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HOW CITIZENS VIEW SCIENCE COMMUNICATION

PATHWAYS TO KNOWLEDGE

Edited by
Carolina Moreno-Castro, Aneta Krzewińska and
Małgorzata Dzimińska

How Citizens View Science Communication

Science communication aims at the successful sharing and explanation of science-related topics to a wider audience. In order to enhance communication between science and society, a better understanding of citizens' habits and perceptions is needed. Therefore, it is vital to understand how citizens acquire knowledge about science-related issues, how this knowledge affects their beliefs, opinions and perceptions, and what sources of information they choose to learn about science – and how they assess their reliability. This book addresses these questions, based on the analyses of public consultations data from Italy, Poland, Portugal, Slovakia and Spain, concerned with the science communication of issues including climate change, vaccines, complementary and alternative medicine (CAM) and genetically modified organisms (GMOs). Sharing experiences of how to engage citizens in public consultation, it provides insights into the mobilisation of interest in science and offers recommendations on how to improve science communication.

Carolina Moreno-Castro is an expert on science communication research. She leads ScienceFlows, a research team focused on analyses of how perceptions and opinions about science are constructed among citizens (general audience, scientists, stakeholders and other social agents) and the role played by media, social networks and other platforms in disseminating science information.

Aneta Krzewińska is an author of methodological publications. She implemented 30+ qualitative and quantitative research studies. Her scientific interests include deliberative techniques and social research methodology. She is actively searching for new tools to collect citizens' opinions and carries out methodological tests on the techniques of group decision-making and consensus reaching.

Małgorzata Dzimińska is a researcher on higher education. She conducts studies on quality, knowledge and innovation management at universities. She actively promotes science communication and community-based participatory research. She is a member of the Society for Research into Higher Education (SRHE) and the European Higher Education Society (EAIR).

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Contributors

Sonia Brondi is Assistant Professor at the Department of Philosophy and Cultural Heritage, Ca' Foscari University of Venice, where she teaches social psychology and social relations. Her main research interests concern environmental issues (ecological citizenship, environmental sustainability, energy transition, natural disasters) and techno-scientific issues (public perception of controversies, trust, public engagement/citizen science, gender inequalities).

Kamil Brzeziński is a researcher and lecturer at the University of Łódź, Faculty of Economics and Sociology. His scientific interest focuses on public and social participation, urban sociology and urban studies. He has implemented and co-implemented many projects of a scientific nature, as well as participatory and social projects.

Ana Delicado is a researcher at the Institute of Social Sciences of the University of Lisbon. She specialises in the social studies of science and technology. She has coordinated nationally funded research projects and the ICS team in international projects. She teaches at PhD and Master programmes. She is particularly interested in public engagements with science and technology, as a research topic and as practice.

Lenka Diener is a researcher and lecturer at the Department of Sociology, University of Trnava. Her research focuses on social ecology, urban studies, social group dynamics and qualitative research. She is actively engaged in projects focused on communication in science, online media and public space.

Małgorzata Dzimińska is a researcher on higher education. She conducts studies on quality, knowledge and innovation management at universities. She actively promotes science communication and community-based participatory research. She is a member of the Society for Research into Higher Education (SRHE) and the European Higher Education Society (EAIR).

João Estevens is a PhD student in global studies. He has done MA in political science and international relations and BA in economics and in political science and international relations. His most recent work focused on political demography,

security and digital studies. He is interested in creative and participatory approaches, public engagement and interdisciplinary research design.

Edurne Gaston Estanga holds a PhD in science and a Masters in science communication. She is actively engaged in project management within organisations that promote the dissemination of science and technology knowledge to the society.

Peter Guran is sociologist and expert on human rights in Slovakia. He is former member of UN Committee on the Rights of the Child in Geneva. Since 2016, he is the Head of Department of Sociology at the University of Trnava. His works focused on children rights, family life and sociological methods.

Agnieszka Kretek-Kamińska is a researcher and lecturer at the University of Łódź. Her scientific interests include social research methodology, STS, public participation. She is an expert and researcher in projects on the functioning of public institutions and NGOs, social innovation, civic participation, production and dissemination of scientific knowledge, and evaluator of educational programmes.

Aneta Krzewińska is an author of methodological publications. She implemented 30+ qualitative and quantitative research studies. Her scientific interests include deliberative techniques and social research methodology. She is actively searching for new tools to collect citizens' opinions and carries out methodological tests on the techniques of group decision-making and consensus reaching.

Carolina Llorente is a PhD researcher on science communication, Associate Professor at the Department of Medicine and Life Sciences at Universitat Pompeu Fabra (UPF), Assistant Director of the Science, Communication and Society Studies Centre, and had Master's Degree in scientific, medical and environmental communication at the UPF–Barcelona School of Management.

Isabel Mendoza has an eclectic profile as a project manager and researcher in various fields. She has been involved in EU-funded research projects related to Biotechnology, Agriculture, Innovation and Science Communication, both from the technical side and on management, communication and dissemination. She holds a PhD in biotechnology and an MBI.

Carolina Moreno-Castro is an expert on science communication research. She leads ScienceFlows, a research team focused on analyses of how perceptions and opinions about science are constructed among citizens (general audience, scientists, stakeholders and other social agents) and the role played by media, social networks and other platforms in disseminating science information.

Giuseppe Pellegrini, PhD Sociology, teaches innovation, technology and society at the University of Trento. His main research interests are related to the study of science, technology and society issues. In this area of investigation, he devoted a specific attention to public engagement and public communication.

He is the President of Observa Science in Society and a member of the Public Communication on Science and Technology network.

Gema Revuelta, PhD, is Director of the Science, Communication and Society Studies Centre (CCS-UPF) and the Master's Degree in Scientific, Medical and Environmental Communication at Universitat Pompeu Fabra–Barcelona School of Management, Associate Professor at the Department of Medicine and Life Sciences at UPF. Revuelta did research on social perception of science, science communication and RRI.

Jussara Rowland is a sociologist and postdoctoral researcher at the Institute of Social Sciences, University of Lisbon. She has participated in several EU-funded projects related to youth, digital practices and science communication. Her current interests are centred around participatory and creative methodologies, the impact of digital technologies on society and effective science communication.

Andrea Rubin is a research fellow at the Department of Humanities, University of Ferrara. His main research interests are related to the study of science, technology and society issues, with specific attention to science communication. He participated in national and EU-founded research projects related to S&T studies.

Empar Vengut-Climent holding a PhD in chemistry and then specialising in science communication, her main research interests are related to DNA interactions and nanotechnology, and public comprehension of science and disinformation. She works as a researcher, manager and communicator in several interdisciplinary projects.

Izabela Warwas is a PhD Professor at the Faculty of Economics and Sociology at the University of Lodz and Chair of the Department of Labour and Social Policy. Her scientific interests focus on the issues related to human resources management, age and diversity management. Moreover, she participated in several national projects ordered by the Ministry of Science and Higher Education, Ministry of Regional Development, marshal offices.

Justyna Wiktorowicz's scientific interests focus on the situation of older persons on the labour market, generations and the application of statistical methods in social and economic research. She is the author or co-author of approximately 160 publications. She is a coordinator, expert and researcher in approximately 50 national and international projects. She is a member of Polish Academy of Science.

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- Observa Science in Society (Italy)
- University of Łódź, Faculty of Economics and Sociology (Poland)
- Trnava University (Slovakia)
- Universitat de València (Spain)
- Instituto de Ciências Sociais da Universidade de Lisboa (Portugal)
- Asociación Española de Comunicación Científica (Spain)
- Studies Centre on Science, Communication and Society, Universitat Pompeu Fabra (Spain)
- FYG Consultores (Spain)
- Asociación Española de Comunicación Científica (Spain)
- Danmar Computers (Poland)

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Abbreviations

CAM	complementary and alternative medicine
CC	climate change
CONCISE	the Horizon 2020 project CONCISE: Communication Role on Perception and Beliefs of EU Citizens about Science (G.A. number 824537), funded by the European Commission
EC	European Commission
EU	European Union
GM	genetically modified
GMOs	genetically modified organisms
OECD	Organisation for Economic Co-operation and Development
SDGs	sustainable development goals
UN	United Nations
VAX	vaccines
WWV	world-wide views method

Introduction

The intention of this book is to contribute to the general discussion on the public perception of science, the issue of information overload, trust in science sources and the most effective ways of communicating science information. These topics are especially relevant at present, due to the fact that the citizenry's information consumption has increased considerably and to the growing need for and importance of access to reliable science information, which could be observed during the COVID-19 pandemic when the scale of mis/disinformation was alarming.

There are so much data (2.5 billion GB are produced globally every day) that in about 350 years there may be more bytes of information than atoms on Earth. In such an event, data production will absorb much of the energy that we are capable of generating on the planet (Vopson, 2020). According to Melvin M. Vopson's grim prediction, we are heading towards an information catastrophe.

Moreover, everybody is to blame for this state of affairs because those bytes of information are produced by adults, as well as children, both for professional and personal purposes, around the clock. This task is facilitated by smartphones, apps, social media and the ubiquitous culture of productivity. Obviously, scientific knowledge is just a part of that production. However, nobody is capable of consuming all of it. Approximately 2.5 million scientific articles are published yearly. At this pace, 50 million texts will be produced within the next 20 years – namely, as many as were published from 1665 to 2009.[1] To these should be added the dozens of scientific conferences that are held every day.[2] Moreover, scientists are finding it increasingly harder to keep up with discoveries in their fields. At the same time, their narrow specialisation makes it difficult for them to follow what their colleagues from other disciplines, sub-disciplines or paradigms are working on, without having to resort to a qualified 'translator' or curator.

People who have nothing to do with academia cannot be expected to keep up with the current state of scientific knowledge by looking for answers to pressing questions in some of the approximately 30,000 scientific journals currently available.[3] Especially when there is readily available information in the media, on Internet search engines and in other algorithms that can assess whether a given piece of information adjusts to the profile of those searching for it and aligns with their views and behaviours and the opinions of their friends.

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Given the constant bombardment of information and other stimuli, rapid availability and easy processing are understandable requirements. In an age characterised by trillions of gigabytes, the human brain – always striving for cognitive optimisation – has no choice but to accept the first piece of convincing information, because although the speed of data production is accelerating exponentially, its cognitive capacity is not increasing at the same rate. As populists, advertisers and fake-news creators are perfectly aware of this, they afflict the exhausted brains of citizens with uncertainty and ambiguity by elaborating simple, catchy stories that trigger their emotions and heuristics. Owing to the attention deficits of their readers, even reliable, traditional news media are obliged to resort to clickbait headlines, short texts and strong views. These manufactured instant messages vie with scientific papers, which are often complex, contain footnotes and clash with simple formulas, quick-fix solutions and solid remedies. It seems, therefore, that they are doomed to communication failure, particularly considering that advertising, the media and populist communication rely on powerful data analysis and profiling tools which flawlessly adjust content to the views and interests of target audiences and the channels that they tend to use.

If scientists do not want to be left behind in the race, they need to learn the rules of effective communication in a world of scattered attention, short messages and new media actions. Furthermore, they also need to learn how to engage receivers on the fly by harnessing their cognitive resources for milliseconds at a time in order to draw them into a realm that, albeit slightly more demanding, offers them far more fascinating and significantly more valuable content. Otherwise, scientists will ultimately lose the battle for the truth and will be condemned to pursuing their careers in an impervious bubble populated by increasingly more alienated specialists devoting their time to narrow disciplines.

It is decidedly easier to urge people to fight than to lead them to victory. After all, the world of science will never have the funds or technologies to engage people as efficiently as major corporations or corrupt politicians do. Because of ethical constraints, for example, scientists are not permitted to gather or use certain kinds of data. However, science has a significant advantage: the ability to conduct research, to generate new knowledge and to verify it. The recognition that research can improve knowledge and the diagnosis of problems and offer new ways of tackling information overload, misinformation and the current deluge of fake news led to the launching of the European research project CONCISE (Communication Role on Perception and Beliefs of EU Citizens about Science), aimed among other things at re-examining the role that science communication plays in contemporary societies. Additionally, the intention was to conduct a new kind of research (employing participatory data collection methods) and to identify the information sources that citizens actually use, how they transmit that information to others, whom they trust and how they influence each another's views on science issues. And, lastly, the objective was to enquire into the views held by citizens on science communication and what they would require from scientists so as to resort to them more often as information sources, to gain a better understanding of that information and to share it with others.

Accordingly, during the autumn of 2019, the consortium partners organised five public consultations in the cities of Vicenza (Italy), Łódź (Poland), Trnava (Slovakia), Valencia (Spain) and Lisbon (Portugal), in which a total of 497 citizens participated. For one day (Saturday), the attendees discussed four topics relating to science controversies, namely vaccines, complementary and alternative medicine (hereinafter CAM), climate change and genetically modified organisms (hereinafter GMOs). They were divided into discussion group, according to similar sociodemographic criteria, including age and educational level. All the discussions in the five countries followed the same protocol, which had previously been agreed on by the project partners (Llorente et al., 2022).

The research methodology, which employed a variety of both quantitative and qualitative information sources (the transcripts of the group discussions and the answers to closed and open-ended questions), generated abundant data which was then analysed with different information technology tools. Specifically, T-LAB software, which combines linguistics with statistical graphic tools to gain further insights into the different textual layers of the data, was employed for the analyses. The qualitative interpretation of the statements of the participants in the public consultations was supported by NVivo software, while a statistical analysis was performed on the answers to the different questions using the SPSS package. Methodological triangulation during the data collection and preparation stages was essential for studying such a multidimensional phenomenon.

The results of previous studies (Fischhoff, 2013; Brake & Weitkamp, 2017; Bucchi & Trench, 2017; Brondi et al., 2021; Trench, 2008) pointed to the fact that, despite the relentless march towards globalisation, citizens employ diverse channels to access science information and trust different sources and opinion leaders, depending on their country of origin. In other words, there is probably no universal science communication method that could work just as effectively across the board. That is why the CONCISE research project had an international scope and a consistent balance between the local – national and European – and transnational perspective.

The research findings confirmed that some countries have particular communication characteristics, which means that they should implement different solutions for improving science communication. Nevertheless, it was the participatory nature of the research that really made the project stand out. As most complex scientific problems are inherent to modern societies and continually debated in the public sphere (Brossard & Lewenstein, 2009), the trend towards conducting research '[…] together with people, not only about them' (Greenwood, 2012: 117) was followed. Researchers who take part in participatory action research and organise deliberative or co-creative workshops are well acquainted with this trend. So, the spotlight was placed on determining how discussions among the participants would develop, how they would express their ideas, what kind of anecdotes they would tell and whom they would or would not trust when receiving science information. The participants had the opportunity to discuss their own experiences and then to state what they expected from scientists and to establish the guidelines that they should follow to achieve this.

For their part, the job of the moderators was to encourage the participants to develop and elaborate on their statements by asking them for examples, justifications and arguments. The moderators went out of their way to make the discussion sessions as pleasant as possible, evidenced by the fact that in all the consultations the attendees were fully involved and happy to be the centre of attention for a day. The research project was also designed to allow the consortium members to determine how citizens communicated science issues, how they shared scientific knowledge and the arguments that they deployed while doing so, which authorities they referred to, how dynamic those discussions were and the extent to which they prompted the participants to change their views. The analysis of their statements allowed for gauging how consciously or unconsciously involved the participants were in science issues, in light of the availability and negotiability of scientific knowledge in the media and on social networking sites (Van Dijck, 2003). As a result, a large amount of data was gathered, which then enabled the consortium members to formulate valuable conclusions applicable to various target audiences, including science communicators, decision-makers, researchers and ordinary citizens.

Chapter 1, 'Collecting, analysing and interpreting the results of the European public consultations on science issues', describes the participatory data collection method employed. The methodology developed in the CONCISE project, based on the World Wide Views (hereinafter WWV) method (Blue & Medlock, 2014), provides a new standard for conducting public consultations in the field of science communication which can be further popularised in other contexts.

Chapter 2, which explores 'What do citizens want? Science communication in the eyes of the public', presents the results of an in-depth qualitative analysis of the views of almost 500 European citizens on how to improve science communication. The authors develop a citizens' science communication improvement framework with four main dimensions – accessibility, validity, understanding and engagement – that mirror the citizenry's multidimensional perception of science communication, while also representing the quality standards that science communication outputs should meet.

Chapter 3, 'Citizens' acceptance of public consultation rules: insights into their evaluations', summarises how the citizens of the five European countries participating in the research – Poland, Slovakia, Spain, Portugal and Italy – perceived the participatory data collection method employed. The analysis revealed that they all had their own science communication cultures and a different degree of willingness to participate.

Chapter 4, 'The trustworthiness and reliability of science information channels and sources in the public's view', confirms that channels are often regarded and used as real information sources and that it is not easy to trace the primary sources from which citizens obtain science information. The search for drivers of trust considering the dimensions of credibility, authority and legitimacy allowed for generating a novel model of how citizens choose public science information sources and channels.

Finally, Chapter 5 focuses on revealing the differences in 'Perceptions of science information on climate change and GMOs'. While both are environmental topics, they have quite different characteristics and saliences in terms of public opinion. Climate change is perceived as a pressing issue because it could endanger human life on Earth. Scientists and the media combine the multidimensional analysis of this issue with politics, policymaking, economics, the environment and so forth. On the other hand, notwithstanding the fact that they also have an impact on the daily lives of the citizenry, GMOs are still mainly perceived as a science issue in which there have been few recent newsworthy developments. The analysis helps to understand how science communication can influence the general viewpoints and beliefs of the public at large.

By employing a participatory data collection method, the CONCISE project contributed to establish a closer link between science and society by empowering citizens and involving them in the research process, which on its own is a unique case study of the most inclusive science communication practices. We trust that this book will offer all those interested in the European dimension of science communication further insights in this respect.

The research described in this book was conducted during the last quarter of 2019, namely, immediately before the outbreak of the COVID-19 pandemic. While analysing the data, our perception of the importance of science communication was strengthened through participant observation. We witnessed how all national and international public health institutions were attempting to disseminate information that was capable of combating disinformation (Da Silva & Toledo, 2020; Zarocostas, 2020). We clearly observed that people needed information not only to fill their knowledge gaps and to correct their misconceptions but also to build on their existing beliefs (Bruine de Bruin & Bostrom, 2013). Therefore, we consider that our findings and their applicability to the resolution of common problems affecting people's decisions about their health and lives are very valuable.

We believe that the results of the public consultations described in this book will make a direct contribution to the development of the field of science communication. The project's practical-functional results should be useful for all those people involved, in some way or another, in science communication, including scientists in different fields, journalists, opinion leaders, public policymakers and scientific experts from government agencies or non-governmental organisations (hereinafter NGOs) who wish to develop communication materials and documents with the aim of informing citizens about topics relating to science and technology. To our mind, the implementation of the recommendations on how to communicate science set out in this book will allow EU citizens to have easier access to understandable and valid science information. We also anticipate that they will make more informed decisions based on verified knowledge and will be more immune to fake news, pseudoscience and anti-science views. Should this be the case, we would thus have contributed to strengthen the humanistic and civic foundations of our European community. Likewise, it would be interesting to perform future studies in order to verify whether or not the implementation of the recommendations presented here

have improved the degree of comprehension and informed decision-making of the citizenry.

Notes

1 http://blog.cdnsciencepub.com/21st-century-science-overload/
2 For instance, over 90 conferences were held on 19 November 2020, according to www.worldconferencealerts.com (accessed 19 November 2020).
3 www.universityworldnews.com/post.php?story=20180905095203579 (accessed 10 November 2020).

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1 Collecting, analysing and interpreting the results of the European public consultations on science issues

Carolina Llorente, Gema Revuelta, Izabela Warwas and Aneta Krzewińska

Contextualising the public consultations

The three main aspects of public engagement in science proposed by Rowe and Frewer (2005) are public communication, consultation and participation. Citizen engagement in science can therefore be achieved in many ways. This chapter offers a brief overview of the CONCISE project consultation approach and its peculiarities. According to the Organisation for Economic Co-operation and Development (OECD, 2008), 'Public consultation is one of the key regulatory tools employed to improve transparency, efficiency, and effectiveness of regulation'. It can also be assumed that public consultations require 'actively seeking the opinions of interested and affected groups in a two-way flow of information' (OECD, 2008). Moreover, as the information obtained in such consultations presumably represents currently held views on a specific topic, they are valuable tools for gathering information from many people discussing a given topic (Rowe & Frewer, 2005; Bruns & Wilson, 2010; Diviani, Obrenovic, Montoya, & Karcz, 2020; Kupper, Moreno-Castro, & Fornetti, 2021).

Public consultations have been carried out in democratic countries since the 1950s as citizen participation mechanisms. They are currently widespread in local and international policy design. For instance, the public consultation model is one of the global initiatives for addressing the Sustainable Development Goals (SDGs) of the United Nations. According to Fox and Stoett (2016), citizen participation should be seen as complementary to governmental representation and not as a substitute for it. In the main, better overall results are achieved from policy implementation when citizens' views are taken into account as part of a broader process of democratic deliberation that involves a full spectrum of stakeholders (Entradas, 2016; Fox & Stoett, 2016).

At the same time, however, there are consultation models that focus on the 'dialogue approach' (Davies, McCallie, Simonsson, Lehr, & Duensing, 2009), in which the deliberation process itself is a crucial element. In this kind of public consultation, the interactions promoted between science and those taking part are symmetrical, thus helping to shape discussions and to highlight personal aspects of the object of consultation, while affecting how professionals view the public (Armstrong et al., 2019).

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Dialogue events of this type, such as citizen participation in science and technology that does not seek to inform public policy, are growing in popularity (Davies et al., 2009). The active participation of citizens in leveraging different types of knowledge for finding solutions to specific problems fulfils the purported desire of society to have a say, to act and to have greater responsibility in the scientific production process and its governance (Llorente, Revuelta, & Carrió, 2020; Rogers, 2006). It also helps to promote a vision of a shared future (Jacobi et al., 2017), as well as a feeling of belonging (Calder, 2002) and popular legitimacy (Bernauer & Gampfer, 2013). It is for all these reasons that consultation processes designed to engage citizens with specific science-related issues without forming part of a policy process (Davies et al., 2009), such as the WWV global citizen consultation initiative (Blue & Medlock, 2014) and the CONCISE project consultations (Moreno-Castro, Mendoza-Poudereux, & Vengut-Climent, 2020), have been carried out.

Accordingly, the main objective of this chapter is to summarise the public consultation procedure by offering a brief overview of the context of the public consultations, the structure of the discussion groups, the objectives, the approach and the behind-the-scenes preparations.

To design the public consultation protocol, the partners drew inspiration from the WWV consultation approach (Blue & Medlock, 2014; Rask & Worthington, 2015; Riedy & Herriman, 2011) and traditional discussion group methodology (Krueger & Casey, 2000; Onwuegbuzie et al., 2009). The WWV method was first employed in 2009 by the Danish Technology Council (hereinafter DTC) to organise a discussion on global warming. DTC decided to invite ordinary citizens to participate in the consultations forming the core of the method because it believed that there was a disparity between the enormous leverage of decision-makers, individual governments, lobbies and big business and the negligible influence of the people of a country, region or continent. The opinion of ordinary citizens was very rarely considered when making decisions on important international issues. The WWV method has also been used in consultations about biodiversity, energy and the state of the seas and oceans. And although the word 'world' appears in the name of this method, such discussions have also been held at lower levels (e.g. in individual countries, regions, cities, local communities, etc.). The whole procedure revolves around the deliberation of 100 citizens selected to reflect the sociodemographic profile of the city, region or country in question. At the venue chosen for the consultation, they are divided into small groups of five to eight people to discuss the most important issues relating to the topic of debate in several rounds, each lasting no longer than 90 minutes. The consultation ends with the completion of a questionnaire on the issues discussed. The results obtained in each city, region or country are then compared and made public. In the CONCISE project, involving international consultations, the choice of the framework of the discussions held in each country made it possible to compare the results. In social research, traditional group discussions are identified with focus group interviews, namely, a procedure involving a moderator-led group of respondents discussing a single issue. Such a study usually involves several groups (from 8 to 12 people each), with purposefully selected participants, more often than not so as to guarantee that they

are internally homogeneous (grouping together people who are similar in certain important aspects) and externally heterogeneous, that is, each group is slightly different in terms of the characteristics relevant to the study. The specially prepared moderators are expected to lead groups in such a way as to offer all the participants a chance to express their views on each topic. In other words, more than getting group members to agree on a common solution, the intention is to gather as many opinions on a given topic as possible.

The CONCISE partners organised a one-day consultation in five European countries (Italy, Poland, Portugal, Slovakia and Spain) with a standard format: the selection of 100 citizens as diverse and inclusive as possible, divided into small groups to discuss, with the intervention of a moderator, an identical set of questions on four socially relevant topics: vaccines, CAM, GMOs and climate change.

There are examples of citizen participation in scientific policymaking on these topics, such as genetically modified (hereinafter GM) food legislation (Berg & Lidskog, 2018) and vaccines (Ward et al., 2019). On the other hand, in recent years, society's informal links to science policies on climate change have been evidenced by the #FridaysForFuture phenomenon and the figure of Greta Thunberg (Fisher, 2019).

The CONCISE public consultations were not only designed to gather information from citizens in three main areas (i.e. information channels and sources, trust and recommendations for improving science communication as regards the topics discussed) but were also meant to be a participatory experience for all the attendees, offering them a unique opportunity for empowerment, active participation and suggesting possible solutions. In each consultation, the 100 citizens were all involved in group activities (the welcome ceremony, coffee and lunch breaks, etc.) and actively interacted with a minimum of 20 people during the event. So, while discussing science-related issues with their fellow citizens, they were aware that they were making a useful contribution to the design of specific practical actions for improving the communication of these socially relevant topics.

The citizens taking part knew in advance the objectives and details of their participation in the public consultations. They were also aware that they formed part of the CONCISE project and that their results were going to be shared with politicians and science communicators from the different countries involved. In addition, many national and international outreach events were subsequently held in which the project results were shared with the target audience. The main results of the consultations were also made available to all the participants.

The procedure was tested in a pilot event held in Barcelona six months prior to the first consultation. This allowed the consortium members to identify the issues and considerations that should be considered when organising the public consultations per se, like, for example, how to manage citizen recruitment, the schedule to be developed and how scripts should be drafted. The moderators of the discussion groups were expected to replicate all these aspects in their respective countries. Besides, the pilot consultation made it easier to determine the agreements that citizens should sign, such as their informed consent to participate in the research, image rights and privacy statements (Revuelta & Llorente, 2020).

Description of the public consultation approach

The European public consultations, which involved nearly 500 participants in five countries, took place between September and November 2019 at intervals of one to four weeks (see Figure 1.1). The project partners chose these dates so as to prevent the consultations from clashing with other events scheduled to be held in each host country or city. However, they also needed to be established on dates when the partners responsible for support could travel.

Organising such large-scale public meetings requires the investment of adequate amounts of human, financial and organisational resources, as well as staggered phases. The involvement of the people responsible for recruiting participants and communicating with them, marketing and promotional activities, preparing facilitators and observers to run the discussion sessions, administrative arrangements and those relating to procurement in the case of public institutions, plus hotel bookings and travel reimbursements for the participants, all required time and effort on the part of the organisers. The whole undertaking should be considered as a project that requires the professional management of its budget, scope and time constraints. A professional approach to organising a public consultation also entails integrating it into the organisational structure of the host institution. As to academic institutions which, by and large, have functional organisational structures, there is also a need to overcome the challenges arising from the non-project-oriented environment, with its own rules and procedures, into which such a project must fit (Llorente et al., 2022).

In the pre-consultation stage, a methodological concept was designed, the main objective being to adapt the WWV method to science communication and the assumptions for carrying out the consultations in the five countries. These guidelines included a brief introduction to the public consultation methodology, an explanation of the multiple benefits of using the group discussion format and information on the number and composition of the groups, plus their size, schedules and moderator and observer roles (Moreno-Castro, Mendoza-Poudereux, & Vengut-Climent, 2020). They also included specific recommendations for staging the public consultations during the CONCISE project. All the stages of the consultations, including a brief description, were represented in a flowchart (see Figure 1.1). Following this, a framework version of the tentative agenda was drawn up. An essential part of the guidelines was dedicated to strategic recommendations for the moderators, focusing on core competencies, attitudes and mindsets.

The first version of the consultation script (Llorente et al., 2022) was developed for each one of the four socially relevant topics (climate change, vaccines, GMOs and CAM), accompanied by specific questionnaires. As part of the public consultations, a number of quantitative or semi-quantitative activities were planned (short questionnaires: exploring the citizens' views on science information sources, evaluating the messages conveyed through different communication channels and highlighting any change of opinion as a result of the discussions). Accordingly, information on this subject was also included in the script, with a

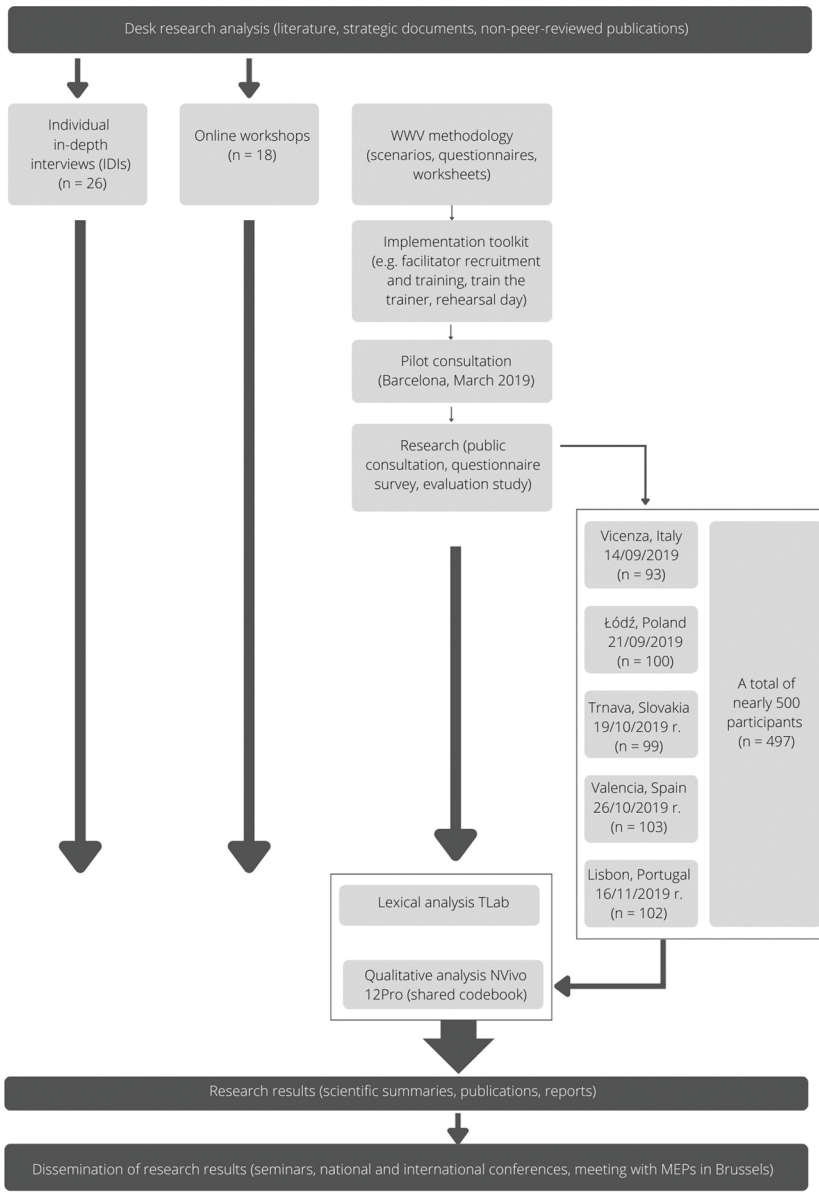

Figure 1.1 The CONCISE public consultation flowchart.

Source: Own elaboration.

view to maximising the project's impact and to ensuring that qualitative and quantitative empirical data would be collected in the same way.

The document concluded with a number of recommendations on citizen recruitment and selection, participant registration, facilitator recruitment, guidelines on consents and several practical requirements and communication templates. This document served as the basis for piloting, respecting needs and concerns, operational suggestions and specific instructions for carrying out the different activities during the consultations. The pilot consultation formed a vital part of the procedure for presenting the methodology to all the partners and for testing the approach taken. The pilot consultation took place in the Campus Mar of Pompeu Fabra University almost half a year before the first public consultation per se, with the attendance of 17 citizens (8 women and 9 men) coming from 14 Spanish cities, who were offered free tickets to different exhibitions and events being held in Barcelona at the time.

From a methodological point of view, the presence of two advisory board members, José Pío Beltrán and Cissi Askwall, invited by the University of Valencia (hereinafter UVEG), at the pilot consultation and the meeting held afterwards, was vital. Both submitted a short report with suggestions, which helped to fine-tune the research procedure and tools (Llorente et al., 2022).

During the pilot process, a series of guidelines were developed and then transformed into a set of documents, namely, the Implementation Toolkit, whose intention was to provide the partners with concrete tools and solutions to help ensure a similar standard of performance across the consortium. The Implementation Toolkit included the following:

- A project management template and a Gantt chart
- A communication set to streamline the promotion of the event and the recruitment of participants and sponsors
- An example of the sociodemographic profile of the participants for n = 100 (completed sample size) and n = 150 (assumed sample size)
- A facilitator and observer set
- Forms to be translated into the national languages of the project partners
- Checklists
- An evaluation set
- A summary report template

In sum, over 30 documents served as common resources for the project partners' daily work. Containing valuable information for the organisers and facilitators, this collection of documents helped them to organise and stage the public consultations and to obtain and record the results. After the consultations, all the consortium members stressed the importance of the guidelines and the usefulness of the Implementation Toolkit. At the same time, they highlighted the project management skills of their teams, especially those relating to scrupulous time and scope management, insofar as the number of details that needed to be taken into consideration when organising the consultations was much larger than expected.

Participant selection and the number and composition of the discussion groups

Although the literature on citizen consultations addresses various organisational aspects and the selection of an adequate consultation methodology, it has less to say about those relating to the sociodemographic profile of the participants. This can be seen primarily in the fact that public consultations (in the traditional sense of the word) place virtually no restrictions on participation. Stewart and Shamdasani (1990, p. 53) use the term 'convenience sampling' to refer to when researchers performing qualitative studies do not extrapolate the results obtained from the sample to the population as a whole. As the sample contains all the values of the variables of interest to researchers, which also occur in society, they can make confident (cautious) generalisations and talk about certain tendencies in the distribution of opinions, shared views and the frequency of behaviours in the population from which the sample has been taken. Adopting an identical list of features (variables) and their values also allows researchers to make comparisons between countries. The sample composition and distribution of participant characteristics are presented in Appendix, including the assumed and completed sample size.

Of course, such a participant selection method also has its limitations, primarily resulting from the fact that in no country is a sample of 100 people large enough to be able to claim that it is inclusive or that it reflects all possible opinions. In the case at hand, an additional limitation had to do with the fact that during recruitment, no attention was paid to aspects relating to the consultation topics that had nothing to do with the sociodemographic profile of the participants. For example, aspects associated with the use of electronic media were not considered. This was so because there was no reliable information on their use in individual societies. Besides, it has also been stressed that, owing to the disparity between the topics under discussion, making groups too diverse may affect their discussions. The organisers of public consultations should create a non-judgemental atmosphere in which individuals can freely express their emotions, values and feelings. While venues need to be comfortable, quiet and accessible so as to favour group interaction, in addition to being free of symbolic meanings and far removed from contexts that could influence group discussions. Moreover, the system employed to identify the participants must be agreed on beforehand. It is advisable to delegate this task to the observer, who can keep track of them and their respective ID numbers.

