned by the interviewees

	Schools	Trustees	Nat. Gov.	Local Gov.	University	Teachers	Public (visitors)	Media	Donors	Scientists	Associations; Civil Society	Industry
Board (2)			100%	50%	50%	50%	50%					
Directors (5)		20%	100%	80%	60%	40%	60%	20%	40%	40%	40%	60%
Staff (11)	45%	10%	65%	55%	55%	35%	65%	20%	10%	35%	30%	35%

Figure 2. Museum stakeholders as mentioned by the interviewees.
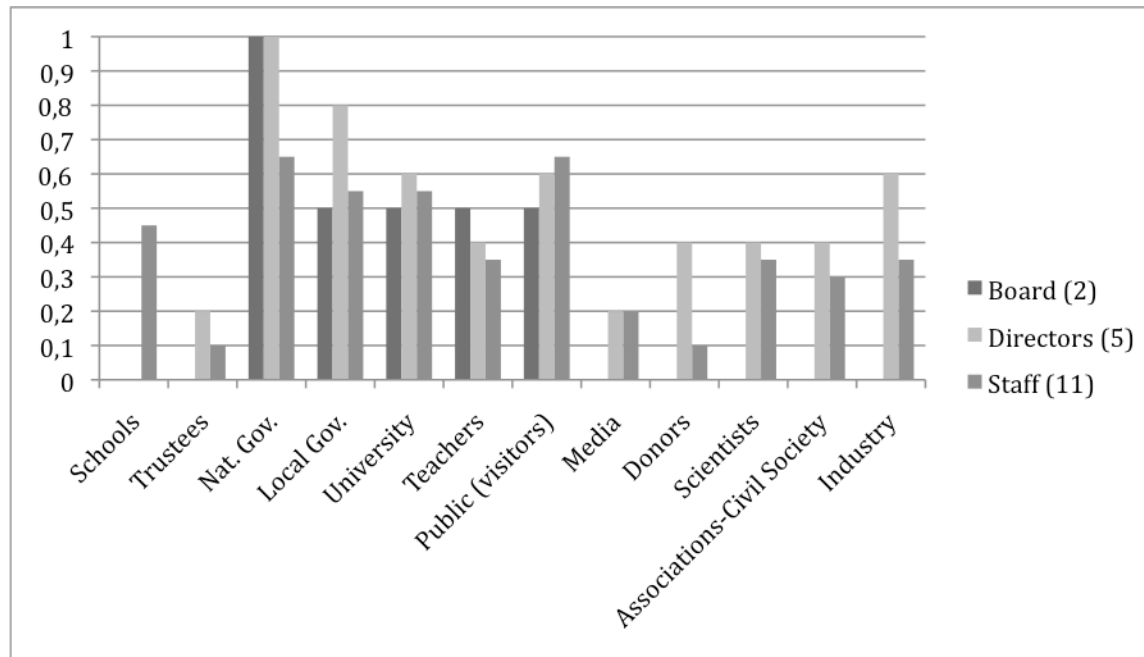
At the same time it is also clear that the public's contribution lies especially in the social and experiential domains; this however creates a strategic problem with the way SCMs generate value. SCMs are still measured in terms of the number of their visitors, not because of the social value they help to build together with their public. After a visitor pays the entrance ticket, he/she becomes a statistical number for the museum. The tools that can quantify what the public brings to the museum, such as comment cards, guest books and the many tools described in the *Visitor Voices* literature (Gammon & Mazda, 2000; Livingstone, Pedretti, & Soren, 2001; McLean & Pollock, 2007; Pedretti & Soren, 2003) are not acknowledged outside the professional field of museums as instruments to assess the value of museums (M. L. Anderson, 2004): The leading indicator is usually the number of visitors and in some cases the income generated by the institution, or the number of temporary exhibitions.

One strategy that is being increasingly adopted is the direct involvement of the public in building alternative "storylines" to an exhibition or a program. A structural way to do so is by exposing the epistemological method used by the museum to build an exhibition and "co-develop" the exhibition from the beginning with the public:

> Tower-manager-1: While you're doing the research phase, you can encourage the audience to give their feedback and you can embed it in the exhibition. It's not like "here's the exhibition, we're finished, tell us what you think and leave your comments", it's more like "here's the research, tell us what you think while we're doing that", because that might be quite different from what you get once the exhibition is done.

A similar approach is also mentioned by another institution in the sample, with a specific mention of using web-based technology to "add a seat to the table" during the development process for a new exhibition. This kind of involvement seems to be more effective for broadening the relevance

of the institution than for opening up the content already on the floor to the comments of the public. In both of these approaches public participation becomes part of an integral method within the institution, instead of being a "feature" added at a later stage after the content has been researched and developed.

There is, however, a perceived limit to this approach: Sooner or later the public involved in this early stage of development starts to assimilate the institutional culture of the museum and will lose the perspectives for which they were originally consulted.

> Tower-manager-2: The difficulty in the process is to ensure that the people you are talking to remain representative of the issues that you need to overcome for all the visitors and don't become either individual advocates of what they would personally like, or become "museum people". And I do think that by involving people in the process, there is a point where they become museum people. So that's the difficulty.

