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ITALY

The long and winding path of science communication

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1. Setting the scene

The relationship between science and the general public in Italy is longstanding. The publication in the 17th century of *Il Saggiatore* by Galileo Galilei is an early example of popular science communication. Writing in vernacular Italian, Galileo, the father of modern science, became Italy's first important communicator. His work used language that would be accessible to a non-expert readership, but at the same time in *Il Saggiatore* Galileo also focused on topics that were subjects of dispute among scholars.

Nor should we forget the work entitled *Il dialogo sopra i due massimi sistemi del mondo* [The Dialogue on the Two Chief Systems of the World], in which Galileo proposed a debate between two experts and a reader, who in the course of the narration seeks explanations, starting from simple observations on everyday life.

With Galileo, Bacon, Descartes, Harvey and other scientists, the figure of a person dedicated to the sciences was established in Europe in the 17th century, presenting a new method and a new vision of the world. In Italy, in the wake of Galileo, various scientists, such as Torricelli, Redi, Morgagni, Cassini and others, followed the experimental method and asserted themselves not only in Italy but also in the rest of Europe. Many scientists were financially assisted by local patrons at a time when Italy was still divided into several autonomous states.

In this particular cultural context, scientific divulgation was limited to groups of scholars, unlike other countries such as England, where science courses were organised (Golinskj, 2002). In Italy, scientific divulgation occurred mainly in institutions such as the Accademia dei Lincei and the Accademia del Cimento, where communication focused on scientific experiments and philosophical discussion was developed with the support of the State.

In the 18th century, a public space dedicated to science communication developed progressively in Europe and in Italy. Middle-class citizens could participate in experiments organised by the academies and carried out in an open setting. From the mid-18th century, Italian journals publishing scientific articles became more popular and scientific periodicals developed, especially in northern Italy (Delpiano, 1989). The institutionalisation of research practices ensured a degree of continuity in the activity of scientists, helping both the dissemination of scientific knowledge through the press and the development of specialised disciplines (Farinella, 2003).

The early 1800s saw the beginning of two major developments: a second industrial revolution and the *Risorgimento*, the 'resurgence' movement that aimed to unite the individual Italian states and form a national community. Italian scientists contributed in important ways (Ciardi, 2013) including through their organisation of congresses that strengthened the community of scholars. Italian scientists modelled their behaviour on their British counterparts, and this contributed to the outstanding success of Italian popular science in the 1870s and 1880s. The decades following political unification in 1861 represented the period of greatest success for the 'Science for All' movement in Europe (Govoni, 2007).

Interest in the sciences grew at the end of the 19th century with an increase in the number of public and private initiatives aimed at promoting scientific interests. Science was professionalised and became linked to industrial development. These developments established the need to make the general public aware of technological innovations such as electricity and transport.

The Milan International Expo held in 1906 represented one of the most important events related to the public communication of science and technology. Other contributions were conferences, presentations and the publication of a variety of popular magazines (such as the *Nuova Illustrazione Universale*) aimed at disseminating scientific culture in the country. The outbreak of World War I in 1914 caused many magazines stop publishing and only one periodical, *La Scienza per Tutti*, managed to continue during the war period (Battifoglia, 2004).

The end of World War I saw the introduction of research policies aiming to develop laboratories and institutions and foster scientific and technological autonomy in the country. The National Research Council (Consiglio Nazionale delle Ricerche, CNR) was founded in 1923 to promote the application of the results of research, and is still the most important body of its kind in Italy.

The Fascist regime of the 1930s was highly destructive to science, making matters steadily worse. Mussolini's government controlled the dissemination of information and reduced investments in research and innovation to organisations such as the Accademia Nazionale dei Lincei, one of Europe's oldest scientific institutions which was founded in Rome in 1603. At the same time, his fascist government established and financed the short-lived Reale Accademia d'Italia [Royal Academy of Italy] in 1929; and also supported important scientists like Enrico Fermi. The number of graduates in scientific subjects dropped from 15.9 per 100,000 inhabitants in 1925 to 11.6 at the beginning of World War II. There was no freedom of the press and all initiatives involving free expression were controlled by the regime. Scientists could not express themselves freely and scientific activity was strongly conditioned by the choices made by Mussolini's government.

Fascism led to the removal of the best brains from every area of society. Many scientists and scholars were imprisoned and others emigrated. In addition, scientific institutions were heavily damaged in the final phase of World War II by a combination of Allied bombing raids and the systematic requisitioning of laboratory instruments by the retreating German army. By 1945, Italian science was in ruins.

The first post-war government led by Alcide de Gasperi did not consider research as a priority. The United Nations Relief and Rehabilitation Administration showed minimal interest in the resumption of scientific activities. It did propose the construction of a penicillin factory, but at the same time forced a reluctant Italian government, when science was not high on the list of national priorities, to make an extraordinary 200 million lire contribution to the Italian National Research Council.

But science had its champions. The freedom of the press had been restored and some intellectuals, including Ludovico Geymonat, sought to bring science back to the centre of public attention, attempting to promote and draw attention to the value of a new scientific humanism to avoid the traditional contrast between humanistic culture and scientific culture. An important role was played by private businesses: Olivetti in the IT sector and Montecatini in the chemical sector, are two examples of enterprises that engaged in research

and development. The former produced what is considered to be the world's first personal computer, and the latter allowed Giulio Natta to win the Nobel Prize for chemistry in 1963 in recognition of his studies of high polymers.

