Deliverable 1.3

D1.3 Investigating the links between science communication actors and between actors and their audiences

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Executive Summary

The audiences reached by those engaged in science communication and the nature of the connections with those audiences is of central importance to the science-society relationship. It determines who is reading, listening and watching information about science but also characterises those interactions. Do the interactions involve a one-directional 'broadcast' of information from communicator to audience, or is the relationship more of a two-way approach that fosters a more integrated relationship between science and society?

To answer such questions, an online questionnaire was distributed in seven European countries: Italy, The Netherlands, Poland, Portugal, Serbia, Sweden and the UK. This explored the audiences these communicators sought to reach and the nature of their connections with them. Further insights into audience connections were provided by 'Rethinkerspace' workshops held in the same seven European countries. These workshops involved a variety of 'actors' involved in science communication, as well as academics.

A high proportion of the questionnaire respondents said that their intended audience is individuals already interested in science, technology and/or health topics to some degree. Only 1.5% of survey respondents aim to reach audiences that are not interested in science-related topics. Reaching underserved audiences, was mentioned by only 29.2% of survey respondents overall. There were national differences across Europe in the extent to which underserved audiences are being targeted.

The discussions with Rethinkerspace members show that a lack of time to communicate science is a barrier that transcends actors and European countries. In terms of digital communications, many communicators reported a sense of disconnect with their audience. There are also indications that while digital media, such as social media, offer a mechanism for two-way interaction between communicator and audience, in practice this often does not happen.

Taken together, these findings have implications for the connection between science and society, since they imply that the connections are not equal across all of society. Also, that in spite of the promise of digitalization to integrate science and society more fully, there is still a linear relationship between the two to a great extent, in which knowledge production and use are distinct.

Other results from the questionnaire are presented in RETHINK deliverable D1.2, which explores the working practices of those engaged in science communication. Reading deliverables D1.2 and D1.3 in tandem will provide a fuller picture of contemporary science communication across Europe.

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1. Introduction

Digitalization has been changing the roles and repertoires of those engaged in science communication (as is explored in Deliverable 1.2). But it is also important to understand the audiences that those engaged in science communication reach, or intend to reach, since this is central to the science-society relationship.

Earlier research in the RETHINK project has sought to understand who the actors engaged in science communication are, the media and forms of communication they use as well as their underlying motivations. The research presented here focuses on the audiences these actors seek to reach and who they believe they reach.

Existing studies have explored the audiences being reached by a specific type of actor engaged in science communication, or a small range of actors. An example of this type of research is a survey of researchers in science, technology, engineering and maths (STEM) in the UK commissioned by funders led by the Wellcome Trust and conducted by TNS BMRB and University of Westminster (2015). It demonstrated a traditional form of science communication – giving a public lecture - to still be one of the most common forms of public engagement undertaken, having been undertaken by 40% of respondents in the past 12 months (TNS BRNB and University of Westminster, 2015). Engagements with policy makers (34%) and with teachers/schools (33%) were also fairly common. The most common form of public engagement undertaken was via social media (52%); though the intended audience for this was not stated (TNS BRNB and University of Westminster, 2015).

When the same group of STEM researchers were asked which audiences outside academia it is *important* for researchers to engage with, policy-makers and politicians were the most commonly selected (78%) alongside the general public (78%) (TNS BRNB and University of Westminster, 2015). Young people outside of school (49%) and patients/patient groups (54%) were the least commonly selected audiences (TNS BRNB and University of Westminster, 2015).

A global survey of science journalists found that most respondents (76%) saw their audience as being the 'general wider public' (Bauer et al., 2013). Whereas around one third (38%) write for 'specialist' publics; though who these specialists are is not specified (Bauer et al., 2013).

While science communication training may seek to encourage communicators to "…foster fruitful dialogues with diverse audiences" (Baram-Tsabari and Lewenstien, 2017, p.288), there is evidence that broad conceptions of audiences are common among actors engaged in science communication. Interviews with scientists and communication practitioners at European scientific research institutions found that "…interviewees attempt to address different audiences. However, the segmentation is often poorly developed, since/because neither communication practitioners nor scientists seem fully aware of the need to differentiate their activities according to the group or stakeholder targeted" (Casini and Neresini 2012, p.45).

A common frustration among science communicators, however, is that public engagement activities, such as research institution open days, often reach those who already have an interest in science (Casini and Neresini, 2012), so only a fraction of society. Similarly, science-interested audiences are commonly being reached by digital media but this may be the intention of producers of such sources. In interviews with bloggers writing for some of the highest profile science blogs, Bultitude and Ranger (2016) found that they all assumed an

audience with an interest in science. One respondent stated: "My intended target is the kind of mildly curious sort of science interested person like me" (Bultitude and Ranger 2016, p. 367). Similarly Brown Jarreau and Porter (2018) found science blog readers mainly to be highly educated individuals who are mostly scientists and future scientists. However, in her study of female online science communicators, Abighannam (2016) found them to consider their audiences to be a mixture of those with and without an interest in science.

The logic behind the approach of appealing to science-interested audiences is clear; one of Bultitude and Ranger's interviewees stating: "If I had a website about a video game, I would assume that the people who come to my website liked that video game" (Bultitude and Ranger 2016, p. 367). However, taking science communication as a whole, the fact that only certain audiences are being reached presents challenges to an open science-society relationship.

Concerns about the lack of connection between science and some audiences has prompted institutions involved with science communication to adopt policies of facilitating and promoting projects that involve 'hard to reach audiences', such as those from certain socio-economic backgrounds. Typical of this is the UK Association of Science and Discovery Centres' (ASDC) report on Effectively Engaging Under-Represented Groups (ASDC, 2014). Similarly, in its online mission statement, the European network of science centres, Ecsite, states: "We commit to including everyone as a participant regardless of age, gender, sexual orientation, religion, ethnicity, ability or political affiliation" (Ecsite, date unknown).

While digital communication mechanisms such as websites and social media have the potential to reach a wide range of audiences, in practice getting noticed online can be challenging (Wilkinson and Weitkamp, 2016). Part of the problem is that the internet is a pull medium where users have to actively seek content (Wilkinson and Weitkamp, 2016). Whether it is in relation to climate change (Walter, Bruggemann and Engesser, 2017), science news or science-related conspiracy theories (Brugnoli et al. 2019), readers seek online content consistent with their existing beliefs. Search algorithms accentuate the problem by prioritising popular pages over those with less traffic (Wilkinson and Weitkamp, 2016) and by showing users content similar to their previous searches, or those of their followers. This means it is hard for scientists, science communication practitioners and anyone else for that matter to get traction and their blogs, podcasts and other material seen; and seen by those with differing viewpoints in particular.

Internet access is also not ubiquitous and access online is varied across Europe, as it is in the rest of the world. Whereas in some countries such as Belgium, France and The Netherlands, internet access within the population is comfortably over 80%, in others it is lower such as Italy (74%), Portugal (75%) and Greece (73%) (World Bank, 2019).

Far from being a context in which scientific information flows freely, 'echo chambers' exist online, inside of which social homogeneity drives diffusion of information (Del Vicario et al., 2015) but between which information and discussion are rarely shared. It means that online audiences can be fragmented and views polarised.

Another challenge created by science communication online is knowing who the audience is. While online analytics, such as the number of views, are easy to find, finding out *who* is viewing, listening or reading is often not possible without further research such as audience surveys.

One view of a YouTube science video may be a high-school teacher showing a video to an entire class or one individual watching a video numerous times (Haran and Poliakoff, 2011).

Some barriers to reaching audiences transcend medium and audience; competing pressures on time being a prominent barrier for researchers (TNS BRNB and University of Westminster, 2015). For scientists, negative perceptions of public engagement by researchers' peers can also be a barrier (TNS BRNB and University of Westminster, 2015). Perceptions of audiences' interest (or lack of) in science is a barrier for some scientists, with some researchers believing their research would not be of interest to the public (TNS BRNB and University of Westminster, 2015) or science in general is not of interest (Eckland, James and Lincoln, 2012). There is also a perception by some scientists that a lack of scientific knowledge among the public presents a barrier to communicating advanced scientific discoveries beyond academia (Ecklund, James and Lincoln, 2012).

It's important to recognise however, that digital technologies allow anyone to be a content producer (Wilkinson and Weitkamp, 2016). Those who were once science information consumers, can now also be producers. Today "...scientists journalists, advocates and the people formerly known as audiences are all content contributors..." (Fahy and Nisbet, 2011). Such content production, may take the form of creating content about contested science issues, such as vaccines (Milani, Weitkamp, and Webb, in press).

In this sense the term 'the audience' can be contentious in itself (Wilkinson and Weitkamp, 2016), since to many in the science communication field it does not convey the reality of some contemporary communication approaches and/or the aspiration for communication. Audience can imply a passive role for recipients of information, whereas the affordances of online platforms such as news websites and social media mean that someone may actively seek out information (Hornig Priest, 2009). In contexts where someone may also go beyond simply listening to or seeking out information by actively contributing to it through participation in public engagement activities, such as science festivals or creating media themselves, individuals may more accurately be described as 'participants', 'publics' or 'citizens' (Wilkinson and Weitkamp, 2016). The term 'audience' is used here in the broad sense to denote all recipients of (science) information, while recognising that they may have played a role in seeking out information or contributing towards its development to varying degrees.

Digitalization is presenting communicators with new opportunities to foster dialogue with their audiences through the affordances of online platforms. It is also enabling new connections and collaborations between those with expertise in non-digital communication and those with expertise in digital communication. Science centres, for example, are increasingly employing digital technologies in their exhibition design, such as those that invite visitors to use their mobile phones to enhance the experience (Quistgaard and Kar-Hojland, 2009) and those that employ augmented reality (Salmi, Sotiriou and Bogner, 2010).

The research presented here attempts to understand the intended audiences of a wide range of actors engaged in science communication, the nature of the connections they have as well as the barriers they experience in forming or developing these connections.

2. Methodology

The majority of the data for this report was collected by means of a survey in each of the RETHINK partner countries - Italy, the Netherlands, the UK, Sweden, Poland, Serbia and Portugal. The questionnaire for the survey was developed by Elena Milani, Clare Wilkinson and Emma Weitkamp at UWE Bristol.

Further data, relating to the barriers science communicators experience in reaching their intended audiences, was collected at Rethinkerspace workshops held in each partner country. These workshops will take place throughout the RETHINK project and will provide environments in which science communication practitioners and academics working in science communication and related disciplines can provide their own perspectives and experiences. The data presented here were collected at the first of these Rethinkerspace meetings.

2.1 Survey

The development of the questionnaire and its distribution are described in the following paragraphs. The English version of the questionnaire is available in Appendix B.

The survey aimed to investigate the actors communicating science, technology and/or health and which audiences these individuals aim to reach and how. A number of questions in the questionnaire were adapted from previous reports on researchers communicating science topics (TNS BMRB and University of Westminster 2015; Royal Society, 2006). Other questions were informed by the observations made during the scoping study described in Derivable 1.1.