The direct involvement of the public in the development process of programs and activities requires a more "layered" perspective to public segmentation, considering psychographic variables that are currently not exploited by SCMs. In addition to the demographic data about visitors currently available to museums, the interviewees mentioned the need to describe in more detail attitudes, values, interests and lifestyle of their public in order to better understand the motivations and expectations of the public involved in this process.

In this way it would be easier to identify and work together with the groups of collectors, scholars and amateurs who want to share their passion for science for instance, and to engage with the fast growing field of citizen science (Bonney et al., 2009; Meyer, 2008). Furthermore, the role of the "friends of the museum" and members as brokers to reach new publics currently absent from museums (such as university students and immigrants, for example) can be further considered.

Members and friends are very committed publics who not only support the institution financially but are in most cases also "ambassadors" of the institution within their circle of friends, colleagues and acquaintances. They value the museum and are usually well informed about its activities. Our interviewees agreed that this is a public where SCMs could invest more, offering members and friends a more active role in the development of programs and activities in order to better address the needs of their circles of acquaintances.

Finally, another strategy which is being developed is the definition of professional profiles among the staff to include the public's voice in the content of the museum. Two methods to do so emerged from our analysis. One is to have "audience advocates" who represent the public internally in the institution. This approach can allegedly be afforded only by large institutions and remains a project-based approach, and thus it is not structurally integrated (Koutsika, 2006).

The other method is to empower the staff to become social agents in order to harvest the political and social role that SCMs can play to strengthen the scientific citizenship of their public (Elam & Bertilsson, 2003; Irwin, 2001). This requires a considerable effort on the side of the staff who must be able to access professional development opportunities in the field of science communication theory and social studies, and translate this knowledge into programs and activities for the science center.

> Grand-board: We can refer to Bauman's concept of liquid society – in fact, we live in a world where everything is liquid, there are only fears, and you have to communicate that science doesn't give answers, but is a tool to give answers and live better. What is important for us is not the number of visitors or the exhibits, but the quality of the staff we have. Science centers, compared to traditional museums, changed a lot and became "living" places. Today it's necessary to make a new step forward. Those who work in a science center must be able to build scenarios and projects about the future with a capacity to self-interrogate about what can be done.

In conclusion, SCMs are trying out different strategies to move from being only content providers to being places which support the two dimensions of scientific citizenship: scientific competence and actual participation (Horst, 2007; Mejlgaard & Stares, 2009). While providing scientific competence to their public is a task SCMs have always embraced, implementing actual participation is seen as a necessary but still uneasy activity.

What are the barriers and obstacles that limit or prevent public participation in museums?
The current barriers and obstacles that prevent a structural participation of the public in the decision making process of SCMs are several, and all the interviewed subjects - with no exception - identified at least one which affects their work directly, and in many cases several more.

From the point of view of the staff and directors, the barriers and obstacles are either internal (i.e., the source of the problem is identified and originating from within the institution) or external (i.e., public participation is made difficult or impossible by problems lying outside of the institution). At the same time these barriers can be controllable by the staff (i.e., the staff has identified methods and solutions to address the problem, even if their implementation may be difficult) or uncontrollable (i.e., the solution to the problem is beyond the remit and possibilities of the staff).

We analyzed the stated barriers and obstacles alongside the two indicated axes: internal/external and controllable/non-controllable. The resulting matrix (see Figure 3) allows us to define four categories of barriers.

Figure 3. Barriers and obstacles to a structural participation of the public in the decision making process of science museums.

