

CHAPTER 4

Can people really change their opinion about scientists?

Antonio Tintori

Large public outreach events such as the ones we organized are exciting ways to engage the public in interacting with scientists. These events are relatively easy to promote and share with a broad audience using internet tools and social media, as well as using “traditional” communication tools (i.e. advertisements on newspapers, radio spots, street posters etc.).

The general public seems increasingly interested in knowing about science, what it means and what are the consequences of recent scientific discoveries on their everyday life. But, while science holds an esteemed place among citizens and policy-makers,

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the stereotypes affecting the image of scientists persist. Although the skills and work of scientists are highly respected, that admiration does not seem to extend to other aspects of their lives. As we have seen in the previous chapters, the charming and charismatic scientist is not a common image in popular culture, and the entertainment industry often portrays scientists as unattractive, reclusive and socially inept individuals.

Image has a lot to do with how effective communication is in capturing the attention of the public. The more appealing the image, the more likely that people will listen to what is being said and shown. This is why the European Commission funds activities like the ones we implemented through specific programmes of action.

But did the implemented activities really help in changing the image of scientists to a more positive one? In order to answer this question we have to carry out an evaluation. Several reports from recent large outreach events (see for example Sardo and Grand 2014; Castell et al. 2014; Koolstra 2008) show that science communication events lead policy-makers, institutions and the general public to want to know more about what participants are gaining from these activities and about the overall impact of these efforts.

Therefore, there is an increasing interest in gaining insight in how science communication events attended by the public can be evaluated. In many cases, for example when the European Commission promotes and funds projects and events, the evaluation of the effects of the activities is mandatory. In addition, the evaluation may help event organizers to gain new ideas on how to adjust specific elements of the events, to make them more effective in the future.

Evaluation is the measurement of how relevant the implemented actions were in causing change. It serves the dual function

of providing a basis for improving the quality of future activities, and a tool to verify achievements against intended results. The more accurate and reliable the gathered information is, the more the evaluation will help to build a solid basis for improvement.

In our case, the informal nature of the event, the various types of activities and the little possibility of control over their implementation (implementation which relies on the capacities and creativity of the researchers) make traditional evaluation (i.e. posing questions to rate visitors' satisfaction and ask general information about event logistics) far from ideal to understand the true impact of these events. Measuring the complete impact of initiatives that involve multiple and different activities, all of which operate in mutually reinforcing ways, is more complex than taking a snapshot of a given activity's effectiveness. Only the whole initiative's different parts and the ways they interact may tell the whole story. Moreover, we aimed to change and measure a highly complex issue, that of stereotypes about scientists – a difficult task.

Nevertheless, a high-quality evaluation of impact that is made by professionals and carefully conducted and analysed may provide a basis to understand which aspects of science communication initiatives have worked (in our case in breaking down stereotypes about scientists and science), and for which audience.

4.1 Goals and Design of the Evaluation Study

Defining the goals and objectives of any event is essential in deciding how to measure its impact. If the event is part of a more general programme, its goals should be aligned with the ones of the general programme. Under the Marie Skłodowska-Curie Actions programme, the European Commission funds and supports the European Researchers' Night, whose aim is to bring

together the general public and the exciting world of research and innovation and to show that science is fun and accessible to everyone. The activities must increase awareness of research and innovation, with a view to support the public recognition of researchers, create an understanding of the impact of researchers' work on daily life and encourage young people to embark on scientific careers.

Though not explicitly mentioned, the suppression or reduction of stereotypes about scientists in the minds of members of the general public is a necessary action to take to make the interaction between scientists and the general public effective. Therefore, our aim to dislodge stereotypical images of scientists was well aligned to the European Commission's general objectives, and our project was funded.

Evaluation studies may pertain to various types of possible effects deriving from being exposed to specific activities. Many effects may be evaluated by an impact analysis technique, such as changes in knowledge, attitudes and/or behaviour. Our evaluation study was aimed at determining whether the following main goals were achieved: a) would visiting the event lead to a more positive image of science and scientists among attendees?; and b) how would the visitors experience and judge the event? Therefore, we focused our interest on the effects pertaining to the public image of science and scientists.

The evaluation assessment took place through interviews with visitors of the event; outside experts were entrusted with this task to ensure the impartiality of the results. The feedback was collected using semi-structured evaluation questionnaires consisting of 14 questions and delivered face-to-face by professional interviewers. Visitors were interviewed about their experiences at the event and about their attitudes regarding the public image of

science and scientists. The impact analysis activities involved the following three steps:

- 1) defining the questionnaire;
- 2) conducting the interviews;
- 3) analysing the results.

