Attitudes Towards Outreach within the Particle-Physics Research Community

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Abstract

This paper presents early results from research into the attitudes of the particle-physics community towards science communication (specifically, towards "public engagement" or "outreach"). To represent the population of particle-physics researchers, the sample chosen was the Compact Muon Solenoid (CMS) Collaboration, one of the four large collaborations performing research at the Large Hadron Collider located at CERN, the European laboratory for particle physics. Named after the Compact Muon Solenoid particle detector, the collaboration counts among its members over 4000 scientists and engineers from nearly 200 institutes representing more than 40 countries. The paper focuses on analysis of quantitative data, which were collected via an in-depth online survey distributed to the entire CMS Collaboration in early 2015. Over the data-collection period, 391 valid responses were recorded. The results shown here relate to two topics among many covered in the survey: (1) Concerning outreach activities, the majority of the respondents stated that they had participated in some form of outreach in the past. (2) When asked to classify potential audiences, colleagues were ranked as the most important, the most knowledgeable and the easiest to communicate with, when it comes to matters of their (the respondents') research topics.

The survey was part of the author's research towards a PhD in Science Communication.

1 Introduction

Much research into public engagement has involved studying fields of research with either a direct or an immediate impact on human life and society (e.g. climate change, genetically modified organisms, nuclear power), but the literature is lacking when it comes to fields such as particle physics that are less accessible or "every-day" to a lay public. For example, a recent Ipsos MORI project in the UK studying public attitudes to science presented the following research areas to participants to determine how well informed they were about these topics: *Climate change*, *Vaccination of people against diseases*, *Human rights*, *Renewable energy*, *The use of animals in research*, *The way the economy works*, *Medical ethics*, *Nuclear power*, *Research into human behaviour*, *Genetically modified plants (GM crops)*, *Ensuring the UK has enough food*, *Stem cells research*, *Clinical trials*, *Radioactive waste*,

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Nanotechnology, *Synthetic biology* (Ipsos MORI, 2011). Fields of fundamental research, such as number theory or cosmology, are conspicuous by their absence.

Anecdotally, the author has found that science-communication efforts within fundamental sciences are criticised for being "deficit-style" approaches, or ones that seek to educate – rather than engage – the audiences being communicated with. While this might be a valid criticism, no solutions seem to have been proposed for having so-called "upstream" engagement in these research areas. It is therefore pertinent that fields such as particle physics are sufficiently represented in science-communication discourse, in order to ensure that the conversation, and subsequent policy recommendations, are not biased by areas of research that are comparatively closer to everyday human activities.

1.1 Representing particle physics

CERN, the European laboratory for particle physics, is the premier research facility for high-energy physics. It is estimated that around half of the 20,000 or so particle physicists around the world conduct their research at the laboratory. Science-communication research involving those working at CERN can therefore be thought to be applicable to the particle-physics community as a whole. To represent the population of particle-physics researchers, the sample chosen for this study was the CMS Collaboration, which is one of the four large collaborations performing research at the Large Hadron Collider and which discovered the Higgs boson in 2012. Named after the Compact Muon Solenoid particle detector, the collaboration counts among its members over 4000 scientists and engineers from nearly 200 institutes representing more than 40 countries (as of June 2015). The international but close-knit nature of the collaboration makes CMS a unique source of rich, novel data into cross-national and cross-cultural attitudes towards science communication.

1.2 Defining public engagement

For the purposes of this project, the term selected to refer to "public engagement" is in fact "outreach", since this latter term is used both at CERN and within the wider particle-physics community to refer to activities ranging from working with schools to direct dialogue with the public to disseminating information through the media. Indeed, a recent re-structure of the laboratory's departments saw the creation of the "Education, Communication and Outreach" team, while global public engagement in the field has long been coordinated by the International Particle Physics Outreach Group. This choice of the term "outreach" is also supported by others such as Crettaz von Roten (2011), who acknowledges that it is used to refer to all science-communication activities "designed for an audience outside academia".

2 Methods and data

2.1 Methods

It would have been unfeasible to conduct a census of all 4000+ members of the CMS Collaboration to collect data for this project. It would have been equally problematic to ensure that all members of a random sample would be willing to respond to a survey. It was therefore decided to circulate an

electronic survey to the entire collaboration, soliciting as many responses as possible. This approach had the endorsement of the management of the collaboration. The survey was developed using existing questionnaires as templates (MORI, 2000; Poliakoff & Webb, 2007; Royal Society, Research Councils UK & Wellcome Trust, 2006; Wilkinson & Weitkamp, 2013), so as to have other research with which to compare this work, but it was tailored to address the specific research questions of the research project.

