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>> Version of Record - Nov 13, 2013

OnlineFirst Version of Record - May 21, 2013

What is This?

A Field of Expertise, the Organization, or Science Itself? Scientists' Perception of Representing Research in Public Communication

Maja Horst[1]

Abstract
Social and political interest in science regularly prompts scientists to assume the role of public spokesperson. The article investigates this role of representing science as both "speaking on behalf of" science and symbolically "standing for" science and its organizations. With inspiration from the field of organizational communication, it is argued that science communication should be considered as an activity intimately linked with perceptions of identity and organizational culture. When scientists communicate publicly, they do not just disseminate knowledge, they also represent a particular sense making about what science, scientists, and scientific organizations are. Based on a qualitative analysis of 20 leading Danish scientists' views on their own role in public communication, three different modes of representation are identified: Expert, Research Manager, and Guardian of Science. Each of these modes of representation implies particular notions of quality, audience, motivation, and learning in science communication.

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Public communication about science is increasingly seen as an important element within the creation of a knowledge society. Certainly, there has been a large investment in communication activities during the past decades (Commission of the European Communities, 2001; Felt, 2007; Gregory & Miller, 1998). Science communication has become a serious consideration for nations and universities, and science communicators are on the way to establishing themselves as a profession (Neresini & Bucchi, 2011). It is often science communication professionals who organize and manage larger communication activities, but scientists themselves are also important, since they are expected to participate as those who represent science (Bauer & Jensen, 2011).

This article investigates this function of "representing science." With inspiration from organizational communication, the concept of representing is defined broadly to include not only "speaking on behalf of" science but also the symbolic embodiment of science—that is, "standing for" science and its organizations. It is based on in-depth interviews with leading scientists in one country and tries to explore how they make sense of their own public communication activities. What do they think they represent when they speak publicly about science? How do they reflect about the task of science communication as something with which they and their colleagues engage? Representation in this perspective is not primarily about the textual representation in discursive constructions of science (e.g., Dijck, 1998; Nelkin & Lindee, 1995). Instead, it is focused on the way scientists consider their own role as spokespeople (Latour, 1987, pp. 71-74).

Science Communication as Organizational Communication

Several studies have investigated scientists' motivation for and participation in public communication activities. In a secondary analysis of two large-scale surveys, Besley, Oh, and Nisbet (2012) concluded that demographic factors such as gender and age are relatively minor predictors of scientists' participation in public communication, whereas scientist's attitudes toward public engagement have more predictive power. In general, scientists are motivated by a wish to improve public interest, awareness, understanding, and enthusiasm for science (Martín-Sempere, Garzón-García, & Rey-Rocha, 2008; Poliakoff & Webb, 2007; The Royal Society, 2006; Tsfati, Cohen, & Gunther, 2011; Watermeyer, 2012). Scientists have also been observed to participate from a sense of duty (Pearson, Pringle, & Thomas, 1997; The Royal Society, 2006). One study found that previous behavior is the most important predictor for whether scientists are likely to engage in public communication

(Poliakoff & Webb, 2007). This implies that scientists either engage in science communication on a continuous basis or they do not do it at all. Several scholars have noted that a deficit model of one-way communication is prevalent among scientists (Casini & Neresini, 2012; Davies, 2008; Watermeyer, 2012), although Davies (2008) reports that the picture is more multifaceted, identifying alternative discourses of complexity, context dependence, and dialogue among scientists.

Although these studies are predominantly about individual behavior and motivation, they also point to the importance of the organizational setting. The Royal Society study (2006) found that leadership support would encourage junior scientists to participate in public communication. This study also suggests, however, that some scientists believe that colleagues who engage in public communication do this because they are not excellent scientists. Similarly, Poliakoff and Webb (2007) found that scientists' perception of their colleagues' level of engagement was an important predictor of their own choice to engage. Scientists are therefore expected to be more likely to engage in public communication if they believe it is something their colleagues also do. This suggests that organizational culture and also leadership strategies on public communication are important as they either support or discourage the individual scientist. In a study of 40 European Research Institutions, however, Casini and Neresini (2012) conclude that these institutions have failed to recognize public communication activities as an integral part of the research profession and therefore an organizational responsibility.

