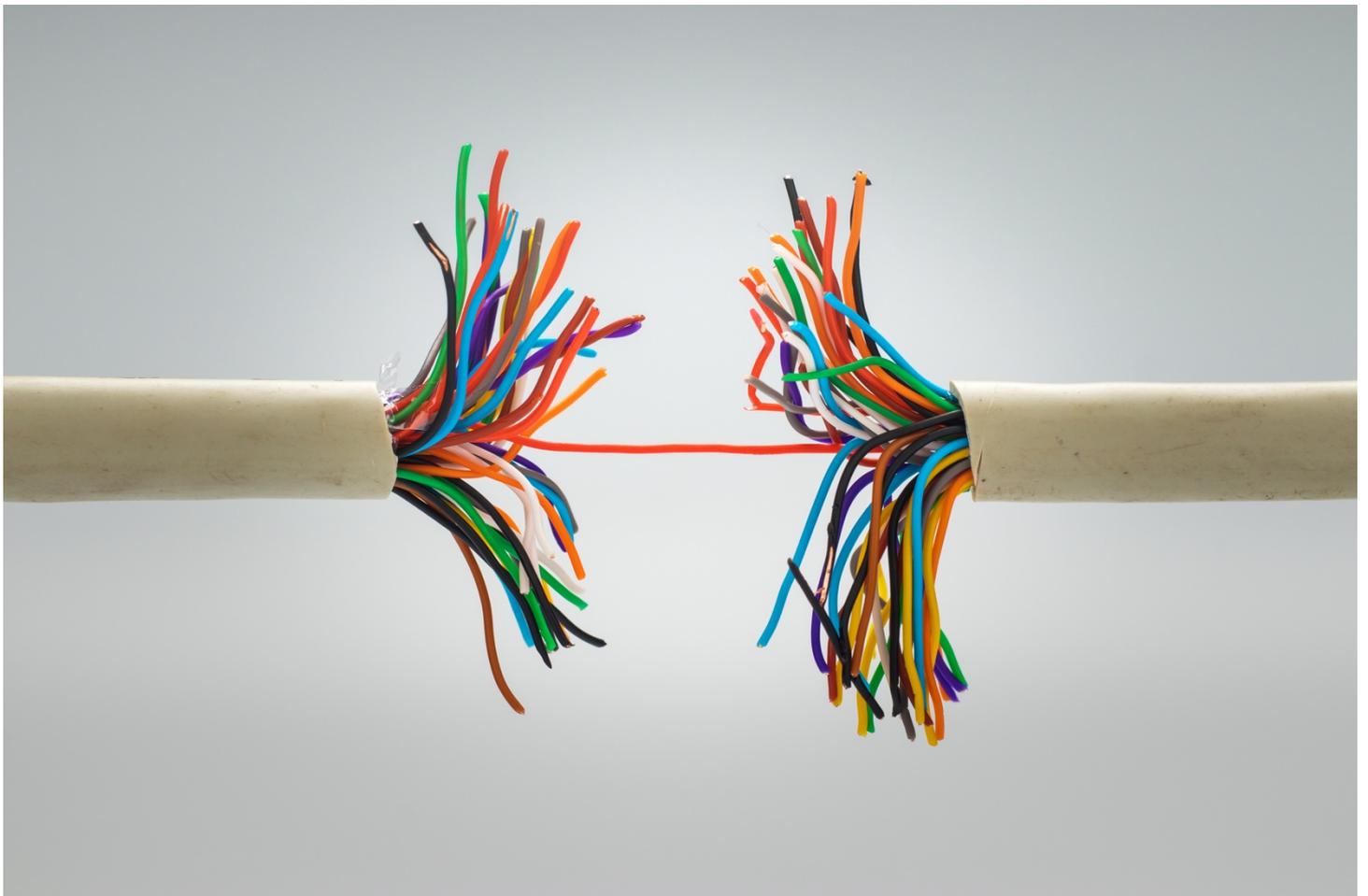


“AT LEAST WE’RE TRYING”: EXPERIMENTING WITH
ROLES AND REPERTOIRES TO FOSTER NEW CONNECTIONS
BETWEEN SCIENCE AND SOCIETY



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SUMMARY

The current science communication ecosystem is highly fragmented, dynamic and complex. This provides science communicators with both opportunities, but also leads to difficult challenges. The RETHINK project aims to understand the changing landscape of science communication and research, experiment with and develop methods for science communicators to stimulate open, transparent and productive science-society interactions. In the past two and a half years RETHINK has strived to understand this complex ecosystem. Whilst science communicators generally recognize opportunities to strengthen the ties between science and society, many science communication practitioners and scholars involved in the RETHINK project perceive a *disconnect* between science and society, i.e., a disconnect with their audiences.

Four (interrelated) developments play an important role in this *disconnect*, and have been explored in earlier research by RETHINK. First, the boundaries between science and society have become *blurred*, confronting the public with a vast amount of information from a variety of sources and as a result, facts are increasingly becoming mixed with opinions and scientific issues are becoming politicized. Second, science communication has become heavily *digitalized*, fundamentally changing the relationship between science and society, leading to new channels and resources for science communication, and facilitating the creation of information about science by a variety of publics online. Third, the rapid proliferation of *misinformation* and affiliated *polarization*, magnified by the pandemic's sudden emergence, changes the dynamics between science and society further. Fourth, *misconceptions* of how citizens make sense of complex science-related problems and the *inability to reach all members of society equally* when communicating about science are sobering insights for science communication professionals: their practice might not reach their audiences as effectively as thought.

The contemporary science communication ecosystem is thus highly complex and science communicators are working to find ways to address the disconnect between science and society, something RETHINK aims to account for in this study. Traditional roles (e.g., conduits, watchdogs) for science communication professionals might no longer be suitable and sufficient in the current landscape under varying circumstances. Therefore, the aim of this report is *to explore the different roles science communicators assume – or should be assuming – to meet the challenges and demands in the contemporary science communication landscape.*

On the basis of earlier RETHINK research on how science communicators employ innovative techniques to reach underserved audiences, six roles were formulated that can be – and are – adopted by science communication practitioners to enhance their connections with a wider range of audiences: The Broker, creates connections between target audience and actors to obtain access to a target group, links with other actors to supply, involves all actors in dialogue; The Listener, connects to target audience with active listening and empathy and integrates that what is learned in communication activity; The Includer, breaks

down physical, social, cultural barriers to give audience access to resources, spaces, knowledge & opportunities; The Enabler, provides target audience with access to information, resources, spaces, and changes power dynamics between science-society; The Educator, contributes to understanding scientific method and process, and critical thinking skills leading to misinformation identification; and The Entertainer, gets scientific communication across via games, arts, performances, hands-on activities & storytelling.

This deliverable reports how a broad range of different science communicators experimented with these different roles in science communication. Accordingly, we seek to conceptually deepen the understanding of these roles by drawing from other RETHINK research on *role repertoires*. *Repertoires* link scientists' underlying perspective on science-society interactions to the activities they deploy. By expanding the conceptual scope by also including repertoires, we aim to contribute to a comprehensive understanding of how roles in science communication take shape.

Our approach

To research the *role repertoires* that science communication professionals apply in their practice, but also about the roles that seem to be lacking, particularly in relation to addressing the disconnect between science and society, we facilitated communicating scientists, science journalists and other science communicators in conducting *small-scale reflective practice experiments* in their own science communication practice. The 23 participants in these experiments volunteered to experiment with and reflect on their interactions with their audiences after having participated in various RETHINK workshops. The reflective practice experiments consisted of: 1) a 'kick-off' interview, in which the challenges experienced by practitioners were identified, and subsequently small (thought) experiments were designed; 2) conduct of the small (thought) experiments, of which participants filled in multiple reflection diary entries to keep track of their experiences in experimenting; and 3) a second interview to discuss their experiences. From this data, we performed a qualitative analysis in which we adopted a deductive approach to find these six roles – we constructed various role repertoires per participant while simultaneously looking for overarching themes and patterns across the various participants.

Findings

Our findings suggest that the participants assumed the various aforementioned roles when acting at the science-society interface. In order to overcome the disconnect between science and society, we emphasize the importance of roles that engage in two-way (or multi-way) communication, i.e., the *Broker*, *Enabler* and *Listener* are important, and particularly the role of the *Listener*, which was occasionally enabled by the reflective practice experiments. Furthermore, participants mentioned the importance of establishing connections between science and society. Yet, only a few participants apply these roles and even fewer engage in activities that aim to gain insights into what society needs and wants and enable this information to feed back into the scientific process. Furthermore, three overarching challenges can be identified that

concern how the different roles in science communication were displayed by the participants: 1) the need to strengthen roles that facilitate two-way communication; 2) audiences are frequently undefined; and 3) there are unproductive perspectives of society.

What now?

On the basis of this study, we conclude that valuable science communication activities are undertaken to bridge/overcome the found disconnect between the sciences and society, and our results show that all six roles (*Educator, Broker, Listener, Includer, Enabler and Entertainer*) are relevant and warrant cultivation. However, based on the challenges we found, we conclude that a concerted effort is necessary. Therefore, in order to strengthen the plethora of roles needed to overcome the disconnect between science and society, we propose two new roles that operate on the level of governance i.e., the *Change Agent* ('actors who promote and practically facilitate a culture of science communication') and the *Playmaker* ('actors who assume problem ownership or either have (implied) responsibility about issues that arise at the science-society interface and also have the means to facilitate change'). Ultimately, we propose three strategies (stimulate reflective practice in science communication; invest in learning networks; promote science communication through policy) to strengthen science communication roles.

