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PORTUGAL

The late bloom of (modern) science communication

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1. Introduction

This chapter describes the emergence of modern science communication in Portugal. The chapter is organised in parts. Part 2 sets the context in which science communication activities emerged and flourished in the country during the mid-1990s, anchored by a top-down government policy. This story is an historical account of the social and political factors leading up to this important episode. Whenever possible, we situate national moves within academic and policy debates on the public understanding of science, which may have influenced them. Part 3 maps the main events, activities, group initiatives and moments in science communication since then and describes the emergence of a community of practitioners, and opportunities in the professionalisation of the field. Part 4, we consider the late blooming and rapid developments of today, and the overall impact of the top-down approach on the development of modern science communication.

2. The political context and the emergence of a government policy for 'scientific culture'

2.1. The pre-1990s

Modern science communication is relatively new in Portugal compared to its European neighbours, who have longer traditions of public understanding of science (PUS), or public participation in science policy. See, for example,

the 'PUS movement' in the United Kingdom in the 1980s (Gregory and Miller, 1998) and publication of the internationally influential report *Public Understanding of Science* by the Royal Society in 1985, the Norwegian government policies in science communication since 1975 (Hetland, 2014), and the Danish consensus conferences organised since 1995 (Einsiedel et al., 2001). In the early 1990s, Portugal was a country with few modern scientific resources, public relations with science were weak, and the practice of science communication was scarce (Entradas, 2015). This was a consequence of a dictatorship and authoritarian state that ruled for more than 40 years[1] and kept scientific institutions and scientists away from society (Gonçalves and Castro, 2002). The second half of the 1990s saw, however, a turning point in science–society relationships, with 'scientific culture' and the 'promotion of science to the public'—as it was termed in our country—becoming an integral part of the science policy agenda. Since then, Portugal has quickly expanded its infrastructure for science communication, with political support, and continues to do so (Entradas, 2015).

During the 20th century, the university was an elitist space for the education of the few, based on the values of the New State (Rosas and Sisifredo, 2013). Research was confined mostly to the State Laboratories. Until the 1950s there were only four universities in the country—Coimbra, Lisbon, Porto, and Lisbon Technical University (Teixeira et al., 2007, p. 347)—and only 0.04 per cent of the Portuguese population completed a university degree. Today, there are 14 universities and 13 polytechnic institutes around Portugal, with 372,000 students enrolled (DGEEC, 2018), and 18 per cent of population has a degree (Instituto Nacional de Estatística, 2017).

With the fall of the authoritarian regime, overthrown by a military coup on 25 April 1974, the country focused on developing scientific infrastructure, expanding its scientific community and universities, and increasing the population's levels of education. Despite these developments, the science–society relationship was (still) distant from both the political agenda and university practices during the 1980s. The communication of science relied mostly on the activities of a few scientific authorities (Gago, 1990). There was no tradition of science journalism or science museums and exhibitions (Machado and Conde, 1988) and engaging with the public was not well regarded amongst the scientific community (Jesuíno and Diego, 2003). A study of the Portuguese scientific community in the early 1990s shows

1 The 'New State' was the far-right regime installed in Portugal from 1933 to 1974, created by Prime Minister Antonio de Oliveira Salazar, who ruled between 1932 and 1968, and continued under Marcelo Caetano, the last prime minister of the New State, ruling from 1968 until his overthrow in the Carnation Revolution of 1974.

that 'scientific dissemination' was regarded as an unimportant factor in the recognition of scientific authority and not a reputable activity for a scientist (Jesuíno et al., 1992; Machado and Conde, 1988). Still, it is during the 1980s that the first signs of a public dissemination culture in the country emerge; for instance, in 1982, the first national publisher Gradiva is created with an editorial profile oriented to science collections, probably a result of a growing public demand, and a community of science journalists begins to emerge. Central to these developments was the integration of Portugal in the European Union in 1986, which greatly advanced the economy in many sectors, including scientific and education infrastructures, and modernised the country more broadly, while also promoting stronger political and economic relationships with other member-states (e.g. Rodrigues, 2015; Soares, 2008).