Non-controllable

Institutional barriers   Fear

Internal   *External*

Professional development   Reaching the public

Controllable
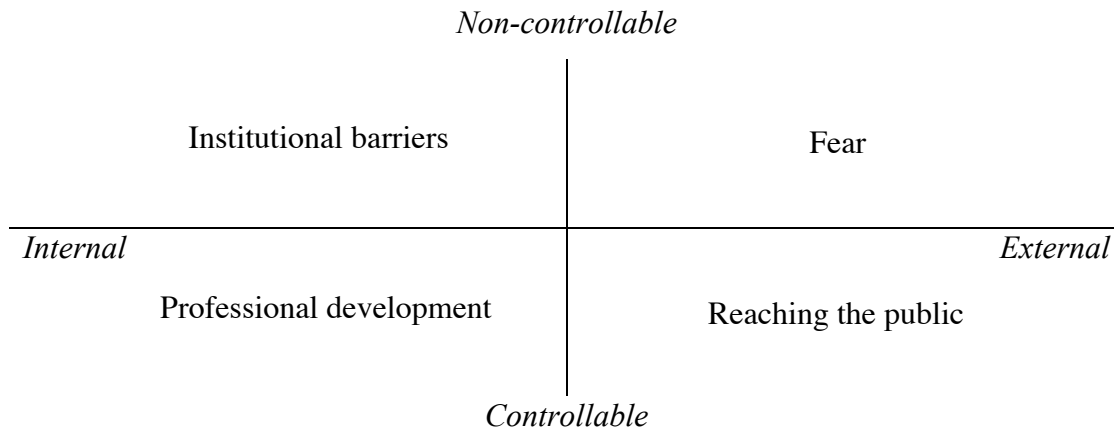
Institutional barriers

Institutional barriers are conflicts between the established practices of the institution and the process of change necessary to include the public in the governance of the institution. These conflicts usually originate from different understandings within the institutions and in the field at large about the social role of SCMs. They are still commonly perceived as establishments where knowledge is displayed and offered to the public, rather than places where knowledge is constantly generated, questioned, discussed and improved. This is not only an internal institutional problem but it is also a consequence of a poor recognition and visibility of SCMs among other cultural institutions. The value of a museum or science center is still largely measured by the number of its visitors, but this measure obfuscates other important roles and functions. A board member's comment clearly describes the uneasiness of science centers in this regard, when the entertainment and leisure goals of the institution take over the concept of "science citizenship" that science centers aim to foster:

> Grand-board: Science centers have betrayed Frank Oppenheimer's original idea when he founded the Exploratorium, which was to give everybody ownership of complicated science concepts, and have become instead places were there is an excess of simplification and popularization. Science centers must now regain a new level of experimentation, the science center as a place in the city, by

the citizens, where serious things are done. In an entertaining and playful way, but doing serious things.

The professionals in the field also share concerns on the lack of innovation in science centers and on the difficulties to capitalize on the experience of innovative projects:

Grand-manager-1: The European projects have been opportunities to do something we would have never been able to do, in terms of themes or in terms of methodologies, like participatory tools where the public can contribute to our development. It's been a very innovative process, but we are not able to capitalize on this innovation to change our own programs. You need new competencies, new dynamics, which are different – and often absent – from the skills you normally have in an organization.

Another institutional barrier is the lack of transparency of the internal decision making protocols and the opportunism of certain decisions, described above when referring to the "bypassing" of decisions by the directors and the staff. This barrier is twofold: on the one hand it prevents the development of participatory methods for the public because it is unclear at which stage and with which actors within the institution the public can effectively interact; on the other hand, when the public is invited to contribute to the decision-making process the lack of transparency creates internal opportunities to bypass or ignore the contributions of the public itself, weakening therefore the relationship and the trust between the institution and the public, and confusing the roles of the public (and of the staff) in this process.

Lack of professional development

The lack of professional development about the methods, tools and purposes to include the public in the decision making process of museums is a major weakness on which all the staff interviewed agree. There is a lack of documentation and research on this subject and the museums themselves

rely mostly on anecdotal evidence and personal insights to better listen to and understand the public (Mayfield, 2004). A problem outlined by several staff is that it is still very difficult to get "unbiased" feedback from the public: usually it's only the most enthusiastic public and the most disappointed one who take the effort to communicate their views with the museum. During a regular visit, the only member of the staff most people come in contact with is the ticket seller (when this function still exists). There is a structural lack of opportunities for the public to actually interact with the staff working at SCMs; and even when explainers or educators are available, they are not always well prepared to interact effectively with the public (Tran and King, 2007).

Alongside the problems of "listening" to the public, there is also the problem of making use of what is learnt from the public, which means exposing the social and political values of that information:

> Tower-manager-1: We are struggling with how we represent the public's opinions on issues of contemporary science to other people so that it makes a difference. It's about whom do you represent that viewpoint to, and get people to take it seriously. There's a nervousness about people's expectations of what actually happens with that information that at the moment doesn't get reflected back in the museum. We haven't found any real successful way moving that to a sort of political level saying "we've got so many people through the door and they are not happy with this sort of research or they are uncomfortable with that". How do you lobby that, or how do you get that taken seriously, if that is what we want to do?

This quotation exemplifies the stride between the ambition of SCMs as a field to bring public opinions into decision-making processes (as stated in the Cape Town declaration, see footnote 2) and the uncertainties when the institutions try to implement methods to incorporate these opinions into actual processes.

Quite often the activities where the public could provide feedback and interact with the museum

(and its floor staff) are developed without a real consciousness of this process and a lack of knowledge of the current and potential interactions that take place between the public and the SCM:

> Grand-explainer: The cultural gap between those who develop and those who implement the activities is a major problem. Their experience on the floor (of those who now sit in the office) is from 6-8 years ago, now the public is different, you can't develop the same things. You really need to observe what goes on. There isn't a real "osmosis" between the management and the staff on the floor. Certainly, now some managers spend time on the floor, they see what goes on: but they don't wear our clothes, so to speak.

This gap between those who develop the activities and those who implement them and interact with the public is also relevant to collection-based exhibitions:

> Tower-manager-2: Traditionally, there has been more of a "the curators are the font of all knowledge", you should be grateful that they've put something out there, the object is king, that sort of stuff. There has been a lack of understanding in that team that just putting something out there doesn't mean you are engaging in any way, you have to give it more work, and that the visitors genuinely are not like you, in lots of ways.