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1. INTRODUCTION

The RETHINK project aims to understand the emerging landscape of science communication and establish conditions for science communicators to stimulate open, transparent and productive science-society interactions. The current science communication ecosystem is highly fragmented, dynamic and complex. This provides science communicators with opportunities, but also leads to difficult challenges. In the past two and a half years RETHINK has strived to understand this complex ecosystem. In spite of the opportunities to strengthen the ties between science and society, many science communication practitioners and scholars involved in the RETHINK project perceive a *disconnect* between science and society.

How can we understand this disconnect? First of all, two (interrelated) developments that are at the centre of the RETHINK project play an important role herein, namely the *blurring boundaries between science and society* and the rise of *digitalization*. The boundaries between science and society have become blurred, confronting the public with a vast amount of information from a variety of sources, some including biases and vested interests (Nowotny, Scott & Gibbons, 2001; Roedema, Broerse & Kupper 2021; Langkjær & Hyldgård 2021). As a result, opinions are increasingly becoming mixed with facts and scientific issues are becoming politicized. Furthermore, science communication has become heavily digitalized, fundamentally changing the relationship between science and society. Digitalization has led to new channels and resources for science communication. A variety of publics cannot only find, but also generate information about science online (Rutsaert *et al.*, 2013). On the one hand, digitalization creates new opportunities to quickly and easily access scientific findings. On the other hand, this can lead to an overload of accessible information, part of which may be inaccurate, incomplete or biased (Roedema *et al.* 2021). It also means that traditional journalists and other science communicators are no longer the ‘gatekeepers’ of what scientific information enters our societal debate. The public now often reads and watches information about science from sources where the traditional media’s editorial oversight and fact-checking are lacking (Trench, 2008). Indeed, the number of fora where public discussions take place increased tremendously due to digitalization. Such fora continuously demonstrate the diversity of voices, all of which are underpinned by their own values and worldviews (Roedema *et al.*, 2021; Langkjær & Hyldgård, 2021). The often-harsh discussions that are continuously taking place about the Covid-19 pandemic illustrate these trends and the complexity of the contemporary science communication landscape (Rerimassie *et al.*, 2021).

The societal discussions on Covid-19 also illustrate other elements of the disconnect: the role of *misinformation* and *polarization*. The pandemic’s sudden emergence was met with an equally rapid proliferation of false and misleading claims, particularly on digital platforms. Authorities are not only fighting a pandemic, but to use the words of the World Health Organization also an *infodemic* (Dan & Dixon, 2021; Scheufele *et al.* 2021). Relatedly, the pandemic highlights – and potentially even exacerbates – societal polarization meaning that the gaps between attitudes in society are widening and hostility among different-

minded groups is increasing (Scheufele et al. 2021). Misinformation and polarization play an important role in the dynamics of the contemporary science communication ecosystem. Evidently, they can be observed in the context of the pandemic, but also for instance, regarding the societal debate on climate change.

Another element of the disconnect may be found in misconceptions of *how citizens make sense of complex science-related problems*. By examining how European citizens make sense of the Covid-19 pandemic, we found that the participants we interviewed predominantly make sense of socio-scientific issues on the basis of their personal situation or social context. In their sensemaking practices they only scarcely refer to actual science communication output. This is a sobering insight for science communicators and entails that misunderstandings or disputes in public discussions on socio-scientific matters are often not necessarily the result of a lack of knowledge, but rather that different worldviews, emotions and values lay to the basis of differing perspectives on the relation between science and society (Rerimassie et al. 2021).

Lastly, it is important to note that *not all members of society are reached equally* by science when it is communicated. As fellow RETHINK researchers observed, the typical audience for science communication in contexts such as science festivals and museums is white, affluent, with a relatively high level of formal education and with a pre-existing interest in science (Milani et al., 2021). Conversely, RETHINK research has shown that relatively few science communicators sought to reach underserved audiences (Milani et al., 2020a).

1.1 RESEARCH WITHIN RETHINK

Taking stock, the contemporary science communication ecosystem is highly complex and science communicators need to find ways to address the disconnect between science and society. If we consider the aforementioned dynamics that make up the disconnect between science and society, traditional roles for science communicators/journalists might no longer be suitable and sufficient in the current landscape: for instance, it is no longer the science communicator who, as gatekeeper and watchdog, determines how citizens consume and evaluate scientific information. At least, we need to ask ourselves if we need to *expand* on the roles that traditionally have been assumed by science communicators. In this respect, we also recognize the increased attention in the past decades to move from approaches adhering to a public understanding of science perspective to more dialogue-oriented approaches, i.e. approaches that focus on facilitating two-way (or multi-directional) forms of communication, rather than merely informing citizens (Bubela et al. 2009; Nisbet & Scheufele 2009; Roedema, Rerimassie & Kupper 2020).

RETHINK conducted research to examine how the disconnect between science and society can be met by science communication professionals. First of all, we explored the approaches science communicators used to reach underserved and disinterested audiences and amongst others concluded that *innovative roles* are required for today's science communicators that may help to foster connections with new audiences (Milani

et al., 2021), a ‘role’ being a characterization of the activities of an individual engaged in science communication that encapsulates several aspects of what they do (Pielke, 2007). To this end, Milani and colleagues considered the roles previously identified by Fahy and Nisbet (2011) in their study of journalists’ working practices as well as a previous RETHINK report that considered the working practices of a broader cross section of science communicators (Milani et. al. 2020b). Ultimately, six different roles were identified (*Educator, Broker, Listener, Includer, Enabler and Entertainer*, see Chapter 2 for elaboration) all of which can potentially play a valuable role in making connections with audiences, including those who are perceived to be marginalised or who do not have a pre-existing interest in science.

In addition, we investigated how *openness* and *reflexivity* may contribute to practices that aim to address challenges prevalent in the contemporary science communication landscape (Roedema et al. 2021). We facilitated communicating scientists, science journalists and other science communicators in conducting *small-scale reflective practice experiments* in which they tried to adopt openness and reflexivity in their own science communication practice. Here reflexivity is understood as being aware of – and critically reflecting on – your own and other people’s situations, context and assumptions, and being capable to take actions on the basis of these insights. Openness is described as considering a wide range of information sources, perspectives, values and emotions; and being capable of changing your own opinion based on the offered arguments and stories. The purpose of these experiments was to explore how openness and reflexivity can be operationalized and understand what value this may bring to the field of science communication – or more specifically, how this may help address the aforementioned disconnect between science and society. Participants in these experiments were recruited from the project’s so-called Rethinkerspaces. RETHINK established seven communities of practice, with whom action research is undertaken. Rethinkerspaces are established in seven European countries: Italy, the Netherlands, Poland, Portugal, Serbia, Sweden and the United Kingdom. Each Rethinkerspace consists of a heterogeneous group, varying from science communicators, to science journalists, communicating scientists, policy makers and science enablers, such as members of funding bodies. We recruited twenty-three volunteers, which pursued a large variety of activities in the contemporary science communication landscape to participate in our reflective practice experiments. The participants conducted experiments in roughly two categories: first, experiments that aimed to gain a better understanding of their audience, and second, experiments on conversational tactics that included openness and reflexivity. Ultimately, the reflective practice experiments were perceived to be valuable for both the individual science communicator as well as the audiences they aim to reach (ibid.).

1.2 AIM AND APPROACH OF THIS REPORT

In this report we build and expand on the aforementioned activities, and the perceived disconnect between science and society, the aim of this report is *to explore the different roles science communicators assume – or should be assuming – to meet the challenges and demands in the contemporary science communication landscape*. On the basis of our research on how science communicators employ innovative techniques to reach underserved audiences, the RETHINK project formulated six roles that can be adopted by science communication practitioners to enhance their connections with a wider range of audiences. Our assumption is that adoption of such roles can contribute to closer and more equitable connections between science and society *in a broader sense* as well. In turn, the reflective practice experiments we conducted with the Rethinkerspace volunteers on openness and reflexivity culminated into changes in assumptions and working practices. Evidently, such insights have important bearing for *the role* a particular science communicator assumes. Accordingly, in this report we will integrate both research activities by re-examining reflective practice experiments from the perspective of the six roles formulated by Milani et al. (2021). This allows us first, to *validate* the roles we previously formulated. In addition, we seek to conceptually *deepen* the understanding of these roles by drawing from other RETHINK research on *role repertoires* (Roedema, Broerse & Kupper 2021). The concept of *repertoire* emphasizes that roles are not static but depend on context, situation and an individual's values, views and styles (Turnhout et al., 2013). 'Repertoires' link scientists' underlying perspective on science-society interactions to the activities they deploy. By expanding the conceptual scope by also including repertoires, we aim to contribute to a comprehensive understanding of how roles in science communication take shape.

In sum, this deliverable reports how a broad range of different science communicators experimented with different roles in science *communication*. We aim to learn about the roles that are assumed, but also about the roles that seem to be lacking, particularly in relation to addressing the disconnect between science and society.

1.3 STRUCTURE OF THIS REPORT

The report is structured as follows: first we outline our analytical framework and explain the methods we used for this research. Then, the results section discusses to which extent the roles we consider to be valuable in the contemporary science communication system were assumed by the volunteers in our experiments, followed by a discussion section in which we reflect on how such roles may be strengthened. Lastly, we take stock of our findings in the conclusion and consider what our findings imply for RETHINK and the future development of science communication in Europe.