The interviews were held when attendees were leaving the location of the event, i.e. immediately after the event; this gave us the possibility to perform the evaluation in a more personal and qualitative manner.

The sections of the questionnaire were the following:

- a) socio-demographic profile of the visitors;
- b) event assessment;
- c) through which information channels used in the promotion of the event had the respondents learned about the event;
- d) perception of respondents about stereotypes that pertain to the life and work of researchers;
- e) reflections and suggestions for future initiatives.

Our “operational approach” in designing the impact assessment activities responded to two specific needs:

- the usability of the instrument: as the questionnaire was intended as a research instrument able to investigate the perceptions and the comments of very different respondents, its usability implied simplicity in its structure and in the language and rapidity in the submission and collection of answers;
- the wide range of topics to be treated: in order to provide a picture of attendees’ perceptions on science and

scientists and their recommendations for the improvement of future and similar events, the questionnaire was designed to contain sections on the profiles of respondents, their perceptions and comments and suggestions for future improvement.

Usability and complexity are not easy to integrate; our questionnaire was an attempt to respond to these two antithetic objectives. The integration of these objectives has resulted in a questionnaire which has proved to be easy to submit, quick to compile and rich in information. The questionnaire was a semi-structured one, to allow participants to give responses in their own words. It was designed in such a way that participants had freedom to express their views when answering the questions, without any influence or clues from the interviewers. Some questions were open-ended to allow the respondents to give either positive or negative answers. The interviews were carried out by experienced researchers, trained on the specific objectives of the survey, who could carry out a qualitative interview.

A key characteristic of every science communication event is their fleeting nature and at the same time the temporal “validity” of the change in attitudes (i.e. if it is permanent or not). Lasting effects of the event cannot be measured with our approach, but the methodology that guided our interviews provided the possibility of getting a good idea of how visitors perceived the event and its messages.

The survey included questions about whether respondents had been exposed to all or part of the activities, as well as questions on the public reputation of scientists in general, on the researchers’ work, on the effectiveness of the event and also about the attendees’ personal considerations inspired by our activities.

Additionally, participants' motivations for attending the event were also considered.

Asking about background characteristics such as age, sex and educational level provided us the possibility to determine whether visitors of the event could be compared with their peers in general and whether possible effects would differ between sub-groups defined on the basis of these background characteristics. We measured whether the experience had produced more effects on male or female visitors, and on younger or older ones, and we crossed the data with other variables such as education level.

As mentioned before, the survey was conducted at the moment when attendees left the location of the event. Using this method allowed us to receive feedback from a large number of participants. However, there were unavoidable problems of sampling bias, because only those who were willing to be interviewed and had time for it were included in the survey – for example, it was very difficult to gather feedback from people leaving the event late in the night. An electronic evaluation questionnaire delivered by means of a Computer-Assisted Web Interviewing (CAWI) system that attendees may fill out once at home may overcome this problem, but the validity of such an electronic evaluation is under question.

A total of 1,087 face-to-face interviews were conducted for *Light'13*. The event's assessment was therefore conducted on over 5 per cent of the audience (the 2013 edition of the event hosted about 20,000 visitors). Over 95 per cent of respondents filled up the full questionnaire; this high percentage is probably due to the survey's short length and the willingness of respondents to express their feelings about the experience they just had. The respondents profile plays a fundamental role in the impact assessment, as it provides – when crossed with other data – precious

information on the attitudes and expectations of specific groups of visitors in relation to the various implemented activities. The profiles revealed that 58 per cent of the respondents were female and 42 per cent were male; the majority of people interviewed were in the 21- to 30-years-old age group (25 per cent), which was followed by the less than 20-years-old age group (22 per cent of respondents).

The event started at 5.00 p.m. The first interview was completed at 6.18 p.m., when the first visitor left the location. It has been estimated that the average duration of a visit was 2h30 with a maximum visit duration of 4h49 among housewives and almost 3h among the more highly educated visitors.

4.2 Can People Change their Attitudes Towards Scientists?

An important section of the questionnaire was designed to acquire a clear understanding of the respondents' perceptions and points of view on a crucial issue: the image of science and scientists within the civil society. The importance of science and scientific knowledge is gradually increasing, and by consequence the importance of the scientists who give a direction to science and scientific activities is also increasing. Stakeholders, policy-makers, and researchers themselves strive for the general public to have positive images of scientists.