To ensure a diversity of opinions (Krueger & Casey, 2000), the CONCISE consultations involved 10–14 different discussion groups in the 5 countries. All the groups were relatively homogeneous in term of the educational level and age of their members for the purpose of fostering interaction and gathering some of their views on the topics under discussion. The profiles of the group members also included those variables contributing to foster a plural discussion (i.e. gender, rural or urban background and age). At least two groups were formed for each segmentation variable with a view to reaching data saturation as regards each stance. The members of a discussion group must be strangers, as most people tend to feel more at ease talking about some issues in front of people they do not know

(Krueger & Casey, 2000). Each discussion group had from eight to ten members in order to ensure a diversity of opinions on the topics discussed. This limit was established in the belief that too many participants make it difficult to create an atmosphere in which they feel comfortable about sharing their thoughts, opinions, beliefs and experiences (Onwuegbuzie et al., 2009).

Behind-the-scenes preparations

All the project partners were encouraged to use the Implementation Toolkit resources, after being adapted to their national and institutional particularities.

Facilitator training sessions

The training sessions for the facilitators from the five participating countries were held in September 2019, before the public consultations. The sessions were based on a two-stage strategy. First of all, the University of Łódź prepared a training package and trained representatives in each country, who then trained the facilitators recruited to conduct the public consultations. Representatives of all the partners organising the consultations and the coordinator were present during the training sessions.

During the national training sessions, the facilitators were provided with all the necessary materials (including scripts and exercises) which were then explained and discussed in further detail. Following this presentation, they participated in a practical exercise with the aim of showing them how all the tools worked in 'real situations'. They were also encouraged to clarify any doubts during one-on-one sessions with their coordinator by e-mail and mobile phone. The training sessions not only focused on recalling the general principles of group discussions and highlighting potential difficulties but also established specific guidelines regarding the consultation scenarios, activities and evaluation. The aim of going to such great lengths to prepare the facilitators was to standardise their work across the consortium, to make it less stressful for them and to help them to feel more confident and at ease.

All the project partners ran some sort of rehearsal before the public consultations. The intention was to check the set-up of tables, to deliver the final package of materials to the facilitators, to do a walkthrough at the venue and to share their views on what deserved further attention to make sure that the participants felt properly taken care of.

Date and venue selection

The public consultation dates were initially agreed upon at the start of the project and subsequently confirmed five months before the first one was held. Each partner chose a date that was most convenient in terms of the participants' availability and the recruitment incentives, plus the availability of event venues and staff. During this period, the UVEG prepared the online registration form in English, which was

then translated into Polish, Spanish, Portuguese, Slovak and Italian. The partners distributed information on the project and a link to the online registration form through various channels, including social media, websites, posters, leaflets and so forth. All the participants from each country used the online form to register, which allowed for the safe storage and management of their personal data.

A critical issue that might have contributed significantly to the success or failure of the public consultations was the choice of venue. These were selected with great care to meet many criteria, including their accessibility by public transport and for people with disabilities (lifts, ramps, etc.), their adequate lighting and the availability of an appropriate place for providing the participants with childcare services. In a context in which several discussion sessions were to be held simultaneously, it was also crucial to consider background noise so as to guarantee their adequate development, with the participants in each one of them having enough space to relax, walk and talk. In sum, it was important to ensure that each group had sufficient space to discuss the public consultation topics in a noise-free environment. All these selection criteria were considered to be essential for creating the right atmosphere for interaction, in which the members of the discussion groups felt comfortable about expressing their emotions, values and feelings. Furthermore, the consortium members agreed from the outset that the venues had to be free of symbolic meanings and far removed from contexts that might influence the development of the discussions.

For all the partners, the choice of venue was a strategic decision that might also offer the citizens an additional incentive for attending the event. Trnava University and the University of Łódź decided to hold the consultations in their own facilities, while the Italian, Spanish and Portuguese partners rented venues for the occasion. Specifically, the Italian public consultation took place in the historical Villa Valmarana – a sixteenth-century Renaissance villa designed by Andrea Palladio – the Botanical Garden was the venue chosen for the Spanish consultation and the Cultural Centre of Belém hosted the participants in the Portuguese consultation. While the university venues enhanced the academic prestige of the consultations, the three rented venues with historical, environmental or cultural connotations helped to create a specific atmosphere that favoured the correct development of the activities.

The noise accompanying the public consultations was, to some extent, distracting for both the participants and the moderators. Furthermore, some of the recordings were incomprehensible owing to this. On the other hand, being grouped together in large spaces gave the citizens the impression of participating in a major public event where their opinions mattered. Based on these experiences, we recommend using the open-plan formula but always making sure that the tables are not too close together.

Each public consultation was a significant undertaking, attended by about 150 people, including around 100 participants, 10–20 facilitators/observers, academic and non-academic staff, students, PhD students, media representatives and local authorities.

Recruitment of the moderators and observers

The recruitment of the moderators and observers was a demanding and important task for it might have affected the correct implementation of the methodology. To this end, an ideal facilitator profile was created, focusing on the ability to create the right group atmosphere. The factors that were taken into account included a profound conviction of the value of cooperation and dialogue, observation skills, mindfulness towards others, sensitivity to the feelings of others, active listening skills, a welcoming and enthusiastic attitude, the ability to create an atmosphere conducive to cooperation and to adjust the communication style to particular participants, avoiding value judgements about the topic in question and the capability to intervene in situations hindering group work.

The profile also included skills central to the process of gathering the right amount of valuable information: the ability to lead a group; readiness to play a 'passive' role in group discussions; being supportive instead of overbearing; addressing questions and comments directly to particular participants; trying not to interrupt unless participants break the rules or digress; maintaining eye contact with them, especially the passive ones; being sincerely interested in their views; remaining neutral, objective and open and creating (and recreating) a secure environment conducive to creating trust.

This long list of skills and operationalised behaviours was used to standardise the moderators' performance.

The CONCISE guidelines recommended recruiting moderators with previous experience in focus group discussions, such as sociologists, journalists and communicators. The role of observer, however, can be assumed by less experienced people. All the complex decisions regarding the recruitment of the moderators and their training for the consultations were made by each partner individually.

Considering the target profile of the facilitators leading the consultations, the partners took different approaches to their recruitment and training (see Table 1.1).

Operational aspects

The sessions were divided into morning and afternoon blocks, with all the public consultations following the same agenda. In most countries, the day started at 8 am, with registration or transport to the venue, while the event per se got underway at 9 am. As the discussion sessions ended at around 5 pm, this meant that the four rounds of discussions took up about 8 hours of the participants' time. Before the sessions began, the participants registered and received an official welcome. During the consultations, there were pauses, specifically, coffee breaks between the first and second and third and fourth rounds of discussions, and a longer lunch break between the second and third ones. After the last round, an evaluation was performed, the participants were thanked and the consultation came to end.

The organisers were free to decide on whether to change the composition of the groups during the day or to rotate the facilitators and observers between them. The first discussion session was preceded by an ice-breaking activity to allow the

Table 1.1 Different approaches taken by the CONCISE organisers to the recruitment and training of facilitators

Italy	• The facilitators came from Observa, a network of diverse and multidisciplinary collaborators • The facilitators had a socio-organisational background and held a degree or a PhD • A briefing on the eve of the consultation • The facilitators' preparation of a brief report on the event
Poland	• A rehearsal involving all the facilitators two days before the consultation • The 'specialisation' of moderators in one topic • Swapping tables after two discussion sessions • Interchangeability of the roles of the moderators and observers, both being equally qualified • Recordings transcribed by the moderators and reviewed by the observers • Preparation of the transcripts in Polish, summarising the four topics
Portugal	• The moderators did not only possess formal skills to facilitate discussion sessions but also some knowledge of the topics discussed • A diverse group of facilitators: experienced (fellows, post-doctorate) and junior (PhD candidates) facilitators of both sexes • Several joint training sessions
Slovakia	• Sociology students were employed as observers • A meeting between moderators immediately after discussion sessions so as to assess them • Entrusting the observers with the task of transcribing the recordings, under the supervision of the facilitators and organisers
Spain	• The moderators were journalists, science communicators or university professors of journalism or communication • The observers were members of the research team from the UVEG, scientists from public research institutes or other ScienceFlows team collaborators, while the facilitators, trained by the organisers, offered their support to all the participants, observers and moderators. Specifically, they helped many of the participants to complete the different activities • The facilitators were members of FYG Consultores, a CONCISE partner, or students taking a master's degree in history of science and science communication • The discussions were transcribed by members of the ScienceFlows team, supervised by an UVEG coordinator

Source: Llorente et al. (2022).

participants to get to know each other. If the group composition was changed after the lunch break, then another ice-breaking activity was held before the third discussion session got underway. Each session lasted between 60 and 90 minutes.

The main similarity between the five public consultations was the approach to the scripts. As already noted, a specific script for each topic was developed. Each consultation followed the same script translated into the language in question, which was made available to the moderators and observers beforehand. Each discussion group had a similar scenario for addressing a chosen topic. The citizens taking part in all the consultations were asked how they kept abreast of scientific

issues, what sources and channels they used and how scientific messages could be better conveyed. These elements of the discussion and their order were repeated in each round, while the cordiality and predictability of the research context were conducive to creating a positive atmosphere. The purpose of these consultations was to obtain new, authentic and unbiased answers from the participants in order to gather data on their behaviours, beliefs, perceptions and experiences relating to their quest for scientific knowledge on the topics discussed, for their subsequent analysis.

Recruitment strategies

The recruitment strategies implemented followed common principles adapted to national specificities. The project partners developed a country-based toolbox for recruitment. While the arguments deployed in the recruitment process were related to the development of science, namely, the participants were informed that they could contribute to the development of a given field and practical principles, with their inputs being employed in the design of specific actions. The accent was also placed on how they could personally benefit from their participation – broadening their perspective and knowledge – and on the fact that they would have the opportunity to express their views and to make suggestions. Additional arguments deployed included the following: taking part in an exciting event, participating in a different and unusual type of leisure activity, an opportunity to visit the city, receiving free museum entrance tickets or small gifts provided by sponsors and so forth.

Each potential participant was offered several arguments with a view to increasing the number of citizens willing to participate in the public consultations. The partners organising them provided information about them via traditional (i.e. the press, radio and television) and online media (websites, Facebook, Instagram, Twitter, etc.), in addition to the distribution of flyers and displaying posters in busy public places. They also sent invitations to social institutions and organisations by land mail and e-mail. The success of the recruitment activities was also achieved by implementing further strategies for engaging potential participants.

The CONCISE project complied with the personal data management policies established in European and national laws. The same general registration procedure was followed in the five countries, with only minor technical differences on the actual day of the consultations. The participants registered for the event via an online form (translated into five languages), thus guaranteeing that their personal data was gathered, stored and managed securely. Due to their different levels of computer literacy, the organisers needed to help some of them to register online throughout the recruitment process. The recruited citizens were informed about the kind of data collected, how it would be anonymised and stored and how they could withdraw their consent at any time. Online registration was followed by onsite registration at the venue, where each citizen was asked to sign consent forms to participate in the project and to be videoed. For those who withheld their consent to be videoed, the partners implemented different labelling methods,

like, for instance, coloured badges (Poland) or stickers (Italy, Spain and Portugal) or seating them in a discrete area (Slovakia). The most effective option was the Slovak approach, whereas the other options left room for human error due to the loss of badges or stickers or these being concealed by clothing, making it hard to identify the person's status. To resolve this limitation, video drafts of each consultation were reviewed by the project partners.

A similar approach was taken to ethical aspects, data security and the certification process. The organisers placed particular emphasis on ethical aspects. The citizens were provided with full information on the terms and conditions for participating in the public consultations, clearly set out in the informed consent document submitted to them for their approval. To ensure that they fully understood all the documents with which they were provided, these were translated into the national language of each one of the consortium members organising the public consultations. They were also offered the opportunity to clarify any doubts or concerns by phone, e-mail or during personal meetings.

As to the second aspect, due care was taken to guarantee the security of personal data. The participants in the public consultations voluntarily registered online, with those who were not computer literate being helped by recruiting consultants. All the participants were informed about the purpose of collecting their data and how they would be stored and protected, while stressing that they could access them or ask for them to be deleted at any time. For their part, the people involved in recruiting and communicating with the participants were instructed to follow the personal data management policies established in European and national laws at all times.

As to certificates, they were also a way of thanking both the participants and the facilitators. Lucky draws were also organised for the participants so as to reward them for their time and effort.

Coding and analysing the collected material

All the discussions taking place during the consultations were recorded, totalling more than 500 hours in all, and then transcribed, resulting in more than 3,500 pages of text. To ensure the privacy and confidentiality of the participants, all the transcripts were anonymised and encrypted, before performing several quantitative and qualitative analyses. The quantitative approach used content analysis, a systematic process of extracting and summarising information through which it was possible to detect references to specific issues during the consultations. In the first lexical-metric step, the aim was to count individual words which allowed for comparative analyses between countries. Adequate software (T-Lab) was helpful here, facilitating the performance of quick and simple operations on very large datasets (properly prepared and coded corpora, in which each statement was supplemented with information about the table, topic of discussion, gender, age group, academic qualifications and place of residence). It was thus possible to determine the frequency of appearance of single words during the discussions, the relationships between words (co-occurrence analysis), which words tended to be employed

by specific groups of participants (e.g. young people, women, etc.), the different forms of communication (cluster analysis) and the stances taken by the groups of participants on science communication (correspondence analysis).

The qualitative analysis was conducted using NVivo software, based on a uniform codebook for all the countries with independent (sociodemographic characteristics of the participants and the four discussion topics) and dependent (statement content) variables. The three main discussion scenario-related sets of dependent variables were expanded with additional specific categories:

1 'How citizens obtain information' was expanded by adding the channels and sources from which they obtained it, broken down into communicators, politicians, organisations, institutions and the media. To these were added questions about how familiar the participants were with specific issues (level of knowledge, high or low) and how committed they were to obtain information (level of interest and sharing, high or low). The data gathered were also assessed in terms of their quantity (e.g. lack or overload) and quality (e.g. misrepresentation).
2 'Credibility of sources' was coded using a trust/distrust continuum (i.e. the extent to which the participants trusted or distrusted science information), according to the attributes of communication processes (i.e. credibility, legitimacy, authority, novelty, desirability). The analysis was expanded to include the different ways in which the participants assessed the credibility of science information (e.g. fact-checking, triangulating information sources so as to obtain a more comprehensive overview and using one's own criteria, e.g. instinct, common sense).
3 The suggestions and recommendations for improving science communication appearing in the statements of the participants were recorded according to the information source, the channel, the message and the audience. Three areas of action and analysis were considered: public engagement, co-creation and citizen science.

The coded data were used to conduct in-depth analyses in each one of the five countries and comparisons between countries.

Final insights and conclusions

The European public consultations differed from other citizen participation strategies that generally seek to build a consensus for implementing specific public policies or for searching for answers to concrete problems. Specifically, CONCISE's approach focused on the participants' opinions which were analysed for the purpose of determining how they viewed the issues being discussed so as to establish guidelines for best practices in science communication. Thus, the CONCISE public consultations offered the opportunity to test and fine-tune methods for collecting citizens' opinions on science communication topics.

Of course, using a participatory approach to study science communication has its pros and cons. From a research perspective, for example, when recruiting

the participants, the accent was placed on ensuring sociodemographic diversity, considering the particularities of each country. Nevertheless, this gave rise to a number of limitations. Despite the efforts made, some audiences were difficult to reach and, as often occurs in outreach activities, the people participating in the public consultations were not representative of their society. Therefore, a future challenge is to develop communication strategies capable of engaging those citizens who tend not to participate in this kind of activity and, therefore, whose views are systematically ignored (Holliman & Jensen, 2009).

As the European Commission does not allow the participants in European projects to receive any financial compensation, in the CONCISE public consultations it was only possible to pay for their travel and accommodation, while offering them non-monetary incentives (e.g. the opportunity to visit the city, free museum entrance tickets, small gifts provided by sponsors). The absence of a financial compensation, however, can be considered as a limitation on sample diversity, insofar as poorer people and those uninterested in science or with family commitments, among other things, may be more reluctant to participate.

As highlighted in previous sections, the CONCISE consultation approach has many advantages, for it gave the participants a feeling of belonging and the opportunity to share their opinions and motivations, since they knew that their views would be passed on to decision-makers. It also posed a number of challenges. For example, 100 people talking simultaneously in the same place produced constant background noise that occasionally hindered the discussions and their recording.

The project's large-scale and multinational consortium also had its advantages and disadvantages. On the one hand, the opportunity to replicate such an event in five European countries made it possible to gather a considerable amount of data and offered the citizenry the chance to participate in an important research project. On the other, this posed a series of challenges. For instance, it was essential to translate the methodology, plus many other documents relating to data storage, participant recruitment and so forth, into the different national languages.

Moreover, the project's tight time frame meant that there were no second chances. In other words, the public consultations had to be held in each country on a specific date with very little time between them. For this reason, the pilot consultation in Barcelona and the pre-consultation rehearsal in each country so as to be familiar with the procedures were crucial aspects.

In this regard, the figure of the facilitator was vital for the correct development of the consultations. The main challenge for the organisers was to coordinate a large number of facilitators who were unfamiliar with the methodology and the project. Most of them were also involved in the facilitation of discussions and their transcription, namely, a combination of stimulating and tedious work. The facilitators' training was crucial for preparing them for this situation.

In sum, the standardisation of the CONCISE public consultations required a professional management approach, the use of well-designed tools helping to achieve this across the board. Despite this standardisation, it was flexible enough to allow for any necessary modifications due to national, cultural or organisational idiosyncrasies.

To our mind, the experiences described in this chapter and the following ones will offer valuable insights into the standard methodology developed for public consultations on science communication. Its capacity to be replicated in different countries and cultural contexts has been demonstrated in the project per se. Moreover, the same approach could be replicated over time to monitor differences or changes in citizens' perceptions of other science-related topics or it could be employed for online consultations.

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2 What do citizens want?

Science communication in the eyes of the public

Jussara Rowland, Małgorzata Dzimińska, Andrea Rubin, Edurne Gaston Estanga, Lenka Diener and Empar Vengut-Climent

Introduction

Over the past 20 years, science and innovation have been democratised to promote the involvement of the general public. This interest in public engagement has also led to a shift in science communication, from the deficit model, based on the understanding that the citizenry's distrust of science is mostly due to ignorance, to more dialogic and participatory models.

Traditionally, science was communicated through dissemination and popularisation in a linear, closed fashion – from experts to laypersons, who were seen as lacking in awareness and understanding – with science usually being 'translated' for society by journalists and communicators. Today, science communication is looking for ways to make it easier for citizens to express their opinions and views and for scientists to listen to them, so that a common understanding can be developed (Gascoigne et al., 2020). So, in recent years, there has been a tendency towards two-way or multi-channel communication, via dialogue, active participation and the involvement of different audiences who, in some cases, can make a contribution and have a stake in the outcome of deliberations and discussions (Bucchi & Trench, 2016).

Despite the theoretical distinction between models, in practice, they all form part of a continuum characterised by two dimensions: (1) the intensity of collaboration between the different actors in the knowledge production process and (2) the extent to which the public is engaged by the promoters of initiatives (Bucchi, 2009). Therefore, different kinds of science communication coexist, which will continue to be put to use in certain circumstances and may contribute to enhance the science-society relationship.

The effectiveness of the public communication of science has long been the subject of empirical reflection and study, and one of the main drivers behind the search for innovative science communication strategies (Newman, 2020; Kupper, Moreno-Castro, & Fornetti, 2021). Most studies aimed at improving the effectiveness of science communication have focused on the opinions, ideas and experiences of scientists and science communication practitioners (e.g. Llorente et al., 2019; Rafter, 2019; Anjos, Russo, & Carvalho, 2021), while fewer have considered the contribution of citizens.

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In the CONCISE project, a different approach, consisting in the analysis of citizens' views on science communication, was taken. To this end, five consultations with 100 participants each were held, in which they were asked to discuss different issues relating to science information. The choice of the public consultation format as the data collection method was justified by the intention to (1) run multiple group discussions simultaneously; (2) to create a participatory experience for the attendees and to empower them by offering them the opportunity to contribute to scientific development; and (3) to foster among them the feeling of forming part of a national and international community. Such a qualitative, multilayer data collection approach can, among other things, help to gather citizen feedback that could be overlooked when employing other survey techniques and to attune science communication more to citizens' needs and concerns (Delicado et al., 2021).

This chapter focuses on the third part of the group discussions in which the citizens taking part were directly engaged in the research process by asking them how science communication on the four topics discussed – climate change, vaccines, CAM and GMOs – could be improved. The aim was not only to discover their views on different aspects of science communication but also to understand, from their perspective, what the main priorities were in terms of improving this and the presentation of scientific knowledge.

The suggestions made by the citizens from the five countries focused on different types of initiatives, audiences, producers of communication and topics (for an analysis of the suggestions made on the topic of climate change, see Dzimińska et al., 2021). Sometimes, the suggestions were very specific, including examples of types of initiatives or measures that could be adopted. While at other times, they were broader and focused on general concerns about science communication. The citizens made many suggestions relating to the need for science content not only in traditional (e.g. TV, radio and the press) but also digital media (e.g. social media like YouTube and Instagram), as well as in other specific formats (e.g. flyers and billboards). They also expressed their views on the education system (e.g. school initiatives and science in the syllabus), while highlighting the importance of specific communication styles and advocating for the dissemination of science information in a clearer, more engaging way, in addition to the need for the institutional recognition of the social relevance of science.

To make sense of all this material, a grounded theory qualitative analysis was performed on the citizens' statements so as to gain further insights into the array of ideas put forward and to understand their interrelationships. This analysis was based on a common codebook that allowed for identifying all the suggestions made by the citizens during the discussion sessions in all five countries. An inductive analysis was then performed on their suggestions, with the aim of determining (1) their priorities for improving science communication, (2) whether or not there were differences between countries and topics, and (3) how their suggestions reflected specific ways of understanding public engagement with science (hereinafter PES).

As a result of these analyses, it was initially possible to identify 14 science communication themes, which were not mutually exclusive. They included aspects such as the availability, curation and relatability of science information. These

dimensions were then grouped and recoded into broader categories, allowing for classifying them in four main science communication dimensions that the citizens appreciated and in which they believed that there was room for improvement: accessibility, validation, understanding and engagement. Table 2.1 presents an overview of the results and proposes a multidimensional/multilayer framework that includes the main dimensions, sub-dimensions and examples of the types of suggestions made by the citizens.

In the following sections, the project results are presented in further detail, taking into consideration the main dimensions and sub-dimensions. The citizens' quotes provided below for illustrative purposes are identified by country, topic (climate change – CC, alternative medicines – CAM, vaccines – VAX, and genetically modified organisms – GMOs), gender (male, female, non-binary and others), age group and level of education (primary ed., secondary ed. and university ed.).

Accessibility

The accessibility of science information was the main issue highlighted by the citizens in the five countries involved. Many were concerned about the need to disseminate science to the public at large and to make it available in the mass media, while also contending that it should be better targeted so as to engage hard-to-reach and/or disengaged audiences. They also stressed how important it was to make science more easily available to both the general public and to specific groups, more visible in the public sphere and more accessible in terms of language and content.

One of their concerns was that science information should be readily *available* to everyone, suggesting different ways of achieving this, like, for example, by creating content and programmes in the mass media to ensure that it reached even those who had no interest in such topics. Television, in particular, was considered as an essential medium for communicating with larger audiences.

> In all those [media channels] that have a greater impact on the general public. And above all television, without a doubt. Because we all realise there isn't much information on the subject [on TV]. There is, but in a very limited way. I think it should be mainly on television. And why? So that it's disseminated as widely as possible.
>
> (Portugal, CAM, female, 55–64, university ed.)

> I think there should be special TV programmes because TV's the quickest way of reaching the largest number of citizens possible. And it should be immediately clear that this is a scientific programme and that by watching it, we'll find answers to the most relevant and most interesting questions.
>
> (Poland, CC, male, 65+, university ed.)

This concern about the dissemination of science content in the mass media was also reflected in their suggestions for making more room for it, like, for example, through specific TV formats like documentaries, debates and dedicated channels.

Table 2.1 Citizens' science communication improvement framework

Main dimensions	*Definition*	*Sub-dimension*	*Definition*	*Types of suggestions (examples)*
Accessibility	Improving public access to science information	Availability	Making science information readily available to the general public and hard-to-reach audiences	Science content in large-audience programmes, debates, monographic programmes and specialist TV channels, fiction programmes, podcasts, flyers, posters, specific outlets like social media, schools, local newspapers and health centres
		Visibility	Attracting attention to science and making it more visible in the public sphere	Primetime TV science programmes; increasing the number of science programmes; more scientific coverage in newspapers; social campaigns; open days; celebrity endorsements/ involvement
		Intelligibility	Simplifying/adapting the message	Good communicators, comprehensible messages and an appropriate language for the public; the use of concrete data and visual images
Validation	Making it easier for the public to assess information quality	Curation	Selecting relevant and credible information for the public	Institutional websites linking to relevant, credible information, repositories and databases; social media content curation; promoting credible research and the official communication channels of research institutes
		Certification	Having relevant information verified and certified by credible institutions	Environmental and health certificates, green labels, fact-checking services, accurate labelling

		Recognition	Enhancing the social relevance and/or importance of scientific knowledge	Initiatives that promote political recognition of the value and authority of science; the promotion of expertise through public campaigns; the visibility of scientists/experts
Understanding	Taking into account the way in which the public understands and relates to science information	Literacy	Promoting the public's knowledge of science	Science educational initiatives; promoting science content in educational programmes; literacy skills initiatives; lifelong educational initiatives
		Critical thinking	Fostering the citizenry's ability to evaluate science information	Initiatives that promote information analysis, scientific methods, digital literacy and on- and offline evaluation skills
		Appropriation	Sharing information to which citizens can relate because of similarities to themselves or their own experience	Information that includes recommendations on what people can do or how they are impacted by a specific issue; engaging formats that take into account peoples' interests
Engagement	Involving the public in science communication	Direct contact	Promoting direct contact between scientists/ science communicators and citizens	Scientists visiting schools; science students making presentations in bars/ unconventional venues; face-to-face presentations; science fairs; seminars; lectures
		Dialogue	Offering citizens the opportunity to pose questions	Digital platforms on which citizens can pose questions, talk with experts or take part in workshops; specialist phone lines; debates with the public
		Participation	Promoting initiatives/ projects that take into account the citizenry's knowledge and perceptions	Consultations, local initiatives, citizen councils, participatory projects

Source: Own elaboration.

> There're a lack of TV programmes that explain science; there're a lack of documentaries, debates […] there should be less sensationalist news and more programmes devoted to educating the public.
>
> (Spain, CAM, male, 25–34, university ed.)

> We've … I don't know how many sports channels … . With 20 or 30 universities, we could have a science channel … […] The state would have to make an effort and it could even include different institutions. […] There's a serious problem in our country. We have a string of rubbish TV programmes that reach us every day […] there's no alternative for those who want to keep themselves informed about anything. And nowadays, it's very easy with television, with a remote control for flicking back and forth, to have a programme, or two or three or four, on certain scientific topics, which we can easily access.
>
> (Portugal, VAX, male, 45–54, university ed.)

The citizens also advocated for adopting different formats that engaged people through a variety of channels, such as social media, billboards, leaflets and new digital outlets, among others, as well as specific initiatives and formats in schools and universities.

> I think theatre's fantastic. For example, organising shows on the use of separate waste collection […], undoubtedly theatre has a very strong impact. Of course, it should be public theatre and not along the lines of people being shut up inside a hall, but on the street, where instead of juggling an actor tells me the story of the Earth […]. In my opinion, theatre can play this role.
>
> (Italy, CC, female, 45–54, secondary ed.)

> I think different types of large festivals, like, for example, the Pol'and'Rock Festival [Polish 'Woodstock Stop' Festival held yearly from 1995–2017], are good for spreading information. Greenpeace, look, they were really active at [the Polish] Woodstock; yes, I learned about the problems with the Baltic Sea just at Woodstock. There were half a million people there and everyone was hooked somewhere; they were given leaflets, invitations to meetings with specialists in the fields of biology, meteorology, chemistry and so on.
>
> (Poland, CC, female, 25–34, university ed.)

> I think a format like the Political Tribune could also be useful. […] For political information, there used to be the Political Tribune, which in 15–20 minutes proposed a small roundtable, very quick, on a topic. It was stimulating … then someone says, 'Hell, I've never thought about that!' This topic has many aspects. It's a format that doesn't only provide information, but can also stimulate curiosity …
>
> (Italy, GMOs, male, 65+, university ed.)

This interest in specific dissemination formats also emerged when the citizens highlighted the importance of making science content available to hard-to-reach

audiences. They were often aware that they themselves were privileged, in terms of access to information and knowledge, while referring to the need to design communication strategies for reaching less engaged audiences. They also stressed the importance of local print media or tabloid newspapers for reaching older audiences, in addition to creative strategies tailored to the daily lives of these specific groups.

> Somewhere in the media, the traditional print media that everyone reads, more should be written about it with substantiated arguments. For example, the print version of the [mainstream] newspaper *SME*'s also read by older people in different regions. They should offer more coverage of this topic, because some of my older neighbours don't even know what GMOs are.
>
> (Slovakia, GMOs, female, 45–54, university ed.)

> In villages, because people there don't go looking on the Internet or turn on a computer … . There should be information in parish councils. There should be clarification sessions. There should be door-to-door leaflets like with Lidl. Or make agreements with Lidl to inform the nation in its leaflets. […] Or in the *Correio da Manhã*. Those newspapers distributed in all the coffee shops and village associations, a page of the *Correio da Manhã* on which the state informs the citizenry about vaccines.
>
> (Portugal, VAX, female, 45–54, university ed.)

Similarly, the citizens also considered that, in order to appeal to younger people, it was necessary to devise alternative strategies, such as creating engaging campaigns in their preferred channels, namely social media platforms, like YouTube and Instagram:

> Maybe the format of the press that we read's boring for the younger generations, because of social networks, because they're digital natives. Current press formats should be adapted so as to make them more appealing to these types of people, in order to arouse their interest in the topic. But, instead, the press has adopted a format identical to that of social networks, and that isn't how it should be.
>
> (Spain, GMOs, female, 25–34, university ed.)

> State science institutes should find a more appealing way of communicating. They should be active on social media and do something like popularisers do, some kind of popularisation of their science.
>
> (Slovakia, GMOs, female, 45–54, university ed.)

To improve accessibility, availability must be considered together with *visibility*. This means that to improve science communication it has to be made more visible in the public sphere, stressing its significance and value for society. This concern was apparent in the suggestion that more room should be made for science communication on primetime TV. The citizens often said that they were aware of some programmes on science-related topics, but that they were often relegated to cable

networks, secondary channels and off-peak hours. Many suggested broadcasting science programmes in primetime, inviting scientists to large-audience news programmes or even including science content in general TV programmes.

> In terms of science, visual images have a big impact. I wouldn't just have a debate; I'd have a programme designed for the whole family and present it, just like the open days at a research institute, so that it could be shown on television in order to engage people of all ages with science. Maybe make some kind of quiz show for children, bring science back to the whole family, present it in a quiz format, so that people can see the applications of science.
>
> (Spain, GMOs, female, 35–44, university ed.)

> But you have to know how to show it. You have to know how to engage press journalists with interesting information. You have to know how to sell it. Science information's a kind of commodity. You can't limit yourself only to periodicals. Because if you want to reach society, you have to use technological developments.
>
> (Poland, VAX, male, 45–54, university ed.)

The citizens also believed that the visibility of science could be enhanced by creating campaigns that reached large audiences more systematically. This was particularly relevant, for example, in those statements in which they suggested that the state had a duty, or mission, to act and to keep the general public informed about specific topics. In this case, they advocated for campaigns based on relevant information that had the ability to reach the public at large and to highlight the social relevance of the topic in question.

> Social campaigns. Not advertising, but social campaigns. Well, they have them about road safety which are often quite poignant … . I think those about road accidents reach at least some people. Perhaps this type of campaign on vaccines would also be a good idea; it'd counteract the anti-vaccine campaigners in some way.
>
> (Poland, VAX, female, 55–64, university ed.)

> You see different billboards and banners that are placed so purposefully that you don't even notice it. This should also be done with vaccination because sometimes, when you hear about the topic, you can recall one of those banners. If there were such banners or billboards with information on how important vaccination is, it'd influence your decision-making. It comes from the depths of the mind, it's essential and I want it.
>
> (Slovakia, VAX, male, 45–54, university ed.)

Another suggestion for improving the visibility of science was to recruit famous people, celebrities and even prominent scientists to disseminate scientific

knowledge. Their participation was seen as a relevant way of engaging the population, reaching larger audiences and making the message more appealing.

> It's also good to use authoritative figures or people who are even very well known; I don't know – actors, sports stars and so on. They could endorse solid science information.
>
> (Poland, CAM, male, 45–54, university ed.)

> There's television, the medium to which Italians resort most. Maybe … an authoritative figure, like Piero Angela, is necessary. Maybe it isn't necessary to be a figure like Professor Roberto Burioni. He's too divisive. We could invite a vaccine expert and let them also do a televised comparison with another expert. We need to make it interesting!
>
> (Italy, VAX, male, 35–44, university ed.)

The citizens also criticised the accessibility of science information when it was communicated in a complex manner, using technical jargon, in a way that did not engage people. To deal with this problem, they also pointed to *intelligibility* issues, in terms of content that could be read and understood by the public. This concern was expressed mostly for those sections of society with lower levels of literacy (e.g. 'my grandparents') but also:

> If there was someone who could simplify the messages that are conveyed, it'd be much easier for my grandparents to understand them and maybe become aware of what's important. […] I think that's where the problem lies: the message and the way it's transmitted. Because if they simplified it, I think more people would become interested in the subject, in that topic. And maybe they'd start researching on it, and maybe if they said that those sites were good places to search, maybe people would visit them, and maybe they would read a little bit every day, or a news item or two, and start to be more aware of that subject.
>
> (Portugal, CC, female, 18–24, secondary ed.)

> I think scientific articles are very often heavy going and have a lot of vocabulary that's difficult to understand and perhaps not accessible to the general public. What I want to say is, although it's true that anyone can read it, a potentially interested 12-year-old might not understand it, nor an older person either. So, what's needed is a language that's more accessible and easier to read and that's much more entertaining so that it motivates you to continue reading.
>
> (Spain, CC, female, 18–24, secondary ed.)

The citizens also highlighted the importance of having 'good communicators' sharing information on science-related topics to improve their intelligibility. These communicators were seen to play an essential role in translating relevant

information for the general public, not only making it more engaging but also easier to understand.

> I think the mainstream media lack good communicators … . If we had good communicators … I see a clear example; I think it's Pedro Azevedo, if I'm not mistaken. He's an astronomer at RTP [national television channel] whose a great communicator. I wasn't interested in anything, but he communicates so well that I get hooked watching him and learn about astronomy. Something that didn't interest me directly. I think we lack that kind of good communicator to talk about climate change and sustainability in the media, especially in the mainstream media.
>
> (Portugal, CC, male, 25–34, university ed.)