2. ANALYTICAL FRAMEWORK

Science communicators carry out their practice on the intersection of science and society, for example when they report on scientific research as a journalist or stimulate scientific discourse between science and society as an advocate of public engagement. In other words, science communicators engage in *boundary work*. The slowly disappearing distinction between online creators and consumers of (scientific) information makes boundary work increasingly complex: communications here are ephemeral, dynamic, controversial, hard to track and involve many actors (Milani *et al.*, 2020b). Moreover, boundary work takes place on multiple platforms and interfaces, such as Twitter, Instagram, YouTube and Reddit. These platforms are textbook examples of complex online science communication practice, whereon simultaneously interaction with larger, diverse audiences is enabled. If other analogous places for scientific discourse in formal meeting places (science museums, city halls, community centres) and informal meeting places (grocery shops, supermarkets, at home) are also taken into account, we see that boundary work has become increasingly diffused and complex. Key to the concept of boundary work is the idea that in such a complex systems, interfaces or practice, conflicts might arise on what views, knowledge or scientific information is useful or trustworthy (McGreavy *et al.*, 2013). As such, insight into the complexity of boundary work is essential in order to contribute to constructive and meaningful science communication practice.

This report applies a boundary work perspective to explore how the practices of science communicators crystallize at the boundary between science and society – if not to see what is demanded from a meta or meso level, then perhaps to stimulate the reflection of individual practitioners on their own boundary work in interaction with their addressees (Roedema *et al.*, 2021). Earlier literature in the field of science policy makes use of different descriptions of roles for scientific experts (Bauer & Kastenhofer, 2019). Others describe how communicating scientists practice these roles, or in other words, what repertoire communicators deploy (Spruijt *et al.*, 2013; Turnhout *et al.*, 2013). This report aims to build on previous RETHINK research into the individual experiences of science communicators and communicating scientists with regards to role and repertoires (Milani *et al.*, 2021; Roedema *et al.*, 2021). The corresponding analytical framework that is applied to assess the experiences of science communicators with boundary work and how this works out in practice, with the aim to provide leads to how the field of science communication should be organized according to science communicators in order to establish meaningful connections with various audiences, is based on the framework for roles and repertoires of scientists' online public engagement (Roedema *et al.*, 2021; see table 1).

2.1 ROLES

In the analytical framework, the concept of 'roles' refers to science communicators' focus and desired contribution aimed for in science–society interactions (Roedema *et al.* 2021; p.6). Depending on local,

personal and cultural circumstances, science communicators may apply varying roles while interacting with their addressees. As mentioned, previous RETHINK research by Milani *et al.* (2021) built on Fahy & Nisbet's (2011) typology to formulate roles for science communicators who communicate about science, technology or health topics, and seeking to reach underserved audiences, e.g., those from certain socioeconomic backgrounds, older people, younger people, local communities, those disinterested in science. Six innovative roles were identified that can be adopted by science communicators to foster connections with new audiences :The Broker, The Listener, The Includer, The Enabler, The Educator (see Box 1 for definitions). These roles describe foci or an intended effect in audiences, that consider the audience at the centre of their communication strategies, entertainment, encourage the formation of active connections and networks, or enable dissemination of information from science to society in order to enable audiences to make decisions in their daily lives based on scientific knowledge. With this, the type of contribution that science communicators add to boundary interactions are knowledge, understanding, empowerment of individuals and communities, and many more.

Box 1: Roles as identified by Milani et al. (2021) that science communicators take when they communicate about science, technology or health topics. These roles characterise the communication activities that connect participants with the hard-to-reach audiences.

- *The Broker:* creates connections between target audience and actors to obtain access to a target group; links with other actors to supply; involves all actors in dialogue;
- *The Listener:* connects to target audience with active listening and empathy and integrates that what is learned in communication activity;
- *The Includer:* Breaks down physical, social, cultural barriers to give audience access to resources, spaces, knowledge & opportunities;
- *The Enabler:* provides target audience with access to information, resources, spaces; changes power dynamics between science-society;
- *The Educator:* contributes to understanding scientific method and process, and critical thinking skills leading to misinformation identification;
- *The Entertainer:* gets scientific communication across via games, arts, performances, hands-on activities & storytelling.

2.2 REPERTOIRES

Closely connected to the concept of 'role' are 'repertoires'. Repertoires stress that roles are not static but rather fluid and depend on an individual's contexts and (lived) experiences (cf. Roedema *et al.*, 2021; Turnhout *et al.*, 2013; Trench, 2008). Repertoires can be described as "*science communication actors' perspectives on the science-society relationship and, subsequently, a set of work-related activities that complement the science communicator's perspective*" (Milani et al. 2020b, p.6). Next to a science

communicators' perspective on science-society interactions, repertoires describe the activity they deploy and audiences they (intend to) address, connections and interaction patterns they establish and challenges they encounter in their practice or boundary interaction (Roedema et al., 2021; see table 1). Role and repertoires are predominantly described in the field of science policy and knowledge brokering. For example, Turnhout *et al.* (2013) identified three types of knowledge brokering repertoires: supplying, bridging and facilitating. Herein, 'supplying' emphasizes the distinction between the creation and use of scientific knowledge and focuses on providing knowledge to an audience (such as the stereotype of the reporting science journalist mentioned earlier); whereas in 'bridging' an increased focus is laid on interaction between knowledge producers and users; and in 'facilitating' these boundaries disappear and knowledge production and use are integrated (as with the example of the public engagement advocate) (Turnhout et al., 2013). In the context of this deliverable, a repertoire comprises the perspective of a science communicator on science-society interactions, the audiences they aim to address, activities deployed, outputs produced, interaction patterns and boundary challenges and opportunities experienced (Roedema et al., 2021; based on Bauer & Kastenhofer, 2019; Spruit et al., 2013; Turnhout et al., 2013; and Fahy & Nisbet, 2012). Herein, a science communicator's perspective on science society interactions is described as "*how scientists perceive and frame the status of scientific method and knowledge and its implications or use in society*" (p.4), or, how science communicators perceive the appropriate mode of science communication (Roedema et al., 2021). For example, some science communicators might prefer to communicate about fundamental science over social sciences due to the nature of scientific methods used in these fields, whilst others tend towards a scientific discipline or science communication mode that incorporates emotions and societal values into their working practice. This perspective consequently influences the audiences science communicators find relevant or desire to address and the outputs they produce, as well as the boundary interactions, patterns or challenges they establish and experience.

In summary, the analytical framework comprises of the following categories and related dimensions:

1. Science communicators' role: type of contribution; focus; and type of role
2. Science communicators' repertoires: perspectives on science-society relations; activities and outputs; addressees; interaction patters; and boundary challenges and opportunitites

| Category | Dimension | Description |
|------------|--|---|
| Role | <i>Focus</i> | <p>What scientists try to achieve with respect to boundary interaction; the effect the scientists aim to achieve with their engagement activities, e.g. informing, educating, awareness-raising, critiquing and democratising</p> <p>- <i>The Broker</i>: creates connections between target audience and actors to obtain access to a target group; links with other actors to supply; involves all actors in dialogue</p> <p>- <i>The Listener</i>: connects to target audience with active listening and empathy and integrates that what is learned in communication activity</p> <p>- <i>The Includer</i>: Breaks down physical, social, cultural barriers to give audience access to resources, spaces, knowledge & opportunities</p> |
| | <i>Type of contribution</i> | <p>What scientists add to boundary interaction; the contribution scientists want to make, e.g. knowledge, understanding, meaning, agenda, empowerment, connections and perspectives</p> <p>- <i>The Enabler</i>: provides target audience with access to information, resources, spaces; changes power dynamics between science-society</p> <p>- <i>The Educator</i>: contributes to understanding scientific method and process, and critical thinking skills leading to misinformation identification</p> <p>- <i>The Entertainer</i>: gets scientific communication across via games, arts, performances, hands-on activities & storytelling</p> |
| Repertoire | <i>Perspective on science-society</i> | How scientists perceive and frame the status of scientific method and knowledge and its implications or use in society; how scientists perceive and frame the appropriate model of science communication in terms of direction, framework and nature of communication |
| | <i>Activities and outputs</i> | What scientists do to address boundary interactions and the form they take, e.g. science writing, video-making, deliberative processes and capacity-building |
| | <i>Addressees</i> | The scientist's intended and target audiences |
| | <i>Interaction patterns</i> | The way practitioners identify, engage, connect the public, stakeholders and scientists; boundary strategies scientists use, e.g. supplying, demarcating, bridging, facilitating and blurring |
| | <i>Boundary challenges & opportunities</i> | Boundary interaction problems and opportunities available to scientists, including scientists' interactions with addressees in the digital public sphere and in the context of organisations, institutes, science systems and cultures |

Table 1: Analytical framework for roles and repertoires of science communicators' in science-society interactions, from Roedema *et al.*, (2021). Based on Milani *et al.*, 2021; Bauer & Kastenhofer, 2019; Spruijt *et al.*, 2013; Turnhout *et al.*, 2013; Fahy & Nisbet, 2012.