Physicists had a great influence in the post-war reconstruction of Italian science, taking advantage of the international prestige enjoyed by Nobel Prize winner Enrico Fermi and the school in via Panisperna. In the early 1950s, the National Institute of Nuclear Physics (Istituto Nazionale di Fisica Nucleare, INFN) and the National Nuclear Research Committee (Comitato Nazionale per l'Energia Nucleare, CNRN) were created. The INFN managed fundamental research, while the CNRN assumed the main responsibility for the Italian nuclear power sector. Nuclear physics was elevated to a position of supremacy in the Italian scientific sector, not only in terms of funding but also with respect to national and international cultural prestige. Italy became one of the leading countries in European scientific integration for large structures such as the CERN, EURATOM (the conventional name of the European Atomic Energy Community) and the European Space Research Organisation, and the Italian physicist Edoardo Amaldi was appointed as the first Secretary-General of the CERN.

These historical developments in science and research helped shape science communication, which had worked through developments of its own (Govoni, 2002). The Italian word *divulgazione* [divulgation], as 'science communication' is known in Italy, dates back to the 16th century. The term 'popular science' was previously used in the Italian context; however, the use of the adjective 'popular' was excessively reminiscent of the idea of a 'popular culture', from which individuals involved in scientific divulgation would tend to distance themselves. Corresponding to the Italian word *divulgazione*, the English term *popularisation* appeared between 1797 and 1801, and the French word *vulgarisation* came into use between the 1850s and 1870s.

2. Changes from the 1960s onwards: Research policies

The growth of science and technology in Italy after World War II followed a different path to other European countries and the United States, which had grasped the political and economic importance of scientific discoveries for the development of nations. Numerous leading researchers had emigrated following the anti-Jewish measures of the Fascist regime (Israel and Nastasi,

1998) and research policies had slowed down with a reduction in investment. The only exception was nuclear research, in which there was a renewed commitment, both private and public.

In 1962, the government carried out various reforms and, in particular, nationalised the production of electricity. The conflict this policy caused led to crisis, and subsequent scandals (the 'Ippolito affair') paralysed the Italian scientific system. However, the CNR, untouched by the scandals, embarked on a path of renewal that established new committees (including one for the humanities), additional facilities for the organisation of laboratories and research programs, and greater integration with industry. The number of national committees rose from seven to 11, and financing was raised from 4 to 6 billion lire in 1961 (Simili, 2013).

Over a 10-year period, from 1958 to 1968, the share of national wealth allocated to research rose from 0.3 per cent to 0.7 per cent. This addressed a widespread concern about the backwardness of Italy in certain technical sectors and a lack of technical and scientific personnel in particular. Despite these increases, funding was still significantly lower than other European countries such as Belgium or the United Kingdom, or the United States, which was allocating 3 per cent of its national income to research activities (Bucchi, 2001). Nor did the boost to funding spare Italy from severe criticism from the OECD, whose report highlighted the backwardness of Italy's research system in comparison with other developed countries (OECD, 1975a).

Despite changes to the administration of research policies in the 1980s (including the establishment of the Ministry of Education, Universities and Research, which reaffirmed the importance of relating research activities to the content of university courses), the decade ended with another harsh judgement concerning Italian scientific and technological policies by the OECD. They wrote another report that showed that Italy was under-investing in research: 1.29 per cent of GDP against an average of 2.5 per cent in OECD countries. By 2017, this percentage had barely increased and funding for public institutions and universities has actually gone down (OECD, 1975b).

To complete a gloomy picture, the OECD report showed that the number of researchers was below average levels: 27 per 10,000 inhabitants against an OECD average of 49 (OECD, 1991). The distribution of researchers was severely unbalanced, with 24 researchers for every 10,000 inhabitants in the central-northern area of the country and only three in the southern regions (Cannavò, Agnoli and Ciampi, 1989). From the 1960s onwards, the Italian government had chosen to focus its economic policies on public expenditure for goods and services and rather costly welfare programs.

3. Changes from the 1960s onwards: Science in the media

Until the end of the 1950s, the popularisation of the sciences was entrusted to periodicals. This built on a tradition of the post-unification period some 70 years earlier, featuring an authentic flourishing of the production of scientific information for the public, marked by the visibility of scientists who became authors of editorial series and magazines (see Govoni 2002, 2011). Only a few weeks after its first appearance in 1876, the principal national daily newspaper the *Corriere della Sera* ran a science story on its front page (Caprara, 2009). But this was a relatively short phase, and the tradition had begun to wane by the end of the 19th century.

In Italian newspapers the dedication of an entire page to scientific subjects did not occur until 1958, appearing first in the newspaper *Il Giorno*. Subsequently, and inspired by the 'race to conquer space', newspapers such as the *Corriere della Sera* and *La Stampa* began to dedicate pages to science and technology.