The questionnaire was developed in Qualtrics, a tool for designing and distributing surveys online. The questionnaire was pilot-tested between the 28th of August and the 7th of September 2019. Thirty-four professionals who were representative of the target participants were contacted by the UWE Bristol research team; seven of them were members of the RETHINK research teams in the partner countries. Twenty-two of these respondents completed the questionnaire and provided feedback, though three of them did not complete it fully. The questionnaire was edited to incorporate the pilot feedback and then translated by each research team into their national language. The translations were uploaded to Qualtrics to enable data collection.

The final version of the questionnaire was distributed between the 30th of September 2019 and the 1st of November 2019. The survey was distributed through official mailing lists, networks, associations, and societies of journalists, writers, press officers, communication officers, scientists, and organisers of public events that communicate science. Each research team in each country identified and contacted these types of groups and organisations. Snowball sampling was also applied to enrich the diversity of participants; respondents were asked to pass the survey to other potential participants. Individuals identified in the scoping study described in Derivable 1.1 who had a public email address were also contacted to increase the variety of participants.

2.2 Rethinkerspace workshops

Rethinkerspace workshops were held in RETHINK partner countries - the Netherlands, Poland, Portugal, the UK, Italy, Serbia and Sweden - between November 2019 and January 2020. During these meetings, participants took part in a series of group and plenary discussions and also completed activity sheets aimed at understanding and characterising their work. Organisers of the Rethinkerspaces followed a protocol developed by researchers at VU Amsterdam and UWE Bristol. The activity sheets were created by researchers at UWE Bristol.

The results presented here (Section 3.5) are derived from an 'audiences and connections activity' in which participants were asked to note down on a worksheet (provided in Appendix C) the audiences they intended to reach, the nature of the connections they have with these audiences, such as the social media platforms used and other mechanisms such as blogs, and the barriers they face in reaching those audiences. For some of the case studies, the data collected in this activity was supplemented by an emailed request for further information and/or clarification from specific Rethinkerspace members.

Rethinkerspace participants included science communication practitioners, academics and researchers in related fields such as journalism. Table 1 shows the roles of the participants of each Rethinkerspace. Those Rethinkerspace participants who were not engaged in science communication activities were asked to indicate the audiences they think practitioners *should* reach and the connections they *should* have on the audiences and connections activity sheet. Coding of the Rethinkerspace participant roles for Table 1 and the audience barriers analysis was conducted by Tessa Roedema at VU Amsterdam and Andy Ridgway at UWE Bristol.

The questionnaire and the Rethinkerspace workshops received ethical approval from UWE Bristol. Respondents were provided with GDPR compliant consent and information materials.

Table 1 Role of Rethinkerspace members in each country.

	Netherlands	Poland	Portugal	UK	Italy	Serbia	Sweden
Researcher (incl PhD student) - scicom/journalism							
University lecturer/professor - science			4	2	1		
University lecturer/professor - scicomm/journalism	1			1			
Journalist or editor	3	2	2	1	1	4	
Freelance communicator or writer	2				1	2	
Press officer or communication officer			7	3	1		5
Curator, explainer or museum employee	1				1	2	1
Policy maker or adviser	1						
Current undergraduate or postgraduate taught student				1			
Teacher						1	
Activist		2					

Blogger, YouTuber, social media influencer		2		1			1
Public engagement enabler	2		1	2			1
General science communication practitioner	4	2	2		1		2
Publisher					1		
(Video) Producer	1					1	
Joint role: scientist and science communicator	1	3	1	2	4	1	1
Total	**16**	**11**	**17**	**13**	**11**	**11**	**11**

Notes. The following categories were provided as options but not they were not included in any of the countries/Rethinkerspaces: Researcher (incl PhD student) – science; Healthcare professional; Documentary or movie maker; Artist or illustrator; Designer.

Individuals were included in the scientist and science communicator joint role when these two roles were a substantive component of their work life. This means that some subjective categorisation of individuals was required.

3. Results

Out of the 778 responses collected through the survey, 465 were complete[1]. Figure 1 below shows how many complete responses were collected for each country. Though we targeted participants from seven countries, twelve of the 465 completed responses were from Belgium, Ireland, Germany, Spain, France, Mexico or Canada. We included these twelve responses in the data analysis.

Figure 2 Complete responses received from each country.
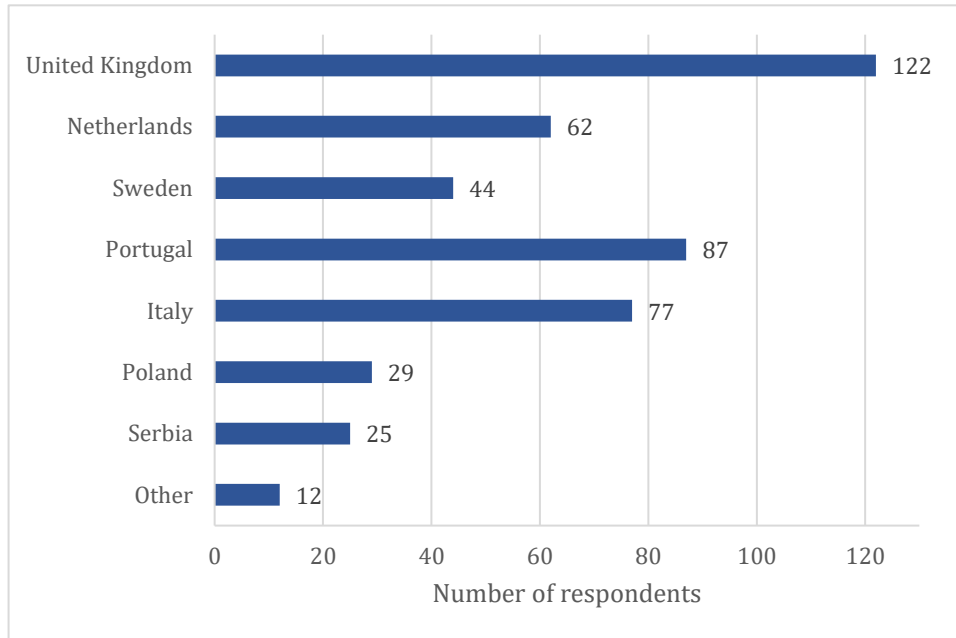
3.1 Respondent demographics

Of the respondents (total n=459) to the questionnaire, over half were female (59.3%, n=272) and 39.7% (n=182) were male. As shown in **Error! Reference source not found.**, the higher response rate from females occurred for most countries, except Poland, where females accounted for 37.9% (n=11) of the respondents.

Across all of the responses, in all of the countries, most of the respondents (83.6%) were under 45 years old; 30.8% (n=141) were 35-44 years old, 29.7% (n=136) were 25-34 years old, and 2.6% (n=12) were 18-24 years old. Again, similar patterns occurred across most countries: in Italy, the UK and Portugal, 60-70% of respondents were under 45 years old. In Poland and Serbia this percentage 80% were under 45 years old. Sweden was the only country where most respondents were older than 45 years old (75.0%, n=33) (**Error! Reference source not found.**).

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[1] 465 questionnaire respondents completed every section of the questionnaire. Response rates vary on some questions and % and numbers are provided for all data.

Figure 4 Percentage of female, male and non-binary respondents across countries
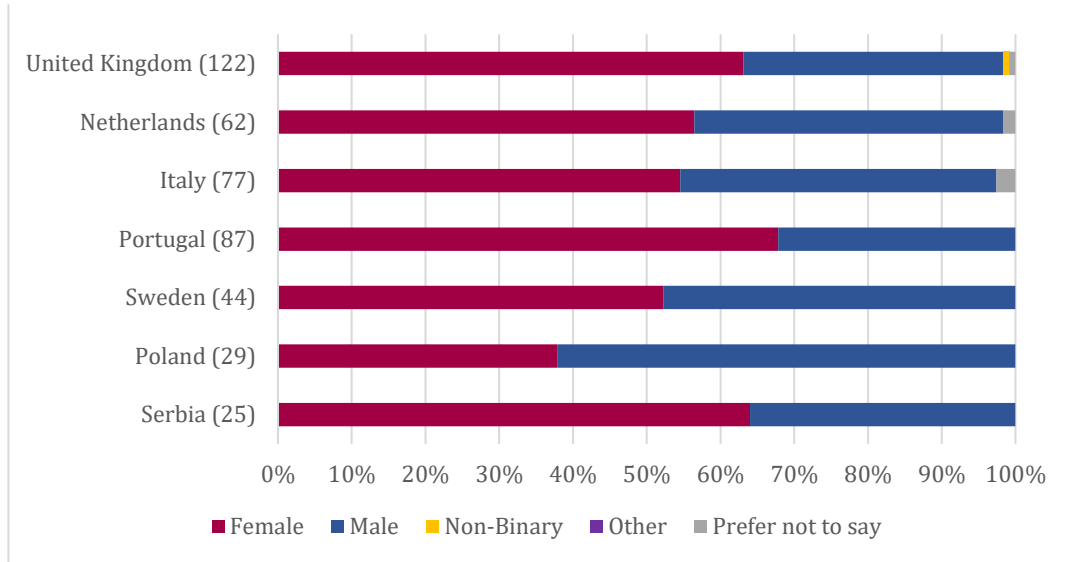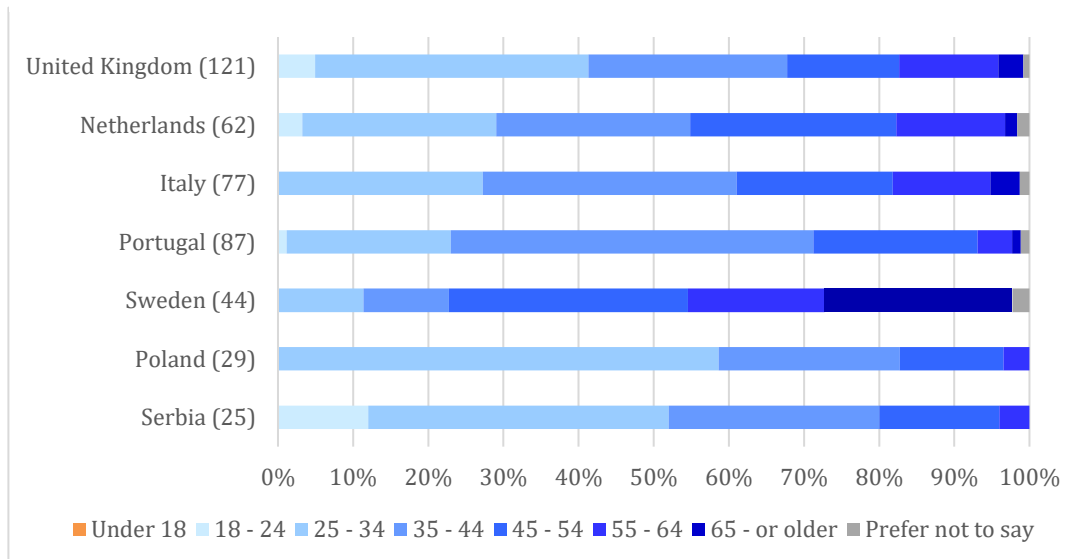

Figure 3 Percentages of respondents by age for each country

Many respondents defined themselves as press officers or communication officers, freelance communicators or writers, journalists, and/or researchers (they could choose more than one response)[2]. 85% of the respondents worked for an organisation (n=456). Of these, 202 worked for universities and research centres, 54 for museums and science centres, 40 for non-profit organisations and charities, 23 for the media and publishers, 19 in the business sector and 12 for professional associations and learned societies. 63% of the freelance communicators or writers work for an organisation as well (n=118), with universities and research centres being the most common sources of employment.