This article argues that our understanding of science communication will benefit from a perspective that understands it as an organizational activity. When scientists talk about science in public, they are doing more than just disseminating scientific knowledge to nonscientists. They are also representing science and its organizations in a very broad sense and enacting particular understandings of what science, scientific organizations, and scientists are and should be. In this perspective, science communication can be viewed as a *sense-making* activity (Weick, 2001, p. ix), that is, a process of enacting meaning in order to achieve a coherent worldview. In what follows, the chosen perspective on organizational communication is symbolic, nonessentialist, and focused on process (Cheney, Christensen, Zorn, & Ganesh, 2011). Communication, in this perspective, is *constitutive* of social relations since the internal and external—as well as formal and informal—exchanges of information and meaning constantly shape and reshape the organization (Taylor & Every, 2000).

Within this symbolic perspective, there is an intimate connection between individual and organizational identities. Organizations have become an important source of identity in the modern world (Cheney & Ashcraft, 2007).

Similarly, employee identification is an important resource for any organization as it prompts the employer "to select alternatives with the interests of the organization—as best they can be determined—uppermost in mind" (Cheney et al., 2011, p. 114). The symbolic perspective also implies close links between internal perceptions of identity and external images of the organization (Hatch & Schultz, 1997). Organizations and their members are constantly influenced by, and trying to influence, the perceived reputation of the organization, thereby also shaping what the organization is. An important point in this context is that organizational identities should not be understood as singular and well-defined. While leaders might try to present a clear picture of one identity, there are always subcultures and an endless variation of identity constructions. Also clashes between, for instance, allegiance to a profession and allegiance to an organization can result in conflicting processes of identification (Anderson, Perucci, Schendel, & Trachtman, 1980). Nevertheless, organizational members can be expected to actively engage in external and internal identity work if they perceive the external image to be threatened (Dutton & Dukerich, 1991; Elsbach & Kramer, 1996). Despite the common understanding of identity as something that is *central, distinct*, and *enduring* in an organization (Albert & Whetten, 1985, p. 265), Gioia, Schultz, and Corley (2000) have concluded that identity should be viewed as relatively fluid:

> The seeming durability of identity is actually contained in the stability of the *labels* used by organization members to express who or what they believe the organization to be, but (. . .) the meaning associated with these labels (. . . change) so that identity actually is mutable. (p. 64)

This form of mutability of the meaning associated with labels such as science and science communication is the focus of this article.

Sense making around science may be expected to be particularly volatile in the current situation of transformation of the sector. During the past decades, universities and other public research organizations have witnessed profound changes in terms of marketization (Bok, 2005; Kleinman & Vallas, 2001; Shattock, 2009), which means that they increasingly find themselves competing with each other for resources. Simultaneously, the focus on relevance and commercialization of research necessitates an escalating interest in collaboration and coordination across disciplinary, organizational, sectoral, and institutional boundaries (Bercovitz & Feldman, 2008; Jain, George, & Maltarich, 2009; Lam, 2010). Whether these changes are understood as a problematic commercialization of higher education (Slaughter & Leslie, 1997) or positive developments toward "entrepreneurial universities" (Etzkowitz, 1998), they should be perceived as an important background for science

communication because they have made leadership and organization of science a central activity for many leading scientists.

Seen from the perspective of organizational communication, leading scientists are important figures in the collective enactment of internal identity and external images of science and scientific organizations. Just as top leaders of large companies often become the central focus point for sense making about that company (Guthey, Clark, & Jackson, 2009), top scientists often symbolize science and its organizations in public communication. The present article investigates this organizational function with the concept of representation in a period where funding, regulation, and organization of science are changing profoundly. *Representation* implies that science communication is a form of organizational communication, which enacts meaning and at the same time cocreates identities and images of science, scientists, and scientific organizations

Analytical Strategy

In order to investigate the sense making of the individual scientists, an inductive exploratory design has been chosen in which a group of 20 leading Danish scientists within bio- and nanotechnology were selected as interviewees. Denmark is generally regarded as a country with a tradition of participatory science communication (Mejlgaard, 2009) and of reaching consensus on political regulation of controversial science through dialogue (Horst & Irwin, 2010). Relative to other national cultures, Denmark is characterized by low power distance and a culture that values cooperation, modesty, and security over assertiveness, challenge, and the explicit display of excellence (Hofstede, Hofstede, & Minkov, 2010). Danish culture scores relatively high on individualism but not as high as Anglo-Saxon countries. The cultural backdrop of science communication in Denmark is an expectation that citizens are relatively competent and confident of engaging in discussion with scientific authorities. The cultural expectations of scientific experts are that they should not explicitly brag about their high position or use their expertise and authority to silence others.