2.2. The post-1990s

In the mid-1990s, we see a radical change in the science–society relationship in Portugal, which begins in the form of a top-down government policy (Entradas, 2015). In 1995, the Ministry of Science and Higher Education is created. José Mariano Gago, the first Minister for Science and Technology from 1995 to 2002, puts 'scientific culture' strongly on the political agenda, as part of a broader aim of building a scientifically literate society (Gago, 1990). Modern science communication thus emerges in a context of full political support, with the government becoming a major player in the promotion of initiatives to foster scientific culture in the country (Entradas, 2015). The 'policy for scientific culture' is perhaps the most significant event in the history of science communication in Portugal, having had positive impacts at many levels, and the turning point from which we can best trace the beginning of modern science communication in the country.

2.2.1. National 'policy for scientific culture'

The Portuguese national policy for scientific culture created in the 1990s was reflected in a series of actions by the government to encourage research institutions and scientists to increase their relations with society, and to widen public access to science. Two of the most pre-eminent actions were:

i. the formulation of legislation governing scientific research institutions, teaching and research staff, to expand and strengthen science communication. For example, the revised Legal Framework for Scientific Research institutions declared that all publicly funded research centres should communicate their scientific activity and allocate funding for this task (e.g. Legal Framework for Scientific Research Institutions, Article 13 of Decree Law No. 128/99, 17 April). Similarly, the higher education

career statute establishes scientific dissemination as one of the duties of university teaching staff (Decree Law No. 205/2009, Article 4, revision of the Decree Law No. 448/79). The government's emphasis on science communication is seen in more recent examples, such as including researchers' communication activities in the assessment of their academic performance; requiring 'dissemination and public engagement' plans in project grants (e.g. Guidelines for FCT[2] Investigator 2016, Guidelines for Individual Stimulus 2017); and assessing science and society activities as part of the evaluation of the research and development (R&D) units for competitive funding.

ii. The second action was the creation in 1996 of Ciência Viva Agency (Science Alive! – National Agency for the Scientific and Technological Culture). This national non-profit public awareness association was funded by the government through the Ministry of Science and Technology to develop science communication infrastructure and activities in the country.

But there were other important government initiatives during these years, including the creation of fellowships (one to six years duration) in science and technology management (BGCT – Bolsa de Gestão de Ciência e Tecnologia) covering science communication. A second initiative was the addition of a new research area to the six areas already existing for individual fellowship applications at the postgraduate level. This was called PACT (Promotion and Administration of Science and Technology), and those intending to pursue science communication at the postgraduate level could apply for PhDs and postdoctoral fellowships. These fellowships were in place for almost a decade (2005–13). We do not have numbers for the ratio of management to science communication fellowships awarded during these years, but we believe it to have been split evenly. Importantly, this marks the early years in the emergence of a community of science communicators.

What we observed then is a growing panoply of opportunities to increase the presence of science in society. Science begins to be regularly presented in the media, the number of science museums and centres expands significantly, and scientific organisations create structures dedicated to outreach and training programs in science communication. These developments are the focus of Part 3 of this chapter. At the academic level, a body of social studies examining the science–society relationship, publics for science, and the scientific community emerges (e.g. Costa et al., 2002; Gonçalves, 1996).

2 FCT (Fundacao para a Cienciaea a Tecnologia [Foundation for Science and Technology]) is the Portugues natoinal funding agency for research.

2.2.2. Portuguese society and science

The effort by the Portuguese government to increase public scientific literacy is visible in the national surveys introduced in the 1990s (discontinued in the 2000s). The first survey was conducted in 1996/97 by the Science and Technology Observatory (OCT), part of the Ministry of Science and Higher Education, and the second in 2000 by the same institution.

It is perhaps not surprising that these studies portrayed a gap between the Portuguese population and science. Nevertheless, the 2000 survey saw an increase in public interest and positive attitudes to science and technology when compared to the 1996 survey. For example, 20 per cent of the respondents in 2000 versus 10 per cent in 1996 declared themselves very interested in scientific topics; there was a broader recognition that science could contribute to improving people's quality of life; and people had higher expectations about science and technology in general (OCT, 1996, 2000; Ávila and Castro, 2003). Yet the levels of 'scientific literacy' of the Portuguese have ranked low compared to European standards, as shown by the Eurobarometer surveys of knowledge conducted by the European Commission (1992, 2001, 2005). Portugal presents more similarities with the countries from the southern and eastern Europe than the northern European countries, which in general have stronger relations with science.