2.1.1 Survey pilot

The survey was piloted with a small number of researchers who work at CERN but who do not belong to the CMS Collaboration. These researchers were of the following nationalities: the United States of America (America), the Russian Federation (Russia) and the People's Republic of China (China). The countries were selected to be different enough culturally and linguistically to identify patterns in the responses or difficulties with accessing the questions presented in the survey itself. These countries[2] have the following representation within CMS (as of June 2015):

Country	**CMS members**
America	1442
Russia	295
China	94

The pilot study identified several issues with the questions included in the survey. The first was that the term "outreach" was not clear to the respondents from Russia and China – who requested clarification on whether the term referred to "education", "media relations", "popularisation" and/or "propaganda". It therefore became necessary to include the following note at the beginning of the survey:

> The term "outreach" refers to all science communication and education activities that bring scientific research to audiences outside the research community. It is also known as "popularisation".

Further changes to the structure and content of the survey included restructuring the order of questions, grouping questions of a similar type together and the removal of superfluous questions or ones that did not provide meaningful data.

[2] This use of the term "country" here does not refer to the nationality of the individual researcher, but to the country their institute or university is based in.

2.1.2 Final survey

The survey was thus tweaked based on feedback gathered from the pilot respondents, and was then uploaded to a server at CERN for distribution. Access to the website hosting the survey was restricted to members of the CMS Collaboration. Although the survey was confidential, it wasn't anonymous: that is, the survey software recorded the names of all respondents along with their responses. Identifying the respondents was necessary in order to extract *auxiliary data* about the individual respondents (such as their age, nationality, institutional affiliation etc.) from the internal database of CMS members. Procuring the auxiliary data from this internal database reduces the number of questions the respondents have to answer, thus reducing the overall time they would need to spend on the survey. Ethical approval for gaining access to these personal records was sought and granted by UWE, with the backing of both the CERN Legal Service and the CMS management.

The link to the survey was circulated to the entire collaboration via internal e-mail. Periodic reminders were sent to the whole collaboration thrice. Each e-mail generated a flurry of responses that died down within a few days. Noticing a lack of responses from engineers within the collaboration, they were contacted separately with a request to respond to the survey. Also, members from countries with a proportionally low response rate were also re-contacted. However, it is important to note that these last two reminders (engineers and low-response countries) did not yield many new responses.

2.2 Data

Over the course of the data-collection period, a total of 402 responses were received. Of these, 10 were duplicates (the respondents seemingly having forgotten that they had already answered the questions). The duplicates were used as a sort of "control" to check whether people's responses had changed significantly over time: no substantial changes (a Likert rating of 4 may have gone to 5 or vice versa) were observed. One of the responses was invalid for other reasons. This left a total of 391 responses for further analysis, or slightly less than 10% of the collaboration.

3 Results

The survey covered a variety of areas pertaining to science communication, but this paper focuses on two themes only: outreach participation and communication audiences.

3.1 Outreach participation

The respondents were asked whether or not they had previously participated in any outreach activities. Further, they were asked to provide an estimate of the number of outreach activities they had been involved in in the preceding 12 months and the amount of time they had devoted to these activities. The majority of respondents stated that they had indeed participated in outreach activities in the past (see Figure 1). An approximately equal percentage of men and women had said they had done so.

The survey also asked respondents to pick the statement they most agreed with from the following:

- I plan to participate in an outreach activity in the next 12 months.
- I do not plan to participate in an outreach activity in the next 12 months.
- I may participate in an outreach activity in the next 12 months.

These options can be interpreted respectively as “Yes”, “No” and “Maybe” responses to the question: “Do you plan to participate in an outreach activity in the next 12 months?” The responses to this question were rather interesting (see Figure 2): a small number of those who had previously participated said they would not (9 out of 348), but a significant number of those who had previously never participated said that they definitely would or may participate in outreach in the near future (6 and 21 out of 43 respectively). It is unclear whether this change in attitude was a consequence of thinking about outreach participation in general while responding to the survey.

3.2 Communication audiences

The survey presented the respondents with several audience groups and asked them to rate how **knowledgeable** they thought the audience was regarding their area of research, how **important** it was to communicate their research to this audience, and how **easy** it was to do so.

