Strategies to promote science communication: organisation and evaluation of a workshop to improve the communication between Portuguese researchers, the media and the public

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Abstract

As western societies become increasingly dependent on scientific and technological developments, the full exercise of citizenship requires the ability to understand those developments. Scientists should be able to make this progress meaningful to different communities and to discuss its implications. However, science communication is still not part of the formal education of researchers. We organized a pioneering workshop in Portugal, *Comunicar Ciência* ('Comunicating Science'), at the Gulbenkian Institute of Science (10-12 September 2003). In this workshop, 17 Portuguese scientists, from PhD students to heads of research institutes, experienced a plethora of practical exercises organised by journalists and science communication experts from Portugal and the UK. Summary and follow-up evaluations show that scientists feel more confident in their communication skills and ability to participate in activities after the workshop. This work suggests that when targeting the right people, a small, low budget activity, such as this science communication workshop, can improve the participation of scientists in science communication activities.

Keywords: science communication; workshop; communication skills; media; public engagement

1. Introduction

Portugal is lagging behind in Europe regarding scientific development and public knowledge and appreciation of Science and Technology (S&T). Portugal has been described as a country with low knowledge levels in *Eurobarometer 55.2* (Miller *et*

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al., 2002b), a survey carried out by the European Union (EU). In this study, Portuguese citizens gave the lowest average of correct answers in science-related questions in the EU. Portugal is the fourth to last country in the EU regarding claimed interest in S&T. Less than 23 percent of Portuguese people go to museums, libraries or art galleries in one year (Research-EU, 2001). Esteem for doctors and scientists is also below the European average. Additionally, in an analysis of the publics of science in Portugal, Firmino and collaborators (2002) have found that more than two thirds of the Portuguese have a distant relationship with science, having developed very few strategies for acquiring scientific information (Firmino, 2002).

While formal education, the media, and science-related centres (e.g. museums) play an important role in disseminating S&T, it is becoming more accepted that the scientific community has a duty to keep society informed of their work, to discuss the implications of such work and to play a role in making scientific knowledge and technologies meaningful to everyday lives of many different communities. A two-way dialogue between the scientific community and lay audiences should empower the economy and democracy of the Portuguese society and have important consequences on the future of its S&T.

1.1. Scientists and lay audiences: a complex relationship?

In the last 20 years, the importance of communication between scientists and lay audiences, as a way to development, has been widely advocated in several places, starting in western countries and more recently in less developed countries. In the UK, in 1985, The Royal Society produced the 'Bodmer Report' (Bodmer, 1985) which identified the positive consequences of having citizens who are more informed about science and stated that 'our most direct and urgent message must be to the scientists themselves: learn to communicate with the public, be willing to do so and consider it your duty to do so' (Bodmer, 1985:36). However at this time, and during the following years, scientists frequently followed a top-down view of *Public Understanding of Science* (PUS), also called the 'deficit model' approach. A common view was that knowledge and expertise were located mostly with scientists and that more knowledge would bring more appreciation of science by the public (Gregory and Miller, 1998). This model of communication ignored several facts that are now often found in the discourse of science communicators. It ignored the existence of different publics, and that these different publics may have different interests and perceive things differently (Firmino, 2002; OST, 2000). Secondly, it ignored that knowing facts is often of little help to citizens who are trying to understand contemporary issues in science (Gregory & Miller, 1998). Finally, it ignored that the public should have a say about science and its issues (Firmino, 2002).

Studies from different countries have indicated that knowledge and approval of science may not be that naively linked, that more knowledge may not be unequivocally associated with better appraisal of science (Ávila, 2002; Firmino, 2002; Thomas,

1997; Wynne, 2001) and criticised the one-way, 'deficit model' of communication (Millar & Wynne, 1988; Miller, 2001; Thomas, 1997). In the UK, despite an increase in number of PUS activities following the Bodmer Report, the level of 'scientific literacy'[1] changed little when comparing a survey performed in 1988 with its follow-up in 1996 (Miller, 2001). The relationship between researchers and lay audiences needed new formulae.

In the UK, in the year 2000, the report from the House of Lords Select Committee on Science and Technology – *Science and Society* – rejected the 'deficit model' and suggested a new model of communication with less emphasis on contents, more importance given to public engagement in science and proper dialogue between scientists and the public: '…the crisis of trust has produced a new mood for dialogue. In addition to seeking to improve public understanding of their work, scientists are beginning to understand its impact on society and on public opinion.' (Select Committee on S&T, 2000: 2). The acronym PUS is now often substituted by PEST (*Public Engagement with Science and Technology*). Dialogue plays an important role in this new approach of the relationship between science and society.

1.2. Promoting communication between scientists and lay audiences

An approach followed by governments to promote communication between scientists and lay audiences is to make communication an integral part of research grants, since frequently scientists depend on grants from government bodies to finance their research. In the UK, the Office of Science and Technology (OST) Committee proposed to the Research Councils that grants should declare how researchers will communicate their work and its implications to the public; that reports on the work should explain how science was communicated to the public; and that success in promoting science awareness should be taken into account in assessing subsequent grant applications. The European Union has also given attention to the communication between scientists and lay audiences: in the *Science and Society Action Plan,* the European Commission claims that researchers, research organizations and industry have a particular responsibility *vis-à-vis* society in terms of providing scientific and technological information to Europe's citizens. (European Commission, 2001). In the Report from the Expert group on Benchmarking the Promotion of Research Technology and Development (RTD) culture and PUS (Miller et al., 2002b), the European Commission recommended that the scientific community should recognise its responsibility for the improvement of basic science education, promote a culture of transparency and communicate their results to the public. The European Commission

[1] The concept of 'scientific literacy' is difficult to define. According to Jon D. Miller, the scientific literacy that can be probed by survey techniques consists of knowledge of facts and concepts, understanding of the scientific process and awareness of the impact of science on society (Miller, 1998) That has been criticized by many authors who say that citizens need to understand science in the making, which surveys can hardly measure. However, surveys and questionnaires are well-established techniques for difficult measurings, such as public attitudes to a range of subjects and issues (Miller *et al.*, 2002b).

suggested the enforcement of those recommendations by initiatives, such as financing programmes and awards aimed at promoting RTD (Research Technology and Development) culture and PUS (Miller et al., 2002b).