In sum, how a science communicator positions him or herself within, and perceives the relationship between science and society, inherently influences the activities undertaken and interactions with audiences. This

interconnectedness of role, perspective on science-society interactions, and subsequent repertoire deployed, is caught in the concept 'role repertoire' (Roedema et al., 2021). With the concept of role repertoires, a connection is made between the activities that a science communicator deploys, audiences addressed, boundary interactions established (i.e., repertoire); the perspective science communicators have on science-society interactions; and the intended focus and contribution of science communicators with regards to boundary interactions (i.e., role) (Roedema et al., 2021). Untangling the working practice and experiences of science communicators by use of the concept of role repertoire allows for an exploration of challenges or conflicts encountered and directions for change. With this, finding the discrepancies within science communicators' role repertoire may help science communicators become reflective practitioners; for it facilitates finding the *why* behind certain boundary interactions with their addressees and investigate or experiment with new working practices to overcome their boundary challenges. It bears mentioning that with these categories, we are not aiming to compartmentalize science communicators, e.g., labelling someone an Entertainer using one-way communication. On the contrary, these roles and repertoires are fluid and subject to the events, context and environment applicable at that moment. Individuals may adopt and alter various role repertoires in widely diverse situations. This categorization can, however, provide an indication of what is currently happening in the science communication field and what is needed in the future according to science communication practitioners.

3. METHODOLOGY

In this phase of the RETHINK project, a focus is laid on experimenting with the workings of role repertoires in the practice of science communicators. With this deliverable, we build upon the work of UWE Bristol, and especially on that of the identified roles for science communication practitioners that seek to create connections with underserved audiences (Milani *et al.*, 2021). It is our aim to test their work in a broader context, by looking at how the roles and associated repertoire live across the science communication field. To this end we engaged with the Rethinkerspace community to conduct research on role repertoires in a broader context, since members of these Rethinkerspaces engage in a wide variety of communication activities, but are also sympathetic to the aims of the RETHINK project. Accordingly, this deliverable included and analysed interview transcripts and reflection diaries of Rethinkerspace members that volunteered to experiment with and reflect on their interactions with their audiences, which are described in more detail here below. An overview of these participants can be found in Annex I. Next, we describe the process of analysis with help of the analytical framework. Lastly, ethical considerations are described.

3.1 REFLECTIVE PRACTICE EXPERIMENTS: INTERVIEWS & REFLECTION DIARIES

We asked Rethinkerspace members to, together with researchers from the VU Amsterdam, experiment with the concepts of openness and reflexivity. A total of 23 science communication practitioners participated, of which 6 were communicating scientists, 9 science journalists and 9 ‘other’ science communicators. The included science communication practitioners in this study recognize the three developments that are highlighted within the RETHINK project and the previous work package 1 deliverables, namely: that of a more complex field of science communication; the realization that citizens are making sense of science-related issues such as the Covid-19 pandemic in their own environment and not necessarily with evidence-based scientific information and; the growing degree of polarization and misunderstandings in society. By reflecting on and experimenting with the interaction that these practitioners have with their audience, we think we can provide some direction in how to cope with these aforementioned developments.

Participants were evenly spread over the seven participating Rethinkerspace countries. Participants were invited for a ‘kick-off’ interview, subsequently went experimenting with various role repertoires and the inclusion of the concepts ‘openness and reflexivity’, and lastly were invited back for a second interview to discuss their experiences. In the first interview, lasting one hour, the challenges experienced by practitioners were identified, and subsequently small (thought) experiments were designed. The goal of this small experiment was to test out several practices or strategies that enable practitioners to deal with challenges – which the current science communication ecosystem brings. Participants experimented for the duration of a minimum of 6 hours, spread over several working days in multiple weeks. A total of 21 participants continued with experimenting with different role repertoires, which means that 3 participants indicated they did not have time to continue in the study. Experiments took place in the months of April, May and June

2021. Participants filled in multiple reflection diary entries to keep track of their experiences in experimenting, which led to a total of 79 science communication situations and activities on which participants reflected. The participants who filled in a reflection diary were invited for a second interview, to reflect on their experiments, the use of the reflection diary and the value of openness and reflexivity for the practice of science communication. Together with the first interview, this led to a total of 45 conducted interviews of approximately one hour.

3.2 DATA ANALYSIS

Data from the interview transcripts and reflection diaries was coded thematically, by using Microsoft Powerpoint and Microsoft Excel, constructing various role repertoires per participant while simultaneously looking for overarching themes and patterns across the various participants. This allowed the researchers of this study to observe how role repertoires work out in the practice of science communicators, what challenges are experienced, and what participants indicated to see as needed role repertoires in the future. As such, axial coding was based on the theoretical framework as described in chapter 2.

3.3 ETHICAL CONSIDERATIONS

Prior to workshops and interviews, participants were asked to sign an informed consent for data sharing and long-term preservation of data. The informed consent form includes a section on the collection and storage of personal data in databases, a statement regarding the period of storage of data and possible use in future research. Participants were informed that they may request their data to be deleted. Participants at all times have the freedom to contact the researchers of this study for questions, concerns and remarks. No personal data or information was collected during this study, and as such no data that is confidential or sensitive will be revealed. The privacy of participants is protected by means of restricted access to the data. Lastly, all personalia are anonymised. These details are only known to the researchers of this project.

4. RESULTS

This section describes the various role repertoires that participants in this study expressed, particularly in relation to the perceived disconnect between science and society. Most of the time, the role repertoires displayed were already assumed by the participants prior to the reflective practice experiments. However, the reflective practice experiments prompted reorientations herein on a number of occasions – this will be mentioned when this is the case. Furthermore, we recall that we interviewed participants with different professions regarding science communication, such as communicating scientists, science journalists, communications advisors, etc. The participants assumed different roles when acting at the science-society interface. Sometimes their activities fitted predominantly within a specific category, but often overlapping activities were observed. We will first discuss our findings per role and then close this chapter by sharing overarching challenges.

4.1 SCIENCE COMMUNICATION PRACTITIONERS' ROLE REPERTOIRES

4.1.1 THE EDUCATOR

The role of the Educator is not necessarily about teaching, but also about giving the audience the tools to understand the scientific method and research. It also involves improving critical thinking skills, e.g., by helping audiences to become able in distinguishing reliable from non-reliable information (Milani *et al.*, 2021).

- Role

Several participants of this study assumed the role of the Educator. This holds particularly for communicating scientists and science journalists. Many of them focus on the transfer of knowledge, but also intended to convey the idea that *science is a process*, meaning that communicators were inclined to show that science is complex, occasionally messy (for instance, when scientists disagree) and moreover a human activity. Combatting misinformation and pseudo-science was often mentioned as an important motivation to this end. Several participants mentioned the importance of making the public familiar and comfortable with the complexity of the scientific process. While participants considered it valuable to communicate briefly and “sexy” about scientific topics, they often stressed the importance of embracing complexity, particularly in the context of combatting misinformation and pseudoscience. Rather than being (overly) brief, the need is felt to explain how the scientific method works, why it is sometimes so difficult to give a simple answer, and that it is this very trait that distinguishes science from opinion. Participant 3, who works in a laboratory in Poland, but also writes blogs, for instance notes that:

“My hypothesis is that in order to influence society and to increase trust in science and decrease confidence in pseudoscience, we must change our long-term strategy. By choosing quick, pleasant ways of scientific communication, we try to fight pseudoscience with weapons in which pseudoscience is a master. After all, this

pseudoscientific content is easy and fun, promises easy solutions, and gives quick, simple answers. In my opinion, using the same principles, we will not win against pseudoscience, because science and scientists are not specialists in this. Scientists are specialists in being a scientist. That is, they appreciate complex processes and the constant scientific response of ‘it depends’. I believe that it is from these qualities that we should make a strong weapon against pseudoscience”. – Participant 3

Several participants refer to the context of the Covid-19 pandemic, notably because the situation occasionally demonstrated dissent among scientists. How should citizens make sense hereof? Participant 1, an external relations advisor at the Swedish Research Council, observed:

“The pandemic has shown that people are being totally freaked out that the scientists have different opinions. So, the discussion that, before the pandemic, has been inside academia, now it's actually going on in the media. And people are totally freaked out. Why do scientists, why do they say different things? This is the scientific process, that you try something, you come to level, you find evidence for it, or you have to try it again and find new evidence. It's a discussing process that you're doing. And you try to find evidence, but sometimes to have to change. Because the evidence was not enough, and you have to start all off from the beginning again”. – Participant 19

Participants thus find it important to become aware of and feel comfortable with the complexity of the scientific process and accordingly, are able to grasp why scientists may disagree about issues relating to the Covid-19 crisis. Next, conveying an appropriate image of scientists was a recurring theme. Participant 1, a PhD student in the field of immunology for instance, pursues several science communication activities, such as displaying lab work in a local museum, hosting a radio show and also a pen pal for a young girl in the USA, and herein considered the importance of “humanizing scientists”. In a similar vein, participant 7, a lab researcher in Poland, organizes science meetings in pubs and recalled a talk of a vaccine expert (two weeks before the pandemic hit Poland): “he started, you know, in full suit, standing and showing off, and then he was talking more and more open, and he ended up without his jacket, sitting on the stage, on the same level of everyone else. For me, this is a good thing”.