Until the 1950s public radio was an important medium for the dissemination of scientific news. The advent of television in 1954 was a significant turning point, allowing the public to see science through television quiz shows, specialist series and documentaries. Science on television increased in the 1960s covering topics such as nuclear energy, astrophysics and medicine. Piero Angela, who produced the most popular television science shows in Italy, directed his first program in 1969: *Il Futuro nello Spazio*. Such programs disseminated information while educating and entertaining the general public (Apollonio, 2002).

Anno I. Domenica-Lunedì, 30 Aprile-1 Maggio 1876 Num. 56.

CORRIERE DELLA SERA

Centesimi 5 in Milano — 7 fuori — numeri arretrati 10.

Ufficii di Direzione ed Amministrazione in Milano, Galleria Vittorio Emanuele, 77

ABBONAMENTO STRAORDINARIO

Un abbonamento straordinario è aperto a tutto l'anno 1876 ai seguenti prezzi:

Per Milano a domicilio.
Dal 1° maggio al 31 dicembre L. 9.
In tutto il Regno franco di porto
Dal 1° maggio al 31 dicembre L. 12.
Estero (Stati dell'Unione Postale)
Dal 1° maggio al 31 dicembre L. 20.

MILANO, 30 APRILE.

DIARIO

GARBUGLI MINISTERIALI

DALLA CAPITALE

APPENDICE DEL CORRIERE DELLA SERA

SCIENZE

Figure 20.1: A front page story on science in the *Corriere della Sera* from 1876.

Source: Archivio Storico del Corriere della Sera (Historical Archive of Corriere delle Sera).

4. Moving towards the modern era of science communication

4.1. The media

The period from the 1970s has seen fluctuations in the way the media covered science as the industry responded to changing fashions and economic circumstances. Thanks to the influence of the student movements that arose in 1968, more rapid cultural growth had occurred in the 1970s. Supporting and reinforcing this development, the public was increasingly eager to learn about new fields of knowledge. This was a positive period for scientific information, influenced by the success of the first television programs dedicated to science, the founding of numerous magazines dedicated to the popularisation of the sciences and the emergence of new social concerns (such as that relating to environmental issues), which shifted the interest of the public towards new disciplines. But the competition from other sources had a negative effect on newspaper coverage, and in 1972 the page dedicated to scientific and technical matters in the daily newspaper *Il Giorno* was abandoned.

However, in the 1980s an interest in the 'storytelling of science' was rekindled on the pages of newspapers. The daily newspaper *Il Giorno* once again included a section entitled *L'Era della Tecnica* four times a week. There was an increase in the number of pages dedicated to science and technology in the other main national newspapers (*Corriere della Sera* and *La Stampa*). At the end of the 1980s the creation on a daily basis of a page dedicated to scientific communication had become a clear objective of newspapers.

By 1987 the cycle had changed again, and the only newspaper to publish a daily page dedicated to science was *L'Unità*, originally founded as the official journal of the Italian Communist Party. (At that time in Europe, only the French newspaper *Le Monde* presented on a daily basis a page dedicated to science.) This position may have been influenced by the fact that the Central Committee of the Italian Communist Party included many scientists and the director of the daily *L'Unità* was the engineer Gerardo Chiaramonte. Following an initiative of the latter and, above all, with the support of the journalist Romeo Bassoli, it was decided that the newspaper should present a daily page covering current topics relating to the sciences, technology and the environment. This section of the publication was highly appreciated by the

readership, who followed it assiduously, and it became the most popular page of the whole newspaper.[1] A situation such as this had never been experienced by any other newspaper.[2]

Today all the main daily newspapers have a scientific supplement. *La Stampa* publishes *TuttoScienze*, *La Repubblica* publishes *RLab* and the *Corriere della Sera* publishes *Corriere innovazione*. The economic-financial newspaper *Il Sole 24 Ore* also offers a supplement (*Nòva24*) dedicated to technological and scientific development.

Television also ran dedicated programs to scientific subjects. Since it began in Italy in 1954, television has played a fundamental role in increasing the cultural level of the Italian population. It remains as the source of information most frequently used by people who want to learn about science and technology, followed by newspapers, websites, blogs, magazines and the radio (Pellegrini, 2018).

Science programs were included in the programming schedule from the beginning (Schiavini, 1988). *Piccola Enciclopedia Scientifica* (presented in the early evening) lasted about half an hour and was aimed at a very broad and heterogeneous audience. A very different audience, more keen on learning about scientific issues, was catered for in the late evening. Professor Enrico Medi, then professor of terrestrial physics at the University of Rome and director of the National Institute of Geophysics, conducted six episodes of a pioneering program entitled *Avventure nella Scienza*. This program, highly appreciated by the general public, was repeated in 1955 and 1956.

In 1957, *La Macchina per Vivere* focused on the subject of the biological and physiological aspects of the human body and was broadcast in the late evening. Anna Maria Di Giorgio was a communicator who assumed the role of the 'expert' to teach or explain certain topics to a general audience. The model of presentation was that of a university lesson, conducted in a clear and precise manner, and using simple language so the general public could understand.

The role of the conductor/presenter was a typical feature of the communicative modality in other programs broadcast in 1958: *Quarta Dimensione* or *Uomini nello Spazio*. Later, this 'top-down' model of communication tended to be replaced by the 'edutainment' educational model. In the early 1960s, Italy

1 A reconstruction resulting from a conversation on 26 July 2018 between the authors and Pietro Greco, the journalist who was the science specialist of *L'Unità* in that period.