1.3. Scientists should be trained in communication skills

While in the 19th century there were great scientist popularisers, in the 20th century, with growing specialisation and complexity in science, there was an increase in intermediaries in science communication such as journalists, professional popularisers and press officers (Gregory & Miller, 1998). In recent years, the workloads of professional scientists have increased, particularly in the area of administration and teaching (in the case of university-based researchers). Scientists are trained to do research and to teach, to evaluate research, to present it and to discuss it with their peers. In many countries these are the only factors that play a part in the career advancement of individual scientists (Miller et al., 2002b). The professional training of scientists in the EU does not usually include how to deal with science in its public dimension (Miller et al., 2002b). While there are scientists willing and capable of participating in dialogue with the public (Welcome Trust, 2000), many researchers feel they need training (Pringle, 1997; Welcome Trust, 2000).

Scientists also need to be trained to communicate with the media. Scientists are generally fearful or suspicious of dealing with the media, especially if they have had little experience. They see journalists as inaccurate, not objective and antiscientific (Peters, 1995), and are particularly afraid of misrepresentation, inaccuracy, and loss of control (Gascoigne & Metcalfe, 1999; Gascoigne & Metcalfe, 1997). It is very common that journalists and scientists are not happy with the final product of that experience: journalists claim that scientists do not make an effort to explain science and scientists are unhappy with the oversimplification or overstatement treatment that their research is given (Gascoigne & Metcalfe, 1999; Gascoigne & Metcalfe, 1997). There are several barriers towards the popularisation of science in the mass media by the scientific community: first, the scientific community may penalize members who do so; secondly, this communication has very different norms from those governing scientific publication (Dunwoody, 1985). For example, while the publication in journalism is dictated by audiences, it is dictated by the peer review process in science (Dunwoody, 1985; Peters, 1995). As such, understanding a little bit of the 'other culture' may help build bridges between the two communities and reduce the anxiety and anger many scientists feel when it comes to talking with the media (Gascoigne & Metcalfe, 1999; Metcalfe, 1999).

The Report from the Expert group to the European Commission on Benchmarking the Promotion of RTD culture and PUS recommends that scientists should be given training in communication skills, taking into account the need for public dialogue, debate and inclusion in decision making (Miller et al., 2002b). Countries such as the

UK and Australia have training schemes and scientists who receive training report the experience to be useful (Gascoigne & Metcalfe, 1999; Miller et al., 2002b; Pringle, 1997). Gascoigne & Metcalfe (1999) report that training in media skills can help overcome the barriers between scientists and journalists. In the report of the OST Committee to Review the Contribution of Scientists and Engineers to the Public Understanding of Science, Engineering and Technology (OST, 1995) the Committee claims that it is important to equip professional scientists, engineers and research students to communicate an understanding and appreciation of their work to the general public, and to provide an institutional context which favours such activity. They suggest that Undergraduate and Post-graduate education in science and engineering should include a course in communication skills and that training should also be available for members of staff. This has since been recognised by many science funding programmes (Miller et al., 2002b; Pringle, 1997; UNESCO, 1999). Examples of other strategies that have been used by research councils and governments to motivate and help scientists to communicate with lay audiences are: brochures with guidelines to help in the organization and evaluation of events (COPUS, 1996; OST, 1996; Research Councils UK, 2002); guidelines to help in the contacts with the media (OST, 1996); media fellowships where scientists can spend some time as reporters, researchers, and production assistants in mass media organizations (see for example www.aaas.org); long courses, such as the Birkbeck Diploma in Science Communication, or the Imperial College and the Open University Master programmes in Science Communication in the UK. Meetings between scientists and journalists are another strategy.

Another approach is the use of workshops for media training (Metcalfe, 1999) or training in communicating with the public (BBSRC, 2003). Usually, workshops focus on only one aspect of those. That is the case of workshops organized by the Royal Society of London[2], British research councils, such as the BBSRC[3] (Biotechnology and Biological Sciences Research Council) and by other organisations and individuals[4] . An exception to that rule is clearly the European Science Communication Workshop, a workshop organized by ENSCOT (European Network of Science Communication Teachers; now called ENSCORT-European Network of Science Communication Researchers and Teachers) with the aims of 'equipping scientists to communicate effectively with different audiences in a variety of scenarios, taking into account the cultural and media differences throughout Europe' (Miller, 2003).

Science communication workshops are very attractive as they are generally not time-consuming; they can be very hands-on, they can cover a variety of different topics and skills, and they do not need to be very costly. Because of the above-mentioned

[2] See http://www.royalsoc.ac.uk/ and http://www.copus.org.uk/ for more info.

[3] See http://www.bbsrc.ac.uk/support/communicate/training/roadshow.html for more info.

[4] E.g. workshops organised by Toss Gascoigne and Jenny Metcalfe in Australia, South Africa and New Zealand (Metcalfe & Gascoigne, 1999).

properties a workshop makes it possible to have some of the best trainers (from different parts of the world). For the same reasons, it allows the participation of strongly motivated people, from different parts of the country, with different ages and different jobs, and some of them in highly qualified positions. It may thus result in an activity with high impact in the promotion of PEST.