Despite the generally positive attitude towards science and an improvement in the science–society relationship during the 2000s, we also see signs of a decrease in trust in science among the Portuguese, indicated by a more negative view of the benefits that science brings to individual life and its role in solving societal issues. For example, in 2005, 77 per cent agreed that 'science and technology make our lives healthier, easier and more comfortable', compared to 62 per cent in 2010 (European Commission, 2005, 2010). This decrease in trust in science has been attributed to public controversies around scientific issues in the 1980s and 1990s, such as the bovine spongiform encephalopathy (BSE) or genetically modified foods (GMF), which were also felt by Portuguese society (Gonçalves, 1996). Perhaps most significant were local controversies around environmental impacts of incinerators (Lima, 1995; Gonçalves, 2003a) and the aborted construction of a hydro-electric dam in the Foz Côa Valley, interfering with one of the most important national Palaeolithic sites of rock art (Jesuíno, 2001; Gonçalves, 2001). The Côa Valley rock art site has been on UNESCO's world heritage list since 1998. Studies showed that the public remained a marginal actor in influencing policy and the scientific debates were highly politicised (Lima, 1995; Castro and Lima, 2003; Gonçalves, 2003a, 2003b).

This illustrates how the policy for 'scientific culture' was approached as a dissemination model rather than in dialogical contexts of public participation, which were at that time intensely under debate in Europe (House of Lords, 2000; European Commission, 2001; Wynne, 1996). The fact that modern science communication in Portugal was just in its beginnings may in part explain this. Although traditional deficit-style communication still predominates, public participation initiatives have emerged, such as citizen science initiatives and public participation labs (Laboratórios de Participação Pública) to engage local communities. These initiatives have often resulted from partnerships between municipalities and universities. An example is the Open Science Hub (2017), a partnership between Figueira de Castelo Rodrigo municipality and Leiden University, to engage local communities in the development of innovation products, through collaborations between schools, civil society, industry, universities and the broader community.[3] Another example is the initiative Participatory Budgeting for Science (2017) promoted by the Ciência Viva Agency and the Portuguese Foundation for Science and Technology (FCT), in which citizens get involved in decision-making on the Portuguese participatory budget for science through a voting process (Ciência Viva, 2017).

Mariano Gago (1948–2015) was the first Minister for Science and Technology in Portugal. During his mandate (1995–2002) in the XIII and XIV Constitutional Governments, he introduced science communication into the political agenda. He became an influential voice in the promotion of research and scientific culture through his tenure as president of the Junta Nacional de Investigação Científica e Tecnológica (JNICT), the precursor to the FCT, between 1986 and 1989, where he coordinated early efforts at modernising science policy. Not long after, he published his influential essay *Manifesto para a Ciência* (Gago, 1990), where he called for a change in academic institutions from their historic isolation to make Portuguese science more open to society. He asked for the renewal of scientific education and research, and the promotion of scientific culture in Portugal. Mariano Gago became Minister for Science, Technology and Higher Education of Portugal again in the XVII Constitutional Government, between 2005 and 2011.

Rómulo de Carvalho (1906–97) was an early promoter of scientific culture in Portugal. He was a physics and chemistry high school teacher and influential poet (under the name António Gedeão). He had an important role in promoting scientific culture in Portugal since the 1950s and is still a reference for science communication in Portugal—his birthday was officially named

3 See www.cm-fcr.pt/plataforma-ciencia-aberta/.

National Scientific Culture Day in 1996. He wrote several popular science book collections: *Science for young people* (10 volumes, 1952–62), *Physics for the people* (two volumes, 1968), *Notebooks of initiation to science* (18 volumes, 1979–1995), among other books and articles on science communication. He was founder and director of the first popular science periodical, *Gazeta da Física* [Physics Gazette], which was first published in 1946.