> La gata de Schrödinger and Quantum fracture [well-known Spanish science communicators on YouTube]: I think the dynamics or the language or the strategies they're using are very interesting, because they're getting young people involved in scientific issues and in keeping themselves informed. I think the media or information on climate change could copy or consider this way of communicating. Because now we've a lot of tools, videos, social networks, text, photos, 360º videos and infographics; we've a lot of tools that could be used to attract people with an appealing language and to keep them informed in a rigorous way without resorting to sensationalism.
>
> (Spain, CC, female, 18–24, university ed.)

Finally, the citizens also referred to the importance of using visual images and including concrete data in science communication to make it more understandable and relatable. For they were of the mind that this type of information allowed for a better visualisation of the issues under discussion and for understanding their implications in a very concrete manner.

> I reiterate what I was saying and what S. also said, which is to use images, use information … something that's easy. We usually say a picture is worth a 1,000 words, right?
>
> (Portugal, CC, male, 35–44, university ed.)

> Statistical data, I think. Reliable statistics. How many cases of the disease are there in the vaccinated group, how many in the group that didn't get vaccinated?
>
> (Poland, VAX, male, 65+, secondary ed.)

> Specify it in more detail and in the context of universal history, that is to say, contrast more data, but not just say that the situation's very bad, that we're going to die, which is terrifying for the public. I don't want 15 minutes of being reminded about this; I want 15 minutes of them explaining to me what's going on. Maybe it's because I'm studying physics and like to see data, but I want to see figures, I want to see what the situation's like now and how it was 50 years

> ago, in order to be able to contrast it with a little more empirical rigour, instead of really subjective opinions; at least that's how they seem to me in the way things are being explained to us right now.
>
> (Spain, CC, male, 25–34, university ed.)

Validation

Although the accessibility of science information was undoubtedly the main issue raised by the citizens, many of their suggestions related to another dimension of science communication: information validation. This is particularly relevant because they often felt overwhelmed by the quantity of information that they received on certain 'hot' topics (like climate change) and by the spread of disinformation and misinformation, both on traditional and digital media. The citizens felt that it was difficult for the public to assess the quality and credibility of the science information that they came across and called for different mechanisms for validating it, namely, initiatives relating to content curation, certification and recognition.

The citizens talked about the difficulty that they had in choosing and being able to identify relevant information when there was so much available through so many channels and sources. In this case, they often suggested the need to have access to *curated* information, to wit, information selected by reliable sources and made available to the public. For example, they requested repositories that guaranteed access and information quality, websites that summarised credible information on a specific topic and official communication channels providing the citizenry with such information:

> But at a European level, it'd be possible, for example, to make an effort and gather all the credible information on the same page, on the same website, tailored to different population groups. From the most detailed information, very scientific, to the more general kind. That would be possible. […] At a European level, it'd be possible to build a space where information was filtered and served as a support for schools, families, whoever wants to access that specific information.
>
> (Portugal, CC, male, 55–64, university ed.)

> So, on the Internet, there's all this pseudoscience that actually generates more fear than true information. The problem is that academies and research centres would need official channels for communicating with citizens. In other words, open science: so, if I've doubts about the greenhouse effect and want to look for information on it and there's a group of scholars at the Polytechnic of Milan who're really studying it and […] they should make popular science, because […] chemical-physical parameters, which no one really understands, are useless to us.
>
> (Italy, CC, female, 55–64, university ed.)

This concern applied especially to the information that the citizens accessed on the Internet and social media. They often criticised the criteria used by platforms to promote content and how information circulated on them. In this respect, they claimed that science information disseminated online was often dubious and that it should be selected according to expert criteria and checked before being shared online. In some countries, the citizens expressed how important it was to have official bodies that fact-checked the information posted online, so as to guarantee its quality for the average citizen.

> Excuse me, but I must insist: the Internet isn't the ideal place for looking for information because who controls the Internet? As anyone can post what they want, it's the Ministry of Health that should have its experts and studies, and clarify what's good, what isn't, and what's good for us and what isn't good for us.
>
> (Spain, CAM, male, 65+, university ed.)

> It'd be an uphill struggle to verify that the information's correct and not distorted. People are being bombarded with a lot of bullshit.
>
> (Italy, GMOs, Male, 45–54, secondary ed.)

Many of the citizens also suggested that *certificates*, issued by reputable institutions, would be a good way of providing the general public with guidance and helping them to assess information or product quality. This was suggested in relation not only to the explicit labelling of GM products, for example, but also to the development of environmental certificates for different types of products (in the context of the climate change discussions).

> Definitely state institutions, the Ministry of Health, the Ministry of Agriculture or other state institutions should take responsibility. There should be a catalogue, register or database available with official information on food certificates.
>
> (Slovakia, GMOs, female, 25–34, secondary ed.)

> There should be a seal of quality, a stamp that's on these products but certified and legalised, so that the seal isn't given to those who don't meet the requirements. Just as there is for other products and services, such as designations of origin [a type of geographical indication aimed at preserving the designations of origin of food-related products] and everything else.
>
> (Spain, CAM, male, 45–64, primary ed.)

> Now, whenever we buy a product, we should be able to know its environmental impact […] this mug was on sale in the supermarket; on the label of the mug it said, 'For this mug, so many litres of water were used, so many litres of oil, so many this, so many that, and it emitted I don't know how much CO_2.' If this – let's call it a green label – was provided, I could decide between buying this mug

> or buying a glass mug, imagine, and make the decision taking into account that green label.
>
> (Portugal, CC, male, 45–54, university ed.)

To improve the public's assessment of science information, the citizens also referred to the importance of enhancing the social *recognition* of science by promoting the authority of scientific expertise. For example, they emphasised the role of the state in the communication of science topics like vaccines and climate change, stating that this would prevent radical differences of opinion on these subjects, thus making the message clearer for the general public.

> Here, the state, or the Ministry of Health, plays an important role in popularisation. Well, because how else can we fight? Going by experience, you don't discuss things with stupid people because they'll bring you down and defeat you. So, if the state took over, a RESPONSIBLE STATE, such reliable information – why are we doing this, why is this important? What does epidemiology involve, what's the increase in a disease, how could it end, what are the symptoms of polio? For example, to show, to make people aware of, to visualise what this disease looks like.
>
> (Poland, VAX, male, 45–54, university ed.)

> I think there should be some state scientific organisations. The Slovak Academy of Sciences has a department that deals with this topic and, if there's an interest, they should provide the public with more information about it. They should work on some informative materials, like the posters announcing EU funding. They should cooperate in creating informative materials about GMOs to disseminate such information.
>
> (Slovakia, GMOs, female, 35–44, university ed.)

But they also advocated for science communication initiatives that gave scientists visibility and promoted them as experts, while also stressing the importance and value of scientific knowledge for society.

> I do think the meaning of the word 'expert' should be highly valued, and the opinion of experts must always be taken into account in their area of expertise, instead of believing what anybody says about that issue. So, it does seem to me that the media and politicians, the European Union, etc., should shoulder some of responsibility for facilitating access to expert information, but in an informative way so that the public can understand it. You shouldn't address them using technical jargon.
>
> (Spain, VAX, female, 18–24, secondary ed.)

> It seems to me that one more thing can be added: maybe know-it-all politicians shouldn't become involved; maybe they should leave it in the hands of competent people. So many interviews are conducted with politicians, but they rarely

include the experts advising them. As a result, this knowledge is only acquired in bits and pieces. […] However, this is too delicate and serious an issue for our health and for future generations, which's why competent people must speak out.

(Poland, GMOs, female, 65+, university ed.)

Understanding

The third aspect of science communication reflected in the suggestions made by the citizens for improving it was the importance of considering how people understood science and the information that they received and how they related to it. This dimension is different from the others because it focuses on the importance of the skills, knowledge and interests of citizens receiving science information.

There were plenty of references to the need to improve people's *scientific literacy*. This was particularly visible in many of the citizens' suggestions, including the importance of investing in science at all levels of the education system, implementing initiatives aimed at different age groups, promoting lifelong learning and setting up a university for seniors.

It'd be nice if there was a subject in primary education for teaching young children to live more ecologically – education in ecology.

(Slovakia, CC, female, 18–24, secondary ed.)

It's important to educate the population, just as we all know that killing's bad, we should also […] educate the population to be critical, to have a science education, to have an education in health, … […] so that when a crackpot comes along and defends something, like a treatment or something else, people are in a position to say, 'I get the message, but …' […] above all, it's … I think it's a question of educating society.

(Spain, VAX, female, 18–24, university ed.)

Lifelong learning, a university for seniors and so on. Education for the older generations should provide them with information on genetically modified organisms, how they're produced, the risks they pose and why.

(Slovakia, GMOs, male, 45–54, university ed.)

The citizens attached particular importance to the need to teach the public *critical thinking* skills. In this connection, more than specific science content, they considered that it was a priority for the public to be able to understand the scientific method and to evaluate science information critically.

It'd be useful if school children were also taught the scientific method, critical thinking. I think it'd also be incredibly important.

(Poland, VAX, male, 25–34, university ed.)

> [It's necessary] to provide the tools for finding one's bearings in the information chaos … . It's useful to recognise information that perhaps isn't black or white. […] In my opinion, perhaps the crux of the problem's forming a scientific mentality for everyone […] otherwise there's a democratic deficit because we don't have the tools to choose, because there's currently a lot of information and we cannot manage or control all of it.
>
> (Italy, VAX, female, 55–64, university ed.)

> I believe that education's fundamental, that this topic must be taught, without being macabre, in schools in a scientific way, explaining the data. […] I also believe that it's necessary to train citizens so that they have criteria and can draw their own conclusions, regardless of media they read.
>
> (Spain, CC, female, 65+, university ed.)

Some citizens also expressed the idea that people felt more engaged with science communication when they could *appropriate* the information being shared, namely, when it ceased to be an abstract, technical issue to become something with which they could identify in their personal lives. According to them, this appropriation of science could be achieved not only by including practical examples, actionable knowledge – things people could do in relation to an issue – but also by exemplifying how people could be impacted by these issues in their daily lives.

> It seems to me that the best option is to present some concrete examples from real life that show how they affect our lives and the actual things they do.
>
> (Poland, GMOs, female, 18–24, secondary ed.)

> I'd also like them to actually provide a solution. Because they give you a 48-page article on the thaw in the Arctic, ok, and I read that article and now what am I supposed to do? So, at least those scientists who performed the study should reach a consensus on guidelines for reversing the situation. […] I think a section of the article should be dedicated to concrete solutions proposed by its authors.
>
> (Spain, CC, male, 25–34, university ed.)

Engagement

The final category reflected in the citizens' suggestions concerns PES. In one-way communication, this dimension was referred to in terms of direct contact between science communicators and scientists and the public. The citizens also stressed the importance of creating opportunities for dialogue between the general public and scientists, as well as the need to promote participatory initiatives that took into account the formers' knowledge and perceptions.

The citizens confirmed their interest in promoting *direct contact* between scientists, practitioners or science communicators and the members of the public and in leveraging direct communication for disseminating scientific knowledge among them.

> Face-to-face communication's very important to us, right? Direct contact with people who tell us things. So, in my opinion, favouring that contact would benefit us all, more or less that we'd believe in it more, we'd be more trusting … so, use the right people … whether they be politicians or not.
>
> (Italy, CC, male, 35–44, university ed.)

> And it wouldn't be a bad idea to organise, for example, once a year, a day in which specialists, doctors, pharmacists, the Ministry […] could get together and reach out to the general public. […] Then we'd be encouraged to regain trust.
>
> (Spain, VAX, male, 25–34, secondary ed.)

In particular, the citizens stressed the importance of educational activities involving science communicators in school initiatives, especially with younger children.

> I'd like the communication style to be enhanced. For me, that's one of the ways in which it engages me. It's through schools. My daughter brings information home. And perhaps some of you – your children, grandchildren, nieces and nephews … I think it's important that those who study this, in academic terms, go and hold mini-conferences at schools!
>
> (Portugal, CC, female, 45–54, university ed.)

> What I was saying is that if, for example, there were talks at school given by professionals to children, that'd engage them much more than the information they receive from their parents or even teachers. After all, children are with their parents and teachers on a daily basis, but in the end they trust more in someone from outside their daily lives who comes to talk to them, because it's exciting for them.
>
> (Spain, CAM, female, 45–54, university ed.)

The citizens appreciated direct communication when scientists were involved. Many of them referred to the importance of having scientists explain their own research to the public, interacting with the population outside academia and devising a proximity strategy to stimulate interest and promote trust in science (see Chapter 4).

> We should be able to encourage scientists to leave their studies, libraries and universities for the streets; that's where the people are … . In my opinion, this is necessary, but doesn't happen … we discover people when they express their opinions, but sometimes it's a bit like crying in the wilderness. Get them out of the academic environment to where the people are.
>
> (Italy, CC, male, 45–54, secondary ed.)

> I think this information on the environment shouldn't be provided by politicians; it has to be provided by scientists, the people who're doing research, in order to engage us, so that meetings are more enjoyable, so that people get involved

> a little more. It's the scientists themselves who're trying to change the world; they're the ones who should give the talks.
>
> (Spain, CC, female, 55–64, primary ed.)

> One thing I experience a lot in the municipality of Braga and in the district of Braga, we have a nanotechnology institute there and, fortunately, we're increasingly connected with science in that context. Why do I think it's the best example of scientists that we have experienced in Braga, fortunately? Proximity. I think proximity's the secret. Proximity to the school community. Proximity to the business community. Proximity to ordinary citizens.
>
> (Portugal, CC, female, 25–34, university ed.)

Some of the citizens also emphasised the importance of *dialogue* between scientists/science communicators and the public, calling for opportunities to interact and spaces for the general public to ask questions. They claimed that the members of the public were willing to participate in direct discussions with experts in those scientific fields in which they had an interest, so as to clear up their doubts or to gain a better understanding of different topics.

> Meeting experts and discussing this subject with them. In my opinion, that's a great way for anyone to approach someone with expertise, to obtain relevant information, to talk directly with an expert.
>
> (Slovakia, CC, female, 45–54, university ed.)

> I'd love to be given the opportunity to have a face-to-face conversation with a specialist, to participate in a consultation. It'd be great for parents of nursery school children to have the opportunity to obtain information at nursery schools at a meeting held on a given day. That's the group that's probably most interested and attendance would be high.
>
> (Poland, VAX, female, 35–44, university ed.)

The suggestions made by the citizens mostly included digital platforms on which they could ask experts questions, maintain a dialogue with them at science workshops or have access to phone lines to discuss issues directly with them.

> But initiatives like GiovedìScienza [science festival] are also really useful, because one of the things that – in my limited experience – work very well is having that kind of relationship with people, giving participants the possibility to ask questions and to receive answers from a person who appreciates their interest.
>
> (Italy, GMOs, female, 25–34, university ed.)

> I think what's needed is an additional space where scientists could make a contribution and talk to citizens in some kind of debate. As we're doing now, but with experts and lay people where we could speak our minds, like we're doing

> now, but in an additional space on social media or other media that could explain to us or bring us closer to the disaster in which we're currently immersed.
>
> (Spain, CC, female, 45–54, secondary ed.)

In addition, the citizens expressed the need to involve different communities and groups in the debate so as to gain further insights into their needs and to engage them with the right kind of science communication.

> Organising debates in local communities involving all generations, convening people with different views to debate in a … first in a dispassionate way, before communicating the results to other communities.
>
> (Portugal, CC, male, 35–44, university ed.)

Finally, the citizens also highlighted the importance of citizen *participation* in science communication, an approach that considers the public's perspectives and creates spaces for their participation in the construction of scientific knowledge. The public consultations carried out in the framework of the CONCISE project offered the citizens participating in them the chance to understand the importance of public engagement. In this respect, emphasis was placed on the need to gather and make use of the public's feedback on acceptable scientific research aims and applications.

> For example, more initiatives like this. In this case, it's a public consultation, but doing this kind of … sometimes there's also the flip side of the coin, which is that people don't participate, but create these … these lectures, these debates. […] having a person there who knows how to deal with the situation, bringing matters into the public eye, so that they can express their opinions on the subject, to see what they know, what they don't know, to interact …
>
> (Portugal, CC, female, 25–34, university ed.)

> I think that, as you were saying, it's also the first time they've asked us for our opinion and the truth is that it'd never have occurred to me that our opinion could count for something. I mean, things like today's event […] we've been told this is being done in five countries now, that there may be many more projects like this. I'd never really considered that I could express my opinion and that it had any importance […] The fact that everyone can hear my opinion's important to me; it can be a good, bad or so-so opinion, but it's mine and it's being heard.
>
> (Spain, CAM, female, 45–54, university ed.)

The citizens also discussed the importance of gathering the public's local knowledge and adapting science communication to different levels. They believed that the venue where this should be done was a crucial factor for science communication, especially in the field of climate change, because they believed that the public's knowledge and experience were essential to mitigate its impact.

> I think there's a need for moments like this, when we have governments, with scientists, with communicators, with locals, with communities … . I think we can have these moments of sharing, but active sharing, because it isn't a forum on climate change, it's listening to scientists talking about their studies. No … it's real sharing […]. Let's design a strategy that makes sense in Loulé, but that isn't the same that makes sense in S. João da Madeira.
>
> (Portugal, CC, female, 18–24, university ed.)

> Because people in the community are also [knowledgeable] … maybe if there was an effort on the part of municipalities and councils … . For example, in rural areas people are used to the idea of saving and reusing water. Until 2005, there were areas in the borough of Loulé that didn't have mains water. People had to have their own cisterns, their own wells, and they had to manage that water. So, the knowledge of these people can help us – those who're far removed from these experiences …
>
> (Portugal, CC, male, 35–44, university ed.)

The citizens' suggestions about PES showed that they had had direct experiences with these kinds of science initiatives, which demonstrates the effectiveness as well as the interest in the public's involvement in creating science knowledge and actively improving their beliefs about science.

> I don't know if you've noticed it's happening more and more often. Even today, we're taking part in projects. These projects are being carried out and the scientific side's making an effort to communicate with society. There're various polls … not polls, actions, and that instead of a plastic bag, it's a linen bag, right?
>
> (Poland, CC, female, 35–44, university ed.)

> I like the kind of participatory events they have in Trnava – ekotopfilm, children see a film, also in the afternoon for adults … about food wastage. This should be more frequent. At this event, there're also conferences and workshops with ecologists; there're discussions in which anyone can participate … about how to resolve all these issues, how to persuade people to take action. There's a lot in the newspapers about climate change, but such events are lacking. I formed part of an open debate with an expert from the Institute of Circular Economics, and we discussed how the circular economy could be achieved in everyday life. People need to be involved in discussions, they need someone to explain to them why things should be done sustainably.
>
> (Slovakia, CC, female, 25–34, university ed.)

Discussion

Studies in the field of science communication often focus on specific aspects either associated with one or a few key characteristics, such as accessibility, validity, understanding and engagement. Few studies have offered a framework that

describes in detail the characteristics of effective, high-quality science communication. Seethaler et al. (2019), for example, identified a series of ethical elements and values that promoted effective science communication, while Mercer-Mapstone and Kuchel (2017) distinguished 12 fundamental skills for achieving this. The analysis of the suggestions made by the citizens during the consultations points to an understanding of science communication in which the identified dimensions and sub-dimensions complement each other, as well as suggesting that their joint application may promote science communication outreach. The key dimensions of the citizens' science communication improvement framework that were identified by analysing their suggestions support the findings presented in the literature. However, the framework offers a novel synthesis and contextualisation of recommendations for improvements.

Accessibility tends to be a major issue when discussing science communication. On the one hand, it is about ensuring that the greatest number of people not only have access to information, but that it is also understandable to them. On the other, it is a way of improving social inclusion (Matias et al., 2021). In recent decades, the media have allowed scientific knowledge to be shared at unprecedented rates, enabling widespread access to science information and bolstering public engagement and transparency. Many studies have focused on the coverage of science and technology issues in the media, showing that the overall coverage of science in newspapers and on television has slowly but surely increased over the past few decades (Bauer et al., 1995; Pellechia, 1997; Bucchi & Mazzolini, 2003).

However, the citizens taking part in the public consultations advocated for increasing the accessibility of science information to the public in general, making information easier to obtain for all those actively searching for it. For those less engaged with or less interested in science, the citizens suggested solutions aimed at passive receivers, for example, on primetime TV. They also proposed enhancing the visibility of science and its role in society. Finally, they pointed to the need to communicate science using an understandable language tailored to different audiences. In other words, communicators need to ensure that their messages are understandable, with the final public in mind, implementing different strategies, such as more adept use of visuals or data (Bucchi & Saracino, 2017; Rigutto, 2017; Delicado & Rowland, 2021).

The idea of the *validity* of science information is directly connected with a specific assumption about the public communication of science: the more science information there is, the more accurate it will be and the greater the social acceptance of science and technological innovation will be. This conception has long been the dominant view on the role of science communication (Hilgartner, 1990). Many of the citizens' suggestions reflected a growing concern about how to ensure the validity of available information. As Weingart and Guenther (2016) noted, science communication depends on trust, both in the source and in the communication channel. In recent years, there has been an apparent increase in 'anti-scientific' positions. According to some authors (Vernon, 2017; Crease, 2019), authoritative observers, anti-vaccination propaganda, climate change deniers, promoters of medicines not based on scientific evidence and many more have been waging a real

'war on science'. They also pose a real threat to the health of millions of people and to the protection of the environment (Douglas & Sutton, 2015). This mistrust of science has often been traced to specific information sources and channels, particularly to the increasingly more important role played by social media.

According to the dominant narrative circulating in the media in recent times, we have witnessed an uncontrolled spread of 'fake news', with repercussions for the political, economic and social spheres, marking the beginning of an era that some call 'post-truth'. As Scheufele and Krause (2019) observed, being misinformed depends not only on the citizenry's ability and motivation to spot falsehoods but also on their chances of being exposed to (mis)information. For this reason, fact-checking sites and other initiatives aimed at countering science misinformation have proliferated. In this context of growing misinformation (Schiele, 2020; Allcott & Gentzkow, 2017), the citizens put forward ideas on how to make content curation more targeted and how to support its verification so as to ensure that the public had access to credible information (ALLEA, 2021). These included introducing certification schemes and campaigns aimed at highlighting the importance of science, with the public authorities being signalled out as those that should shoulder this responsibility (EC, 2020).

Traditionally, the deficit model of the public communication of science has been based on the assumption that *understanding* science is related, by and large, to scientific literacy (Miller, 1983), and that achieving this guarantees favourable attitudes towards scientific and technological innovations. This model has also emphasised the public's inability to understand or appreciate scientific achievements. In order to resolve this deficit, public and private bodies – especially since the mid-1980s – have launched schemes to promote public interest in and awareness of science. Since the early 1990s, these assumptions have been strongly criticised on several grounds (Evans & Durant, 1995; Wynne, 1991), although many studies have shown that scientific literacy is associated with positive attitudes towards science (Sturgis & Allum, 2004; Rutjens et al., 2018). In this study, the citizens' views revealed that they endorsed this line of research, for they believed that they needed to have the necessary skills to understand science information, to verify its validity and to identify its relevance for their lives. They advocated for developing science literacy and critical thinking skills more intensively in the education system in order that society should be better prepared to evaluate and differentiate true information from the false kind (ACARA, 2015). With increased knowledge and skills, they would also be able to put the information gained from their own experiences to better use and to see how it could be applied in their daily lives (Cook et al., 2011).

In recent years, citizens have also increasingly called for the involvement of lay-people in science, allowing them to help to shape the research agenda. This has led to reconsidering the role of the public communication of science and technology. In the year 2000, the UK House of Lords identified a 'new model for dialogue'. Subsequently, other institutions supported the need to review existing strategies, in light of the broader agenda that science communication was addressing (Bucchi, 2008). New models of science communication, namely, those involving dialogue and participation, started to appear during this period. In line with these trends, a

final dimension that emerged from the citizens' suggestions was the *engagement* of society with science. They called for bridging the gap between science and the public at large, while contending that science should not be an intellectual exercise practiced in isolation but should be within the reach of all citizens and more aligned with their needs. Accordingly, they proposed many initiatives that promoted direct contact between scientists and society, organising events that helped ordinary people to enter into dialogue with specialists, experts or scientists in order to obtain explanations or to broaden their knowledge of topics of interest.

The citizens also suggested initiatives that encouraged the public to play an active role in science-related activities. They believed that their *engagement* with science could consolidate their knowledge, generate trust and encourage new attitudes and behaviours. This was especially evident in the discussions on climate change, in which some citizens held that incorporating their concerns and local experience in science communication was not only positive but potentially transformative for science and the state-society relationship.

When analysing the findings, it was revealed that there were striking similarities between the ideas expressed, regardless of nationality. In all five countries, the citizens advocated for the more widespread use of television to reach the general public with a greater impact, the greater involvement of public authorities in verifying and certifying available information and the role of scientists, who should be more active in disseminating scientific findings, cooperating with the media and becoming directly involved in initiatives with the public. In all five countries, it was also suggested that health practitioners should be more involved in communicating medical topics to the public because of their direct contact with patients and presentation of scientific facts, while having the credibility of experts. This communality is significant. Despite the differences existing between the five countries in terms of science communication and public access to science information (see Chapters 3 and 4), when asked about what could be done to improve science communication, the citizens often shared the same priorities.

The differences observed were related to the fact that some dimensions were emphasised more in specific topics. For example, the suggestions for verifying information, certification or recognising science through legislation were widely discussed during the CAM and vaccine sessions, in which the citizens highlighted the health risks posed by the dissemination of false information in these areas. For example, the fact that choosing CAM over conventional medicine might pose a risk to people's health and lives, prompting them to stress the importance of validating available information in this regard. The discussions on CAM revealed that there was still much to be done to improve the effectiveness of communication in this field, especially in light of the fact that the citizens' views on CAM were based mainly on the opinions of family or friends and rarely on scientific evidence. The importance of validation for science communication was also emphasised during the discussions on vaccines, in which the proposals for wider social campaigning and state involvement so as to guarantee information credibility stood out. On the other hand, the topic of climate change elicited the largest number of suggestions of all, especially in relation to direct involvement, being able to enter into a dialogue

with scientists and the introduction of participatory initiatives or events. There were also calls for hands-on initiatives, in which citizens were directly involved, actively participating and acquiring new habits, as well as understanding the consequences of their actions in relation to their own lives or to the town or country in which they lived (Dzimińska et al., 2021).

As will be seen in Chapter 5, traditional (mostly TV) and digital media (i.e. social networking sites) were the main channels for keeping abreast of science news. In all five countries, the older participants preferred the former, while the younger ones opted for the latter. There was also a preference for digital media among the Slovak and Polish citizens, in contrast to their Portuguese, Spanish and Italian counterparts who tended to consume traditional media more. This difference was also reflected in their perception of the quantity/quality of the science information to which they had access. On the one hand, they held that there was a lack of science news in the traditional media. On the other, they considered that there was too much information in digital media. Their suggestions for improving science communication tended to reflect these 'media diets'. Indeed, the citizens put forward suggestions based on how they accessed information on the different topics. Environmental topics (GMOs and climate change) were available through a variety of news channels, with climate change being the most widely discussed and covered topic in both types of media. Health topics (vaccines and CAM), by contrast, were mostly discussed on the Internet and on social media. For example, there were many suggestions for using databases or fact-checking websites for validating information on the topics that were mostly accessed on social media, in particular, and the Internet, in general (climate change but also vaccines and CAM). On the other hand, to improve the quality of science information on the issues most covered in the traditional media, the citizens chiefly suggested promoting programmes aimed at increasing the public's scientific literacy and the greater involvement of experts in science communication aimed at lay audiences.

If the findings are interpreted from the deficit-engagement model perspective (Bucchi & Trench, 2016), it can be observed that most of the citizens' suggestions implied that lay audiences had a knowledge deficit and that there was a need for transmitting science information from experts to the public at large. In other words, they proposed a one-way communication model involving formal education, sharing information through the mass media and organising major social campaigns. They recommended that producers and broadcasters ensure the availability, visibility and intelligibility of the science information that they shared. They also highlighted the importance of programmes for developing the skills of citizens in terms of critical thinking and literacy, alike. Although recommendations of this type might indicate that the deficit model was still deeply rooted in the citizens' perceptions, they also tended to reflect what they knew or were familiar with, that is, the current dominance of one-way models in science communication.

On the other hand, the call for two-way communication models was expressed through references to dialogue and deliberation between the citizenry, scientists, experts and policymakers. This was evidenced, for example, by suggestions relating to the importance of dialogue between practitioners and patients on health-related

issues. As their nature implies individual involvement in one's health, the citizens recommended obtaining information actively and direct interaction with specialists. Additionally, as to the climate change discussions, participatory actions were advocated for because the agency and knowledge of individuals were seen as key to resolving this issue. The fact that the engagement dimension was more present in the suggestions made in the climate change discussions than in those on GMOs and CAM might have something to do with the nature of these topics. In the case of the climate change discussions, for instance, the citizens advocated for various types of actions: social campaigns or events in which climate change impacts were explained and citizen participation was promoted. However, such actions might not be considered as being relevant to GMOs or CAM.

In many cases, the citizens who made these suggestions had previous experience of these kinds of initiatives which they considered to have been positive. Moreover, in view of their suggestions and evaluations (see Chapter 3), it became clear that even those who had never had such a previous experience enjoyed taking part in the consultations, often using them as an example of the kind of initiatives that they would like to be replicated in order to improve science communication. This exemplifies how support for engagement initiatives is often directly related to participation. It is through involvement in participatory projects that the engagement model becomes tangible for citizens and, consequently, something to which to aspire.

Conclusion

All the suggestions made by the citizens taking part in the five public consultations point to a multi-layered understanding of science communication, in which the transversal dimensions of information accessibility and validity and the public's understanding of and engagement with science coexist and are often entwined. This multidimensionality of science communication should come as no surprise. As observed by Trench (2008), several science communication models, including the one-way kind, continue to coexist with two-way models that place varying emphasis on interactivity. This has been confirmed by the findings of our analysis.

The suggestions made by the citizens highlighted the dimensions of science communication that they considered important and in which they saw room for improvement. They stressed the importance of increasing accessibility to science information, especially for the general public and hard-to-reach or less engaged audiences. By their reckoning, there was a need for validation procedures so as to facilitate the assessment of the quality and credibility of science information in a media context in which information and misinformation are increasingly shared. They underscored the importance of taking into account the general public's level of understanding of science for its more effective communication. Lastly, they placed the accent on the importance of citizen participation in science communication not only through dialogue but also, in some cases, through their direct involvement in the construction of scientific knowledge.

Our findings show that the dimensions for improving science communication encompassed the different aspects of the four topics discussed and were relevant in all the countries included in the study. They also show that these dimensions are often seen as complementary. The resulting science communication improvement framework offers an integrated representation of the citizens' suggestions and recommendations that could be used to assess the quality of a specific message or initiative. For example, a message that is accessible (available, visible and understandable) might have a wider outreach than one that meets only the availability criterion. Or when concerns about the accessibility of a message are supplemented by considerations on the direct engagement of the receivers, it might be more likely to appeal to the public. To our mind, the application of this framework has significant advantages since it is based on a methodology that takes into account the richness of perspectives revealed by the citizens in the discussions on four science topics, reflecting not only their major concerns about science communication but also specific ideas on how to improve it to meet their needs and desires.

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3 Citizens' acceptance of public consultation rules

Insights into their evaluations

Izabela Warwas, Kamil Brzeziński and Agnieszka Kretek-Kamińska

Introduction

Over the past 50 years, the transformation of democratic systems around the world has been based on several theoretical concepts that point to a number of defects and limitations of representative democracy. These concepts have also stressed the importance of the participation and inclusion of citizens in decision-making processes (Dryzek, 2002; Sroka, 2009; Held, 2010; Krzewińska, 2016) as a kind of remedy for the diagnosed drawbacks (Dias, 2014).

Participation, broadly defined as 'involvement on a voluntary basis in political, governance or decision-making processes at any level' (Brodie et al., 2009: 14), has gradually become more widespread since the second half of the twentieth century. However, it was the turbulent 1960s – the mass rebellions of the younger generations, including the student revolts and developments in France in May 1968, plus the feminist movements – that led to its intense development (see Pateman, 2012). During this period, Jane Jacobs published her book *The Death and Life of Great American Cities* (1961), which contributed to the emergence of grassroots urban movements. Seven years later, Henri Lefebvre published *Le Droit a la Ville* (*The Right to the City*) (1968), initiating a debate on the fair use of the city, along the principles of sustainability, democracy, equality and social justice, which has continued to this day. The following year, Sherry Arnstein published her influential article, 'Ladder of Citizen Participation' (1969), with those participation practitioners calling for a real impact on cities still referring to this text.

Since then, theoretical alternatives to the classical concept of democracy, in the form of participatory and deliberative democracy theories, have become widespread (see Juchacz, 2006; Pateman, 2012; Pawłowska & Radzik, 2016; Michels, 2017; Bachtiger, Dryzak, Mansbridge, & Warren, 2018). The popularity of both concepts has had an increasingly greater impact on social practices. While a growing number of guides on involving citizens in co-decision processes are appearing in the literature (cf. Wates, 2000; Chambers, 2002), contributing to the spread of democratic innovations based on deliberative principles, among others (Bachtiger, Dryzak, Mansbridge, & Warren 2018); it does not finds standardised procedures to carry out public consultations, relate to the methodology of data analysis, questionnaires, timeline, and facilitators, collaborators, and interviewers.

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The idea of participation is not limited to the political sphere. Analogous changes can be observed in social and civic practice, as well as in the scientific field, while the need to develop a new relationship between science and society has been emphasised. This relationship should involve democratisation and allow members of the public to play an active role in producing and evaluating scientific knowledge (Liberatore & Funtowicz, 2003; Esguerra et al., 2017). The idea of co-creating scientific knowledge with the active participation of its potential recipients has been accompanied by the development of various research concepts: participatory action research, community action research, cooperative research and so forth (Kindon, Pain, & Kesby, 2007; Lengwiler, 2008; Kemmis & McTaggart, 2009; Dudkiewicz, 2011; Greenwood, 2012; Kafel, 2016). They emphasise the active involvement of participants, their empowerment in the research process and their inclusion in cocreation, as well as the importance of local knowledge and experiences in generating theoretical interpretations of social reality in citizen science. In turn, these developing concepts have been transformed into research practices, as exemplified by the CONCISE project which has employed the WWV methodology (Warwas, 2021).

Acculturation of participatory trends in the CONCISE project countries

As mentioned above, there has been a growing number of attempts to involve citizens in shaping policies and finding solutions to various public problems. The inclusion of citizens in decision-making processes has also been accompanied by efforts to develop methods to study the progress and effectiveness of these initiatives. Inclusion activities are studied and evaluated based on their impact on public decisions: the quality of communication, deliberation and capturing of turning moments, plus the coherence of reasoning processes (e.g. Capella, Price, & Nir, 2002; Hino, Imai, & Chiba, 2015; Mączka et al., 2020; Steenbergen et al., 2003; Sprain & Black, 2017).

However, for such activities to have any chance of success, the dissemination of concepts that emphasise the need to involve citizens in shaping the public sphere must be accompanied by their readiness and willingness to participate in activities carried out in this area.