- *Repertoires*

Looking at the repertoires of the participants that assumed the role of the Educator, we first find that the public is largely perceived as in need of information and education. Therefore, the activities of the Educators we interviewed are aimed at supplying knowledge and information as to address the perceived lack hereof. In terms of the perspective the participants have on society – and their audience – a spectrum can be observed. One end considers the public as being emotional and sometimes even ignorant. Participant 1 for instance, remarks:

“we all know, as science communicators there is just a lot of disinformation and misinformation going around. And people are very scared. [...]. I think as scientists, we try to find evidence, and we put that together and create a picture. And It's all about making sense of the world in a very logical way [...]. The real world is very emotional, complex. Science is robust and rational”. – Participant 1

From the perspective of RETHINK, we note that this particular view demarcates science from society in a problematic way and is likely to reinforce the disconnect between science and society. On the other hand, however, some participants consider society (and their audience) as being aware of important socio-scientific issues. Participant 12 for instance, refers to growing sensitivity towards climate change of the Serbian public. However, she also explicitly notes, that this can, at least in part, be ascribed to the fact that Serbian citizens are personally experiencing more and more environmental issues, such as air pollution, which triggered broader awareness. Looking at their activities and outputs, we see Educators make use of a plethora of communication such as: podcasts, using social media, writing blogs or science articles for newspapers or magazine, hosting a radio show exhibiting lab work in museums, and organizing science festivals. Participant 4 remarks the following about the available options to engage in science communication:

“you can use so many tools and your own skills nowadays. It’s amazing. You can have a podcast, you can moderate a conference. You can do your own radio show. You can go to television. You can have your own program over there. So, you have so many channels nowadays that it’s up to you what you choose and which way is the best for you”. – Participant 4

In spite of the available channels, we found that almost all of the Educators have a rather undefined and scattered image of their audience. Responses to questions about who their audience is, remain fairly general such as ‘young people’, ‘online readers’ or “people who are not anti-science” (Participant 15). In fact, many participants found it an important challenge to gain a better idea of their exact audience, as well as to find out what this audience needs or appreciates from the participant (see: 4.1.3).

4.1.2 THE BROKER

The role of the Broker can be defined as someone who creates connections between the target audience, scientists, and/or other organisations and actors, such as media, local authorities, charities, designers, artists, bloggers, and social media influencers (Milani *et al.*, 2021).

- Role

In comparison with the Educator, less participants of this study assumed the role of the broker. However, many participants expressed the importance of brokering and we found insightful examples of how some Brokers seek to establish meaningful connections between science and society. The focus of the Brokers primarily revolved around two themes. First of all, *helping scientists to communicate better* and secondly, *articulating and connecting and demand (from society) and supply (from science)*. Several communicators acted as mediators that sought to establish better links between scientists and citizens in a broad sense. Many Brokers strived to help scientists communicate better and reach a broader audience, through establishing connections with journalistic media and providing training. Participant 19, communications advisor external relations, in Sweden, for instance, mentioned: “I use my network among journalists, and

also among vloggers, bloggers, some associations that are potential beneficiaries of this research and make it possible for a scientist to tell his or her story”.

Additionally, most Brokers in this sample wanted to connect science to specific relevant parties in society that could practically benefit from the work of scientists. Participants refer to “connecting people within the ecosystem” and “forming alliances”. Connections are for instance sought with governments, companies and NGOs. Participant 13, a Serbian communications officer, actively aims to facilitate relevant Serbian ministries, local governments, companies (such as banks) and NGOs with the outcomes of scientific work on energy and environmental protection, for instance, through a news portal and magazine. Interestingly, this participant mentioned that her organization assumed her being a Broker, without this being assigned as formal role. And noted: “we are kind of like proud of that, because people call us. People tend to see us as kind of like, I don't know, point of connection, which we are not, we weren't established with this goal in mind”. Evidently, this reflexivity is highly relevant from the perspective of RETHINK.

- *Repertoire*

From the perspective of repertoires, a number of observations can be made. First of all, most Brokers thus perceive practical demands in society and the scientists they cooperate with can provide insights and knowledge that are valuable in this context. Participant 11, a science journalist from Serbia, remarked the following about this topic:

“We must know what is important for both sides: for scientists, for publicly (sic). And to know what are their opinions, what are their issues, what are their obligations. And I want to know how the public is reacting to something. We then can go to the scientists and say that there is a problem about that and maybe they are not informed. The scientists are in their researching and they don't maybe know the what are questions that people have”. – Participant 11

Another reason that was often mentioned, is that science should be held publicly accountable. The same science journalist noted:

“It is important, scientists are people who are paid public money in most cases, and they are working things that are for public good. And it is a thing that is ours, it isn't only for researchers who are in the laboratory in a small group, closed; it is for all of us”. – Participant 11

Furthermore, only two participants actively sought to gain insight into what the actual societal demand is. With regards to the public in its broadest sense, Participant 12, A Serbian science journalist offered the audience the opportunity to ask questions during livestreams with experts. Secondly, the aforementioned Participant 19, who helps scientists with grant writing and project development noted the following:

“What does it mean to produce knowledge? ‘You are part of this’, is really what we try to say. Join us, you are important. You are helping science. Greta Thunberg said: listen to the scientists. Now we come here and say we want to listen to you. We're trying to make this messaging coming and going. I hope that... I don't know if we've successful yet, but we're at least trying it”. – Participant 19

Lastly, an example of Participant 15, a Polish science journalist, is noteworthy to illustrate both misconceptions between science and society, and opportunities in this context:

“I went to a press conference organized about something current (...) organized by some professors from Polish Academy of Sciences. That's an institution that's just really not there, you know, for normal people, they're really closed off. But some point they organized something and in fact invited journalists, and actually quite a lot of journalists came to that because, you know, like they needed like television and radio news for some voice, some people talking. But they actually listened to them and were interested in that and at some point, when we were just kind of like sitting around, one of these professors just looked around and asked: are you actually interested in what we have to say? Could we actually do more of this?”. – Participant 15

Taking stock, several participants mention the importance of establishing connections between science and society; a role that is taken up by Brokers. Yet, only a few of them participate in Brokering activities and even fewer engage in activities that aim to gain insights into what society needs and wants and make sure this is fed into the scientific process.

4.1.3 THE LISTENER

Listeners try to understand audiences better and use skills such as active listening and empathy for this purpose. They try to find out what is important to their public, what is useful, and also how they live their lives, what's exciting to them, what problems they've got. Then, the listeners integrate what they learned about their audience in their communication activities. They also try to make the science topic relevant and relatable to the target public, by integrating the topic with the public's needs, daily activities or interests (Milani *et al.*, 2021).

- *Role*

In many instances, we observed roles and repertoires that were already assumed by the participants, prior to the reflective practice experiments. In the case of the Listener, however, we note that many participants did not (yet) assume this role and the reflective practice experiments enabled them to do so. In these, two categories could broadly be distinguished: first, experiments that enabled the participants to gain a better understanding of their audience, and second, experiments on conversational tactics that included openness and reflexivity.

Several participants mentioned to have gained a better understanding of the perspective and emotions of audiences, knew better how to adapt their science communication activities accordingly, and found new inspiration for activities or topics to explore in their future practice. Participants stressed to have learned to listen better, postpone their judgments about ‘the other’ and to become sensitive towards underlying values and emotions in order to find common ground. Two examples will be highlighted. First of all, participant 6, a postdoc in science communication, attended a science communication event with the intention to focus only on listening. He noted the following:

“I participated as an observer. [...] And I was like, well, this is one of the first times I’m hearing people. I’m not talking to them; I am hearing what they think. And it’s really enlightening. [...] And that was really an aha-moment for me, because I was like: OK, I’m listening to them and learning more about what they know and don’t know. And perhaps this is one of the fundamental steps of communication”. – Participant 6

Another participant, a communicating scientist active in the field of immunology, sent a questionnaire to the listeners of her radio show, aimed to better understand each listener’s point of view on science, coronavirus and vaccines. Additionally, she engaged in conversations with her sister, who worried the safety of vaccines and moreover how authorities dealt with the pandemic. In retrospective, she noted that:

“These conversations have been really challenging but have helped me to improve my patience in communicating divisive topics in science. It has taught me to not be too defensive and to listen to people’s points before responding. [...] It gave me a better insight into the types of myths that are being communicated to cynics. This has allowed me to adapt my own practice and to better understand what could appeal to those tricky audiences.”. – Participant 1

These two examples illustrate that assuming the role of Listener can take practically implemented through conducting a questionnaire or engaging in a conversation, but also can be seen as an attitude of science communicators, which prompts them to actively look for better understanding perspectives in society.

- *Repertoire*

Looking at the repertoires of the Listeners, the most important observation is that listening leads to new insights regarding the perception of the audience of communicators or even society in a broader sense. At the same time, listening may provide communicators with a mirror to reflect on one’s own activities, as well as one’s perception of science and science communication.

