Reaching Underserved Audiences:

How Science Communicators are Making New Connections Using Innovative Techniques
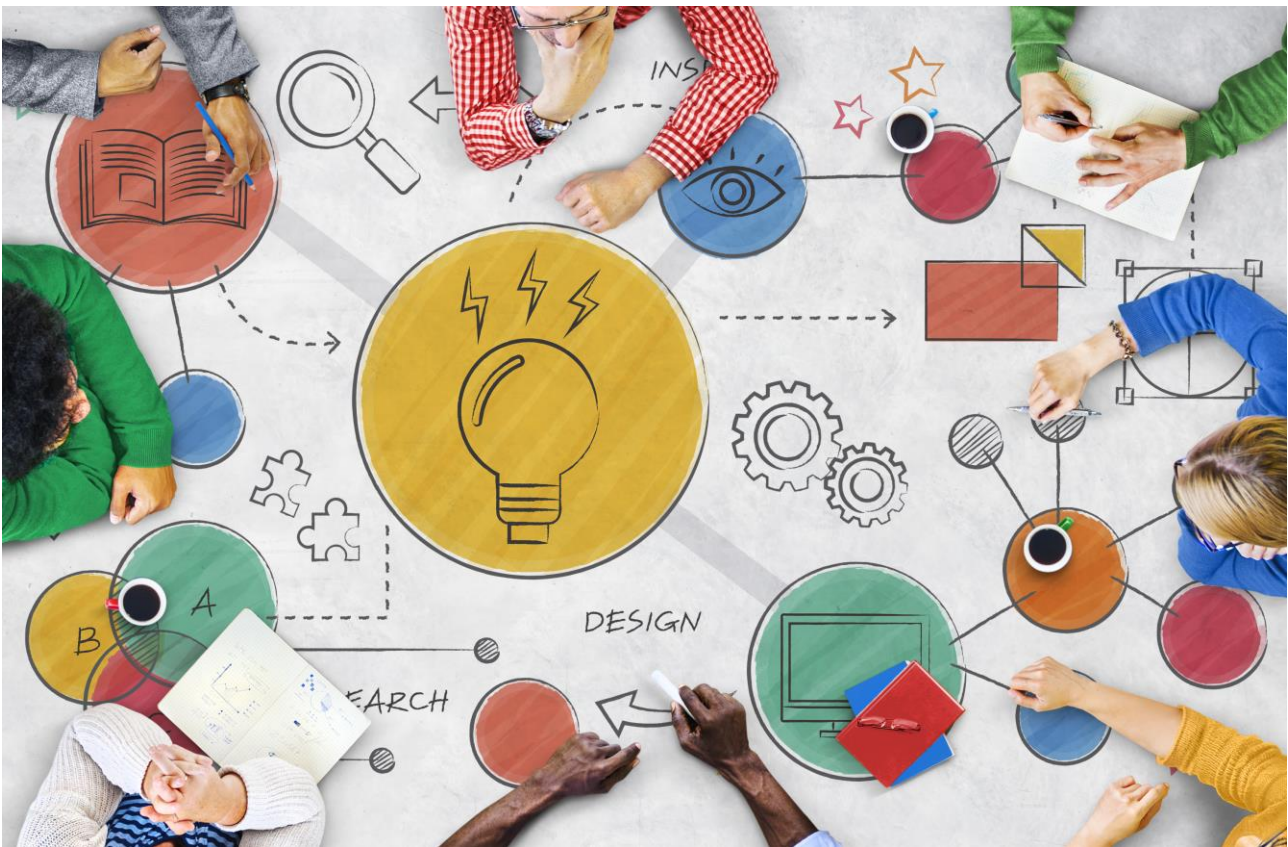

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Executive Summary

When science is communicated, the audiences are most typically white, affluent, with relatively high levels of formal education and a pre-existing interest in science (Kennedy, Jensen and Verbeke, 2017; Humm, Schrögel and Leßmöllmann, 2020). This means that access to and engagement with information about science is limited within groups who are underserved and/or disinterested in science. This represents a barrier to efforts to create closer connections between science and all members of society so that the future trajectory of science may be informed by citizens as well as the scientific community.

A survey of science communicators across Europe conducted within RETHINK showed that relatively few of those who communicate science (29%, n=465) seek to reach underserved audiences with their activities (Milani et al. 2020a). Only a very small proportion, just 1.5%, said that they aim their communication activities at those not already interested in science (Milani et al. 2020a). A much higher proportion, 74.4% described their audience as being a mix of those interested in science and those who are not.

The research presented in this report is the result of interviews conducted with 32 science communicators in Italy, the Netherlands, Poland, Portugal, Serbia, Sweden and the UK who had taken part in the earlier survey. They work as press officers, writers and journalists, researchers who communicate about their work, as well as organisers of public events. In many instances, these communicators, when completing the initial survey, had indicated that they sought to reach underserved audiences. The overall aim here was to explore the approaches these communicators used to reach underserved and disinterested audiences and characterise these as 'roles' that they adopt. By doing so, it is hoped that the techniques they employ and the successes they experience may inform the communication activities of others.

Interviewees described a wide range of audiences they considered or found harder to engage, such as those from certain socioeconomic backgrounds, older people, younger people, local communities, as well as those disinterested in science. They discussed how they had endeavoured to design and undertake their communication activities to engage specific groups not typically reached by science communication activities.

Many of the interviewees described how they sought to engage in dialogue before or during a communication activity to enable it to be better targeted at the existing interests of those in the target audiences. In some instances, interviewees had involved individuals or groups that represent a target audience in a communication activity to help shape what was being communicated. Others enlisted the help of influencers and opinion leaders with existing links to underserved audiences to help form connections.

Some communicators adopted innovative approaches to changing the dynamic between scientists and citizens, so that citizens felt empowered to engage with scientists. Many

described how they would go where their audience is, either geographically or in online spaces, to seek them out.

Through this research, we have been able to identify several innovative roles being adopted by some of today's science communicators that may help to foster connections with new audiences. These comprise the *includers* who seek to remove barriers with audiences, either physically by making events accessible or simply through the use of more relatable language. Whereas *listeners* seek to understand audiences better to cater for their existing interests.

Some of the communicators we spoke with sought to enable citizens to inform science by organising events at which citizens are given a platform to ask questions and provide their views, potentially influencing scientists' perspectives on their research.

The interviews we conducted provide an insight into the creativity that many science communication practitioners employ in their work when seeking to reach underserved or disinterested audiences. The successes they described may provide inspiration and encouragement to others in the field and a sense of optimism that meaningful connections can be created with diverse science publics. This is important in the field of science communication where there is still much to be done in relation to inclusivity.

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1. Introduction

1.1 The context for this research

Not all members of society are reached equally by science when it is communicated. 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 (Dawson, 2014a; Kennedy, Jensen and Verbeke, 2017; Humm, Schrögel and Leßmöllmann, 2020). While there has been a desire for social inclusion across the sciences and the arts, there has been a lack of clear tools to put this into place (Wilkinson and Weitkamp, 2016) and the problem has remained largely intractable. The importance of science communication in society is well documented and described, including its role in democratic decision making. "…many public policy decisions involve science, and these can only be democratic if they arise out of informed public debate…" (Durrant et al. 1989, p.11). In part, this role of science communication in democracy involves shaping the trajectories of future research so it is in keeping with societal goals and perspectives, Responsible Research and Innovation (RRI) in other words. But there are wider benefits, too. As Davies (2020) noted: "…sharing knowledge – and its attendant benefits – is the ethically correct thing to do, for aesthetic, practical, or economic reasons." (Davies, 2020, p. 13).

Given these functions of science communication in society, equality in access to and engagement with information about scientific research is of vital importance. While digitalization has transformed how science is communicated, potentially providing more equal access to information about science across society through the likes of blogs, vlogs and podcasts, there are large variations in the extent to which individuals engage with this material. At the same time, the proliferation of misinformation about science online has added a new dimension to the challenge of - providing equality in access to *reliable* information about science (Scheufele and Krause, 2019).

Taken together, these challenges may require those communicating science to develop new ways of connecting with audiences – to adopt new roles, a 'role' being a characterisation of the activities of an individual engaged in science communication that encapsulates several aspects of what they do (Pielke, 2007).

Research into the nature of science communication audiences is most established in informal science education. In the UK, visitors to science centres and museums tend to be white and middle class (Dawson, 2014) and it is a similar picture with science festivals (Kennedy, Jensen and Verbeke, 2018). In the latest Public Attitudes to Science (PAS) report in the UK, 88% of those educated to degree level or above compared with 38% with no qualifications had attended a science-related attraction or event in the past 12 months (Ipsos MORI, 2019). There is a similar pattern across Europe and the US (Dawson, 2014). Those who do not fall within a typical audience for science communication, , are often described as 'underserved' or 'marginalised' (Wilkinson and Weitkamp, 2016).

Online, many of those who engage in science communication do not seek out audiences who do not already have an interest in science. Interviews with high profile bloggers found them to be aiming at audiences with a shared personal interest in science (Bultitude and Ranger, 2014). Schäfer et al., (2018), who explored science consumption in Switzerland, described 'sciencephiles' who have the highest level of science education and who engage with science material online (and offline) to much a greater degree than the 'passive supporters'. The 'disengaged' rarely consume science-related content.

However, the internet appears to be a place where audiences who typically do not engage with science may encounter it. In a study of engagement with science communication among low income, minority ethnic groups, Dawson (2018) found the internet and TV were both places where participants encountered science. Though few participants actively sought out science through these media. Instead, their everyday practices around TV watching and going online sometimes "…overlapped with science content." (Dawson, 2018, p. 780). Similarly, Humm, Schrögel and Leßmöllmann (2020) found underserved German audiences most likely to encounter science on TV or online and Schäfer et al. (2018) found the same pattern with Swiss 'disengaged' audiences.

When exploring the causes of the disparities in engagement with communicated science between audiences, Humm, Schrögel and Leßmöllmann (2020) found 'material exclusion factors' such as a lack of local science events and a lack of money to visit places like science museums to be factors behind non-engagement. Language was also a barrier. As were 'emotional factors', including a fear and insecurity with engaging with unfamiliar places and subject matter as well as a self-perception of not having a connection with science. Dawson (2018) found her participants perceived traditional science communication and institutions such as museums "…as a form of 'high-brow' culture and, as a result, broadly unappealing and inaccessible for people like them…" (Dawson, 2018, p.779).

The challenges around inequalities in access to science are multifaceted and complex, hampering efforts to overcome them. The removal of entrance fees from some British museums increased the number of white, middle-class urban families attending, and the number of visits they made, rather than attracting new, more diverse visitors (Dawson, 2019). Poorly adapted communication can also result in an already marginalised audience feeling that they have been 'othered'; that they don't belong in a particular context (Dawson, 2014b).

There have also been attempts to diversify science audiences online. Kaul, Schrögel and Humm (2020) sought to find out whether content on environmental topics produced by YouTube influencers for #EarthOvershootDay by the WWF (World Wide Fund for Nature) Germany and the educational initiative MESH Collective would attract an audience of young viewers who would not typically engage with science. The results were mixed, with only one of the three videos produced reaching more viewers than the average views per video of the respective

channel. However, comments from viewers on the topic choice and presentation style were positive.

In a similar vein, Nisbet and Scheufele (2009) suggest 'opinion leaders' are recruited with pre-existing connections with members of hard-to-reach audiences and tasked with talking with family, friends and co-workers about science topics. These opinion leaders would serve as "connective communication tissue" (Nisbet and Scheufele, 2009, p.1776) between science organisations and specific audiences.

The approach of using influencers and opinion leaders with pre-existing connections with underserved audiences suggests a new role for those engaged in science communication – either to act as one of these mediators themselves, or to recruit and nurture them.