In terms of scale, Denmark is a useful setting for this study, because it is possible to speak with all leading scientists in a research area within a national context. In addition, the strong culture of public debate implies that leading scientists must be expected to have considered their role as public spokespeople, since they will regularly have been met with an expectation to speak publicly. The areas of bio- and nanotechnology were chosen because they are expected to be exemplary of competitive research fields due to the large public and private investments in them. Simultaneously, they have been subject to public controversy, and scientists in these fields are therefore expected to have been particularly active as public spokespeople.

In order to identify leading scientists as the ones who are doing well in the competitive research system, interviewees were selected by looking at the distribution of grants from public research councils over a period of 3 years. In this sample, 17 scientists in the areas of biotechnology and nanotechnology stood out as receiving the most grant money (it turned out to be impossible to schedule interviews with 2 of the 17). In order to broaden the sample, 5 extra people were added based on previous knowledge of extensive media presence. The scientists in the resulting sample all had substantial grant portfolios and impressive publication records, and most of them had a record of extensive public communication activity—for example, media coverage, public engagement activities, or direct policy advice.[1]

For each of the scientists, a public profile was identified through the analysis of publicly available material from media, blogs, and web pages. Subsequently these public profiles served as the basis for in-depth semistructured interviews focused on the following topics:

- Purpose of public communication
- Representation of science
- Organization and management of communication activities in group/center
- Public communication about risk
- Communication and regulation of science

The interviews were transcribed and coded inductively in NVivo by the author. In what follows, the focus will be on the first three themes, since the topic of what scientists represent produced an interesting pattern in which three different roles for the scientist stood out. In one role, the scientists were primarily talking about representing *a scientific field or discipline*, in another role they were explicitly referring to *the research organization*, while the third role related to the representation of what could be called *the institution of science*.

The remainder of this article is devoted to an exploration of these differences as they form the basis for a typology of different ways of making sense of science communication. Not only will this typology help differentiate between the objectives that can guide science communication, it will also make it possible to distinguish between fundamentally different motivations and forms of evaluating the outcome of science communication.

The pattern of three modes of representing, however, did not simply follow the individuals. Approximately one half of the interviewees seemed to move between these roles depending on the context. The other half of the interviewees talked primarily about one of the roles, but they also

occasionally said things that could be ascribed to a secondary role. On this account, the typology will be synthesized not as a typology of scientists but rather as modes of representing. In the discussion of findings, I will describe these three modes as ideal types (Weber, 2004), which is a methodological concept used "to select and express *significant* aspects of reality" (Bruun, 2007, p. 209) by making a theoretical "synthesis of a variety of diffuse, discrete, *individual* phenomena (. . .) so that they form a uniform construction *in thought*" (Weber, 2004, pp. 387-388). Describing the three different modes of representing science as ideal types allows us to synthesize the patterns of sense making in the interviewees' responses without claiming that the scientists *are* these types. With regard to generalization, the article is therefore concerned with the qualitative validity of the identification of the three modes of representation. It cannot, however, testify to the quantitative prevalence of these modes outside of the sample.

Three Modes of Representing Research

In the following two sections, each of the three modes of representing will be described drawing especially on the interviews in which that particular mode was most pronounced. In order to make the analysis as transparent as possible, a few illustrative quotations and a few remarks about numbers will be included. The first section is focused on how the researchers perceive their own role, whereas the subsequent section will investigate how each of these roles is connected to particular views on communication as an organizational activity.