2 An attempt was also made by the newspaper *L'indipendente* in the period 1991–2007.

was engaged in the construction of plants for the production of atomic power and, simultaneously, programs such as *Italia Nucleare*, *Storia della Bomba Atomica* and *Atomo Pratico* were broadcast on television.

Between 1966 and 1973, the program *Orizzonti della Scienza e della Tecnica* was broadcast every Sunday in the late evening. A new range of rather diverse programs flourished, where presenters from different cultural and professional backgrounds presented heterogeneous subjects, using different expressive modalities and communicative intentions. These included *Sapere* (1967), *Planetario* (1968), *Verso il futuro* (1968) and *Dopo Hiroshima* (1969) (Giaccardi, 1988). The medical sector in particular provided a rich source of news (Bauer, 1998), and was communicated to the general public through programs such as *L'altra Medicina* (1970), *Medicina Oggi* (1970) and *Boomerang* (1971).

However, it was only when the program *Quark* was founded in 1981 by Piero Angela (the former presenter of *Il Futuro nello Spazio*, 1969, and *Destinazione Uomo*, 1971) that the Italian public began to follow the development of science and technology on television. It is interesting to note that from the very beginning, the Italian state television company devoted space to science also in programs for children.

Figure 20.2: Piero Angela, founder of the science TV program *Quark*.
Source: Wikiquote.

The media drastically increased their attention to science and technology in the 1990s and the television news program *Leonardo,* produced by RAI (known until 1954 as Radio Audizioni Italiane, now Radiotelevisione italiana), the Italian national broadcasting company, was founded in May 1992. Italy thus proved it was at the forefront of European scientific television broadcasting: *Leonardo* was the first daily scientific news report in Europe.

Radio is the medium least frequently used by Italians to learn about science and technology. Nonetheless, some science communication programs have been broadcast such as *Radio3 Scienza,* the first episode of which went on the air on 6 January 2003. This daily scientific news report is transmitted by Rai Radio 3 five days a week. The program was originally conceived by Rossella Panarese, who is still its editor. This cultural report offers a reflection on scientific issues and the relationship between science and society. It provides the news of the day, explores and offers a reflection on various topics, and presents interviews conducted with researchers. It also provides overviews of books and presents relevant articles that appear in newspapers, discussing their content from a scientific point of view. All *Radio3 Scienza* episodes are available online in the broadcasting archive, offering a form of synergy between different media.

4.2. Science centres

As a member state of the European Union, Italy has benefited from research funds, which to some extent have permitted an investment in public science communication activities. The framework programs have increasingly dedicated resources to foster better communication between the research world and the public. Since 2002, with the adoption of the Science and Society Action Plan, a set of activities has been developed to support communication and dialogue between science and society (European Commission, 2002). These resources have been invested to increase public engagement activities and to modernise old structures. Since the 1990s, significant growth has been achieved in the number of science centres and the modernisation of old science museums.

Since 1995, an educational playground centre for children called the Città dei Bambini e dei Ragazzi has been open to the public in Genoa. Originally inspired by the Cité des Sciences de la Villette in Paris, this was also influenced by the modern approach adopted at the Museo del Balì interactive science centre. The only national museum specifically dedicated to science and technology is in Milan, and Florence has a Museum of the History of Science dedicated to Galileo Galilei. Other Italian science centres include the Città

della Scienza [City of Science] in Naples and the MUSE science museum and educational centre in Trento. A branch of the innovative international Science Gallery network will soon be opened in Venice.

4.3. National associations

In Italy, many associations promote the communication of scientific knowledge, not only to experts and scholars, but also to the public. The National Association of Scientific Museums, for example, was founded in 1972, while the Italian Society for the History of Science organises conferences, seminars, lectures, exhibitions and the publication of specialist works to promote research in various fields.

Science and Technology Studies (STS) in general, and studies on the Public Communication of Science and Technology (PCST) in particular, emerge from the convergence of a variety of disciplines and cultural fields.

The Unione Giornalisti Scientifici Italiani (UGIS), the first association of Italian science journalists, was established in 1976 and was one of the promoters of the EUSJA (European Union of Science Journalists' Associations) founded by the presidents of the national associations of seven European countries.

In 2005, a group of Italian academics founded STS Italia—the Italian Society for Social Studies of Science and Technology—to build up an Italian network of researchers oriented towards science and technology and science communication studies, and creating opportunities for the exchange and sharing of research experiences, projects and research activities related to the social dimensions of techno-scientific phenomena.

Regarding scientific journalism, in 2009 the Ettore Majorana Foundation and Centre for Scientific Culture promoted the first course organised by the International School of Science Journalism, the 11th edition of which will be held in 2021. In March 2010, the association Science Writers in Italy (SWIM) was created in Milan and subsequently became associated with the World Federation of Science Journalists (WFSJ). In 2018, it launched the new European Federation for Science Journalism together with corresponding associations in France, Switzerland, the United Kingdom, Germany, the Netherlands and Russia.