1.4. Training scientists to communicate with lay audiences in Portugal

In comparison with other European countries, such as the UK, there is no major tradition of promotion of science communication in Portugal. The major agent for sponsoring the diffusion of science and technology was created in 1996 – *Ciência Viva* (www.cienciaviva.pt), a national initiative for promotion of scientific and technological culture (Miller *et al.*, 2002a). *Ciência Viva* has done a big effort in the past years to raise science awareness. This includes many activities to encourage the interaction between the scientific community and the public. In fact, a growing number of scientific institutions now independently encourage public awareness campaigns, have established strong links with the educational community, and uphold their own, local, science weeks (Miller *et al.*, 2002a). However, no large study has been performed in Portugal to evaluate attitudes and behaviour of Portuguese scientists towards science communication. A study involving a small group of researchers from different fields indicates that despite the increase in perception of the importance of science communication, many Portuguese scientists still do not view popularisation of science as part of their normal activities (Jesuíno and Diego, 2002). Additionally, to our knowledge, there has been, in the past, only a single science communication workshop for active researchers in Portugal and it dealt only with communication with the Press. Here we describe the organisation and evaluation of a workshop to train Portuguese scientists to communicate with all audiences: media and the public. We hope that this description may motivate other people to organise similar events.

Our aims with this workshop were to intervene, to promote change, to stimulate scientists to communicate and to give them the skills and motivation to do so. We also hoped that the discussion of activities during the workshop and the interaction between different people could lead to the generation of new activities, increasing the effect of the intervention. In order to organise this workshop it was important to define measurable targets to use as guidelines.

2. Method

2.1 Recruiting and selecting researchers to attend the workshop

As the workshop had many practical sessions we had to limit the number of participants to 17. E-mail and posters went out to all science departments, institutes and learned societies in Portugal. We asked people to reply, sending a *curriculum vitae* and a cover letter. We selected Portuguese researchers more likely to profit from it, and to

further pass on what they learn to other scientists. As such, we decided for *impact* through *diversity* – by choosing people from different areas of science and different parts of the country – and *effectiveness* – by choosing people that were targets of the media and/or public activities and people that already had a background of participating and/or organising science communication-related activities (or showed motivation to do so).

2.2. Defining the programme

What science communication skills should researchers acquire in this workshop?

Researchers should be able to dialogue with the public and to interact with the media, namely to prepare for an interview. In our opinion, researchers should also be pro-active, being able to use the media to communicate science and to promote events, and organising science communication activities for the public. Being pro-active with the media is all the more important in a country like Portugal where few Scientific Institutions have Press Offices and there is very little of a specialised press or broadcasting industry to translate science into the media. Taking into account other workshops and our own experience as researchers, we thought it would be important to provide training in the following skills:

• Researchers should *be able to write a Press Release (PR)*. As writing a press release is very similar to a small news story, this should also allow researchers to attempt *to write news for the Press*. Three trainers with experience of writing and reading press releases were involved in this session[5]. Participants were asked to write a PR about their work or a scientific topic of their interest (one page maximum) and send it in one week before the workshop. After an introductory session on how to write a PR, participants were asked to rewrite their submitted pieces in three groups with the help of one of the trainers. At the end the *lead* of each PR was read out loud to everyone and the best was selected, recreating the pressure of a newsroom.

• Researchers should also know *how to prepare a radio or TV interview* – this may also give them a hint on how to conduct an interview. Three trainers were involved in this section[6]. In a first session it was discussed how broadcasting works and how people have to encapsulate their message. In three groups, in different rooms, people were interviewed on camera, one by one. Interviews were replayed to the participants so that everyone could see and criticise themselves on screen. When possible, the interview process was repeated a second time.

[5] Ana Coutinho, a former neurobiology researcher, current science communications manager at the Instituto Gulbenkian de Ciência (IGC) and a student of the Open University MSc in Science Communication; Ana Correia Moutinho, an ex-plant biology researcher, and former freelance science journalist, currently doing research in science policy, who had taught in the previous Portuguese science communication workshop (focusing on the Press); and Claudia Magalhães, a qualified journalist, who at the time of the workshop was working for a communications agency dealing with Universities.

[6] Malcolm Love, a media producer in the UK who has taught on several media training workshops and is responsible for part of the Birkbeck Diploma in Science Communication in the UK; Ana Correia Moutinho and Helen Pilcher, a former neuroscience researcher with a Birkbeck science communication diploma that recently worked for Einstein TV and is now a news writer for the Nature website.

• Learn *how to chose and organise the information to put in a website* – since the web is considered a privileged form of communication, it is very easy and practical for people to popularise science via websites. Helen Pilcher discussed how to achieve a good science communication website.

• How to be *proactive with the media* and for more adventurous researchers *how to organise activities through the media* (e.g., make a small radio programme, write a news article for a newspaper or magazine). One trainer[7] organised a discussion focused on news values; establishing contacts with journalists, deadlines for events to pass on TV, organising press conferences, amongst others.

• It is also very important to learn *how to organise an event for the public* (this involves many important issues, such as evaluation). One trainer[8] conducted a discussion on the concept of engaging the public in science and gave examples of such activities. Participants were divided into four groups and challenged to think about and present an activity they would like to organise. This project proposal was then presented to a panel composed by Frank Burnet[9], Rosalia Vargas[10], Malcolm Love and Helen Pilcher, focusing on audiences, budgets and strategies. One project was selected as the 'winner'. Additionally, Rosalia Vargas and Frank Burnet discussed science communication in Portugal and in the UK.