3. Science communication activities in modern Portugal

In what follows we offer a descriptive view of the evolution of science communication activities and emergence of a community of practitioners in the modern science communication period in our country.

3.1. When and what

3.1.1. Science museums and centres

The first signs of science being open to the public in Portugal can be traced back to the first museums and botanical gardens established at the end of the 18th century, associated with universities and based on private and royal collections (Fiolhais, 2011, 2014; Granado and Malheiros, 2015). The first were created in Lisbon—for example, the Royal Museum of Natural History (1768) and the Botanical Garden of Lisbon (1878) (today the National Museum of Natural History and Science)—and in Coimbra, the Cabinets of Natural History and Physics, and the Botanical Garden of Coimbra University (1772), currently the Science Museum and Botanical Garden of Coimbra University (Brigola 2003, 2010). In the second half of the 19th century, other institutions were established by professional groups such as geologists and naturalists, and scientific associations such as the Society of Geography of Lisbon (1875). Examples are the Geological Museum created in Lisbon in 1859 by pioneers in geology such as Carlos Ribeiro and Nery Delgado (LNEG, 2018), and the first zoological garden (the Lisbon Zoo) created in 1884 by three naturalists: Dr Pedro Van Der Laan, José Martins and the Baron of Kessler (Jardim Zoológico de Lisboa, 2018). Although these institutions were important spaces for people to access science, it is fair to say that their reach was limited, possibly as attractions for the educated few living in cosmopolitan areas. In the 1980s, the number of natural history museums, science museums, botanical gardens, zoos and aquariums was only 13 (Delicado et al., 2013).

This picture has changed with an increased number of science museums in the country. One of the most important is the Lisbon Oceanarium, built as one of the centrepieces of the 1998 Lisbon World Exposition, and the most visited cultural venue in the country with about 1 million visitors per year (Oceanário de Lisboa, 2015). Other science museums run by a diversity of actors (associations, companies, municipalities) are important spaces for public interaction with science. Examples include the Visionarium, an interactive science centre created in 1998; the Museum of Energy created by EDP (former state energy company) on the site of an old power plant in Lisbon in 1990; and the Museum of Pharmacy, maintained by the National Pharmacies Association since 1996. The number of science museums grew from 23 in 2000 to 40 in 2016, and of aquariums, zoos and botanical gardens from three in 2000 to 20 in 2011 (Instituto Nacional de Estatística, 2002, 2013, 2016).

3.1.2. Scientific associations

Scientific associations have been important players in science communication. The *Gazeta da Física*, one of the earliest science magazines for non-specialists, was founded in 1946 by Rómulo de Carvalho and a group of physicists, and in 1974 integrated into the Portuguese Physics Society as its official publication. Nowadays, in a context where national societies have lost some peer communication functions to their international counterparts, many scientific societies find outreach to be an important component of their activities: around 50 per cent say they regularly engage in public communication (Delicado et al., 2013). One of their best-known activities is the organisation of the national science Olympiads in mathematics (since 1983), physics (1985), chemistry (2000) and biology (2010) by their respective scientific societies. Besides the traditional scientific societies, there are associations created by researchers to promote citizen science. These include amateur astronomers' associations that organise skygazing events and associations for nature observation activities such as bird or butterfly watching. A survey by Delicado et al. (2013) found 62 of these associations in Portugal, 51 of which were created after 1990.

However, the most significant change within the realm of associations is seen with the creation of the Ciência Viva Agency, as described above. This has had a profound impact on the amount and diversity of science communication activities all over the country, allowing science to expand from the main cities to more peripherical areas. Ciência Viva rapidly became a nexus for science outreach (Costa et al., 2005) by promoting a national science communication program based on three main axes (Conceição, 2011). The first was to improve science teaching by funding experimental projects developed by schools. The second was the Ciência Viva no Verão [Science Alive in the Summer],

a program of outdoor scientific activities directed at the general public. This had its first edition in 1997, Astronomy in the Summer, and expanded over the years to include other disciplines such as geology (1998), biology (2001) and engineering (2002). In these activities, citizens engage in astronomical observations, birdwatching, nature walks, spelunking and visits to technology sites (mines, factories, power plants, treatment plants), among others.

