5 Perceptions of science information on climate change and GMOs

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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

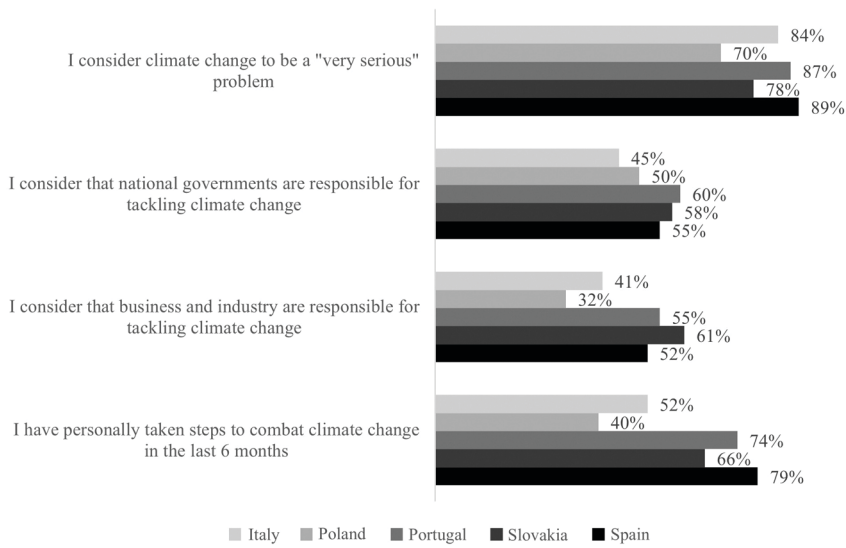

Figure 5.1 Climate change perceptions in the target EU Member States in 2019 (%).

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

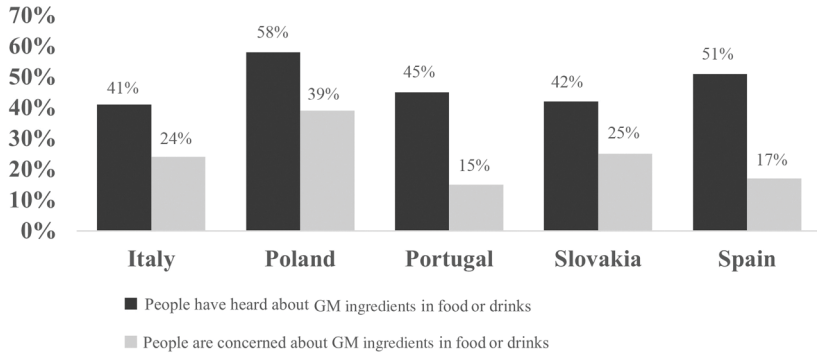

Figure 5.2 Interest in GMOs in the target EU Member States in 2019 (%).

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

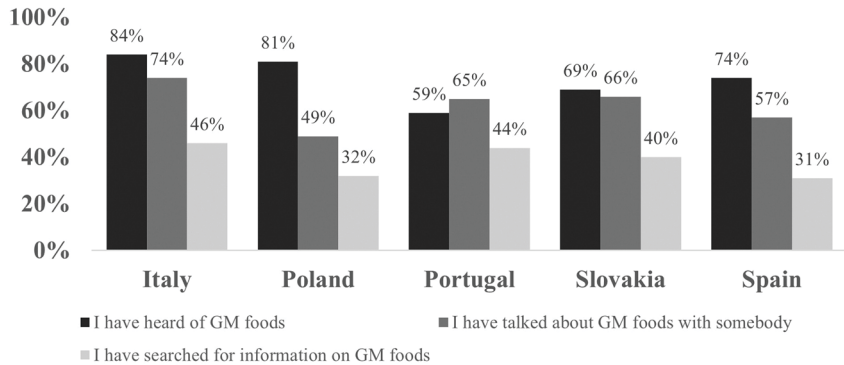

Figure 5.3 Interest in GMOs in the target EU Member States in 2010 (%).

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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