• As scientists are very often exposed to the public they should be prepared to *answer questions from the public* – Ana Coutinho Godinho and Sofia Araújo conducted a brief discussion on the subject.

What contents should researchers learn in the workshop to make them more effective and proactive towards communicating science with lay audiences?

Several topics were discussed. That is the case of:

• Science vs. the Media

As discussed above, there are several barriers towards the popularisation of science in the mass media by the scientific community. Many authors advocate that a number of problems in the interaction between journalists and scientists come from cultural differences between the two professions and that understanding a little bit of the 'other culture' may help to reduce the anxiety and anger many scientists feel towards the media (Gascoigne & Metcalfe, 1999; Metcalfe, 1999). A discussion on the differences between the scientific and the journalist cultures was conducted by Ana Correia Moutinho, approaching topics such as the day-to-day life of a journalist and the pressures they are subject to.

• PUS vs PEST – understanding cases of failures and successes in science communication

Portugal has just recently started to make an investment in the communication of

[7] Elizabete Caramelo, a journalist and now Chief Press Officer for the President of the Portuguese Republic lead this discussion.

[8] Sofia Araújo, a developmental biology researcher holding the Birkbeck Diploma on science communication.

[9] Frank Burnet is professor of Science Communication at the University of the West of England and Co-Director of the Cheltenham Science Festival.

[10] Director of *Ciência Viva*.

science. One trainer[11] discussed the importance of science communication. Another trainer[12] discussed the historical context of science communication and the meanings of 'public understanding of science': we should learn from the history of science communication in other countries and avoid strategies that were shown to be less effective, such as the 'deficit', 'one-way' model of communication. Mónica Bettencourt-Dias also discussed public awareness of science in Portugal and the obstacles that scientists encounter when they want to communicate science. Sofia Araújo and Frank Burnett discussed examples of successful activities on the spirit of engaging people with science.

• Learn where to get information related to science communication

Documents and contacts can be very useful in planning communication strategies. These include communication guidelines, media contacts, statistics and documents that help in organisation and evaluation of events. It is important that researchers know where to get this information. The interpersonal contact during the workshop with other participants and trainers should increase the 'list of useful contacts' gained from the workshop and should raise ideas for possible collaborations. Additionally, at different stages, different trainers gave different information: list of contacts of journalists, websites with information relevant for organising science communication activities and guidelines for effective communication.

2.3. The schedule maximised the time for discussion and 'hands-on' activities

The length of the workshop was 3 days, considered the minimum amount of time to attain the desirable objectives and to maximise the chance of getting people to participate. Its structure was defined to maximise time for discussion and 'hands-on' activities (see Programme- Figure 1). The use of small groups in some activities should encourage discussion. Interaction between participants and between trainers and participants was promoted by sessions involving discussions, group work, lunches and coffee breaks in the cafeteria. At the end of the workshop there was a cocktail party aimed at promoting interaction between people interested in science communication in Portugal.

[11] João Caraça, professor in Intituto Superior de Gestão e Economia (Lisboa) and Head of the Gulbenkian Department of Science.

[12] Mónica Bettencourt-Dias, a researcher in Cell Biology in the University of Cambridge (UK) and student of the Birkbeck Diploma in Science Communication.

Figure 1 – Structure of the workshop. See text for details on trainers for each session.

1st day	2nd day	3rd day
Introduction	Being interviewed for radio and TV	Science communication in Portugal
Communicating science to wider audiences; Movements in science communication	Coffee Break	Communicating science to the public-how o engage people with science
Coffee Break	Interviews (hands-on exercise)	Coffee Break
Introduction to the media; media vs science		Presentation and discussion of students' projects
How to write a Press release	Lunch break	Lunch break
Lunch break	How to write for the web	How to answer questions from the public (discussion session)
Time to rewrite Press Releases (hands-on exercise)	Coffee Break	Final discussion and course evaluation
Press Release presentation and discussion	How to be proactive with the media	Coffee Break
Coffee Break	Preparation of projects (hands-on exercise)	Open seminar by Frank Burnet
Press Release presentation and discussion		Debate–science communication in Portugal
Communicating directly with the public		Reception

2.4 Evaluation of the workshop as a strategy to help promoting science communication in Portugal

Three components were evaluated during and after the workshop: the workshop as an activity, whether the aims set for the workshop had been achieved, and the impact of the workshop on its participants. Questionnaires for participants and trainers were used, which is a standard way of capturing evaluation data for most activities (Ayers, 1989; Research-Councils-UK, 2002). Additionally, on the last day of the workshop Mónica Bettencourt-Dias conducted a discussion to get feedback on the workshop.

An objective of the workshop was to cause changes in attitude and acquisition of skills. In order to access the achievement of those objectives there is the need to compare measurements before and after the activity. Different questionnaires were used: a questionnaire at the beginning of the workshop; a questionnaire at the end of the workshop (summary evaluation); a questionnaire three months after the workshop (follow-up evaluation); and questionnaires for trainers and organisers at the end of the workshop. Suggestions on questions, its appearance and limiting size were taken from (Bell, 1999) and (COPUS, 1996). Some of the questions were also inspired on questionnaires used by Jenny Metcalfe and Toss Gascoigne in their Media Training workshops for scientists (Metcalfe & Gascoigne, 1999). Three researchers and a social scientist piloted the questionnaires. Analysis of closed questions was done by quantification of the number of answers for each option. Open questions were analysed through content analysis. This was performed by reading the answers from all participants and going for key words as the core concepts to define categories for coding (Sapsford, 1999). After coding, each answer was assigned to a category and the total number of answers per category was scored. Questionnaires were anonymous. All participants answered the questionnaires. In the case of follow-up evaluation, most people answered by e-mail, while 3 responded by phone. This evaluation was not anonymous.