These audiences that were presented to the respondents can themselves be considered to fall under the following categories:

Research	**Education**	**Media**	**Other**
Colleagues	Teachers	General journalists	Government
Other scientists	University students	**Science journalists**	Industry
Press officers	**School students**	Other media	**Non-specialist public**

Institutional press officers can be thought of as belonging to the research community, due to the nature of their jobs and their proximity with researchers. The audiences in bold are the ones that are being discussed in this paper.

Figures 3, 4, 5 and 6 show the ratings for these audiences in the plots in the top row and on the bottom left. The fourth plot in each of these figures (bottom right) shows a “Combination” score, which is simply a sum of the votes shown in the plots for Importance, Knowledge and Ease of Communication. This plot serves only an illustrative purpose, as its shape can be thought of as showing the overall perceived favourability of each audience (1 being “Unfavourable” and 5 being “Favourable”).

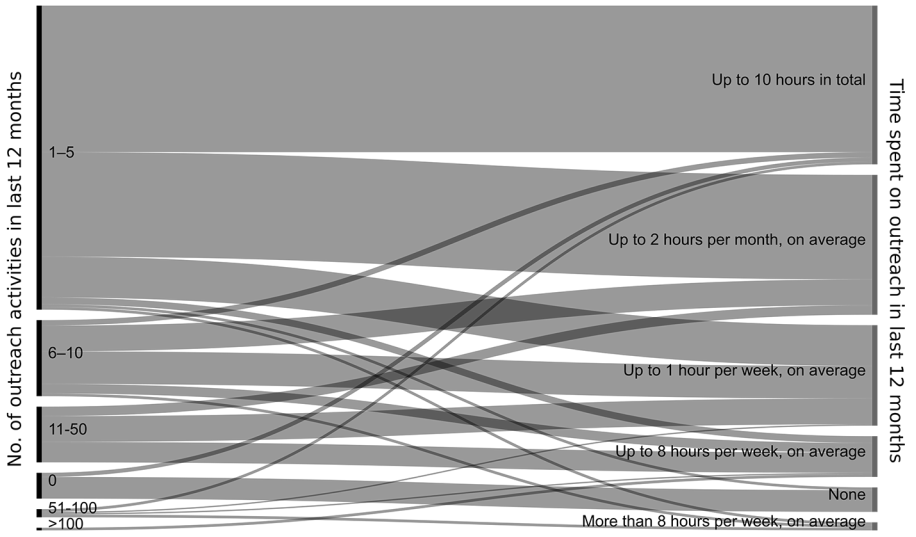

Figure 1. Previous participation in outreach This alluvial plot maps the number of outreach activities the survey respondents said they had participated in during the previous 12 months to the amount of time they said they had devoted to outreach in the same time window.

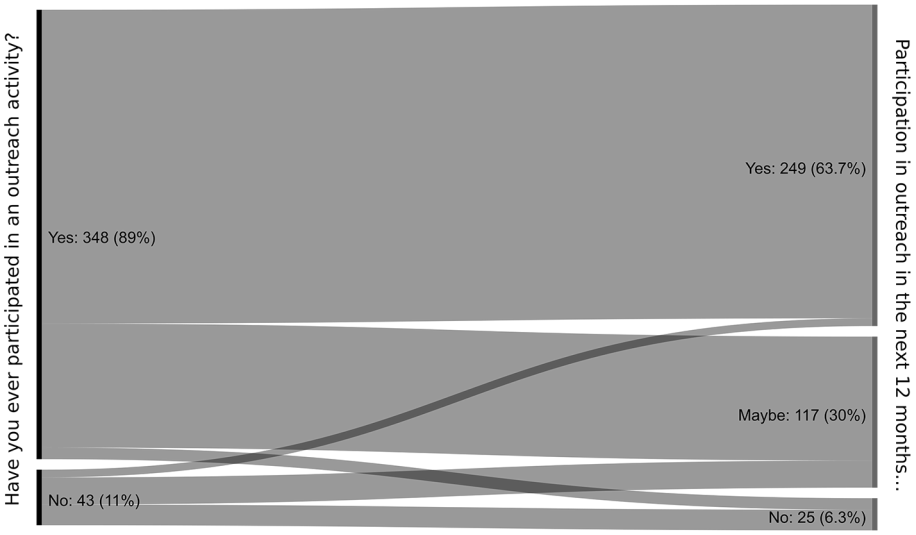

Figure 2. Future participation in outreach *This alluvial plot maps the responses given to questions regarding previous and future participation in outreach.*

Perhaps unsurprisingly, colleagues were ranked as the most important group, the most knowledgeable group and the easiest to communicate with about one's research. When it came to importance and ease of communication, science journalists, school students and the non-specialist public were ranked approximately on par with each other, although science journalists were thought to be more knowledgeable than the other two groups (and were generally viewed more favourably, as also shown in the "Combination" plots).