Among the initiatives undertaken to promote and support scientific culture is the National Scientific Degree Plan, which has carried out numerous activities to improve the knowledge and perception of scientific disciplines in Italian schools, bringing students closer to the world of research. In 2010, various institutional bodies induced the Ministry of Education, Universities and Research to relaunch the Science Degree Project with the aim of establishing

best practices and experimenting with new activities that might further strengthen the relationship existing between scholastic institutions and universities, and also between universities and the professional world.

5. Changing attitudes towards science

On 6 April 2009, a magnitude 6.3 earthquake occurred in the Abruzzo region in central Italy, seriously damaging the city of L'Aquila and destroying some of the nearby villages. There were 309 fatalities. Six years later, the Court of Law at L'Aquila sentenced six experts of the National Major Risks Commission and Bernardo De Bernardinis, all of whom were members of a technical-scientific advisory board of the Italian Civil Protection department, to six years' imprisonment for criminal negligence resulting in multiple homicide. According to the prosecutors' allegations, in the days preceding the earthquake these scientists did not correctly inform the population about the seismic risk. Such an important event drew attention to the role of public communication in the scientific world. In fact, many scientists and the national and international media interpreted the sentence as a condemnation of Italian scientists for not having foreseen the earthquake. In fact the trial was based on the accusation of having provided the local population with 'inaccurate, incomplete and contradictory information'. The defendants were not challenged on account of their inability to predict the earthquake, but for having misinformed the public. The defendants were later acquitted in subsequent sets of proceedings.

This event and other issues involving the judicial system with science have contributed to the idea that in Italy a prevailing 'anti-scientist' attitude is present or, worse still, that a real 'war on science' is under way. Data on the public perception of science, however, would appear to disprove this prejudice.

An analysis of the scientific knowledge of Italians in recent years reveals significant changes. For example, the level of scientific knowledge is one of the most frequently cited indicators in debates on public attitudes towards the sciences through three questions: Is the Sun is a planet? Do antibiotics kill both viruses and bacteria? Are electrons smaller than atoms? Since 2007, the year of the first survey conducted by Observa Science in Society, an Italian Social Research Institute, the level of 'scientific literacy' of Italians has increased. In 2016, it reached a new peak. One third of the respondents answered all questions correctly, and only 13 per cent got them all wrong. In the latest round, 62.5 per cent of Italians know that the Sun is not a planet, while more than half of the population know the function of antibiotics and know that electrons are smaller than atoms.

As in previous years, the survey showed that scientific knowledge decreases in relation to age and increases with the level of education. The highest percentage of respondents unable to answer any of the questions were individuals over 60 years of age and those who have a low level of education. The number able answer all three questions exceeds 50 per cent among graduates.

The use of scientific and technological content in the media is also a relevant indicator of the relationship between science and the general public.

The data for 2017 show an increasing interest in scientific and technological programs or presentations in the press, on television and on the web. Over the last eight years the percentage who enjoy scientific and technological content on television or via the internet has grown by more than 20 points. This is now 58 per cent of the number of people who report reading news relating to science and technology in newspapers at least once a week. The sources of information deemed to be the most credible are public conferences held by researchers and magazines specialising in the divulgation of scientific news. These are judged positively by almost four out of five respondents. Television programs focusing on scientific and technological issues and websites and social media organised by research institutes are not far behind. The levels of reliability attributed to radio programs dedicated to scientific subjects, science pages in newspapers and blogs or the social media presentations of researchers are not quite so high but remain above 65 per cent.

The number of Italians who believe that science and technology change our lifestyle too quickly remains high (seven out of 10), and an equal proportion believe that only science can reveal to us the truth about humans and our place in nature. More than one in two citizens believe that in Italy the freedom of scientists is excessively restricted by religion. In Italy, above all, utilitarian expectations regarding 'relapses' in technological (and scientific) development drive the people's trust in scientific research. Young Italians seem to have great confidence in scientists and in the possibility that science may have a beneficial impact on everyday life. Italian citizens believe that thanks to science and technology there will be more opportunities for the next generation, a consistent result since the mid-1990s. However, this is consistent with all the major international surveys on public attitudes and opinion with respect to science and technology. For a long time, for example, the Eurobarometer recorded the confidence in science shown by Italians, establishing that it is in line with—if not higher than—the European average (European Commission, 2001, 2005). In public debate on science, some people express a hostile attitude towards science and those representing the scientific world. However, empirical studies show this is a minority view:

from 2011 at least 73 per cent of Italian citizens have recognised the benefits of science, and occasionally this proportion has risen to over 80 per cent (European Commission, 2014; Saracino, 2017).

In recent years, exposure of the Italian public to techno-scientific issues has increased. The number attending centres dedicated to the sciences, museums and scientific exhibitions, public participation in festivals or open meetings, and conferences held by scientists and public engagement initiatives has increased (Pellegrini, 2018). In fact, public speaking has been a traditional activity of scientists and researchers for over 25 years. The Italian initiative Settimana della Cultura Scientifica e Tecnologica, first held on the 18–23 May 1991, became the European Week for Scientific Culture in 1993, and in the period 1989–2005 there was a great increase in science events, festivals, conferences and in the publication of books.