3. Results

3.1 Participants were at several different stages in their career and were from different areas of science

Forty people applied for the workshop; of those, seventeen were selected on the basis of a *curriculum vitae* and a cover letter according to the criteria defined above. Eleven people were from Lisbon (near to where the course took place), other participants were from different cities in the country. Different areas of science were represented, from biology to geology and computer science. There were 6 PhD students, 3 post-docs, 6 university professors/lecturers, the Head of a research institute, and the manager of the science communication programme of a research institute.

3.2 The majority of the participants had previous experience in communicating science to lay audiences but felt they needed to improve their communication skills

As is to be expected in a non-compulsory science communication workshop for scientists, all participants thought that scientists should make an effort to communicate their science to lay audiences. The conviction that the public and the media should know more about science contents and the research process was a strong motivation for all participants to make an effort to communicate science to lay audiences (Table 1). Motivating people to go into science, obtaining funding, or listening to lay audiences was not a strong motivation (Table 1). Most of the participants (10/17) had previous experience of organizing an activity for lay audiences. Seven participants pointed out that: 'there are no excuses not to organise activities' and that 'it is part of my duty'. Participants that had never organised an activity indicated time (2/7) and not knowing what activities they can organise (5/7), as the major reasons for not having done it.

Table 1 – At the beginning of the workshop researchers were asked what were their motivations to communicate science. They were asked to grade sentences on a scale of 1 (strongly disagree) – to 5 (strongly agree). Results are indicated as average plus or minus standard deviation.

Question	Answer
1. The public and the media should know more science contents	4.8±0.4
2. The public and the media should appreciate the research process	4.4±0.5
3. I want to motivate more people to go into science	3.4±1
4. My research may get more funding If I do so	3.3±1.4
5. I am interested in what lay audiences may think about my research	3.3±1.1
6. Lay audiences should be consulted where ethical decisions related to research have to be taken	3.3±1
7. Lay audiences should be consulted where decisions related to funding of research have to be taken	3.0±0.9

When probed with sentences qualifying journalists, most participants did not have very strong feelings, although the majority agreed with the claim that journalists may be sensationalists (12/17) and superficial in their approach (10/17). Although 11 said they would fear inaccuracy if interviewed by a journalist, the majority (15/17) would speak with the media about their work.

Only four (out of 16) of the participants thought scientists know how to communicate their work. The remainder were not sure or thought scientists did not know how to communicate with lay audiences. Most participants felt they would rate 'average' on communication skills – from writing PRs to organising activities. The fact that participants did not feel very confident in their communication skills may be one

of the reasons that brought them to this workshop. In fact, when asked what were the three top things they expected from this workshop all participants referred to the acquisition of communication skills. For example some participants said: 'being able to make the complex look simple'; 'how to speak with the media'; how to speak with the public'; 'how to explain my work' (Table 2).

Table 2 – At the beginning of the workshop participants were asked what were the three top things they expected from the workshop (max 1 short sentence each)

Category	Number of participants
Acquisition of communication skills	17
Learning Contents	
Discuss the Portuguese science communication situation	4
Understanding how the media works	4
Understanding the difference between communicating with children and adults	1
Learning how to motivate students to follow a career in science	1
Meeting People: interaction with other people interested in science communication; exchange contacts and experiences and discuss strategies	**6**

Question analysed through content analysis. After coding, each answer was assigned to a category and the total number of answers per category was scored. 17 participants answered this question.

3.3. A high point of the workshop was the organization and presentation of science communication projects by students

The workshop went according to plan (see Method). A high point of the workshop was the students' presentation of their science communication project proposals to the panel for evaluation (Helen Pilcher, Rosalia Vargas, Malcolm Love and Frank Burnet). Participants exposed the idea, the target audience, ways of looking for funding, marketing and evaluation, as indicated by Frank Burnet, in his presentation. All wanted to engage the public with science but with no particular emphasis on discussing issues such as ethics, funding or future directions of research. The four different projects were:

– 'Science in everyday objects' idea, proposing to have engaging pieces of science in everyday objects (e.g. butter and milk packages, cornflake packages);

– 'Ask the taxi driver', where pieces of science were written in a thought-provoking way outside taxis, so that taxi users would ask questions to taxi drivers;

– A 5-minute daily TV programme about 'science around us';

– A 'science on stage' project.

The first project won the fictitious contest.

3.4. Evaluation of the workshop by participants shows that the workshop was well balanced and useful

When asked 'If a colleague asked you for your opinion on this workshop what would you say?' all participants were positive and enthusiastic regarding the workshop. Most used the following adjectives to qualify the course: constructive (2 participants); successful (7); excellent (2); good trainers (4); very useful (6); interesting (4) and worth repeating (2). Some also gave clues on what was important for them about the workshop: learnt a lot (5); had fun (2); met people (1); and good practical exercises (2). Similar comments were also given in the discussion that took place at the end of the workshop. When participants were asked what they liked most about the workshop eleven participants referred to the structure of the workshop, having time for debate and the 'hands-on' type of approach (e.g. many referred to the session where they had to present an activity for the public). Many referred to the trainers and to learning new things (Table 3). When participants were asked what they gained with the workshop, the majority referred to an improvement in their communication skills, namely writing press releases and being interviewed (Table 4). Many participants referred also to the learning of contents, meeting people and getting new ideas for activities (Table 4). In general the participants found the workshop contents highly relevant and useful and that the presentation style of the trainers was enabling (Table 5). The majority thought that the structure of the workshop was well balanced although some would have preferred to have a longer and less intensive course with more time for the 'science and the public' session and 'hands-on' activities.