But it is not only the attitude of the staff or the cultural gap that constitutes a barrier for a deeper interaction with the public; also the working methods of the staff, which rely almost completely on paper and written documents, are responsible for this. One of the common concerns is that this way of working is unable to fully capture and describe the multiple and increasingly participatory languages (video, interactive and social media etc.) that the public is used to nowadays in daily life.

Difficulties in reaching specific publics

Our interviewees all express that if science centers want to involve the public in their decision

making and governance process, they need to target and work with small groups, usually over a longer time than the usual interaction with an exhibit. The public that can be engaged with these activities is also a niche group, much more segmented than the "general public" that museums broadly address. This is an issue that creates a series of barriers for the current way science centers operate. The first one is a stride between this definition of the public and the way the majority of visitors experience the museum:

> Grand-manager-2: Visitors don't want to spend one hour on an activity when there are other hundreds available. A science center is still seen by many people like a "grab and go" activity, where you try something and you move to the next.

For many visitors, therefore, being involved in a deeper conversation about why and how the museum is dealing with a certain topic is something against their expectations of the visit. And when the public wants to be engaged in such an activity, it's the museum that struggles to frame this pursuit:

> Central-manager-1: Events for small groups are expensive and we don't get any money, on the contrary, we have to spend money to support them. There is a big value in what we learn from these events – knowledge that we would have otherwise paid for. But we're not used to think this way yet.

> Tower-manager-1: Audience-led programs are very staff-intensive, and it is quite difficult to demonstrate whether they are making any real long-term difference. You may attract people and audiences for that event, I'm not sure there is any real evidence to show that when you've got them for that event they'll come back for anything else.

Another important barrier is the fact that not everybody wants or cares to engage with the museum. Or better, not everybody thinks they care to engage with the museum. There are still many

misconceptions and false expectations (on both sides, museum staff and the public) about what SCMs should do and stand for, that prevent potentially interested people to approach or be approached by the museum and establish a deeper interaction. For instance, many science centers are considered by the public opinion as places for children, where only a certain kind of simple and entertaining science is dealt with.

As explained above, selected publics are particularly suitable to be engaged in the decision making process of SCMs – amateurs, collectors, but also people who have gained formal or informal knowledge about certain issues (like activists, for example). However, the main concern expressed by the sample is that many of the "triggers" that could engage these publics have a much lower visibility than the core activity of the museum, that is, the exhibition.

Fear of public controversy and of institutional change

The fear of changing existing practices plays a major role against the development of new participatory methods, according to the interviewed. Whereas other barriers and obstacles are rather well identified and can be addressed with experiments and exploratory actions, fear is an irrational block that can prevent further action and that is difficult to tackle directly. For most institutions the major fear is of controversy in the public opinion:

> Grand-explainer: We want to keep our existing public, kids, and we know what works for them, so we don't have an incentive to change. And then there is a fear of exposing yourself to criticism, discussion, reactions from the public opinion. The institution wants to avoid it.

> Tower-manager-1: We need some way of representing, in a really obvious way, where different pieces of content are coming from. This is a piece that's been written by the museum, this is a piece that the public contributed, this is a piece that an expert in the field has written, but it's a personal opinion, it's not the museum's opinion. We're all thinking about how that might happen, we are all

excited by the fact that it may be possible to do that, but also are worried that we might get it horrendously wrong, and that might be more damaging than not doing anything at all.

Internal fears also exist – internal opposition to changing the way of working, because people feel less secure when confronted with methods they are not familiar with. For example, when talking about the fact that scientists, developers, managers and directors should spend more time in direct contact with the public, one director said:

> Rover-director: My colleagues theoretically say it, but they don't do it. I want them out there on the floor, in direct contact, and it's not something they do. So our organization is interesting, intellectually all of this they will get, but in their heart sometimes it's a long way because it's a personal thing.

Thus, just like scientists, who easily revert to a "one-way education to a deficit public" (S. R. Davies, 2008, p. 430), the museum staff tends also to fall back to one-way communication rather than challenging their established way of working.

4. Discussion

Towards a public model of governance?

We do not claim that the results of our analysis can be generalized to the whole field of science centers and museums: given the variety and diversity of institutions that belong to the field, it would be very hard to design a research project to sustain such a claim. However, we built our sample in such a way to guarantee a wide applicability of the results, both in terms of institutional structures and range of activities. The organizations in our sample were carefully selected to portray a variety of approaches to public participation and of governance structures, ranging from small and dynamic organization to more traditional, big museums. Even across such diversity of institutional settings,

we found several common issues, problems and strategies which are indicative of a large part of the professional field of SCMs.

Our research highlighted a number of mechanisms for the public to be "heard" by the decision makers. In all cases however the public appears to be an informant to the decision makers, who filter and act upon the contributions of the public, rather than negotiate such contributions with the public. There are instances where the public gives a direct and personal contribution to the decision making process (for instance by taking part to the co-development of exhibitions or audience-led projects). However, these situations do not lead to an actual sharing of authority with the public, since the contribution of the public is filtered and mediated by the staff, or by reports, summaries of events, media reports, etcetera. We found the most instances of unfiltered contributions by the public in the situations where the staff has decision making power, and it can therefore hand it over to the public; however, as described above, these are not structural in the institution but are limited to one-off events, and are incidental to the whole institutional decision making process.