The third axis for Ciência Viva's activities was the creation of a national network of science centres and following a trending model of science exhibitions based on interactive modules and activities (Schiele, 2008), a novelty in science museology in Portugal at the time. This network of science centres has been built through partnerships between the agency and local actors including universities and municipalities, usually relying on a theme of local significance to organise the centre's activities. The first centre opened in Faro (Algarve) in 1997, a partnership between Ciência Viva, Albufeira and Faro municipalities, and the University of Algarve (Pinto and Amorim, 2018). The centre was installed on the site of a deactivated power plant with a focus on ocean sciences. The network also opened the Knowledge Pavilion in 1999 to serve as a flagship science centre under the agency's administration (Delicado, 2006). This is the largest and most visited science centre in the country and attracts about a third of the number of visitors for the whole network. Ciência Viva network centres received an average of 626,000 visitors per year between 2012 and 2015 (Garcia et al., 2016); for comparison, art museums had an average of 3 million visitors over the same period (Instituto Nacional de Estatística, 2013, 2014, 2015, 2016). Today, the Ciência Viva network has 20 science centres spread throughout the country (including the Azores Islands), with themes varying from astronomy and geology, to forestry, hydrology, biodiversity, energy, sustainability and navigation technology. Ciência Viva's initiatives have become very popular among universities and are among the main outreach activities in which universities participate (Entradas and Bauer, 2017). The program has been acknowledged as a successful model of science communication in Europe (Miller et al., 2002).

3.1.3. National events

National science events have also played an important role in public access to science, having grown in diversity and public reach over the last few decades. The earliest was the Science and Technology Week starting in 1998, promoted by the Ministry of Science (Conceição, 2011). Science Week activities are usually organised by universities and museums and include public lectures, exhibitions, visits to scientific institutions, open days and hands-on workshops. The European Researchers' Night and the FameLab promoted by the European Union (EU) in many European countries have

become a staple of the universities' public outreach calendar. Similar events are organised by universities themselves, the most notable being Physics Week, started in 1996 by the Instituto Superior Técnico of Lisbon (IST-UL) and continued annually. During Physics Week, non-scientists participate in public lectures and an interactive exhibition of physics experiments called The Physics Circus is a core activity of the event. It is important to note the role of the Calouste Gulbenkian Foundation—a Portuguese institution established in 1956 to promote the arts, charity, science and education—in organising large science public exhibitions. Examples include the *At Einstein's Light* (2005) and the *Darwin's Evolution* (2009). The latter celebrated the 200th birthday of Charles Darwin and had 161,000 visitors in Lisbon (Delicado et al., 2010). The Institute Gulbenkian of Science (a research centre in the biomedical sciences, which is part of the Gulbenkian Foundation) has had a marked presence at one of the largest music festivals Nos Alive (Algés, Lisbon) since 2008 with a stand dedicated to public information about life sciences. For three days in July, about 600 participants per year (mostly young adults and teenagers) have engaged in outreach activities such as speed dating with scientists, experiments and science games in an informal environment (Leão and Castro, 2012).

3.1.4. Media science communication

In the national media, the 1980s are regarded as a landmark for an increase in science news in the most read national newspapers including the *Expresso*, the *Diário de Notícias* and *A Capital* (Fonseca, 2017; Machado and Conde, 1988; Mendes, 2003). These newspapers have published articles about science and technology since the establishment of democracy in the late 1970s, though irregularly. Dedicated sections to science in national newspapers came only later and not always as a regular feature in the papers. For example, the newspaper *Público* had a daily page on science news from the newspaper's creation in 1990 until 2007, when it was discontinued, returning in 2012 until the present day. *Diário de Notícias* had a daily science section between 1999 and 2003, and between 2007 and 2014, but today science news is published in the daily pages of this newspaper (Granado and Malheiros, 2015). Some of these newspapers had science supplements, which also often changed names and formats, sometimes being reduced and/or discontinued (Fonseca, 2017).