1.2 Research within RETHINK

Earlier research within RETHINK also provides useful context for this report by demonstrating the potential inequalities in access to information about science and opportunities to engage in dialogue with those involved in science among different members of society across Europe.

Only 29% (n=465) of those who communicate science and who completed an online survey as part of the RETHINK project in Italy, the Netherlands, Poland, Portugal, Serbia, Sweden and the UK stated that they targeted underserved audiences (Milani et al. 2020a). These individuals included journalists, scientists who engage in communication activities and museum staff who communicate using online and offline methods. There was a wide variation in the percentage who target underserved audiences between countries, with 43% looking to reach underserved audiences in the UK, 36% in Serbia while in Poland one respondent out of 29 aimed to reach underserved audiences.

It was a similar picture when, in the same survey, respondents were asked about their intended audiences for their communication activities in terms of their existing interest in science, technology or health. Only seven respondents out of 460, that's just 1.5%, said that they aim to reach audiences not already interested in these topics (Milani et al. 2020a). The majority of respondents, 74.4%, said some members of their audience are interested, and some not. The remaining respondents said all members of their audience have an interest in these topics.

Research within RETHINK has also demonstrated the challenges some science communicators face in forming connections with their audiences, even on online platforms such as social media (Milani et al. 2020a). As a member of the UK Rethinkerspace, a community of practice formed as part of the RETHINK project, put it, this makes it "…difficult to know what they [the audience] want." (Milani et al. 2020a, p.24). Rethinkerspace members described how it was difficult to create conversations with audiences online.

1.3 Working towards closer science-society connections

Given the connections that need to be forged with marginalised audiences to enable Responsible Research and Innovation (RRI) as well as the increasing volume of science communication that is taking place online, there is a need to consider how interactions between science and society may be improved.

The approach in this research is to explore techniques adopted by science communicators to make connections with their audiences, including those who are perceived to be marginalised or who do not have a pre-existing interest in science. To do this, interviews were conducted in 2020 with 32 science communicators in Italy, The Netherlands, Poland, Portugal, Serbia, Sweden and the UK. Those interviewed are engaged in a range of fields of science communication including working as journalists, being a blogger, or as a press or public engagement officer. Some focused on specific social media platforms such as Instagram..

The different working practices of those engaged in science communication as they seek to forge connections with their audiences are described here as distinct 'roles' (Pielke, 2007). Fahy and Nisbet (2011) sought to describe roles of science journalists by characterising their activities in terms of the nature of the articles they were writing, as journalists seek to find their place in today's competitive online media landscape. Similarly, Pielke (2007), interested in the science-policy interface, characterised roles that different scientists adopt by the nature of the information they provide to politicians and policy makers. Given that the focus of this research is on how science communicators forge connections with audiences, especially those who are underserved or disinterested, the roles are only partly defined by the nature of the material communicated. They are also defined by the practices adopted by communicators to make connections with their intended audience – how they reach them and enable some form of communication. In fact, it is these acts of reaching out that shape the communicators' roles in this context to a much greater extent.

Also within this report, we consider the repertoires of the science communicators. Here repertoires are defined as "...science communication actors' perspectives on the science-society relationship and a set of work-related activities that complement these." (Milani et al. 2020b, p.6). This draws on studies of 'knowledge brokers' that consider perspectives on knowledge production and use and the work-related activities appropriate to these perspectives (Gilbert and Mulkay, 1984; Turnhout et al., 2013). While science communicators may not explicitly articulate their perspectives on the science-society relationship, this can sometimes be inferred from the nature of the communication activities they undertake. Here Turnhout et al.'s (2013) characterisation of repertoires has been used as a framework to consider what the activities of science communicators who were interviewed imply about their perspectives on the relationship between science and society. These repertoires are:

Supplying: Here individuals supply knowledge or experts to knowledge users. There is some interaction between knowledge producers, such as scientists, and users so that the producers

know which questions to answer. But this is purely to enable them to provide the desired information. This implies a linear relationship between science and society with information flowing towards society.

Bridging: Here there is a greater interaction between knowledge producers and users and importantly, knowledge producers seek input from users to inform the knowledge production process. As with the supplying repertoire, there is a linear relationship and separation between science and society but the interaction between the two enables society to shape science.

Facilitating: This repertoire envisages an integration between knowledge production and use. Knowledge users are integral to the knowledge production process, rather than just being consulted on it, and all actors are considered to have relevant knowledge to offer. Here, science and society are integrated and not seen as distinct.

After developing a better understanding of the techniques used by science communicators to connect with their audiences, the next step within RETHINK is to test these approaches in small scale experiments. Ultimately, the aim is to develop tried and tested techniques that can be adopted by science communication practitioners across Europe to enhance their connections with a wider range of audiences, thereby contributing to closer and more equitable connections between science and society.

2. Methodology

The research presented here builds on earlier reports within the RETHINK project that considered the working practices of those who communicate science (Deliverable D1.2) and the connections communicators forge with their audiences (Deliverable D1.3). It sought to explore in more depth how communicators connect with their audiences, particularly those who are underserved or disinterested. These connections are then characterised as 'roles' that communicators adopt when reaching out to audiences. What these communication activities imply about communicators' perspectives on the science-society relationship are also considered.

The RETHINK team at UWE Bristol designed and conducted semi-structured interviews in 2020 with individuals engaged in science communication. An interview schedule was developed that addressed:
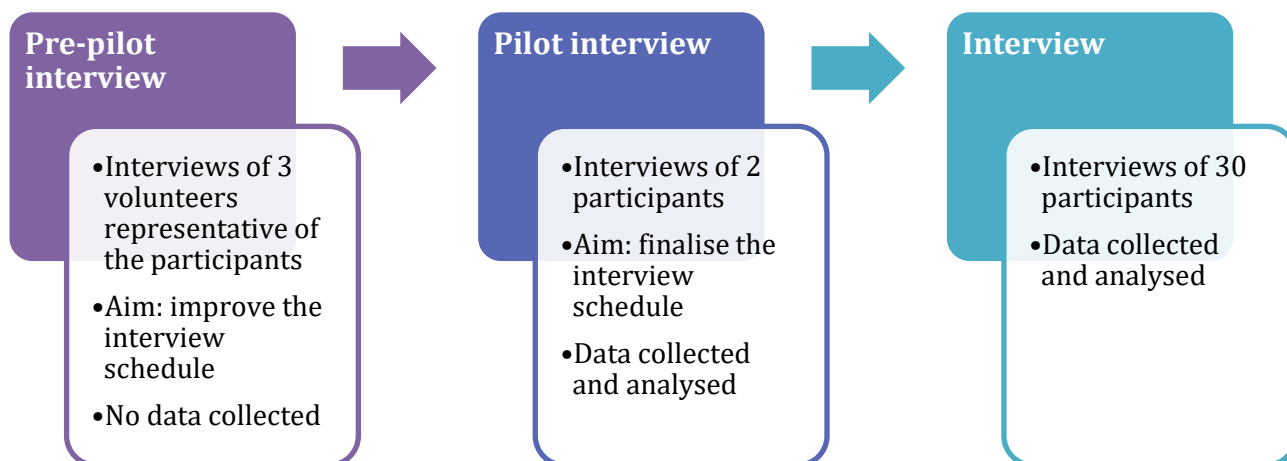
- Interviewees' job position (e.g. press officer)
- Audiences – who they try to reach, who they have not reached yet and why
- Challenges – what challenges and barriers to communication they face, what solutions they found to overcome these challenges
- Trust - how the interviewees seek to engender trust with their audiences, what challenges to building trust they face
- Guidance – further recommendations for breaking barriers and engendering trust

As Figure 1 shows, before conducting the interviews, the interview schedule (see Appendix A) was piloted to ensure its efficacy. Two interviewees participated in the pilot, one from Belgium and one from Italy; their answers were also included in the analysis. Once the schedule was confirmed, 30 participants were interviewed from Italy (n=3), the Netherlands (n=5), Poland (n=4), Portugal (n=5), Serbia (n=4), Sweden (n=5), and the UK (n=4) from June to September 2020. The interviews were conducted either via Microsoft Teams or Skype and lasted 30-40 minutes on average. The interviews were transcribed by the researcher who conducted the interviews and a professional transcriber at UWE Bristol.

This study received ethical approval from UWE Bristol.

Figure 1 Interview testing and piloting process.

The participants were selected from the respondents to a previous survey conducted for previous RETHINK reports, deliverables D1.2 and D1.3 in 2019. Interviewees were selected from those who included their contact details in the questionnaire and indicated they would be happy to be interviewed. For each country, participants were selected if their communication aims (e.g.. inform, educate, debunk) reflected the top five aims of their country (see Table 1), so they would be broadly representative of the communication intentions within their country. They were also selected if they claimed to reach underserved audiences. Given that only 29% of those who completed our survey indicated that they target underserved audiences (Milani et al 2020a), those who do and were interviewed here could be considered pioneers in the field.

The interview participants were also selected for a balance of gender, the type of organisation they worked for, their profession, and when possible, their age.

Table 1 Top five communicative aims pursued by the survey respondents for each country

	Italy	Netherlands	Poland	Portugal	Serbia	Sweden	United Kingdom
1	Inform	Inform	Educate	Inform	Inform	Inform	Inform
2	Counter	Entertain	Counter	Educate	Educate	Educate	Educate
3	Create	Create	Create	Counter	Inspire	Create	Create
4	Educate	Promote	Inform	Encourage	Encourage	Encourage	Encourage
5	Encourage	Counter	Encourage	Create	Create	Counter	Counter

Table 2 shows how many participants were contacted and interviewed for each country. The team aimed to interview four participants from each country, though for three countries (the Netherlands, Portugal and Sweden) five participants were willing to contribute to the study. One participant from Belgium was interviewed as part of the piloting.

Table 2 Number of participants contacted for the interview and interviewed for each country.

	Contacted	Interviewed
Italy	5	4
Netherlands	6	5
Poland	7	4
Portugal	8	5
Serbia	9	4
Sweden	10	5
United Kingdom	13	4
Belgium	1	1
Total	58	32

The team developed a codebook to allow a qualitative analysis of the transcribed interviews. These codes included the audiences communicators were seeking to reach, their communication strategies, how they build trust and the enablers and barriers to communication. The codes also sought to explore the roles and repertoires of the communicators. This codebook allowed the researchers to code the interviews consistently and rigorously. As shown in Figure 2, the initial codebook was developed to include new roles that emerged from a preliminary analysis of three interviews. Once the codebook was finalised, all the interviews were coded. Three members of the UWE Bristol team were involved in the coding of the interview transcriptions.

Figure 2 Process of the codebook development and application for analysis.