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[2] For full details on the role breakdown of respondents, see Deliverable 1.2 (Determining the roles and action repertoires of those engaged in science communication).

3.2 How these actors communicate about science, technology and/or health topics

Almost all respondents communicate about science (92.3%, n=429), while 47.5% (n=221) and 41.9% (n=195) communicate about technology and health topics, respectively (**Error! Reference source not found.**). Most of the respondents communicating about technology (97.7%, n=216) or health (90.8%, n=177) also communicate about another topic (e.g. science). Among those communicating about science, 64.8% (n=278) also communicated about another topic. Some respondents said they also communicate about other topics that were not listed in the question, such as sustainability or the environment, and many of these topics overlapped with science, technology and health issues.

When asked how they have communicated about these topics, 58.7% (n=266) and 55.6% (n=253) of respondents said they have regularly used social media for public engagement or outreach and written for the public, respectively. These percentages rose to 87.4% (n=396) and 86.4% (n=393) when including those who have communicated about sciences in these ways occasionally. Many respondents said they have engaged in several other activities to communicate about science-related topics, such as taking part in festivals or organising public events. Derivable D1.2 provides further information on how actors communicate about science, technology and health.

3.3 Who these actors are trying to reach

All respondents indicated a desire to reach particular audiences, with the exception of one person who specified no audiences. Most respondents however, ticked a wide range of audiences they are trying to reach, with only a few respondents selecting three choices or fewer. As shown in **Error! Reference source not found.**7, the majority of respondents said their target publics are non-specialist audiences (94.3%, n=414). Apart from in Serbia, non-specialist audiences were the top targeted audience in all countries. All respondents from Serbia indicated they target university students, and 22 out of 25 also aimed to reach non-specialist audiences. Table 1 illustrates the differences in priority of replies across countries.

University students, school teachers and/or researchers were targeted by more than half of the respondents in most countries. However, the level of interest in young people as an audience varied between countries. In Serbia both young people in and outside school were important target audiences, whereas in Sweden 25% or less of respondents aimed to reach them (n=11, n=8, respectively). In Portugal, the Netherlands and the UK more respondents said they target young people in school than outside school settings, whereas in Poland and Italy it was the opposite.

Overall, 52.2% (n=229) of respondents aimed at reaching policy makers, whereas fewer targeted non-governmental organisations (31.9%, n=140) and businesses (31.4%, n=138). Many respondents from Sweden focused on charities, think tanks, foundations (56.8%, n=25), and businesses (45.5%, n=20) as opposed to local communities (31.8%, n=14) and underserved audiences (22.7%, n=10). Charities and businesses were among the least targeted audiences in Italy (13.0%, n=10; 15.6%, n=12, respectively).

Only, 98 respondents targeted patients and patient groups; this could be related to the relatively small number of respondents (n=195) who communicate about health (most communicate about science and/or technology) and only 8 were health practitioners. 50.8% (n=223) of respondents aimed to reach local communities. In some countries this percentage was slightly higher (Portugal, Serbia) or lower (e.g. Sweden, Italy, the Netherlands). 29.4% (n=129) of respondents targeted underserved audiences; however, in the UK (42.6%, n=52) and in Serbia (36.0%, n=9) there was a much higher proportion of respondents seeking to reach these audiences. In Poland, only one respondent out of 29 aimed to reach underserved audiences.

Figure 7 Audiences targeted by the respondents.
Q) Which audiences do you aim to reach? Tick all that apply.
Total number of respondents: 439
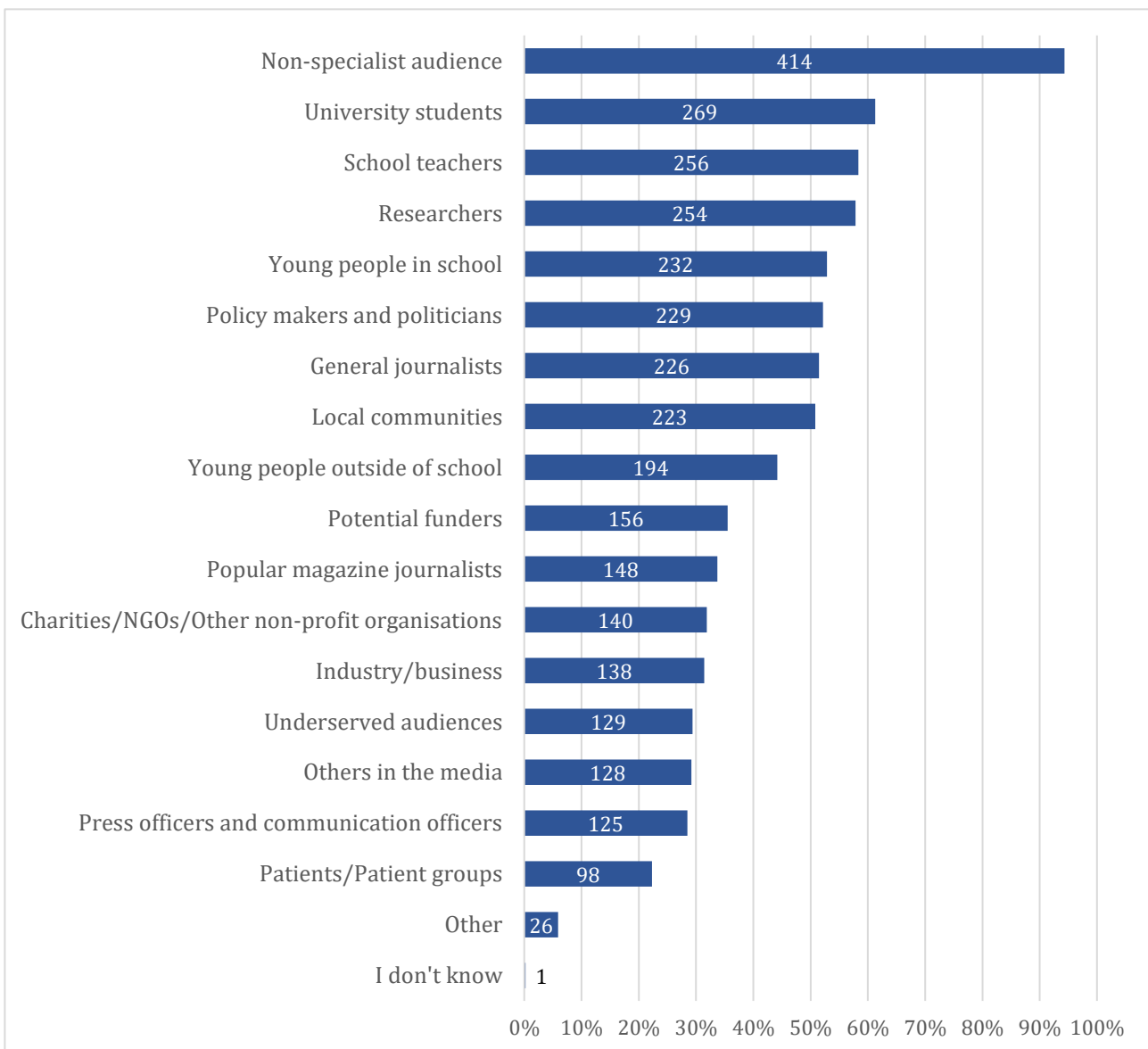
Priority of replies	1st	2nd	3rd	4th	5th
Non-specialist audience	Italy, Netherlands, Poland, Portugal, Sweden, UK	Serbia			
Researchers		UK, Sweden	Netherlands	Italy, Serbia	
Policy makers and politicians	Sweden		Netherlands, UK		
Local communities				Portugal, UK	Italy
University students	Serbia	Poland, Sweden	Italy	UK	Netherlands, Portugal
General journalists		Netherlands, Sweden		Poland	UK
School teachers		Italy, Portugal	Poland		Serbia
Young people outside of school	Poland	Serbia	Italy		
Young people in school			Portugal, Serbia	Netherlands	Poland
Charities/NGOs/Other non-profit organisations			Sweden		
Popular magazine journalists			Sweden		
Press officers and communication officers				Sweden	
Industry/business					Sweden

Links between actors engaged in science communication

Within the questionnaire we also took the opportunity to assess how communicators were seeking to reach other communicators within their professional settings. Several respondents targeted other communicators, especially school teachers (58.3% n=256), researchers (57.9%, n=254), policy makers (52.2%, n=229) and general journalists (51.5%, n=226). Fewer respondents aimed to reach popular magazine journalists (33.7%, n=148), writers, documentary and programme makers (29.2%, n=128) or press officers and communication officers (28.5%, n=125). These differences are detailed in Table 2.

Bloggers, YouTubers and social media influencers aimed at a wide range of communicators, from journalists and teachers (45%, n=9 each), to researchers (40%, n=8), press officers (30%, n=6) and others in the media (35%, n=7). Similarly, **healthcare professionals** aimed to reach a variety of communicators of science, technology and/or health. In particular, they targeted general journalists (75%, n=6), popular magazine journalists, press officers, researchers and policy makers (63%, n=5 each). Unlike bloggers and social media influencers, only a few healthcare professionals targeted school teachers (13%, n=1) or others in the media, such as writers or programme makers (38%, n=3).

Press officers and communication officers aimed to reach some communication professionals more than others. For example, 82% of press officers targeted general journalists (n=117). 52% of them aimed at popular magazine journalists (n=75) and 41% targeted other professionals in the media (n=59). Many press officers also aimed to reach researchers (69%, n=99) and policy makers (64%, n=91).

Documentary and movie makers also targeted other communicators, though not as broadly as bloggers, healthcare professionals and communication officers. Movie makers aimed to reach especially school teachers (83%, n=10), general journalists, researchers and policy makers (58%, n=7 each). **Journalists, editors, freelance communicators and writers** aimed their content at the same communicators targeted by documentary and movie makers, though in different percentages. For example, just over half of the journalists (56%, n=54) and of the freelance communicators (63%, n=74) aimed to reach school teachers.

Among the **researchers**, 44% aimed to reach general journalists (n=41), while less than 30% targeted popular magazine journalists (n=26), press officers (n=28) or others in the media (n=22). Researchers mostly targeted school teachers (60%, n=56) and other researchers (50%, n=55), as other communicators mentioned above did. **University lecturers and professors** aimed to reach the same type of communicators as the researchers and in a similar rank of priorities (n=24).

Curators, explainers and museum employees targeted very few types of communicators of science, technology and/or health. For example, 84% targeted school teachers (n=36), and less than half aimed to reach policy makers (n=17) and researchers (n=15). School teachers were even more selective; the majority targeted other teachers 86% (n=19) and only a few communicated to other professionals involved in science communication (see Table 2).