Therefore it is still very difficult to find a "public model" of decision making, in which the public is charged with direct decision making power and the other actors such as director, board, staff, other stakeholders act as informants for the decisions that the public makes (Bandelli et al., 2009). Such a model can be found, thus far, only in the plans for a more transparent development process which opens up the epistemological nature of the process (as described in section "*Are there methods and strategies to include the public in the decision making processes in science centers?*"). The main question is therefore whether such a model can be implemented in a museum, and what would be the consequences. This question is particularly significant today in light of the current developments in the field of science and technology studies and the public engagement with science which argue for a more direct and structural participation of the public in the governance of science (Horst & Irwin, 2009; Irwin, 2006; Wynne, 2007). Our interviewees however mentioned examples

of mechanisms where the participation of the public is starting to become structural within the organization. Such projects and activities include "discussion games" such as PlayDecide (Bandelli & Konijn, 2011; Parisse-Brassens, 2009), citizen science projects where the public contributes to scientific research with observations and simple analysis of data (Bonney et al., 2009), "fair" or festival events which bring scientists and researchers in direct contact with the public, community-specific projects (such as the involvement of ethnic groups or teenagers in the planning and development of programs and exhibitions), forums and policy advice meetings (Bell, 2008), co-design of exhibitions (S. Davies, 2010) and "science live" research experiments on the museum floor.

All these activities are fairly recent, and with the exception of science festivals and citizen science projects they have been consistently employed only during the last three to four years. Even if no institution, to our knowledge, has a policy in place to use these approaches for the development of new activities and programs, all the organizations in our sample agree that these best practices constitute a solid base to become structural instruments.

Implementing two-way communication in the governance of science museums

The move from the "public understanding of science" to the "public engagement with science" has shown that, on the one hand, we have a much stronger integration between science, governance, and the public today than previously. On the other hand, there is still a wide gap between these new forms of scientific governance and the actual culture of science and the scientific governance (Irwin, 2006). Our research shows that also in the case of SCMs there is still a disconnect between the rhetoric of public participation (arguing for a direct participation of the public in the choices and decisions processes) and the actual practice; about the same was observed by scholars such as Irwin, Wynne, and Hagendijk (Hagendijk, 2004; Hagendijk & Irwin, 2006; Irwin, 2006; Wynne, 2006, 2007). Also for SCMs, the main obstacle for a transformation from a "deficit" model to a

democratic one is the change of institutional practices and the cultural and epistemological assumptions behind them.

The key factor under the institutional control to achieve this change is the "framing" of the interaction with the public, both in terms of reaching the public(s) to be engaged and in having appropriate professional skills to manage such interactions. Wynne (2007) makes an important distinction between *invited* and *uninvited* publics: The former in fact usually suffer from a "paternalistic" approach (or tokenism) from the side of the science institutions, which frame the dialogue leaving little room for actual contributions from the public that can challenge the top-down models of governance. It is our understanding that so far SCMs are mostly dealing with *invited* publics, framing the discussions in ways that are instrumental to maintaining established practices and approaches (Lynch, 2011).

However, *un-invited* publics can bring true innovation to the governance structures, even though they require new strategies to reach them and a new positioning of the museum in regard to its stakeholders, highlighting its role as a "broker" between different constituencies rather than as a content provider (Horst, 2011; Horst & Michael, 2011). It is in this new role that SCMs can demonstrate their (until now arguable) neutrality, not of the content they present, but rather of the openness of a process that allows the questions of the public to be formulated and raised, questions which are often more far-reaching than those allowed or foreseen by the current engagement frameworks.

The current modalities of public engagement in SCMs that we found in our research also confirm the ambiguities that exist in describing and defining the publics in public engagement exercises (Felt & Fochler, 2010). Of relevance to museums is the fact that the "mini publics" that do take part in the initiatives have an ambivalent relationship with the "general public". This means that

depending on the design of the participation exercise, the representational value of these publics is dubious: they neither feel representatives of a general public nor even qualified to take part in such exercises. For SCMs this means coming to terms with a modality of public engagement that values dissensus rather than consensus and the acceptance of inequalities of knowledge among the public (Tlili & Dawson, 2010).

Our research has identified two weaknesses that prevent public participation to happen: 1) The lack of appropriate evaluation and assessment methods to measure the contributions of the public to the decision making process in SCMs and 2) the lack of recognition of SCMs as important players in the field of science governance. These two factors are intrinsically related: because of the lack of reliable instruments to illustrate the importance of what the public can bring to the museum (rather than of what the public learns from the museum), SCMs are not able to demonstrate their role in the larger field of science governance. Furthermore, because SCMs are still seen only as "ancillary" informal learning institutions, lacking recognition from the other stakeholders, they do not invest in methods to qualify (and possibly quantify) their role as brokers in mediating the science and society dialogue. This "impasse" was recently experienced in the UK, when the formal exercise to assess the effectiveness of science centers in supporting the science and society agenda concluded that there was not enough evidence to draw a definitive conclusion (Frontier Economics, 2009). Additionally, the response from the field still lacks concrete methods and measures that help to understand what the public can contribute to the science centers in particular and to the science and society agenda in general (UK Association for Science and Discovery Centres, 2010).