A specific indicator of the budding interest in citizen participation and inclusion in decision-making is the growing popularity of participatory budgeting. Since its introduction in Porto Alegre (Brazil) in 1989, participatory budgeting has gained global popularity over the past three decades, becoming the most widely used participatory tool (Sintomer, Herzberg, Röcke, & Allegretti, 2008, 2012; Dias, 2014; Dias, Enriquez, & Julio, 2019). The study 'The Participatory Budgeting World Atlas' shows that this innovative way of involving citizens in co-decision processes occurs on every continent. It is estimated that more than 11,000 participatory budgets are currently being implemented globally at different levels: local, regional and national (Dias, Enriquez, & Julio 2019). According to Dias (2014: 21), the growing popularity of participatory budgeting is due to a type of 'democratic disenchantment'. This crisis of democracy manifests itself through, among other

things, a declining participation rate in elections, an increasingly greater distrust of politicians and institutions and a growing sense of civic alienation (Dias, 2014; cf. Putnam, 2008; Michels, 2017). It is as if people did not feel represented anymore and as if their role as citizens had been reduced to casting their ballot (Dias, 2014; cf. Domański, 2018).

In this context, participation in the broadest sense of the word can be seen as a 'cure' or 'remedy' for the crisis of representative democracy (see Torcal & Montero, 2006; Sintomer, Herzberg, Röcke, & Allegretti, 2012). The aforementioned study 'The Participatory Budgeting World Atlas' (Dias, Enriquez, & Julio, 2019) shows that of the European countries whose citizens took part in the CONCISE public consultations, Poland leads the field with the annual implementation of about 1,840 projects.

Portugal, where more than 1,680 participatory budgets are being implemented, comes in second place, while also being an unquestionable leader in terms of project innovation. In this country, participatory budgeting is implemented at three levels: national, regional and local. In addition, school and youth participatory budgeting has recently been introduced to teach children and young people about democracy (Abrantes, Lopes, & Baptista, 2018; Paz, 2018).

Meanwhile, in Spain, around 350–400 budgets are implemented annually. According to the Spanish constitution, 'it is the responsibility of the administration to facilitate the participation of all citizens in the country's political, economic, cultural and social life. In Article 6, moreover, it is stated that participation should be understood as being complementary to the representation system, while the task of political parties should be to meet the needs of stakeholders' (Nebot et al., 2019: 182). Taking this into account, the number of implemented budgets seems relatively small.

In Italy, the idea of participatory budgeting has not caught on at all, with the citizenry's interest in participation being negligible (Dias, Enriquez, & Julio, 2019) and only 63 projects having been implemented to date, whereas in Slovakia, only 12 projects are started up annually.

The phenomenon of participatory budgeting illustrates the growing interest in participation. However, it should be noted that all activities that involve citizens in decision-making, in addition to the opportunities for participation that the organisers of participatory processes offer them, also require, albeit not primarily, their willingness and readiness to become involved. While some claim that the crisis of democracy is evidenced by lower levels of citizen participation in elections (Dias, 2014: 21), others have pointed out that the level of electoral participation is an important indicator of citizen participation in governance (Solijonov, 2016: 13). In other words, it can be presumed that in societies with high levels of citizen participation in elections, public consultations and other participatory processes may also be of significant interest. Furthermore, these societies may more readily accept the ground rules governing public consultations.

Since the beginning of the twenty-first century, electoral participation has decreased all over the world (Solijonov, 2016). A significant drop has been registered in Europe and in the former Eastern Bloc countries, the average turnout in the latter declining by around 20 per cent since the first free elections held at the

end of the 1980s. However, it is important to note a consistent decline in turnout of about 10 per cent in established European democracies during the same period, albeit starting from a higher base (Solijonov, 2016: 25). These observations are partly confirmed by previous analyses comparing participation levels in national elections in the United States and Europe in 1996, 2000 and 2004. They have also shown that the post-communist countries are closer to the relatively low level of voter turnout in the United States than to that in Western European countries. Of the five countries participating in the research conducted in the framework of the CONCISE project, the lowest voter turnout was recorded in Poland and Portugal. In Slovakia, it was higher than the average for the ten former Eastern Bloc countries and close to the level in Spain, which, in turn, was lower than the average turnout in Western European countries. The highest voter turnout was recorded in Italy (Alber & Kohler, 2008).

Apart from the level of electoral participation, which can be seen as a predictor of the citizenry's willingness to participate in public consultations, namely, other forms of participation, the literature points to many additional elements that influence citizen participation. The factors influencing citizen participation and engagement mentioned most frequently include status factors (level of education and wealth) and the possession of appropriate civic skills and capabilities (see Verba & Nie, 1972; Verba, Nie, & Kim, 1978; Michels, 2017). These skills, as well as the need to engage in public affairs, derive from both primary (family home) and secondary (school, work and NGOs) institutions (Marks-Krzyszkowska & Michalska-Żyła, 2018).

Furthermore, it has been stressed that involvement depends on psychological variables such as a sense of community and emotional attachment (see Michels, 2017). Social trust is also an extremely important element (Ulsaner, 1998; Putnam, 2008; Klijn, Edelenbos, & Stein, 2010; Michels & de Graaf, 2010), which influences, among other things, the positive evaluation of democracy (see Paxton, 1999). As the level of trust drops, civic participation may also decrease, as confirmed by data analyses in the United States (see Patterson, 1999; Putnam, 2008). Other analyses have confirmed that political trust is positively associated with institutionalised political participation (Hooghe & Marien, 2013). In other words, it can be assumed that a higher level of trust is accompanied by a greater willingness to engage in participatory initiatives and co-decision processes. Involved people have more hope (trust) that their involvement will have an impact on the decisions made and changes implemented.

The level of public trust registered in the five countries in which the CONCISE public consultations were carried out, as examined in the European Social Survey, is fairly similar and generally rather low (Domański, 2018). In Europe, the highest levels of trust, both generalised and institutional, are systematically recorded in Scandinavia. The second group comprises countries with long democratic traditions, such as Great Britain, France and the Netherlands. The third group – despite some differences – includes some Mediterranean countries, as well as those belonging to the former Eastern Bloc. As one Polish researcher – Henryk Domański (2018) – notes, the relatively low level of social trust in Spain, Portugal and Italy may be due to the remnants of totalitarian regimes (Franco, Salazar and

Mussolini), as well as to a specific type of social ties defined by Banfield (1958) as 'amoral familism'. Amoral familism is a combination of extreme individualism with the perception of social relationships as a kind of battlefield and competition. According to Domański (2018), the cautiousness in establishing relationships among Italians may be related to the era of fascism, while in the case of Portugal, it is linked to the several decades of the Salazar presidency, and in Spain, to the Franco dictatorship.

In turn, the relatively low level of social trust in the former Eastern Bloc countries may be related to the belief that it is associated with high costs and relatively low benefits (Domański, 2018). Domański believes that this is due to the experience of a centrally planned economy and one of the specific features of the former system, the so-called 'small collectivism', among other things. Small collectivism was a strategy that involved acquiring the resources needed for living by all means possible. This strategy was accompanied by an attitude of vigilance, tension and acceptance of dishonesty. To some extent, it may still be valid today due to intergenerational transmission (ibid.).

The level of trust in the former Eastern Bloc countries has also been influenced by the experience of transformation. An analysis of that transformation highlights the trauma associated with the many negative social consequences (Sztompka, 2000). As Miszalska (1996) notes, the radical and sudden social change became a macro trauma resulting from the decline in living standards and the increase in crime. The sudden change in the system also caused existential anxiety, apathy and depression (Długosz, 2019), while the socio-cultural symptoms of that trauma included mistrust, pessimism, a nostalgic image of the past and political apathy, among others (Sztompka, 2000; Długosz, 2019). Although it is assumed that the transition ended when the former Eastern Bloc countries joined the European Union (Ziółkowski, 2014; Marody et al., 2019), data from the European Social Survey seem to confirm that their societies have not yet managed to build a social trust comparable to that of the 'old democratic' countries.

To sum up, although the five countries involved in the CONCISE project are characterised by a low level of social trust, they differ in the level of electoral participation. This is highest in Italy, a country that has been quickest in making the transition to democracy. They also differ in the number of participatory budgets. Apart from allocating a certain pool of public funds, they also have an educational role: that of shaping civic attitudes. As a result, it could be assumed that the public consultations held in the framework of the project would be most positively assessed by members of Italian society – the oldest democracy in the group – plus those of Portugal and Poland – shaping civic attitudes through participatory budgets.

Citizen participation in science

This vogue for participation, for the involvement of citizens in various decision-making processes and for the increasingly popular inclusive approach also applies to the field of science. According to EU strategy and the concept of responsible

science, for public engagement to make a difference, it must become part of routine practice (Public Engagement in Science, 2007). If the scientific community wants to establish an effective dialogue between science and society, it is important to be aware of the opinions and perceptions that both parties have of each other (Llorente et al., 2019). The implication of researchers in public engagement activities is one of the things that the public values most, because they talk from a first-person perspective and with a comprehensive knowledge of the topic (Revuelta, 2014).

Science communication is about bridging the gap between various sectors (Cheng et al., 2008). It creates broad avenues for contact and interaction between scientists and different levels of government, industry and business and the community. Bauer (2009) pointed out that when describing the evolution of the public understanding of science (hereinafter PUS), two strands can be observed: firstly, the evolution of discourse from science literacy (1960–1980), through public understanding (1985–1990s), to science and society (1990s–present), with its controversy over the notion of 'public deficits'; and, secondly, the evidence of substantive changes in the public's relationship with science.

A dialogue-based approach, including the public consultation mechanism, which is designed to discover the ideas, values, beliefs and feelings of citizens as regards science-related topics, can be helpful for identifying the sources and the origin of their decision-making processes (Lezaun & Soneryd, 2007). At a personal level, participation in science communication is thought to benefit people by sharing valuable knowledge (Dawson, 2018). This is important because, just as social research methods contribute to 'making' publics and influencing how their practices are understood, so too has research constructed publics and participation in relation to science and its communication (Michael, 2012). Therefore, non-participation is problematic for societies in a normative sense, insofar as it may impair political and market processes (Dawson, 2018).

In light of the foregoing, there is a need for a new relationship between science and society, with an emphasis on democratising the former. The public and stakeholders should be allowed to play an active role in the production and evaluation of scientific knowledge (Liberatore & Funtowicz, 2003; Berg & Lidskog, 2018). So, the objectives of democratic collective deliberation should be, at least: (1) to enable as broad and diverse a cross-section of citizens as possible to form and express their opinions on the strength of accessible and even-handed information; and (2) to give voice to minority views, to draw out unspoken, perhaps subconscious, opinions and to ensure that they are taken into account. Thus, the inclusion of the public in this process must be deeper and based on dialogue. Science communication draws from deliberation and builds upon it. Citizens should have the right to have a say in knowledge issues. The basis for inclusion is not that people have contextual knowledge and a specialised competence that can complement or question science (Berg & Lidskog, 2018). The general public should be involved in developing the issue by asking questions about the underlying causes of a problem and its broader social consequences (Jasanoff, 2003; Wynne, 2006) and in generating a more inclusive and reflective problem-framing process (Berg & Lidskog, 2018).

Researchers simultaneously emphasise that in a changing context, a sceptical public is highly desirable. However, this is contrary to the traditional missions of science communication, which should promote public scientific literacy and a positive image of science and foster public acceptance of new technology. But a sceptical public is necessary to compensate for the proliferation of exaggerated claims. Just as the knowledge society needs a public with critical attitudes, so too does the consumer society need consumers with a consumer awareness. This attitude is necessary but insufficient to increase vigilance. It needs to be cultivated, maintained, mobilised, invested in, amplified and made to resonate by competent social actors. The various social movements that establish the benchmarks for societal progress have an important role to play here (Cheng et al., 2008).

The origin of the field of study known as PUS has its roots in the democratisation of the public – at least to some degree. Much of its early impetus was based on improving citizens' 'scientific literacy' (Knight & Barnett, 2010). And although much has changed in recent years since the 'deficit model' was abandoned, there are still many challenges facing citizen participation in science.

In reality, little is known about the effect of formal public participation initiatives, inasmuch as there are rarely evaluations of processes or outcomes. More generally, empirical research on the relationship between efficacy and public participation in politics has found that people who have a strong belief in the power of their collective voice trust their systems of governance (Knight & Barnett, 2010).

A large body of research has identified a wide range of factors, views and values that influence the public's attitude towards science. They include political and scientific knowledge, 'culture, economic factors, social and political values, trust, risk perception, and worldviews' (Sturgis & Allum, 2004: 58). However, the relationship between political efficacy and attitudes towards science has yet to receive attention (Knight & Barnett, 2010).

Research has shown that comparing beliefs in ideology and the perception of the societal relevance of science allows for profiling different 'scientific cultures' in European countries:

- Sceptics are critical on both accounts (such as the Swiss and the Luxembourgers).
- Those who mainly see science in a 'mystical' light, far removed from real-world issues (such as the Turks and the Italians).
- Those for whom science is highly relevant, but who are also mystified by ideological claims (such as the Macedonians and the Maltese).
- Those who mainly see science as a demystified utility (such as the Danes).

The state of affairs outlined above points to different types of cultural patterns that merit closer examination and further research (Cheng et al., 2008).

The study performed by Mejlgaard et al. (2012) showed that in countries where the culture of science communication was weak, where science hardly played any role in policymaking and where institutions and procedures for public engagement were deficient, citizens were relatively less satisfied with their own engagement with science and technology. The different scientific culture is indirectly

visible in the results of scientific research, namely, publications. The research papers that have been published in the three main journals in the field (*Science Communication: Linking Theory and Practice*, *Public Understanding of Science* and the *Journal of Science Communication* [hereinafter *JCOM*]) between 1979 (the launching of the first journal) and 2016 illustrate their geographical scope. The majority of them concern the United States (1,401 articles, almost 40%) and the United Kingdom (almost 16%), followed by Canada, the Netherlands, Australia, Germany, Spain, Italy, Japan and Brazil. With only a few papers, Poland is way down the list (Guenther & Joubert, 2017). Weitkamp (2016) arrived at similar conclusions when analysing the first five years of *JCOM*. She emphasised the journal's importance in providing a platform for geographically diverse voices to reflect a global field of study like communication. Listing 19 countries from where the authors came, she revealed the predominance of researchers from the Northern Hemisphere (12 out of 19 countries). Conversely, the contribution of researchers from Africa and Asia was noticeably low.

Cámara-Hurtado and López-Cerezo (2012) proposed the 'stairway of scientific culture', in which the steps reflect a classification of the gradual assimilation of science (see Table 3.1).

The stairway comprises four dimensions, two of which are broken down into specific components: (1a) expression of interest – people show interest in science and technology issues; (1b) expression of interest – they consume science information, for instance, on television or in the press; (2a) relevance is attributed to science and technology – they evaluate the potential risks or benefits; (2b) relevance is attributed to science and technology – they evaluate how useful it is in their personal lives; (3) inclination to make use of scientific knowledge, for example, reading the information contained in patient information leaflets or food labels or seeking medical advice before following a diet; and (4) willingness to participate, for instance, are they affected or concerned by something? (Cámara-Hurtado & López-Cerezo, 2012). In this transition, it is possible to observe the evolution in understanding science, from perceiving it as an exceptional and distant concept to considering it as a research process in which non-professionals can participate and co-create. This makes the concept of science more familiar and open to the public.

Table 3.1 Stairway of scientific culture

(6) Willingness to participate
(5) Inclination to make use of scientific knowledge
(4) Relevance attributed to science and technology: usefulness in personal life evaluation
(3) Relevance attributed to science and technology: evaluation of potential effects
(2) Expression of interest: consumption of science information
(1) Expression of interest: interest in science and technology issues

Source: Cámara-Hurtado and López-Cerezo (2010).

The level of acceptance of public consultation rules of the participants in the European public consultations: results of the evaluation research

The evaluation research conducted in the five European countries (Slovakia, Spain, Poland, Portugal and Italy) participating in the CONCISE project took the shape of a survey. Questionnaires asking the citizens to evaluate different aspects of the consultation were distributed after each discussion session and after the meeting.[1] Although all the citizens took part in the consultations, not everyone answered every question, including those about age and gender (see Table 3.2), for which demographic data are missing from some of the analyses.

The objectives of the evaluation research, apart from gathering the citizens' opinions on their organisation and structure, included examining their level of understanding and acceptance of the procedures and rules of public consultations and identifying factors influencing their involvement. Accordingly, they were asked to give their opinion on the adequacy of the public consultation procedure used to gather information on science communication and to evaluate several dimensions of the discussion sessions in which they had participated. These dimensions were based on the principles of effective deliberation, including the following: free and full participation of all group members in the discussion, this being tantamount to having equal opportunities to influence its course; respect for other people, their views and arguments; trying to reach agreements; and sticking to the point (Chambers, 2018; Dryzek, 2002; Steenbergen et al., 2003; Krzewińska, 2016; Sroka 2009, 2018; Wesołowska, 2013). Additionally, after each session, the citizens were asked to rate the importance of the topic discussed, their level of interest in it, their involvement in the discussion and their satisfaction with the results. They also evaluated the organisation of the consultations.

The results of the survey showed that the vast majority of the respondents (98%) felt that the procedure was a good way of obtaining information on science communication (64% – definitely yes, 34% – yes, to a point). It was the Portuguese respondents who were most convinced about its appropriateness (74%), while their

Table 3.2 Structure of the study population by the country where the consultation took place, gender and age of participants (%)

Country	*Gender*				*Age brackets*				
	Female	*Male*	*Other*	*No data*	*18–34*	*35–49*	*50–64*	*65 +*	*No data*
IT (n = 90)	48	52	0	0	31	29	30	10	0
PL (n = 100)	62	37	0	1	31	24	24	19	2
PT (n = 102)	67	33	0	0	26.5	32	27.5	14	0
SK (n = 96)	57	42	0	1	49	27	17	7	0
SP (n = 100)	56	42	2	0	16	16	30	14	24
Total (n = 488)	58.2	41	0.4	0.4	30.5	25.6	25.6	12.9	5.3

Source: CONCISE public consultation, evaluation of participant questionnaires.

Slovak counterparts were the least convinced (57%). In the other three countries, the proportion of citizens agreeing with the format ranged from 61 to 63 per cent of the total (see Table 3.3).

The positive evaluation of the procedure was also emphasised by the additional statements that the respondents provided in the evaluation questionnaire. They not only expressed satisfaction with their participation in the consultations but also asserted that it had enabled them to broaden their knowledge of the topics under discussion and to clarify their position after contrasting their opinions with those of others, often people with whom they had not previously exchanged views: 'I'm very satisfied with the consultations and I think I've learned things I was not interested in; it has helped me to clarify my opinion' (SK); 'Having mixed groups with people of different ages has helped to identify more points of view in society. I'm satisfied with this experience (IT)'; 'A very cool, mind-opening experience; an opportunity to listen to people outside your own information bubble; a nice day' (PL).

Consequently, the respondents also indicated that this type of consultation 'should happen more often as they're a way of bringing science closer to the citizenry' (PT); 'The results of this consultation should be widely disseminated. They're very important for improving the relationship between science and society and they can generate more interest' (PT). They also called for this type of event to have a wider reach: 'These events should be repeated on other topics, in areas such as education, health and justice. Promoting such discussions with people from different parts of the country fosters sharing and cross culture. The conclusions of these public consultations should be the basis for the reforms to be implemented in these systems. The organisation dynamics allow for the interaction of different ideas' (PT); 'Public policies should be designed and developed from activities such as these' (IT). Therefore, the respondents not only stressed the need for consultations but also pointed to their causal nature – seeing them as a basis for decision-making and the development of different policies.

Table 3.3 Assessment of the appropriateness of the consultation formula

Evaluation of the public consultation as a way of obtaining views on science communication methods	*% of respondents choosing a given answer*					
	IT	*PL*	*PT*	*SK*	*SP*	*Total*
Definitely the right way to collect opinions	62	63	74	57.3	61	64
Mostly the right way to collect opinions	36	37	23	39.3	37	34
Mostly the wrong way to collect opinions	2	-	1	2.2	1	1
Definitely the wrong way to collect opinions	-	-	-	-	-	-
No opinion	-	-	2	1.1	1	1

Source: CONCISE public consultation, evaluation of participant questionnaires.

The respondents' statements also indicate a high level of acceptance of the discussion rules applicable to public consultations and the willingness of most of them to respect them. The vast majority, regardless of their countries of origin, assessed that the participants in the consultations had treated each other with respect (a mean score of 4.85 on a scale of 1–5) and had avoided making unwelcome or malicious comments (4.63), and that everyone had had an equal opportunity to influence the discussions (4.66). They rated their discussion partners slightly lower in terms of not ignoring other people's views (4.52), trying to understand their position (4.31), taking their arguments into account (4.28) and not forcing their own opinion on them (4.15).

The lowest scores were given to adherence to the rules on seeking agreements (a mean score of 4.06), sticking to the point (3.98) and not sticking to one's own opinion at all costs (3.97).

The composition of the average scores for adhering to the discussion rules was similar in all the countries surveyed, but the proportion of people giving the highest scores to the participants' adherence to particular rules differed from country to country. Sticking to the point and wanting to reach an agreement gave rise to the greatest discrepancies. The across-the-board compliance with the first rule was reported by only 19 per cent of the Italian respondents and 15 per cent of the Portuguese. By contrast, in Slovakia, it was 52 per cent and in Poland, 60 per cent. The desire of all the participants in a discussion to reach an agreement was noted by 14 per cent of the Italian respondents, nearly 40 per cent of the Slovaks and Portuguese and almost 60 per cent of the Poles (see Table 3.4).

Interestingly, across the countries, the differences in the respondents' scores regarding adhering to the rules were not associated, by and large, with a significant variation in the level of engagement in the discussion. In all the study communities, engagement was rated as high (the average score in each session ranged from 4.17 to 4.55 on a five-point scale). The Slovak respondents gave the lowest average scores, ranging from 3.82 to 4.32, to participant engagement in all the discussion sessions, except for the one on CAM (see Table 3.5).

Similar differences were also observed in each country between discussion sessions on different topics. It was the Polish respondents who gave the most similar scores in all the sessions, whereas it was the Italians' scores that differed most for particular topics.

The Italian and Portuguese citizens were most involved in the discussion session on climate change (mean scores of 4.79 and 4.55, respectively). In Poland, vaccines proved to be the most discussed topic among the citizens (4.61), while in Slovakia, it was CAM (4.32). At the same time, however, climate change was given the greatest proportion of highest scores in all the countries. In all the public consultations, it was observed that the citizens were least engaged in the discussions on GMOs (see Table 3.5).

Thus, adherence to public consultation rules and involvement in the discussions seemed to be related not only to the socio-cultural context and the different experiences of individual societies in the area of participation in the broad sense

Table 3.4 Assessment of the level of the participants' adherence to the discussion rules

Behaviour of participants	*Mean score on a scale of 1–5*[a]					*% of respondents giving the highest score*				
	IT n = 89	*PL n = 99*	*PT n = 102*	*SK n = 96*	*Total n = 386*	*IT n = 89*	*PL n = 99*	*PT n = 102*	*SK n = 96*	*Total n = 386*
Treating each other with respect	4.67	4.94	4.93	4.85	**4.85**	71	94	93	85	**86**
Having equal opportunities to influence the course of the discussion	4.48	4.62	4.76	4.76	**4.66**	60	73	79	79	**73**
Trying to understand the views of others	4.09	4.36	4.47	4.28	**4.31**	32	50	57	45	**45**
Taking into account other people's arguments	4.09	4.12	4.57	4.29	**4.28**	38	37	64	46	**47**
Wanting to reach an agreement	3.17	4.52	4.18	4.06	**4.01**	14	58	39	38	**38**
Making unwelcome and malicious comments about each other	4.80	4.84	4.30	4.62	**4.63**	88	95	64	74	**80**
Ignoring other people's views	4.27	4.55	4.64	4.59	**4.52**	53	77	75	73	**70**
Trying to impose their own opinion	4.34	4.31	4.17	3.78	4.15	57	60	54	31	50
Speaking off-topic	3.55	4.39	3.50	4.45	3.98	19	60	15	52	37
Stubbornly sticking to their opinions	3.84	3.55	4.37	4.10	3.97	33	25	52	46	39
Total (mean score)	4.04	4.29	4.36	4.33	4.26					

Source: CONCISE public consultation, evaluation of participant questionnaires.

Notes: [a]For the first five statements, 1 point meant that the description did not fit any participant, and five points meant that it applied to the behaviour of all of them. For the next five statements, the maximum number of points meant that no one behaved as described in the statement.

Table 3.5 Assessment of participants' involvement in the discussions

Topic	*Mean score on a scale of 1–5*					*% of respondents giving the highest score*				
	IT n = 90	*PL n = 99*	*PT n = 100*	*SK n = 95*	*Total n = 384*	*IT n = 90*	*PL n = 99*	*PT n = 100*	*SK n = 95*	*Total n = 384*
Climate change	4.79	4.52	4.55	4.27	**4.55**	80	74	58	53	**66**
Vaccines	4.52	4.61	4.46	4.25	**4.46**	63	71	51	50	**59**
CAM	4.23	4.55	4.38	4.32	**4.37**	49	66	46	54	**54**
GMOs	3.97	4.55	4.33	3.82	**4.17**	42	66	46	34	**47**

Source: CONCISE public consultation, evaluation of participant questionnaires.

Table 3.6 Assessment of the social importance of the topics discussed

Topic	*Assessment of the social importance of the topics discussed on a scale of 1–5*					*Assessment of the social importance of topics discussed – % of respondents giving the highest score*				
	IT n = 90	*PL n = 99*	*PT n = 100*	*SK n = 95*	*Total n = 384*	*IT n = 90*	*PL n = 99*	*PT n = 100*	*SK n = 95*	*Total n = 384*
Climate change	4.84	4.80	4.91	4.60	**4.79**	90	86	91	78	**86**
Vaccines	4.46	4.68	4.56	4.46	**4.54**	69	77	59	65	**68**
CAM	4.18	4.56	4.43	3.96	**4.25**	45	59	54	43	**50**
GMOs	4.05	4.46	4.16	3.74	**4.04**	48	52	38	37	**44**

Source: CONCISE public consultation, evaluation of participant questionnaires.

of the word (which were not examined in the evaluation) but also to the discussion topics themselves. This is primarily about the sense of social importance of the topic and the level of interest in it. In all the countries where the survey on the importance of particular topics was conducted, the respondents gave the highest scores – considering them 'very important from a social point of view' – to climate change (ranging from 78% in Slovakia to 91% in Portugal),[2] with an average score of 4.79 on a five-point scale, followed by vaccines, GMOs and CAM (see Table 3.6).

An analogous distribution of scores was also obtained for the citizens' interest in the individual topics. However, a lower proportion of respondents gave the highest scores to this aspect than to the importance of the topics. Consequently, the average scores for the level of interest in these topics were also somewhat lower than those for their importance, ranging from 3.85 for interest in CAM to 4.54 for interest in climate change (see Table 3.7).

In view of the distributions of the scores given to the importance of particular topics, to the level of interest in them and to involvement in the discussions, it can

Table 3.7 Assessment of the participants' level of interest in the topics discussed

Topic	*Assessment of the level of interest in the topics discussed – mean score on a scale of 1–5*					*Assessment of the level of interest in the topics discussed – % of respondents giving the highest scores*				
	IT n = 90	*PL n = 99*	*PT n = 100*	*SK n = 95*	*Total n = 384*	*IT n = 90*	*PL n = 99*	*PT n = 100*	*SK n = 95*	*Total n = 384*
Climate change	4.73	4.47	4.62	4.34	**4.54**	78	63	65	54	**65**
Vaccines	4.02	4.26	4.04	3.84	**4.05**	44	55	33	39	**43**
CAM	3.79	4.24	3.96	3.48	**3.88**	36	52	35	28	**38**
GMOs	3.85	4.03	3.75	3.74	**3.85**	44	47	30	35	**39**

Source: CONCISE public consultation, evaluation of participant questionnaires.

Table 3.8 Comparison of involvement, interest and satisfaction with the results of the discussions between those respondents who considered a given topic to be very important to society and those who gave it lower scores

Topic	*% of the respondents considering the social importance of the topic to be very high*[a]			*% of other respondents*		
	Very high interest	*Very high involvement*	*Very high satisfaction*	*Very high interest*	*Very high involvement*	*Very high satisfaction*
Climate change	73	68	56	14	55	42
Vaccines	68	58	64	11	41	34
CAM	57	57	51	18	38	28
GMOs	67	67	57	17	45	40

Source: CONCISE public consultation, evaluation of participant questionnaires.
Note: [a]In the individual sessions, the number of participants were as follows: 322 (climate change), 252 (vaccines), 188 (GMOs) and 162 (CAM) of the 374 respondents who answered these specific questions.

be assumed that they are interrelated. The citizens who considered a given topic to be socially very important also included a higher proportion of those who were very interested in it and very engaged in the discussion than among those who did not consider it to be important. It is also noteworthy that the high scores given to the social importance of the topics were also reflected in a high level of satisfaction with the results of the discussion (see Table 3.8).

The survey also showed that all the factors identified as being potentially significant for the structure and quality of the consultations were also related to how their organisational aspects were evaluated. Those expressing the highest level of satisfaction with their organisation included a higher proportion of those who

Table 3.9 Comparison of the involvement and interest in the discussions and satisfaction with the results between those respondents who gave the highest scores to the organisational aspects of the consultations and those who gave them lower scores

Topic	*% of respondents giving the highest scores to the organisational aspects of the consultationsa n = 203*			*% of other respondents n = 285*		
	Very high interest	*Very high involvement*	*Very high satisfaction*	*Very high interest*	*Very high involvement*	*Very high satisfaction*
Climate change	72	79	65	56	50	40
Vaccines	52	72	64	31	41	40
CAM	40	57	48	35	35	29
GMOs	47	65	48	28	39	45

Source: CONCISE public consultation, evaluation of participant questionnaires.

Note: [a]These participants gave maximum scores to at least three of the four aspects of the organisation of the consultations that were assessed: the venue, the catering, the duration of the consultation and the length of the breaks between discussion sessions.

claimed to have a greater interest in the public consultation topics, a higher level of involvement in the discussions and a higher level of satisfaction with the results (Table 3.9).

Finally, the factors favouring engagement in the public consultations included the citizens' demographic profile, such as gender and age. While these did not have any negative impact on engagement in the discussions per se, they proved to have a significant influence on interest in certain topics. Age and gender were associated with the level of interest in vaccines and CAM, to wit, those topics most directly related to healthcare or minimising the effects of diseases. More women than men declared a higher level of interest in both topics, while the oldest participants included the highest proportion of people professing to be highly interested in them.

Conclusion

The results of our research show that the vast majority of the citizens taking part in the public consultations, regardless of their country of origin, considered the procedure followed for gathering information to be appropriate for the issues addressed in the project. In their opinion, conducting research in this way gave them the opportunity to express their own point of view, as well as to acquire information and to learn about alternative perspectives on a given issue, making them more receptive to the views of others. Furthermore, they believed that the public consultation format was a good way of engaging the public with science and involving them in decision-making on socially important issues. They also

contended that they had had a positive impact on their willingness to participate in such activities.

The majority of the respondents were also of the mind that the citizens participating in the consultations had generally complied with the applicable discussion ground rules. Irrespective of their country of origin, the citizens found it easier to follow basic rules of communication and personal culture, such as showing one another respect and avoiding malicious comments. In contrast, they found it harder to stick to the point, to refrain from sticking to their own beliefs and to reach agreements. This is crucial for effective deliberation but is extremely difficult in negotiations, disputes and discussions in which there are differences of opinion. At the same time, it was in these aspects that most differences were observed among the citizens from the five countries. The average scores for the acceptance of each rule were high in all the groups. However, in the case of 'sticking to the point' and 'trying to reach an agreement', there were significant differences depending on the country in terms of the proportion of the respondents giving them the highest scores (indicating that they were accepted by all the participants in the discussions). These differences were more than 40 percentage points for both the aforementioned rules.

It is interesting to note that the lowest level of acceptance of the discussion rules was observed among the Italian respondents, the first country to make the transition to democracy among the five involved in the project. Somewhat surprisingly, however, there was a relatively high level of acceptance of both discussion rules among the citizens of the former Eastern Bloc countries (Poland and Slovakia). Perhaps this has to do with a historical tendency towards conformity.

The high acceptance of the discussion rules were reflected in the high scores given to involvement in the discussions, although they varied from session to session and from topic to topic. It was higher in those discussions on topics that the citizens considered more socially relevant and interesting. At the same time, involvement in the discussions on issues considered to be socially important gave them greater satisfaction.

In this regard, the relatively high involvement of the Portuguese and Spanish citizens in the discussions on climate change should come as no surprise, for they are the European countries that are most likely to feel its effects first in Europe. In these countries, on the eve of the consultation, climate change was a 'hot' topic, raising citizens' awareness. Both are also characterised by a high culture of science communication.

Therefore, the results of the evaluation show that the level of acceptance of the consultation procedures and the level of the citizens' involvement in them were closely related to the discussion topics. A condition for the success of such an undertaking and for achieving a high level of involvement is their interest in the subject and their conviction that it is socially important.

Organising the consultation procedure in line with their needs and expectations also had an impact on involvement. The respondents who gave the highest scores

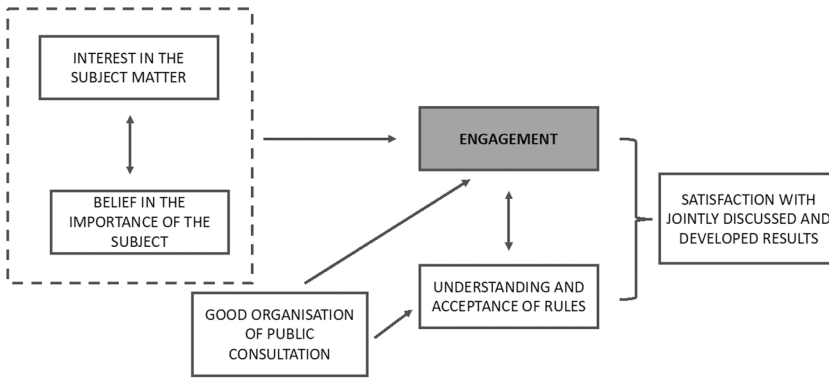

Figure 3.1 Simplified 'method' for organising a public consultation.

Source: Own elaboration.

to the organisation of the consultations included a much higher proportion of those who were interested in the subject, involved in the discussions and satisfied with their results than those who gave slightly lower scores, namely, those who were less satisfied with the way in which they had been organised.

In conclusion, as stated by Crawford, Dytham and Naylor (2017), a key driver for evaluation was the feeling that it was important to demonstrate the success of this participatory initiative. We believe that public consultations are the right way to make progress in the democratisation of science, to develop science communication and citizen science and to broaden general social and civic skills. In light of the results, we propose a simplified 'method' for organising similar undertakings (see Figure 3.1). It seems to us that, contrary to our original assumptions, socio-historical factors and sociodemographic characteristics play a lesser role, the key being participant engagement.

Although the citizens from the countries surveyed (Poland and Slovakia, Spain, Portugal and Italy) are characterised by different cultures of science communication and levels of willingness to participate, it seems that they are only on the first steps of Cámara-Hurtado and López-Cerezo's stairway of scientific culture. We believe that initiatives similar to the CONCISE project, following the recipe that we propose (Figure 3.1), may result in positive change.