We know from the last Eurobarometer survey on science and technology that more than one fourth of Europeans consider scientists to be too focused on extremely complicated and specific scientific issues: scientists are seen as remote from society, unable to look at problems from a wider perspective and responsible for locking themselves up in ivory towers of knowledge; in addition,

more than half of Europeans think that scientific knowledge gives scientists an extremely dangerous power (Eurobarometer 2010). Therefore, the image of scientists is far from positive and stereotypes are present and strong. On the contrary, science has an indisputable high reputation among Europeans and the majority of respondents in the Eurobarometer survey are convinced that science and innovation can sort out every problem and make our lives better (Eurobarometer 2010). There is an evident gap between the image of science and that of scientists, who are the ones who make science possible. The main goal is therefore to stimulate people's minds to portray a new public image of scientists, closing the gaps between scientific research and the civil society.

We implemented the activities described in the previous chapters in order to improve the image of scientists, to make people change attitudes towards scientists and to make scientists feel closer and friendly. We will present the results of the 2013 event here. Since we started the experience in 2008, we also give comparisons with the previous years' surveys when appropriate.

Despite the fundamental role played by science in society, an extremely high percentage of interviewees (77 per cent) declared that scientists are shown scarcely any appreciation in our society. Respondents with a higher level of education are more aware of the lack of public recognition of scientists; they are without doubt better informed about technological and scientific developments and more sensitive to the need to improve the perception of the role of scientists in society at large.

Since 2008, our event has attracted an audience with a very high level of education: 76 per cent of the respondents have at least a university degree or a postgraduate one beyond a master's degree. It is to be noted that Italy is a country where a small

percentage of the population holds a university degree: the fact that the event attracted mainly graduates is a point of weakness of our action. A better-planned communication campaign, tailored to a wider audience, might have increased the participation of less educated people. However, because visitors to our events were a self-selected part of the general population, their attitudes may well be considered as being the most advanced ones. This aspect reinforces the conclusion that the widespread perception of the lack of public attention to scientists' societal role needs specific interventions from institutions and policy-makers. Public opinion is often only mobilized when research and new discoveries raise ethical questions; on the contrary, the public needs to be properly informed on the general work of scientists, so that it can make up its mind about the relevance of science and scientists, break down stereotypes and open up new lines of communication with the scientific community.

Our activities increased the general public's knowledge and understanding of the benefits of scientific research and the work of scientists. Around 80 per cent of respondents declared that their participation in the event contributed to them having a clearer view of what the work of researchers consists of. All our efforts to make the interaction between scientists and the general public easier and effective were thus rewarded. Scientists were able to overcome their institutional reticence and let their voices be heard beyond the restricted forum of scholars and colleagues.

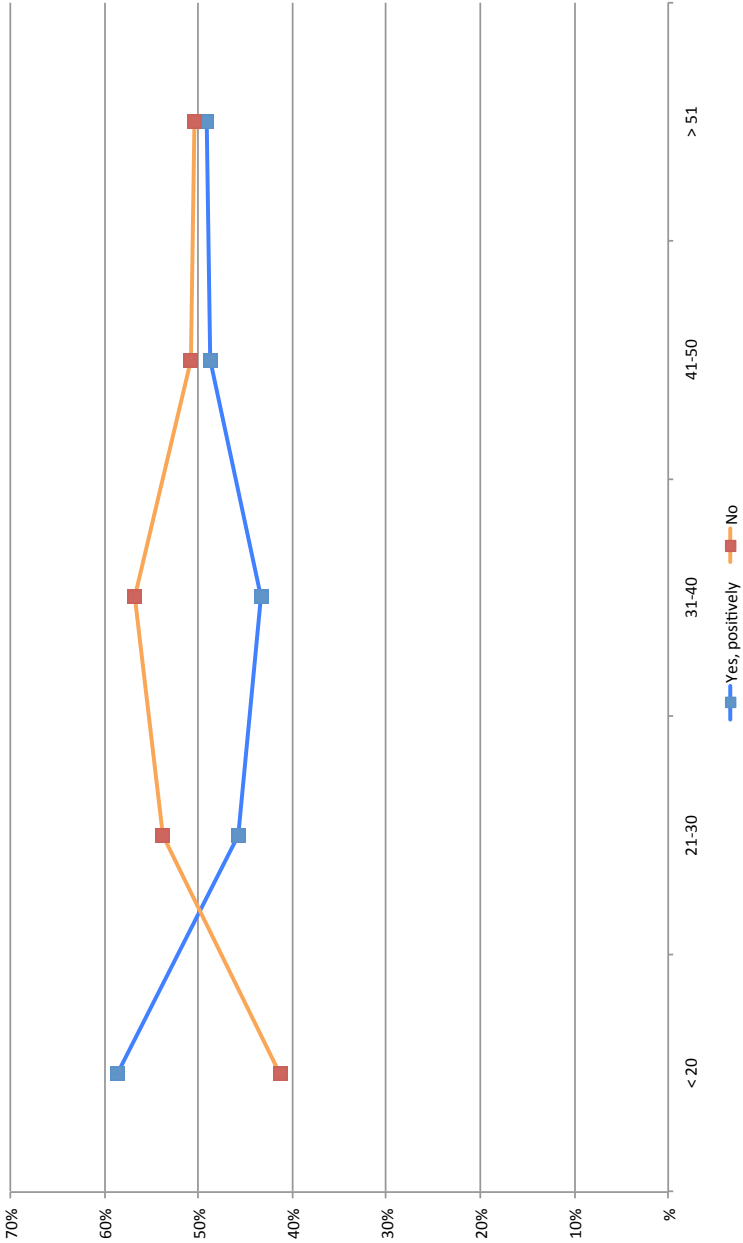
As observed by the science communicator Feliú-Mójer (2015), when scientists are able to communicate effectively beyond their peer groups to broader, non-scientist audiences, it builds support for science, promotes understanding of its wider relevance to society and encourages more informed decision-making at all levels, from government to communities to individuals. What we