Some participants mentioned it is important to learn how to be more patient, listen to the other side without being judgmental, and try to understand the background that person comes from. This will allow them to better explain themselves while being respectful of others’ beliefs and experiences, being careful with what they bring and in providing evidence. For example, participant 15, a science journalist in Poland, remarked:

“(…) science journalists could use a lot less antagonism. We should force ourselves to be humbler and keep the perspective of ‘a normal person’.” Participant 16, a science communication advisor and trainer in the Netherlands, provided a good example of how listening led to better understanding and respecting a citizen journalist of a platform that is perceived highly critical and antagonistic in the Dutch debate on the Covid-19 pandemic. He remarked: “I learned that it’s not right to dismiss someone like her, but to listen to what she’s actually saying. Once you realize that scientists are occupied with the ‘cause’ of something and most people with the ‘reason’ for it, it becomes easier to understand the misunderstanding”. Assuming the role of the Listener thus prompts communicator to reevaluate the nature of science on the one hand and society on the other. However, it is noteworthy, that the participants in this study mostly employed listening to learn about how they can optimize their supplying activities, i.e. providing information and knowledge in a more tailored fashion. In this case, listening is not necessarily blurring the boundary between science and society, nor allowing knowledge to flow back to science in terms of co-production.¹ In terms of challenges, most participants felt feedback mechanisms for checking the science communicator’s assumptions about their audience were lacking. Additionally, time constraints were mentioned, as many communicators do not necessarily run into situations in which they can naturally assume the role of the Listener in their daily work practice.

4.1.4 THE ENABLER AND THE INCLUDER

For the RETHINK study conducted by Milani and colleagues (2021), communicators were interviewed that explicitly sought to reach underserved audiences and in their sample the roles of the Enabler and the Includer could easily be distinguished. The sample of this study is made up of a broader range of science communication practitioners in which this distinction is more difficult to make. Given the interrelatedness of the role of the Enabler and the Includer, they will be discussed under a single heading.

First, the role of the Includer can be described as follows. Includers break down the physical, social and cultural barriers that may prevent others from accessing resources, spaces, knowledge, and opportunities. They work to make science and research accessible, and especially inclusive (Milani *et al.*, 2021).

In our sample only two distinct examples of the Includer were visible. One aiming to strive for *open science* and another seeking to strive for *inclusiveness in (science) museum programming*. Participant 17, a community engagement officer in Sweden, is very passionate about opening up neurosciences and promotes research that is conducted under the FAIR principles, i.e. making data and research findable, accessible, interoperable and reusable. We will revisit her work under the role of the Enabler. Participant 21 and 22 work at a museum in the Netherlands and are engaged with programming and designing exhibitions. They intend to disclose science for all layers of society. Recently, they shifted their attention to the

¹ The activities of Participant 19 are a noteworthy exception in this regard, but these were discussed under the role of the Broker and will be revisited under the role of the Enabler as well.

programme surrounding an exhibition, rather than putting the exhibition as such at centre. In doing so, they aspire to create an open environment for dialogue. The plans for this were already made, but the collaboration with RETHINK aided in the reflecting hereon. They remarked the following about their struggles to achieve such an open environment:

“Ultimately, only few succeed in achieving this, our museum included...that it really is an open space, a safe space where people can express their opinion. We have this to some extent, but that there is a genuine dialogue, or that we are able to bring the insights further, that is not finished”. – Participant 21 & 22 (joint interview)

The role of the Includer is valuable in addressing the disconnect between science and society and could be observed in the activities in the participants in this study, albeit only by a small portion. We will now focus on the role of the Enabler, who works on enabling (underserved) audiences to participate in the public debate about science. Enablers do so in two ways: by providing the target group with information, resources, or spaces, or by changing the power dynamics between scientists and the audience (Milani *et al.*, 2021). So, while Includers aim to make science, research and science communication activities inclusive for underserved audiences, they do not necessarily empower or enable underserved audiences to participate in the public debate about science and research in the same way that Enablers do.

- *Role*

Enablers thus aim to go further than Includers in terms of empowering society to participate in science or the societal debate on science. Our sample provided three examples of participants that assumed this role and mostly already did so prior to the reflective practice experiments. All three of them seek to *enable citizens to engage with science*, either in terms of doing science, or by actively facilitating citizens to engage in the societal debate on socio-scientific issues. It is highly noteworthy that all of these participants are from Sweden. First of all, two participants engaged in organizing hands-on science-oriented activities for citizens. Participant 2 works as a senior consultant in a makerspace in Sweden. In this makerspace she enables citizens to engage in scientific activities and for instance, refers to recreating experiments about the crystallization of saliva using microscopes. Participant 17, already mentioned while discussing the role of the Includer above, is – next to promoting open science – involved in a mentorship programme for students to learn about coding. She mentioned the following about this programme:

“which is a mentorship program for students who get to spend their summer doing coding instead sowing sausages or something trivial. It started out and Google puts a lot of money into this, so they finance about 1000 stipends or something like that for student who works the summer on code. And what we do is that we supply the mentors. [...] That’s a program that puts a lot of new people, young people in open science and gives them something to show that they have done themselves”. – Participant 17

These two participants thus help citizens to engage in scientific activities themselves. Additionally, participant 19 helps scientists to write proposals that include meaningful science communication activities. In this context, she is experimenting with engaging young people in climate research by means of storytelling. She remarked the following about these activities.

“Let's start with seeing if we can use this creative force of storytelling and match it with climate research in an accessible way. So, this Climate Research Center, they are asking young people to say, what did you not do during the pandemic? Then we can show what climate effects that have. And then we ask them, what does your future look like? The stories they tell, we make patterns out of them, and tell about what that kind of impact would have. So, they can see if I want to travel around the world, well, that has consequences. But if I want to travel something once in a while and mainly work and have a good life where I live, that will have other consequences. Making it not too gloomy and hard, but still very realistic”. – Participant 19

The stories that are produced help the students to engage with the difficult topic of climate change, but are also important input for the research: “join us, you are important. You are helping science. Greta Thunberg said: listen to the scientists. Now we come here and say we want to listen to you”.

- *Repertoire*

Looking at the repertoires displayed by the Enablers, some interesting observations can be drawn, particularly in the context of the disconnect between science and society. Although the sample of the Enablers was only limited to three participants, they, in fact, displayed a lot of commonalities in terms of perspective on science and society and interaction patterns. First of all, they had a *humbler and sometimes even critical stance towards science*. Participant 2 for instance, was outspokenly critical about the lack of reflection among scientists and the pretense of science being omniscient and remarks. Rather she believes that science is something everyone can pursue. She provided the following quote about this stance:

“It's very simple what we do. Our way of working is a lot in performing questions, collective questions. And then we try to find some answers, if we don't have the answers. So, the important thing is about being explicit about what we know and being explicit what we don't know and what we should find information about. This idea of the fact that we don't know everything, that the scientists don't know everything, it's an ethical based point of view, that we think is really important. So asking questions is more important than finding answers.” – Participant 2

To illustrate the limits of science, she often referred to bias in research towards males, and seeks to balance out such gender bias by hosting activities that revisited studies by focusing on females. Similar to the promotion of coding skills, here we thus see the intention to *blur the boundaries* between science and society: there is nothing that prevents citizens to engage in scientific activity. About the use of microscopes, she for instance remarks: “we want people to be more comfortable in using a very simple technology like

the microscope that is almost the same as those 200 years ago”. Subsequently, together with attendees of the makerspace they compare their findings to published research. Furthermore, this participant learned about the notion of co-production of knowledge through the RETHINK experiment activities and actively tried to put this concept into practice whilst hosting a workshop on the aforementioned research on saliva. Indeed, as the storytelling activities on climate change also illustrate, the Enablers in this sample are appreciative of what members of society have to offer for science. From the perspective of RETHINK, we find both the activities conducted, as well as the perspective on science and society valuable in relation to the disconnect between science and society.

4.1.5 THE ENTERTAINER

Lastly, we consider the role of the Entertainer. The entertainers use games, arts, performances, hands-on activities and storytelling to entertain the audience. Through entertainment, they communicate about scientific topics without doing so explicitly. Digital outlets are particular suited for the entertainers’ activities (Milani *et al.*, 2021). A number of participants assumed the role of the Entertainer, often in conjunction with the role of the Educator.

- *Role*

In our sample, a number of participants displayed the role of the Entertainer. Entertainment around scientific topics is pursued as a means to an end or an end in itself or a combination of the two. Communication activities are employed for society to enjoy science, similar to how society enjoys art or music. Participant 23, a science journalist from Portugal, for instance notes, “Well, in a very poetic way I tried to bring the beauty of science to the common people. I try to engage that, I would say it's my purpose as a science journalist is to engage the public with science itself, with the beauty of it”. In other instances, entertainment is a vehicle to convey more serious messages as well. In this regard, the role of the Entertainer is combined with the role of the Educator, which enables communicators to convey the scientific process in an appealing way. The ability of communicators to shift between the two roles is nicely reflected in the following quote from a Dutch science journalist, who noted that: “your mission is then to either control power or just tell fun stories”.

- *Repertoire*

Looking at the repertoires of the Entertainers present in our sample, we can first observe that they used a variety of channels to bring the fun, such as: exhibiting lab work in local museum; organizing (science) festivals, acting as a radio or podcast host or participant, and writing science articles for blogs, science and technology magazines or general newspapers. Moreover, an important motivation for Entertainers is to bring society closer to science through entertaining activities. For instance, participant 11, a Serbian science journalist, wants to lower the bar for people to enjoy science and notes: “my goal is to inform people, to

bring them this enthusiasm and to everyone of listeners ask themselves what is important for them, what they want to know, what they want to explore. Someone can be a philosopher and scientist in their head". Particularly the latter remark indicates that Entertainers may try to invite society to step in the shoes of scientists, which can be understood as an attempt to blur the boundary between science and society in a creative manner.