Table 3 – At the end of the workshop participants were asked what they liked/disliked most about the workshop

Question/category	Number participants
What did you like most about the workshop?	
The structure of the workshop (e.g. ' having time for debate	
and the 'hands-on' type of approach')	11
The interaction (e.g. 'with the trainers and the other participants')	6
The trainers (e.g. 'their competence and relaxed attitude')	8
Learning new things that will be useful	5
The originality of the workshop	1
What did you dislike most about the workshop	
Time management as sessions overrun	3
More time for the activities (related to radio and TV; communicating with the public; answering questions from the public)	9
Session on writing for the web (e.g. session too short; session not very informative)	5

Question analysed through content analysis. After coding, each answer was assigned to a cate-gory and the total number of answers per category was scored. 17 participants answered this question.

Table 4 – At the end of the workshop participants were asked what they gained from the workshop

Question/category	Number of participants
Skills	
Improvement in their communication skills, namely writing press releases and being interviewed	13
Learning contents	
Getting to know the Portuguese situation regarding science communication	2
Gained knowledge on how the media works	6
Learning a lot in the field of science communication	5
Meeting people	
Meeting people in Portugal with whom to collaborate	4
Meeting people involved in science communication, namely the journalists	4
Impact	
Getting new ideas for activities	4

Question analysed through content analysis. After coding, each answer was assigned to a category and the total number of answers per category was scored. 17 participants answered this question.

Table 5 – General evaluation of the course by participants. Results are indicated as average plus or minus standard deviation.

Question	Answer
Overall assessment of the course Please rate: 1 No use or relevance – 5 Highly useful and relevant	5±0.4
Course content, information and ideas presented Please rate 1 No use or relevance – 5 Highly useful and relevant	5±0.5
The presentation/facilitation style of the consultant(s) was Please rate 1 Not helpful/disenabling – 5 Helpful/enabling	5±0.5
The mix of information, presentation, discussion and activity was Please rate 1 Not balanced – 5 Well balanced	4±0.7
Logistics (time, accommodation, schedule, lunch…) Please rate 1 Very bad – 5 Very good	5±0.7

3.5. Trainers and organizers were impressed with the enthusiasm of participants

When asked what they had enjoyed most about the workshop, all trainers referred to the enthusiasm of participants and the interactiveness of the workshop: 'participants were eager to learn'; 'there was a warm atmosphere'; 'participants were very creative' and 'the atmosphere was informal and practical'. Two trainers claimed they had felt time pressure and suggested that more specific workshops with more time for each session should help.

3.6. Participants and trainers felt there was an improvement in communication skills

Most participants felt they had improved in their communication skills, such as writing and being interviewed (Table 6). In the follow-up evaluation (16 answered), when asked 'Did the workshop influence the way you communicate science to lay audiences?' fourteen stated that their communications skills had improved. Different aspects of communication skills were referred, such as: attention to details in presentations (4 gave this answer); attention to details in interviews and in writing (4; e.g. Press Releases); focusing on the essential (5); improved dealings with the media (3); and being proactive with the media (3). For example participants answered: 'I had one contact with the media and this time I was more careful – I have learnt that if I do not want to say something I don't'; 'Yes, I wrote a PR for my group' and 'Yes, I was more proactive with the media and in organising the message'. Two people said they had not had many opportunities: 'No, because the only contacts that I had so far was with students and I did it the same way I used to do before' and 'did not have many opportunities; I have only discussed my work with high school students and tried to make it simple.' In their comments regarding the achievements of participants all trainers reported that the students got very involved in their sessions. In their quantitative evaluation of students' skills all trainers reported an improvement in skills and confidence (see Table 7). However, according to trainers the initial skills in their specific activity were low (average answer is 2 in Table 7, question 2).

Table 6 – At the end of the workshop participants were asked to qualify their skill on a scale of 1 (skills became worse with the workshop) to 5 (improved skills with the workshop). Results are indicated as average plus or minus standard deviation.

Question	Answer
1. Writing a press release/news story	4.6±0.5
2. Preparing for an interview	4.3±0.5
3. Conducing yourself in an interview to achieve the best of it	4.4±0.5
4. Being proactive with the media/call their attention	4.2±0.6
5. Dealing with questions from the public	3.5±0.8
6. Organising activities for children and teenagers	3.8±0.8
7. Organising activities for adults	3.9±0.7

Table 7 – Trainers (10) were asked to evaluate the progress of the participants on a scale of 1 (very low/very bad) to 5 (very high/very good). Results are indicated as average plus or minus standard deviation. When comparing question 2 and 3 for each individual trainer, all trainers registered an improvement in skills.

Question	Answer
1. Students interest in the topic	4.5±0.7
2. Students initial skills	2.3±0.8
3. Students achieved skills	3.5±0.7
4. Student participation	4.7±0.6
5. Perceived gain of confidence in that skill	4±0.5

3.7. The majority of participants felt their attitude towards the media had changed

Most participants would speak to the media about their work, both at the beginning and end of the workshop. However the majority (13/17) thinks the workshop has changed their attitude towards the media. When asked why, they said: 'I have a better understanding of the conditions that journalists work with'; 'I can now appreciate the difficulties and stress that journalists are subject to; I think I will be better able to communicate with them'; 'More knowledge on how people work leads to more understanding and probably better interaction' and 'I have more respect for the work of journalists'. The participants that answered that the workshop did not change their attitude towards the media said that 'It confirmed existing ideas' or 'my attitude will be similar'; or 'I already had a good relationship with the media'. It is important to note that most participants, both at the beginning and at the end of the workshop, did not have strong feelings either against or for journalists.