Development of the codebook

To code roles, action repertories and audiences discussed in the interviews

Testing of the codebook

Preliminary analysis of 3 interviews to test the codebook and find new potential codes

Team discussion

Discussion of the validity of the initial codes and new ones. Improvement of the codebook

Finalisation of the codebook

Polishing the final codebook

Coding

Application of the codebook to code the interviews

Analysis

Analysis of the codes to find common roles, repertoires and strategies to reach audiences
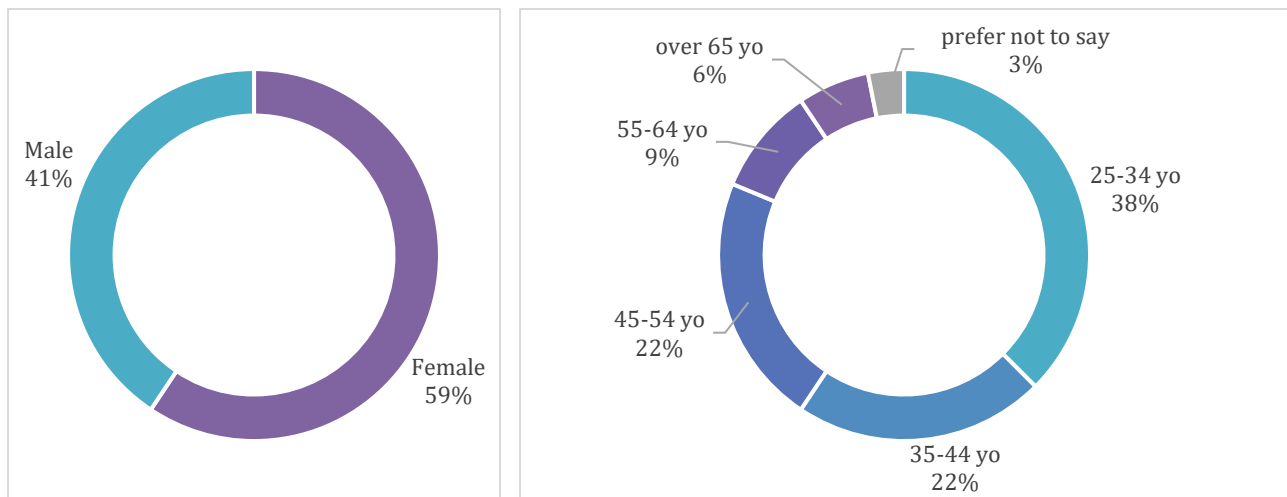
3. Results

3.1 Description of the interviewees

We interviewed 32 participants from eight different countries; 19 were female and 13 were male. Around a third of the interviewees were 25 to 34 years old (12 out of 32), seven were 35 to 44 years old and seven 45 to 54 years old. Only five interviewees were older than 55 years old and none of them were younger than 25 years old. Information about gender and age was not gathered during the interview - it was taken from the corresponding survey responses. Figure 3 shows the gender and age distribution within the sample.

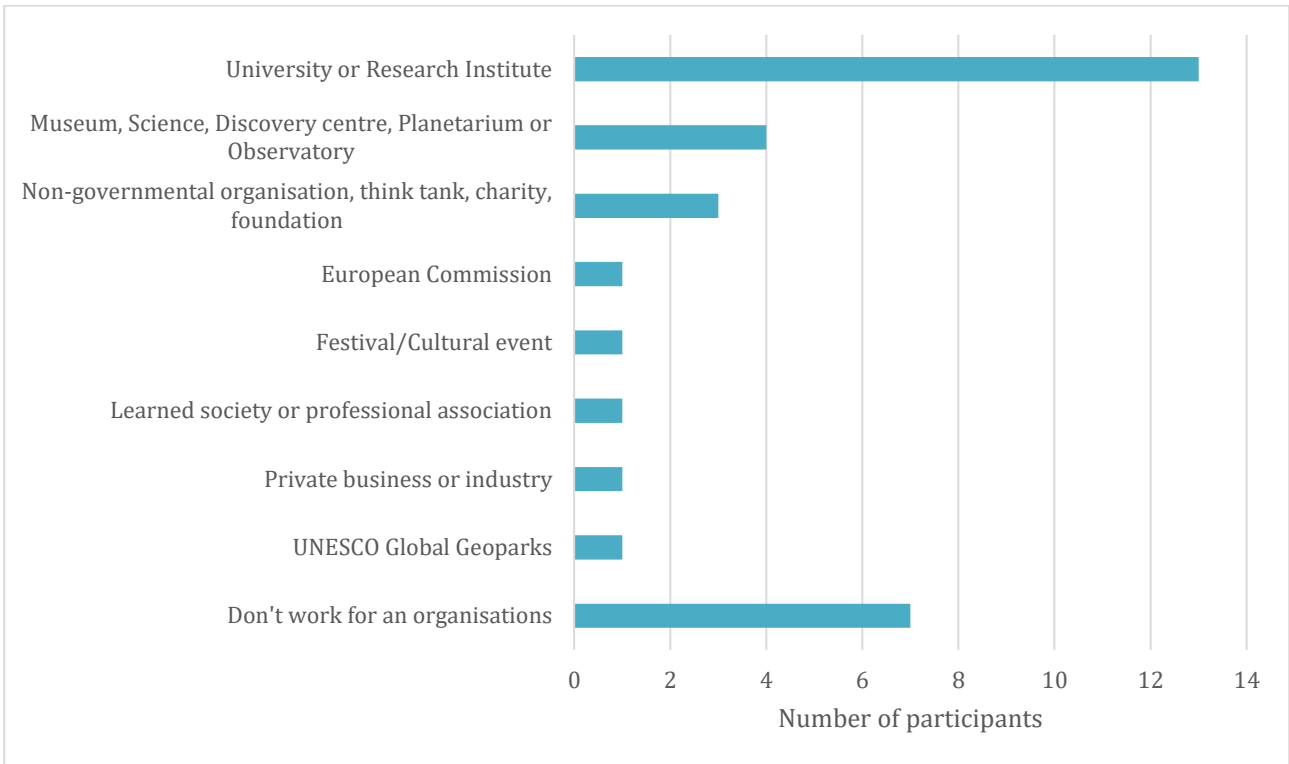*Figure 3 Gender and age range distribution within the interviewee sample.*

Most of the interviewees worked for an organisation (78%, n=25), while seven interviewees did not work for any institutions. Thirteen worked for a university or research centre, four for a museum or science centre, three for non-profit organisations, and the other interviewees for various institutions (see Figure 4).

Figure 4 Type of organisations where interviewees work.

The participants we interviewed have different professional positions, such as researchers, freelance communicators, journalists, press officers or curators for museums and planetariums. The interviewees indicated the nature of their employment when completing the survey they had participated in in 2019 (see Derivables 1.2 and 1.3). In a number of cases, they also had more than one job; for example, some researchers also worked as freelance communicators, and three bloggers or social media influencers also worked as journalists. Other interviewees described what they do as project manager, public engagement or outreach officer, science popularisers and spokespersons for their organisation. Figure 5 shows all the work activities of the interviewees.

Figure 5 Professional positions of the interviewees

The figure shows the professional identities of the interviewees. Interviewees indicated what professional identities best described their job(s) when they completed the survey and these have been used in this report. In the survey, they could choose more than one job.

The characteristics of the individual interviewees (country, gender, professional identities and organisations) are provided in Appendix B.

3.2 Underserved audiences and those not interested in science

When we analysed the transcripts of the interviews, we identified several types of publics that the interviewees targeted. In this report, we focussed especially on those audiences the interviewees considered or found hard-to-reach, such as underserved publics, local and rural communities, individuals not interested in science topics, older people, and young people. These five audiences were discussed by most interviewees. A smaller number of interviewees said they also found it challenging to reach policy makers, entrepreneurs and patient groups. But since we did not have many insights about these groups provided by the interviewees they are not discussed in this report. Science sceptics and science deniers were also mentioned as challenging individuals to communicate with, but they were not a focus for the interviewees' communication activities. For this reason, they are not included in the report, given its focus on effective techniques for reaching specific audiences.

Below, we provided a definition of each public based on the interviewees' responses and descriptions.

Underserved audiences

Here we use the term underserved audiences to include social groups that might be in a marginalised situation for social, economic or cultural reasons and are not commonly reached by science communication activities. Within this research, audiences were considered to be underserved if participants defined them in this way.

Interviewees described how they reached underserved audiences which they defined in many different ways: individuals from poorer socioeconomic backgrounds, ethnic minorities, individuals with physical and learning disabilities and members of LGTBQ+ communities. A few interviewees also reached individuals with limited formal education, pupils at schools where many children come from less privileged socioeconomic backgrounds, or students who do not come from a family of graduates and would be considered 'first generation' to study at university.. Interviewee 19 mentioned some common barriers that prevent some of these groups from participating in science communication events:

"There's a whole host of reasons why somebody might not come to an event. It could be they don't have the money, they don't have the travel, maybe the venue isn't accessible and maybe they're not able bodied so they can't get into the venue. Maybe they just don't see the information, like the material… the advertising material we're putting out there, or it just doesn't appeal." **Interviewee 19** (UK, Female)

Other interviewees also mentioned members of immigrant communities who might not speak or read the language of the country in which they now live fluently. For example, Interviewee 5

discuss reaching an immigrant community originally from Africa, whose members were predominantly older people.

When talking about underserved groups, some interviewees mentioned that some members of these audiences are not interested in science, especially if they have limited formal education. Other interviewees discussed, instead, how a lack of inclusivity in some university, museum and science communication programmes hinders these audiences from engaging in science. Interviewees also mentioned how underserved audiences may not be aware of some science communication activities or programmes, especially if these activities are not specifically designed for them.

Local and rural communities

Those in rural communities sometimes shared characteristics with underserved audiences, such as having a lower socioeconomic background. However, they are considered as a distinct group in this report as they have defined geographical boundaries and geographical barriers and so may face specific challenges associated to this. In the interviews, rural groups were often defined as not being connected to cities, universities and other aspects of urban life. As Interviewee 3 said:

"*I think it's still much easier to access people in cities and who already have access to different spaces or public transport. And so there's a lot of work I still need to do in accessing rural groups and people who are less connected to the rest of… well, to universities, to hospitals, to other infrastructure.*"
Interviewee 3 (UK, Female)

Local communities were not necessarily rural, but they were often described as groups strongly defined by their geographical boundaries. Specifically, they were described as people close geographically to those doing the science communication.

Those uninterested in science

Interviewees often mentioned that individuals who are not interested in science are difficult to reach, and that they may be older people, young people, or also belong to underserved groups. Even so, those who are uninterested in science topics are considered as a distinct group in this report, defined by their attitude towards science and research. This group also includes parents who do not engage in science even though they may take their children to science outreach activities. Among those not interested in science, Interviewee 9 described highly-educated individuals who are interested in art, culture and music but who have a negative perception of science. In his country, Italy, these circles are influential and formed by individuals who are

highly educated in law, humanities or arts, but perceive science as "for people that are slaves to the system". He also said:

"I think that engaging in that part of society would be very, very important and at the moment I don't know if we have the tools - social tools or technological tools, or institutional tools, to engage with them."
Interviewee 9 (Italy, Male)

Interviewees mentioned several reasons behind the disinterest in science among potential audiences, such as stereotypical perspectives about specific subjects being too difficult or boring (e.g. maths) and refusal to learn (e.g. I already know what I need). Some stereotypes around scientific subjects can be cultural. For example, both in Italy and Portugal those that are good at the arts in school often believe they cannot learn about maths or science in general. As Interviewee 5 said:

"In school there are people from arts, there are people from science. So I'm from arts. I don't know anything about it [science]. So most of the barriers I see are related with this, with like preconceptions."
Interviewee 5 (Portugal, Female)

Interviewee 10 found that this audience sometimes give up easily when they try to learn something, which means that they may disengage early during a communication activity. Interviewee 10 described this problem as follow:

"I think what tortures [these audiences] is a low self-esteem. So they... they give up pretty quickly when they try to understand something and they don't... and they... and they can't. And they... and maybe it's related to that, but they also mistrust or distrust a lot of authorities."
Interviewee 10 (Netherlands, Male)

Older people

Several interviewees defined as older people those individuals who are older than 65 years. Those reaching this audience stated that they may be difficult to engage because some members of this age group might be less interested in science than in other subjects or might not see why it is relevant to them. Interviewees appeared to have some quite strong perceptions around the interests of older people. Interviewee 5 said older people might prefer other topics, like history because they might "see it like in an entertaining way. Almost like seeing a movie." Interviewees also found that this audience is sometimes reluctant to learn as they might believe that they are too old to learn something new. As Interviewee 18 said: "they are not as ready to learn everything new as the 10 years old or the 15 years old." Interviewee 31 found their reluctance to learn something different often presented the biggest barrier:

"...they [older people] don't care. First, because this kind of audience doesn't like new things. They are used to having their lives for the last 90 years more or less the same way without so many new things. So when something new comes, they are always like, no, I don't want that."
Interviewee 31 (Portugal, Female)

Another issue identified by interviewees was how to make science relevant to older people and show how it can be useful to them. This is not always possible, though a few interviewees were able to address this barrier by communicating about technology (such as how to use video call platforms).