achieved is well in line with the more general goals of the European Commission related to the need to create a bridge between civil society and the scientific research community. We offered scientists the possibility to improve their interactions with the public: we trained them on how to better communicate and we created an easy channel for interaction, and they were able to manage well.

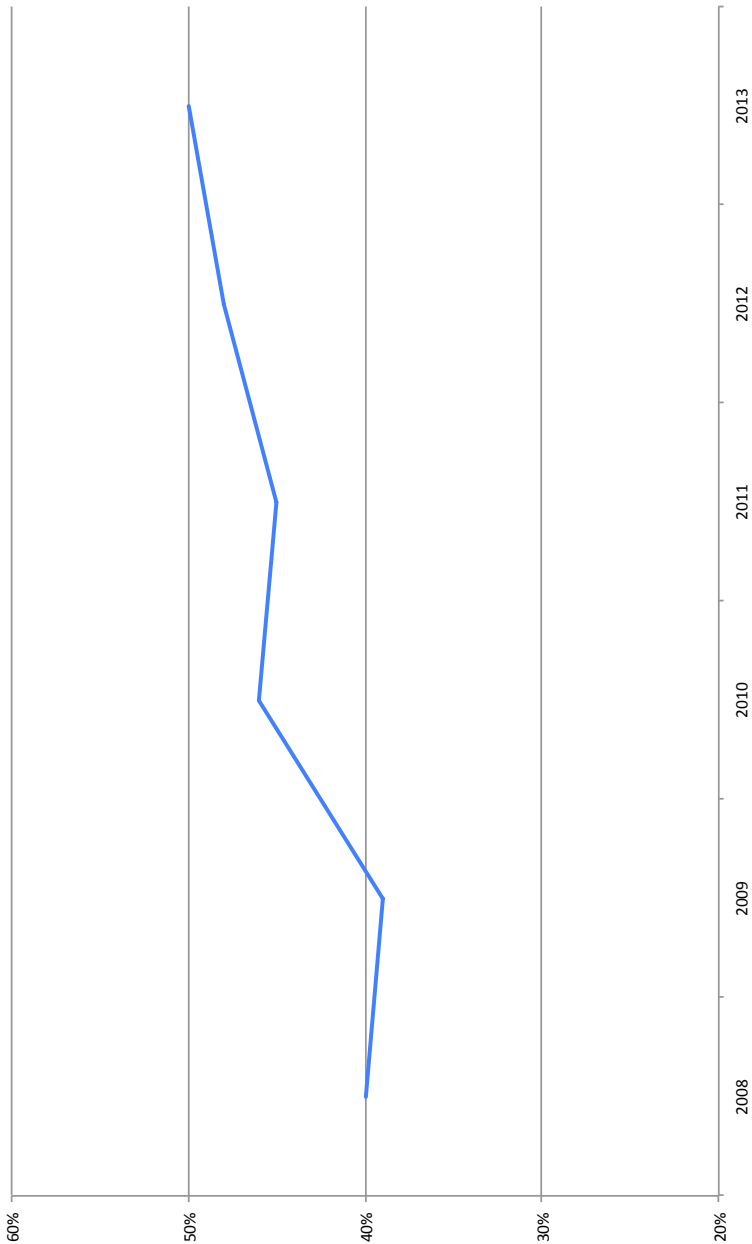
The crucial question to answer is: did we really change people's minds towards researchers? Half of the respondents declared that the event has contributed to change image they had of researchers in a positive manner. The positive change concerning the image of scientists is remarkable among teens and less evident among the 20- to 40-year-old age group, as shown in Graph 1; the former result is an important achievement and the latter calls for new actions aimed at changing the attitudes towards scientists of those aged between 20 and 40.