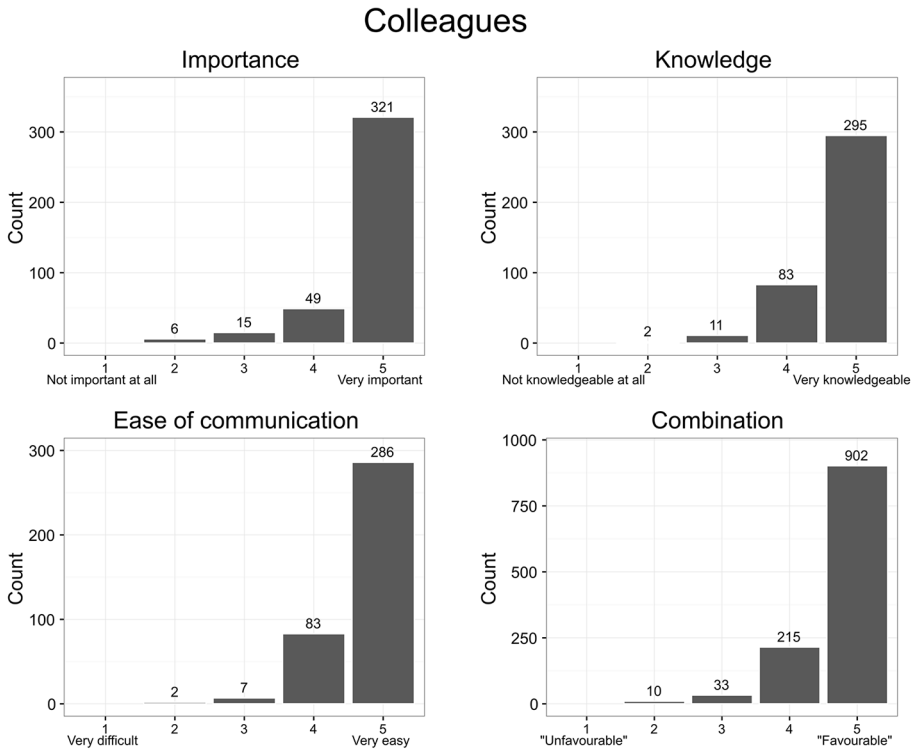

Figure 3. Communicating with Colleagues

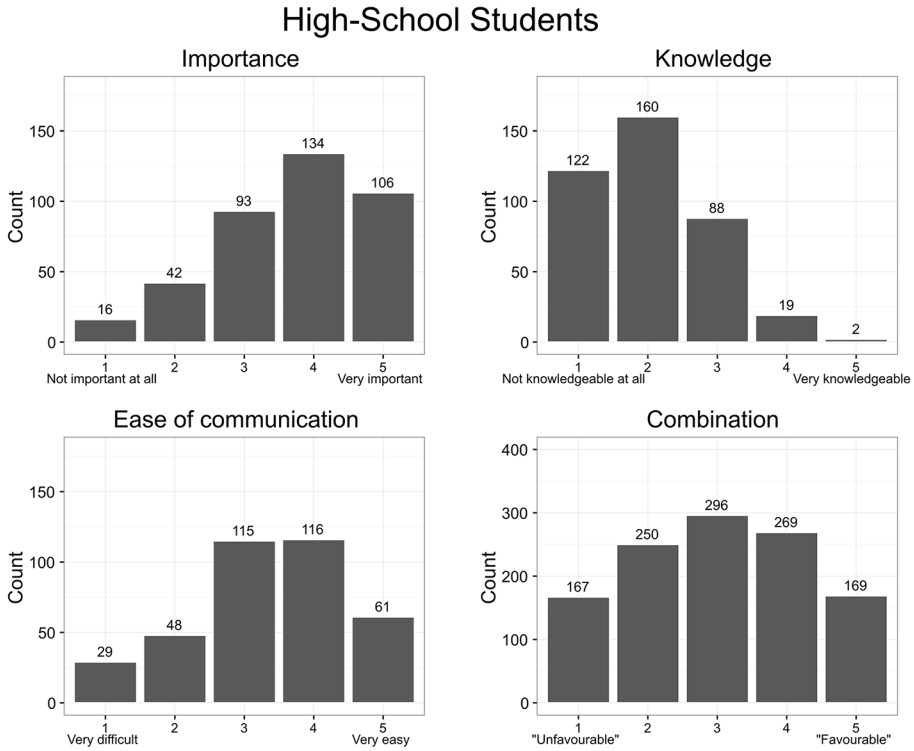

Figure 4. Communicating with High-School Students

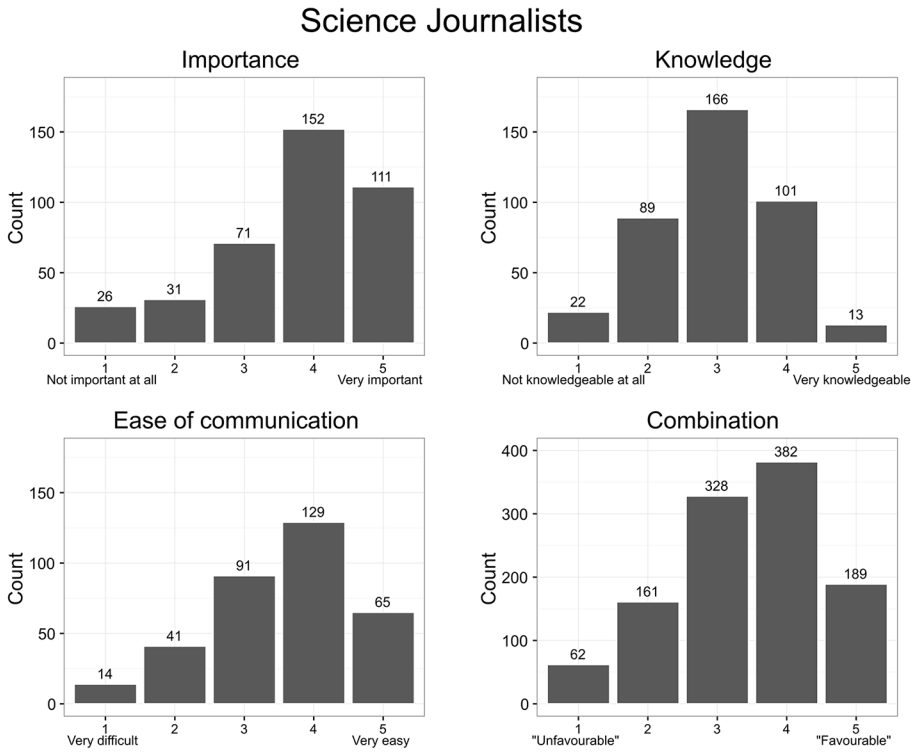

Figure 5. Communicating with Science Journalists

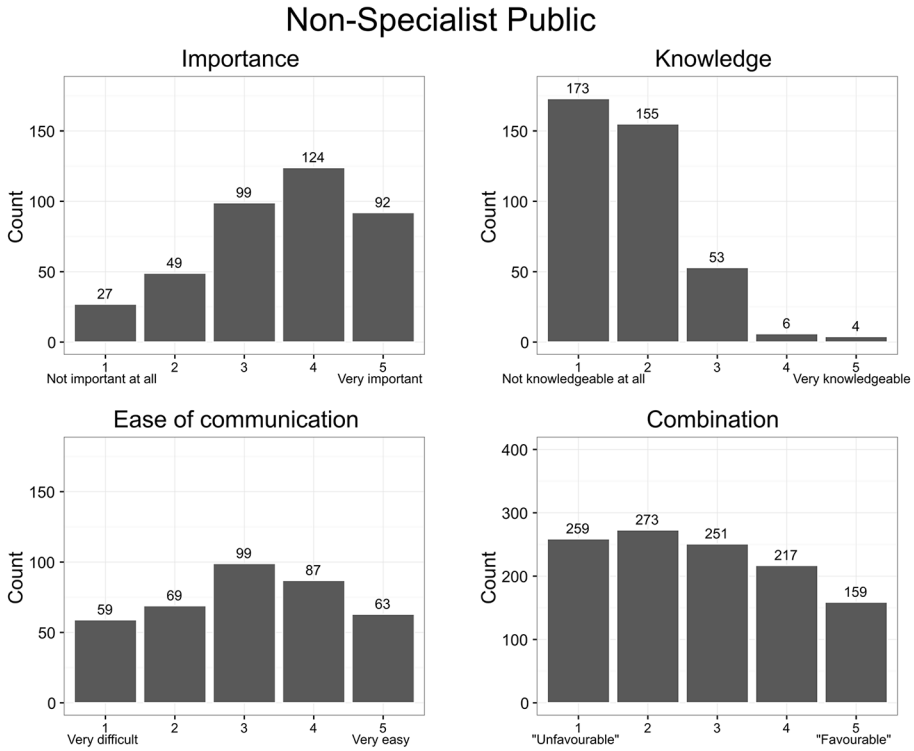

Figure 6. Communicating with the Non-Specialist Public

4 Conclusions

In terms of the importance of communicating with certain audiences, the responses to this survey can be compared with similar questions asked in a previous survey by Royal Society, Research Councils UK & Wellcome Trust (2006). In the Royal Society survey, the respondents were asked to rate the importance of communicating with a list of audiences, two of which map exactly with the audiences mentioned in this paper: (1) science journalists and (2) the non-specialist public. Notably, the importance of both these groups was rated considerably higher in this study than in the Royal Society survey, as shown in Figure 7.