Table 2 Priorities of type of communicators reached by participants.

Priorities of communicators reached	1°	2°	3°	4°	5°	6°	7°
Researchers (n=93)	School teachers (56)	Researchers (55)	Policy makers and politicians (47)	General journalists (41)	PR and communication officers (28)	Popular magazine journalists (26)	Others in the media (22)
University lecturers/ professors (n=63)	School teachers (34)	Researchers (41)	Policy makers and politicians (34)	General journalists (34)	Popular magazine journalists (24)	Press officers and communication officers (19)	Others in the media (18)
Health professionals (n=8)	General journalists (6)	Popular magazine journalists (5)	PR and communication officers (5)	Researchers (5)	Policy makers and politicians (5)	Others in the media (3)	School teachers (1)
Journalists or editors (n=97)	School teachers (54)	General journalists (51)	Researchers (49)	Policy makers and politicians (45)	Popular magazine journalists (36)	PR and communication officers (29)	Others in the media (29)
Documentary or movie makers (n=12)	School teachers (10)	General journalists (7)	Researchers (7)	Policy makers and politicians (7)	Popular magazine journalists (5)	PR and communication officers (4)	Others in the media (4)
Freelance communicators or writers (n=118)	School teachers (74)	Researchers (52)	General journalists (49)	Policy makers and politicians (49)	Popular magazine journalists (33)	Others in the media (32)	PR and communication officers (26)
Press officers (PR) or communication officers (n=143)	General journalists (117)	Researchers (99)	Policy makers and politicians (91)	Popular magazine journalists (75)	Others in the media (59)	School teachers (58)	PR and communication officers (55)
Curators, explainers or museum employees (n=43)	School teachers (36)	Policy makers and politicians (17)	Researchers (15)	General journalists (11)	PR and communication officers (10)	Others in the media (8)	Popular magazine journalists (6)

Policy makers or advisers (n=20)	Policy makers and politicians (13)	School teachers (9)	Researchers (9)	General journalists (6)	PR and communication officers (5)	Others in the media (3)	Popular magazine journalists (2)
Artists or illustrators (n=13)	School teachers (7)	Researchers (7)	PR and communication officers (5)	Others in the media (5)	Popular magazine journalists (3)	General journalists (2)	Popular magazine journalists (1)
Designers (n=14)	Researchers (9)	School teachers (7)	General journalists (4)	Policy makers and politicians (4)	PR and communication officers (3)	Others in the media (2)	Popular magazine journalists (1)
Current undergraduate or postgraduate students (n=13)	School teachers (8)	Researchers (6)	Policy makers and politicians (4)	General journalists (3)	Popular magazine journalists (3)	PR and communication officers (3)	Others in the media (3)
Teachers (n=22)	School teachers (19)	Policy makers and politicians (6)	Researchers (6)	Popular magazine journalists (4)	Others in the media (4)	General journalists (3)	PR and communication officers (3)
Activists (n=19)	School teachers (13)	Policy makers and politicians (11)	General journalists (8)	Researchers (8)	PR and communication officers (5)	Others in the media (4)	Popular magazine journalists (3)
Bloggers, YouTubers, social media influencers (n=20)	General journalists (9)	School teachers (9)	Researchers (8)	Others in the media (7)	PR and communication officers (6)	Popular magazine journalists (6)	Policy makers and politicians (4)

Level of interest in science among target audiences

When asked about the interest in science, technology and/or health topics of their audiences, only 7 respondents out of 460 said their target audiences were not already interested in these topics, suggesting a high degree of focus on audiences with a pre-existing interest in science, technology and/or health (**Error! Reference source not found.**8). These seven respondents were from Portugal (2), Poland (1), the Netherlands (1) and Italy (3). The majority of respondents in all countries replied that some individuals in their audiences were already interested in science, technology and/or health, while others are not (74.4%, n=342).

Figure 8 Interest in science, technology and/or health of the respondents' target audiences.
Q) In your view, are your audiences already interested in science, technology and/or health?
Total respondents: 460

- Yes, they are already interested in these topics
- Some of them are interested in these topics others are not
- No, they are not interested in these topics yet
- I don't know
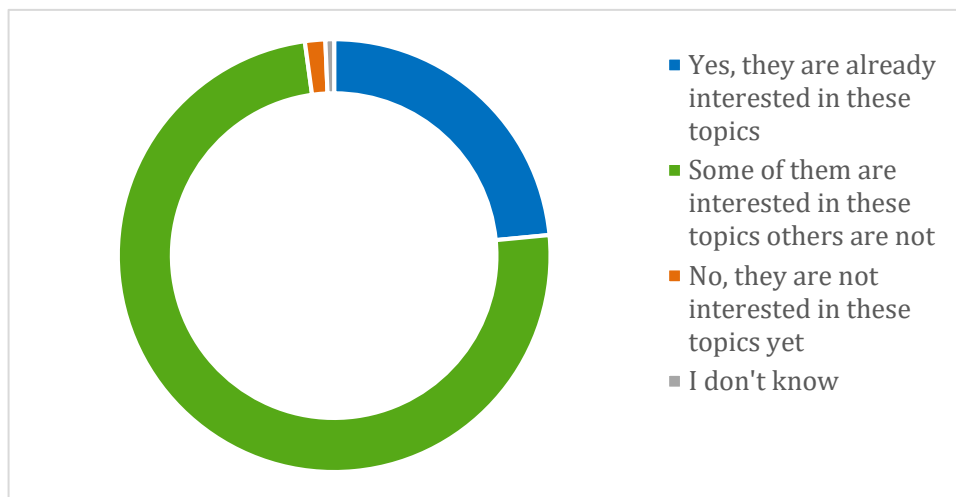
Audience geography and language

Though 223 respondents said they aim to reach 'local' communities, only 29 targeted audiences from their town or surrounding areas and 50 targeted publics from their region (**Error! Reference source not found.**). Just over half of the respondents aimed to reach audiences from everywhere – both within their country and overseas (52.2%, n=240), while 29.4% aimed at audiences within their country alone (n=135). These proportions varied across countries. In the UK, 71.3% (n=87) of respondents targeted international audiences and 9.8% national audiences (n=12), whereas in Italy only 29.9% (n=23) aimed at a global audience and 48.4% (n=33) aimed at those from their own country. In the Netherlands and Poland, around 41% target audiences from everywhere (n=26, n=12, respectively) and around 48% targeted national audiences (n=30, n=14, respectively).

Figure 96 Where the respondents' audiences are from. Total respondents: 460.
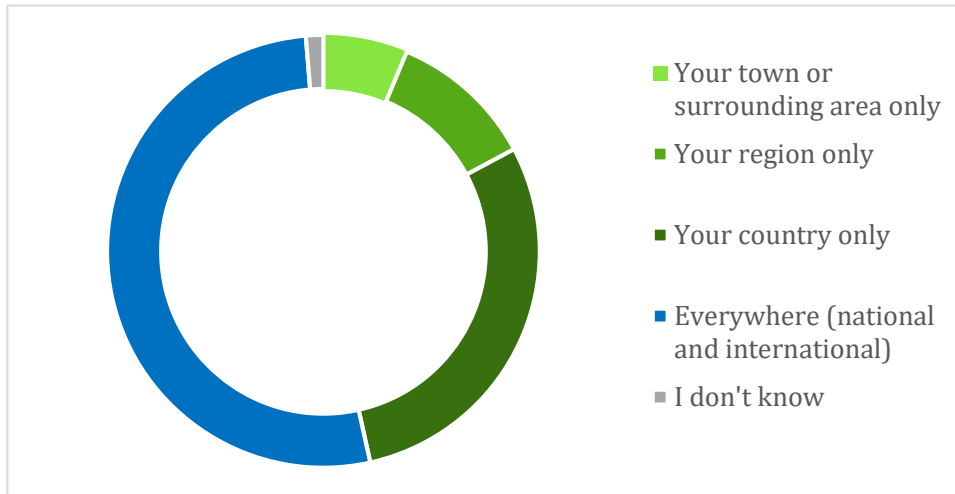
These findings make sense when you consider the respondents' answers about the language in which they communicate. As shown in **Error! Reference source not found.**0, 62.9% (n=288) of respondents said they communicate in their first language, 9.6% (n=44) in another language, and 27.5% (n-126) in both a first and second language. In the UK, 85.0% (n=102) communicated to their audiences in their first language, English. 10.8% (n=13) of communicators from the UK who were not English speakers (as their first language) communicated in English as their second language. Only 4.2% (n=5) of the respondents from the UK communicate both in their local language and another language. This proportion was higher in the other countries, especially in Sweden (43.2%, n=19) and Portugal (48.2%, n=42), where more than half of the respondents aimed to reach international audiences. In Italy, Poland and Serbia, most respondents communicated in their first language only. In particular, 76.3% of Italian respondents (n=58) communicated only in Italian, and 68.8% (n= 53) aimed at national audiences (regional – local audiences). The most common second language across all countries (except the UK) was English.

Figure 50 In what language respondents communicate to their audiences. Total respondents: 458
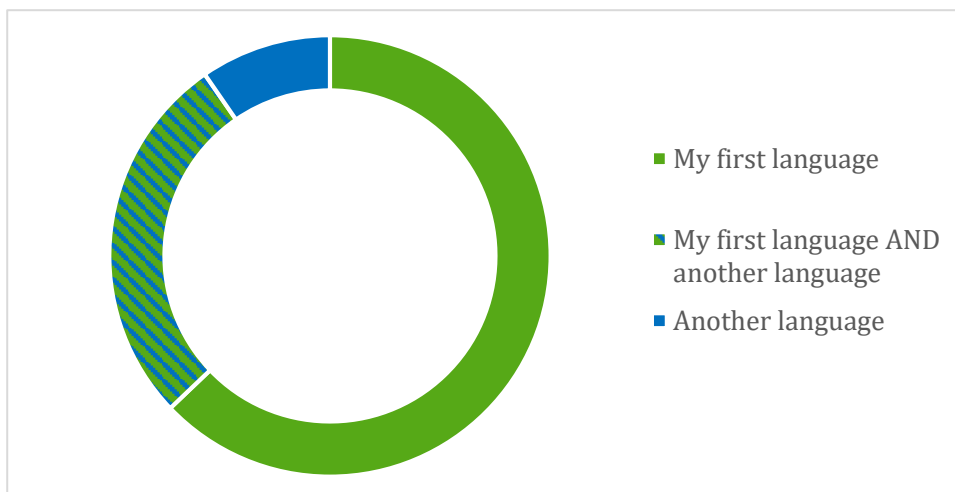
3.4 Evaluation of communication activities

Most of the respondents both produce content and curate content for their audiences (Figure 11); i.e. they create content (content production), and they re-share, repost content that could be relevant to the audience (content curation). Few respondents only curate content (7.2%, n=33); the proportion of respondents doing this was higher in Serbia (16.0%, n=25), Portugal (10.3%, n=87) and Sweden (9.3%, n=43). In the Netherlands, only 1.6% of respondents only curated science content for their audiences (n=62).