When we compare the 2013 results with the ones collected in the previous years, we find that what we have done has contributed in a remarkable way to change the image of scientists for an extremely relevant and increasing number of visitors. A statistical analysis of the historical trend of answers to this question allows us to check for changes in the stereotypical views of scientists held by laypeople. A six-year period was analysed: from 2008 to 2013. In this period the percentage of visitors who declare that our activity is a helpful and necessary tool in changing the public image of science and scientists grows steadily, as shown in Graph 2.

In recent years, attention towards scientific progress has increased, and this fact may have positively affected our data. However, in the same period we observed a clear persistence of stereotypes about science both from statistical data coming from national and European surveys and during meetings that we



Graph 1. Does the event help to change the image of researchers? (percentages of responses by age).



Graph 2. Does the event help to change the image of researchers positively? (percentage of “Yes, positively” answers, 2008–2013).

organized with students for the promotion of scientific careers (particularly STEM ones). This is why our activism in dismantling stereotypical images of scientists seems very timely, and hopefully efficient in producing change. Year after year, our research team was involved in breaking down stereotypes about scientists and science and improving the effectiveness of the actions aimed at achieving this goal. The trend illustrated in Graph 2 shows a positive step in this direction.

The growing number of visitors, all curious and enthusiastic about scientific discoveries, also testifies to the success of our initiative. We created the right atmosphere to facilitate the interaction between scientists and citizens, combining scientific complexity with entertainment. The impact of scientists' work on the everyday life of citizens was also highlighted.

One third of our respondents had already participated in the previous years' events from 2009 onwards: this shows a "loyalty" behaviour in this type of activities. In order to undo stereotypes about scientists, it is very important to not only attract first-time visitors, but also retain previous attendees over the years. In fact, people who have been repeatedly exposed to the event's messages said they had changed their ideas regarding science and the work of researchers significantly and positively (9 out of 10 of the respondents who visited the previous years' events reported this change). Again, this is an interesting result that demonstrates that it is possible to achieve a positive change in attitudes towards scientists.

It is very important to "set" the attitudinal change by repeatedly exposing the lay audience to activities aimed at breaking down the stereotypical image of scientists. While there is a clear reduction of stereotypes related to scientists among those who

participated many times in our activities, the event's visit duration is another variable that influences the effectiveness of the exposure. As already mentioned, it has been estimated that the average duration of the event visit was of 2h30'. From the survey, it emerged that the percentage of people who considered the event able to change the image of scientists was higher in the group who visited the event for more than the average time than in the group whose visit length was below the average (64 per cent of respondents in the former group, compared to 50 per cent in the latter).

In our events, we combined scientific experiments and demonstrations with entertainment. Scientists entertained the public by dancing, playing music and performing sports and arts. They showed they had hobbies that offered them a vital escape from the laborious life of their labs, and that they take their hobbies very seriously. It has been observed that the average scientist is not statistically more likely than a member of the general public to have an artistic or sport hobby, but that the more accomplished a scientist is, the more likely he or she is to have one. Root-Bernstein (2008) has calculated that Nobel Prize winning scientists are 2.85 times more likely than the average scientist to have an artistic or crafty hobby. A recent paper by Scheffer et al. (2015) suggests that artistic engagement develops talents that are necessary to be a more creative scientist.

It is very important to let scientists show their human and friendly face in order to change the image of scientists positively in non-scientists' minds. Generally, contacts between non-scientists and researchers take place in laboratories: citizens go to meet scientists in labs during special events or science festivals. Although visiting a research centre can be an enriching experience, this approach is cold and puts the audience in a listening position. It is

very different to see a well known physicist or biologist dancing, acting or playing musical instruments: it facilitates a more open interaction and engagement between science, scientists and the general public. The best quality of any scientist is their “humanity” applied in solving problems and achieving new results for the benefit of everyone. The communication of this humanity is what we were striving for.

As expected, visitors to our event appreciated in particular the scientific experiments area (61 per cent), while only 35 per cent preferred the scientists’ artistic and sport performances. This result is encouraging and goes exactly in the direction we wanted. It shows that the public is not motivated to come to our event purely for entertainment, but because it is an occasion where science and citizens meet, a place where the public and the researchers interact and have fun, a place where the experience is mainly about bilateral communication. This encounter between seemingly distant worlds generates a stimulating relationship and is full of new meanings for the visitors, who learn a new way to be and to do science.