Representing a Field of Expertise

A common answer to the question about what researchers represent when they talk about science outside their academic field comes in two parts: "I represent myself" (. . .) "as a professor of physics" (Interviewee 8). The first part of this quotation signals that the interviewee does not speak on behalf of his university or colleagues but only answers to himself for what he says. The second half of the quotation implies that he does not speak as a private person but that he has a particular academic position, from which he can speak knowledgably about a field. In this way, some interviewees can be said to represent a field of expertise when they speak in public. Three of the interviewees drew almost exclusively on this mode of representation, but at the same time it is the most common mode of representation and can be detected in almost all the interviews:

So if I am invited as an expert, I know what is expected of me. (. . .) If I am invited to talk on the TV news, then I am not just myself. Everybody will see me, and there will be a little sign saying "professor" in the corner. Because nanotechnology is such a broad field there are areas where my knowledge is not very deep. So I have to be quite well prepared and I have talked to my colleagues. (. . .) But if I think it is something I don't know about, then I would much rather say that they should ring someone else. There has to be an academic basis for what I am saying. (Interviewee 1)

This scientist does not want to be seen to talk about scientific topics outside her field of expertise. Later in the interview, she describes how the borders of this field are constantly up for negotiation. The sensation of continuous negotiation is shared by other interviewees as they talk about the constant need to consider whether they are overstepping the limits to their field of expertise:

It is very easy to end up being presented like an expert, because you have the professor title, without actually knowing more than most people about it. You have to be very careful with that (. . .) I only respond publicly in areas where I know something and when I think that I possess a knowledge that is larger than most others. (Interviewee 8)

In this way, the motivation to speak publicly is based on expertise. As publicly employed experts, several interviewees describe an obligation to engage in dissemination activities, although communication is rarely described as a favorite activity. Their main concern when speaking in public is that the content, the facts, are correct. When drawing on this mode of representation, interviewees often only have vague notions about the audiences to which they communicate, but when prompted, their answers usually point to a group that they think might have a need for their factual knowledge.

Representing an Organization

Nearly all of the interviewees mention that their organization has an interest in establishing a favorable public profile. A group of interviewees, however, distinguish themselves by being very specific about representing their research organization when they speak in public. This is particularly true of four out of the seven center directors in the sample. They speak explicitly about the need to brand their center and the university as a professional research organization in order to be able to attract funding, students, and qualified staff. This does not mean that they consider themselves to be simply managers, because they talk about themselves as scientists, and they tend to

state how it is their personal scientific standing (e.g., their h-factor: an index that attempts to measure both the productivity and impact of the published work of a scientist) that makes them able to represent their center in a credible way: "If you make a list over highest cited articles from this center, my name is on them. That gives me street cred in everybody's eyes" (Interviewee 19). But being good at science is not enough. These interviewees also work explicitly to make this ability visible to their stakeholders because a good brand will help them attract resources and collaborators by showing "what useful things we are doing" (Interviewee 7). When talking about branding activities, they therefore do not mean an empty gloss detached from the work that goes on. They are very specific that their brand is primarily built on what they do:

> It is incredibly important that the center's name makes people think, "Oh well, it is very exciting what they are doing or last time I heard about it—they said they were going to do this and now they have done it." (. . .) I am actually a very withdrawn manager—at least I try to be. I am definitely not the kind who goes out with lists of publications and says, "Look how many publications we have, and how many contacts." I am much more interested in . . . it is much better if it is the companies who say that they have had an exciting collaboration with our center. It is a lot more effective than if I go around saying it. (Interviewee 19)

Several of the interviewees representing a research organization explicitly stressed that their own person is not important and that they make an effort to focus the attention on their organization as a whole. The Danish culture might mean that scientists are very careful about being seen to promote their own person, but it could also be more generally true that even as research managers, scientists believe it is important to be careful about promoting their own person rather than science or the scientific organization. Nevertheless, in this mode the scientists can be seen to aim to represent a research organization that is responsible with respect to the resources it receives. The organizational output is the production of knowledge, and their branding efforts are intended to make it visible that they are professional at making this product. This form of professionalism has two sides: They demonstrate their research excellence by communicating about publications in top journals, and they demonstrate research relevance by making it visible that they have a large number of collaborative projects with companies and other organizations.