Interviewees said that older people are often excluded by science communication programmes because of their age. However, Interviewee 5 remarked:

"...people are getting older. So the average number of years that you live is getting high. So you have a lot of people I would say from 65 to 80 that have a lot of time, and I think they would really enjoy interacting with this type of activities."
Interviewee 5 (Portugal, Female)

Given that typical audiences for science communication are often perceived to be white, affluent, and with a relatively high level of formal education (Dawson, 2014a; Kennedy, Jensen and Verbeke, 2017; Humm, Schrögel and Leßmöllmann, 2020), and that some science communication activities, such as café scientifiques and citizen science, tend to have audiences who have more time to be involved or volunteer, such as retired people (Wilkinson and Weitkamp, 2016), it is perhaps surprising to see older people included here.

Young people

Despite many science communication activities targeting young people, this group was also seen to have its challenges. This group includes children as well as young adults who are under 25 years old. Interviewees often mentioned the importance of engaging with this group, since they will be the 'readers of tomorrow', for example in the context of a newspaper, as well as the members of the workforce. Therefore, according to interviewees it is important to give young people the tools to form their opinions and understand issues such as climate change or health. Interviewee 4, for example, said he is interested in targeting this audience because they "are not really aware of the conditions in workplaces." On a similar note, Interviewee 32 discussed the importance of targeting young people while they are forming their opinions on climate change and sustainability, because when they become members of the workforce they could push for different environmental policies in the country.

Interviewees said that young people are difficult to reach for several reasons. Some interviewees mentioned this audience is often disinterested in learning about scientific topics; others said that this disinterest emerges when the science communication activity resembles a

school lesson. Some interviewees mentioned that young people seek information on different social media channels than those consulted by adults and use them in a different way. Interviewee 8, for example, said that young people often have a short attention span in terms of online content. They might "dedicate very short time, I mean, sometimes a few minutes to understand what you are talking about." Interviewee 1 said that young people learn by doing, they learn on the go, and they learn and look for information in a different way to adults, especially online. Therefore, just being on social media is not enough to reach young people. She further claimed:

"And nobody is taking care of the youngest [audiences]. You know, we organise a lot of things in the schools, in the museums and so on, but nothing on the Internet. The internet is still something for the adults."
Interviewee 1 (Italy, Female)

3.3 Strategies to reach underserved and disinterested audiences

During the interviews, interviewees described the strategies they use to reach the groups described in the previous section. Here, we summarise these strategies and suggestions for each audience. However, some of these strategies are similar across different audiences.

Reaching underserved audiences

Interviewees reaching underserved audiences said that the first step of their communication is to get to know the group they are communicating with, and they stressed the importance of **not making assumptions** about the target group's needs. If the communicator is not a member of the target group, they should never assume what the group needs or what barriers they face. Rather, the communicator should **work with the target group** whenever possible to develop communication activities.

Interviewee 5's experience is an example of how to involve underserved groups in communication design. She reached out to a local community of older immigrants living in a disadvantaged area. The interviewee first talked to them to **understand what scientific subjects or topics could be interesting to them**, though "it was not easy because they actually didn't even know what scientific subjects are." During the conversation, she found out that her audience had "memories from Africa" and wanted to talk about memories; hence, she linked the topic of memories to neuroscience. She then asked a neuroscientist to work with her "on this topic to explain stuff about the brain" and brought the audience to a museum "because the museum is like an archive of memories". Therefore, Interviewee 5's strategy was to understand her audience and find a scientific topic that could be relevant for them.

Some interviewees also involve the equity and diversity group of the organisation they work for in the design of communication campaigns. Others recommend having members representative of the targeted group as part of the board committee of the project. Among the various strategies to reach underserved groups, the most common was to **consult or partner with organisations or community groups that already work with that audience**. Collaborating with these organisations helps facilitate understanding of the audiences' issues more deeply and allows you to find out what they may find interesting and engaging. Interviewee 3 gave an example of this strategy:

"… before working with those audiences [groups of different ethnicities] I would make sure I was working with one of their community groups first. So we had a community group that worked with Asian boys, who were teenage and having trouble with school, so that community group helped me know that audience better."
Interviewee 3 (UK, Female)

Partnering with organisations such as charities and community groups can also help reach audiences. Working with different media can help reach audiences outside of the usual circles, such as underserved groups. For example, Interviewee 16 **looks for magazines that target underserved audiences** and pitches science articles to them.

Interviewees not only consulted these organisations, but also **involved partners in the communication**. For example, Interviewee 19 partnered with her local Pride festival to promote her event to the local LGBTQ+ community:

"They jointly advertised it with us and then basically all the science speakers were people who identified as LGBTQ. And we kind of promoted the visibility of LGBTQ people in science via our A Pint of Science event."
Interviewee 19 (UK, Female)

Interviewee 3 suggested that sometimes it is better to **help the organisation or community group working with an underserved audience**, in the case of her work black and minority ethnic groups, rather than reaching them herself. In this case, she provided assistance and resources to the community group:

"For the black and minority ethnic groups again, it's not that they're hard to reach, it's just that I don't think I'm the right person necessarily to be doing it. So I… what I want to do now is not to reach them directly myself, I want to help the community groups already working in that space to have access to the resources I have available to me, like scientists and science stories."
Interviewee 3 (UK, Female)

Interviewees mentioned that **finding the right mediator** is also a good strategy to reach underserved groups. This mediator can be a community leader or a social assistant, someone who knows the target group and is trusted by its members. Interviewee 5 reached out to a community of immigrants thanks to a social service assistant; when she talked to her about her

project "she [the social service assistant] saw the benefits of this interaction" and "went to them [the community]. So when I went to them they were already with the door half open." Mediators and partner organisations already have a relationship of trust with the target group. Therefore, engaging with these parties first engenders trust with the group and helps create a conversation.

When starting a conversation with an underserved group, interviewees suggested **looking for a common ground** with them, finding something in common. This could be "something that we all have in common like barriers to work experience say, or not feeling included in science spaces", as Interviewee 3 said. Or as Interviewee 6 said, you can often find something in common with a member of a specific group. She provided a hypothetical example of seeking to find common ground with a three-year-old boy to help start a conversation, and how that might be a shared enjoyment of blueberries.

Reaching out and accessing an underserved audience is the first step in communication identified amongst our interviewees. As mentioned earlier, involving the audience or partner organisations in communication design increases the chances of success. There are other strategies that can make communication with these audiences effective. For example, interviewees stressed the importance of **creating an environment that is inclusive and welcoming** for the target group. Interviewee 19 did this by inviting a diverse panel of speakers at the public talks she organised. Hence, she included speakers that were scientists and members of the LGTBQ+ and ethnic minority communities. She said:

"I think generally the science communication community need to make sure that [making events inclusive] that's something that's at the top of the list when you're choosing speakers. Making sure that you've got a diverse panel of people there. That you're representing as many different groups and backgrounds as you can because if… yeah, if it becomes exclusionary at that point, even if you are one of those minorities who go to that talk, like I said, if you see… if you don't see anyone like you there or anyone that could be like you, it excludes you and makes you feel like you can't be in their shoes."
Interviewee 19 (UK, Female)

Interviewee 5 also tried to create an inclusive and accessible environment for the underserved group she sought to reach. Her target group consisted of older individuals who also had issues with literacy, and felt certain topics or environments (e.g. museums, research laboratories) were not for them. Since she wanted to give them "access to knowledge", she had first to break the barriers:

"I think that the most important thing for that project was to break the fear almost, of this is not for me. I don't know what you're talking about. I'm not in school so I don't know what you're talking about. So on that one I felt… most of the project our job was breaking the… breaking the barriers. So that when you visit a laboratory you explain things around so they feel the atmosphere and feel that there's nothing wrong with them being there. We went to the

museum. They've never been inside a museum, so they didn't know that they could actually go in because 'we don't know anything about art, so we thought we could not get in'. So the purpose was more to... to make them feel comfortable to talk about things that they don't know about, because of obviously people have some... it's complex for them because they feel that they don't know anything."
Interviewee 5 (Portugal, Female)

While some interviewees focused on giving access to knowledge or making environments and events inclusive, other interviewees focused on **empowering underserved audiences**. For example, Interviewee 23 organised a game that made school students from less privileged socioeconomic backgrounds feel more comfortable in the presence of a scientist. She put the students in a position of power by putting the scientists (trained beforehand) on the spot:

"Scientists had to present a project to the students and the students play the role of millionaires that had a million pounds and they had to decide which projects to fund. And that might seem really silly, but by giving the students a role and a million pounds the questions that we got on those sessions were so clever. Because the children were really saying look, I've got a million pounds. Not really, but like, you know. You need to prove to me that you're worth it, so I'm going to ask you this question that I really want to know because I don't understand it."
Interviewee 23 (UK, Female)

Reaching local and rural communities

Interviewees reaching both local and rural communities often recommend **physically going there**. One structure that is already in place to do so and was often mentioned by the interviewees is **European Researchers' Night**. This event is organised in several European cities at the same time and lasts for one to three nights. Scientists and science communicators can present their work at this event and reach out to a diverse local audience.

Some interviewees also **collaborate with local festivals**. Interviewee 6, is often invited to speak at festivals, talks and activities organised by local communities. Interviewee 7 and the organisation he works for are also regular guests at local science festivals. Interviewee 9 takes a more active role in finding opportunities to engage with local communities, by contacting local associations:

"So I go out for example to reach festivals on the territory[1]. Maybe not scientific but cultural. Also link to, for example, in Italy, we have a lot of sagre[2], and festivals of food, of local history. I try to reach the organisers of that kind of event, to give, to engage in conversations with them, to organise some part of scientific popularisation inside their events. So to reach people that would

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[1] In this quote, 'territory' means in the region, in the local area.
[2] Small food festivals often organised by the local parish or local community.

Several interviewees working with local and rural communities also **engage with local authorities**. For example, the local municipality helps Interviewee 25 and the organisation she works for to recruit interviewees for their citizen assemblies. Interviewee 14 also said that her organisation involved the local municipality in the project. She said that working with the municipality makes it more likely that a project will be developed that satisfies or is aligned with the local community's needs. When Interviewee 22 started his science communication project, he first contacted the local municipality and province and received their support: "they think it's great that we're starting it here, so that was a surprise to me that local authorities are really open to welcome such a project".

Another strategy to reach local and rural communities is to **work with local media**, such as radio programmes and newspapers. For example, Interviewee 22 collaborates with regional newspapers and broadcasting agencies to advertise his public events. This collaboration helps him to reach individuals from the local community who might be already interested in science or have a positive attitude towards science, but are not used to attending the type of events he organises.

Some interviewees have alternative techniques to reach local communities. The organisation Interviewee 7 works for established a club for young people to learn about sciences, and then exported the format of the club to other towns. Each club is adapted to the local context to make the communication more efficient. Interviewee 18 organised IT classes for older people that are called clubs. This club format is again repeated in various Swedish towns thereby reaching several local communities.

As for the underserved communities, interviewees recommended not to making assumptions about rural and local communities' needs. Interviewee 14 insisted on the importance of **involving the local community in the project** from the beginning, especially if the project affects their town (e.g. by remodelling areas or building constructions). She recommended asking the community "more about what they want, and then try to incorporate that more seriously in the concepts" of the project. Involving the local community at an early stage is also a way to engender trust with them, "incorporate their needs" and show "your work [is] for them not for yourself" (Interviewee 14). Interviewee 25 uses a similar approach:

"We are now doing some assemblies with citizen from [name removed due to confidentiality]. And we ask some questions like what they want in science on the next ten years, and they answer to us. And then we try to show what our researchers are doing that can fit with their questions."
Interviewee 25 (Portugal, Female)

Interviewees emphasised the importance of relating the science topic to the audience. Interviewee 6, tailors her communication in a way to give her public the knowledge and skills to protect themselves from the hazard she studies. She often works with local communities that are exposed to this natural hazard and uses her personal and lived experience to communicate about the topic, thus shortening the distance between herself and her audience.