Attending entertainment shows and scientists’ artistic and sports performances at the Globe Science Theatre – a relevant part of our format for breaking down the stereotypes about scientists – has proved to be an influential variable for changing the image of researchers. Although the public expressed a clear preference for the experimental-science area compared to the performances’ area, the stereotypes have been most questioned in the minds of attendees who went to both areas: interaction with researchers showing both the public and the private spheres of their lives helped to spread a new and more realistic idea of scientific work and of who scientists are in about 7 out of 10 visitors. Coming to

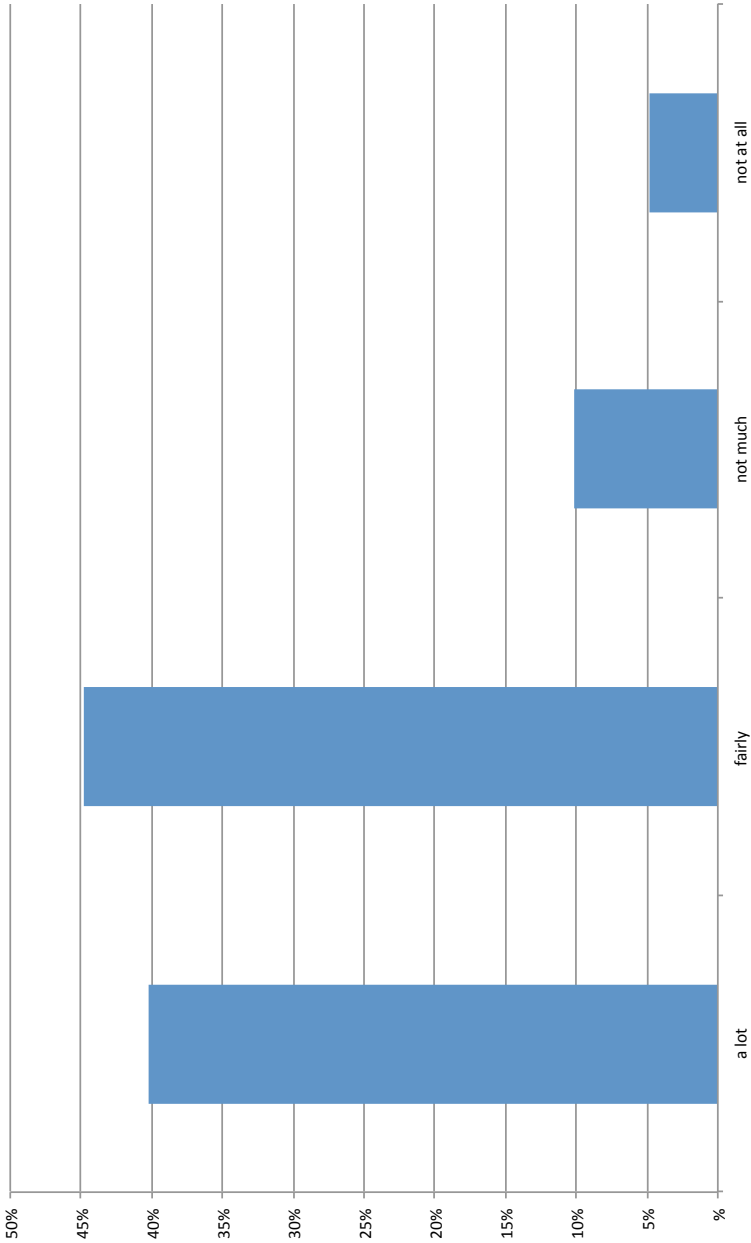
and participating in our activities more than once, visiting the event for more than two hours (the average time) and taking part in different experiences are all elements that have proved to be useful in changing the image of researchers positively.

Respondents were very positive towards the proposed format of the event. About 8 out of 10 respondents said they felt it was very appropriate to combine the figure of the researcher with an entertainment event; 40 per cent were even excited about this unusual format, as shown in Graph 3.

It is common sense that there is no simple relationship between knowledge of science and the acceptance or appreciation of science and scientists. Today's approaches in science communication are dialogue-oriented and focused on interaction, which is considered the greatest predictor of positive learning outcomes for attendees. We are convinced that what we did represented a successful mediating point to start a profitable dialogue between citizens and scientists and to create a more positive image of researchers and their work.