Representing the Institution of Science

A third group of four interviewees answered in a very broad fashion when asked about representing science in public. Rather than trying to stick to their

own field of expertise, these interviewees talk about science in general. They understand scientific knowledge production as "the rational" way of dealing with challenges and problems in society, and they want to inform the public about science in order to enhance the rationality of society. They talk about the need for social investments in science, but they also stress how it is important for the public to understand the role of science in society. Communication efforts are therefore motivated by a wish to help citizens understand and appreciate science in general:

> I rarely think that I represent an organization. I would like to represent science and I don't think about representing myself. I am aware that there is a connection between the person and the person's interest and then science, but I am rather aware . . . I am rather idealistic about being a representative of science, that is, something that is at a higher level than the interest of the organization or the politician (. . .) I don't have any trouble with—as colleagues might have—talking about something that goes beyond my area of expertise. I think it is part of being a scientist that you are oriented towards other areas. Of course you have to be explicit about the border of your knowledge, but I think you are letting people down, if you only talk about a very narrow field and something you have very exact data about. (Interviewee 14)

This ambition of representing science "at a higher level" can be interpreted as an ideal of science as a social institution, that is, an institution that serves the societal function of producing truth according to a certain set of procedures. Implicitly, Mertonian norms figure quite prominently, and this group of interviewees distinguishes science from politics precisely by describing how science is above specific interests of organizations or actors. They are also very specific that science has to be conducted according to its own rules. It cannot be made to fit a plan that goes against how science intrinsically develops: "Research is something that grows organically and you cannot suddenly move to a completely new problem if it does not fit with your methodology and world of thought" (Interviewee 11).

In particular, this mode of representing science as an institution is found in interviews with senior scientists at an advanced stage in their career. Although they are very aware of creating a good collaborative climate in their research groups, they seem to put rather little emphasis on representing it as a professional research organization and rather more on describing it as a loosely coupled network of colleagues.

Reflecting on Other Scientists' Communication

In order to understand how scientists reflected on public communication as an organizational activity, the interviews specifically focused on two issues.

First was how they considered public communication by other researchers and whether they would interfere with the way their colleagues communicate. Second, the interviewees were asked about their own role in managing external communication in their organization and whether they would train or help young scientists. The differences in their answers will be investigated in this section.

Representing a Field of Expertise

When drawing on the mode of representing science as a field of expertise, interviewees seemed to respond in two different ways when asked about the communication of other researchers. Some say that there was a lot of bad science communication but described it as futile to try to change this: "I don't have the time for that sort of thing" (Interviewee 4). Other interviewees, however, assert that they would interfere if they thought a colleague was communicating inappropriately: "Once, I was invited to (. . .) talk to some Americans who were supposed to go around and promote biotechnology in Denmark, and I simply had to stop it (. . .) Such loose missiles can be very dangerous" (Interviewee 3). Whereas this argument is primarily driven by a need to protect the research discipline from "loose missiles," other interviewees stress the need to prevent hype, but only one interviewee gave a specific example of having challenged a colleague about hyping a research field.

From the limited empirical material, there seems to be some distinct disciplinary differences in the attitude to the issue of interfering with other scientists' communication. Interviewees within biotechnology seem to have more experiences with joint collegial reflections on communication than interviewees within nanotechnology. This might well be based on the fact that scientists within biotechnology have lived with pronounced public controversy about their field for a very long time. Responding to a question about why the plant biotechnologists often seem to give almost identical public statements, a head of department (Interviewee 2) replies,

> It is not that we have decided to say the same, but we influence each other and we discuss over a cup of coffee when we have experienced something (. . .) so we discuss these things and develop our viewpoints.
> *Interviewer:* If someone said something that you thought was wrong, would you tell them?
> *Interviewee 2:* Yes, I might very well do that. Or ask why they had said that.
> *Interviewer:* Would that be as researcher or manager?
> *Interviewee 2:* That would be as researcher. As a head, I cannot go and . . . I don't have the possibility of giving instructions about that.

The last quotation sums up the way in which the interviewees who draw on the mode of representing a field of expertise consider their right to comment on each other's communication activities. It should be done not as a part of managerial instruction but rather as a conversation between two equal researchers. Talking on behalf of your field of expertise is not something that is regulated through the managerial hierarchy. When scientists represent a field of expertise, they are only responsible toward themselves and the people who also belong to the same field of expertise.