Notes

1 Only the final survey was administered in Spain, which did not include some of the questions posed in the other countries immediately after each discussion session. For this reason, some of the analyses described here are based on the results obtained in only four countries.

2 In comparison, a recent survey of EU citizens (2019) found that 79 per cent of the respondents considered climate change to be a very serious problem.

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4 The trustworthiness and reliability of science information channels and sources in the public's view

Giuseppe Pellegrini, João Estevens, Aneta Krzewińska, Isabel Mendoza and Peter Guran

Introduction

Understanding perceptions of trust in or distrust of information sources is essential in the post-truth era. Current society has created a new communication environment that allows for dissimilar ways of developing (dis)trust and accountability mechanisms, especially considering how subjective this process can be. Indeed, the concept of trust is linked to the subjectivity, intersubjectivity and objectivity expressed by individuals when interacting with others, as in the case of the public consultations carried out in the framework of the CONCISE project. Trust and reliability are relevant for the study of science communication because they influence people's perceptions of scientific developments and reinforce science-related decisions. Trust in science is a constant even in the fake news era and despite the barrage of disinformation via the now omnipresent social networks (Blackburn, 2005).

In the study of trust in the public communication of science, it is vital to consider the integrity of scientific experts who tend to wield considerable influence in the traditional media (Reif, Kneisel, Schäfer, & Taddicken, 2020; Rabinovich & Morton, 2012). At the same time, trust in public institutions plays a key role. In risk communication, for example, when citizens receive information from public institutions, they assess it on the basis of what is proposed (Weingart & Guenther, 2016; Chryssochoidis, Strada, & Krystallis, 2009).

Trust in information sources, institutions and experts

When conceptualising the level of trust in the public communication of science, it is important not to overlook sources such as friends, family and relatives, who often play an essential role in influencing views on scientific issues, especially those relating to health (Larson et al., 2018). In the case of climate change, moreover, some researchers have paid particular attention to parental circles in the quest for information (Leiserowitz et al., 2013).

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The most recent European Eurobarometer survey on citizens' opinions and science focused on the level of trust in the institutions governing science (Eurobarometer, 2021). Half of the respondents (from 18 different countries) agreed that there was no other option but to trust those managing science and technology, this being especially the case in Hungary (68%), Bulgaria (66%) and Poland (65%). In the same vein, there were two different levels of trust in the countries participating in the CONCISE project: Poland (65%), Italy (63%), Spain (62%) and Slovakia (61%) with a high level, and Portugal (52%) with an average level.[1]

In the same survey, the respondents' opinions on scientists were also sounded out. Expressing mixed views about the credibility of scientists, half of the respondents (50%) agreed that 'we can no longer trust scientists to tell the truth about controversial scientific and technological issues, because they depend more and more on money from industry', while 21 per cent disagreed. However, the proportion of respondents agreeing had fallen by 8 per cent since 2010, while the proportion of those disagreeing had increased by 5 per cent. With respect to the citizens participating in the CONCISE public consultations, the Spaniards were the most sceptical about the trustworthiness of scientists (57%), followed by the Portuguese (53%), whereas the Italians (49%), Poles (47%) and Slovaks (46%) were less distrustful.

Health and environmental issues spawn many public controversies, calling scientific authority and competence into question. As a matter of fact, trust is not unconditionally placed in experts and science but varies depending on many factors (Scarfuto, 2020): the science topics in question, gender and culture, scientific literacy, scientific news exposure and political values and contexts. According to Wynne (2007), it can be contended that there are multiple factors that make citizens distrust science and technology. These point to the need for generating a different kind of independent, collective meaning-making and knowledge rooted in social conditions, visions and priorities differing from those of the scientific elites.

So, understanding above all how trust is generated appears to be essential. In the opinion of Boswell (2021), trust is a form of inference based on familiarity or previous experience. We learn to trust people because we know from experience that they will behave in predictable ways, thus putting our mind at rest. In large and complex societies, this confidence cannot be merely grounded in our direct experience of the behaviour of other individuals. We also need to trust familiar social 'archetypes', relying on representative characteristics, such as people with a background similar to ours, who support the same political party or who live in our neighbourhood. Alternatively, and this is especially relevant in emergency contexts, like, for example, the COVID-19 pandemic, we may learn to trust people with specific training or professions, such as doctors and nurses.

Be that as it may, people's trust in experts can diminish when they publicly express different and even conflicting opinions. This is the case of the COVID-19 pandemic in the period between March and October 2020, when many epidemiologists, virologists and doctors offered their prognoses in different media. This public overexposure of very different expert opinions perplexed the public in general and made them criticise the communication skills of these important actors (Bucchi & Saracino, 2020).

Trust in science: a framework for the analysis of public opinion

Given the complexity of studying trust in science, communication research needs to treat it as a multilevel problem. Individual perceptions of science are embedded and shaped by the social dynamics of intersubjective, subjective and objective relationships. To study the views on climate change, vaccines, GMOs and CAM expressed by the citizens taking part in the discussion groups, a particular content analysis method was employed.

Specifically, the citizens' views were analysed considering how trust was built on the basis of the following:

- *Subjectivity* is the self-conscious perception of people or subjects in their interaction with others, as in a public consultation group. Participants in public consultations display subjectivity when they staunchly defend their stances on issues open to many interpretations. Subjectivity defines interpretations, points of view and worldviews. As the citizens participating in the public consultations expressed their opinions and talked about their personal experiences, offering examples from their own lives, theirs was a subjective view of reality. Given that their experiences were unique, it was possible to gather a large amount of material containing many colourful descriptions of specific situations. This subjective perspective provides an opportunity to analyse the material focusing on the individual level by treating all the participants as unique people in terms of their experiences, thoughts and opinions on climate change, vaccines, CAM and GMOs. And while during the analysis of the material gathered, an effort was made to identify certain patterns (similar views and behaviours), it should be recalled that these patterns were illustrated each time with examples from individual subjective experiences.
- *Intersubjectivity*. Each thought community shares social experiences that are different from those of others, which, in turn, gives rise to different beliefs. The fact that these experiences transcend subjectivity explains why an entire thought community can share them. From this perspective, intersubjectivity implies that individual beliefs are often the result of those of a thought community and not just of personal experiences or universal and objective human beliefs. Beliefs are reshaped following standards set by thought communities. The people forming a given thought community share certain ways of thinking about the world around them, which gives rise to shared beliefs about reality, as well as desirable behavioural patterns, resulting in similar actions being taken. To understand how opinions are formed within a given society, it is not enough to aggregate the personal views of individuals. For it is necessary to consider what is created by groups of like-minded people constructing their identities and ideas about the surrounding world and also taking specific actions. As regards trust building, an enquiry was made not only into what was said when the participants recounted their personal experiences but also into whether the views that they expressed had been developed within their own community. In other words, the different levels of trust in individual people, institutions, organisations and the media

reflected those of the members of the community to which the respondents belonged. This clearly shows that although the participants in the consultations shared the same reality, they sometimes experienced it in a different way, which they then shared with other members of their thought community.

- *Objectivity* is an attitude characterised by having an open mind to evidence and its consequences. An objective position is free of personal biases and frequently associated with scientific evidence. As to the four topics discussed during the public consultations, this was expressed by the idea that scientific claims, methods and results are not, or should not be, influenced by individual perspectives, value judgements, community bias or personal interests. During the public consultations, the participants were objective when they cited the statements of scientists or scientific research results or provided examples of scientific studies (books, articles, conferences papers). This was also the case when they talked about the scientific procedure and stressed the need for systematic research and the scientific verification of the results obtained. That objectivity was guaranteed by the independence of the researchers and research institutes involved and by transparent research funding.

Brief note: the CONCISE project consisted of five public consultations involving citizens from Italy, Poland, Portugal, Slovakia and Spain, in which a wide range of opinions on the public communication of science were gathered. The results of the analysis described in this chapter are based on the transcripts of the recordings of the discussion sessions, considering three main dimensions:

- *Authority*. Concerning the role of actors, like, for instance, experts, decision makers and communicators, in the discourse of power and their exercise of authority (Brossard & Nisbet, 2007). This is reflected in the quality of information sources (e.g. competent scientific evidence, authoritative data, referenced information, technical jargon and factual information).
- *Credibility*. Understood as the accuracy of the messages conveyed, an objective scientific writing style and informative scientific data (Bucchi, 2013) (e.g. language, explanations, completeness, independence and depth). Therefore, those texts relating to the public communication of science that employ non-scientific expressions and styles are often regarded as lacking in legitimacy and credibility (Myers, 2003).
- *Legitimacy*. Relating to the relevance of information for individual needs (e.g. health and environmental concerns), the actors who are considered as being the most relevant on the public stage and the citizenry's relationship with a given topic. This also implies that 'decisions made in political institutions are morally acceptable or justifiable in terms of democratic values' (Peter, 2017).

Data analysis and discussion

After performing a data analysis using the four aforementioned dimensions as a reading filter, the time has now come to determine how the citizens expressed their

level of trust in or mistrust of the topics discussed, highlighting similarities and differences between the five countries. This allows for identifying the driver of trust in science information channels and their level of reliability, according to the citizens participating in the discussions. The quotations were chosen following the criteria of nationality and topic – climate change (CC), CAM, GMOs and vaccines (VAX) – gender, age and educational level.

Authority

The main sources of authority were generally public institutions and scientists, albeit varying slightly depending on the topic and country. Authoritativeness was acknowledged when there was a certain degree of coherence between the information channels and sources that could be consulted to verify science news.

> For delving deeper into the topic, I usually visit the National Health Directorate website, because I believe it's credible.
>
> (Portugal, VAX, male, 55–64, university ed.)

> I think there should be a kind of ministry or global, European or national organisation […] with official authority and that's in charge of supervising and regulating companies and also of informing; I think it should act like a bridge between companies and experts and scientists and citizens …
>
> (Spain, GMOs, female,18–24, secondary ed.)

Regarding the climate change topic, most of the participants claimed that they obtained information from communicators, especially journalists, who were considered to be authorities on the subject. Experts and opinion leaders were the second most important source of information. But in some countries, like, for example, in Slovakia, there were not apparently any acknowledged experts in climate change.

> I obtain information on climate change from journalists and I trust relevant media. I don't know any personalities or experts who address this topic in Slovakia.
>
> (Slovakia, CC, male, 55–64, secondary ed.)

The citizens most frequently obtained information from digital media, while they considered that social networks were the communication channels through which false information was disseminated most often. Especially in the case of the health topics discussed (vaccines and CAM), they believed that social networks were not trustworthy sources. It warrants noting, however, that it was those citizens more doubtful about the benefits of vaccines and CAM who preferred to use the Internet as an information source in this regard. Even though they tended to resort to digital information sources, the traditional media were the most credible in their eyes.

> When I read something on a website, I often get pissed off because it's fake news.
>
> (Italy, CAM, female, 55–64, secondary ed.)

> A lot of information in the media's distorted, so I only trust factual information and scientific research.
>
> (Slovakia, CC, male, 18–24, secondary ed.)

In sum, for the citizens, it was necessary to resort to official and institutional sources in order to find authoritative information. Thanks to these sources and by overcoming the preconceptions and subjective beliefs that can often be formed in the family circle, they were able to distinguish what was important and trustworthy from what was not.

Credibility

The credibility of scientific messages is primarily related to the scientific language in which they are formulated but also to the completeness of the data, the objective tone of the statements, the accuracy of the explanations that they contain and the independence of their authors. Interestingly, the factors influencing the assessment of the credibility of specific statements depend primarily on the author of the text in question.

In the discussions on climate change, there were very frequent references to scientists researching on the topic who were credible information sources for the citizens participating in the public consultations (e.g. Antonio Turiel in Spain). For them, the credibility of scientists and researchers was guaranteed by a long track record working in international teams and publishing research results based on empirical data. It should be noted that the Intergovernmental Panel on Climate Change (IPCC) was considered to be a credible organisation in Italy and Portugal.

> […] the IPCC, where however there's an international group of academics who'll hopefully compare their research and seek to offer a coherent and complete vision.
>
> (Italy, CC, male, 35–44, university ed.)

Credible information was mainly that containing or relying on scientific data and which also indicated the source, including websites, TV stations and social media.

> Information without a source is simply rubbish.
>
> (Poland, CC, female, 35–44, secondary ed.)

> I trust official media outlets like Deutsche Welle or the BBC.
>
> (Slovakia, CC, female, 35–44, secondary ed.)

The citizens rejected channels in which other messages prevailed over the scientific kind as unreliable, showing themselves to be particularly critical of those focusing exclusively on economic and communication aspects.

> When a website has loads of adverts, I don't give it any credibility; it's a website that's only there for advertising.
>
> (Portugal, CC, male, 25–34, university ed.)

The citizens in the public consultations singled out three main sources of credibility relating to the vaccine topic. They referred to the knowledge accumulated and published by scientists, although they admitted having difficulties in understanding the results of such studies precisely because of the scientific jargon employed.

> […] when it comes to obtaining information in general, on various subjects, you know that scientific papers, scientific journals, are the most reliable information source. But it's difficult.
>
> (Poland, VAX, male, 18–24, secondary ed.)

Institutions involved in regulating vaccines, such as the World Health Organisation (WHO) and national ministries of health, were also seen as credible sources.

> I think the WHO has reliable sources.
>
> (Slovakia, VAX, male, 55–64, secondary ed.)

Finally, for the citizens, the most accessible and reliable source of information on vaccines were general practitioners.

> I trust doctors! Doctors as conveyers of science.
>
> (Portugal, VAX, male, 35–44, university ed.)

As to CAM, there were several factors that guaranteed the credibility of messages. Firstly, the citizens treated information on CAM as credible when they had tangible evidence that certain treatments were effective.

> The information's credible if the alternative options are provided, e.g. has such a method been used before? How was it used? Was it helpful? Is it something new or did it exist before? […] I feel I'm being treated seriously if I'm provided with options to choose from.
>
> (Poland, CAM, female, 35–44, university ed.)

Secondly, credibility could be provided externally, namely, by some or other independent, conventional medical expert confirming the efficacy of the procedure in question, thus making the information trustworthy for its recipients. As in the case of vaccines, such external experts included conventional doctors offering alternative treatments to patients. In other words, for the citizens, it was important that traditional medicine leant credibility to CAM.

> I trust an alternative method of treatment only when it's been clinically tested and endorsed by doctors.
>
> (Slovakia, CAM, 55–64, female, secondary ed.)

Thirdly, it was those aspects that gave credibility to traditional medical treatments that also made their CAM counterparts seem more trustworthy, including, first and foremost, degrees and certified training courses given by CAM practitioners.

> One of the problems is credibility. Not because of scientists, doctors, but because of the technician, whoever does it. Because there's, of course, a … falsehood in these kinds of things. How do you dignify these issues? […] There're now training courses, there're degrees. They give some credibility to the topic.
>
> (Portugal, CAM, male, 45–54, secondary ed.)

Interestingly, in the discussions on GMOs, there were references to both the credibility and lack of credibility of sources. Messages from political parties, social media posts and any kind of communication that presented the arguments of only one side were considered as unreliable.

> It can't be on Facebook where somebody says this or that. That has zero credibility.
>
> (Portugal, GMOs, male, 45–54, secondary ed.)

As with the other three topics, the messages about GMOs transmitted by the scientific community were considered to be reliable. In addition, the 'GMO-FREE' information available to consumers on food packaging was appreciated.

> I consult information on GMOs and modified food, but also accurate information on labels. Specifically, on food, on food products, so everyone can choose.
>
> (Poland, GMOs, female, 55–64, university ed.)

> GM foods should be labelled.
>
> (Slovakia, male, 25–34, university ed.)

Legitimacy

The legitimacy of the actors involved in the dissemination of science information on these topics tended to derive from the recognition of health or environmental concerns. The citizens participating in the public consultations often associated these concerns with political institutions. At a national level, governments were highlighted as they needed to pass laws and regulations that took into consideration the common good. It was observed that the citizens understood these institutions as having the legitimacy to make choices and to design policies. This was clearer in the vaccine discussions, insofar as national vaccination plans and other policies rely on relevant scientific evidence in this respect.

> I trust that the Ministry of Health will include the relevant vaccines in the national vaccination plan.
>
> (Portugal, VAX, female, 65–74, secondary ed.)

> The government approved a law on the protection of public health …
>
> (Slovakia, VAX, female, 55–64, secondary ed.)

At a transnational level, the citizens highlighted the role of the European Union, as one of the Poles stressed.

> […] there're also European information sources. They're also useful because they're close to the European Commission […] when the bodies working on a given issue do it in a reliable way, they do it in international circles, so it's good, because it gives us an overview of everything, of different approaches […] to a given issue, of all the member states or associated countries.
>
> (Poland, GMOs, female, 35–44, university ed.)

One of the Portuguese citizens compared different legal systems, before offering a positive assessment of the European Union. When comparing EU and Chinese legislation, she emphasised the institutional context made a difference, with the EU institutions following a set of procedures that ensured that the production and sale of products were governed by more restrictive regulations. She was of the opinion that this restrictive approach derived from the desire to protect consumers and the citizenry. Thus, in a way, there was a social motivation that surpassed the economic one.

> I trust the legislator. I trust that if a product is to enter the European space it needs to abide by a set of rules. I trust institutions […] even if that product comes from China … well, not everything coming from China is bad …
>
> (Portugal, GMOs, female, 55–64, university ed.)

Similarly, one of the Slovak citizens, who worked in the automotive sector which was being restructured at the time, underscored the European Union's firm commitment to environmental issues. (As is common knowledge, the European Union aims to become the first climate-neutral continent by 2050.)

> Before my maternity leave, I worked in the automotive industry. I came across the European legislative measures pushing for the reduction of emissions …
>
> (Slovakia, CC, female, 35–44, university ed.)

Although a positive assessment of the role played by the European Union prevailed, there were also several citizens who had their doubts about its legitimacy to introduce regulations of this sort – instead of national parliaments – which implied that, in their eyes, it did not have the same legitimacy as national political institutions in certain areas.

> In my opinion, these are such serious issues that they should be left to national parliaments or referendums in individual states. They shouldn't be decided on at an EU level.
>
> (Slovakia, GMOs, male, 45–54, secondary ed.)

At an individual level, the most cited person was Greta Thunberg, although there were differences of opinion, with some citizens doubting her motivations and others valuing the way in which she raised awareness on this topic with a great deal of energy and charisma. There is also a generational issue concerning Thunberg, as she belongs to Gen Z whose members employ digital tools to identify and decry abuses without any moral, economic or social constraints. Hence, the provocations of people like Thunberg prompted others to reflect on the contradictions and limits of unsustainable development. That seems to have been the opinion of one of the Italian citizens.

> […] Greta has the great merit of having addressed things from a different angle that's also rather forceful […] those of us who aren't so young tend to be bored by certain issues. While young people, either because of their age, […] want to go on strike all the time! However, they have a greater sensitivity towards major issues, which in older people doesn't tend to be so strong.
>
> (Italy, CC, male, 45–54, secondary ed.)

Furthermore, another important point relating to CAM was stressed. The absence of a formal legal framework regulating it meant that the citizens were not so sure who were the legitimate actors in this field. This institutional ambiguity led them to base their opinions on personal experience – either their own or that of friends and family. In other words, the many informal information sources made it unclear which were the most reliable in this respect.

> That has to be the people, since it's an area on which there's been no legislation. It has to be the people who search for information from what seem to be the most reliable sources. Then, information coming from different sources should be contrasted. If there's no [official] information available, it's almost down to trial and error.
>
> (Portugal, CAM, female, 55–64, secondary ed.)

Differences and similarities between countries

As posited in the methodological framework section, the comparison between the data collected in the framework of the CONCISE project allows for glimpsing the differences and similarities between trust mechanisms in the five countries taking part.

In particular, the analysis of specific dimensions is especially useful for identifying the differences and similarities between the views of the citizens from the different countries, filtered according to the categories of authority, credibility and legitimacy. These dimensions refer to the type of topic covered, the level of subjectivity, intersubjectivity and objectivity present and the motivations expressed during the discussion sessions.

Analysing the category of authoritativeness, it is possible to observe significant differences between the topics covered. Trust in health issues was firmly underpinned by subjective and intersubjective mechanisms that permitted the citizens to

identify doctors, above all, as the most reliable people for discussing the issue of vaccines and CAM. The data analysis reveals that the Italian and Portuguese citizens were more willing to place their trust in public institutions.

As to climate change, it is interesting to note that the citizens went to greater lengths to search for objective information, for which reason they were more likely to trust experts and official channels. In other words, they tended to prefer objective information, recognising that personal experience and the lessons that could be learned from it were insufficient for building trust. The analysis also revealed a certain level of scepticism towards the media among the Italian, Portuguese and Spanish citizens, which demonstrates that communication channels often do not provide complete or acceptable information.

As regards GMOs, the citizens believed that there was a need for institutional information based on scientific evidence. When broaching this topic in the discussion sessions, the Poles were more critical towards public institutions.

Moving on to credibility, on the subject of climate change and GMOs, the citizens trusted, by and large, institutional sources and public actors like scientists and scientific experts. In this regard, there was a much clearer confluence between objective, subjective and intersubjective considerations.

The credibility factor was clearly expressed, in various ways, in the discussion sessions on GMOs: the neutrality of science (the Italians and Poles), a particular distrust of politicians (the Portuguese) and the recognition that a lack of information in this respect led to high levels of distrust (the Slovaks), among other aspects. Lastly, a number of citizens also stressed the fact that some very popular online sources, such as blogs and YouTube channels, were unreliable (the Spaniards).

Regarding vaccines, there was a consensus on the need for trained experts and reliable sources, especially among the Italian, Polish and Portuguese citizens, with the accent being placed on specific training, scientific certainty and institutional assurances. In a more nuanced fashion, their Slovak and Spanish counterparts were of the mind that it was important to exclude economic stakeholders and ideology from the discussion.

In the case of CAM, the citizens were generally receptive to non-conventional practices, especially in the case of chronic medical conditions. While the Poles and Slovaks also called for evidence of their effectiveness and the same kind of information available on conventional treatments to place greater trust in CAM.

The data analysis relating to the legitimacy category reveals that, in the main, the citizens tended to prefer what they believed were trustworthy sources, channels and institutions over others. This finding evinces the rather colourful framework of public communication in which it is necessary to move in order to obtain information deemed valid.

With regard to vaccines, two positions stood out. On the one hand, the Italians and Poles emphasised the legitimacy of doctors because of their close relationship with the citizenry and the possibility of obtaining immediate answers from them. On the other, the Slovaks, Spaniards and Portuguese referred to national and international public authorities as guarantors of public health standards.

In relation to climate change, it is interesting to note the citizens' acceptance of some current actors, including Thunberg and Al Gore, from whom they believed that they could obtain useful and, therefore, trustworthy information, this being especially the case in the Italian and Portuguese discussion groups.

In contrast, the Spanish and Slovak citizens tended to place greater trust in the media providing information on the subject, as long as this was used critically, given the different interests that could undermine the accuracy and reliability of the news. The institutional aspect, associated with trust in state regulations, was underscored by the Spaniards.

As to GMOs, there was a consensus among the citizens from all the countries involved on the need for clear guarantees at a supranational level. That was why legitimacy was invoked, particularly the European Union's ability to legislate on complex and controversial issues, like GMOs. Likewise, in this case, institutional sources served as a sort of compass guiding citizens when judging what information they should trust. It can be claimed that the guarantees offered by individual states are not effective enough for managing such issues with a potentially huge impact. Therefore, their legitimacy is insufficient for building high levels of trust.

Conclusion

The analysis of the transcripts of the discussion sessions, recorded during the public consultations held in the framework of the CONCISE project, allowed us to study public opinion. Despite the digital revolution and the advent of social networks, traditional communication channels (the press, radio and television) continue to be important information sources with the ability to build trust among the citizenry.

For the citizens participating in the public consultations, official and governmental sources were the most authoritative, followed by experts, who in general were seen as trustworthy because private interests were not at stake. This stance was very strong in the discussions on climate change and GMOs, in which those taking part recognised that the citizenry did not generally have the knowledge or ability to bring about the desired changes.

On the contrary, for health issues and particularly CAM subjectivity played a more important role in building trust, although the preferred experts were mainly doctors.

The citizens from the five countries used information sources and channels differently to build their trust in science. While the Slovaks called for more institutional information, the Italians, Spaniards and Portuguese placed greater trust in institutional sources.

In light of the results of the data analysis, however, the greatest differences in terms of authority, credibility and legitimacy were mainly due to the different views expressed in the discussion sessions. In relation to health and environmental issues, these also differed depending on the citizens' country of origin, with the Poles and Slovaks calling for more guarantees as regards health issues, especially in the case of vaccines. As to environmental issues, in particular climate change, the Italian and Portuguese citizens tended to place their trust more in non-expert

actors and less traditional communication channels, whereas the Spaniards and Slovaks held that there was a greater need for proven institutional information.

Understanding how citizens build their trust in science, on the basis of the four topics addressed in the discussion sessions, requires a careful analysis of the image that they have of institutions and scientists. Their ability to shift between institutional and non-institutional information sources and channels emerged in its full complexity, thanks to the research performed in the framework of the CONCISE project. These results show how complex the information paths of citizens are and how diverse and plural the media available to them are. While acknowledging that the most credible actors (experts and scientists) are still generally trusted, new actors have emerged. To this should be added that citizens are currently demanding a more active role in communication processes.

Note

1 Percentage of 'Strongly agree' and 'Agree' as answers to the item, 'We have no other option but to trust those governing science and technology'.

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5 Perceptions of science information on climate change and GMOs

Ana Delicado, Carolina Moreno-Castro, Sonia Brondi, Justyna Wiktorowicz and Lenka Diener

Setting the scene: how climate change and GMOs are perceived

In order to understand the context in which the public consultations were held, it is first necessary to offer a brief overview of how climate change and GMOs are perceived in the five countries involved, drawing mainly from public opinion polls, such as Eurobarometer, and previous studies. This background information may help to shed further light on the participants' awareness of these topics and how they assessed the quantity and quality of the science information reaching them through different channels.

Climate change: a (virtually) public consensus

Nowadays, climate change is one of the most important global issues according to the Intergovernmental Panel on Climate Change (IPCC, 2018; IPCC, 2022; IPSOS, 2020; National Intelligence Council, 2017). The United Nations Framework Convention on Climate (United Nations, 1992), the World Heritage Convention (UNESCO, 2007), the Paris Agreement (United Nations, 2015), ratified by the EU on 5 October 2016, the Katowice climate package (United Nations, 2019) and the Glasgow Climate Pact (United Nations, 2021) are the most important international agreements in this respect. According to the Paris Agreement, which over 190 countries have signed, climate change mitigation could be achieved by limiting the increase in the global average temperature to well below 2°C above pre-industrial levels and by making a concerted effort to limit it to 1.5°C.

To these measures should be added increasing the ability to adapt to the adverse effects of climate change and fostering climate resilience and low greenhouse gas emissions, in a manner that does not threaten food production, as well as by making finance flows consistent with these last two goals. Furthermore, 'To achieve this long-term temperature goal, countries aim to reach global peaking of greenhouse gas emissions as soon as possible to achieve a climate neutral world by mid-century' (UN, 2015).

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The Katowice climate package adopted at the UN Climate Change Conference (COP24) in December 2018 contains detailed rules, procedures and guidelines for implementing these commitments (United Nations, 2019). The European Green Deal, namely, the action plan for a sustainable EU economy, assumes that by 2050 the European Union will have become a climate neutral continent (European Commission, 2019a). Consequently, the European Climate Pact proposes activities focusing on disseminating knowledge and supporting activities, by creating a space for information exchange, debate and action in relation to the climate crisis, so that 'people and organisations can learn about climate change, develop and implement solutions'.

More recently, the COP26 Glasgow Climate Pact set out the achievements made so far: (1) secured near-global net zero, NDCs from 153 countries and future strengthening of mitigation measures; (2) boosted efforts to deal with climate impacts; (3) progress towards delivering the $100 billion climate finance goal in developed countries before 2023 at the latest; and (4) accelerating collaboration between governments, businesses and civil society (UN, 2021).

In the five countries participating in the CONCISE project, public opinion polls on climate change have consistently shown that citizens are highly concerned about the issue (see, e.g. Carvalho et al., 2014; Schmidt & Delicado, 2014; digitalpoland, 2020; Gwiazda & Ruszkowski, 2016; Strapcová, 2020; Pellegrini & Rubin, 2020) and they understood there was a broad scientific consensus on climate change (Lynas, Houlton, & Perry, 2021). Recent Eurobarometer surveys show that climate change is treated as a 'very serious' problem – especially in Spain, Portugal and Italy, where the proportion of respondents expressing this concern is the highest (84–89%). Although this proportion is lower in Poland (see Figure 5.1), other opinion polls have revealed that it could be higher (when using a slightly different approach to its measurement). In 2020, for approximately 80 per cent of Poles, climate change was one of the most critical challenges (digitalpoland, 2020); in 2016, 74 per cent considered that it was a very important problem (Gwiazda & Ruszkowski, 2016); and in 2009, 82 per cent believed that it was a severe problem (or very serious for 33% of the respondents) (Gwiazda & Kolbowska, 2009). In subsequent editions of the CBOS survey, there was further support for the thesis that Poles perceived climate change as being currently one of the greatest threats to modern civilisation (15% in 2009, 18% in 2014 and 22% in 2016) (Gwiazda & Ruszkowski, 2016). Research carried out in 2016 and 2018 at the request of WWF Poland confirmed that the importance of these issues remained high – globally (93%), for Poland (90%) and the respondents' families (88%). A 2021 Eurobarometer survey revealed that climate change was the second most important problem (41% of the respondents, 11% of whom ranked it in first place in terms of its significance) (EU, 2021). In Poland, women are more 'sensitive' to climate change (73% rating it as a 'very important' issue – 7–10 points) than men (63%), along with people aged between 15 and 24 (73% rating it as a 'very important' issue). Interestingly, in the 2019 survey, this percentage was the lowest for this particular group (61%), students (79%), those with the highest academic qualifications

(71%), those who never or almost never experienced financial difficulties (72%) and those living in rural areas and cities (71%) (EU, 2021).

In Italy, age, academic qualifications, the level of scientific literacy and exposure to science in the media all have a rather weak influence on the perception of climate change. For instance, the same proportion of young and old people entertain the idea that the climate is getting warmer (Pellegrini & Rubin, 2020).

In Slovakia, the HODYSE survey (2020) showed that attitudes downplaying the importance of environmental protection did not enjoy much support and only a relatively low proportion of Slovaks were sceptical in this regard.

In Portugal, the level of scepticism about climate change, in the sense that it is not happening or human activity is not to blame, has always been very low (Schmidt & Delicado, 2014).

A 2019 Eurobarometer survey also showed that more Spaniards (79%) and Portuguese (74%) had personally taken steps to combat climate change in the last six months than Poles (40%) or Italians (52%) (see Figure 5.1). The Portuguese, Spanish, Slovak and Italian respondents (40–60%) also pointed to the role of governments and business/industry in tackling climate change. In contrast, the Poles believed that governments should play a more important role (50 vs. 32%) in this respect.

In light of the results of Portuguese research, the media representations of climate change focus above all on international policy, while mainly presenting it

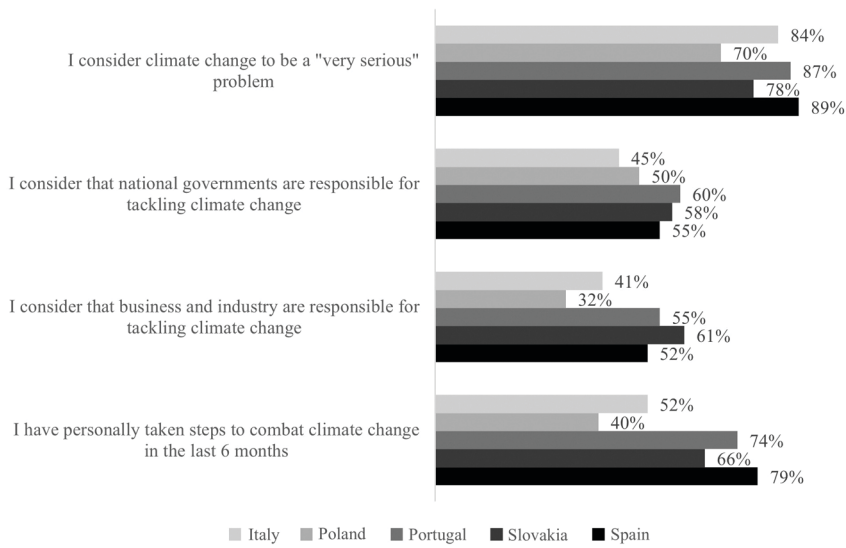

Figure 5.1 Climate change perceptions in the target EU Member States in 2019 (%).

Source: European Commission (2019b). Special Eurobarometer 490. Climate Change. https://ec.europa.eu/clima/sites/clima/files/support/docs/report_2019_en.pdf

as a global problem (Horta & Carvalho, 2017). Although the media coverage of climate change varies, it tends to decrease whenever there is an economic crisis, while national policy events, such as action plans and roadmaps for combating climate change, tend to go all but unnoticed in the press (Horta, Carvalho, & Schmidt, 2014). Nevertheless, some instances of alarmism about climate change can be found in the Portuguese media (particularly on television), but less often than techno-optimist representations that convey the hope of reducing greenhouse gas emissions through technological solutions and green economy policies (Horta & Carvalho, 2017).

Regarding the representation of science information on climate change, Horta and Carvalho (2017), citing previous studies (Carvalho et al., 2011; Carvalho & Pereira, 2008), acknowledged that it was fairly consensual. For their part, Ramos and Carvalho (2008) highlighted how Portuguese press articles tended to follow the rules of scientific writing closely: using scientific jargon and third-person sentence structures, omitting the agent, quantifying, emphasising results, organising journalistic texts in a structure similar to scientific articles (subtitles, sequencing) and webpages (FAQs). Thus, 'This strategy concurs to the creation of a "rhetoric of evidence" that presents scientific claims as spontaneous outcomes of empirical reality, independent of the researcher's work and her/his interpretation. Obviously, it is more difficult to challenge assertions that are presented as mirroring irrefutable facts than opinions or viewpoints assumed by an individual' (Ramos & Carvalho, 2008: 231). Furthermore, the authors state, 'Unlike most of the US mainstream media, the Portuguese newspapers that were analysed here tend to award little space to uncertainty and to the climate change "sceptics", promoting an image of solid scientific knowledge and a unified scientific community' (Ramos & Carvalho, 2008: 229).

Additionally, in Spain, this political context was stressed as an essential factor in shaping public opinion on climate change. First of all, Madrid (Spain) hosted the United Nations Climate Change Conference (COP25) in December 2019. Hence, plenty of information about the climate change agenda was circulating in the media and on social networks. Secondly, during the general election campaign in Spain in November 2019, the country's politicians debated on climate change and governance. Therefore, the Spanish citizens participating in the CONCISE public consultation expressed their perceptions and opinions on climate change in this socio-political context (Moreno-Castro et al., 2022).

The aforementioned national studies allow for further remarks on this topic. For example, although 84 per cent of Poles believed that climate change was related to human activity, the most frequently cited cause, for nearly half of the respondents, it was a natural phenomenon (Wójcik & Byrka, 2016). Interestingly, the proportion of those placing the accent on natural causes increased by 3.5 per cent, from 10.9 to 14.4 per cent, between 2016 and 2018 (Wójcik & Byrka, 2016) – in contrast, natural causes were indicated by 26 per cent of the Polish respondents in 2009 and by 20 per cent in 2016 (Gwiazda & Ruszkowski, 2016).