Despite what was on offer, a study in 2000 on the public consumption of newspaper articles and popular science magazines showed low readership rates of science news by the Portuguese public, below those of European counterparts (Freitas and Ávila, 2002). While this may be in part explained by the scant coverage of science in newspapers in the 1980s and 1990s, science

was still fairly new for the Portuguese. As an attempt to increase science news in the media and public consumption, the Portuguese government under the rule of Minister Mariano Gago signed an agreement in 1998 with the national news agency Lusa to make science news, national and international, freely available to the national and regional press. This agreement ended in 2003, which might have contributed to the significant decrease in science news in Portugal in the last decade. Online newspapers have appeared in recent years: one example is the *Observador* (created in 2014), which often covers science and technology topics and policy. The decrease in traditional science media coverage, accompanied by the emergence of online newspapers, is a trend found in many countries and not just Portugal (Bauer et al., 2012).

Science media coverage can thus be characterised by a certain instability in the regularity of science news, sections and supplements in newspapers over the last two decades. Today, although most national newspapers including *Expresso*, *Correio da Manhã*, *Público* and *Diário de Notícias*, and cultural magazines such as *Visão* and *Sábado*, cover science topics regularly, *Público* is one of the few publications to include a science section.

The greatest change in publication of popular books on science happened with the establishment of the Portuguese science publishing company Gradiva in 1982, although some science collections from foreign authors had been translated into Portuguese much earlier. An example is the *Cosmos* collection of Portuguese titles, edited in the 1940s by the mathematician and science disseminator Bento de Jesus Caraça. Gradiva made a significant contribution by presenting new science authors to Portuguese audiences. More recently, other national editors such as Presença, Relógio D´Água and Europa-América have been publishing popular science books (Fiolhais, 2011; Granado and Malheiros, 2015).

Coverage of science on television and the radio has traditionally been low. A study on television newscasts in the four Portuguese public TV channels shows that in 2011 only 0.8 per cent of the news was about science and technology (ERC, 2012). There were only a few national TV productions such as the magazine *2001* (1996) or the program *MegaScience* (2004). *MegaScience* was broadcast on public TV with demonstrations of scientific experiments by presenters and guests. On radio the first long-term program was the *Antena 1 Science* (1996–2003), a forum where prominent scientists discussed scientific issues of public interest. Other examples of successful radio programs are *The days of the future* (2007) and *Antena 2 Science* (2009), which are still broadcast today on the public radio stations. The program *90 seconds of science* in *Antena 1*, produced by the New University of Lisbon

since 2016 and featuring interviews with scientists about their research, has been very popular having reached around 600 episodes at the time of writing. Overall, despite the instabilities mentioned, science media coverage has grown significantly since the 1980s, due to an increasing availability of content in the editorial market, the press and a growth in public demand.

3.2. By whom? The community of practitioners

The community of science communication practitioners has traditionally been scarce and dispersed. Twenty years ago, it was mostly comprised of personnel working at science museums and a few popularising scientists and journalists, but the situation has changed quite considerably in recent years. This is visible in the increasing number of communication professionals and in the various attempts of professionalisation of science communication in the country, primarily in the shape of science journalism, and more recently PR staff at research institutions and universities (Entradas and Bauer, 2019).

The science journalist community has traditionally been small. The few journalists who reported on science in the 1980s considered themselves pioneers (Machado and Conde, 1988). It is likely that this community has decreased since the early 2000s. The number of journalists working regularly on science issues in the Portuguese media has been recently estimated as about 10 professionals (Granado and Malheiros, 2015), with one or two journalists working at one newspaper or magazine.

The increase in demand for these professionals in recent years is in great part driven by the establishment of the Ciência Viva Agency and its science centres, and the rise of PR offices/communication/marketing (under different names) at universities and research institutes (Entradas and Bauer, 2017). Although the number of science communicators in Portugal is unknown, we could expect a community of a few hundred, although the precise number might be difficult to predict without benchmarking the community. This number might, however, rise significantly if we consider within this spectrum professionals who, although they are not exclusively dedicated to science communication tasks, perform them as part of their jobs. We know from a nationwide study of the Portuguese research institutes conducted in 2015 that around 50 per cent of the research centres in Portugal employ personnel partly dedicated to science communication tasks who often combine their communication roles with administrative functions (Entradas, 2015).