3.8. In a follow-up evaluation most participants say they had been influenced by the workshop in the way they communicate to lay audiences

Evaluation of the impact of the workshop was done through the follow-up evaluation, performed three months after the workshop. 16 participants contributed to this evaluation. There are some interesting examples on how the workshop may have had an impact on the participants and, consequently, on science communication in Portugal. Most participants say they have been influenced in the way they communicate science to lay audiences, for example**:** 'Every time I communicate I am conscious I should improve the scientific culture of the public'; 'I have recently given a presentation and decided to make it less technical and more general and it was a success!'; 'I am more proactive-the list of media contacts was very useful' and 'I am more alert to the importance of creating new publics for science.' When asked 'Were you motivated to participate/organise a science communication activity for lay audiences?' 'Did the workshop help?' three participants said they were very motivated but had no time.

Other participants are thinking about taking three of the four projects presented in the workshop further. For example, five of the participants applied for a prize for innovation, from the local town council. The project they put forward was an 'engage with science' type of activity, adapted from the project 'science in everyday objects' that had won the fictitious contest. Another participant said 'Yes, I have written press releases for my group'. Two other participants and Ana Coutinho are organising an EMBL course for high school teachers. A participant who is responsible for the communication of science to lay audiences in a research institute said that the workshop was very inspiring and that she is developing the communication strategy for her institute using a lot of the ideas that were presented and discussed by the trainers. Another researcher contacted a trainer to improve a PR he had written about his research. The PR was sent out and he got a lot of publicity (was interviewed by several newspapers and TV channels). He said that if it hadn't been for the workshop he might have not sent a PR. Additionally he found that the workshop helped him in the interviews, as he had never been interviewed for TV before. He says that where he works people are not usually interested in communication but have started to ask him how to make their work reach the media. Meeting trainers and other participants was the most important outcome for him.

4. Discussion

4.1. Was the workshop successful in achieving its aims?

The workshop was developed with three major aims in mind: *developing skills, discussing science communication contents with a view to changing attitudes* and to *promote interaction between participants and trainers*. Interestingly, at the beginning of the workshop, all participants had referred to acquisition of skills as something they wanted to get from the workshop (Table 2). The majority of the participants did not think scientists know how to communicate to lay audiences and most of them rated themselves a 3 regarding their communication skills (on a scale ranging from 1 to 5). A large part of the workshop was taken up doing exercises for skill acquisition. Most of them thought their communication skills had improved by the end of the workshop, namely how to write a PR, being interviewed and being proactive with the media (Tables 4 and 6). All trainers felt participants' skills were initially low but had improved with the workshop (Table 7). For participants to become completely confident in those skills more time would have to be allocated for each exercise and most trainers and participants said they would have liked to have more time for exercises. Practice is no doubt an important factor regarding acquisition of skills. In that context it is interesting that the skill in which participants felt more confident after the workshop was writing a PR (Table 6), the exercise for which more time was allocated.

During the workshop three major topics were discussed with the view to providing tools and changing attitudes: *science vs. media; the importance of science communication*

(including PUS vs. PEST) and *where to get information related to science communication*. Most participants said both in the beginning and end of the workshop that they would speak with the media about their work. Still, some participants voiced negative opinions against journalists leading to strong arguments during the course. The questionnaires did not detect a significant change in opinions about journalists. This could be a problem of framing questions, of the small size of the sample, or alternatively the workshop may genuinely not have changed opinions about journalists. Previous workshops that detected a quantitative change in attitude did so in a bigger sample, in a study of 10 courses, looking at a total of 84 scientists (Metcalfe, 1999).

A significant difference between our workshop and those workshops is the participation of working journalists with no scientific training (Metcalfe & Gascoigne, 1999). In our workshop many of the journalists were trained as scientists. In fact, some of the participants suggested that in future it would be interesting to have more interaction between scientists and journalists. Even if the opinion of journalists may not have changed, the attitude towards them seems to have changed, with more understanding and respect: for a great proportion of participants in the workshop changed their attitude towards the media.

The major motivation to communicate, for most participants, was that lay audiences should know more about scientific contents and processes of science. Only a minority would agree to be interested in having feedback from audiences, either related to their research or to consultation regarding ethical decisions or funding of research (Table 1). This lack of interest in feedback from the public could be due to scientists believing that the general public is unable to grasp the workings and contents of science, due, partly, to its low level of schooling. Portuguese scientists know very little about the strategies that exist to enhance dialogue in a context where the public needs to know more (e.g., consensus conferences). Additionally, the traditional view of science communication in Portugal is the one of scientists as teachers- the one-way, communication model. The evaluation of the workshop gives us no indication as to a change in this form of communication. None of the projects presented by the participants involved dialogue and no one mentioned dialogue in the open questions or in the follow-up. Maybe there was little time dedicated to the discussion of activities involving dialogue. The morning after the discussion on 'science and the public', where consensus conferences were mentioned, a participant said 'I could not sleep all night thinking about those consensus conferences and citizens juries; that is for the countries of the North of Europe, where they are used to that; it would never work in Portugal'. There is very little tradition of participative democracy in Portugal; due to characteristics of the Portuguese electoral system, people have no idea who their MPs are. No doubt that developing participative type of strategies in Portugal will be a challenge. It will be interesting to develop forms of making these activities more attractive to researchers. Ana Coutinho is trying to develop participative strategies of communication at the

IGC, as described in the accompanying paper[13]. However, during this workshop people may have genuinely shifted from the initial scholastic perception of communicating science to the public, to a more 'engaged with science' mood. The four proposals, in some way, tried to promote engagement with science.