Reaching those uninterested in science

Some interviewees mentioned the problem of always reaching the same people with their science communication activities - those who are already interested in the topics communicated, an issue that is well documented in science communication. These interviewees discussed using several strategies to reach those individuals that normally would not go to a science café or a public talk about sciences.

Some interviewees **physically go to locations that do not have an immediate connection with science**, such as town squares, local festivals and even thermal springs or shopping malls so they can interact with individuals who do not have an interest in science. For example, Interviewee 27 and his organisation borrowed a space in a shopping centre for a week. They organised various scientific demonstrations and reached "people who would not normally have actively searched you out". Interviewee 7 organised a series of events for his organisation in a popular park in his city; by having "exhibitions, or workshops or lectures, some performances" on the streets, they reached people who do not know about his organisation specifically. Interviewee 31 went to the thermal spring to talk about minerals that are present in the water. However, Interviewee 31 recommended **talking about anything else before talking about science**. Starting a conversation with a science topic to engage a public that is uninterested in science will not work. Instead, engaging in small talk first and a friendly exchange, will naturally lead some members of this public to ask about your activity or stand.

Interviewee 7 also suggested **'hooking' the public first** and (eventually) talking about science. This interviewee organised some outreach activities in a town square, and used games to attract the attention of passers-by. Then, step-by-step, depending on how interested his participants are, he moves the conversation from the activities to science. He also recommended allowing the audience to leave if they do not want to stay.

Another interviewee stressed the importance of knowing your audience's interests (whether it is football, knitting, or anything else for that matter) to improve communication with them. This includes understanding their interests, their language, and their metaphors:

"If you want to reach an audience that likes football, you should watch a few games, you should go to the café and talk to people and know what... what kind of language they speak, and then you adapt your language, your scientific topic to their language, to their analogies, and you... in a way you create a relationship. So I think first you need to know your audience."

Fun and entertainment were often mentioned as a way to engage with uninterested audiences. For example, Interviewee 19 talked about science events in pubs and cabaret (e.g. Science comedy events), where adults can "just chill out, have a drink and can come and watch something funny and learn something." Another strategy is **using arts**, such as **performances and science & art exhibitions**. While performances and exhibitions can be a form of entertainment, they also allow the communicator to 'sneak' in scientific concepts and reach audiences interested in cultural events but not in science.

Reaching older people

The interviewees reaching older people had the perception that this target group is not unwilling to learn in general; for example, some of them might be interested in learning about national or local history or about botany and gardening. Therefore, interviewees stressed the importance of **finding something that interests them** when engaging with this audience. For example, older people are often interested in technology, specifically how to use a computer or a smartphone. As Interviewee 5 said:

"…on the technology side it's easy… it's easier. I know that some of them like to learn about how to use a computer, or because they see it is now very useful, even to talk with their children especially now because they cannot be with them."
Interviewee 5 (Portugal, Female)

Similarly, **finding a science topic that could fit in the public's daily activities**, such as cooking, could help break some barriers between older people and science communication. Talking about an activity they know well, can help catch their interest as well as show science as something close to everyday life. For example, talking about oil and water in cooking could help talk about some chemical concepts. However there is the danger here that this can rely on particular stereotypes of an age group. To apply this strategy, it is necessary to first understand the routines of the audience and not to assume them.

Some interviewees said that making the communication activity **fun or entertaining** can also be an effective approach. Starting the activity with something funny or enjoyable can create an accessible and engaging environment for the public. For example, Interviewee 18 said she starts her IT class with cinnamon rolls because they look like the sign '@'. This interviewee, also applies another strategy when she engages with older people. She stressed the importance of showing this group that they can learn about science, literally. To do this, she involves **role models that represent the target public** in her activities:

"...when you start to attract seniors to use digital tools, it's not so easy from the very beginning. You need to have models, the role models. And we have a lot of them in Sweden. You know, people who are involved, old people who are involved in information technology."
Interviewee 18 (Sweden, Female)

These role models teach or communicate directly with the target group, for example about how to use a computer. Because role models represent the target group, they offer evidence that the members of this group can also learn about science or technology. Role models can be celebrities, journalists, individuals that are well known to the target public and know how to use technology (e.g. video calls). They should also be a similar age; for example if the target audience is over 70s, they might not feel represented by a role model in their 50s.

Interviewees also use other strategies to reach older people, and one of them is **sharing knowledge between the public and the scientists.** For example, Interviewee 31 described how her organisation engaged with a local community of retired miners by involving them in a communication activity. In this activity, scientists explained how they differentiate between two materials using their scientific/academic knowledge, whereas miners showed how they use their experience and empirical knowledge to make this distinction.

Interviewee 5 also stressed the importance of involving this audience in their activities, and especially in science communication projects. She pointed out how there is still a lack of programmes where older people can say what they want to learn about science and how. Therefore, engaging the target group during the planning of the science communication programme is key to its success.

"We should make more [science communication] programmes. Not one-time activities, I mean, programmes where they could be involved, where they could say what they want, what they would like ... the programme to be."
Interviewee 5 (Portugal, Female)

Reaching young people

Interviewees reaching young people stressed the importance of using digital media and **having an online presence**. Interviewee 26 said that "if you don't exist in social media you don't exist at all", and Interviewee 1 reinforced this claim saying that for young people, "if you are not on the Internet, if they cannot Google you, if you don't exist they don't trust you". Some interviewees mentioned that to reach young people, it is vital to **go where they are**, in particular in the online environment. They also stressed the importance of **using the same digital outlets that young people use**. Interviewee 13 said that young people (25 years old and younger) are unlikely to read newspapers, watch TV news or listen to the radio. They seek information on digital outlets, where information is not always accurate or reliable.

"They spend most of the time – I believe – following social channels or other digital outlets where it is more difficult to come across pieces of general information, especially of scientific information".
Interviewee 13 (Italy, Male)

Interviewee 24 also mentioned the same issue, and further claimed:

"Most people still see the same evening news and TV show programs, but they are sceptical many times because social media has told them different stories."
Interviewee 24 (Sweden, Male)

Moving science communication online will not be enough to reach young adults, because not any media will do. Interviewees said they use different social media platforms depending on the age of the target group. For example, Interviewee 26 said: "…we found out that kids were shifting from… Facebook to other social media like Instagram." Interviewees use Instagram to reach those in their 20s or younger, whereas they use Facebook to reach those who are older. Interviewee 32 said:

"…we thought at least for my generation Facebook is the most used platform. We then realised when we started working that the younger generations like, I don't know, 20 years and younger, they are much more on Instagram, so then we also opened an Instagram page."
Interviewee 32 (Serbia, Female)

To successfully communicate about science topics to young people, it is also essential to **use the platforms they use in the same way they use them**. Some interviewees discussed that young people use social media differently from adults. For example, Interviewee 8 mentioned that young people are more engaged by "short concise and quick communication" on social media. Interviewees discussed how they use Facebook and Instagram differently depending on the target groups' age, and how they make strategic use of the affordances of each platform. For example, Interviewee 32 uses her organisation's Instagram profile as follows:

"…we started using this profile as well to promote the blog, but people are more following the profile as its own identity, I don't know. So we start then communicating through small quotes, sayings, interesting facts, something like that so the people can learn immediately something from the Instagram profile and posts without the need to actually read the whole text that we are writing about some topics. So we have every day like really strict schedule of when we post and what we post, and this showed to be really good."
Interviewee 32 (Serbia, Female)

Even the same platform may be used differently by different age-groups. Interviewee 1 used TikTok as an example; she said that "there are a lot of differences from TikTokers of 10 years old, and TikTokers of 20 years old". Hence, a video that works for 10 year olds may not work for others. She then recommended studying what young people say and how on a social media outlet so that you can include these elements in the science communication activities you

undertake on that outlet. Interviewee 1 also stressed the fact that online "young people are continuously looking for information but they are all fragments", so they don't see the bigger picture. For this reason, instead of creating content online, she creates "links on the web" - she links the fragments of online information:

> *"I have to create a lot of linking on Twitter, Instagram, blogs, YouTube and so on with more interesting bits of information to make sure that they follow the link and they collect all the information, all single words that put together make a sentence."*
> **Interviewee 1** (Italy, Female)

Interviewees emphasised the importance of going where the young people are even when they reach them offline. In this case, they discussed how **involving partners already working with young people** facilitates communication. For example, Interviewee 14 collaborates with local young innovators and small start-up businesses that are connected with the community, in particular with hip-hop dance schools or rap communities, social events focussed on music. Interviewee 26 has a connection with a university that organises summer activities for children. His organisation also participates in national and international events, such as the aforementioned Researchers' Night, to reach young audiences.

Most of the interviewees targeting young audiences **work with schools**, especially those working for organisations such as planetariums, museums and science centres. Interviewees conduct activities in schools, such as experiments or workshops, and/or combine researchers' visits in schools with school children's visits to research laboratories. Some interviewees also organise or participate in online conferences with school students. When organising these types of activities, Interviewee 25 recommend **finding a "balance between what students want to know and what the researcher wants to share**."

Interviewee 8 said that working with schools allows the "gap between schools and university" to be narrowed, since school children often do not know what university researchers do. Other interviewees work with schools for a similar reason: they show the researchers' work and the scientific method to reduce the gap between school education and university education, and to get students interested in science. For example, Interviewee 28 gives workshops about chemistry and science to school children, and her activities focus on using the scientific method as scientists do. In this way, the distance between children and scientists can be reduced a little:

> *"I try to show them that is not a chemistry workshop, it's a workshop about general science, general knowledge. You cannot prepare chemistry well for participants in this workshop, but we can work using the scientific method. You can be a scientists, yeah?"*
> **Interviewee 28** (Poland, Female)

Some interviewees **target or collaborate with teachers** in their communication activities. Interviewee 25 said the organisations she works for make videos of experiments targeted at children because the teachers requested this format as an alternative to text. Interviewee 31

said her organisation offers an educational service specifically for formal education. This service is targeted at teachers and aims to create a bridge between the science taught in schools and the science applied in research. Interviewee 9 said that providing teacher training makes his work more efficient because he "can reach literally tens of thousands of students just with teaching 100 teachers".

Interviewees stressed the importance of **making activities interactive and engaging** for young people either in school or outside school. For example, Interviewee 28 uses storytelling to catch her students' attention at the beginning of the workshop. Interviewee 9 organises activities that are hands-on and fun for the students:

"We usually take a hands-on approach so it's not just me talking but we usually like to make them do experiments on their own with support, and especially to touch with their hands."
Interviewee 9 (Italy, Male)

Interviewee 31 has a similar approach, where instead of explaining and talking for the duration of the school visit, she leads the students to make their observations and come up with their answers.

"... instead of being a guide, it's interesting if you say, in the beginning of an activity, well, let's find evidence that this mountain we have here was an ocean 500,000,000 years ago. How can you do it? What evidence can we find? So, you lead people to think, to observe their things."
Interviewee 31 (Portugal, Female)

Interviewee 21 also organises interactive activities, where children aged 12-15 years can create something scientific or technological. These children receive small grants for their project (around €1,000), and can build "various objects, like DIY refrigerators and some simple robots, also digitally operated compost bins". This type of activity allows young people to express their creativity and come up with innovative ideas.