In addition, 7.6% of respondents neither produce nor curate any content about science, technology and/or health topics (n=35). In this question, content curation was defined from an online communication perspective (i.e. as re-sharing or re-posting content). Therefore, those communicators who do not produce nor curate content may communicate content in offline activities (e.g. a public talk). The percentage of communicators who identified with this category was the highest in the UK (11.5%, n=14) and the lowest in Italy (3.9%, n=3).

Figure 71 Respondents' content production and/or curation.
Q) Do you create any original content (e.g. articles, graphics, videos) or curate content produced
by others on science, technology and/or health topics? Total respondents: 460

- I produce content
- I curate content
- I both produce and curate content
- I don't produce or curate content
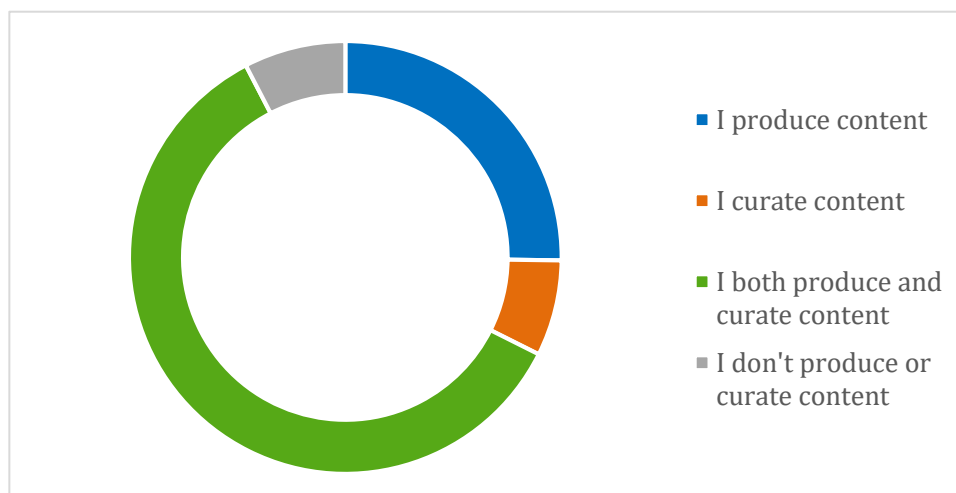
Among the respondents who do produce science, technology and/or health content, the majority do some kind of evaluation on the reach of their information (79.8%, n=313); for example, they check the analytics of their website or social media accounts, carry out questionnaires with their audiences, or work with external evaluators (Figure 12). Among those who do any kind of evaluation, slightly more respondents (43.1%, n=169) tend to work with others to evaluate their content and communication rather than doing it themselves (36.7%, n=144) (**Error! Reference source not found.**2). Those who do not evaluate their content, said they lack the time to do the evaluation or the skills, and 7.4% said evaluating content is not relevant to their work (n=29).

In almost all countries, despite many working with others to evaluate, over 60% of respondents that produce content also evaluate it; the only exception is the Netherlands, where only 40.4% of respondents do any evaluation (n=23). Moreover, the main reason why respondents do not evaluate their content or communication in the Netherlands, is that they say this task is not

relevant to their work (31.6%, n=18). In the other countries, the main reason that respondents do not evaluate their content is lack of time (Poland, Sweden, and he UK) and/or lack of skills (Italy, Portugal, Serbia).

Figure 82 Respondents' evaluation of content.
Q) Do you carry out any evaluation of the content you produce (e.g. check data analytics, carry out questionnaires, work with external evaluators)? Tick all that apply. Total respondents: 392
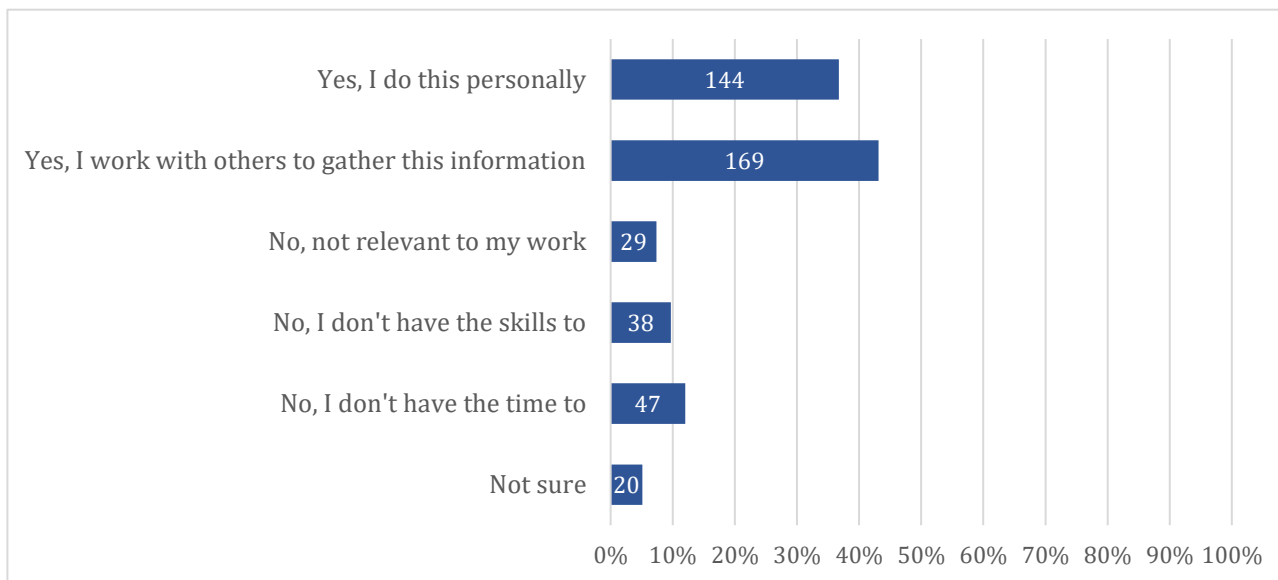
3.5 Barriers to reaching audiences

This section explores barriers faced by Rethinkerspace participants in reaching their audiences through mini case studies of individual Rethinkerspace participants. These case studies (one from each country) have been selected to provide examples of barriers typical of those experienced by science communication practitioners in each country as 'thinking' insights. The discussion below is intended as an exploration of barriers rather than being a comprehensive analysis. It illustrates the similarities and differences in the barriers experienced by science communicators with different roles and audiences.

UK Rethinkerspace

Number of members: 13   *Most common member role*: Press officer/communication officer

Case study

A Rethinkerspace member who works as a press officer listed "potential future employees" as an audience. She broke this down further into sub-audiences of parents, young people, women and "harder to reach audiences e.g. lower earning areas". In terms of the nature of the communications with these audiences, these were described as "own channels" and "outside

channels". Own channels included several digital platforms; Facebook, Instagram, Twitter, Website/blog as well as face to face connections. Outside channels comprised contributions to blogs run by other organisations, contributions to the media as well as staff contributing to their own social media channels, such as LinkedIn.

Barriers to communication with these "potential future employees" were linked to the digital platforms used and listed as: "Getting info back, generating a conversation. Difficult to know what they [the audience] want," and "How to break out of existing audiences to a broader group." Some of these potential future employees are those who are qualified to work for the organisation. Here there is deemed to be a lack of knowledge of the style of content and language that appeals to this audience when jobs are being advertised. Other potential employees targeted are younger; employees of the future. Here the aim is to encourage young people to study STEM subjects so they may work for the organisation in the future. With these individuals, the challenge is deemed to be around understanding how to segment what is perceived to be a broad audience, and knowing what content appeals to which groups.

The barriers linked to the outside channels were: "Hard to make space relatable" and "Competing with lots of other media".

The other audience listed by this Rethinkerspace member was "policymakers/funders" and communications with these audiences take place via Twitter and LinkedIn as well as being "face to face" at events run by her employer, or events they take part in. This participant stated barriers to communication as the "…competing priorities faced by policy makers" as well as a perceived need for "… general public support and interest" to get policymakers to act on the science being communicated. Such public support is deemed to be particularly important in securing funding from the policymakers.

Italian Rethinkerspace

Number of members: 11   *Most common member role*: Scientist and science communicator

Case study

A scientist and science communicator in the Italian Rethinkerspace identified school classes among her audiences, stating that connections take the form of visits by pupils to her research centre. In terms of barriers, she said: "The more 'served' schools are more active and hard-to-reach schools/classes are less served." The hard to reach schools are those in which teachers and/or the headteacher does not or cannot respond to offers of visits to the research centre. In some instances, says this Rethinkerspace member, it may be a teacher's lack of time to request or attend these visits due to other responsibilities, such as supporting pupils from disadvantaged backgrounds, that stands in their way. She also stated: "Time is a huge constraint. One would need longer interactions to build solid interactions."

This participant also described collaborations with researchers to communicate their research with the public, including schools. In terms of barriers they described: "Desire of researchers to be very specific vs comprehensibility." Also: "The researchers don't have enough time" and

"Principle investigators and research group leaders often consider science communication a loss of time and don't like their students/postdocs to do it."

Citizens in the local community were identified as another audience. Here the communication takes place through conferences, exhibitions and citizen science projects. In terms of barriers, this participant stated: "Difficult to get in touch with many social groups. We miss the good channels to involve them. Probably we would need to involve more intermediaries."

Serbian Rethinkerspace

Number of members: 11   *Most common member role:* Journalist or editor

Case study

A science communication practitioner who works in a venue that hosts science activities and at science events stated that one audience is young people outside of school and he connects with them through workshops and lectures. The barrier to the audience was "lack of interest" on the part of the audience. They added: "It is tremendously difficult to get children aged 11-16 interested in any kind of workshops or lectures. They stated that the primary school and high school system does not encourage an interest in science and added: "Therefore, a great deal of effort must be made to bring science closer to children."

Another audience was researchers, who are reached via social networks. The stated barriers are "Lack of support" and "Hard to reach target group." A final audience is "Teachers/professors". As with the researchers, the goal in reaching these is to encourage them to communicate their science and encourage others to do that too. No connections are described and "lack of support" and "lack of time" are the barriers provided. This lack of support was said to be from the target institutions, such as Universities. This participant added: "Even laboratories at Universities are hard to reach and they play a major role in the effort of researchers who want to advance by presenting their research to a bigger audience."

This participant stated that they aimed to create a community of science communication practitioners who will work together to overcome their respective barriers to reaching their audiences.

Swedish Rethinkerspace

Number of members: 11   *Most common member role:* Press officer/communication officer

Case study

One Rethinkerspace participant runs a science podcast and stated that the intended audience is "listeners". The barriers to this audience were "Lack of time to engage with listeners" and "[There are] 1000s of podcasts. How to break through and reach out?" They also stated that a barrier is: "Reach[ing] those not used to podcast listening." This participant also runs live science events and stated that the audience is mostly aged 20-40. The barriers are: "Little

knowledge of what happens after the shows. Does the knowledge get spread?" This participant also stated: "Short time to talk about complicated stuff" and "Some academics tend not to want to speak about stuff outside their field."