Representing an Organization

Similar to the quotation above, interviewees who describe their own role as representing a research organization do not think it is right for them to use their managerial position to interfere with what their colleagues and group members choose to say in public. But they do sometimes discuss a responsibility to manage communication flows. The most obvious way is by working with communication professionals at the university in order to put forward positive stories to the press. They also sometimes consider having to assume responsibility that their younger staff do not suddenly find themselves in situations that they cannot handle:

> If it is something about risk, for instance, then I would like to do it myself. Then I can take the blows, instead of sending some younger person, who then gets put through the meat grinder. Because I have a sense of when to stop and say that I don't want to participate anymore, while some younger and less trained person might be driven a step further, where they see themselves in the paper on the Monday and ask, "Why did I say this?" (Interviewee 6)

There can also be other barriers to the involvement of younger researchers in public communication. One researcher talks about how he does most of the public communication himself, because most of his staff are not Danish:

> [Their] mentality (. . .) is not very Danish. It has to be fitted to Danish circumstances if you are to communicate in Denmark, both in terms of language and opinions. So therefore I think I take on more of the external branding (. . .) than I would like to. (Interviewee 15)

Not only can language be a problem in terms of communicating to a national public that is not English speaking, but this interviewee also points out that a shared cultural frame of reference is necessary if public science communication is to succeed.

In general, the training of communication competences does not seem to be a systematic part of research management. Rather, the interviewees drawing on this mode of representing primarily seem to understand communication skills as the result of inborn personality traits. They explain how some researchers "just aren't good at it and probably never will be" (Interviewee 6), whereas others just excel at it naturally. A couple of the interviewees, however, have tried to incorporate communication training in daily life when the opportunity arises—for instance, one center director has prepared junior staff for a media interview by playing the journalist. But in general, it is seen as one of many things that future scientists have to learn somehow along the way. Mostly, these interviewees seem to consider it their *own* duty as managers of a research group or center to represent the organization and not something they can delegate to others.

Representing the Institution of Science

When interviewees draw on the mode of representing science as a social institution, they seem little inclined to interfere with the communication of other researchers. The four interviewees who predominantly draw on this mode demonstrate elaborate reflections on their own communication style built over years of experience where they have paid close attention to how they could improve. Despite this, they do not seem to expect the same thing of other researchers. These interviewees talk about communication as a personal choice based on their normative understanding of the world, and they do not think they can oblige other scientists to make the same choice to engage, although they do consider science communication very beneficial to society.

When it comes to junior researchers in their own group, these scientists express differing views on whether they want to encourage them to participate in science communication activities. One interviewee in charge of a research center argues that public communication is improving his ability to do research, because good ideas often appear when a person finds himself in unusual situations. He believes that it is equally beneficial for the younger researchers to engage in public communication and thinks that they learn from his example: "I don't run a campaign, but I can see that it rubs off, and some—also the students—they get engaged in this and that. (. . .) I can see that some of them let themselves be inspired" (Interviewee 14).

Other interviewees drawing on this mode of representing are more ambiguous. They primarily want the students to focus on the core of the matter—the science—although they think public communication is important. One of

the interviewees describes how his own interest in communication, however, sometimes makes him involve his younger group members despite his explicit wish to protect them so they can concentrate on building their own research:

> I have this student, and unfortunately, he is also interested in ethics. And I tell him he has to watch it, because you cannot do everything (. . .) but then I can't help myself going and talking to him, if something has come up. (Interviewee 20)

This quotation sums up neatly the way these interviewees describe their own position. They might not consider public communication part of their core activity as a scientist, but they do it and they might engage others because they are personally engaged.

Discussion: Three Ideal Typical Roles in Science Communication

Each of the three modes of representing science enacts a particular identity for scientists and a corresponding understanding of what science *is.* When scientists represent a field of expertise they act as *experts*. Science is understood as a number of expert communities—disciplines—that supply factual knowledge about the world. When scientists represent a professional research organization, they act as *research managers*. In this mode, science is a social activity organized in universities and other research organizations, which demands resources in order to produce knowledge. And finally, when scientists represent science as a social institution, they take on a role as *guardians* of science. In this mode, science is described as the basis for rational problem solving in society and the source of enlightenment. In this section, the differences between the three modes of representation will be fleshed out by referring to them as three ideal typical roles as Expert, Research Manager, and Guardian of Science. In doing this, the descriptions should be seen not as a summary of what was found in the interviews but rather as analytical constructs that synthesize the observations into a typology, which is deliberately stripped of any empirical messiness. The objective is to provide a set of ideal types that can help understand the variance in scientists' motivations and their criteria for evaluating communication by illuminating distinct patterns, as illustrated in Table 1.

Each of the three types evaluates the quality of communication differently just as they also conceive of their audiences in different ways. Experts predominantly worry about whether the content of their communication is correct. They do not necessarily think very much about audiences, but if they do,

Table 1. Three Ideal Types of Representing Science.