4.3 Assessing The Impact on Young People

In general, students love science, they study science at school, watch sci-fi and are usually attracted by discoveries. Young people choose scientific university courses, but few of them plan to pursue a scientific career. This is of course a very urgent issue, because the more science we do, the more scientists we will need. The lack of interest in scientific careers among young people is due to different reasons, but there is mainly a lack of awareness about the work of scientists. Our event was considered fundamental in convincing young people to embark on a scientific



Graph 3. Is it appropriate to combine the image of scientists with an entertainment event? (answers in percentages).

career by 43 per cent of respondents (and fairly important in doing so by 41 per cent).

Looking at the impact of the event on the less than 20-years-old age group, we note that a large majority of young respondents (78 per cent) stated that they changed their opinion about scientists in an extremely positive way, and over 51 per cent considered their participation in our activities crucial in attracting them towards a scientific career.

As observed by Csermely (2003), attracting young students to scientific research has become a topic of growing importance from the point of view of science and policy-makers. Many scientists, economists and politicians in Europe have been deploring the decreasing numbers of students choosing a career in the sciences and are becoming concerned about a potential lack of scientists and engineers, which could hamper the growth of high-tech industries and the process of social development (Csermely 2003).

The issue of making science and research attractive to young people has sparked many a debate about the future of research and research-related technologies. It has been estimated that Europe needed to attract and train between 600,000 and 700,000 new researchers by 2010 to meet its research needs – a number not yet reached. Last but not least, as science and technology have an increasing influence on individuals and societies, it is equally important for young people to better understand the problems and challenges they create.

We think that activities and events such as the ones we organized may really help make scientific careers attractive for young people. Building capacities and developing innovative ways of connecting science to society is a priority under the EU Framework Programme Horizon 2020. Occasions for younger generations to interact in a friendly way with scientists will help to make science

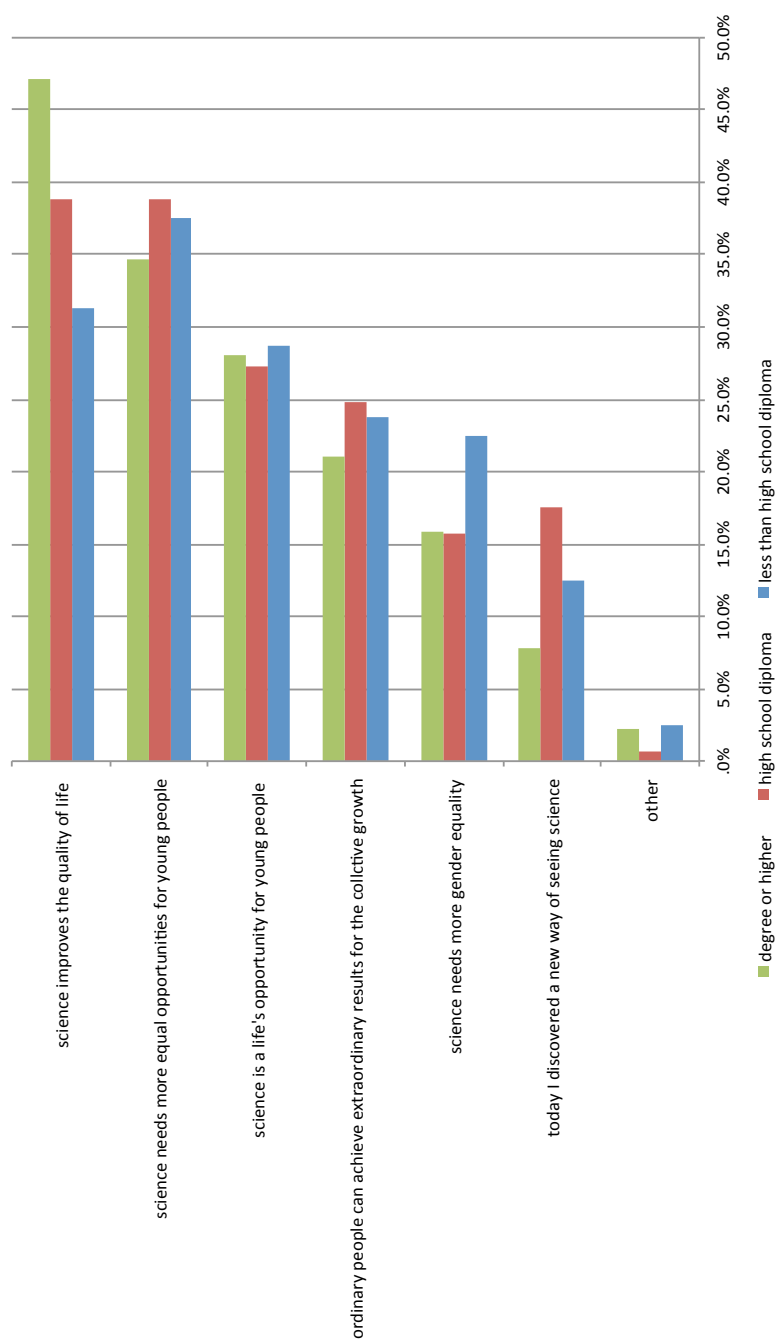
more attractive to young people, increase their appetite for innovation and open up further research and innovation activities.