Dutch Rethinkerspace

Number of members: 16   *Most common member role:* General science communication practitioner

Case study

A freelance journalist in this Rethinkerspace indicated that she mainly reaches those already interested in science, but she aims to reach those of lower socio-economic status and less well educated people as well. She communicates through articles in newspapers and magazines as well as via Twitter. In terms of the less well-educated audience, the barrier mentioned here was: "They might not read the kind of media I produce and they are discouraged by the language I use."

In terms of the more educated readers, this Rethinkerspace member divided them into two broad groups – those who are extremely critical of the mainstream media she writes for, such as newspapers, and those who are not critical of what they read because they identify with the publication. When speaking of the typically more educated readers, she said: "I wouldn't be able to get to them because they hate mainstream media and are very critical of it. She said that someone in this group may say something like: "Well, newspapers, you can't trust them all."

This Rethinkerspace member also writes for a popular science publication. She said of this: "The articles included in there are of a different caliber. Some people mainly respond 'gosh, nice to know' but it ends there. It doesn't make you a very critical citizen. People can browse through the magazine and find nice things in it, but that is not my goal."

In terms of her goal, this participant indicated that it is important to her that she enables people to shape their own opinion based on well balanced and fair information.

Polish Rethinkersapce

Number of members: 11   *Most common member role:* Scientist and science communication practitioner

Case study

One scientist blogger stated they want to reach 'average Joe' through blogs, Facebook posts and lectures. The barriers stated by this participant were: "inherent fear of science" and "hard topics" – adding that sometimes just by seeing chemical formula or simple equation induces a panic reaction in the audience. Another stated barrier is the politicization of topics, like climate or energy. As is "people wanting clear and fast answers to complicated issues, and you must have

time to be able to do that". In relation to this barrier, this Rethinkerspace participant added that they believe these complicated issues are not beyond the capacity of the audience to understand, but it requires time to explain them. Several participants in this Rethinkerspace mentioned not having enough time and money to do science communication properly; especially when aiming to reach out to new or hard to reach audiences.

Portuguese Rethinkerspace

Number of members: 17   *Most common member role:* Press officer/communication officer

Case study

One Rethinkerspace participant who works as a public relations employee stated their intended audience to be policymakers, who they reach through their support staff; advisors who work with political parties in commissions and committees. They stated that some support staff are specialized in specific subjects and these can be particularly helpful in reaching policymakers. These support staff are usually reached through direct contact (with the ones known to the Rethinkerspace member), by email or social media.

This participant considered policymakers to be a hard audience to reach, due to a "lack of interest" and a "lack of forums to meet or discuss". They stated that it a "stable connection" with them through teams that support science-based policy and discussion forums with policy makers would facilitate this interaction. They also suggested science cafes at parliament and regular debates involving scientists and policymakers.

This participant also aims to reach journalists. The connection here was direct contact, such as through phone calls and e-mail, press releases and social media platforms, such as Twitter. Barriers mentioned here were a lack of time on both sides, little space for science in the media, and the lack of availability of scientists. University students were the third audience that this participant indicated they aimed to reach. Again, social media, such as Twitter, Instagram and Facebook, were indicated to be a connection with this audience. However, this participant indicated that universities themselves formed a barrier towards connecting with University students, adding that organizing presentations for students and inviting students to participate at events can be a challenge.

4. Conclusions

This report captures the activities a variety of actors communicating about science, technology and/or health to diverse audiences. Among the actors who participated in the survey, many were press officers and communication officers. There were also journalists and editors, freelance writers and communicators, researchers and university lecturers or professors.

Almost all survey participants aimed to reach non-specialist audiences and a very high number targeted individuals who were already interested in science, technology and/or health topics to some degree, echoing the findings of Bultitude and Ranger (2016) and Brown Jarreau and Porter (2018). Only 1.5% (n=7) of survey respondents aimed to reach publics that are not interested in science-related topics. Moreover, most of the respondents aimed to reach international or national audiences. Though 50.8% (n=223) of participants said they want to reach local communities, only 17.2% (n=79) targeted audiences from their surrounding area or their region. The respondents also targeted several other groups other than non-specialist audiences, such as other communicators or young people and university students.

Underserved audiences were mentioned by only 29.2% (n=129) of survey respondents despite the attention that is often now paid to these groups from a strategic perspective. The percentage of respondents targeting these audiences differed across countries: 42.6% of participants in the UK (n=52) and 36.0% in Serbia (n=9) wanted to reach underserved audiences. In the other countries this percentage was lower, reaching its lowest value at 3.4% in Poland (n=1). These differences could be related to different policies and practices applied in each country. Even so, there may be a gap between the science communication and public engagement policies advocated by organisations and institutions, and the actual practices and aims of the actors carrying out science communication activities.

In terms of the links between actors engaged in science communication, the survey demonstrates that the most commonly targeted communicators are school teachers. They were targeted by 58.3% of respondents overall and were selected as the highest priority of the communicators to reach by several of the different types of actors surveyed. Researchers and policy makers were also commonly targeted (57.9% and 52.2% respectively).

For press officers and communications officers, their primary target was general journalists (82%), as might be expected with this job role. However, for some actors their primary targets were less obvious. For researchers and university lecturers/professors for example, their primary target was school teachers, followed by researchers and then policy makers. Whereas bloggers, YouTubers and social media influencers aimed at a wide range of fellow communicators.

Most of the survey respondents both produce and curate content about science, technology and/or health. The majority of participants also evaluate the reach of their content and communication either by working with others, or doing it themselves. This evaluation may take the form of checking the website or social media analytics or questionnaires. Some respondents do not evaluate the information they produce because they lack the time or the skills to do so.

The Rethinkerspace member case studies provide an insight into some of the specific barriers faced by those communicating science to reaching their intended audiences. The nature of these barriers is influenced by the role of the science communicator, their intended audience and the

medium of communication employed. The case studies demonstrate that while digital forms of communication, such as social media, can facilitate two-way conversations between communicator and audience in principle, in practice this may not happen. Digital media may instead act as a one-way, broadcast medium in many instances.

Time was listed as a barrier to reaching audiences by several Rethinkerspace members. For the Swedish participant with a podcast, time was the perceived constraint on engaging in dialogue with the audience. The Italian Rethinkerspace participant, a scientist, related that their desire to collaborate with fellow researchers on communication activities is stymied by the lack of time these researchers have for such activities. This may well be connected with a further point they made about science communication activities not being perceived as a valuable use of time by research principle investigators; which will then influence the priorities of the researchers themselves. The restrictions on science communication activities presented by time and the perceptions of such activities by other researchers, echo the findings of similar earlier studies, such TNS BRNB and University of Westminster, 2015 and are also further discussed in Deliverable 1.2.

Several Rethinkerspace members reported a sense of being disconnected with their intended audience when outlining the barriers. This disconnect took different forms. For the UK Rethinkerspace participant seeking to reach potential employees through digital means, it took the form of not knowing what the audience wants. For the Swedish Rethinkerspace participant, this took the form of not knowing how the audience responds after their live science shows. For the Italian Rethinkerspace participant, the disconnect manifested itself through a lack of communication channels through which to reach an intended audience of the local community.

This research demonstrates that in spite of the intentions of many within the sector to broaden the range of audiences reached by science communication, this is being achieved to varying degrees. Also, in spite of the opportunities afforded by digitization, many communicators still sense a lack of connection between themselves and those they intend to reach. It must also be recognised that there are national differences between European countries in the extent to which broadening the range of audiences *is* the stated intention.

It is a similar picture with another established tenet of science communication, at least within the academic literature; that of engaging audiences in a two-way dialogue rather than one-way 'deficit' communication. There are national differences in the extent to which this is an aspiration and even where it is, such intentions are frustrated even on digital platforms that would appear to facilitate such discussion.

References

AbiGhannam, N. (2016) Madam Science Communicator: A Typology of Women's Experiences in Online Science Communication. *Science Communication*. 38(4). Pp. 468-494.

ASDC (2014) UK Science and Discovery Centres: Effectively Engaging Under-Represented Groups. ASDC. Bristol, UK. Available online: https://www.sciencecentres.org.uk/national-impact/uk-science-and-discovery-centres-effectively-engaging-under-represented-groups/uk-science-and-discovery-centres-effectively-engaging-under-represented-groups/ [accessed on 06/03/20]

Baram-Tsabari, A. and Lewenstein, B.V. (2017) Science Communication Training: What Are We Trying to Teach? International Journal of Science Education, Part B. 7 (3). Pp. 285-300.

Bauer, M.W., Howard, S., Romo, R., Yulye, J., Massarani, L., and Amorim, L. (2013) Global Science Journalism Report: Working Conditions and Practices, Professional Ethos and Future Expectations. Our learning series, Science and Development Network, London, UK.

Brown Jarreau, P., and Porter, L. (2018) Science in the Social Media Age: Profiles of Science Blog Readers. Journalism and Mass Communication Quarterly. 9(1). Pp142-168.

Brugnoli, E., Cinelli, M., Quattrociocchi, W., and Scala, A. (2019) Recursive Patterns in Online Echo Chambers. *Scientific Reports.* (9). Available online: nature.com/articles/s41598-019-56191-7#citeas [Accessed on: 12 May 2020].

Carpentier, N., Dahlgren, P. and Pasquali, F. (2014) The Democratic (Media) Revolution: A Parallel Genealogy of Political and Media Participation. In Carpentier, N., Schroder, C., and Hallet, L. (eds) Audience Transformations: Shifting Audience Positions in Late Modernity. New York: Routledge.

Casini, S., Neresini, F. (2012) Behind Closed Doors: Scientists' and Science Communicators' Discourses on Science in Society. A Study Across European Research Institutions. Tecnoscienza. 3(2), Pp. 37-62.

Del Vicario, M., Vivaldo, G., Bessi, A., Zollo, F., Scala, A., Caldarelli, G., Quattrociocchi, W. (2016) Echo Chambers: Emotional Contagion and Group Polarization on Facebook. *Scientific Reports*. 6. Available online: https://www.nature.com/articles/srep37825#citeas [Accessed on 06/03/20].

Ecklund, E.H., James, S.A., Lincoln, A.E. (2012) How Academic Biologists and Physicists View Science Outreach. *PLoS One.* 7(5). Pp. 1-5.

Ecsite (date unknown). Mission. Ecsite. https://www.ecsite.eu/about/mission [viewed 06/03/20]

Fahy, D. and Nisbet, M. (2011) The Science Journalist Online: Shifting Roles and Emerging Practices. *Journalism*. 12(7). Pp. 778-793.

Fitts Willougby, J. and Smith, H. (2016) Communication Strategies and New Media Platforms: Exploring the Synergistic Potential of Health and Environmental Communication. *Science Communication*. 38(4). Pp. 535-545.

Haran, B. and Poliakoff, M. (2011) How to Measure the Impact of Chemistry on the Small Screen. *Nature Chemistry*. 3. Pp. 180-182.

Karacapilidis, N. Web-based Learning Solutions for Communities of Practice: Developin Virtual Environments For Social and Pedagogical Advancement. Hersey, PA. Pp.185-208.

Milani, E., Weitkamp, E. and Webb, P. (in press) The Visual Debate on Twitter: A Social Network Analysis. Media and Communication.