Another strategy again used to reach young people is making the communication **fun and entertaining**. As Interviewee 17 said:

"I don't think children really respond very well to... to being talked at, so I think you'd have to use different media. They're very creative, in my limited experience, and so if you can communicate something through art or song or video, I think that's probably the best way to do it. But it'd have to be interactive and... and fun, and it may be that they don't go away with something, they... they just go away with a feeling."
Interviewee 17 (UK, Male)

To make communication fun, interviewees often **make their activities creative, unconventional or relatable**. For example, Interviewee 29 wants to organise a mathematical circus in her country after seeing the one in Portugal, to show "tricks and similar things, which in essence are mathematical". Interviewee 5 did creative dance to explain geoscience concepts

to very small children, and she also runs activities that help students relate what they study in class with their everyday life. Since the students at her local schools live near the coast, she could relate her subject to "something they can see because it's the beach, it's the dunes, it's the sea, the waves." She further explained the importance of this strategy as follows:

"So it was… it's more to… so that they can see that science is also about what's around them, not just putting the animals in the right categories and all that boring things that they normally don't like that much."
Participant 5 (Portugal, Female)

Some interviewees also mentioned **games as a way to communicate science** to young people. For example, Interviewee 29 talked about a board game competition hosted in Portugal that she wants to replicate in her country. The games used in the competition are simple and easy for children to play, and "are actually built in a way to make kids learn to think". Interviewee 1, instead, created a game on a Telegram[3] group with interviewees of age 10-12 years old, where she leaves fragments of information for them to decode. These pieces of information are about current issues (e.g. how to wear face masks) and are composed of words in different languages. Fragment after fragment, and question after question, she provides correct information and sources of information in a fun, engaging and conversational way. She recommended participating in the conversation as an equal, not as an expert, because being in a position of power can hinder the communication and the relationships with young people.

Giving young people **a space** where they can talk and exchange ideas is also an effective strategy to reach them. Interviewee 17 facilitates conversations among his students to get them engaged in a topic and he allows them "the space to talk about it". In this space, he only directs questions "which may be relevant and help them develop their own ideas." Interviewee 14 pushed this concept of giving space further, discussing the importance of providing a physical place to young people, made for them and by them, where they can meet and discuss.

Finally, interviewees mentioned the role of the **cascade-effect** in reaching young adults. For example, Interviewee 1 observed that the children participating in her activity on Telegram shared what they had discussed and learned with their classroom. Hence, they communicated information to their peers. **Peer-to-peer communication** is particularly valuable when reaching young people, because as Interviewee 29 said:

"…this part when you ask the student to tell other students, I think it's the best way of recommendation, because they're learning from each other and it's not the same when the teacher recommends something."
Interviewee 29 (Serbia, F)

Interviewee 29 suggested encouraging school children, who find maths too difficult, to read chapters of maths books that are intended for the general public. These books can be about

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[3] Telegram is an Instant Message app similar to WhatsApp.

history of mathematics rather than pure mathematics. The children would then have to explain in class what they learned and what they liked. She said this strategy can help children who feel that mathematics is too difficult for them become familiar with the subject. She also said by having children recommending what they liked about the books, the other children will be more likely become interested in the subject too.

3.3 Summary

The approaches used by communicators to reach underserved and/or disinterested audiences demonstrate the creativity and flexibility of these individuals. They involve adapting the nature of what is communicated and being open to the interests and preferences of different audiences. But what are particularly evident are approaches these communicators employ to forge an initial connection with others, in some instances involving an individual or organisation with a pre-existing relationship with an audience. The strategies interviewees described to reach their intended audiences are summarised in Table 3.

Table 3. Summary of the strategies employed by the interviewees to reach their audiences.

Underserved audiences	Rural and local communities	Those uninterested in science	Older people	Young people
Don't make assumptions about their needs and interests	Go physically to where they are	Go physically to where they are (e.g. pub)	Understand what subjects or topics could be of interest to them	Go where they are physically or digitally
Understand what scientific subjects or topics could be of interest to them	Collaborate with local science/cultural/food festivals or events	Hook them with something curious, unusual, entertaining	Find a scientific topic that could fit into their daily activities	Have an online presence
Look for common ground with them	Participate in the European Researchers' Night	Talk about something else before talking about science	Have role models that represent them	Use the same digital outlets they use and in the same way they use them
Find a mediator	Engage with local authorities	Make the activity fun and entertaining	Make the activity fun and entertaining	Make the activity fun and entertaining, use games
Involve them in the design of the communication activity/project/programme	Involve them in the design of the communication activity/project/programme	Use arts (e.g. dance/theatre performances, artistic exhibitions) or other communicative approaches	Share/exchange knowledge between them and scientists	Make the activity interactive and engaging, creative, unconventional or relatable
Consult or partner with organisations or community groups that already work with them	Work with local media			Find a balance between what they want to know and what you want to share

Help organisations or community groups that already work with them (e.g. provide resources)				Consult or partner with organisations that already work with them
Work with media that already target them				Work with schools and/or target or collaborate with school teachers
Create an environment that is inclusive and welcoming				
Empower them				Give them a space to meet, talk and discuss
				Use the cascade-effect and peer-to-peer communication

3.4 Roles of those reaching underserved and disinterested audiences

By analysing the strategies highlighted in the previous section, it is possible to identify several roles that interviewees adopt when they communicate about science, technology or health topics. These roles characterise the communication activities that connect interviewees with underserved and disinterested audiences. For the analysis, we 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). Given the focus here on underserved and disinterested audiences, new roles have been defined. Where there are parallels with existing role typologies, these have been described.

The roles described here do not necessarily encapsulate all aspects of what communicators do in their working lives – in fact some interviewees took on multiple roles; for example, Interviewee 5 acted as a broker and listener.

The Broker

The *broker* 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. *Brokers* can form these connections to obtain access to a target group; for example, they could partner with organisations already working with the audience or mediators and opinion leaders within the target community. *Brokers* can also form connections with different actors to develop a communication activity; for example, they could bring together scientists and artists to design materials for an exhibition.

Based on the interviewees' responses, we observe two types of *brokers* that differed in the purpose of their connections. The first type creates links with other actors (e.g. media, community leaders) to reach the target audience effectively and supply them with information. An example of this type is Interviewee 16, who reaches out to media outlets targeting underserved audiences. The second type of *broker* involves all the actors they connect, including members of the target group, in a dialogue. Interviewee 22 is representative of this type of *broker*, as he organised public events where experts and audience can interact with each other:

"I try to create a format that really simulates or enables the exchange between visitors of the evening and… and experts/scientists, because I truly believe that the direct interaction between the scientists, academics, and the broader public is a good way of creating understanding for each other from… from human to human."
Participant 22 (Netherlands, Male)

Some interviewees within this second type of *broker* also mediate between scientists and underserved groups to create a science communication activity that benefits both. This type of broker has parallels with the journalists who act as 'conveners' in Fahy and Nisbet's (2011) role typology as these individuals bring together scientists and non-specialist publics to discuss science-related issues.

Interviewees who act as *brokers* stressed the importance of building a relationship with the audience. To build this relationship, *brokers* need to establish common ground with the public, such as shared interests. Interviewees who are scientists often said that it is important to show the audience your human side and the similarities you have with them, rather than your identity as expert. A relationship with an audience is sometimes facilitated by a third party (e.g. a local charity or municipality) as well.

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" (Interviewee 3). Then, the *listeners* integrate what they learned about their audience in their communication activities. For example, they look for a common ground between what scientists offer and what the audience want. 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 (e.g. football). Interviewee 5 is an example of someone who exemplifies this role: she reached out to an underserved community, talked and listened to them, and found out that they are interested in memories. Then, she designed a communication project that could combine the concept of memories with neuroscience. Interviewee 3 further defines the role of *listener* in this quote:

"Listen, listen, listen. Find some people. Pay them. Value them for their time, like if you can in some way make sure that they are benefitting from that process, like they're not being used. Make sure they're being included and partnered with. Take time to reflect on what you've heard. So it's not enough to just listen to people. You actually have to work out how you're going to deploy that learning into your own work."
Interviewee 3 (UK, Female)

Interviewees taking the role of *listeners* also emphasised the importance of not making assumptions about the target group. This attitude includes not making assumptions about the audience's needs as well as on their intelligence and knowledge. As Interviewee 11 said, "just because someone doesn't know about a topic, that doesn't mean that they're dumb, it just means that they're not aware of that topic". Hence, it is essential to treat the audience with respect, as an equal, and avoid being condescending or patronising. Interviewee 2 also

emphasised the importance of not being judgemental or criticising when talking with certain audiences, such as anti-vaxxers:

> *"I think one skill that is very underrated and is very necessary is listening. Like the real capacity of listening to people and empathy, so try to understand what the other is going through. There's a lot of controversy [removed to maintain confidentiality] with anti-vaxxers again…. And when I see how people react to that on Twitter, or on another social media, I am like guys, we are going nowhere. They feel they are superior to the anti-vaxxers. So I think we need to have a bit more empathy and listen to these people, and try to understand what's going on."*
> **Interviewee 2** (Belgium, Female)

The communicators' attitude has a big influence on the interactions they can have with underserved or disinterested audiences. Strong preconceptions and a condescending attitude will obstruct the dialogue with the audience, meaning that the audience will not feel listened to. Whereas a respectful and open attitude will create an atmosphere where the audience feels valued and free to talk .

The Includer

The *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. For example, Interviewee 19 acts as an *includer* when she recruited speakers for a panel that represented the diversity of the public with whom she wished to communicate, both in terms of gender and ethnicity. Interviewee 24 works as press officer in a university, and he publishes articles about the university students' contribution to research projects as a way to recruit prospective students with a similar background (e.g. first generation students in the family to graduate). The strategies employed by *includers* like Interviewee 19 and Interviewee 24 aimed to show underserved groups that they can be there, for example in a museum or at an event, and/or that they can become scientists.

Other interviewees act as *includers* by making events, exhibitions and activities physically accessible, affordable and comfortable for underserved groups; hence, they make them inclusive. These activities should be accessible in terms of language as well. This means not only avoiding jargon, but also phrasing things in the same way as the target group. To make a science communication activity inclusive, the *includers* strongly discourage assumptions about the target audience's needs. Rather, they advise working together with members of the target group or partnering with organisations already reaching this audience. It can be even more effective to involve members of the target public in the project design or as members of the board committee.

The Enabler

The role of the *enabler* works on enabling underservedaudiences 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. 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.

The first type of *enabler* outlined above provides some space for the target group to talk and develop their own ideas about the topic. For example, Interviewee 17 gives his students some space to discuss climate change among themselves and facilitates the conversations to help them come up with their own ideas and thoughts about this issue. Hence, enablers do not teach or educate the audience, but enable them to develop their own voice and thoughts about an issue or subject. Interviewees that provide information and resources to the target public or to the community groups and organisations working with a particular audience also belong to the first type of *enabler*.

While the first type of *enabler* helps underserved audiences to develop their own ideas about a science topic or issue, the second type helps them voice these ideas. Because of the different level of expertise and power between scientists and members of the audience, the latter might not feel comfortable to ask questions, express concerns or opinions. Therefore, *enablers* design activities that can break this barrier and make people comfortable. Interviewee 21 is an example of this type of *enabler.* To make the audience feel "like there was no barrier between them and the experts," he organises activities that create a friendly and relaxed atmosphere and facilitate dialogue between them and scientists. He also organised a talk where experts were challenged any time they did not provide a scientific argument to their claims but used their authority to support them. By challenging experts in this way, it was possible to break barriers between them and the audience:

"So you have to explain it [your argument] not because you say so because you are the expert, because that is completely biased, because people trust authority. You have to explain it in terms of why this is true, why do you think this is true? And there was a lot of laughter, a lot of self-criticism, but that kind of broke the ice and people felt really comfortable with… it was the same thing like with this common table format. You break this wall that separates experts from lay people."
Participant 21 (Poland, Male)

The Educator

The role of the *educator* is not about teaching, but giving the audience the tools to understand the scientific method and research process in a similar vein to the 'civic educator' described by Fahy and Nisbet (2011). But unlike Fahy and Nisbet's (2011) civic educator, the educators characterised here are also interested in improving their audience's critical thinking skills so that they can discriminate between reliable and unreliable sources of scientific information and make informed and rational decisions. For example, Interviewee 28 delivers workshops showing the scientific method to school students, aiming to make them "developed members of society" that can evaluate information and decide whether it is true or not. Interviewee 9 also shows the scientific methods in school classes, and educates students to look at "reality through the eyes of a scientist". Interviewees taking this role see education also as a way to build trust between the audience and scientists. If the audience can understand the research process and scientific uncertainty, they can also understand the benefits of science and the challenges that researchers face. As Interviewee 9 said: "I think [education] is the key to the transformation for the understanding of science."