4.4 Considerations on Science Inspired by our Activities

When respondents were asked to indicate what reflections their participation in the various activities inspired in themselves, they stated that the event showed that “Science improves quality of life” (28 per cent), that “Science needs more equal opportunities” (23 per cent), that “Science is a life opportunity for young people” (18 per cent) and that “Scientists are ordinary people who can achieve extraordinary results for the collective growth” (14 per cent), proving they had at least in part understood that research work is not only for geniuses, but also for those who are passionate and want to contribute through scientific research to the collective growth and well-being.

Even those who have a lower level of education showed they had a general awareness of the importance of research work for young people, as well as for the need for more equal opportunities, especially for girls, as shown in Graph 4.

Overall, a very positive judgement of the event emerges from the survey. In fact, 60 per cent of the respondents assessed the event as one of good quality and almost 19 per cent of the interviewees declared it to be excellent. In particular, visitors liked the interaction with researchers. This is a good result, as it is a clear indication that the possibility to interact in a friendly way with scientists is the most attractive factor of any science outreach activity. We have certainly achieved the objective of raising people’s interest and built an attractive space to which people would like to come back.



Graph 4. Life opportunity statements about science inspired by our activities (percentages by education).

The general public participating in scientific events may become more knowledgeable and diverse year after year. Our experience demonstrates that a good outreach event needs to be accessible to people from all walks of life, and should aim to make science attractive. This is the reason why we think that our activity is fully appropriate to give scientists and their work status and recognition and has certainly contributed to create a new and more positive image of scientists.

4.5 Lessons Learned and Improvements for the Future

The participation in events aiming to break down stereotypes about science and scientists can generate positive and lasting effects in the medium and long term. Specific actions can make the general public able to digest new information and can make the public start to assess science and scientists in a different way, and to identify more quickly the social impact and everyday-life benefits of scientific progress, and the importance of supporting scientific research and careers. It is likely that the impact of the learning increases in proportion to the duration and intensity of the stimulus or event. The duration of the interaction between researchers and citizens supports the effectiveness of the event and the learning of a new, non-stereotyped cultural form.

Our experience aimed to break down stereotypes about scientists. Therefore, it was essential that scientists abandon their white coats, metaphorically considered as a sign of authority and competency, and present themselves to the public with their passions and their artistic and sporting hobbies, which are part of their everyday life.

An effective science event oriented towards enhancing the image of science should excite audiences and promote gender equal

opportunities, community cohesion and cultural exchange, but also develop the scientific pride and the sense of identity of citizens who take part in a positive event for the cultural growth of the community. In this way, people could be stimulated to seek a greater understanding of all forms of science and culture, and to explore new cultural views.

Our survey did not include a follow-up sample. The follow-up is necessary to assess the temporal “reliability” of changes in stereotyping about scientists. We did not have the opportunity to include it due to lack of funding, but were lucky enough to have the possibility to repeat the event once a year for a period of six years. Therefore, on the one hand we had a periodic reinforcement of the positive messages about scientists, and on the other hand we had the possibility to check the change in attitudes towards scientists of those who participated to our activities more than once over time.

For the future, we are planning a “*Light on tour*” event to be held regularly in different cities. This would also certainly lead to a strengthening of the positive image of scientists through the virtuous circle it will create in the media. Being a demographer and a sociologist, our great aspiration is to improve our methodological approach to assess the effects of our activities over time by means of follow-up studies involving the same sample of attendees exposed to activities that aim to de-stereotype scientists. For the moment this remains an elusive goal. A more realistic improvement – though very difficult to implement in practice – may be to interview a sample of attendees both at the entrance and at the exit of the event in order to measure the effect of their exposure to our activities.

To conclude, the following recommendations may be of help when planning the evaluation of large public outreach events:

- understand the motivations and expectations of visitors;
- choose visitor-centred goals that reflect the free-choice nature of these events;
- use data collection tools that allow for easy deployment at a variety of locations.