Mode of representation	A field of expertise	A professional research organization	A societal institution
Scientist's role	Expert	Research manager	Guardian of science
Content of communication	Factual knowledge	Knowledge products	Rationality and scientific method
Quality criterion	Is it correct?	Is it good branding?	Does it enhance enlightenment?
Audience	Target groups	Stakeholders	Citizens
Motivation	Obligation to make facts available	Integrated part of managerial role	Personal commitment
Learning	Learning by doing as part of academic community	Acquisition of competences	Learning by example of role models

they might have a vague idea of different target groups with an interest in their particular knowledge. Research Managers similarly worry about whether their communication is correct, but they also consider whether it will portray their research organization in a favorable light: Does the communication help the organization achieve a good brand? They think quite strategically about audiences and typically consider different types of stakeholders as important. In contrast, Guardians of Science are most preoccupied with whether communication will improve the public's understanding of science. Although they also reflect on the importance of correctness in communication, an important quality criterion for them is whether the communication will serve to enhance enlightenment among citizens.

When we consider motivation to engage in public communication, both Experts and Guardians of Science complain that publics and politicians lack an understanding of science. Both of these roles illustrate the previous finding that a deficit model is prevalent among scientists (Casini & Neresini, 2012; Davies, 2008; Watermeyer, 2012). It could have been expected that this was not so pronounced in Denmark with its tradition of participatory science communication, but Danish scientists are apparently similar to their international colleagues in this regard. However, the present analysis also suggests that it troubles the Guardians of Science most. To the Guardian, enlightenment is something that cannot be taken for granted but rather an active battle and one that has to be fought in every public communication. Guardians of Science often portray the world in dichotomies where science is

under pressure, and they try actively to change this by their personal commitment. Experts consider it part of their obligation as academics to disseminate their knowledge. They can be quite upset about how much they have to simplify their messages, but they do not consider the perceived lack of public understanding as a foundational problem in quite the same way as in the role of Guardian. However, Experts will complain about the mass media and how difficult it is to get their expert knowledge communicated without distortion.

Similar to other studies, a sense of duty to communicate is also a motivation to do so (Martín-Sempere et al., 2008; Pearson et al., 1997; The Royal Society, 2006), but on the basis of the present analysis, it might be important to distinguish between the Experts' sense of duty to make expert knowledge available and the Guardians' sense of duty to increase enlightenment and rationality in society. Whereas the former is oriented toward "making the facts available" and focused on providing information, the latter is more concerned with whether the communication makes a difference and focused on publics as receivers of meaning. In contrast to this sense of duty, Research Managers consider it an integral and important part of their managerial role to communicate publicly in order to brand their organization. The purpose of this is not to provide expertise or enlighten citizens but rather to put the research organization itself in the most favorable competitive situation.

It is noteworthy that none of the interviewees consider public communication as an organizational activity for which organizational members systematically should be trained. External images and internal identities are therefore not something being actively managed through communication efforts. The finding corresponds to that of Casini and Neresini (2012) that European research organizations have so far failed to understand public communication as an activity integral to research. From the perspective of organizational communication, however, this does not mean that communication does not influence both images and identities. Here, we can conclude that the roles as Expert and Guardian coconstruct science as a collegial activity that makes the scientific organizations much less visible than the role of Research Managers, where the organizations are central for the sense making about what science is.

Looking at how the three ideal types understand the communication of other researchers gives additional insights into how each of these roles implies a particular view on the management of external images and internal identities. The main concern of Experts is that researchers, including themselves, should stick to their field of expertise. They might interfere with their colleagues' communication, if they think it is unwarranted or wrong, but if they choose to do so, they explicitly do it as one colleague to another. Guardians have spent a lot of effort reflecting on their own communication

and worked deliberately to improve their personal communication style. This effort is a personal development story and related to an individual choice to engage, but they do not necessarily want to oblige other researchers to do the same although it might work as inspiration for younger researchers. Neither Guardians of Science nor Experts, however, have fixed ideas about how younger researchers are supposed to learn to communicate. In general, talking to nonscientists about science is an issue that more or less comes with the job. It seems that scientists learn to deal with journalists, companies, publics, and policy makers in much the same way as they learn to deal with administrative staff, travel budgets, library subscriptions, and coffee machines.