While the overarching problem of establishing a more trustworthy relationship between science museums and the public remains a complex one, there are some actions that museums can put in place to address it.

The first is the formulation and implementation of detailed psychographic indicators and activity and commitment indicators for the public. This would help to identify the characteristics and needs of those publics which already see SCMs as an institutions to interact with, rather than a leisure or learning destination.

The second is to grant more agency and support to those structures within the institution which are currently interacting with the public. We have observed that the members of the staff in charge of the interaction with the public suffer from three main limitations: lack of knowledge of science communication theory; difficulty to properly exploit the current exhibitions when they do not include participatory elements and tools in their design; and a lack of a clear position and mandate during the development process of new activities – they are usually presented with a "fait accompli" on the museum floor with which they have to deal.

5. Conclusions

Science centers and museums have been pioneers in exploring and implementing methods to engage the public with their programs and exhibitions. By communicating contemporary science and research however, many of these methods and the underlying assumptions are challenged. The very nature of contemporary science requires new rules for the engagement with the public, and SCMs experience this change both as an opportunity to strengthen their social role, but also as a series of obstacles to their usual practices. The current study addressed several of them to increase the relevance of SCMs in the science and society arena.

The results of the current study highlight how several of these obstacles can be brought within control of the institution. In particular, decreasing institutional barriers and addressing the fear of negative reactions from external stakeholders would bring the obstacles under control of the staff

working with the public, thus enabling a more systematic interaction between the public and the museum. Our study revealed a great awareness among the institutions surveyed to move in this direction, as well as the agreement that enabling a structural participation of the public in the museum's governance would strengthen not only the relevance of the museum but ultimately also its success.

While the position of SCMs is therefore quite clear, the same cannot be said about the public yet. There are still many assumptions about the willingness of the public to participate in the science and society dialogue, and in particular through the engagement with SCMs. We propose therefore to focus on efforts elucidating the relationship between museums and the public. In addition to the existing studies on the learning and satisfaction of the public, we argue that it is necessary to understand the other side of this relationship. That is, the actual contribution that the public is willing to bring to the museum in terms of inputs, questions, proposals and directions that fulfill and support a democratic science citizenship. Therefore, future research could focus on the publics that interact with science centers and museums and explore how scientific citizenship as proclaimed in current science and technology studies is constructed in these institutions. With such knowledge, science centers will be able to structure and define their role as active agents in the science and society arena.

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References

Anderson, I., Joss, S., Ng, K., Rauws, G., Steyaert, S., van Est, R., & Vandensande, T. (2007). *European Citizens Deliberation. Method Description*. (S. Steyert & T. Vandensande, Eds.). Brussels: King Baudouin Foundation.

Anderson, M. L. (2004). Metrics of success in art museums. Los Angeles: The Getty Leadership Institute.

Bandelli, A., & Konijn, E. (2011). An experimental approach to strengthen the role of science centers in the governance of science. In J. C. Marstine (Ed.), *The Routledge Companion to Museum Ethics* (pp. 164-173). London: Routledge.

Bandelli, A., Konijn, E., & Willems, J. (2009). The need for public participation in the governance of science centers. *Museum Management and Curatorship*, *24*(2), 89-104. doi:10.1080/09647770902857497

Bell, L. (2008). Engaging the Public in Technology Policy: A New Role for Science Museums. *Science Communication*, *29*(3), 386-398. doi:10.1177/1075547007311971

Bonney, R., Cooper, C. B., Dickinson, J., Kelling, S., Phillips, T., Rosenberg, K. V., & Shirk, J. (2009). Citizen Science: A Developing Tool for Expanding Science Knowledge and Scientific Literacy. *BioScience*, *59*(11), 977-984. doi:10.1525/bio.2009.59.11.9

Cameron, F. (2008). Safe places for unsafe ideas? History and science museums, hot topics and moral predicaments. *Social History in Museums*, *32*, 5-16.

Cameron, F. (2010). Risk Society, Controversial Topics and Museum Interventions: (Re)reading Controversy and the Museum through a Risk Optic. In L. Kelly & F. Cameron (Eds.), *Hot Topics, Public Culture, Museums* (pp. 53-75). Newcastle upon Tyne, UK: Cambridge Scholars Publishing.

Caron-Flinterman, J. F., Broerse, J. E. W., & Bunders, J. F. G. (2007). Patient Partnership in Decision-Making on Biomedical Research: Changing the Network. *Science, Technology & Human Values*, *32*(3), 339-368. doi:10.1177/0162243906298354

Chittenden, D. (2011). Commentary: Roles, opportunities, and challenges—science museums engaging the public in emerging science and technology. *Journal of Nanoparticle Research*, *13*(4), 1549-1556. doi:10.1007/s11051-011-0311-5

Chittenden, D., Farmelo, G., & Lewenstein, B. V. (Eds.). (2004). *Creating Connections: museums and the public understanding of current research* (p. 379). Walnut Creek, CA: Altamira Press.