Similarly, in the Spanish Foundation for Science and Technology (FECYT) survey (2020), 64 per cent of the respondents contended that human activity

directly affected the climate (for 74% of the population with a university degree, climate change was the result of the accumulation of greenhouse gases). Be that as it may, more than a third of the respondents did not relate climate change to human activity. Specifically, 67 per cent of the respondents were of the mind that environmental problems were due, above all, to the high level of consumption, 21 per cent believed that environmental problems had always existed, but that they were currently being given more coverage and for 12 per cent environmental problems were due, by and large, to scientific and technological progress.

Moving on to Italy, almost 80 per cent of the respondents were convinced that climate change currently posed a threat to humankind. More than one in three (34%) thought that the effects of climate change were overly exaggerated. Around 27 per cent denied that climate change was due to human activity, while almost two out of five disagreed with the idea that only with the individual commitment of everyone would it be possible to combat the problem. Another interesting aspect had to do with the perception of the consensus on climate change in society. Only 40 per cent of those for whom the climate was getting warmer thought that it was impossible for anyone to question the fact that climate change had already got underway. For one in five Italians, many people still were not convinced, and for almost two out of five, some still did not want to admit it (Pellegrini & Rubin, 2020). Additionally, personal experiences and scientific studies influenced the opinions of climate change 'advocates' in an almost equal measure. The proportion of those who based their climate beliefs on their direct experience of increasingly hot summers and warmer winters increased from approximately 40 per cent in 2011 to nearly 50 per cent in 2013 and is now 45 per cent. Instead, the greater number of those who believed that scientific studies clearly demonstrated that climate change was an indisputable fact increased from 19 per cent in 2007 to 38 per cent in 2009 and is now 44 per cent (Pellegrini & Rubin, 2020).

In Italy, in the past years, the citizenry's tendency to place more or less trust in scientists when formulating their own opinions has been observed. More than half of the country's young, university graduates and those with a high level of scientific literacy and exposure to science information in the media based their perception of climate change on the availability of scientific studies (Pellegrini & Rubin, 2020).

Many studies have confirmed that, despite the popularity of the climate change topic, further educational actions are required. For example, in Poland, the 2009 CBOS study revealed that nearly half of the respondents felt insufficiently informed about climate change, although nearly 70 per cent searched for information in this respect. To this end, they resorted mainly to television (94%), the Internet (37%), the daily press and radio (34% apiece) and magazines (24%), while friends and family (5%), scientific and research institutes (3.3%), foundations working for climate protection (1.7%) and other institutions and organisations (less than 2%) were less important in this regard. In the 2016 study, television still ranked first (approx. 40%), followed by other traditional media (radio with approx. 33% and the press with 25%) and the Internet (33%) (Gwiazda & Ruszkowski, 2016). As to the 2009 CBOS survey, the following were mentioned as the most useful information sources (i.e. those that should primarily provide such information): the traditional

media, especially television (89%), followed by radio (38%), the daily press (26%) and magazines (17%), with the Internet in fourth place and scientific institutions and research centres in sixth place (Gwiazda & Kolbowska, 2009).

In conclusion, it warrants noting that the same proportion of climate change 'advocates' who considered economic interests as the main obstacle to combating the problem also believed that it was scientists studying the climate who should be given decision-making powers to find solutions. Citizens attached almost the same importance to two other actors who have enlivened the public debate in recent times: environmentalists and young people (such as Greta Thunberg) who have raised the alarm for the planet. Politicians proposing solutions to environmental problems, on the other hand, were given a marginal role.

GMOs: a less known and controversial topic

A GMO is an animal, plant or microbe whose DNA has been altered using genetic engineering techniques. For thousands of years, humans have employed breeding methods to modify organisms. Artificial selection for specifically desired traits has resulted in a variety of different organisms, but it has been limited to naturally occurring variations. In recent decades, however, advances in the field of genetic engineering have allowed for precise control over the genetic changes introduced into an organism (Phillips, 2008), and this is certainly just the beginning. The way on from here will doubtless be influenced by both scientific developments and public attitudes towards GMOs (Karalis et al., 2020). It should be stressed that in biotechnology the term GMO denotes a genetically modified organism, while in the food industry, it only refers to food that has been intentionally designed. The cultivation of genetically modified (hereinafter GM) crops is currently permitted in 24 countries, the most common being soybean, corn, rapeseed and cotton (Krzewińska et al., 2021: 175). In is in this context – genetic engineering in food production – that GMOs are mainly understood.

Under EU legislation, no GMO can be cultivated for commercial purposes, as stipulated in European Directive 2001/18/CE, which was then transposed into national law by the EU Member States. Nevertheless, 24 crops – mostly corn, soybeans, cotton and rapeseed – can be cultivated in a GMO production regime. In Portugal, for instance, two types of GMO crops, namely, corn and potatoes, have been approved for cultivation (Truninger & Ferreira, 2014), but all attempts at introducing additional ones (in 2016) were rejected (Ribeiro et al., 2019). In 2020, the area devoted to the cultivation of GM corn in Portugal was two times smaller than in 2011 (APA, 2021).

The introduction of GMOs in most EU Member States is seen as a threat to the traditional agro-food system (Pappalardo, D'Amico, & Lusk, 2021; Kurzer & Cooper, 2007). On the other hand, the current ban on GM foods is often seen as a result of misinformation or lobbying (see, for example, Pappalardo et al., 2021; Truninger & Ferreira, 2014).

The discussion on GMOs intensified at the beginning of the new millennium. For example, in Poland, the issue first caught the public eye in February 2012,

while in Portugal, it first emerged back in the 1990s, before becoming more visible a decade later (Ribeiro et al., 2019). Nowadays, a search on Google for the term 'GMO' yields about 140 million results, but when the word 'blog' is added to 'GMO', 38,600,000 search results are obtained. The same search on YouTube, Facebook and the relatively new TikTok yields 30,700,000, 60,900,000 and 1,440,000 results, respectively (Krzewińska et al., 2021: 179). Nevertheless, some authors (e.g. Brás et al., 2017) consider that there has barely been any public debate on GMOs in Portugal. Regarding the media coverage of GMOs in this country, in view of the results of their analysis of press articles published between 1999 and 2001, Castro and Gomes (2005) concluded that most of them took no clear stance on GMOs, even though unfavourable articles were more common than favourable ones.

Similarly, in Spain, during the COVID-19 pandemic, the media coverage of GMOs was very thin on the ground and, consequently, there was very little public debate on the issue. Indeed, the media coverage of GMOs has been incidental (e.g. in the context of the 2020 Nobel Prize in Chemistry). In 2020, for instance, a total of 25 references to GMOs were identified in the MyNews database, covering 1,486 media outlets, which offers an idea of how little the issue has been publicly aired.

In Portugal, most articles were authored by journalists (with a noteworthy absence of scientists) and addressed problems like benefits, safety risks and global issues more than local ones (Castro & Gomes, 2005). Dourado and Matos (2014) concluded that the information on GMOs in Portuguese textbooks was wanting, not always scientifically accurate, insufficiently connected with the daily lives of students, more focused on crops than on livestock and biased towards their advantages. Delicado (2009) pointed out that GMOs were sometimes presented in a favourable, controversy-free light (offering, as an example, the exhibition about GMOs held at a Portuguese science centre), while, according to Valente and Ferreira (2014), they were consistently low on the list of issues of concern for Portuguese citizens.

Despite the fact that the debate on GMOs and the consequences of genetic engineering has gathered steam in recent years, a 2019 Eurobarometer survey indicated that approximately half of the population of the five countries participating in the CONCISE project – Italy, Poland, Portugal, Slovakia and Spain – had not heard about GM ingredients in food or drinks (see Figure 5.2). Moreover, only between 15 and 39 per cent of the respondents were concerned about the issue – the lowest percentages (15–17%) being registered in Portugal and Spain.

In a 2010 Eurobarometer survey, EU citizens were asked more generally about GM foods, with between 59 and 84 per cent of the respondents stating that they had heard about them (with the highest percentages in Italy and Poland), and with between 49 and 74 per cent admitting that they had talked with people about them (with the lowest percentage in Poland). Between 33 and 50 per cent of the respondents searched for information on GM foods (with Poland yet again bringing up the rear) (see Figure 5.3). These conclusions were confirmed by Badora (2013) and Valente and Ferreira (2014). It was the respondents with a higher level of education (Valente & Ferreira, 2014; Truninger & Ferreira, 2014) who were most

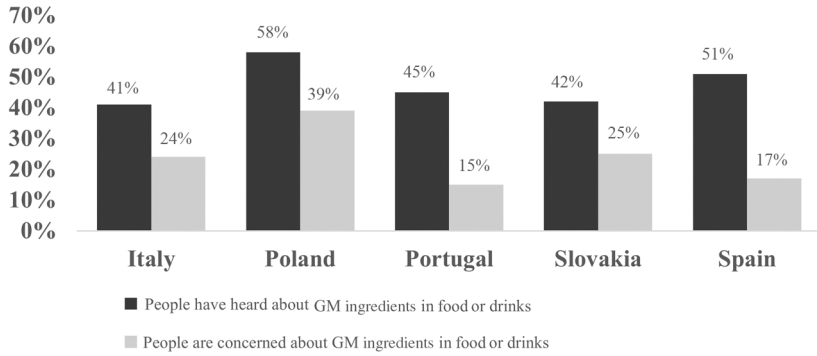

Figure 5.2 Interest in GMOs in the target EU Member States in 2019 (%).

Source: European Commission (2019c). Special Eurobarometer 91.3, Food Safety in the UE. www.efsa.europa.eu/sites/default/files/corporate_publications/files/Eurobarometer2019_Food-safety-in-the-EU_Full-report.pdf

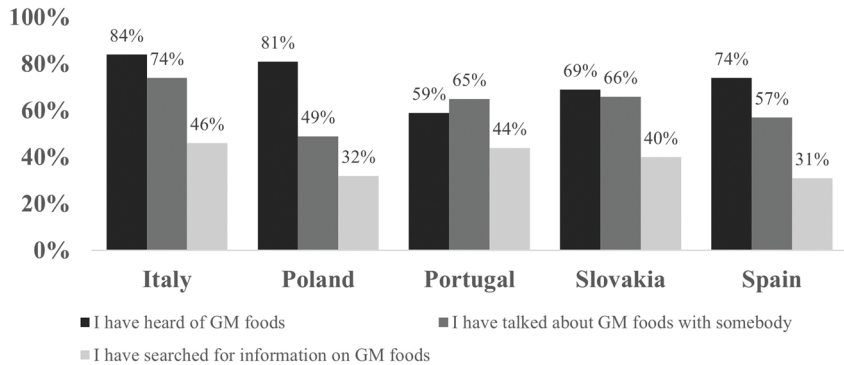

Figure 5.3 Interest in GMOs in the target EU Member States in 2010 (%).

Source: European Commission (2010). Special Eurobarometer 73.1, Biotechnology. https://europa.eu/eurobarometer/surveys/detail/755

familiar with and concerned about GMOs, while the young, men and those living in smaller towns among their number were more well informed (but whose non-response rate was high) (Truninger & Ferreira, 2014).

Additionally, Truninger and Ferreira (2014) concluded that, notwithstanding the widespread opposition to GMOs, there was more public criticism of them in those countries where they were banned (such as Italy, Germany and France). The probability of purchasing GM products was lower for those Italians more risk-adverse,

Table 5.1 Views of citizens of the target EU Member States on GMOs (I agree that …) in 2010 (%)

Item	*Italy (%)*	*Poland (%)*	*Portugal (%)*	*Slovakia (%)*	*Spain (%)*
GM foods are good for the national economy	27	20	29	30	40
GM foods are not good for you and your family	59	53	49	52	44
GM foods help people in developing countries	34	39	36	45	46
GM foods are safe for future generations	23	17	25	29	30
GM foods benefit some people but put others at risk	51	56	45	57	54
GM foods are fundamentally unnatural	**70**	**75**	47	**75**	**67**
GM foods make them feel uneasy	56	**69**	51	59	51
GM foods are safe for you and your family	21	22	25	27	25
GM foods do not harm the environment	25	25	28	35	28
GM food consumption should be encouraged	20	24	25	32	27

Source: European Commission (2010). Special Eurobarometer 73.1, Biotechnology. https://europa.eu/eurobarometer/surveys/detail/755

older, better educated and less confident in institutional guarantees (Soregaroli, Boccaletti, & Moro, 2003).

In the context of genetic engineering, GMOs are a rather controversial topic (Böschen et al., 2006). It is known that they have their advantages, like increased crop yields, lower food prices and cheaper drug production, enhanced nutrient composition and food quality, resistance to pests and disease (thereby making pesticides less necessary), greater food security and medical benefits for the world's growing population. On the contrary, however, there is a danger that genetic modifications could lead to health problems and to different animal species.

These issues were the subject of a 2010 Eurobarometer survey. In Table 5.1, the opinions of respondents from the five countries participating in the CONCISE project are compared. Even though scientific research has confirmed that consuming GM foods does not pose any risk to human health, citizens remain highly sceptical, with the majority of them believing that it is unsafe to consume them. The prevailing belief is that GM foods are fundamentally unnatural and make people feel uneasy, befitting some while posing a risk to others. The respondents from Poland and Slovakia held the most polarised views, with approximately half of them from each country considering that GM foods were not good for them and their families (in Italy, ca. 60%). The benefits of GMOs – for the economy and the inhabitants of

developing countries – were noted mostly by the Spanish respondents. But it was the Slovaks (33%) who most often declared that the development of GM foods did not harm the environment and should be encouraged. Only one in four respondents from each country claimed that they were not afraid of the repercussions that GM foods might have on their health, but that they were more apprehensive about their impact on that of future generations (with the Poles being the wariest).

In line with Badora (2013), who concluded that the Poles were very suspicious of GM foods, a study performed in 2019 confirmed that there was still much distrust of them, with 55 per cent of the respondents asserting that they would never give them to their children (Nowakowska, Berezowska, & Szulińska, 2021), although this proportion was lower than that in a survey conducted by Małyska and Twardowski (2012). Also in Italy, the general public believed that consuming GM foods was a health risk (Lusk et al., 2004; Frewer et al., 2014; Funk, Rainie, & Page, 2015; Delmond et al., 2018; Pappalardo et al., 2021). Specifically, Italians feared that the cultivation of GM crops might have a significant environmental impact and did not believe that they had a higher nutritional value or better organoleptic characteristics than conventional foods (Pappalardo et al., 2021; Shafie & Rennie, 2012).

In Spain, the perception of the potential risks and benefits of GM crops has changed significantly over the years. Comparing data obtained in 2014 and 2020, it can be observed how increasingly more Spaniards believed that there were more advantages in cultivating GM crops than disadvantages. In 2014, those respondents for whom the cultivation of GM crops posed a greater risk also contended that the benefits to be had from this type of genetic engineering were lower, while in 2016, their benefits were perceived to be greater than their drawbacks (in light of the results of a survey conducted in 2020). In contrast, Truninger and Ferreira (2014) confirmed that in Portugal GMOs were a less visible kind of risk.

In a survey conducted in Poland in 2020 (Nowakowska, Berezowska, & Szulińska, 2021), 53 per cent of the respondents were in favour of GM crops and 33 per cent were against them, while only a few years before, in 2017, the opposition to them had been much greater (70%) (Nowakowska, 2018). On the other hand, 54 per cent of the Polish respondents paid no heed to the labels of the products that they purchased (Centrum Nauki Kopernik, 2012; Nowakowska et al., 2021), 47 per cent accepted the use of GMOs in the pharmaceutical industry and 25 per cent thought that this was totally unacceptable (Nowakowska et al., 2021).

It should be stressed that there was a general belief among the Italians that the cultivation of GM crops was in the hands of a few multinational companies, a state of affairs that could negatively affect food markets. Conversely, they shared the view that the cultivation of GM crops for the production of alternative fuels was a positive step, as well as the concern that the exponential growth of the world population could lead to food shortages and the unsustainable exploitation of natural resources.

The traditional general interest media rarely cover GMOs and, when they do, it is only because they are sure that the news will increase their viewership, audience or 'click-through' rate. For example, in Poland, an exception to the rule is

the blog written by Wojciech Zalewski, on the digital platform of the magazine *Polityka*. The situation is completely different in digital media and on social media platforms. As already noted, the search frequency rank for the term 'GMO' is exceedingly high. According to a study of the Spanish Foundation for Science and Technology (2020), risk perception had to do with the use of the Internet, this being lower in those who did not use it or did so very rarely than in those using it frequently. Generally speaking, risk perception was higher in women than in men, coinciding in this regard with other international studies (academic qualifications were not an important factor in this context).

Taking into consideration the different professionals, organisations and institutions linked to biotechnology, the results of a 2010 Eurobarometer survey allow for assessing the level of trust in GMOs at the time. As to the five countries participating in the CONCISE project, the highest level of trust was observed in Slovakia, especially in relation to medical doctors, university scientists and the media. In Spain, trust in medical doctors was also very high but not so in religious leaders, as in Italy and Portugal, although not in Slovakia (see Table 5.2). In sum, medical doctors and university scientists were the most trustworthy actors in all the five countries.

An Italian survey conducted in 2020 (Pappalardo et al., 2021) revealed that this ranking had changed, with the respondents only placing their trust in consumer and farmers' organisations. As to the rest, they had no confidence in environmental organisations, public institutions, private companies or, quite surprisingly, universities and research centres.

Finally, it is important to underscore that on the international stage GMOs, in general, continue to be an object of social research, with the spotlight being placed on identifying the perceptions that respondents have of biotechnological applications and their attitude towards them. On the whole, the results of the CONCISE project

Table 5.2 Trust in professionals, organisations and institutions linked to biotechnology in 2010 (%)

	Italy (%)	*Poland (%)*	*Portugal (%)*	*Slovakia (%)*	*Spain (%)*
Medical doctors	71	77	74	**94**	**90**
University scientists	67	76	67	**88**	78
Consumer organisations	64	70	61	**84**	70
Environmental groups	58	67	62	77	71
Media	55	72	59	**86**	67
Ethics committees	53	64	55	**82**	61
Retailers	51	55	55	**84**	60
European Union	56	64	57	**83**	72
Industries	50	63	47	**81**	59
Government	48	56	46	76	64
Religious leaders	35	46	39	58	37

Source: European Commission (2010). Special Eurobarometer 73.1, Biotechnology. https://europa.eu/eurobarometer/surveys/detail/755

(Moreno-Castro, Mendoza-Poudereux, & Vengut-Climent, 2020) also point to the fact that for the participants in the discussion sessions, GMOs were more a technological than scientific topic, their interest being limited to specific applications (e.g. seeds, food, cloning).

Awareness of climate change and GMOs

In the qualitative analysis of the results of the CONCISE public consultations, the notion of 'awareness' has been defined and operationalised following the considerations of the European Commission's report on Europeans and biotechnologies, drawn up in 2002 (Gaskell, Allum, & Staresin, 2003). It was subsequently recalled and further developed, before being published anew in 2010 (cf. Gaskell et al., 2010). The authors referred to the concepts of 'familiarity' and 'engagement', 'familiarity' being understood as possessing knowledge of a scientific issue and 'engagement' as having an interest in it and sharing it. Thus, the notion of 'being aware' of scientific topics has been expressed by combining both (i.e. 'familiarity' and 'engagement' with them).

Climate change: 'for better or for worse, I'm informed about this'

The results show that the citizens taking part in the public consultations had a high level of awareness of climate change. In all the countries involved in the CONCISE project – with the sole exception of Poland, where there was a greater balance – those citizens explicitly stating that they were aware of climate change were greater in number than those admitting that they were unaware of the problem.

However, the high level of awareness of the topic had to do with two of the aspects described above: engagement and familiarity. If, on the one hand, the references to engagement were, by and large, appreciable during the CONCISE public consultations, those to familiarity were not so plentiful. It can thus be contended that the level of awareness of climate change, whether positive or negative, was mainly driven by engagement and – to a much lesser extent – by familiarity with the issue. Given the relevance of the topic, this result can be interpreted in two ways. The first has to do with the citizens' potentially implicit, but undeclared, assumption of familiarity, namely, the idea that knowledge of such a salient issue as climate change can be taken for granted. This hypothesis is confirmed by the detailed results presented in the following section as regards the citizens' perception of whether or not there was an adequate amount of information available on the subject. The second is related to the potential difficulty for 'non-expert' citizens in self-attributing knowledge on the topic. This hypothesis has also been confirmed by an in-depth analysis of the extracts pertaining to familiarity from the discussion session transcripts and by identifying similarities and differences, as proposed below.

When narrowing the focus on familiarity, some of the differences between countries should first be noted. On the one hand, the Polish, Slovak and Spanish citizens only rarely evoked both positive and negative aspects relating to knowledge

of climate change. However, their Italian and Portuguese counterparts referred more often to their familiarity with the problem, albeit for completely different reasons: the former admitted that their knowledge of climate change was poor, while most of the latter claimed to have an adequate understanding of the issue.

> I'm no expert and even if I studied or read a bit, I wouldn't be any more in the know.
>
> (Italy, CC, male, 18–24, secondary ed.)

> It's rather hard not to have heard about this subject, at least in my opinion.
>
> (Portugal, CC, female, 25–34, university ed.)

It should be noted that, across the different countries, it was those citizens who had learned about climate change at school who more frequently claimed to be knowledgeable about the problem, thus suggesting that educational settings are conducive to conveying knowledge and raising awareness of environmental issues.

> I know about this topic because we talk about it at school, at college high school; so, for better or for worse, I'm informed about this. The topic was covered at secondary school, so I'm familiar with it.
>
> (Italy, CC, female,–18, primary ed.)

However, the citizens' familiarity with the topic did not necessarily mean that their knowledge of it was accurate. Some tended to confuse climate change with other environmental problems, such as pollution and plastics in the oceans, or, on the contrary, did not perceive the direct or indirect relationship between pollution and climate change, regarding the former as a problem but with little relevance to the latter.

> Ordinary citizens are interested because this issue of rubbish at sea's something that came to light very recently … that's odd, isn't it, but the general public only became aware of it, of the actual situation, very recently.
>
> (Portugal, CC, female, 35–44, university ed.)

> I'm not saying that we aren't polluting. I'm simply saying that I don't think it's the same, although pollution may have a minor influence on the climate or on temperature increases or whatever, I don't think pollution's the same as climate change and there're many [experts] who're saying climate change isn't due to pollution, so …
>
> (Spain, CC, female, 45–54, university ed.)

On the other hand, some of the participants in the public consultations conceded that their knowledge of the topic was minimal or sufficient for their needs (i.e. neither did they know much about it, nor did they need to know more). However, this does not imply that they did not recognise the problem. On the whole, they

understood that climate change posed a serious threat, while strongly criticising the influential deniers in the public sphere.

> I believe I know as much as I need to know: I know this poses a threat to us; I know there's a problem.
>
> (Poland, CC, female, 35–44, university ed.)

> I'm very struck by how some important personages [with air quotes] deny climate change. I mean, it's something that strikes me because for me it seems incredible.
>
> (Spain, CC, female, 55–64, secondary ed.)

Finally, lack of familiarity was frequently attributed to generic others rather than to the citizens themselves. When self-attributed, poor knowledge was well compensated by direct experience. Indeed, some often referred to the extent to which the effects of climate change were already crystal-clear in their daily lives.

> Citizens have to have information … which normally isn't the case. Our educational level, compared to Europe, is low. So, we don't have … . We don't obtain information from reading articles, there's no time for that.
>
> (Portugal, CC, male, 65+, secondary ed.)

> We may not be well informed, but we feel them. But we feel the changes.
>
> (Portugal, CC, female, 65+, secondary ed.)

Moving on to engagement, the results show that the citizens were closely engaged with climate change. In all the public consultations, except for the one held in Poland, where there was a greater balance, those citizens explicitly declaring that they were engaged with the problem prevailed over those who admitted to being disengaged.

However, a distinction should be drawn between the different attitudes characterising engagement, namely, interest and sharing. By interest we mean the extent to which the citizens claimed that they actively sought information on the topic; and by sharing, the extent to which they declared that they disseminated such information on social media or in face-to-face interactions. Interest and sharing had both a positive and negative impact on engagement. In the main, interest was more frequently expressed than sharing. Nevertheless, some differences between the five countries were detected. The Italian, Polish and Slovak citizens referred to interest much more often than to sharing, whereas for their Portuguese and Spanish counterparts, sharing played a predominant role in fleshing out engagement.

Concerning interest in climate change, the citizens showing a lot in the topic stated that they actively sought information in this respect. Specifically, it was above all the Italians and Slovaks who displayed this behaviour. They explained

that their interest derived from their desire to understand the current transformations visible in everyday life.

> I do it mainly because I feel so strongly about it. Since I was a child, I've been curious about nature, to understand how the world works. So basically, now there's a current problem in which the world seems to be changing, I'm even more motivated … I put it down to my fascination, academic training and curiosity.
>
> (Italy, CC, male, 35–44, university ed.)

> I watch the news that explains how to adapt, how to prepare for change individually. And, of course, I watched the climate conference and all the discussions on it so as to have a better picture, and I watched it to discover what politicians were doing about it.
>
> (Slovakia, CC, female, 65+, university ed.)

Many of the citizens, regardless of their nationality, professed a great and longstanding interest in the topic.

> I've been following this topic for many years now; I started doing so back in 1987, when the first studies started to come out, or at least that's when I had access to them; they were performed earlier. At the time, I obtained information from *Science & Vie* or possibly from some or other article appearing in *Nature*. When blogs started to be created, namely, Real Climate, among others, I started to read the articles that were posted on a daily or weekly basis. Therefore, I'm an active seeker [of information]. It's a topic that's always interested me and I've always thought it wouldn't be easy to explain.
>
> (Portugal, CC, male, 45–54, university ed.)

> I really got into this topic in the 1990s, while I was at university, when pilot projects, such as research on environmental ecology and environmentalism, were being run. So, I already had some idea about it and was interested in the debates on it at the time. And, since then, I've followed it regularly.
>
> (Slovakia, CC, male, 45–54, university ed.).

> I'm interested in this topic and try to visit such websites as often as possible to read about it and what's happening in the world.
>
> (Poland, CC, female, 18–24, secondary ed.).

However, the younger citizens seemed to be much more active than the older ones in searching for information on climate change, their statements evincing their great interest in the subject, which was also broached at school. The older citizens also emphasised this generation gap.

> We're more and more aware […]. Especially the young, which's excellent, because it's their future, yours anyway, because you, you'll have to live on the Earth as we've left it for you, so we also have to think a little about it. Certainly, something needs to be done, but we have to think about what else can actually be done.
>
> (Poland, CC, female, 55–64, university ed.)

> I read articles written by experts and look for information on this topic off my own bat. It's a fairly popular public issue, and we also obtain information at university where we discuss it […]. I search for further information so as to be better informed.
>
> (Slovakia, CC, male, 25–34, university ed.)

In some cases, the citizens' interest in climate change had to do with their professional or educational paths.

> I'm consciously looking for information because of my education.
>
> (Poland, CC, female, 25–34, university ed.)

> I'm a biology/geology teacher, so I make a point of sending the news to my students so that they can read it and become a little more aware of the reality surrounding them.
>
> (Portugal, CC, female, 45–54, university ed.)

On the contrary, some of the Polish citizens tended to emphasise their lack of interest in climate change, stating that they never searched for information on the topic. The following exchange between a participant and a facilitator – followed by another example of lack of interest – illustrates this point clearly.

> I've little awareness of this topic … well, I won't say anything … [F: Haven't you heard anything about it? (…)] I don't remember anything off the cuff; I can't say much. [F: So, this is perhaps not a topic that grabs your attention?] No, it's irrelevant to me. [F: And why's that, what do you think?] Because of my way of life, well, I don't know, it's just I'm not that curious about the world.
>
> (Poland, CC, male, 18–24, secondary ed.).

> As to whether or not I search for information on this subject, I'll be honest with you: it's not a priority topic in my life.
>
> (Poland, CC, female, 25–34, university ed.)

Besides their personal lack of interest, the remarks of the Polish citizens also revealed that there was a general lack of interest in climate change in society as a whole.

> I don't think they're interested whatsoever in these matters.
>
> (Poland, CC, female, 35–44, university ed.)

> Hardly anyone cares about climate change.
>
> (Poland, CC, male, 45–54, university ed.)

The citizens from the other countries also occasionally mentioned that climate change was not high on their list of priorities. Accordingly, they made little effort to follow the issue, despite the fact that they were exposed to information in this regard. One of the citizens even went so far as to observe that the media were awash with information on climate change, therefore there was no need to purposely search for it.

> It's really a topic I've never researched … I confess. It's not in my line of research. I pay attention to it, but it isn't something that motivates me, for example, and … the Internet, although I use it more and more for my research, but that's another matter, I'm no enthusiast, not about these general things, no.
>
> (Portugal, CC, female, 45–54, university ed.)

> I don't look for information because I receive so much. So, I'm not curious, unless it's necessary to perform a particular study, to analyse a specific situation. But I'm not motivated to look for news.
>
> (Italy, CC, male, 35–44, university ed.)

> Nor am I specifically interested in this topic. If I receive information, I may read it. Sometimes I like to read about it, but I think there's a lot of information in the media; the Internet's overloaded.
>
> (Slovakia, CC, female, 45–54, university ed.)

The lack of interest of some of the citizens, however, did not imply that they were oblivious to climate change, for, by and large, they expressed their deep concern about the problem.

> The future will be very different, for sure, because there'll be fewer species, there'll soon be less rainfall, much warmer winters and higher temperatures. How will the elderly and the most vulnerable communities react to these changes? And in a country like Portugal, which has so many differences, […] the Alentejo will be very different, it'll be almost deserted in a few years' time. And that worries me, because we're really trying to make a difference. But who else could contribute to reduce emissions and reach that level at which the temperature only increases by 1.5 [degrees Celsius], but we aren't going to achieve that goal. It's going to be 2 or 2.5. And I find that worrying.
>
> (Portugal, CC; female, 45–54, university ed.)

> In fact, we're witnessing that something's changing on our planet and that it's changing, probably, not probably but certainly, for the worse, which raises

> concerns about the future of not only the next generations, but also ours. So, I am concerned right now.
>
> (Slovakia, CC, male, 35–44, university ed.)

Finally, with respect to sharing information about climate change, in all the countries taking part in the CONCISE project – with the sole exception of Poland, where there was a greater balance – there were more citizens who explicitly asserted that they did so than those who did not.

> When I obtain some information confirmed by several other sources, regardless of whether they are online or offline, I try to form my own opinion. I decide whether it's correct or true. I certainly share that information, because I care about others and want to let them know about it, as it concerns us all.
>
> (Slovakia, CC, female, 18–24, secondary ed.)

The citizens' interest in seeking information on climate change reflected their willingness to share it, both face-to-face and virtually.

On the one hand, some of the citizens shared information with their family circle or friends with a view to discussing climate change.

> I receive some information on global warming, so, of course, I share it with my family, close friends and classmates. I also participate in some activities, such as school workshops, so as to learn how to protect our environment, to learn about other alternatives. I attend some lectures about it and then share what I've learned with my family.
>
> (Slovakia, CC, female, 18–24, secondary ed.)

> I actively look for things [information on climate change], and, generally, even among friends, if we have some news, we share it.
>
> (Poland, CC, male, 18–24, secondary ed.)

Others shared information on climate change at work.

> I'm a high school science teacher and, therefore, I try to share it at school.
>
> (Italy, CC, male, 45–54, university ed.)

On the other, the citizens also played a relevant role in disseminating information on climate change on social networks, with the majority of them stating that they usually shared content on their networks, thus contributing to raise awareness.

> I share, for example, when I heard about … I'm in several Facebook cinema and documentary groups and when I heard an announcement about these Leonard DiCaprio documentaries, I also made the most of that opportunity to share and disseminate the information … so, I think social networks are important for

> raising awareness, not just sharing … trash, but sharing something useful for society.
>
> (Portugal, CC, female, 25–34, university ed.)

> This is my passion; I try to share it on Facebook; my Facebook profile's a bit of a spammer just about energy and climate change …
>
> (Poland, CC, female, 35–44, university ed.)

It was the Italian citizens who were seemingly the most reluctant to share content about climate change. Their scepticism derived from the idea that virtual environments were unsuitable places for fruitful discussions on this and similar issues.

> I tend not to share much not because I don't care, but because I've seen that sharing doesn't lead to any debate and is therefore quite pointless.
>
> (Italy, CC, male, 25–34, secondary ed.)

GMOs: 'I know nothing about this subject'

Unlike the conclusions that can be drawn from the climate change discussion sessions, the results of those relating to GMOs reveal that there was a low level of awareness among the citizens as a whole. In all the countries involved – with the exception of Spain, where there was a greater awareness – those citizens explicitly admitting that they were unaware of the GMO issue outnumbered those who were indeed aware of it.

However, the low level of awareness of the GMO controversy was influenced by engagement and familiarity. If, on the one hand, there were clear references to engagement during the discussion sessions in the five countries, those to familiarity were less frequent. It can thus be argued that the level of awareness of GMOs, regardless of whether it was positive or negative, was driven more by engagement than by familiarity with the issue. Be that as it may, there was a greater balance between these two aspects than in the case of climate change. Given the complexity of the topic, this finding can be interpreted in light of the potential difficulties that the 'laypeople' among the citizens had in claiming to possess knowledge of such a specialist topic. This hypothesis has been confirmed by performing an in-depth analysis on those extracts relating to the citizens' familiarity with the subject, so as to identify similarities and differences which are described in further detail below.

Focusing on familiarity, the results show that the citizens from the five countries were fairly unfamiliar with GMOs, which was evidenced by the fact that more of them admitted to having a limited knowledge of the issue than to being fairly well informed. Practically, none of them claimed to possess sufficient knowledge of GMOs, which more or less points to their complete illiteracy.

> Honestly, all I know about this topic is that GMO means genetically modified organism, because I learned it at school, but I really don't know anything else.
>
> (Italy, GMO, female, 25–34, university ed.)

> I feel now, during this conversation, that I have too little knowledge of it. Because I don't really see a GMO problem at all.
>
> (Poland, GMO, female, 35–44, university ed.)

> I know nothing about this subject.
>
> (Portugal, GMO, female, 18–24, secondary ed.)

According to the citizens, familiarity with GMOs was also relatively low in society as a whole.

> Polish society's fed up and, saying it mildly, with little knowledge.
>
> (Poland, GMO, male, 25–34, university ed.)

On the one hand, the citizens, especially in Slovakia, tended to blame this lack of knowledge on the very limited media coverage of GMOs.

> In general, there's little information about it, only when a person is motivated to learn about it, needs to look for this information, but those who aren't so motivated know nothing about it.
>
> (Slovakia, GMO, female, 18–24, secondary ed.)

> I hear very little about it; I don't see or hear anything about this topic on TV or the radio.
>
> (Slovakia, GMO, male, 45–54, secondary ed.)

On the other, some citizens, especially in Poland, put their unfamiliarity with the topic down to the fact that it was a relatively recent development.

> It's also a very intense topic and, so far, probably one of those about which we generally know little. Because this is a fresh, relatively fresh topic. Science hasn't yet had time to explore the consequences. Because it's mainly about the consequences, the impact of such food on the environment and on humans and certainly a topic that causes fear in people who are interested in it, right?
>
> (Poland, GMO, female, 35–44, university ed.)