Quistgaard, N. and Kahr-Hojland, A. (2010) New and Innovative Exhibition Concepts at Science Centres Using Communication technologies. *Museum Management and Curatorship.* 25(4). Pp.423-436.

Ranger, M. and Bultitude, K. (2016) 'The Kind of Mildly Curious Sort of Science Interested Person Like Me': Science Bloggers Practices Relating to Audience Recruitment. *Public Understanding of Science*. 25(3). Pp. 361-378.

Royal Society (2006) Science Communication: Survey of Factors Affecting Science Communication by Scientists and Engineers.

Salmi, H., Sotiriou, S. and Bogner, F.X. (2010) Visualising the Invisible in Science Museums and Science Centres: Augmented Reality Technology Application in Science Teaching. In Karacapilidis, N. (Ed) *Web-Based Learning Solutions for Communities of Practice: Developing Virtual Environments for Social and Pedagogical Advancement*. US: Information Science Reference.

TNS BMRB and University of Westminster (2015) Factors Affecting Public Engagement by Researchers: A Study on Behalf of a Consortium of UK Public Research Funders. London: TNS BMRB.

Walter, S., Bruggemann, M. and Engesser, S. (2017) Echo Chambers of Denial: Explaining User Comments on Climate Change. Environmental Communication. 12 (2). Pp. 204-217.

Wilkinson, C. and Weitkamp, E. (2016) *Creative Research Communication: Theory and Practice*. Manchester: Manchester University Press.

World Bank (2019). Individuals Using the Internet (% of Population). World Bank. https://data.worldbank.org/indicator/IT.NET.USER.ZS [Accessed on 06/03/20]

Appendix A

Contact email

The email below was sent to the participants to invite to take the survey (English version). The email was translated in the language relevant to the country where participation was sought.

Dear [name],

I'm getting in touch with the hope you can help. Here at [name of the institution] we are working in collaboration with the University of the West of England (Bristol) on a European on a European Commission-funded research project called RETHINK, which is exploring how science-related topics are communicated across Europe – predominantly online. As part of this research, we have developed a survey aimed at those involved in communication of science, technology and/or health topics in some way, exploring what they do and why. Given your contribution to the communication field, we are hoping that you can spare a little time to complete the survey.

The survey shouldn't take any more than 15 minutes to complete. You can access the survey using this link: https://uwe.eu.qualtrics.com/jfe/form/SV_ai4iDeugRSAE4Ch

Please, can you also pass the survey onto anyone else in your networks in the [country], to whom you think the survey is relevant/pertinent?

The survey will close on **the 21st of October 2019**. Details of the ethical considerations are outlined in the survey.

Thank you in advance for your time.

Appendix B

This Appendix includes the full version of the questionnaire. However, this derivable reports only part of the findings of the survey. Some of the findings, for example those about roles and repertoires, are reported in Derivable 1.2.

RETHINK survey

Welcome to the RETHINK project questionnaire.

This questionnaire is part of RETHINK, a Horizon 2020 project funded by the European Commission. The data gathered will be collected and analysed by researchers based at the Science Communication Unit, University of the West of England, Bristol. This study aims to explore the current practices, motivations, incentives, responsibilities as well as limitations such as time, skills, and resources, of actors engaged in the public communication of research, science and health. It will also capture how these actors engage with their audiences and who their target audiences are.

The data we collect are 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. 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 science communication. The final report will be published online and will be publicly available.

Participation is voluntary. You may ask for your contribution to be withdrawn from the study by the 27th of October 2019 and you will be asked for a memorable word within the questionnaire to facilitate this.

The questionnaire will take approximately 15 minutes to complete, and it is entirely your choice as to whether to complete it or not. When you click the SUBMIT button at the end of the survey, you give your consent for any answers you have given to be included in the study. Additional information on Data Protection is also provided.

If you have any question on the questionnaire or would like 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 to this questionnaire.

Communicating science, technology and/or health

This first section is about how you communicate publically (e.g. on social media) about science, technology and/or health topics.

Q1) Do you communicate any of these three subjects?
Tick all that apply.

☐ Science

☐ Technology

☐ Health

☐ Other. Please specify

Q2) We would like to know more about how you communicate science, technology and/or health topics. Tell us which communication activities have you done on behalf of an organisation or community (e.g. university, company, association) and/or for yourself in the last 12 months.
Tick all that apply.

	I have done this regularly	I have done this occasionally	I haven't done this
Writing for the public (news media, articles, newsletters, books)	○	○	○
Engaging at festivals or fairs (science, literary, arts)	○	○	○
Working/collaborating with a Science Museum or Centre	○	○	○
Giving a public talk to non-specialist audiences	○	○	○
Working with teachers and schools	○	○	○

Engaging via theatre or performance (e.g. dance, science comedy)	○	○	○
Organising public engagement or outreach events	○	○	○
Curating a blog	○	○	○
Making a podcast	○	○	○
Collaborating on the creation of an educational game	○	○	○
Making videos or documentaries	○	○	○
Designing infographics or interactive data visualizations	○	○	○
Working/collaborating in art projects (e.g. Science&Art, graphic novels, comics)	○	○	○
Using social media for public engagement or outreach	○	○	○
Collaborating/co-production with public or patient groups	○	○	○
Engaging with policy makers	○	○	○

Q3) What digital media outlets do you use to communicate science, technology and/or health topics? Tell us which outlets have you used on behalf of an organisation or community (e.g. university, company, association) and/or for yourself in the last 12 months.
Tick all that apply.

	I use it on behalf of an organisation or community	I use it in a professional capacity	I use it in a personal capacity	I don't use it	I don't know what it is
Website	☐	☐	☐	☐	☐
Blog (including Medium and Tumblr)	☐	☐	☐	☐	☐
Twitter	☐	☐	☐	☐	☐
Facebook	☐	☐	☐	☐	☐
Instagram	☐	☐	☐	☐	☐
Pinterest	☐	☐	☐	☐	☐
Flickr	☐	☐	☐	☐	☐
LinkedIn	☐	☐	☐	☐	☐
Reddit	☐	☐	☐	☐	☐

Video platforms (e.g. YouTube, Vimeo)	☐	☐	☐	☐	☐
Forums (e.g. Quora, ASKfm)	☐	☐	☐	☐	☐
Snapchat	☐	☐	☐	☐	☐
Instant Messaging apps (WhatsApp, Telegram)	☐	☐	☐	☐	☐
Apps (e.g. games, news, health-tracking)	☐	☐	☐	☐	☐
Virtual reality or virtual museums	☐	☐	☐	☐	☐
Second life	☐	☐	☐	☐	☐
Myspace	☐	☐	☐	☐	☐
Podcast platforms	☐	☐	☐	☐	☐

Q4) Are there any other communication activities or digital media outlets that you use to communicate science, technology and/or health topics?

Q5) When you communicate about science, technology and/or health, what are you trying to achieve?
Tick all that apply.

- ☐ Inform
- ☐ Educate
- ☐ Entertain
- ☐ Inspire young people to pursue a career in science, health, technology
- ☐ Create conversations between researchers and the public
- ☐ Counter misinformation
- ☐ Promote my work/project/myself
- ☐ Encourage evidence-based attitudes and behaviour
- ☐ Persuade them to adopt my point of view
- ☐ Influence their views on the topic
- ☐ Encourage underserved audiences (e.g. ethnic minority groups, LGTBQ+ community)
- ☐ Don't know
- ☐ Other. Please, specify

Q6) In your communication, how important do you think it is to include the following aspects of science, technology and/or health?

	Very important	Important	Neither important or unimportant	Unimportant	Not important at all
New research	○	○	○	○	○
Areas for future research	○	○	○	○	○
Scientific process, research methods,	○	○	○	○	○

nature of science					
Complexity of science and research	○	○	○	○	○
Scientific uncertainty	○	○	○	○	○
Uncertainty associated with medical treatments	○	○	○	○	○
Policy and regulatory issues	○	○	○	○	○
Social or ethical implications	○	○	○	○	○
Day-to-day research experience	○	○	○	○	○
Scientific controversies	○	○	○	○	○
Scientific information and facts	○	○	○	○	○
Countering misinformation	○	○	○	○	○
Enjoyment and enthusiasm of doing science	○	○	○	○	○

Q7) Are there any other aspects of science, technology and/or health that you consider important to communicate?

Creating and curating content
In this section, we will ask you about the content you produce or curate (e.g. articles, infographics, videos, activities) and how you create your content starting from the story you decide to cover. As a story, we mean an event, discovery, or topic about science, technology and/or health that you choose to communicate.

Q8) Do you create any original content (e.g. articles, graphics, videos) or curate content produced by others on science, technology and/or health topics?

☐ I produce content

☐ I curate content (e.g. reshare, repost content I think it is relevant for my audience)

☐ I both produce and curate content

☐ I don't produce or curate content

Q8.1) Do you carry out any evaluation of the content you produce (e.g. check data analytics, carry out questionnaires, work with external evaluators)?
Tick all that apply.

☐ Yes, I do this personally

☐ Yes, I work with others to gather this information

☐ No, not relevant to my work

☐ No, I don't have the skills to

☐ No, I don't have the time to

☐ Not sure

Q9) How do you choose which science, technology and/or health story to cover? Tell us how important each factor is in determining how you select a story.

	Very important	Important	Neither important or unimportant	Unimportant	Not at all important	I am told to focus on this

Breaking news	○	○	○	○	○	○
Scientific merit	○	○	○	○	○	○
Relevance to society	○	○	○	○	○	○
Relevance to the business sector	○	○	○	○	○	○
Human interest	○	○	○	○	○	○
Entertainment value (e.g. quirky, funny)	○	○	○	○	○	○
Challenge inaccuracy	○	○	○	○	○	○
Already attracting media attention	○	○	○	○	○	○
Unusual or exciting	○	○	○	○	○	○
Will attract new audiences	○	○	○	○	○	○
Potential to go viral	○	○	○	○	○	○
Already attracting social media attention	○	○	○	○	○	○
Responding to an emergency (e.g. Ebola	○	○	○	○	○	○

outbreak,
earthquakes)

Q10) Do you consider any other important factors in determining how you select a story about science, technology and/or health?

Q11) Which sources of information or platforms do you consult and which do you trust?

	I consult it and I trust it	I consult it but I <u>do not</u> trust it	I <u>do not</u> consult it but I trust it	I <u>do not</u> consult it and I <u>do not</u> trust it	I haven't heard of this
Scientific journals (e.g. Nature, Science, The Lancet)	○	○	○	○	○
Scientific conferences or medical congresses	○	○	○	○	○
Newspapers	○	○	○	○	○
Science magazines (e.g. New Scientist)	○	○	○	○	○
Personal network of contacts	○	○	○	○	○
Press release or blogs from University or research centres	○	○	○	○	○
Press release or blogs from Non-governmental organisations, charities, think tank and pressure groups	○	○	○	○	○

Press release or blogs from industries/companies	○	○	○	○	○
Press releases or blogs from government ministries	○	○	○	○	○
Science News release sites (e.g. EurekAlert, BioMedNet)	○	○	○	○	○
Researchers' blogs	○	○	○	○	○
Journalists' blogs	○	○	○	○	○
Wikipedia	○	○	○	○	○
ResearchGate or Academia.edu	○	○	○	○	○
LinkedIn	○	○	○	○	○
Twitter	○	○	○	○	○
Reddit	○	○	○	○	○
YouTube	○	○	○	○	○
Other social media (e.g Facebook, Instagram)	○	○	○	○	○

Q12) Do you <u>consult</u> any other sources of information that we have missed?