Davies, S. (2010). The co-production of temporary museum exhibitions. *Museum Management and Curatorship*, *25*(3), 305-321. doi:10.1080/09647775.2010.498988

Davies, S. R. (2008). Constructing Communication: Talking to Scientists About Talking to the Public. *Science Communication*, *29*(4), 413-434. doi:10.1177/1075547008316222

Davies, S. R. (2009). Doing Dialogue: Genre and Flexibility in Public Engagement with Science. *Science as Culture*, *18*(4), 397-416. Routledge. doi:10.1080/09505430902870591

Davies, S. R. (2011). The rules of engagement: power and interaction in dialogue events. *Public Understanding of Science*. doi:10.1177/0963662511399685

Davies, S. R., McCallie, E., Simonsson, E., Lehr, J. L., & Duensing, S. (2008). Discussing dialogue: perspectives on the value of science dialogue events that do not inform policy. *Public Understanding of Science*, *18*(3), 338-353. doi:10.1177/0963662507079760

Delgado, A., Lein Kjolberg, K., & Wickson, F. (2010). Public engagement coming of age: From theory to practice in sts encounters with nanotechnology. *Public Understanding of Science*, 0963662510363054-. doi:10.1177/0963662510363054

Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *The Academy of Management Review*, *14*(4), 532-550. doi:10.2307/258557

Elam, M., & Bertilsson, M. (2003). Consuming, Engaging and Confronting Science: The Emerging Dimensions of Scientific Citizenship. *European Journal of Social Theory*, *6*(2), 233-251. doi:10.1177/1368431003006002005

Felt, U., & Fochler, M. (2008). The bottom-up meanings of the concept of public participation in science and technology. *Science and Public Policy*, *35*(7), 489-499. Beech Tree Publishing. doi:10.3152/030234208X329086

Felt, U., & Fochler, M. (2010). Machineries for Making Publics: Inscribing and De-scribing Publics in Public Engagement. *Minerva*, *48*(3), 219-238. Springer Netherlands. doi:10.1007/s11024-010-9155-x

Frontier Economics. (2009). *Assessing the impact of science centres in England* (p. 68). London.

Gammon, B., & Mazda, X. (2000). The power of the pencil. (S. Lindqvist, Ed.)*Museums of modern science : Nobel Symposium 112*. Canton, MA: Science History Publications/USA.

Glaser, B. G., & Strauss, A. L. (1967). *The Discovery of Grounded Theory* (p. 271). Chicago, IL: Aldine.

Greco, P. (2007). Science museums in a knowledge-based society. *JCOM - Journal of Science Communication*, *6*(June), 1-3.

Hagendijk, R. (2004). The Public Understanding of Science and Public Participation in Regulated Worlds. *Minerva*, *42*(1), 41-59. doi:10.1023/B:MINE.0000017699.19747.f0

Hagendijk, R., & Irwin, A. (2006). Public Deliberation and Governance: Engaging with Science and Technology in Contemporary Europe. *Minerva*, *44*(2), 167-184. doi:10.1007/s11024-006-0012-x

Horst, M. (2007). Public Expectations of Gene Therapy: Scientific Futures and Their Performative Effects on Scientific Citizenship. *Science, Technology & Human Values*, *32*(2), 150-171. doi:10.1177/0162243906296852

Horst, M. (2011). Taking Our Own Medicine: On an Experiment in Science Communication. *Science and engineering ethics*. doi:10.1007/s11948-011-9306-y

Horst, M., & Irwin, A. (2009). Nations at Ease with Radical Knowledge: On Consensus, Consensusing and False Consensusness. *Social Studies of Science, 40*(1), 105-126. doi:10.1177/0306312709341500

Horst, M., & Michael, M. (2011). On the Shoulders of Idiots: Re-thinking Science Communication as "Event." *Science as Culture, 20*(3), 1-24. Routledge. doi:10.1080/09505431.2010.524199

Irwin, A. (2001). Constructing the scientific citizen: Science and democracy in the biosciences. *Public Understanding of Science, 10*(1), 1-18. doi:10.1088/0963-6625/10/1/301

Irwin, A. (2006). The Politics of Talk: Coming to Terms with the "New" Scientific Governance. *Social Studies of Science, 36*(2), 299-320. doi:10.1177/0306312706053350

Janes, R. (2007). Museums, Corporatism and the Civil Society. *Curator, 50*(2), 219-237.

Jasanoff, S. (2003). Technologies of Humility: Citizen Participation in Governing Science. *Minerva, 41*(3), 223-244. doi:10.1023/A:1025557512320

Jordan, A., Wurzel, R. K. W., & Zito, A. (2005). The Rise of "New" Policy Instruments in Comparative Perspective: Has Governance Eclipsed Government? *Political Studies, 53*(3), 477-496. doi:10.1111/j.1467-9248.2005.00540.x

Koutsika, G. G. (2006). Audience Advocates. *Heritage*, (365), 104-107.