Specifically, the citizens apparently knew very little about the potential applications of GMOs in the field of healthcare (insulin production, treating inherited genetic diseases, etc.), although they did mention controversial cases of genetic manipulation in humans.

> I think with technological advances it'd be necessary to pause a bit. Perhaps, reflect and say, 'Do we have to continue advancing down this path or do we have to drive technology towards other interests relating more to ecology, to maintaining certain things?' I don't know.
>
> (Spain, GMO, female, 25–34, secondary ed.)

> They're already doing genetic reconstruction in humans; I think the biggest experiment has been conducted in China.
>
> (Portugal, GMO, male, 45–54, secondary ed.)

Moreover, the citizens' assessment of GM foods was ambivalent. They agreed that GMOs were positive in that new crop varieties could help to avoid hunger, deficiencies (golden rice), drought – or pest-related problems and so forth. However, they also alluded to the multinationals that exploited these new developments in a negative way, with an always unresolved discursive tension between social and economic benefits.

> I've already read a lot about how genetically modified organisms can resolve huge, even terrible, problems in Third World countries.
>
> (Portugal, GMO, male, 35–44, university ed.)

> I think for me it's one of those subjects that easily give rise to alarmism and in which it's very difficult to distinguish the science-based discourse from the social discourse on something that's important for everyone because it has to do with food, right? On the subject of genetic manipulation, modern genetics started with the genetic manipulation of peas, which was something that farmers always did […] to select those species and organisms capable of surviving the cold, of surviving pests […] I think it benefits people. I know what I'm talking about to some extent – I have acquaintances in Mozambique and China's purchasing land in Africa to produce food. So, food's an issue that affects our daily lives, but which in global terms is a very important issue and, therefore, I see the issue of the scientific use of genetic engineering as a way of responding to the demands of agriculture and for producing food in the future.
>
> (Portugal, GMO, female, 45–54, university ed.)

Only a few citizens were satisfied with their level of knowledge of GMOs, this being especially the case with the Poles and Slovaks, who were mostly people whose expertise or profession brought them into contact with this topic.

> I teach chemistry and biology, the fifth biotechnology programme. As genetic engineering's my field, I really delve into the subject, really reaching the last frontiers of molecular biology.
>
> (Italy, GMO, female, 65+, secondary ed.)

> Yes, I know what it's about, as I've studied genetics. I'm very familiar with the subject … I came into contact with transgenic plants as part of my research, so I know what they are; I know what the risks are, what the possibilities are for using transgenic plants.
>
> (Slovakia, GMO, male, 45–54, university ed.)

Finally, other citizens reported that they were familiar with GMOs because of product labels.

> We probably all notice this when buying food, for very often there's a GMO-free symbol on the packaging, meaning that the product doesn't contain genetically modified ingredients; we all know that.
>
> (Slovakia, GMO, Male, 35–44, university ed.)

Shifting the focus to engagement, it is first essential to note several differences between the five countries. On the one hand, the Polish, Portuguese and Slovak citizens hardly mentioned any positive or negative aspects relating to engagement. On the other, the Italian and Spanish citizens referred more often to engagement but for totally different reasons: the former declared that their level of engagement with GMOs was low, while the latter claimed to be fairly interested in the issue and in sharing information about it.

Nevertheless, a distinction should be drawn between the different attitudes characterising interest and sharing. Interest and sharing had both a positive and negative impact on engagement. In general, the citizens mentioned interest more frequently than sharing, except for the Portuguese, for whom sharing was important for fleshing out engagement.

Concerning the citizens' interest in GMOs, a number of differences between the five countries were detected. On the one hand, the Italians and Slovaks showed very little interest in the topic.

> Honestly, it's a topic that doesn't interest me and I've no information about it.
>
> (Italy, GMO, female, 55–64, secondary ed.)

> The topic's beyond my scope. If I read an article, I don't investigate the source … I don't investigate whether or not it's been verified, sometimes I just read the headline. I sometimes ask a friend for his opinion, as I don't want to waste my time with this; it doesn't interest me.
>
> (Slovakia, GMO, male, 25–34, university ed.)

Neither did the citizens intentionally search for information on the issue nor did they go beyond media content. They stated that as it was not an everyday topic, they encountered news on GMOs but only unintentionally, because they were not looking for this type of content.

> To be quite honest, I don't read beyond the headlines, because I think there're other more important issues to worry about right now. It's not that I don't find it interesting, in which direction the world of science and engineering's moving, because it seems to be one and the same.
>
> (Spain, GMO, female, 25–34, secondary ed.)

> It's also clear that if the subject really interests us and we want to know more about it, we look for these articles more. If it's just curiosity, like wondering what a GMO is, let's say I'll read one or two articles, but maybe I won't investigate the sources, because I am simply not that interested. Maybe it'll interest me in a week, maybe next year, maybe someday it'll interest me, maybe my child will ask me about it and I'll become interested in it.
>
> (Poland, GMO, female, 25–34, university ed.)

In this regard, it should be noted that the citizens rarely went into detail when mentioning the channels through which they received information (e.g. the names of information sources, titles of programmes, press articles, radio broadcasts, websites, etc.). Despite acknowledging the importance of the topic (relating to everyday life), the participants in the public consultations did not make any conscious effort to broaden their knowledge. All considered, it is difficult to say unequivocally what may have been the cause behind the low level of awareness of GMOs – whether it was actually the lack of information sources (or the difficulties in accessing them) or a lack of interest in them.

> It's difficult to say whether the information's insufficient or people aren't interested enough. Because as you can see here, if we were even a bit interested, we'd look for it ourselves. If someone wants to know what it is, Google allows him to understand basically how it works. If we believe that society knows too little, however, perhaps it isn't because there's nowhere to find information, but simply because people don't want to know.
>
> (Poland, GMO, female, 35–44, university ed.)

On the other hand, the Polish, Portuguese and Spanish citizens' interest in GMOs was fairly high, with some of them claiming that they went to great lengths to find information on the topic. This was particularly the case of people with a professional interest, who had teaching jobs and who had to bone up on the subject so as to share that information with their students.

> I partly studied this in biochemistry, but without focusing much on the issue. Only later, when my students started asking me about it, did I pay more attention to it. My first sources were very simple, but since I needed to pass it on to those students, I found scientific articles.
>
> (Slovakia, GMO, female, 35–44, university ed.)

Those citizens who were deeply concerned about the everyday impact of GMOs also declared that they were interested in the subject. This interest was also observed during the discussion sessions in which some of the citizens spontaneously offered examples of GMOs, mentioning the names of companies involved in obscure cases or even scandals relating to genetic modification.

> Well, at the moment I've already created such […] an ecological bubble in my, on my social media, YouTube, Google and so on, so as to receive information that interests me.
>
> (Poland, GMO, male, 18–24, secondary ed.)

> I'm really interested in this topic and every time there's one of those documentaries about 'where food comes from' and the ozone layer, it's already linked to GMOs.
>
> (Portugal, GMO, female, 25–34, university ed.)

Moreover, the citizens who confirmed their interest in this topic seemed to look for more accessible science information and, possibly, for the opportunity to pose questions directly to experts in GMOs.

> I'd be interested in meeting a person who's an expert, discussing, asking questions … so that in those debates I can ask for a deeper analysis.
>
> (Slovakia, GMO, male, 45–54, secondary ed.)

> I'm a person who asks a lot of questions and always goes in search of answers. I'm almost unable to use the phone, but I ask a lot of questions because I want to know.
>
> (Italy, GMO, Female, 65+, primary ed.)

Finally, as to sharing information about GMOs, there were differences between the five countries similar to those already described for engagement. On the one hand, the Italian, Polish and Slovak citizens were very reluctant to share information – both face-to-face and virtually – about GMOs, thus confirming its lack of availability and accessibility in terms of the level of intelligibility of its language or format.

> I don't actively look for it, but if I come across some interesting information, I'll take a look at it, but without sharing it.
>
> (Slovakia, GMO, male, 55–64, university ed.)

> No, in my daily life it's a struggle for me to talk about these topics. Neither do I have the wherewithal, nor am I motivated to do so …
>
> (Italy, GMO, female, 45–54, secondary ed.)

On the other hand, judging by the citizens' replies sharing information about GMOs was a relatively commonplace practice in Portugal and Spain, it being those citizens whose profession was somehow related to the topic who mainly did so, mostly in the shape of scientific articles.

> Since I'm very interested in this topic, I'm more like an observer; I consider it to be relevant to scientific discussions. The Internet can lead you astray. But it's also interesting to see how people perceive the information. As a teacher, I gather information for my students.
>
> (Slovakia, GMO, female, 35–44, university ed.)

Moreover, some of the citizens were more aware of the negative aspects of GMOs, being particularly concerned about their potential impacts (e.g. the vested interests of major companies have implications for health and nutrition and could lead to the loss of traditional and organic agriculture). For these reasons, they shared information with their friends and acquaintances on social media or in face-to-face interactions.

> I noticed this on the Internet. Somehow, I found a page dealing with it. Then, I also received some e-mails requesting signatures for a petition, so I shared it and collected signatures in my neighbourhood from people who were interested in it.
>
> (Slovakia, GMO, female, 18–24, secondary ed.)

> If it's a good documentary, that it's exploring right now, for example, the fact that Monsanto and Bayer are working together; actually, Monsanto was bought by Bayer, right? If it's a good documentary that explores its global impact and I think it's good for everyone to watch it, I share it.
>
> (Portugal, GMO, male, 18–24, university ed.)

> In order to obtain further information for clarification, the next day at work I share the news with colleagues, because I'm fairly interested in their reaction to it.
>
> (Italy, GMO, male, 45–54, university ed.)

Climate change and GMO information channels

The channels through which citizens receive science information is a topic that has received plenty of attention in science communication studies (Weingart & Guenther, 2016; Scheufele & Krause, 2019; Brondi et al., 2021; Dunwoody, 2021). Citizens usually use several channels to access science-related topics, from a single information source, or a unique channel, to multiple ones. The traditional science communication channels, such as newspapers, television and science museums, have expanded to include online channels and other public ones, like scientific platforms and blogs. In recent years, the focus on science communication research has shifted to analysing the new digital media and social networks and, therefore, to how this has changed the way audiences receive (and sometimes produce or distribute) science information (Dutta-Bergman, 2004; Barel-Ben David, Garty, & Baram-Tsabari, 2020).

People trust personal information channels more than the conventional and digital media, depending on the science topic in question (Weingart & Guenther, 2016). This reality has transformed science communication research because the vast majority of studies agree that citizens believe more in the views of people who seem to be credible in their eyes than in facts, as Takahashi and Tandoc Jr (2016) observed. After evaluating digital opinion-leader climate change campaigns, however, Nisbet and Kotcher (2009) concluded that there were likely to be significant trade-offs compared to face-to-face initiatives. They also arrived at the conclusion that the challenge for both scholars and practitioners was to understand the conditions under which digital opinion-leaders were effective and in which ways online interactions could strengthen or build on real-world connections.

On the subject of GMOs, in the words of Landrum, Hallman and Jamieson (2019: 65),

> Current methods of communicating consensus rely on diffusion/deficit models of communication, making the assumption that rejection of scientific consensus occurs because people are misinformed about it (e.g. Oreskes & Conway, 2011), instead of recognizing that there may have ideological reasons to reject it (e.g. Kahan, 2015; Pasek, 2018).

Their study substantiated that appeals to experts and the presentation of hard facts about the safety of GMOs did not appear to be effective in changing the general public's attitude towards them.

Climate change: 'I watch some discussions usually on television'

In the main, the citizens taking part in the five CONCISE public consultations declared that they obtained information on climate change through both digital and conventional media. However, the Slovak and Polish citizens preferred to access information on this topic via digital media. The Polish citizens also stated that they primarily resorted to the Internet, social media, blogs and search engines (including Google News), online magazines (including strictly scientific journals like *Science* and *Nature*) and popular science channels. As to digital media, the most frequently used was Facebook, with YouTube, Instagram and Twitter being mentioned less often by the Polish citizens. Similarly, the Slovak citizens also preferred digital media, the Internet and social networks. Concerning the Internet, there were also generic references to Google and specialist websites. Facebook was the most cited social network, followed by YouTube and Instagram, with the citizens mentioning some of the activists who they followed and social networks for discussing climate change information.

> Where do we get our knowledge from? Usually from the Internet.
>
> (Poland, CC, male, 45–54, secondary ed.)

> I've created my world, so to speak, on Facebook. I simply follow things that interest me, such as science in Poland […] FB sends me some articles […]. It sends me links to some external websites, but this is practically the only channel through which I receive information, because I don't watch TV, listen to the radio or read newspapers.
>
> (Poland, CC, male, 35–44, university ed.)

> Today, the younger generations are more concerned about this topic, thanks to social networks and YouTube videos. They participate in discussions on social networks, so I think we'll be increasingly more interested in this issue in the near the future: social networks, YouTube …
>
> (Slovakia, CC, female, 18–24, secondary ed.)

It was generally perceived that the media provided a lot of information on climate change, especially the catastrophic and sensational kind relating to its most dramatic consequences, in a sort of apocalyptic scenario in an uncertain and vague future.

> In my case, the piece of news that most disturbed me recently appeared in a local newspaper that stated that part of Esposende, which's in Braga, would be flooded. That affected me directly because it was the beach where I used to spend my summer holidays throughout my childhood. It's going to disappear. Thirty years from now, that beach and those other beaches nearby, none of them will exist. And it made an impression on me.
>
> (Portugal, CC, male, 25–34, university ed.)

The climate change debate, however, was rather special because the citizens talked about how they were changing their own behaviour on the basis of the information that they received via different channels. The news that they were receiving concerned them and had made them make some individual decisions (recycling, using public transport, purchasing electric cars, etc.).

> About two years ago, my husband mentioned this American woman who didn't produce any waste. We started to be interested in this topic, studied it and read her book about zero waste. Since then, we have been minimising waste.
>
> (Slovakia, CC, female, 25–34, university ed.)

> I have a little grandchild and children themselves come up with the idea at school; in biology classes they discuss such things. I'm surprised how positively they react to this. They teach them how to separate waste at school, thus making them more responsible.
>
> (Slovakia, CC, female, 35–44, university ed.)

In theory, these individual actions taken by the citizens resulted from the climate change information that they had received, without searching for it. Recycling and

waste separation, reducing consumerism and using more environmentally friendly means of transport were not included on an individual or collective list of dos and don'ts that could be adopted immediately. The citizens also stressed the feeling of powerlessness that not knowing how to bring pressure to bear on governments or companies to act against climate change produced in them. On the other hand, as to institutional channels, they chiefly mentioned the role of institutions at an EU level, including Eurostat and universities. They also generally treated organisations as reliable information sources which, to their mind, were of greater importance than other institutions.

> I recently watched a debate on ČT2 television in which there was a very interesting discussion between two people with completely opposite views on climate change.
>
> (Slovakia, CC, female, 65+, university ed.)

Television was the most cited medium among the conventional sort, especially documentaries that addressed the economic, environmental and social implications of climate change. As regards conventional media, for example, the Polish citizens mentioned television most frequently – information channels and weather programmes. Documentary films and reportages were also popular, as they allowed them to gain a better understanding of the topic. Television (and the radio) was occasionally the primary information source, due to problems in accessing the Internet (this applied especially to the older citizens living in rural areas). On the other hand, there were also those for whom television was irrelevant, either because they never watched it or because they did not have one at home (this was especially the case with the young participants).

> Well, some information, popular science programmes, but higher-end programmes, not those gossip productions, National Geographic, BBC Earth and such.
>
> (Poland, CC, female, 35–44, university ed.)

It was precisely the Italian citizens who resorted to traditional media, like television, newspapers and magazines, most often. Regarding television, they mainly mentioned documentaries, above all some of the most internationally renowned ones (e.g. *Earth Planet*, *The Corporation* and *An Inconvenient Truth*). These were followed by newscasts and, lastly, specific infotainment programmes and national and international channels and platforms (e.g. Al Jazeera, the BBC, the CNN, Netflix, etc.). As to newspapers, they mostly talked about national dailies and, to a lesser extent, the international press, including specific newspapers (e.g. *The New York Times* and *The Guardian*), and local media outlets. Moving on to magazines, they claimed that they normally read national ones, plus some international ones (e.g. *National Geographic* and *The New Yorker*). Other traditional media, like scientific journals (e.g. *Nature* and *Science*), radio stations, books or

essays and films, were also mentioned. There was even an unexpected reference to the Pope's recent encyclical.

> About 15 years ago, I remember hearing – or maybe paying attention to – this topic for the first time; I remember the film, this documentary directed by Al Gore, *An Inconvenient Truth*; I remember watching it and, afterwards, I started to keep abreast of the topic a little more. And then the BBC, Al Jazeera, *The Guardian* … those are the newspapers I read the most.
>
> (Italy, CC, female, 35–44, secondary ed.)

> My first memory goes back to 1992, when I was at school, at the time of the Rio Conference; I remember that with my teacher, my Italian teacher … we already talked a lot about it at the time. There was also a papal encyclical, but also earlier, with Wojtyla, even the Pope had already expressed his opinion; a topic that has doubtless had a huge impact in the last 30, 40 years.
>
> (Italy, CC, female, 35–44, university ed.)

For the Portuguese citizens, television was the most popular conventional channel for obtaining information, particularly news broadcasts and the public broadcaster (hereinafter RTP) but also international channels (e.g. the BBC, Euronews). A few citizens referred to nature documentary programmes (Bioesfera, Bombordo and Minuto Verde) and TV channels (National Geographic). There were also a number of references to a top debate show (*Prós e Contras*) broadcast on RTP. Although newspapers were not mentioned half as much as television, the citizens did bring up the country's quality dailies (*Público*, *Diário de Notícias* and *Jornal de Notícias*) and weeklies (*Expresso*).

> If I'm interested in a subject, I watch television; that's how I obtain information. By and large, I look for information on RTP and Euronews. They're my favourite channels.
>
> (Portugal, CC, male, 25–34, university ed.).

> The last thing I remember hearing about climate change was also on television, and it had to do with global warming and that we were experiencing increasingly drier years. Moreover, it was on television.
>
> (Portugal, CC, female, 45–54, university ed.)

With respect to the conventional media preferences of the Slovak citizens, television topped the list, followed by magazines, newspapers and books. In relation to television, they mainly mentioned documentaries, TV newscasts and certain TV programmes. Regarding magazines, they specifically referred to international magazines like *National Geographic* and local magazines addressing environmental issues. Finally, concerning newspapers, they declared that they mainly read national newspapers (*Sme* and *DennikN*). They also claimed to obtain information on climate change from specialist books.

> When I have the opportunity, I watch debates usually on television. For example, on ČT24 there was an interview with some Nobel Prize winners. Or I watch a debate on TA3 television, recently the interview with a climatologist.
>
> (Slovakia, CC, male, 65+, university ed.)

While the elderly among the Spanish citizens simply did not watch science debates on television, most of them considered formats of this type to be outdated, tiresome and challenging to follow for most millennial viewers. The classic, almost mythical figure of the science communicator – namely, someone with the ability to combine rigour, affability, charisma, meticulousness, a way with words and a polished communication style – seemed to be lacking. This was evidenced by the fact that Jacques-Yves Cousteau, David Attenborough, Félix Rodríguez de la Fuente and Eduardo Punset, plus the TVE programmes 'La Clave' and 'Redes', were frequently mentioned in the discussion sessions. With regard to other traditional media, the Spanish citizens talked about newspapers (*El Mundo*, *El País* and *La Vanguardia*), radio stations (Cadena Dial, Cadena Ser and the alternative and communitarian Radio Klara), magazines (*Muy Interesante*, *Mètode* and *National Geographic*) and scientific journals (*Nature*). Lastly, they also reported that they obtained information on climate change from TV documentaries.

The Polish citizens referred primarily to the Internet in general, as well as to social media (especially Facebook and YouTube), including blogs and search engines (Google News Feed), online magazines (not only strictly scientific ones – *Science* and *Nature* – but also digital dailies like *The Guardian*) and popular science channels (naukawpolsce.pap.pl, 'Kopalnia wiedzy', 'Nauka o klima-cie', 'Ziemia na rozdrożu', 'Nauka głupcze', 'Węglowy szowinista', '7 metrów pod ziemią', 'Agnieszka w Ameryce', 'Naukowy bełkot' Kasi Galdalf, 'SciFan', 'I fucking love science' and Dawid Myśliwiec's channel). Online platforms, including streaming channels like Netflix and Spotify, were also popular. As to traditional media, television was the most frequently mentioned channel – information channels (TVN 24, Wiadomości) and weather programmes (TVN METEO). Documentary films and reportages were also important, for the participants believed that they enabled them to gain further insights into the topic. In this connection, it was the citizens' children (particularly the teenagers among them) who provided them with information on climate change. Some of them described how their teenage children would tell them about what they were learning about the subject at school. Owing to their sensitivity to the problem, their knowledge and/or their activist commitment, this also offered them the chance to express their concerns about climate change to their parents. On the other hand, the younger citizens resorted to social networks and the Internet for news and information, while claiming that expert influencers, the creators of YouTube channels or science podcasts were essential.

Paradoxically, although the general perception was that social media offered the greatest amount of information, that is where the discourse of climate change deniers is most present.

GMOs: 'I had classes on this topic'

On the whole, the discussions on GMOs were less intense and heated than those on climate change, which was probably down to the fact that it was an issue that was aired a lot less frequently in public. Moreover, as it was a topic with which many of the citizens were not familiar enough, many of them were uninterested in GMOs and, consequently, unconcerned about them. It was only a younger minority group, who professed to be well-informed consumers with environmental concerns, who rejected the cultivation of GM crops and the production of GM foods. In fact, in all five countries, the citizens linked GMOs to food and drugs.

During the discussions, there was talk about the channels through which information on GMOs was obtained, with the citizens from all the countries, except for Slovakia where there were many references to social networks and the Internet as trustworthy sources, preferring television. Although the Internet and social networks were the usual channels through which the citizens obtained science information on GMOs, there were references to a number of TV programmes devoted to ecology and agriculture ('El Escarabajo Verde' and 'Agrosfera') and documentaries broadcast on thematic channels (Odyssey and Discovery). Some of them declared, rather regretfully, that TV programmes used to be of better quality.

> I think TV. If this were the main channel, it'd reign. I also watched a lot of TV in junior high school. The Internet wasn't so popular then.
>
> (Poland, GMO, male, 18–24, secondary ed.)

> I heard about it on TV, on one of the channels I like to watch. I still watch some TV … Odyssey, Discovery …
>
> (Portugal, GMO, female, 55–64, university ed.)

> I saw a documentary yesterday on French TV with … about a genetically modified cow molecule with which they're going to make steaks and to produce meat; they expect to be producing in … in an industrialised way within a year!
>
> (Portugal, GMO, female, 65+, university ed.)

Video-on-demand platforms like Netflix and HBO, among others, were also mentioned.

> Netflix, for example, has many documentaries on climate change and some on genetically modified organisms. I think they're a tool … documentaries.
>
> (Spain, female, 18–24, university ed.)

> If I wanted to find some information about GMOs on the Internet, I'd go to the website of some more trustworthy professional publications, such as *National Geographic*, which are monitoring their impact on the planet.
>
> (Slovakia, GMO, male, 35–44, university ed.)

> I heard the latest news on TV, in a newscast in which they talked about the specific case of the Asian bug and about biological control or through antagonistic insects [sic: insect-plant interactions] or through genetically modified crops. It's a topic that interests me personally, but I've never explored it. I think I'd look for information about it on the sites of universities or research centres of which I know – or I can find out – who the funder is, because if the funder's a large farm I doubt that the information I receive will be entirely unbiased.
>
> (Italy, GMO, male, 65+, university ed.)

In addition to television, the citizens alluded to other channels that they actively used to learn more about GMOs. In any case, the information channels can be divided into four groups: conventional (television and thematic channels, radio, newspapers or science popularisation magazines) and digital (the media, social networks, blogs, the Internet, Wikipedia, Google, etc.) channels, on the one hand, and personal (relatives, workmates, friends and acquaintances) and institutional (public institutions, scientific organisations and universities) channels, on the other.

> *Scientific American*'s great, it's beautifully written and isn't overloaded with information. Except that in our country it's only been available in Polish for two years. I personally obtained the mind part from England. But I don't exactly have a language barrier.
>
> (Poland, GMO, female, 35–44, secondary ed.)

Beyond the credibility and trust offered by these potential information channels and sources, arguments and reflections relating to prevention appeared in the citizens' discourses. For example, there was talk about certain gluten allergies, GMO contamination of organic crops, increased resistance to pests, loss of seed biodiversity, long-term doubts about the healthiness of transgenic foods and so forth. There was also an unmet demand for independent and reliable scientific arguments that offered assurances about GMOs, so as to make them more acceptable to society.

> I live in a very rural area with large corn plantations and there's a lot of transgenic corn. There're farmers, organic farming, who complain about the pollution caused by GM corn plantations, which have an impact on organic crops. Because my husband, as a biologist, monitors the quality control of organic crops, it's also a topic we discuss at home but, to be honest, it's not one that awakens my curiosity as much as others. Still, I try to keep informed and to understand the consequences for the environment and health.
>
> (Portugal, GMO, female, 35–44, university ed.)

Regarding how the citizens of the five countries perceived the different information channels, it should be highlighted that, for example, the Italians referred to different types of personal experiences in diverse facets of daily life. Specifically, they talked about the school environment and teachers and the work environment and colleagues. Close relatives and friends were also influential in many ways.

However, they also mentioned more casual friends (e.g. acquaintances) from whom they received information by word of mouth.

> We talked about them maybe when we were in middle school and in first or second grade. I know more or less what they are, but it's not that widespread on Instagram or social networks.
>
> (Italy, GMO, female,–18, primary ed.)

> I have an advantage because I studied molecular biology, so university textbooks and also books in general. I've bought books and articles on the Internet. Then there're some websites that I follow … . There's an English website called 'I fucking love science'.
>
> (Italy, GMO, female, 25–34, university ed.)

> I heard about it for the first time many years ago, but directly from union colleagues who were in the know. I was involved in trade union activities, so this information was based on the knowledge of various subjects. Since then, I've tried to delve deeper into the issue, but, in my opinion, not much is said about it; you hear very little about this matter. I'm currently working on a farm, so I hear my colleagues, who have first-hand knowledge, talking about them.
>
> (Italy, GMO, male, 45–54, secondary ed.)

The Portuguese citizens also claimed to have received information on GMOs from family, friends and acquaintances, while the younger ones among their number also stated that they had heard about them at school. By the same token, a few citizens claimed that they directly consulted scientific sources and read scientific articles or attended training courses on the topic.

> In addition to having heard about it in the media in a more or less indirect way, I also had classes on this topic, in 12th year biology classes to be exact. There's also talk about this topic.
>
> (Portugal, GMO, female, 25–34, secondary ed.)

Furthermore, the Slovak citizens emphasised that institutions played an essential role as channels for gathering information on GMOs, mostly schools covering the topic in their syllabi. They also stressed the importance of family, friends and acquaintances as information channels.

> We, as a family, have discussed this topic, and that's where we always discuss things first. I ask my family what they know and for their opinion so as to get a better picture.
>
> (Slovakia, GMO, male, 65+, university ed.)

As to the Polish and Spanish citizens, however, there were differences of opinion on how channels and sources presented information on GMOs. On the one hand,

the Poles put the accent on 'people who provided them with information on GMO issues', who fell into four main categories: representatives of the world of science; journalists and communicators; family, friends and so forth; and politicians. Scientists dealing with GMO issues included geneticists, medical doctors, biologists, biotechnologists and nutritionists, whereas institutions and organisations (especially pro-environmental ones and large international organisations relating to healthcare or nutrition) carried less weight.

> Well, I search on portals that are directly related to a given topic, right? Whether they be dietetics portals, medical journal databases, like PubMed and Academia.edu. And I try to explore a given topic and find out what's been done recently as much as possible.
>
> (Poland, GMO, female, 45–54, university ed.)

On the other hand, the Spanish citizens who were experts or pursuing university or scientific careers used the Google Scholar search engine to filter information appearing in the results which they considered to be noise or false. These citizens also, or usually, consulted some scientific literature. Nevertheless, those sources or resources were unknown to most of the citizens, since they involved consulting prestigious scientific journals which only a minority with scientific training accessed. Of course, Wikipedia had also become, in this and other topics, the most popular benchmark 'encyclopaedia', regardless of the citizens' sociodemographic profile, and the most trustworthy source, although they subsequently continued to search on other websites for further information.

> Ah, the source I used was Wikipedia in English. Well, I considered it quite reliable because it also coincided with what my teachers explained to me. I also like to contrast information, to ensure that what I saying's true.
>
> (Spain, female, 18–24, secondary ed.)

In any case, the citizens taking part in the public consultation held in Spain did not refer to close relatives as a reliable source of information on this topic, as was indeed the case in the other topics broached in the discussion sessions.

The amount of science information received about climate change and GMOs

In recent years, the amount of science information available to audiences has increased exponentially. Even though science journalism may be in decline, with the crisis of the print media (Pinholster & O'Malley, 2006; Granado, 2011; Bauer et al., 2013), the science communication of research institutes is on the rise (Entradas & Bauer, 2017; Entradas et al., 2020), as are science museums and centres, in addition to science dissemination events (e.g. Cortassa & Rosen, 2020; Lin & Honglin, 2020). Furthermore, the new digital media have paved the way for the proliferation of science communication content in a wide variety of formats

and on different platforms, from websites to YouTube, through social networks and podcasts (Franzen, 2019). However, science communication is not the only information source to which the public has access in this respect. According to Lukyanenko, Wiggins and Rosser (2020), the rapid spread of online content-generation and sharing tools has resulted in an explosion of user-generated content, including the scientific kind (citizen science).

Therefore, how do the members of the public perceive the amount of science information available or to which they are exposed? How does this vary by topic and by country? Do citizens feel more or less informed?

Climate change: 'This information's appearing everywhere at the moment'

In the main, the citizens taking part in the public consultations perceived climate change as a topic that had a strong presence in the public discourse, in contrast to GMOs. However, they declared that there was an information overload which sometimes made it difficult to determine what was relevant and trustworthy. When commenting on the amount of information available on climate change, those claiming that there was a lot, even too much, prevailed over those for whom there was too little. This excessive amount of information led them to feel less informed, more confused and even desensitised to the topic.

> This information's appearing everywhere at the moment, because maybe there wasn't much in the past or perhaps nobody was that interested in it, but now on any news portal, […] on television and on the radio, they're talking about climate change everywhere.
>
> (Poland, CC, male, 45–54, university ed.)

> I think we live in a paradoxical age. We've more and more information, but feel less and less informed, which's a paradox.
>
> (Portugal, female, 55–64, university ed.)

> It's a major topic that has no solution, and there's an information overload everywhere.
>
> (Slovakia, CC, female, 25–34, secondary ed.)

Some citizens also confirmed that there was not enough information or a lack of the specific kind. This pointed to a dearth of information about the concrete actions that individuals could take or to limited information on climate change for specific groups of potential recipients.

> I miss this type of education, information. There's only scaremongering, the Amazon forests are burning, now the glaciers … . But I miss the type of information that tells us what we can do to remedy the situation. This isn't enough; based on my own experience, I can say that in Cracow environmental awareness

> raising has worked quite well, for we're the first city in which the use of coal's been banned.
>
> (Poland, CC, female, 35–44, university ed.)

> It's agriculture that consumes 66 per cent of the planet's water, right here, here on the Iberian Peninsula, isn't it, and why? Because people want to eat, right, and it's not just us, because we're supplying China with fruit. It's natural and, therefore, has to be discussed in depth and measures that influence people have to be taken. So, […] people will be convinced to change their habits, but it takes many years of work, it takes effort. Now, nothing's being done! What information do people receive about these issues? It's very little, isn't it? Almost none, so a great effort's needed because people can be receptive to this, they aren't fools.
>
> (Portugal, CC, male, 65+, primary ed.)

> I'd still pay attention to farmers because there's a lack of information on this issue, as regards climate change, in Slovakia. Very little attention's being paid to it; it's not an appealing issue but is indeed extremely important for our sustainability. Information on the impact of climate change on Slovak agriculture's lacking.
>
> (Slovakia, CC, female, 65+, university ed.)

Some of the citizens talked about a chaotic mass of information in which there was no longer a distinction between reliable and unreliable sources, between rigorous and imprecise news or between the objective and self-serving kind. It was the perfect breeding ground for a form of denialism, a pseudoscientific relativism that yet again mingled geological ages and changes with current climate change.

> In my opinion, they don't tell us everything. As far as I know, it's the consequences that are badly explained. I mean, I think one thing is for a scientist to say the temperature's going to rise, willy-nilly, 1 or 2°C; but when they explain what's going to happen as a result of that … . When I investigate a little, I'm afraid I frankly disagree with what they're saying, that is, in general. I think the media are rather catastrophic when describing the consequences of what's going to happen, willy-nilly, which I personally don't doubt.
>
> (Spain, CC, male, 45–54, university ed.)

As to climate change, besides these general trends, there were similarities between the views expressed by the citizens of all five countries. Half of the Italians believed that there was an excessive amount of information on climate change, while the other half claimed that this was scarce. In other words, there was no consensus.

The Polish citizens considered that there was far too much information on climate change, especially on the Internet and on television. They also pointed out that it was a trendy topic, which was why there was a lot of information available

and people addressing it. However, this did not mean that they found the messages in this regard credible.

The Portuguese citizens frequently stressed that there was an information overload which led people to feel less informed, more confused and even desensitised to the topic. Nonetheless, some of them held the opposite view that there was still a lack of information on climate change, which might make it harder to promote more sustainable behaviours.

The Spanish citizens, for their part, seemed to be unmotivated to search for information on climate change. The fundamental reason behind this passivity might have been the sheer amount and diversity of information available in conventional, online and social media. It was not that they were 'disinterested' in the topic, it was just that the constant barrage of information was such that 'whether you like it or not you're exposed to it'. This barrage prevented the citizens from establishing selection criteria in order to be able to determine the quality of information channels and sources. They also confirmed that it was then difficult to distinguish between information and opinion, between solid scientific evidence and falsehoods.

Lastly, the Slovak citizens were of the mind that there was an information overload in relation to climate change, especially in the digital media. They also declared that there was a lack of specific information in the traditional media, especially in Slovak, on the research of globally renowned scientists, and that scientific evidence concerning Slovakia was not accessible to the public.

GMOs: 'It's not discussed; it doesn't receive enough attention'

According to the participants in the GMO discussion sessions, the quantity of information was generally inadequate. To their mind, it was a topic on which there was not enough accessible information or public debate. Their interest in GMOs was also connected with this alleged lack of accessible information, while, in their opinion, the means for verifying it were insufficient.

> There's little dissemination of the topic. It's not discussed, it doesn't receive enough attention, let's say, from whom it should.
>
> (Italy, GMO, female, 65+, secondary ed.)

> Well, I think fairly little's written about it here in Slovakia. I don't know a lot about it.
>
> (Slovakia, GMO, female, 25–34, university ed.)

> I receive very little information. I get the impression there isn't a lot out here. The only information I get to read is through the products I buy.
>
> (Portugal, GMO, female, 35–44, university ed.)