Only Research Managers might consider communication competencies as something that has to be acquired more systematically. The Research Manager is also more aware of proactively designing communication activities to serve branding purposes, but whether they will develop this from an individual effort into something that is systematically done by all organizational members is an open question. Given the changes in the university sector toward a higher emphasis on competition between research organizations, training and management of communication might become more important in the future.

Before turning to the concluding section, it should be noted that within the sample of interviewees, the Expert role is most widespread—at least as part of how the scientists consider their own identity. The role as Research Manager is in some ways connected to the formal position of the interviewee, but all the interviewees have been in positions where they have managerial responsibilities and they do not all draw on this mode of representing science. Not even all the leaders of big research centers will adopt this role. Based on this sample, it should be therefore concluded that the enactment of these roles is not systematically connected to the formal position or career paths of the scientists. In this sense, the adoption of the three roles in this sample is in line with the findings by Besley et al. (2012) that attitudes are more important than demographic factors. It could be noted, however, that all the interviewees who clearly adopted the role of Research Manager or Guardian of Science were male. The present analysis did not find any patterns to illustrate or support previous findings (Besley et al., 2012; von Roten, 2011) that female scientists believe public communication to be more important than their male colleagues. If anything, the female interviewees were less distinct in their attitudes, but this might be coincidental.

Conclusion

The identification of three ideal types of representing science—Experts, Research Managers, and Guardians of Science—draws out a particular set of

characteristics that make them distinct from each other. In practice, however, scientists will adopt these modes of representing to a larger or lesser degree and in various combinations. This analysis is qualitative and cannot predict the prevalence of the adoption of these modes in a wider group of scientists. As qualitative ideal types, they are generalizable, but further research will have to investigate how and to what extent they are adopted outside the field of Danish leading scientists in biotechnology and nanotechnology.

The elucidation of different ideal types is particularly important in relation to the changing nature of knowledge production. In a situation in which universities compete for resources, branding is likely to become an important activity. The role as Research Manager might therefore be expected to become more widespread in future science communication, because it is the one that is most directly aimed at generating resources. It is also a role that is expected to create legitimacy within a political discourse that values the "entrepreneurial university" as a source for economic growth (Etzkowitz, 1998). However, exactly the opposite could be true within a political discourse that values democratization of science and public engagement. If scientists are primarily focused on the brands of their own organization, they might be considered less legitimate as spokespeople for a field of expertise or the institution of science because they are perceived to be directed by special interests in generating resources. When it comes to the more general public understanding of science, it is probably necessary for scientists to adopt the roles of Experts and Guardians in order to be perceived as legitimate spokespeople for scientific knowledge and the institution of science.

Declaration of Conflicting Interests

Funding

Note

1. Since Denmark is a small country, all selected scientists (apart from four) were previously known to the author. In the following table, a summary of each interviewee profile is presented. The profiles have not been linked to the quotations in the text, since that would compromise anonymity.

Age, years	Gender	Field of research	Media presence	Policy-making engagement
35-39	Female	Biotechnology, red	Medium	Low
40-44	Male	Nanotechnology	Medium	High
40-44	Female	Nanotechnology	Medium	Low
45-49	Female	Biotechnology, red	Low	Low
45-49	Male	Biotechnology, red	Medium	High
50-54	Female	Biotechnology, green	Medium	Medium
50-54	Male	Nanotechnology	Low	Low
50-54	Male	Nanotechnology	Medium	High
50-54	Male	Biotechnology, red	High	Medium
50-54	Male	Biotechnology, red	Medium	Medium
55-59	Female	Nanotechnology	Medium	Low
55-59	Male	Biotechnology, red	High	Medium
55-59	Male	Nanotechnology	Low	Low
55-59	Male	Nanotechnology	High	High
60-64	Male	Biotechnology, red	High	Low
60-64	Female	Biotechnology, green	High	High
60-64	Male	Biotechnology, green	High	High
>65	Male	Nanotechnology	High	High
Undisclosed	Male	Biotechnology, red	Medium	Medium
Undisclosed	Male	Biotechnology, red	Medium	Medium

Note: In some cases, it has been impossible to obtain exact information about dates of birth. Information about media presence and engagement in policy making is based on the public profiles collected.

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