Measuring changes in attitudes is a challenge. To our knowledge, only Metcalfe (1999) has established strategies to evaluate that from the start in their science communication programmes/workshops. This type of evaluation is more common in health campaigns. Because of the little information available, it is difficult to compare our results with other workshops and say how successful *'Comunicar Ciência'* was in achieving its aims. In the future it will be important for us and others to develop better instruments of evaluation.

Another of the aims with the workshop was in providing contacts and promoting interaction. Many people referred to the list of media contacts provided with the workshop as very useful. Seven people refer to meeting people as an important outcome of the programme. Some of them think this was the most important outcome.

4.2. How can the workshop be improved?

In general participants and trainers liked the structure and logistics. However, according to them, it would be worth to have one more day dedicated to 'science and the public', with emphasis on new strategies to promote dialogue with the public[14] and to the communication of risk, and some more time dedicated to practical exercises on writing for the web. Participants should receive material before the workshop, namely instructions about the structure of a PR, as many have no idea of what a PR looks like. Additionally, it would be useful to give foreign trainers information about science communication in Portugal, in order to allow them to tailor their sessions to this population. Finally, it will be important to promote more interaction between journalists and scientists. As other people organise similar workshops it should become easier to better define realistic, measurable goals, and decide on what needs to be improved to achieve them.

4.3. Can this be a strategy to improve the participation of scientists in science communication in Portugal?

The workshop clearly improved the communication skills of participating scientists. Additionally, many participants replied that they are more proactive regarding communicating science, either with the media or in organising activities for the public.

[13] Ana Godinho Coutinho, Sofia Jorge Araújo and Mónica Bettencourt-Dias, Science communication in Portugal: an evaluation of the prospects for two-way, direct communication between scientists and the public

[14] It would be interesting to have members of the public in the workshop. For example there could be a member of the public in the project-evaluating panel.

Their attitude towards communicating seems to be one of engaging the public. It will be interesting to follow the path of these scientists and check whether the workshop really had a long-standing impact. We think that more workshops similar to this one could be part of a strategy to improve the participation of researchers in science communication and to improve the relationship between scientists and journalists. Hopefully, this should increase the number and quality of science communication activities, increase the number of researchers involved in them and improve the quality of science journalism.

Several factors may limit the attendance of scientists at these workshops, such as interest in the topic and availability. In fact, this group of participants was highly pro-communication[15] and does not seem to be a representative sample of the rest of the country[16]. It would be important to devise strategies to reach other scientists. It may be that with time and more researchers engaging in activities, others will understand the importance of communication. Alternatively, as it is happening in other countries such as the UK, funding bodies could have a more active attitude towards requiring researchers to have short training and to participate in science communication activities. Additionally, it will be important if different institutions organise this type of workshop to avoid people having to travel and spend days away from work and home. A workshop like this can be afforded by several institutions (6000 euros). Alternatively, some of the contents could be discussed through distance learning; in fact, some of the European Science Communication modules produced by ENSCOT can be used for distance learning (Miller, 2003). The 'hands-on' part would have to be done locally. To reach the remainder less interested scientists and help them in situations where they need to communicate with the public or media, brochures can be produced with guidelines for the organization and evaluation of events (COPUS, 1996; OST, 1996; Research Councils UK, 2002) and for contacts with the media (OST, 1996).

4.4. Strategies for the development of science communication in Portugal suggested by participants and trainers

In their evaluation, participants and trainers gave several suggestions for future activities, for example: more workshops like this one; more specific workshops, so that there is more time for each activity; meetings with scientists and journalists; universities should have science communication disciplines; research institutes should have more open days; more activities linking marketing, publicity and science; more activities to promote meeting of actors and scientists; prizes promoting science communication; guidelines, helping researchers to communicate their results; workshops about communication with scientists and how to prepare manuscripts; more

[15] We had selected them for that.

[16] Many refer that their colleagues are not interested in science communication. But general attitudes of researchers in Portugal towards science communication have not been measured so far.

on how to do website construction. Other suggestions included meetings with people interested in science communication in Portugal; workshops on communicating in situations of crisis; atypical meetings bringing together people from different cultural and professional backgrounds (artists/scientists; musicians/scientists; writers/scientists); public speaking /presentation skills workshop; media fellowship schemes; Theatre Comedy; more on communication between scientists and children/teenagers; meetings with the public similar to *café scientifique*; taking scientists to media places; role playing of press conferences and presentation of work to journalists; and teaching scientists how to interview and how to approach radio stations in case they want to do a small radio programme.

5. Conclusions and future perspectives

This work shows that, in line with the trend in the rest of Europe, there is a favourable environment to promote science communication in Portugal. There were several candidates applying for the workshop and all contacted institutions were extremely favourable regarding the organisation of the workshop. With some reservations regarding our sampling, this work has shown that researchers in Portugal need training in skills for communicating with lay audiences, and workshops like the one described here are a good strategy to address that problem. Additionally these workshops may motivate researchers to communicate science, hence promoting the start of new initiatives and recruitment of other researchers to these activities.

Through evaluation of the workshop we have found that a key to its success are the practical sessions and discussions. Sessions on writing press releases, being interviewed on camera, organizing and presenting a project of science communication are essential. If more time was available other sessions should be built in the workshop such as discussions with journalists, practical exercises on building web based resources, discussions on answering questions from the public and dealing with risk.

We hope that the structure of this workshop and what we have learnt from its evaluation may help other people in setting up science communication workshops for researchers. It will be important that different institutions will start to have their local initiatives with similar aims. Additionally, in order to reach other scientists, we have started to organise materials provided by trainers of this workshop in a small booklet that will help Portuguese researchers to communicate. Finally, we have acquired a domain (www.comunicar-ciencia.org) where we will be displaying more information, news and events on science communication in Portugal.

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