The citizens did not discuss the topic very actively from a quantitative perspective. However, they emphasised that there was scant information in this regard

and, generally speaking, limited access to it. Even though they might have been interested in actively looking for information on some products, access was very limited and not standardised for all products, which could be quite confusing when attempting to determine whether or not it was reliable.

> I try to look for information on product leaflets. Well, unfortunately, I noticed that, as it used to be with rapeseed oil, there was always information that it came from oil […] from GM rapeseed varieties with a reduced amount of erucic acid. So, after a few years it disappeared, it was further improved, and so on, but this information's no longer available as a GMO. I mean, I don't believe it's natural. […] They don't put GMO information on products, such as soy lecithin; they don't say whether there're GM or normal soybeans.
>
> (Poland, GMO, male, 35–44, secondary ed.)

Some of the citizens considered that there was not only a lack of information on GMOs, but that the topic was also unappealing, for which reason people did not bother to find out more about it. They also regarded GMOs as a topic with which they were very unfamiliar, especially in terms of their repercussions for human health.

> I think there should be information about the benefits, that is, the pros and cons of genetically modified organisms, and I don't think this information's readily available.
>
> (Portugal, GMO, female, 35–44, university ed.)

> The information exists and it's vast. I just don't go searching for it as I'm not interested in that kind of information.
>
> (Portugal, GMO, male, 55–64, university ed.)

> To be quite honest, I don't read beyond the headlines, because I think there're other more important issues to worry about right now. It's not that I don't find it interesting, in which direction the world of science and engineering's moving, because it seems to be one and the same … but right now I think with technological advances it'd be necessary to pause a bit. Perhaps, reflect and say, 'Do we have to continue advancing down this path or do we have to drive technology towards other interests relating more to ecology, to maintaining certain things?' I don't know.
>
> (Spain, GMO, female, 25–34, secondary ed.)

In the case of GMOs, besides these general trends, each country also had its particularities. For the Italian citizens, the information available on GMOs was quantitatively inadequate. Specifically, they thought that it was scarce, a general perception also evidenced by the fact that this point was stressed more in relation to this topic than to climate change. During the sessions, there was no active discussion on the

quantity of information among the Polish citizens, who simply highlighted the fact that there was much less information on GMOs than on climate change.

The Portuguese citizens confirmed the lack of awareness of the topic, with the majority of them considering that this information was very necessary and might be deliberately concealed. However, some of them held that there was enough information, but little or no motivation to search for it.

For their part, the Spanish citizens felt that they possessed scant knowledge of the effects of GMOs on human health. For which reason, they called for an independent and reliable scientific coverage of the issue in the media, with an eye to dispelling the doubts to which the preventive discourse had given rise.

Lastly, for the Slovak citizens, the information available on GMOs was perceived as quantitatively inadequate.

The quality of science information on climate change and GMOs

The quality of science information that citizens come across is perhaps one of the most burning issues nowadays. The increase in the amount of science information available has also been accompanied by a democratisation of its production and dissemination, which is no longer the exclusive preserve of scientists and science communicators. As observed above, citizens receive information through a multitude of channels, some of which are more trustworthy than others (see Chapter 2). Issues such as misinformation (Freiling et al., 2021), polarisation (Marcon & Caufield, 2021), fake news (Taddicken & Wolff, 2020) and inaccuracies and biases in science communication (Hansen, 2016) are raising concerns that the public image of science may be damaged and that citizens may make erroneous decisions based on false information.

It was thus crucial to assess the citizens' perception of the quality of science information on climate change and GMOs during the CONCISE public consultations.

Climate change: 'There're many conflicting opinions'

Regarding the quality of information available on climate change, the participants' perceptions were mostly negative, highlighting the prevalence of misinformation, especially bias, alarmism and false content (fake news).

A minority of the citizens did recognise that there was some high-quality information available, which was generally associated with scientific sources (either institutes or individual scientists), scientific evidence and sound methodology.

> It [the information] should be endorsed by official organisations, research teams and others. In other words, I believe that … . Well, the one with the capacity and expertise, an official body which, in principle, is supposed to defend the general interest, right?
>
> (Spain, CC, female, 35–44, university ed.)

> If I wanted to approach this topic seriously, I'd definitely look for information on professional forums, in professional magazines or on portals. I believe this would definitely help to understand the topic and obtain the right information.

> I'd contact those university departments studying climate change or some or other department of the Academy of Sciences where there are experts. Perhaps some natural history museums where that expertise is guaranteed […]
>
> (Slovakia, CC, male, 35–44, university ed.)

> I remember a special series from National Geographic that included a lot of interactive climate change infographics; it's all online, with reliable NOAA [National Oceanic and Atmospheric Administration] data.
>
> (Portugal, CC, female, 18–24, university ed.)

> It seems to me that science works in this way: some data are presented, on whose basis conclusions are drawn, and other scientists can verify these conclusions, whether they've been correctly drawn or not, whether the presented methodology is appropriate or not; this is how science works.
>
> (Poland, CC, male, 25–34, university ed.)

The citizens also mentioned that the quality of the information to which citizens were exposed on social networks depended on their use criteria, on 'who you follow' on Facebook, Twitter and YouTube. Why people chose them, who had recommended them or what was known about them determined whether these social networks were regarded as either suitable information sources or, on the contrary, a toxic environment.

> But apart from the fact that it's filtered, I also consider that science stories, in which you are interested, aren't the same. For example, I watch some channels, like D-Max, all those English channels broadcasting documentaries or La 2 [Spanish Public TV] that broadcasts scientific documentaries or on my Facebook profile that I've programmed for access to science pages, eh? What if I sat down and watched Ana Rosa or talk shows …
>
> (Spain, CC, male, 55–64, secondary ed.)

> I often look for documentaries, sometimes YouTube videos of science communicators who I know are credible up front and check their sources.
>
> (Portugal, CC, Female, 18–24, university ed.)

> A certificate, of course, for the most reliable, most credible information.
>
> (Spain, CC, male, 25–34, university ed.)

> I often look for these science outreach websites, because it's an area that I don't master at all and that's why I trust these people … many websites account for large numbers of articles and include links to other articles.
>
> (Portugal, CC, Female, 55–64, university ed.)

Nevertheless, in the discussion sessions held in all five countries, it was far more common to encounter strong criticism of the quality of information on climate change. Misinformation and disinformation took different forms. First and

foremost, some of the citizens were critical of the superficiality of information, in particular the dissemination of the imprecise, vague or inaccurate kind (e.g. inconsistencies and generalisations).

> There're many conflicting opinions, or news that you read in one way, then you hear it in another; now everyone says the opposite in everything; there're always those who tell you that there's an interest underlying that interpretation … it's really complex.
>
> (Italy, CC, male, 35–44, university ed.)

> I don't know whether the information we normally receive through digital media is credible. One day we read that it's good that the glaciers are melting; the next day that it's not. I'm giving you this as an example of the fact that we don't really know how to get our heads round it.
>
> (Slovakia, CC, male, 35–44, university ed.)

> The same news is covered differently with different values. And even worse, even in the same news outlet, the figures are different depending on who provides them.
>
> (Portugal, CC, male, 65+, secondary ed.)

Furthermore, the citizens attached great importance to giving the job of explaining science information or news to scientists, since only they could defend and demonstrate that they were authorities on the subject. If the figure of the scientist-author were to disappear, information reliability would decrease.

> The problem is that scientists are mentioned in the news because they have to appear, of course. They say there's a scientific study demonstrating that wine improves health. Sorry, where is that study? So, you have to look for it yourself. The problem is that the news gives you everything summarised. And also, how can they tell you, 'Scientists say', when there's no link to that information. You don't know who those scientists are, where they've said that. Consulting the journal *Nature* to look for the study and read it yourself isn't the same as consuming available information, without a source, without data …
>
> (Spain, CC, male, 45–54, secondary ed.)

The lack of quality information led the citizens to wonder whether or not there was a scientific consensus on climate change. Some said that there were still scientists against the theory of climate change or that the jury was still out on the issue, whereas others were quite certain that a consensus had been reached and that there was no doubt that the climate was changing and that human activity was to blame for it.

> Is there a consensus? Certainly not, some scientists are for climate change, some are against it.
>
> (Poland, CC, male, 25–34, university ed.)

> I've also noticed such a change, that there are fewer and fewer people saying that global warming isn't true. It used to be much more common to encounter such opinions, but now I have the impression that it's more and more consistent, that it's a fact and a major problem.
>
> (Portugal, CC, Female, 18–24, secondary ed.)

> I followed something very curious, in 2000, 2001. There started to be a lot of counter-information, many blogs that had information calling into question something that was already solid science at the time. And today, what causes me some apprehension is to see that the debate hasn't changed in the past 20 years. That is, it seems there's a faction of people who have valid arguments and are questioning climate change. […] it's a topic that's become politicised and it's a purely science topic, it's not even a weird one.
>
> (Portugal, CC, male, 45–54, university ed.)

However, a few of the citizens considered that the information available was too complex to be understood by normal people.

> And they often communicate things as they want […]. But not in a way that the general public can understand them. A lot of technical jargon's used. And I don't know if researching on it can help to understand it. But if my mother read the same articles as I do, she probably wouldn't understand a thing.
>
> (Portugal, CC, female, 18–24, secondary ed.)

Another type of misinformation identified by the citizens was partial information, namely, taking incomplete, prejudiced and/or partisan approaches to the issue (e.g. bias and polarisation).

> The problem is that Italian journalism is 80 per cent opinion and 20 per cent news.
>
> (Italy, CC, male, 35–44, university ed.)

> Information is very one-sided. A tragedy, we're all dying, a two-day deluge and all that … Or basically nothing's happened. We don't have objective information, only facts, no opinions, facts, pure facts.
>
> (Poland, CC, female, 25–34, university ed.)

> Fairly often, the media paint the picture that you, as an individual, as a consumer, generate a huge carbon footprint and that you should reduce it. I've heard many examples of how many of us try to do so. But is our footprint as

> large as that of people in other countries? There're also global corporations. What about their footprint? Are they willing to adopt any austerity measures? I'm not so sure.
>
> (Slovakia, CC, female, 18–24, primary ed.)

During the discussion sessions, many of the citizens pointed to the links between science and business, as well as between business and politics, which meant that science information was occasionally manipulated.

> Well […] it's politicised and economised, it's business and politics, and therefore it'll be very difficult to obtain reliable information, and if such information isn't available, it'll be impossible to counter it. I see this matter in a pessimistic light because that's probably how things are.
>
> (Poland, CC, male, 65+, university ed.)

> In the specific case of climate change, we're up against major economic interests and it's obvious that it carries a lot of weight in the media.
>
> (Portugal, CC, female, 25–34, university ed.)

Similar accusations in this regard were also levelled at organisations such as Greenpeace and against activists like Thunberg:

> I think all these actions […] are greatly exaggerated. I have the same opinion about Greenpeace, for example. I believe many of its actions have been commissioned. They're funded by certain groups in their own interests. Of course, a lot of money's at stake […]. Well, for me, it seems to lead to distortions.
>
> (Poland, CC, male, 65+, secondary ed.)

> I also watched Greta. In my opinion, the media's already so oversaturated that it's a fact that when you turn on your computer, you no longer know what to believe. It's hard to say if I'd take a positive stance on it because now the media can be so negative about everything connected with it.
>
> (Slovakia, CC, female, 18–24 university ed.)

The most common criticism of climate change information had to do with its sensationalist nature, to wit, the broadcasting of tawdry, exaggerated or compelling news (e.g. alarmism, phony titles and clickbait).

> And then I noticed that social networks tended not to calm my fears about a problem, but always to generate alarmism and panic, sometimes even pointlessly in my opinion.
>
> (Italy, CC, female, 25–34, secondary ed.)

> They talk about the effects and some of the consequences of climate change, but the spotlight's always firmly placed on the negative aspects […]. There're

> technological solutions, but these are no longer appealing for the mass media. So, the solutions are unappealing; good news is unappealing.
>
> (Portugal, CC, female, 35–44, university ed.)

Although in some cases the citizens considered that due to the urgency of the problem, it was necessary to adopt extreme measures.

> I'd disagree on this point, because it's a matter in which one cannot say it's a little bit warmer or not a little bit warmer; you cannot use such a middle-of-the-road measure.
>
> (Poland, CC, male, 25–34, university ed.)

Finally, another frequently mentioned type of poor-quality information on climate change involved false information or the dissemination of deceitful, contrived and untruthful content (e.g. fake news, conspiracy theories and pseudoscience), particularly on social media. Politicians, in particular Donal Trump, were cited as sources of erroneous and misleading information.

> On social networks, on Facebook, which's the one I use, sometimes a person sees something and doubts if it's credible or fake. If it's fake. And sometimes you have to be careful and do some screening. But … but let's just say, there're some things that are sometimes … that you don't believe.
>
> (Portugal, CC, male, 45–55, university ed.)

> The problem with fake news […] is that everyone thinks they know everything. And they take it upon themselves to voice their opinion. If there's a topic I don't know about, I investigate before opening my mouth.
>
> (Italy, CC, female, 35–44, secondary ed.)

To sum up, although the evaluation of the quality of information on climate change shared similarities in the five countries, some differences were detected.

The Polish citizens did not unequivocally assess the quality of science information on climate change, since for them it was difficult to do so reliably due to the fact that there was no unambiguous position on the issue. They admitted that there was a lot of information on the subject, although sometimes it was hard to identify the high-quality kind, which was mainly due to the politicisation of this topic and the strong lobbying of polluting corporations, which resulted in the manipulation of science information, thus reducing its reliability.

The majority of the Portuguese citizens shared many concerns about the quality of science information on climate change but were also appreciative of the information based on scientific evidence. The most common criticism had to do with the superficiality of the science information broadcast, although some citizens complained about its complexity. Others claimed that the information that they received was biased, in particular swayed by economic interests that felt threatened by climate action. A similar number referred to the sensationalist nature of news

about climate change, overemphasising the risks and impacts and downplaying the technological solutions that already exist. Digital media, in particular social networks, were blamed for spreading misinformation and fake news. Much less common was the idea that information was polarised, contradictory or imprecise, since as seen above, political and media representations of climate change in Portugal are fairly consensual and science based.

For the Italian citizens, information on climate change was qualitatively inadequate. There was an impressive number of references (95) to some or other form of misleading information, followed by sensationalist news (41) and false information (33), while the superficial and partial kinds were the least frequently mentioned forms of misleading information.

Most of the Spanish citizens believed that there was a glut of information which was also highly politicised. They held that quality information existed but that people had to look for it proactively. They also attached great importance to giving the job of explaining science information or news to scientists, since only they could defend and demonstrate that they were authorities on the subject. If the figure of the scientist-author were to disappear, information reliability would decrease. The citizens habitually resorted to social networks to look for information on climate change. Furthermore, they declared that the quality of the information to which they were exposed on social networks depended on their use criteria. For example, they admitted that on Twitter they followed 'trends', 'the most popular', the 'posts' of people they followed or what 'the followers of your followers' said. Faced with such a huge amount of information or news on climate change, they called for a 'validation' system, such as a 'quality seal', or a certificate issued by a public science institute, something that would allow them to distinguish easily between a hoax or fake news and informed knowledge. Although they were aware that the media system used independent verification organisations, their existence did not weaken their demand for certificates issued by a public science institute.

In the view of the Slovak citizens, there was more misleading information on GMOs than on climate change. Those who found information on climate change misleading pointed to how digital media presented it, without any explanation or verification. They generally held that it could be prevented by allowing local experts (from the country's environmental institutes or the Slovak Academy of Sciences) to explain such information and to weed out fake news. Lastly, they also expressed an interest in information presented by trustworthy experts in the field.

GMOs: 'Politicising scientific issues is a very risky business'

According to the citizens participating in the CONCISE public consultations, the quality of the information that they received about GMOs was rather poor, although, by and large, they were less critical about this aspect than in the case of climate change. For some of the Polish, Italian and Spanish citizens, the reason why there was so little reliable information on GMOs was down to the fact that it was an outdated topic.

The most frequent complaint about information quality was its polarised nature and that the information that was disseminated was partial and biased, according to the interests of the stakeholders, namely, politicians, companies and environmental organisations. They also considered that the GMO issue was much more politicised than others and that this was a dangerous communication practice, because it was not subject to any controls or standards.

> GMOs are very often used as a political weapon in demagogic debates in which ridiculous slogans like 'GMOs are playing the game of God' or 'GMOs spawn evil' are coined … . These things are absurd to people in the know, but unfortunately, it's communicated in such a way, this information's manipulated so as to make people believe it; they start to treat GMOs as something bad.
>
> (Poland, GMO, male, 18–24, secondary ed.)

> Politicising science issues is a very risky business in which, until we remove this political interference, we cannot be honest about it.
>
> (Poland, GMO, female, 18–24, secondary ed.)

> Recently there's been some awareness in offering information. But this information often comes from polarised consumer associations or environmental organisations.
>
> (Portugal, GMO, female, 25–34, university ed.)

> I see it as a problem. Also, information about GMO isn't disseminated through the mainstream media, but by various groups with different interests.
>
> (Slovakia, GMO, male, 45–54, university ed.)

> I don't trust the media on this particular subject, because multinationals have a major financial stake in this, which means that what matters is that we buy more.
>
> (Spain, GMO, female, 35–44, secondary ed.)

> Well, I think labelling also has to do with the financial interests of major companies and multinationals, because as soon as they put genetically modified wheat flour on the label, many consumers will stop consuming those products for that reason and that's why there're also many interests at stake and that's why it isn't done either.
>
> (Spain, GMO, male, 65+, university ed.)

In the case of GMOs, the susceptibility to emotional messages is even greater since not everyone has a knowledge of genetics and its sources are not as readily available as various conspiracy theories. Such practices mean that before scientific messages reach people, previous information has already made them apprehensive, which, in turn, undermines the acquisition of knowledge. For all these reasons, the citizens often considered that information on GMOs was too sensationalist.

> This news appeared on several blogs – I've never seen anything like it on institutional sites – which was very alarming: 'Warning, GMOs are dangerous'. It didn't explain why they were dangerous.
>
> (Italy, GMO, male, 35–44, university ed.)

> When I see something that's GMO-free, I feel this is simply an insult to people, preying on their fear, ignorance and it's simply offensive to Poles. It shouldn't be like that because it's against the law, because it's impossible to demonstrate the difference between GM and GMO-free products. In general, this is stupid […]. In my opinion, if a product is GMO-free, I won't buy it. If this manufacturer's lying to me in this way, it means that maybe he's doing some other stupid things as well.
>
> (Poland, GMO, female, 25–34, university ed.)

> These things are ridiculous for people who have some idea about them, but unfortunately it's communicated in such a way, this information's manipulated so people will believe it and start to treat this GMO business as something bad.
>
> (Poland, GMO, male, 18–24, secondary ed.)

Other citizens mentioned not only the superficiality of information on GMOs but also the complexity of the topic and the contradictions reflecting the lack of consensus among scientists.

> It's difficult to find articles taking a scientific approach to GMOs and, if you can, you find one that tells you one thing and another that tells you the opposite.
>
> (Italy, GMO, male, 55–64, secondary ed.)

> Maybe the information that's available is … still too technical, still too scientific, and inaccessible to the majority.
>
> (Portugal, GMO, female, 45–54, university ed.)

> I'm so sceptical, I've experienced so many situations in which something was 100 per cent certain, confirmed by some science or study, and then other information, also confirmed by science, appeared that was completely the opposite. When I hear something that's based on science, I'm not sure whether I should trust it or not, whether I should wait for its confirmation by some other scientific sources or some state institution.
>
> (Slovakia, GMO, female, 45–54, university ed.)

> And in the end, even if you look for the information, as we've said, you'll find things for and against, which may be a bit confusing …
>
> (Spain, GMO, male 65+, university ed.)

This state of affairs meant that some of the citizens were unable to verify information or to form an informed opinion.

> Most information's on the Internet, but also a lot of delusions, so it's difficult to distinguish between them. It's hard to surf; I have no way of verifying it. It's hard.
>
> (Slovakia, GMO, male, 55–64, university ed.)

Unlike in the discussions on climate change, there were few references to fake news and active disinformation.

> Alternative media disseminate a lot of information about GMOs that claims that they're harmful, that products can be carcinogenic. On the one hand, they're trying to demonise the major companies making these products, and, on the other, to promote bio, organic products in which some companies also have a stake.
>
> (Slovakia, GMO, male, 25–34, university ed.)

As to this point, good quality information was also associated with scientists and science institutes.

> The author's name is important. Some inspire confidence and others do not. And then the title, then the author.
>
> (Portugal, GMO, female, 65+, university ed.)

> I look, for example, in scientific journals and, again, scientific articles because that's where I can find information that, by my reckoning, is most credible, most reliable.
>
> (Portugal, GMO, female, 35–44, university ed.)

> If I were to use a transgenic product for my benefit or whatever, I'd follow the advice of a scientist who's really studying it. Because the others, after all, if they aren't scientists, I don't know how reliable the information that they give me will be.
>
> (Spain, GMO, female, 35–44, secondary ed.)

Interestingly, criteria other than the scientific kind for assessing information on GMOs were also mentioned.

> I think it's an issue that isn't only, or shouldn't only be, in the hands of science, but must be in the hands of … . It's a philosophical and ethical problem. So, you need very, very authoritative voices in the field of ethics, eh? Therefore, this debate isn't currently open in society. We don't hear authoritative opinions from an ethical point of view. We see growth, as a positive effect, of I don't know what, but it could lead to the degradation of the species and mankind.
>
> (Spain, GMO, male, 65+, university ed.)

Besides these general trends, there were also differences depending on the country. The Italian citizens, for instance, referred to misleading information on GMOs far

less often than in the climate change discussions. Moreover, there were relevant differences between the two topics. The partial kind (e.g. bias and polarisation) was the most frequently mentioned form of misleading information, followed by the sensationalist (e.g. alarmism and clickbait) and superficial (e.g. inconsistency) sort. In contrast, there were very few references to false information (e.g. fake news).

When assessing the quality of information on GMOs, the Polish citizens expressed negative opinions more often than positive ones. Some of their number reported information manipulation and misrepresentation. This meant that, before they were exposed to bona fide science information, those manipulated or misrepresented messages had made them wary, thus undermining their acquisition of an adequate knowledge of the topic and preventing them from taking an objective stance on it. Susceptibility to emotional messages was even greater since not all the citizens possessed a knowledge of genetics, while sources were not as readily available as conspiracy theories. Other arguments were based on the fact that science and politics were mixed. According to some of the citizens, this was a very dangerous communication practice, because it was not subject to any controls or standards, and similar to the relationship between science and business. Some of the citizens mentioned difficulties in accessing reliable high-quality information. While others explicitly mentioned misleading messages, namely, providing false information, presenting the topic in a one-sided way or not using appropriate scientific sources.

In addition, the citizens did not have suitable skills for locating or filtering sources in order to identify only the valuable ones, thus weeding out low-quality information. For them, it was those sending scientific messages who guaranteed (or not) their quality. In other words, if the person sending such a message was an authority on the subject, possessing specialist knowledge endorsed by professional achievements and university degrees, then the citizens were more inclined to believe that the quality of that information was high. The combination of expertise and the fact that the sender of the message inspired trust helped to convince them that the information provided was reliable. Even though they appreciated the knowledge provided by scientists, at the same time they felt intimidated by it to a certain extent, mainly owing to the scientific, and thus hermetic, language and the highly specialist content. Accordingly, they were of the mind that this type of information was unlikely to reach a mass audience, with science journalists devoted to the popularisation of science having a much greater chance of engaging audiences and providing them with information on GMOs.

Some of the Portuguese citizens held positive views on the quality of information on GMOs. Be that as it may, most of them were concerned that this information was frequently biased, above all because of the rivalry between two stakeholders: on the one hand, the agro-food industry; and, on the other, consumer associations and environmental organisations. Some of the citizens also considered that GMO information was inaccessible, because it was too technical and, at times, contradictory.

The Slovak citizens also believed that the information available on GMOs was misleading, mentioning that it was indeed possible to find information, especially

on the Internet, but that it was difficult to verify. For them, it was a misleading topic, with a lack of certified and trustworthy information. They also confirmed that science information could be made much more accessible to the public and should be presented in a more comprehensible language with infographics. As to the information available on GMOs in Slovakia, there were some differences of opinions among the participants in the discussion sessions. Some saw GMOs as a vehicle that alternative media employed to spread conspiracy theories or hoaxes and, consequently, believed that this could lead to the polarisation of public opinion. In their view, science information on GMOs was rather inconsistent and confusing as regards the safety of GM products. They contended that there were several conspiracy or alternative media that were more appealing to citizens, but which disseminated scientifically ungrounded fake news. Lastly, they expressed some scepticism about the science information currently available on GMOs.

Although most of the Spanish citizens placed their trust in GMOs, they claimed that the information that they received about them was not always accurate; on the contrary, it was usually vague and anecdotal. They also had faith in the science and technology information disseminated by public organisms and institutions and believed that most scientists agreed on the benefits of GMOs. They saw the reasons and arguments that pro-GMO scientists deployed under a more positive light than the messages and campaigns that environmental NGOs launched against GMOs. Those citizens with some scientific training, who were familiar with specific GM products and their benefits and who had a positive personal attitude towards innovation, were the most confident of all. They trusted in science and in the institutions that researched, approved and regulated their use.

On the contrary, there was a distrustful and reticent minority who were against everything that had to do with GMOs and transgenic crops. These citizens tended to have a lower level of scientific training (or with knowledge or educational gaps), to confuse concepts (seed selection, hybridisation, cloning, GMOs, transgenic crops, etc.) and to express their fears about GMOs. As well as relying more on the ideas disseminated by environmental groups, they tended to consider major multinationals like Monsanto/Bayer as inherently 'immoral and selfish' and as representing the worst of capitalism. Taking a 'neutral' stance, they usually asserted that there was no consensus on whether GMOs and transgenic crops were 'good or bad', a neutrality that they also maintained as regards prestigious scientists and some popularisers of pseudoscience.

The Spanish citizens were the only ones who mentioned the medical applications of GMOs. Advances in genetic medicine made the more religious among their number and those for whom nature was sacrosanct apprehensive, a feeling that was not assuaged by the certainty that GMOs were being used 'for the better'. These citizens needed and called for an 'ethical mediator' who could offer them credible information that dispelled their apprehension, solid reasons to believe that 'manipulating genes is not bad' and did not threaten anything 'sacrosanct'. For example, the young and middle-aged citizens considered that there was food, which was not a drug (medicine/remedy), that would help to prevent disease (preventive medicine), for which reason GMOs could help them to live longer and with a better quality of life.

The citizens who took an anti-GMO stance on their agricultural use held that the information available on them was very simple and fragmented. They confused GMOs with the selection or cloning of seeds and other sophisticated techniques, while, at the same time, referring to age-old agricultural practices. And since there was no information on what a GMO for agricultural use was and its specific advantages, there was always a trace of suspicion in the discussion sessions of all the public consultations.

As to those firmly against the use of GMOs, they always seemed to doubt whether this was done altruistically or whether there were economic interests and financial benefits in play that were disguised as ethics, the latter giving rise to distrust. In addition, there were also several precedents of commercial malpractices that discredited private initiatives, like, for instance, the business interests of companies like Monsanto on other continents such as Africa. They imagined that they were unscrupulous and monopolistic corporations that endangered human lives. In the main, those who deployed these arguments were better informed and possessed some scientific knowledge. When expressing their negative views, they tended to conclude by calling for the strict regulation of the free commercialisation of 'transgenic' products and GMOs. And they also called for rigorous and objective scientific studies, not funded by major agro-food corporations, that showed that GMOs did not really affect the health of ecosystems or people.

Conclusion

According to our research results, there were substantial differences in how the citizens perceived science information on climate change and GMOs. Despite both being environmental topics, climate change could be regarded as a 'hot topic', on which the citizens reported that there was plenty of information available through a multitude of channels and sources, thus allowing them to form their own opinions. As GMOs could be regarded as a 'cold topic', of which there was little awareness, the citizens had difficulty in remembering news stories and in accessing information. However, in both cases, they recognised that the quality of the information available was questionable, polarised by political and economic interests and susceptible to being misleading or even false.

Across the five countries, similarities and differences were also detected. Whereas the Portuguese citizens felt well informed and regarded climate change as a consensual topic, for their Slovak and Polish counterparts, the issue was still under discussion and appeared to be more controversial. The Spanish citizens were particularly aware of GMOs and able to discuss their applications in different fields, although elsewhere the discussions focused on food and spread to other unrelated topics (cloning, lab-produced meat, etc.). The Polish and Slovak citizens tended to favour digital media as science information sources, whereas their Italian, Portuguese and Spanish counterparts preferred traditional media, in particular television, as the best way of obtaining information on climate change and GMOs.

There are other variables affecting the citizens' perceptions of climate change and GMOs that have not been covered in this chapter. Gender, age and education level can also play a relevant role in determining how well informed, both quantitatively and qualitatively speaking, citizens feel about these topics. The number and sociodemographic profile of the participants in the European public consultations (see Chapter 3) may prevent us from drawing conclusions in this respect, but at least allow us to highlight the diversity of opinions and specific indicators of science information divides.

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Appendix: Assumed and completed samples by countries participating in the European public consultations

Spain

Table A.1 Structure of the assumed and completed citizen samples at the Spanish consultation

Assumed sample		*Completed sample*	
Gender	**%**	**Gender**	**%**
Female	51	Female	57
Male	49	Male	43
Age ranges	**%**	**Age ranges**	**%**
18–24	11	18–24	11
25–34	21	25–34	17
35–44	20	35–44	13
45–54	15	45–54	22
55–64	13	55–64	23
65 and over	20	65 and over	16
Studies	**%**	**Studies**	**%**
No formal ed.	9	No formal ed.	2
Primary ed.	14	Primary ed.	10
Secondary ed.	47	Secondary ed.	32
University ed.	30	University ed.	58
Rural/urban background	**%**	**Rural/urban background**	**%**
Rural	20	Rural	28
Urban	80	Urban	72
Nationality	**%**	**Nationality**	**%**
Non-local	10	Non-local	13
Local	90	Local	87
Disability	**%**	**Disability**	**%**
Disability	8	Disability	5
No disability	92	No disability	95
Minority	**%**	**Minority**	**%**
Romani	2	Romani	2
Non-Romani	98	Non-Romani	98

Poland

Table A.2 Structure of the assumed and completed citizen samples at the Polish consultation

Assumed sample		*Completed sample*	
Gender	**%**	**Gender**	**%**
Female	52	Female	63
Male	48	Male	37
Age ranges	**%**	**Age ranges**	**%**
18–24	10	18–24	13
25–34	18	25–34	17
35–44	19	35–44	18
45–54	15	45–54	16
55–64	17	55–64	17
65 and over	21	65 and over	19
Age ranges	**%**	**Age ranges**	**%**
18–34	28	18–34	30
35–49	27	35–49	25
50–64	24	50–64	26
65 and over	21	65 and over	19
Studies	**%**	**Studies**	**%**
No formal ed.	0	No formal ed.	0
Primary ed.	12	Primary ed.	8
Secondary ed.	62	Secondary ed.	44
University ed.	26	University ed.	48
Rural/urban background	**%**	**Rural/urban background**	**%**
Rural	40	Rural	20
Urban	60	Urban	80
Nationality	**%**	**Nationality**	**%**
Non-Polish	0.6	Non-Polish	0
Polish	99.4	Polish	100
Disability	**%**	**Disability**	**%**
Disability	12	Disability	2
No disability	88	No disability	98
Minority	**%**	**Minority**	**%**
Romani	0.044	Romani	0
Jewish	0.019	Jewish	0
Silesian	1	Silesian	1
Kashubian	1	Kashubian	1

Italy

Table A.3 Structure of the assumed and completed citizen samples at the Italian consultation

Assumed sample			
Gender	**%**	**Gender**	**%**
Female	51	Female	46
Male	49	Male	54
Age ranges	**%**	**Age ranges**	**%**
16–24	6	16–24	16
25–34	13	25–34	16
35–44	17	35–44	24
45–54	20	45–54	19
55–64	16	55–64	15
65 and over	28	65 and over	10
Educational level	**%**	**Educational level**	**%**
No formal ed.	–	No formal ed.	–
Primary + lower secondary ed.	55	Primary + lower secondary ed.	16
Upper secondary ed.	32	Upper secondary ed.	39
University ed.	13	University ed.	45
Rural/urban background	**%**	**Rural/urban background**	**%**
Rural	20	Rural	24
Urban	80	Urban	76
Nationality	**%**	**Nationality**	**%**
Non-local	8	Non-local	4
Local	92	Local	96
Disability	**%**	**Disability**	**%**
Disability	7	Disability	1
No disability	93	No disability	99
Minority	**%**	**Minority**	**%**
Romani	–	Romani	–
Non-Romani	100	Non-Romani	100

Portugal

Table A.4 Structure of the assumed and completed citizen samples at the Portuguese consultation

Assumed sample		**Completed sample**	
Gender	**%**	**Gender**	**%**
Female	55	Female	67
Male	45	Male	33
Age ranges	**%**	**Age ranges**	**%**
18–24	10	18–24	13
25–34	15	25–34	14
35–44	18	35–44	18
45–54	22	45–54	26
55–64	15	55–64	16
65 and over	20	65 and over	14
Age ranges	**%**	**Age ranges**	**%**
18–34	25	18–34	26
35–49	28	35–49	31
50–64	27	50–64	28
65 and over	20	65 and over	14
Studies	**%**	**Studies**	**%**
No formal ed.	2	No formal ed.	–
Primary ed.	5	Primary ed.	4
Secondary ed.	50	Secondary ed.	28
University ed.	43	University ed.	68
Rural/urban background	**%**	**Rural/urban background**	**%**
Rural	15	Rural	27
Urban	85	Urban	73
Nationality	**%**	**Nationality**	**%**
Non-local	5	Non-local	4
Local	95	Local	96
Disability	**%**	**Disability**	**%**
Disability	5	Disability	2
No disability	95	No disability	98
Minority	**%**	**Minority**	**%**
Romani	5	Romani	–
Non-Romani	95	Non-Romani	100

Slovakia

Table A.5 Structure of the assumed and completed citizen samples at the Slovak consultation

Assumed sample		**Completed sample**	
Gender	**%**	**Gender**	**%**
Female	51	Female	57
Male	49	Male	42
Age ranges	**%**	**Age ranges**	**%**
18–24	8	18–24	18
25–34	19	25–34	31
35–44	21	35–44	15
45–54	16	45–54	17
55–64	17	55–64	11
65 and over	19	65 and over	8
Education	**%**	**Education**	**%**
No formal ed.	0	No formal ed.	0
Primary ed.	14	Primary ed.	3
Secondary ed.	65	Secondary ed.	40.5
University ed.	21	University ed.	56.5
Nationality	**%**	**Nationality**	**%**
National minorities	19	National minorities	3
Slovak	81	Slovak	97
Disability	**%**	**Disability**	**%**
Disability	5	Disability	3
No disability	95	No disability	97
Region	**%**	**Region**	**%**
Bratislava	12	Bratislava	19
Trnava	10	Trnava	16.2
Trenčín	11	Trenčín	22.2
Nitra	12	Nitra	4
Žilina	13	Žilina	6.1
Banská Bystrica	12	Banská Bystrica	12.1
Prešov	15	Prešov	15.2
Košice	15	Košice	5.1
Unemployment	**%**	**Unemployment**	**%**
Unemployed	5	Unemployed	6.2

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Note: Page numbers in **bold** indicate tables; those in *italics* indicate figures.