Some educators achieve their goal by making the scientific language accessible, simplifying abstract concepts, and debunking misinformation. Others also show the relationships between science and everyday life. Regardless of the strategy an *educator* uses, they avoid telling the audience that they are wrong about a scientific topic. Instead, they try to understand where the audience's beliefs or feelings come from and educate them through a conversation. For example, Interviewee 31 suggested:

"If I want to give them information about climate change but if they don't care at all, perhaps that lack of interest, it's the bridge you need to start the conversation and to start an activity and an engagement. So, first understand them, second, listen to them, of course the next part of understanding, and adapt yourself to that feedback, because even if you understand and you stay strict to your guides, it doesn't make the difference." **Interviewee 31** (Portugal, Female)

Interviewees acting as educators all take a similar approach. They create a dialogue to understand their audience, listen to their doubts, questions and beliefs, and use that understanding to provide them with correct information.

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. *Entertainers* often use unusual or creative strategies to catch and retain the attention of the audience, such as short videos, creative dancing or maths circuses. Digital outlets are particular suited for the *entertainers'* activities. For example, Interviewee 1 created a game on the Instant Messaging app Telegram, whereas Interviewee 32 uses

Instagram stories to engage her audience with quizzes that disappear in 24 hours. Narratives and storytelling are also powerful activities for entertaining. As Interviewee 17 said:

"If you can tell a story that has a beginning, a middle and an end, it's very easy for people to latch onto that story. You know, if you say: I'm going to tell you a story about climate change and these are the actors, this is the plot and this is the... the kind of the unfolding at the end. And, you know, you can have this kind of journey that people can follow with you. And make it entertaining"
Interviewee 17 (UK, Male)

The role of *entertainer* is not limited to creating a fun activity for the audience. For some it is a way to convey some information or simple concepts. For others it is a way to start a dialogue. In the latter case, interviewees that take the role of *entertainers* use fun activities to create an accessible and entertaining environment, where the audience ask the questions. Therefore, is not the communicator who leads the conversation, but the members of the public. However, to create this type of environment, it is essential that the *entertainer* puts themselves at the same level of their audience, so the audience will not feel intimidated or judged.

3.4 Summary

The roles outlined above characterise the different approaches employed by communicators to reach underserved and/or disinterested audiences. These roles also reflect the different motivations communicators have behind their activities. Table 6 provides an overview of each of the roles described above, outlining their key characteristics.

Figure 6 Summary of the roles identified in this study.

Brokers

- Create connections between several actors, such as the target audience, scientists, organisations, charities, media, local authorities, community leaders, designers, artists, bloggers, and social media influencers
- Create connections to reach a target group effectively and supply them with information
- Create connections to develop a communication activity or start a dialogue with different parties (e.g. target group and scientists)

Listeners

- Seek to understand the audience better: who they are, what they want to know/do, what they find interesting
- Integrate what they hear in their communciation programmes/activities
- Use skills such as active listening and empathy

Includers

- Make science and research accessible and inclusive by improving the representation of underserved groups in these fields
- Make events, exhibitions and activities inclusive: they make them physically accessible, affordable and comfortable for underserved groups

Enablers

- Enable audiences to participate in the public debate about science
- Enable audiences to develop their own voice and thoughts about an issue by providing them with information, resources, or spaces
- Enable audiences to voice their ideas and opinions on an issue by changing the power dynamics between them and scientists

Educators

- Provide the audience with the tools to understand the scientific method and research process
- Improve the audiences' critical thinking skills to discriminate between reliable and unreliable sources of scientific information and make informed decisions
- Try to understand where the audience's beliefs or feelings come from and educate them through dialogue

Entertainers

- Use games, arts, performances, hands-on activities and storytelling to entertain the audience
- Use unusual or creative strategies to catch and retain the audience's attention
- Use entertainment to convey scientific information/concepts or to start a dialogue

3.5 Repertoires of those reaching hard-to-reach audiences

While roles characterise the communication activities of those involved in science communication and their overall approach to it, the repertoire of a science communicator provides insights into their conceptions of the nature of the relationship between science and society. Turnhout et al.'s (2013) conception of repertoires provides a framework through which to consider this relationship. In particular, it enables insights into the extent to which communication activities enable a two-way interaction between communicator and audience. Also, the extent to which this interaction enables those who are recipients of knowledge (society) to also contribute towards its production (science).

The communication activities described by the interviewees are described here in relation to Turnhout et al.'s (2013) characterisation of repertoires.

Supplying repertoire

For many of those reaching underserved audiences, the priority was forming connections with these audiences and communicating science to them. For Interviewee 19, this involved making sure there was a diverse panel of speakers at public events. For Interviewee 16, this involved aiming to write for magazines that had "marginalised groups as a target audiences". These methods of communication are more likely to facilitate a one-way transmission of information from knowledge producers, the scientists and communicators, to knowledge users in society.

Some communicators described more discursive approaches to reaching underserved audiences, but here too the technique they used indicates a supplying repertoire. Interviewee 5 described how they sought to reach migrant women who could not read or write. They explained how they sought to find out more about the women's interests so that the area of science they communicated could be targeted towards these interests, settling on memories and neuroscience. The communication activities involved a neuroscientist "…explain[ing] stuff about the brain" as well as visits to a museum and lab. The emphasis was on education and imparting information. The exchange with knowledge users was not aimed at them participating in science, but as a means to know how to engage them so they could learn about it. When describing their motivation, Interviewee 5 stated that it was to provide access to "high quality knowledge".

Other interviewees demonstrated a similar supplying repertoire due to the nature of the activities they engaged in. These included Interviewee 6 who took part in science picnics with their local community, handing out leaflets and visiting forest educational centres and Interviewee 1 who communicates with young people by providing links to information on Telegram groups.

This means that when considering repertoires from the perspective of the roles of science communicators, most of the roles adopted fall within the supplying repertoire, including the **broker**, the **listener**, the **includer** and the **entertainer**. Although they use different approaches to reach underserved audiences or those not interested in science, the ultimate aim is to provide citizens with information. Even with the **listener** and **educator** roles that involve conversations between science communicators/scientists and citizens, the intention in this interaction is to target communication efforts more effectively, rather than enabling the knowledge of citizens to inform science.

Bridging repertoire

This repertoire was much less evident among the communicators than the supplying repertoire. However, interviewee 19, who organised public talks that involved scientists, indicated how researchers may get a new perspective on their research by engaging with members of the public. She said: "Maybe you [as a scientist] can actually get a lot of perspective about your own research just by listening to other people's opinions and that's part of science communication." Enabling an interaction between knowledge producers and users, so those who are typically the users might inform the producers, was what interviewee 19 described as being among the potential benefits of science communication activities.

Interviewee 21 described an event called the 'Common Table' that directly sought to enable members of the public to inform research. There was a table of 15-20 people that both experts and members of the public were able to join when they felt they had something to contribute to a conversation. When describing the members of the public who attended, he said: "These are just people who know things, who are interested in how the world works and they simply want to exchange observations and figure out something new. The best thing about this format was that many experts learned something – learned to look at their results from another perspective." This participant described how some experts may fall into "the trap of obviousness" where they don't question what they are finding or their interpretations. "And then someone comes to an event, listens to something and goes 'wait a minute, that's not entirely true. I think it's different."

Interviewee 31, a scientist, explained how she would engage in activities with older people such as panning for minerals and some of these older people had experience in identifying minerals from a time when there was mining activity in the area. This interviewee acknowledged the empirical knowledge of these older people and commented: "…working with some of the cultural knowledge, some little tips can also teach us sometimes." This is an acknowledgement that learned knowledge of citizens can be of value to the scientific community. However, the extent to which this is put into practice is unclear as this interviewee also stated that their aim was to "raise awareness" of the geological heritage of the area.

Those communicators who embody the **enabler** role, with its emphasis on enabling hard-to-reach audiences to participate in the public debate about science, would appear to fit within the bridging repertoire. The enablers seek to encourage individuals, typically students, to form their own opinions and even question those involved in science about their research and their plans. But as these activities take place in classroom settings, it's unclear whether these discussions and debates do feed into research directly. Even so, by encouraging students to develop their own opinions and question scientists, this may help to engender a confidence to engage with scientists; asking questions and providing opinions that *do* inform science.

Facilitating repertoire

None of the activities discussed by the communicators appear to explicitly demonstrate a facilitating repertoire, enabling knowledge users to be fully integrated into the knowledge production process. That is not to say that some of our interviewees were not engaging in activities that fall within this repertoire in some projects, but that this did not particularly arise in their interview responses.

4. Conclusions

In this research, we interviewed science communicators about the strategies they use to reach, communicate and connect with underserved and disinterested audiences. The communication techniques that we found can help to inform future efforts to broaden the audiences reached when science is communicated.

Our analysis provides insights into many innovative approaches to reaching these audiences, hence into broadening access to information and opportunities to engage around science. Several of these strategies focused on understanding the target groups by working with them directly or by cooperating with other actors already reaching these audiences, such as charities, local authorities and community groups. Many approaches also focused on making the science communication activities and events inclusive, accessible and welcoming to the target group. Some strategies included fun, entertainment and science and art as means to reach audiences, especially those who might be disinterested in science.

When we considered these diverse approaches together, we could identify a range of roles that science communicators adopt in reaching hard-to-reach audiences. Two of these roles, the *broker* and the *educator*, resemble those of *convener* and *civic educator* identified by Fahy and Nisbet (2011). Just as with Fahy and Nisbet's *convener*, the *broker* makes connections between scientists and audiences, though they also build relationships with other intermediary actors to design their communication. The *educator* has parallels with Fahy and Nisbet's *civic educator* role as their communication activities relate to the ways research is done rather than simply

the results of research. But unlike Fahy and Nisbet's *civic educator* here educators also seek to equip citizens with means by which to seek out reliable information and make informed decisions. In this research, we also identify the role of *enabler* – individuals who aim to empower underserved audiences with knowledge and resources so that they can participate in debates about science.

All the roles we observed put the audience at the centre of their communication strategies, especially the *listener*. Those who adopted this role emphasised the importance of deeply understanding the target audience and working with them in planning the communication. Finally, we identified the role of *entertainer*. Entertainment is a powerful tool to reach disinterested audiences, especially young people, and can be further facilitated by digital media.

When comparing the roles we identified in the interviews with those identified in our previous survey (Milani et.al. 2020b), we noticed that *brokers* and *educators* emerged in both studies. The role of *entertainer* appeared in our previous research as well, though not to the extent it was seen here. The role of debunker of misinformation was an important role in our survey. But in this research, the interviewees described a different approach to misinformation – educating the audience to discriminate between reliable and unreliable sources. Hence, the focus shifted from correcting information to providing tools to evaluate information.

All the roles we found within the interviews, encourage interaction with audiences to some extent. This interaction is often to understand an audience's interests and needs, so that the communication activities themselves may be more effective and engaging. These science communicators could be commended for the innovative approaches they employed in connecting with underserved audiences and those not already interested in science. This is particularly the case given that earlier RETHINK research has highlighted that relatively few communicators across Europe currently seek to do this (Milani et al. 2020a) and the wider body of research indicating that many potential science audiences are underserved (Dawson, 2014a; Kennedy, Jensen and Verbeke, 2017; Humm, Schrögel and Leßmöllmann, 2020)..