Italy is also active in public engagement initiatives: an edition of the EuroScience Open Forum was organised in Turin in 2010, and the next edition is scheduled for Trieste in 2020 (although COVID has caused a suspension to registrations). The Genoa Science Festival, the largest European event dedicated to the sciences, is held in the region of Liguria, but many other initiatives have been organised in other parts of the country including Trento, Iglesias, Mantua (Food&Science Festival), Oristano, Agrigento, Palermo, Cagliari, Frascati, Turin, Naples, Trieste, Bologna, Bergamo, Perugia and Spoleto. Italy has had five European projects funded in relation to the organisation of the European Researchers' Night.

The increasingly important role of the internet in the dissemination of news has modified the science communication process (Trench, 2007) and the use of science news by the public. More importantly, and with respect to the purposes of this sub-section, we may note that transformations occurring in the practices of specialist communication are flanked by evident changes also in the field of the public communication of science. In particular, interactive digital media—the so-called Web 2.0—greatly widens the breadth of possibilities to communicate science at the popular level through blogs, videos, interactive infographics and podcasts. Many programs or publications in Italy exclusively dedicated to online scientific popularisation have flourished, including *Scientificast.it*, *Galileo* or *OggiScienza*.

The 'digital revolution' in science communication began with the advent of 'science blogs' in the early 2000s, when scientists began to set up web pages to inform the public about their work (Tola, 2010). Although their significance tended to be overrated, these resources acquired an excellent reputation for their capacity to communicate (Yo and Peters, 2016), and scientific and

popular science journals copied the blog process (Kouper, 2010; Trench, 2008) followed by the digital editions of Italian newspapers. This was an innovation of scientific journalism. In Italy, a differentiation between the content of hardcopy newspapers and their online versions has been a recent development. Multimedia products have given online newspapers new opportunities to communicate with and attract the public.

This profusion of online material has caused an information overload. While the internet represents an opportunity to support and improve scientific communication and contribute more effectively towards public discussion, participation and dialogue (Trench, 2007), it has also caused problems. The validity and reliability of the information available through the internet has been questioned and the terms 'fake news' and 'post-truth' may now refer to matters discussed and presented in the field of science communication. This is a challenge for scientific journalism, in Italy and internationally.

Nor is there a scarcity of private initiatives in the field of science communication. Psiquadro is a science communication company established in 2002 by scientists and science communicators working in the field of science communication since the 1990s. It contended with and filled a gap present in the national scenario, and soon acquired a solid international reputation[3] that allowed it to introduce important initiatives such as FameLab Italia or to participate in European projects for the organisation of the European Researchers' Night. Psiquadro has organised four editions of the Perugia Science Fest and other initiatives including Einstein's Island. Since 2003, it has developed a strong collaboration with important national research institutions and the Ministry of Education, Universities and Research.

6. University research and courses

If, as we have seen, an increasing number of 'popular science' books has been published since the 18th century (Turney, 2007), the development of large scientific and technological exhibitions and magazine articles aimed at satisfying the growing interest of the public (Raichvarg and Jacques, 1991) and research in the field of science communication have occurred only over the last 50 years (Gascoigne et al., 2010; Trench and Bucchi, 2015). Scientific communication has become a dynamic and interdisciplinary field of research that draws on a wide range of disciplines and includes a wide spectrum of scientific approaches (Schiele, Claessens and Shi, 2012). Scholars in this

3 See EUSEA – European Science Events Association: eusea.info/.

field are typically trained in social science disciplines, such as sociology, communication studies, media studies or in related fields of humanistic disciplines, such as philosophy or rhetoric (Hornig Priest, 2007, 2010).

In the Italian academic world, science communication may be seen as a sector that still has to be developed. This is due to a series of historical reasons. One of these reasons is that in the past 'scientific culture' and the 'humanities' were kept separate from a prevailing idealistic culture. The reform of the scholastic system (1923) promoted by Giovanni Gentile and the influence of the thought of the philosopher Benedetto Croce privileged humanistic culture.

It was the philosopher Ludovico Geymonat who first introduced the academic discipline of philosophy of science in Italy at the University of Milan in 1956. This discipline had an important role in the development of the social studies of science. The work of Paolo Rossi, a science historian, is also an important milestone in the academic reflection on social studies of science, particularly his interest in the 'scientific revolution' of the 17th century. More specifically, he identified in this historical period the moment when a revolutionary change occurred in the manner of engaging in scientific activities. This was promoted by a series of factors, such as the new vision of nature, no longer divided between natural and 'artificial' bodies, the continental dimension—or world—of new scientific culture, autonomy from religious thought, the publication and dissemination of results and, above all, the formation of an independent international scientific community.

In the wake of these early works, a multidisciplinary and heterogeneous group of science communication scholars was established, including sociologists specialising in scientific knowledge, historians of technology and philosophers of science.

In 1993, a professional course in science communication was created at the International School for Advanced Studies (Scuola Internazionale Superiore di Studi Avanzati, SISSA) in Trieste. The course, initially a series of seminars for journalists, was referred to as a master's-level degree course in science communication from 1994 onwards, when the master's degree (ISCED – 5A) as such did not exist in Italy.