Lehr, J. L., McCallie, E., Davies, S. R., Caron, B., Gammon, B., & Duensing, S. (2007). The Value of "Dialogue Events" as Sites of Learning: An exploration of research and evaluation frameworks. *International Journal of Science Education, 29*(12), 1467-1487. Taylor Francis Ltd. doi:10.1080/09500690701494092

Livingstone, P., Pedretti, E., & Soren, B. J. (2001). Visitor Comments and the Socio-Cultural Context of Science: Public Perceptions and the Exhibition A Question of Truth. *Museum Management and Curatorship, 19*(4), 355-369. doi:10.1016/S0260-4779(01)00055-3

Lynch, B. T. (2011). Custom-made reflective practice: can museums realise their capabilities in

helping others realise theirs? *Museum Management and Curatorship*, *26*(5), 441-458.

doi:10.1080/09647775.2011.621731

Lévy-Leblond, J.-M. (1992). About misunderstandings about misunderstandings. *Public

Understanding of Science*, *1*(1), 17-21. doi:10.1088/0963-6625/1/1/004

Macdonald, S. (1998). Exhibitions of power and powers of exhibitions. (S Macdonald, Ed.)*The

politics of display: museums, science, culture*. New York: Routledge.

Macdonald, Sharon. (2002). *Behind the scenes at the Science Museum* (p. 293). Oxford UK: Berg.

Macdonald, Sharon. (2010). Exhibition experiments. In A. Filippoupoliti (Ed.), *Science Exhibitions:

Curation and design* (pp. 195-203). Edinburgh: MuseumsEtc.

Mayfield, H. (2004). What About the Audiences? Tailoring Public Understanding of Research

Programs for Museum Visitors. In D. Chittenden, G. Farmelo, & B. V. Lewenstein (Eds.),

Creating connections: museums and the public understanding of current research (pp. 109-

126). Walnut Creek, CA: Altamira press.

McLean, K., & Pollock, W. (2007). *Visitor Voices in museums exhibitions*. (K. McLean & W.

Pollock, Eds.). Washington, DC: Association of Science and Technology Centers.

Mejlgaard, N., & Stares, S. (2009). Participation and competence as joint components in a cross-

national analysis of scientific citizenship. *Public Understanding of Science*, *19*(5), 545-561.

doi:10.1177/0963662509335456

Meyer, M. (2008). On the boundaries and partial connections between amateurs and professionals.

Museum and society, *6*(1), 38-53.

Meyer, M. (2011). Researchers on display: moving the laboratory into the museum. *Museum

Management and Curatorship*, *26*(3), 261-272. Routledge.

doi:10.1080/09647775.2011.585800

Michael, M. (2009). Publics performing publics: of PiGs, PiPs and politics. *Public Understanding

of Science*, *18*(5), 617-631. doi:10.1177/0963662508098581

Parisse-Brassens, J. (2009). POLKA: Patients' Consensus on Preferred Policy Scenarii for Rare
  Disease. Retrieved January 3, 2012, from http://www.eurordis.org/content/polka-patients-
  consensus-preferred-policy-scenarii-rare-disease

Pedretti, E., & Soren, B. J. (2003). A question of truth - A cacophony of visitor voices. *journal of
  museum Education*, (28), 17-20.

Rodari, P., & Merzagora, M. (2007). The role of science centres and museums in the dialogue
  between science and society. *JCOM - Journal of Science Communication*, *6*((2) June).

Seifert, F. (2006). Local steps in an international career: a Danish-style consensus conference in
  Austria. *Public Understanding of Science*, *15*(1), 73-88. doi:10.1177/0963662506058383

Strauss, A. L., & Corbin, J. (1998). *Basics of Qualitative Research: Techniques and Procedures for
  Developing Grounded Theory* (Vol. 2nd). Thousand Oaks, CA: Sage.

Tlili, A., & Dawson, E. (2010). Mediating Science and Society in the EU and UK: From
  Information-Transmission to Deliberative Democracy? *Minerva*, *48*(4), 429-461.
  doi:10.1007/s11024-010-9160-0

Tran, L. U., & King, H. (2007). The Professionalization of Museum Educators: The Case in Science
  Museums. *Museum Management and Curatorship*, *22*(2), 131-149.
  doi:10.1080/09647770701470328

UK Association for Science and Discovery Centres. (2010). Assessing the Impact of UK Science
  and Discovery Centres: Towards a set of common indicators. Bristol.

Wynne, B. (2006). Public engagement as a means of restoring public trust in science--hitting the
  notes, but missing the music? *Community Genetics*, *9*(3), 211-20. doi:10.1159/000092659

Wynne, B. (2007). Public Participation in Science and Technology: Performing and Obscuring a
  Political–Conceptual Category Mistake. *East Asian Science, Technology and Society: an
  International Journal*, *1*(1), 99-110. Springer Netherlands. doi:10.1007/s12280-007-9004-7

van Dijck, J. (2003). After the "Two Cultures": Toward a "(Multi)cultural" Practice of Science
  Communication. *Science Communication*, *25*(2), 177-190. doi:10.1177/1075547003259540