While many of the communicators we spoke with seek interaction with their audiences, in many instances this was to facilitate communication rather than to allow citizens to inform science. When considered from the perspective of repertoires, this means that many of the communicators were exemplifying the supplying repertoire.

However, some interviewees described how they sought to enable scientists to see their work from a different perspective thanks to the input of citizens. In the case of one interviewee, who was involved in the organisation of a Common Table event at which both scientists and citizens spoke, their encouragement of this was direct and so indicative of a bridging repertoire.

While there was limited evidence of communicators seeking to enable citizens to shape the trajectory of science or be involved in the process of knowledge acquisition, it must be

recognised that the nature of the interviews may have influenced this. The interviews sought primarily to explore how communicators reach audiences that are underserved or disinterested in science, potentially limiting the opportunities for communicators to describe attempts to allow citizens to inform science. Enabling citizens to inform science may also simply fall outside of what is feasible within the communicator's work, such as a journalist who is paid to write articles for a publication.

It should be recognised that our approach to selecting participants may have limited the number of roles identified here as well as the extent to which bridging and facilitating repertoires were evident. The sampling approach was employed to ensure the nature of the communication activities of our interviewees was in some way representative of the communication activities within their respective countries. Further studies of science communicators who seek to reach underserved or disinterested audiences may identify additional roles as well as more activities that enable citizens to become involved in knowledge production in some contexts.

Taken together, the approaches employed by the communicators we interviewed point to the role that certain key principles can play in communicating with underserved and disinterested audiences:

- Engaging in dialogue with the intended audiences to explore their interests, so that the science communicated is within their existing spheres of interest and to enable you to use language with which they are familiar.
- Involving individuals or groups that represent a target audience with communication activities to enable co-creation of projects.
- Changing the dynamic between citizens and those communicating science, so citizens feel empowered to engage and ask questions.
- Go to where your target audience is rather than expecting them to come to you – this may be physically, whether it is a town square or thermal spring, or increasingly these days online, such as the social media platform TikTok.

The approaches to reaching underserved and disinterested audiences described by the communicators we interviewed are testament to the creativity they employ in their work as well as their genuine desire to connect with new audiences. Their ideas and successes may offer inspiration to others who share similar aspirations and who seek to continue to drive inclusivity in science communication.

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Appendix A

Information sheet

UWE Bristol | University of the West of England

RETHINK Project

Project Information sheet

We are contacting you to participate in a short interview on online science communication practices; in the questionnaire you completed, you agreed to be contacted for a follow-up interview.

This study is part of RETHINK, a Horizon 2020 project funded by the European Commission. The interviews and data analysis will be carried out by the researchers who are based at the Science Communication Unit at the University of the West of England, Bristol.

The interview will be recorded and it should take approximately thirty minutes to complete. It is entirely your choice as to whether to participate. If you do not wish to answer a particular question, you can let the researcher know. We will ask you how you use digital media to communicate science to broad audiences as well as hard-to-reach audiences, such as those with little knowledge of or interest in science.

The data we collect is processed, stored and shared in accordance with the European Data Protection Regulation. This means that your data will not be identified in any reports or publications and any data extracts will be carefully reviewed to ensure you are not identifiable. The audio-recordings and any sensitive or identifiable data will be kept confidential, whereas aggregated and pseudonymised data will be shared with our project partners and third parties.

The information gathered will be used for the purposes of the study report, academic dissemination, and potentially as a basis for future guidelines on best practices in online science communication. The final report will be published online and will be publicly available.

You may ask for your contribution to be withdrawn from the study at any time before the **16th of October** 2020; after that date, it may not be possible for us to remove your data from the study. If you would like your data to be withdrawn or more information on the study, please contact Elena Milani via email elena.milani@uwe.ac.uk or telephone 0117 32 81994.

Thank you for considering taking part in this interview. If you wish to go ahead, you will need to complete the consent form at the time of the interview.

Consent form

RETHINK Project

Project consent form

If you consent to being interviewed and to any data gathered being processed as outlined below, please print and sign your name, and date the form in the spaces provided below. You should read this consent form in conjunction with the information sheet for this project.

- This study is being conducted by researchers in the Science Communication Unit at the University of the West of England and RETHINKerspaces (partners and third parties) as part of the European project RETHINK.
- All data will be treated as personal under the European Data Protection Regulation and will be stored securely. Your data will be analysed by the researchers in the Science Communication Unit at UWE
- Interviews will be recorded by the researcher and transcribed; you can have a copy of the interview transcript on request.
- Your data will be used for the purposes of the study report, academic dissemination, and potentially as a basis for future guidelines on best practices in online science communication. The final report will be published online and will be publicly available.

Please indicate by ticking <u>one</u> of the boxes below, whether you are willing to be identified in any reporting or would prefer to remain anonymous.

☐ I consent to participate in this interview, and I <u>may</u> be identified in conjunction to my data.

☐ I consent to participate in this interview, and I <u>may not</u> be identified in conjunction to my data. I wish to remain anonymous.

Please print your name: ……………………………………………………………

Signature ………………………………………….Date …………………..

You may ask for your contribution to be withdrawn from the study at any time **before the 16th of October 2020**. If you would like your data to be withdrawn or more information on the study, please contact Elena Milani via email elena.milani@uwe.ac.uk or telephone 0117 32 81994.
Thank you for participating in this study.

Interview schedule

In this interview, I will ask you about your professional role, your science communication activities, and your audiences. In particular, I will ask you about your relationships with your audiences, including how you build trust with them.

Topic	Aim of the questions	Questions
Description of their job role	*Icebreaker*	Please describe your professional role
		Prompt: for example, tell me a little about what you do on a day-to-day basis?
		Prompt: How long have you been working in your role?
		Prompt: What got you into this profession?
Role	*Exploring their role and practices in science communication.*	I would like to talk about your science communication activities now. When you communicate about science, tell me, what do you do?
	Insights on repertoires	Prompt: what formats or media do you use?
		Prompt: why do you use these tools/media?
		When you communicate about science, what type of things are you trying to achieve?
		Prompt: can you give me an example from one of your projects?
		What motivates you personally to communicate about science?
		Prompt: Why?
		What is the benefit of science (communication) for society? And for science?
Audience	*Explore their audiences.*	What kind of interactions do you have with your audience?
	Further Insight on repertoires	Who are you trying to reach with your communications?
	Link roles and barriers.	Prompt: is your audience international or local?
		Prompt: How interested is your audience in the science/topics you communicate? (e.g. are they already interested in the topic?)

		How well do you know your audience?
		Prompt: Are there any things that you don't know about them that you would like to know?
		Are there any audiences you would like to reach, but haven't been able to reach?
		Prompt: If so, which?
		Why do you think these audiences have been hard to reach?
		What do you think might help you to reach them? (e.g. are there practical things that could help you reach them?)
Trust	*Explore how the interviewees (would) engender trust with their audiences.*	Tell me about the relationship with your audience
		What role do you feel trust have in building that relationship?
		How do/would you build trust with your audience?
		Prompt: Could you give an example?
		Are there any challenges in building trust with you audience?
		Prompt: Which?
		Prompt: Could you give an example?
		Have you been able to overcome any of these challenges?
		Prompt: Could you give an example?
Barriers	*Explore the barriers between the interviewees and their audiences.* *Explore how the interviewees (would) break these barriers.*	What challenges, if any, do you face when you try to communicate with your audience? (beyond building trust)
		Prompt: Could you describe these challenges?
		Have you been able to overcome these challenges?
		Prompt: How?
		Prompt: Could you give me an example?
		(if they haven't) Do you have any ideas about how you could overcome these challenges?
Guidance	*Wrapping-up* *Final insights on practices and*	Do you have any recommendations on how to build good relationships between science communicators and their audience?

recommendations for breaking barriers and engendering trust.

Thinking about science communicators, what skills are most helpful in reaching audiences?

Is there anything else you would like to add on the issues we have talked about?

Appendix B

Description of the interviewees. Organisational information is only provided where this does not jeopardise the anonymity of the individual. The professional identities described here are derived from the responses to the survey that preceded the interviews; respondents selected from pre-defined categories. Some of the interviewees indicated more than one professional identity at that time.

Interviewee	Country	Gender	Professional identities	Organisation
Interviewee 1 (Pilot)	Italy	Female	University lecturer/professor Journalist or editor Freelance communicator or writer	University or Research Institute
Interviewee 2 (Pilot)	Belgium	Female	Project manager	Organisation that facilitates face-to-face science communication
Interviewee 3	UK	Female	Freelance communicator or writer	//
Interviewee 4	Sweden	Male	Journalist or editor Freelance communicator or writer	//
Interviewee 5	Portugal	Female	Researcher (including PhD student) Freelance communicator or writer	University or Research Institute
Interviewee 6	Poland	Female	Researcher (including PhD student) University lecturer/professor	University or Research Institute
Interviewee 7	Serbia	Male	Researcher (including PhD student) Journalist or editor Curator, explainer or museum employee	//
Interviewee 8	Italy	Female	Press officer or communication officer	University or Research Institute

Interviewee 9	Italy	Male	Freelance communicator or writer Curator, explainer or museum employee	//
Interviewee 10	Netherlands	Male	Journalist or editor Freelance communicator or writer Press officer or communication officer Blogger, YouTuber, Social media influencer	University or Research Institute
Interviewee 11	Portugal	Male	Documentary or movie maker Press officer or communication officer Designer	University or Research Institute
Interviewee 12	Netherlands	Female	Press officer or communication officer	University or Research Institute
Interviewee 13	Italy	Male	Journalist or editor Freelance communicator or writer Press officer or communication officer	//
Interviewee 14	Netherlands	Female	Project management	Festival/Cultural event
Interviewee 15	Poland	Male	Freelance communicator or writer Activist	//
Interviewee 16	Netherlands	Female	Journalist or editor Freelance communicator or writer Blogger, YouTuber, Social media influencer	//
Interviewee 17	UK	Male	University lecturer/professor	University or Research Institute
Interviewee 18	Sweden	Female	Journalist or editor	//

			Press officer or communication officer	
Interviewee 19	UK	Female	Researcher (including PhD student) Radio show co-presenter, event organiser	//
Interviewee 20	Sweden	Female	Business Spokesperson	Learned Society or Professional Association
Interviewee 21	Poland	Male	Journalist or editor Curator, explainer or museum employee Blogger, YouTuber, Social media influencer	Museum, Science, Discovery centre, Planetarium or Observatory
Interviewee 22	Netherlands	Male	Journalist or editor Freelance communicator or writer	//
Interviewee 23	UK	Female	Curator, explainer or museum employee	Museum, Science, Discovery centre, Planetarium or Observatory
Interviewee 24	Sweden	Male	Journalist or editor Freelance communicator or writer	//
Interviewee 25	Portugal	Female	Freelance communicator or writer Communication project manager	Private Business or Industry
Interviewee 26	Portugal	Male	Freelance communicator or writer Press officer or communication officer Curator, explainer or museum employee Current undergraduate or postgraduate student	Museum, Science, Discovery centre, Planetarium or Observatory
Interviewee 27	Sweden	Male	Researcher (including PhD student)	University or Research Institute

			University lecturer/professor	
Interviewee 28	Poland	Female	University lecturer/professor Activist	University or Research Institute
Interviewee 29	Serbia	Female	Freelance communicator or writer	//
Interviewee 30	Serbia	Female	Journalist or editor Press officer or communication officer	University or Research Institute
Interviewee 31	Portugal	Female	Researcher (including PhD student)	//
Interviewee 32	Serbia	Female	Journalist or editor Press officer or communication officer Activist	Non-governmental Organisation, No-profit organisation, Think Tank, Charity, Foundation