4.2 IDENTIFYING OVERARCHING CHALLENGES

Taking stock from the results, we see that the six roles that RETHINK identified, and considers valuable in addressing the disconnect between science and society, could be observed in our sample. Most roles were already displayed by the participants prior to the reflective practice experiments. However, particularly the role of the Listener was enabled by the reflective practice experiments. Looking at the findings from the perspective of RETHINK, in search of strategies to overcome the disconnect between science and society, we identified three overarching challenges, which will be discussed below.

4.2.1 NEED TO STRENGTHEN ROLES THAT FACILITATE TWO-WAY COMMUNICATION

First of all, in order to overcome the disconnect between science and society, roles that engage in two-way (or multi-way) communication, i.e. the Broker, Enabler and Listener are important. However, these roles were demonstrated less than say, the role of the Educator. The reflective practice experiments did prompt several participants to experiment with the role of the Listener. Yet, we also observe that this role was often assumed by the communicator to explore how he or she could conduct better one-way communication (for instance, in the case of learning what radio or podcasts listeners like to hear). Accordingly, in such instances there is still little two-way interaction established. In terms of interaction patterns, there was fairly little blurring of science and society visible, nor were there many instances where insights and knowledge of society were feeding back into the scientific process. Two important remarks can be made at this point. First of all, several participants mention the importance of dialogue, public engagement and two-way communication with society, but are not putting this to practice. To quote participant 6 "it's true, most of it is like a one-way communication. So, there's not so much dialogue [...] but it could be something that could be improved in the future". Secondly, a small portion of the participants does not really see added value in two-way communication. This is problematic from the perspective of overcoming the disconnect between science and society. For example, RETHINK research on sensemaking demonstrated that citizens primarily make sense of socio-scientific issues on the basis of their personal situation or social context and only scarcely refer to actual science communication output. This entails that misunderstandings or disputes in public discussions on socio-scientific matters are often not necessarily the result of a lack of knowledge, but rather that different worldviews, emotions and values lay to the basis of differing perspectives on the relation between science and society (cf. Rerimassie *et al.* 2021). If science communicators do not engage more in forms of two-way communication, scientists and science communicators will remain unaware of such

worldviews, emotions and values, and continue to communicate on the basis of potentially wrongful assumptions. Accordingly, roles that facilitate such two-way communication ought to be strengthened.

4.2.2 UNDEFINED AUDIENCES

Furthermore, it became clear that many participants in our study do not really know their audiences. As discussed in 4.1.1, Educators for instance, had a scattered image of their audience. Responses to questions about who their audience is, remained very such as ‘young people’, ‘online readers’. Some participants, particularly those using radio or newspaper articles as communication channels, speak of ‘chance’ of reaching an audience. From the perspective of the disconnect between science and society, we note that if science communicators want to connect supply (from science communicators) and demand (from society), defining one’s audience is an important challenge.

4.2.3. UNPRODUCTIVE PERSPECTIVES OF SOCIETY

Lastly, some participants displayed unproductive perspectives of the public. On occasion, the public was perceived as being emotional and sometimes even ignorant, whilst science is perceived as rational and reliable. To quote one participant: it’s all about making sense of the world in a very logical way [...]. The real world is very emotional, complex. Science is robust and rational”. Such perspectives also have bearing on how science communicators think they can or should communicate with the public. Some participants believe the public is only able to grasp science if it is presented to them in an easily digestible way and relatedly, that the public is very susceptible to pseudoscientific content, but also fear the oversimplification of science. Such views of the public of demarcate science from society in a problematic way and disregard the aforementioned complex sensemaking practices of citizens. Upholding such negative views of the public is likely to reinforce the disconnect between science and society. At the same time, we recognize that science communicators make themselves vulnerable as well when engaging with public (cf. Roedema, Broerse & Kupper, 2021; Roedema *et al.*, 2021).

5. STRENGTHENING ROLES IN SCIENCE COMMUNICATION

The aim of this report is to explore how science communication can foster new connections between science and society and what roles are needed to achieve this. The participants in this study each seek to play their part in overcoming the disconnect between science and society. On the basis of this study we conclude that valuable activities are undertaken in this regard, but also important challenges need to be addressed in order to ultimately, a concerted effort is needed to overcome the disconnect between science and society. Generally speaking, we believe that all six roles displayed here are relevant and warrant cultivation. In addition, we propose two new roles that could act as a catalyst to facilitate desired change: the *Change Agent* and the *Playmaker*.

Specific challenges were discussed in the previous section: 1) strengthening roles that facilitate two-way communication, 2) gaining a more defined insight of one's audience, and 3) changing unproductive perspectives of society among science communicators. In order to address such challenges and moreover, strengthen the plethora of roles needed to overcome the disconnect between science and society, actions are to be taken. To this end, we propose three strategies which will also be discussed in this section.

5.1. INTRODUCING THE CHANGE AGENT AND THE PLAYMAKER

In order to address the disconnect of science and society, a lot of weight is put on scientists and science communicators. Given the magnitude of this disconnect we believe it is important to approach this challenge from a birds-eye-view and consider this as a *governance challenge*. In this light we ask ourselves: who has problem ownership of ensuring that supply and demand are met? How does what science communication offer relate to what is needed in society, and who monitors that this need is fulfilled, or seeks to promote change? Moreover, given the immense complexity of the contemporary science communication ecosystem and the magnitude of disconnect, we consider it unrealistic and unfair to demand from science communication practitioners alone that this challenge is addressed solely in a bottom-up fashion. Therefore, we propose two roles that can play an important catalysing role in this regard. They are first grounded in the results of this study, for we observed several valuable activities that could not easily be categorized in the existing framework. Secondly, they are inspired by lessons learned workshops that were held with our Rethinkerspaces. We do not have the pretence that they are sufficiently (conceptually) defined nor empirically substantiated. In spite hereof, we do believe that both roles – prematurely as they may be formulated – are valuable in addressing the disconnect between science and society.

- *The Change Agent*

First of all, the *Change Agent*: *actors who promote and practically facilitate a culture of science communication. For instance, by enabling scientists to engage in science communication and public engagement. Moreover, Change Agents critically assess the current supply the supply and demand of*

contemporary science communication, and seek to prompt other actors in the science communication ecosystem take notice and action if needed. Change Agents may play this role within their own organization, but may also act as public intellectuals in the public debate on the science-society interface.

In our sample, four participants assumed the role of the Change Agent. Two examples will be elaborated. First, participant 5, based in Italy, helps scientists to integrate science communication into their research plan when applying for research grants. She is highly critical of prevailing ideas among scientists connected to the deficit model and successfully enables scientists to shift from mere dissemination to more forms of two-way communication. As such, this participant particularly illustrates the duality of wanting to change a culture combined with practical facilitation. She notes: “so, we are trying to create a culture within the researcher milieu that is able to understand what it means, communication, the difference between communication and dissemination”. Another interesting example was provided by participant 20, who runs a small PR company for scientists in Poland. This participant remarks the following:

“First of all, I motivate scientists to open for the external audience. I invite them for workshops that are for free, then I explain them, what kind of benefits for their private and professional life they will get thanks to science communication. [...] I'm an advisor, so I'm always following the scientist. I'm advising. I'm protecting. I am explaining, because it is always strange for a scientist that is a rookie in this area, why a journalist behaves in such a way that is in general different than a way that scientists follow. Afterwards, I help scientists to understand if he or she attained the goal and how to measure it, how to understand the results, because they have really big needs to understand it was worth to invest time in such action. In science, in SciComm actions, results don't come easily and often they don't come quickly. – Participant 20

Interestingly, this participant is also particularly sensitive towards the vulnerable position a scientist may put him or herself in, as becomes clear in the notion of “protecting”. Other examples of participants that demonstrated traits of the Change Agent are participant 16 who gives workshops to help scientists in science communication and participant 9 helps scientists with communication via digital media.

- *The Playmaker*

Next, we introduce the Playmaker: *Playmakers assume problem ownership – or either have (implied) responsibility – about issues that arise at the science-society interface. They have an overview of both the supply and demand of the current landscape, and also have the means to facilitate change, i.e. promote science communication activities that are perceived as valuable. One may for instance, think of policymakers at governmental institutions or funding agencies, which for instance, facilitate change through devising funding schemes. From a policy sciences perspective, Playmakers can offer ‘the carrot’ to promote desired change.*

During the course of the REHINK project we ran into several examples of individuals or organizations that assume the role of the Playmaker. A good example hereof is provided by the Pilot Fund ‘Wetenschapscommunicatie door Wetenschappers Gewaardeerd’, a funding scheme of the Dutch Royal Academy of Sciences, whose project officers participate in the Dutch Rethinkerspace.² The scheme intends to structurally promote science communication activities of scientists and is particularly targeted at promoting two-way interactions and knowledge co-production. In our sample the role of the Playmaker was reflected clearly by participant 19, who acts as an external relations advisor at the Swedish Research Council. The participant is involved in promoting science communication through training and funding. Her motivation to do this becomes clear in the quote: “It’s not that you communicate, this is part of the research process. I mean, it’s not something that... you do your science or your research, and when it’s finished, you publish it, and you communicate it. You should do it as an integrated part in the process”. Within the council she is vocal about promoting science communication – particularly with regards to two-way communication and co-production activities – and is also witnessing increasing support. Positive experiences play an important role herein. On this topic she notes:

“They showed that the scientists really want to communicate much more than we ever thought. But what they lack is sort of support and training. Very few had actually had any training. But after they had the training, they felt much more prepared and sort of equipped to do science communication”. – Participant 19

In this light she was currently exploring to what extent science communication trainings and courses could be made “mandatory at a national level”.