Studies of members of this community in Portugal, although limited, point to an undefined professional identity of the community (Agostinho and Trindade, 2013) seen in the range of professional backgrounds, portfolios and skills, and temporary work contracts (Entradas and Bauer, 2017). This is not a singularity of our country, but rather a trend in many countries (Wellcome Trust, 2015; Buhler et al., 2007; Kohring et al., 2013).

Attempts at professionalisation (Evetts, 2003) are evident in the proliferation of platforms, networks and associations for public science communication, and in universities' efforts in offering training in science communication. A major step was the creation of the Portuguese Science Communication Association (the Rede SciComPT). This network has about 400 members, ranging from communications officers/PR and managers working in research centres and universities, science centres and museums, to science journalists, illustrators and scientists. This association was created in 2013 (and legally established in 2014) by a group of science communicators and science journalists, and aims to 'promote science communication in all its aspects, to enhance the collaboration between science communication professionals and to promote the participation of citizens in all matters involving science and technology' (adapted from Rede de Comunicação de Ciência e Tecnologia de Portugal, 2018). One of its main activities is the organisation of an annual conference normally attended by around 200 participants, though the first national congress of science communication took place in 2013, before the creation of this network (Granado and Malheiros, 2015). The SciComPT conferences have since been organised every year, taking place in science centres, museums and universities in different cities in Portugal, and serving as important meeting points for discussion among science communicators, practitioners and scholars (Rede de Comunicação de Ciência e Tecnologia de Portugal, 2018). Examples of other networks are the online social network group on Facebook SciCom Portugal (created in 2010), where more than 1,800 members interact on science communication topics; and the Finca-Pé discussion group, an informal forum where science managers and communication professionals meet six times per year in the greater region of Lisbon to discuss best practices and ongoing projects (Entradas and Bauer, 2019).

3.2.1. Initiatives for training and education in science communication

Formal training in science communication in Portugal was first directed at professional groups of journalists and scientists. For example, the Technical School for Journalists (Cenjor) developed and ran a three-month course on science journalism in 1999/2000 and in 2005/06 (Granado and Malheiros, 2015), and the Institute Gulbenkian of Science organised a series of science

communication workshops for scientists in 2003, 2005, 2006, 2007 and 2010 (Lamas et al., 2007). At about the same time, the government funded the program Scientists in the Newsroom in collaboration with the daily newspaper *Público*, where scientists would spend three months writing news about science in the newspapers' rooms. These were important initiatives to strengthen the relationships between Portuguese journalists and scientists.

In terms of specialised education, the first master's courses in science communication were created in the early 2000s. In 2002/03, the University of Porto created a MSc degree in science communication, but this was discontinued in 2006/07, presumably due to lack of demand. In the following year, the University of Aveiro created a MSc degree in communication and education of science. That also ended in 2006/07. In 2011, the New University of Lisbon created a MSc in science communication, still running today due to the practical focus of the course. In 2017, 14 students completed a degree. The New University of Lisbon also promotes training modules and summer school courses in science communication (FCSH, 2018). In 2017/18, the University of Lisbon opened a MSc degree in scientific culture and dissemination of science; and in 2019/20, the University of Minho started offering a MSc in science communication and the University of Porto, a MSc in science education and dissemination. Workshops or short-term courses in science communication are offered by universities and larger research institutions (e.g. Iberian Nanotechnology Centre in Guarda). It is evident that the number of science communicators is increasing, that they perform a variety of jobs, and the field is beginning to take shape, in part catalysed by these important networks and training initiatives.