Q13) Do you <u>trust</u> any other sources of information that we have missed?

Q14) Are there any other comments you would like to make on the sources and platforms you trust and/or consult?

About your audiences

In this section, we would like to know more about the audiences you want to reach.

Q15) Which audiences do you aim to reach?
Tick all that apply.

☐ Non-specialist audience

☐ General journalists (i.e. press, TV, radio)

☐ Popular magazine journalists (e.g. New Scientist)

☐ Others in the media such as writers, documentary and other programme makers

☐ Press officers and communication officers

☐ School teachers

☐ University students

☐ Young people in school

☐ Young people outside of school

☐ Researchers

☐ Policy makers and politicians

☐ Industry/business

☐ Charities/NGOs/Other non-profit organisations

☐ Potential funders

☐ Patients/Patient groups

☐ Underserved audiences (e.g. ethnic minority groups, LGTBQ+ community)

☐ Local communities

☐ I don't know

☐ Other. Please, specify

Q16) In your view, are your audiences already interested in science, technology and/or health?

☐ Yes, they are already interested in these topics

☐ Some of them are interested in these topics others are not

☐ No, they are not interested in these topics yet

☐ I don't know

Q17) Are your audiences from...

☐ Your town or surrounding area

☐ Your region

☐ Your country

☐ Everywhere (national and international)

☐ I don't know

Q18) In what language do you write or speak to your audience?
Tick all that apply.

☐ My first language

☐ Other. Please, specify

Motivations and barriers
In this section, we would like to know more about what motivates or discourages you from communicating about science, technology and/or health.

Q19) Which of the following are the most important reasons you communicate science, technology and/or health topics?
technology and/or health topics?
Please select a maximum of three responses

☐ Because I am enthusiastic about science, technology and/or health topics

☐ Because I am keen to educate others about science, technology and/or health topics

☐ Because I want to counter misinformation on science, technology and/or health topics

☐ It raises my profile

☐ It helps my own career

☐ It is part of my job role

☐ My manager/organisation supports it

☐ It counts towards my career (e.g. professional memberships/promotion)

☐ The opportunity to win prizes or awards for my communication work

☐ Because my communication work is recognised and valued

☐ The opportunity to work with other organisations (e.g. museums, science centres, schools)

☐ There are financial benefits for my organisation

☐ There are financial benefits for me personally

☐ Because I am invited to communicate

☐ None of the above

☐ Other. Please specify

Q20) Which of the following are the most important reasons that prevent you from getting more involved in activities to communicate science, technology and/or health topics? Please select a maximum of three responses

☐ Not appropriate for my level/role

☐ Insufficient support from my manager/organisation

☐ Insufficient support from other staff at my organisation

☐ Insufficient communication specialists at my organisation

☐ Negative perception towards the role of science communication from my peers

☐ Difficult to get others (e.g. researchers) involved in science communication work

☐ Difficult to attract audiences to my science communication work

☐ Lack of reward and recognition for science communication work

☐ Insufficient encouragement from funders for science communication work

☐ Not enough financial rewards from science communication work

☐ Lack of resources for science communication work

☐ Lack of time

☐ Does not help my career progression

☐ Lack of opportunities

☐ Lack of confidence

☐ Could have a detrimental impact on my profile (e.g. drawn into controversy)

☐ I am happy with the amount I do now

☐ I just don't want to

☐ I don't have the right skills/training

☐ There are no barriers

☐ Other. Please specify

Training and skills in communication
This section will explore how you have acquired your skills in communicating science, technology and/or health topics.

Q21) How have you developed your communication skills to convey science, technology and/or health topics?
Tick all that apply.

☐ I have / I am completing a degree in journalism, media or science communication

☐ I have received training in public engagement or communication (e.g. writing, public speaking, social media)

☐ I have experience in public engagement or communication (e.g. writing, public speaking, social media)

☐ I have consulted resources on how to communicate with non-specialist audiences (e.g. books, handbooks, blogs, YouTube videos...)

☐ I have watched how other people (either professionals or amateurs) communicate with non-specialist audiences

☐ I have been informally mentored by other communicators/journalists

☐ None of the above

☐ Other, please specify

Q21.1) What type of training have you received?
Tick all that apply.

☐ Media training

☐ Writing for non-specialist audiences

☐ Public speaking

☐ Social media

☐ Storytelling

☐ Public engagement

☐ Visual communication

☐ Organising public events

☐ Curating exhibitions (e.g. museum-related)

☐ Making videos or podcasts

☐ Performance (e.g. acting, dancing, comedy)

☐ Other, please specify

Q22) Are there areas of training in communication and public engagement that you would be interested to undertake?

	Interested	Already confident	Not interested
Media	○	○	○
Writing for non-specialist audiences	○	○	○
Public speaking	○	○	○
Social media for public engagement or outreach	○	○	○
Storytelling	○	○	○
Public engagement	○	○	○

Visual communication	○	○	○
Organising public events	○	○	○
Curating exhibitions (e.g. museum-related)	○	○	○
Making videos or podcasts	○	○	○
Performance (e.g. acting, dancing, comedy)	○	○	○

Q23) Are any types of communication/public engagement training that we have missed? If so, please write your suggestions in the box below.

Your thoughts on science, technology and/or health
In this section, we would like to know more about your opinion towards experts, science, technology and health.

Q24) How much do you trust each of the following? Do you trust them a lot, some, not much, or not at all?

	A lot	Some	Not much	Not at all	Don't know
Your national government	○	○	○	○	○
Scientists working in the public sector (e.g. colleges, universities)	○	○	○	○	○
Scientists working in	○	○	○	○	○

Medical and/or health professionals	○	○	○	○	○
Journalists	○	○	○	○	○
Science as a discipline	○	○	○	○	○

Q25) In general, do you think the work that scientists do benefits most, some, very few people or no one in your country?

☐ Most people

☐ Some people

☐ Very few people

☐ No one

☐ Don't know

Q26) Overall, do you think that science and technology will help improve life for the next generation?

☐ Yes

☐ No

☐ Don't know

Q27) Is there anything you would like to add on your thoughts on science, technology and/or health?

About yourself

We would like to ask you a few more questions about you and your role.

Q28) How would you describe yourself?

Please, select maximum three answers.

☐ Researcher (including PhD student)

☐ University lecturer/professor

☐ Health professional (including allied health professional)

☐ Journalist or editor

☐ Documentary or movie maker

☐ Freelance communicator or writer

☐ Press officer or communication officer

☐ Curator, explainer or museum employee

☐ Policy maker or adviser

☐ Artist or illustrator

☐ Designer

☐ Current undergraduate or postgraduate student

☐ Teacher

☐ Activist

☐ Blogger, Youtuber, Social media influencer

☐ Other. Please, specify

Q29) In the above capacity, do you work for an organisation or institution?

☐ Yes, I do

☐ No, I don't

Q29.1) Which of the following best describes the organisation you work for?
(If you work for more than one organisation, tick the one for which you spend most of your time).

- ☐ Museum, Science, Discovery centre, Planetarium or Observatory
- ☐ University or Research Institute
- ☐ Learned society or professional association
- ☐ Library
- ☐ Festival/Cultural event
- ☐ Arts/Culture organisation
- ☐ School or College
- ☐ Media, Broadcast or publisher
- ☐ Non-governmental organisation, no-profit organisation, think tank, charity, foundation
- ☐ Private business or industry
- ☐ Governmental organisation or ministry
- ☐ Funding body (e.g. research councils)
- ☐ Consultancy
- ☐ Other. Please, specify

Q30) We would like to know about your level of education in science, technology and/or health.
Tick all that apply.

	Science, Technology, Engineer, Maths or Health	Other
I have studied these subjects at school	☐	☐
I have / am completing an undergraduate degree	☐	☐
I have / am completing a postgraduate degree	☐	☐
I have / am completing a doctorate	☐	☐

I am self-taught

Q31) Are you...

☐ Male

☐ Female

☐ Non-Binary

☐ Other (please self-identify here if you would prefer to):

☐ Prefer not to say

Q32) How old are you?

☐ Under 18

☐ 18 - 24

☐ 25 - 34

☐ 35 - 44

☐ 45 - 54

☐ 55 - 64

☐ 65 - or older

☐ Prefer not to say

Q33) Where do you live?

☐ United Kingdom

☐ Netherlands

☐ Sweden

☐ Portugal

☐ Italy

☐ Poland

☐ Serbia

☐ Other. Please specify.

Q34) What nationality are you?

Submission and consent

By submitting this information you are consenting for your questionnaire answers to be included in the study.

Data Protection Privacy Notice
All data will be treated as personal under the Data Protection Act 2018 and the General Data Protection Regulation 2016 (GDPR).The data controller for this project will be the University of the West of England, Bristol. Your personal data will be processed only for the purposes outlined in this questionnaire. The legal basis that we will rely on to process your personal data is that it is necessary for the performance of a task carried out in the public interest.

Personally, identifiable raw data will only be processed for the duration of the study and subsequent analysis of results. Anonymised data will be kept for a longer period for the purposes of RETHINK project; for example to compare findings with subsequent study.

Your personal data, provided in this questionnaire, is not shared with our partners or third parties.

What are your rights?
You have a number of qualified rights including a right to access your personal information. Please visit the University Data Protection webpages for further information in relation to your rights. Any requests or objections should be made in writing to the University Data Protection Officer: dataprotection@uwe.ac.uk

How to make a complaint
If you are unhappy with the way in which your personal data has been processed you may in the first instance contact the University Data Protection Officer using the contact details above. If you remain dissatisfied then you have the right to apply directly to the Information Commissioner for a decision. The Information Commissioner can be contacted at: Information Commissioner's Office, Wycliffe House, Water Lane, Wilmslow, Cheshire, SK9 5AF www.ico.org.uk

If you would like more information on this study, to withdraw your data (before the 27th of October 2019) or to see the final report, please contact Elena Milani (email elena.milani@uwe.ac.uk; telephone 0117 32 81994).

Thank you for participating in this questionnaire.

Please, write in the box below a memorable word to facilitate the process in the case you want your contribution to be withdrawn from the study. _____

We would like to contact you for a follow up interview. If you are interested in participating, please write your email address in the box below. Your email will be separated from your survey responses. _____

Appendix C

Audiences/participants and connections

- Write the audiences/participants you aim to reach, including those you do reach and those you would like to reach but don't.
- Write down the connections you have with the audiences (eg social media) and the barriers.
- Be as specific as possible about the connections (eg what type of social media) and the barriers.

Your initials _____

Month and day of birth _____

Nature of connection

Nature of barrier

You

You

You

Audience/participant _____

Audience/participant _____

Audience/participant _____

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