5.2. STRATEGIES FOR STRENGTHENING ROLES IN SCIENCE COMMUNICATION

In this section we reflect on possible strategies to strengthen science communication roles on three levels. We remark that both Playmakers and Change Agents can play a valuable role in this regard.

- *Stimulate reflective practice in science communication*

Firstly, our results show that science communication practitioners individually experience challenges in connecting with their audiences through their deployed activities – and as such we see opportunities in strengthening the practitioner on an *individual level*. For example, practitioners mentioned they were aware of the importance to listen carefully to ‘the other’s’ perspective and including multiple perspectives in their science communication practices; yet in their actual practice participants did not always deploy such practices. To this end, especially the roles of Broker, Listener and Enabler were relevant in this regard. Yet, specifically *how to* adapt this practice so as to accommodate for the multitude of ways in which various

² See: <https://www.knaw.nl/nl/actueel/nieuws/meer-dan-negentig-teams-van-wetenschappers-gewaardeerd>.

audiences make sense of science was not (always) known by participants. This was also connected to the observation that participants often times designed small-scaled experiments that focused on ‘getting to know the audience’ – and as such mostly deployed The Listener in terms of role repertoire. With this, participants indicated they did not always had a lot of insights into the ways in which their audience made sense of the science communication output they engaged with. In this light, we argue that a reflective practice for science communication provides some solace for practitioners who try to navigate their way through the disconnect between science and society. This includes the adoption of openness and reflexivity in the practice of science communication. Openness is the willingness to seek out or thoughtfully engage with new information and other perspectives that potentially contradict your own views - whilst at the same time being able to postpone judgement and willing to potentially change your own perspectives and viewpoints. Reflexivity is being aware of and thinking critically about your own assumptions, perspectives, and ideas; and how this shapes your communication activities, influence what you communicate, and shape the interactions with your audience. In earlier RETHINK research we found that openness and reflexivity enabled practitioners to feel better equipped to connect to values and emotions present in audiences that engaged with science communication outputs (see: Roedema et al., 2021; Deliverable 2.4). Practicing openness and reflexivity enabled practitioners to untangle what perspective or assumptions they had towards their audiences, and how this influenced their science communication activities or interaction patterns. In other words, the concepts of openness and reflexivity provide science communication practitioners with the tools to better understand where ‘disconnects’ stem from.

- *Invest in learning networks*

Furthermore, we note that learning networks can play a valuable role in strengthening roles in science communication. To this end, inspiration can be drawn from the concept of the *community of practice*. When multiple stakeholders share a passion, interest or a sense of urgency to progress together – often with respect to a specific topic, *in casu* promoting meaningful science communication – and form a community around a shared domain of interest this is called a Community of Practice (CoP). Through mutual engagement and by working on challenges in their shared domain of interest, members of a CoP generate innovative and creative solutions, and new practices. Successful, CoPs are first, driven by intrinsically motivated members, stimulate the imagination of participants, that is they promote ‘out of the box’ thinking, thirdly, are flexible and continuously adapt their activities in relation to the context at the boundaries of the CoP, and lastly, develop collaborative relationships and mutual norms between its members (Fenollosa et al., 2019). Science communication organizations or associations, could play a valuable role in this regard. In the Netherlands for instance, the organization SciCommNL aspires to promote continuous learning and self-reflective dialogue. Change Agents and Playmakers can play an important role in this regard. Such learning networks could for instance, promote learning on what the perceived societal needs are and whether these needs are fulfilled. In addition, such networks could facilitate reflective practice.

- *Promote science communication through policy*

Lastly, we note that given the immense complexity of the dynamics in the contemporary science communication ecosystem, the challenges science communication practitioners face, and lastly, the magnitude of the disconnect between science and society, a concerted effort is needed. We cannot expect from science communication practitioners to come up with solutions solely from bottom-up. The challenge of the disconnect should be approached as a *governance challenge*, which also warrants attention from government and funding bodies, but also from academia, i.e. universities and academies. Policy makers in such institutions should assume responsibility of this problem, particularly as they have the means to facilitate directed change, i.e. assume the role of Playmaker. In this capacity, they should strive to promote openness and reflexivity, and moreover a reward and support system for science communication activities, particularly those that are targeted at promoting two-way communication between science and society.

6. CONCLUSION

This deliverable reported how a broad range of different science communicators experimented with different roles in science *communication*. The participants assumed a variety of roles when acting at the science-society interface. In order to overcome the disconnect between science and society, we emphasize the importance of roles that engage in two-way (or multi-way) communication, i.e., the *Broker*, *Enabler* and *Listener* are important, and particularly the role of the *Listener*, which was occasionally enabled by the reflective practice experiments. Furthermore, participants mentioned the importance of establishing connections between science and society. Yet, only a few participants apply these roles and even fewer engage in activities that aim to gain insights into what society needs and wants and enable this information to feed back into the scientific process. Furthermore, three overarching challenges can be identified that concern how the different roles in science communication were displayed by the participants: 1) the need to strengthen roles that facilitate two-way communication; 2) audiences are frequently undefined; and 3) there are unproductive perspectives of society.

On the basis of this study, we conclude that valuable science communication activities are undertaken to bridge/overcome the found disconnect between the sciences and society, and our results show that all six roles (*Educator*, *Broker*, *Listener*, *Includer*, *Enabler* and *Entertainer*) are relevant and warrant cultivation. However, based on the challenges we found, we conclude that a concerted effort is necessary. Therefore, in order to strengthen the plethora of roles needed to overcome the disconnect between science and society, we propose two new roles that operate on the level of governance i.e., the *Change Agent* ('actors who promote and practically facilitate a culture of science communication') and the *Playmaker* ('actors who assume problem ownership or either have (implied) responsibility about issues that arise at the science-society interface and also have the means to facilitate change'). Ultimately, we propose three strategies (stimulate reflective practice in science communication; invest in learning networks; promote science communication through policy) to strengthen science communication roles.

6.1. WHAT DOES THIS MEAN FOR RETHINK?

In the spirit of the newly defined role of the Change Agent, RETHINK will try to seek to strengthen the eight different roles we identified as valuable in the light of the disconnect between science and society. Following the three different levels discussed in section 5.2. we commit to promoting the following activities.

- *Stimulate reflective practice in science communication*

First of all, RETHINK aims to develop practical tools that help science communication practitioners to engage in reflective practice. RETHINK will make available a large variety of training resources via an online hub, including resources for reflective practice. We will for instance, optimize the reflection diaries that were

used by the participants of this study to promote openness and reflexivity, as well as develop workshops and suggestions for experimentation by science communicators.

- *Invest in learning networks*

Furthermore, we commit to contribute to learning networks in science communication. To this end, the seven Rethinkerspaces we established in seven countries are highly important. As the RETHINK project is coming to an end, together with the members of the Rethinkerspaces we will seek how we consolidate and expand these communities of practice, beyond the duration of the project. This is relevant for all Rethinkerspaces, but perhaps even more relevant for the Rethinkerspaces in Serbia and Poland, given the fact that the science communication communities there are young by comparison and therefore less networked as for instance in Sweden or the Netherlands. In addition, we will seek how to promote cross-country networks, for instance through our European Sounding Board.

- *Promote science communication through policy*

Lastly, a concerted effort is needed to address the immense challenge of the disconnect between science and society. The challenge is too big to expect from the science communication practitioners that they are the ones to come up with solutions. Accordingly, a concerted effort is needed and therefore we will address policy makers within government, funding bodies and academic institutions – both nationally and on a European level – to assume the role of Playmaker. We recommend to promote openness and reflexivity among science communicators, and moreover a reward and support system for science communication activities, particularly those that are targeted at promoting two-way communication between science and society. To this end, RETHINK partners in work package 5 will be organizing policy workshops aimed at developing guidelines and policy briefs on this subject matter.

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ANNEX I – RETHINKERSPACE VOLUNTEERS

| # | Profession | Job description | Country | Gender |
|----|-------------------------|-----------------------------------|---------|--------|
| 1 | Communicating scientist | PhD student | UK | F |
| 2 | Science communicator | Trainer workshops, R&D consultant | IT | F |
| 3 | Communicating scientist | Senior researcher | PL | F |
| 4 | Communicating scientist | Associate professor | PL | F |
| 5 | Communicating scientist | PhD student | IT | F |
| 6 | Communicating scientist | Post-doc | PT | F |
| 7 | Communicating scientist | PhD student | PL | M |
| 8 | Science journalist | Freelancer | PT | F |
| 9 | Science communicator | Digital content creator | UK | F |
| 10 | Science journalist | Freelancer | NL | M |
| 11 | Science journalist | Online magazine | SB | F |
| 12 | Science journalist | Freelancer | SB | F |
| 13 | Science journalist | Freelancer | SB | F |
| 14 | Science journalist | Freelancer | IT | M |
| 15 | Science journalist | Online magazine | PL | F |
| 16 | Science journalist | Freelancer | NL | M |
| 17 | Science communicator | Community engagement officer | SE | F |
| 18 | Science communicator | Senior advisor external relations | SE | F |
| 19 | Science communicator | Senior communications manager | SE | F |
| 20 | Science communicator | Public relations officer | PL | F |
| 21 | Science communicator | Museum | NL | M |
| 22 | Science communicator | Museum | NL | M |
| 23 | Science journalist | Magazine | PT | F |