Another postgraduate course in science communication (Journalism and Institutional Communication of Science) was introduced at the University of Ferrara in the academic year 2000/01. Recently, other postgraduate courses in this field of study have been held at the Milano-Bicocca University, the University of Padua, at the Sapienza University of Rome and, since the beginning of the 2018/19 academic year, at the University of Trento.

Only a few undergraduate courses in science communication are currently available. These include a course on sociology and science communication at the Milano-Bicocca University, a course held at the University of Insubria as part of the syllabus leading to the science of communication degree at the University of Turin (mathematics degree syllabus) and Teaching and Understanding Science, which is part of the degree course in educational sciences at the University of Parma. The fact that only a few courses are currently available may be attributed to two factors in particular: a) research activity relating to science communication is a very recent development in the whole of Europe; and b) in Italy, media scholars and social scientists show little interest in science communication.

In Europe, it was only in 1992 that the scholarly journal *Public Understanding of Science* was founded. In 1994, the oldest peer-reviewed journal in this field, *Knowledge: Creation, Diffusion, Utilisation*, changed its name to *Science Communication*. It was not until 2002 that the first Italian scholarly journal in the field of science communication was published: the *Journal of Science Communication* (*JCOM*), edited by the SISSA in Trieste. At the moment *JCOM* is the only peer-reviewed journal published in Italy specifically dedicated to science communication. This open-access journal was founded when a group of lecturers and former students who had been awarded the master's-level degree in science communication concluded that training should include a commitment to research on science communication issues. For the first time in Italy the favourable educational environment of the master's-level degree course promoted the awareness that the community of professionals—not only academics—and sociologists in particular should identify more specific and systematic analytical instruments in order to comprehend the role and functions of communication in the science–society relationship. The insight and the proposals of the science journalist Pietro Greco were recognised and granted the necessary institutional support at the SISSA (Pitrelli, 2009). Another journal focusing on the relationships between science, technology and society is *Tecnoscienza – Italian Journal of Science & Technology Studies*.[4] It is an open-access journal for academic discussions of religious, gender-based, environmental, ethical and political topics about science and society.

The early years of the 21st century have been a particularly prosperous period for research activities in science communication. In 2002, the first National Conference in Science Communication was held in Forlì, and three years later a group of social scientists gathered at the Observa – Science in Society

4 The journal is available at www.tecnoscienza.net/index.php/tsj/index.

institute, a non-profit, independent, legally recognised research centre that promotes the study and discussion of the interaction of science, technology and society, with a view to stimulating dialogue among researchers, policymakers and citizens. Based in Vicenza, in the North East of Italy, it has published annually since 2005 the *Science Technology and Society Yearbook*, which probably represents the most complete and updated source of data and information on the relationship between the Italian public, science and technology (Pellegrini and Rubin, 2020). This is the most authoritative reference for those who aim at reconstructing the position of Italy on the relationships between public opinion and the principal technical and scientific issues within the national public debate, the image and reputation of science and its producers, and media coverage of the most topical scientific issues. The activities of the Observa research centre are supervised by an international and interdisciplinary scientific committee. Its activities focus on three main areas: science communication, research and innovation policies and science, citizens and technology. Observa was founded because in Italy, unlike other European countries, there were no research centres that dealt with the relationship between science and society and, in particular, the role of science communication.

In 2012, collaborating with the PCST International Network, the Giannino Bassetti Foundation, the Galileo Museum in Florence and the National Institute for Astrophysics (INAF), Observa organised for the first time in Italy the 12th International Public Communication of Science and Technology Conference. The conference attracted 700 registered participants from 50 countries. A total of 368 papers were presented together with over 450 presentations of various kinds.

Through the National Agency for the Evaluation of Universities and Research Institutes (ANVUR), in 2004 the Italian universities introduced a program involving the analysis and assessment of activities of a social, educational and cultural nature that produce public assets not directly linked to the initiation of innovative processes by enterprises. Many of these activities relate to the public communication of science and are commonly referred to as 'third mission' activities of the universities. This process has been adopted by universities across Europe and the Observatory of European Universities (OEU) was called upon to study the various activities of universities, drawing attention to their relations with enterprises, government authorities and society with a view to measuring not only economic effects but also the impact on public policies and on cultural and social life. The OEU examines four economic dimensions and four social dimensions.

In 2006, the University of Turin established the Agorà Scienza Inter-University Centre, and by 2009 all of the universities in the Piedmont region were participating. The centre facilitates the dissemination of science, contributing towards the dissemination of scientific reasoning and knowledge among citizens (cf. 'scientific literacy') with a special focus on schools and, in a symmetrical manner, making university researchers aware of their responsibilities towards society. In other words, Agorà Scienza undertakes the task of promoting public engagement as an objective of the third mission assigned to universities.

7. Latest developments and issues

Public engagement programs have been activated not only to inform but also to actively involve citizens and civil society organisations and develop a public debate that will allow for an appropriate orientation of choices regarding research policies. In this process, the media are mainly involved in expanding the communication offered through broadcasts, events, and television and internet programs. Italy is active in the promotion of scientific topics. For example, five projects have been established to implement the European Researchers' Night.