Then again, the majority of the respondents to the Royal Society survey had not participated in any outreach activities in the 12 months prior to the survey. It may therefore be that the differences between the two sets of data are because the respondents within the particle-physics group had recently engaged in outreach and consequently viewed these audiences more favourably than their counterparts surveyed by the Royal Society.

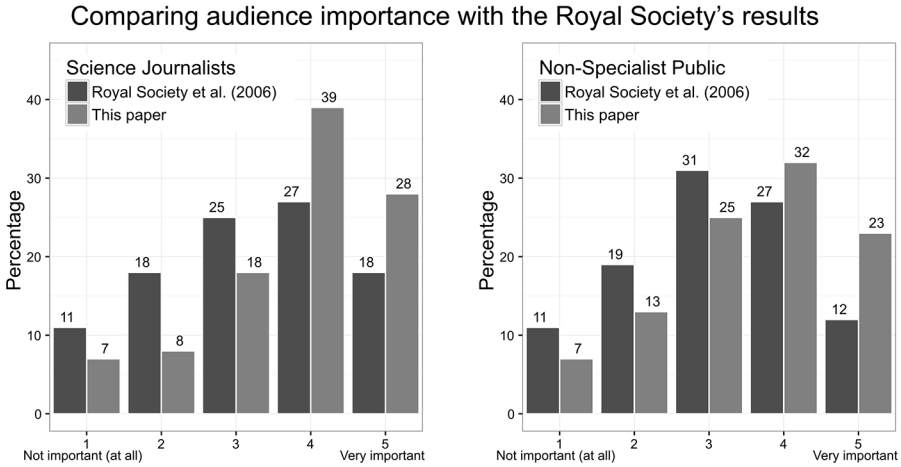

Figure 7. Comparing audience importance *The ratings in this paper for two audiences – Science Journalists (left) and Non-Specialist Public (right) – compared with the ratings from a survey by Royal Society et al. (2006).*

4.1 Limitations

The fact that the majority of the respondents state that they have previously participated in outreach is indicative of the self-selection bias involved in such methods of data collection. It would seem that these respondents are invested, emotionally or professionally, in outreach activities and therefore chose to respond to the survey.

The questions regarding audiences groups required the respondents to select a value from 1 to 5 on a Likert scale corresponding to how they rated the respective audiences' importance, knowledge and ease of communication (1 being a very unfavourable rating and 5 being the most favourable). By definition, Likert scales limit the statistical analyses that can be performed on data they produce. Conclusions must therefore be interpreted with care.

4.2 Next steps

The work presented at PCST 2016 is only a small part of a much larger research project. Although certain themes have emerged from the preliminary analysis presented here, they will be treated more thoroughly in future analysis of the quantative data. In addition, questions such as whether the respondents' attitudes towards outreach changed favourably over the course of responding to the survey – or whether these responses correlate with the respondents' ages, for example – will be explored via personal interviews during the period of qualitative-data collection.

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