4. Final considerations: The impact of top-down initiatives

As we describe here, modern science communication emerged in Portugal over the last 25 years and can be attributed to top-down government initiatives, initiated in the mid-1990s under Mariano Gago's mandate. Despite its recent emergence, Portugal has quickly expanded its infrastructure for science communication and undergone remarkable changes. Some have followed models and trends of other European countries (e.g. measurements of scientific literacy, PUS models and interactive science centres, national initiatives such as the Science and Technology Week and the European Researchers' Night), but others are specific to the Portuguese political and social context, bringing singularities to modern science communication in Portugal in relation to other countries. The most significant is perhaps the

national policy for scientific culture described above and the continuing role played by the government in supporting science outreach. This policy, which had initially been implemented through centralised initiatives such as the Ciência Viva Agency, has acquired more dispersed dimensions, with many actors assuming roles in the promotion of science in the country.

We can then ask what the impact has been of these government top-down initiatives on the development of science communication in our country. There are many indicators that point to a greater openness and accessibility of Portuguese science to society during recent years. The most prominent examples are the increasing number of initiatives for the public organised by universities and research centres (Entradas and Bauer, 2017), the network of Ciência Viva centres across the country, and the increased number of communication professionals. All these point to a national spread of science communication. However, we cannot attribute the national expansion entirely to national policies. Along the way, other factors have fostered the continued effort seen in Portugal in the field, particularly in more recent years. These include the resources allocated to public communication and professionalised staff in research institutions and universities; European demands and directives; and the overall international mobilisation for science communication. We can, nevertheless, say the national policy was the turning point and the motive for the beginning of a commitment to science communication in the country—the top-down efforts have certainly promoted scientific culture in Portugal.

This does not mean, however, that the field has become fully integrated in the scientific and societal spheres. It suffers from lack of resources and professionalisation, and public participation in research and policy is marginal (Entradas and Bauer, 2017). An explanation may lie in the national policies themselves, which foster a culture of increased scientific literacy, emphasising unidirectional 'deficit' approaches to communication—these may have inhibited a more intimate public involvement in science (Entradas, 2015). This raises questions such as to whether the dominant unidirectional practices are a response to the national policies, or a lack of understanding/interest in adopting mechanisms for public involvement, or national constraints such as lack of public interest or opportunities to participate and maintain a more decisive role in decision-making. Despite significant achievements over the years, much remains to be done to engage Portuguese society in science as required in modern societies. Science communication in Portugal could benefit from closer collaborations between the high diversity of professionals and stakeholders already involved in science communication and the broadening of bottom-up approaches to promote more dialogical communication—for example, setting up more structures to involve citizens

in decision-making around science-related issues, and adopting successful models of public participation from neighbouring countries. To conclude, the initially adopted deficit model of communication has brought a certain amount of success, but it is now time to open modern science communication to other approaches such as dialogue and discussion in order to get a greater involvement and trust in science.

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Timeline

Event	Name	Date	Comment
First interactive science centre established.	Centro Ciência Viva do Algarve	1997	
An association of science writers or journalists or communicators established.	Rede de comunicação de ciência e tecnologia de Portugal [Science and Technology Communication Network of Portugal]	2014	Rede SciCom PT
First university courses to train science communicators.	Instituto Gulbenkian da Ciência (IGC)	2004–10	Workshops in science communication
First master's students in science communication graduate.	MSc in Science Communication, University of Porto	2002/03	
First PhD students in science communication graduate.	University of Coimbra and University of Minho	2015	Theses in science communication have been completed in PhD programs in sociology (ISCTE, ICS) and science education
First national conference in science communication.	At Pavilion of Knowledge in Lisbon	2013	
National government program to support science communication established.	Ciência Viva Program	1996	
First significant initiative or report on science communication.	*Públicos da Ciência em Portugal*	2002	
National Science Week founded.	Science and Technology Week	1998	
First significant radio programs on science.	*Antena 1 Science*	1996	One national radio channel produced by the Portuguese public broadcasting Rádio e Televisão de Portugal

Event	Name	Date	Comment
First significant TV programs on science.	*2001* (RTP2)	1996	A Portuguese 24-hour public service news channel owned by Rádio e Televisão de Portugal (RTP)
First awards for scientists or journalists or others for science communication.	Ciência Viva Montepio Prize	2012	For public communication work (big prize); educational projects (education prize); and science dissemination in the media (media prize)
Other significant events.	Ecsite Annual Conference	2017	Hosted by the Natural History and Science Museum, University of Porto

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