This process of the dissemination of knowledge and the involvement of the public occurs parallel to a considerable effort made by European universities to meet their third mission obligations for 'the generation, use, application and exploitation of knowledge and other university functions outside academic environments' (Molas-Gallart et al., 2002). This function aims to broaden the spectrum of intervention by universities, alongside the two main research and teaching missions.

The Italian government has recently financed activities in all fields including the promotion of public science communication initiatives, and above all for the dissemination of the results of scientific activities, through the Research Projects of National Interest (PRIN) fund.

Through the National Agency for the Evaluation of Universities and Research Institutes (ANVUR) the Italian government has also established a program for the study of third mission activities dating back to 2004, including the communication of science, with the introduction of a particular monitoring and evaluation method. This institutional process involves the use of an assessment program managed by the ANVUR relating to the period 2004–2010. The aim

of this system is to test result indicators and determine a form of stabilisation in view of a periodic assessment that will be performed on an annual or biennial basis.

Over the years, the Ministry of Education, Universities and Research has promoted and developed the Week for Scientific Culture, which provided a model for the European Weeks for Scientific Culture, promoted in 1993 by the European Economic Community (EEC) as an initiative of the European Commissioner for Research, Antonio Ruberti. Numerous public and private entities organise events for the public, offering encouragement and support and coordination at the local and regional levels.

Despite this effort to focus on research communication activities, incentives for scientists in research institutes and universities to communicate their work are rather poor. In the Italian case, but also in many European countries, career advancement is linked to intellectual production and, to a lesser extent, to the quality of teaching offered to students and public communication activities. Currently there are no incentives and no economic or disciplinary mechanisms to reward third mission activities. Preparing public conferences, holding workshops to involve the recipients of experimentation and activating dialogue and discussion with secondary school students to gather opinions on technological innovations are not considered initiatives for which economic support and/or credits may be obtained. These activities cannot be used to achieve an advancement in the ranking of a university or in the national research setting (Pellegrini, 2016).

8. Conclusions

Italian scientists have always enjoyed broad public visibility. In certain periods Italy was a pioneering state in the field of science communication, but these were followed by darker moments. However, in recent years numerous activities, organisations and initiatives in the field of science communication have allowed Italy to make up for lost time and attain the level of other European countries. There is no lack of excellence.

Scientists, institutions, associations and citizens nowadays have to employ new methods of communication. These affect not only content but often involve the use of new instruments, making it possible to produce and adopt scientific information in ways never before imagined. The capacity to manage such great potential and the resulting complexity currently represents the principal challenge to the development of effective and inclusive public science communication.

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Timeline

Event	Name	Date	Comment
First interactive science centre established.	Città della Scienza (Napoli)	1996	Many science museums have opened, including 4 science centres designed for children and teenagers
First national (or large regional) science festival.	Festival della Scienza di Genova	2003	
An association of science writers or journalists or communicators established.	Unione Giornalisti Scientifici Italiani (UGIS)	1966	2010: Science Writers in Italy (SWIM) founded by freelance journalist and communicators 2011: SWIM joins World Federation of Science Journalists (WFSJ)

Event	Name	Date	Comment
First university courses to train science communicators.	Lectures on science communication	1990	There are no degree courses on public communication of science, just lectures
First master's students in science communication graduate.	Master in Comunicazione della Scienza 'Franco Prattico' SISSA Trieste	1993	The first course dedicated to the public communication of science
First PhD students in science communication graduate.	Bicocca-Milano University offered a PhD in science and society	2007	The PhD course was not re-activated after a few years
First national conference in science communication.	National Conference on Science Communication	2002	The conference in Forlì was organised by the SISSA group
National government program to support science communication established.	Law No. 113 on Dissemination of scientific culture	1991	To support and strengthen dissemination of scientific culture and contribute to the protection of the technical-scientific heritage of historical interest preserved in our country
First significant initiative or report on science communication.	European Open Science Forum in Italy, Turin	2010	For the second time in Italy, ESOF will be hosted in Trieste in 2021
National Science Week founded.	National Science Week established	1991	Known as Settimana della cultura scientifica
A journal completely or substantially devoted to science communication established.	*Le Scienze*	1968	*Le Scienze* is the Italian edition of *Scientific American*. Felice Ippolito, created this in 1968, and is still a widely read weekly magazine
First significant radio programs on science.	*Radio3 Scienza*	2003	
First significant TV programs on science.	*Piccola enciclopedia scientifica*	1954	1981: The longest running program is *Quark*. Spin-offs include *Il mondo di Quark* and *Superquark*
First awards for scientists or journalists or others for science communication.	Premio letterario Galileo per la divulgazione scientifica (Galileo Award)	2007	2013: Premio Nazionale di Divulgazione Scientifica [National Science Popularisation Award] was established in 2013
Date hosted a PCST conference.		2012	Florence hosted the 12th PCST Conference

Event	Name	Date	Comment
Other significant events.	European Researchers Night (ERN)	2009	Italy has participated with a high number of projects since ERN started
	Scienza in Parlamento [Science in Parliament]	2019	An independent initiative of a group of researchers, scientists and journalists aiming to put science and technology at the service of democracy
	Patto trasversale per la scienza [Cross-cutting pact for science]	2019	Aims to ensure legislation is based on scientific evidence, to promote the culture of science and to fight hoaxes and pseudoscience

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