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UWE Science Communication Postgraduate Papers

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Foreword

The Science Communication Unit in the Faculty of Health & Life Sciences at the University of the West of England (UWE) has a vibrant postgraduate community. Each year approximately twenty students undertake a Masters level project in order to complete the requirements for an MSc Science Communication. This publication is a celebration of the work carried out during such projects.

This collection of papers is based on a selection of projects occurring between 2006 and 2008. Whilst they cover a range of topics and a variety of methods, they are not a comprehensive representation of the broad variety of projects undertaken by science communication students. A number of students were invited to participate in this publication and those featured here represent only a small sample of the animated and innovative work carried out by the postgraduate community.

Firstly, Hayley Birch describes her research on the role of science podcasts in stimulating discussion about science. Based on an analysis of blogs and discussion forums, as well as interviews with listeners, the paper shares a number of interesting findings related to the use of these media. The work suggests that podcasts and their associated sites do provoke discussion and debate and that there might be avenues for increased conversations between producers and publics.

Anna Phlippen delivered and evaluated a hands-on science workshop for families at UK campsites. Anna was interested to see whether such workshops in a generic holiday venue could encourage more adults to become involved, including those with little or no interest in science. The workshop Anna developed was well received, popular and enjoyable, and whilst it was successful in attracting a number of adults with a low interest in science, the work highlighted the need for further research in this area.

In the third paper Joanna Hodges examines the reaction of visitors to touchable exhibits at The Oxford University Museum of Natural History. The research, which included tracking, observations, interviews and the analysis of visitor's comments, suggested family visitors are noticeably more engaged in touchable areas. It also highlighted that, despite the concerns of museum staff, non-touchable exhibits were not more likely to be handled.

Christopher Bugeja's paper examines the use of radio to communicate science in Malta. Christopher produced and evaluated the impact of 'Science On The Air', a radio-based science communication initiative designed to explore the potential for science-related radio programmes in Malta. Comments from the 256 listeners who contributed to the evaluation were highly favourable and Christopher demonstrated an opportunity for programming of this type on the Maltese Islands.

Next, Joana Silva examined the views of researchers, explainers and trainers, attending or providing training programmes for public engagement with Science, Technology, Engineering and Maths. Her work highlights that very little is currently known about the impact of such training or the types of people attending. Using an online survey and semi-structured interviews Joana was able to establish that such trainees are often personally motivated to attend and are more likely to become involved in public engagement after undertaking training.

Finally, Sharon Hall undertakes an investigation of science-based policymaking, exploring the communication and 'translation' processes that occur when interdisciplinary teams are brought together. Using the experiences of the Rural Economy and Land Use (RELU) programme's 'Biopesticides project', Sharon was able to establish that developing a common language and understanding was key in a project of this type. This experience was then likely to have a broader influence on the wider communication occurring within this project.

In performing these research projects the students involved have invested care and commitment to their research. The students whose work is presented in this volume should be congratulated on their work and thanked for enabling a wider audience to access their findings through the preparation of these papers. Should you wish to contact any of the students please do so via the contact details below. The considerable support and input provided by students' academic supervisors and co-authors is also acknowledged. Thanks are also extended to the various organisations who have been involved in the projects presented here.

We are very pleased to be able to share our students' success and hard work with a wider audience and wish them every success with their future careers as science communicators.

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Podologues: Conversations Created by Science Podcasts

Hayley Birch and Emma Weitkamp

This paper is based on research carried out by Hayley Birch as part of her MSc Science Communication.

1. Introduction

A podcast is a type of digital media file that can be downloaded from the internet. In its simplest form, it could be a recording of a meeting or lecture; a more sophisticated podcast could encompass news, features, interviews and music. Podcasts can be 'fetched' from the internet by a piece of technology called a really simple syndication (RSS) feed that allows subscribers to receive new episodes automatically, as soon as they are published. The iTunes 'podcatcher' and Podbean and Odeo podcast aggregators all offer hundreds of different podcast feeds just within the Science and Medicine categories, with specific subject matters ranging from stem cells to particle colliders (iTunes, 2008; Odeo, 2008; Podbean, 2008).

2. Context of this Project

Audio as a format is considered a less formal, more engaging way of communicating about science than written material, and can be used to establish a more intimate connection with an audience (Gay, 2007; Herrington, 2005). But what makes podcasts unique is that they are not subject to the same 'space and time' constraints as radio – they are far more versatile. Listeners can play podcasts online, or transfer them to MP3 players and listen whilst commuting, shopping or working out at the gym. Podcasts can also be paused, rewound and replayed over and over again. In this way, listening schedules are completely under the control of the listener.

The flexible approach to scheduling gives podcast producers more creative freedom than radio producers, whilst low production costs make the medium accessible to amateur broadcasters and organisations on a tight budget. Podcasting, therefore, is an innovative way for science communicators with limited resources to engage with niche audiences (and reach new audiences) online. Used in combination with blogs and forums – which will be referred to here under the umbrella term 'integrated online discussion facilities' (IODFs) – they represent a new way of establishing a dialogue with an audience. Blogs with comment facilities may be of particular interest since this is the publishing format used by many podcast producers.

Web-based comment and discussion facilities provide media producers with opportunities to interact with their audience and receive feedback on their work. But recent research shows that only a very small proportion of web users actually take part in online discussions (Thurman, 2008). It has also been suggested that much of the content that appears on blogs and forums is irrelevant (Minol et al., 2007). Therefore, it is important to probe these assertions in the context of science podcasts that have forums or comment facilities.

Sources suggest podcasts can be effective tools for formal learning (Lim, 2006; Shim and Shropshire, 2007). What is unclear is whether podcasts not explicitly designed as learning aids can serve this purpose - as informal learning tools. Therefore, in this project, the IODFs associated with podcasts were also considered in terms of their potential for enhancing the learning process.

3. Methods

The project aimed to analyse the role of science podcasts in stimulating discussion about science. It was intended that the information gathered be used to assess the relevance and value for listeners of (largely online) discussions stimulated by the selected podcasts. However, based on the analysis undertaken, it was also possible to make a number of recommendations for podcast producers.

The extent and content of discussions on blogs or discussion forums associated with five science podcasts were analysed over a six week period. In addition, interviews with listeners were used to determine how discussions about the selected podcasts served to enhance the listening experience.

For the analysis, only podcasts with an associated IODF were selected. An initial starting sample was established through monitoring of the top 100 ranked podcasts in iTunes, widely accepted to be the dominant podcatcher (Friess, 2006). The final selection of five podcasts was obtained through a funnelling strategy as shown in Figure 1.

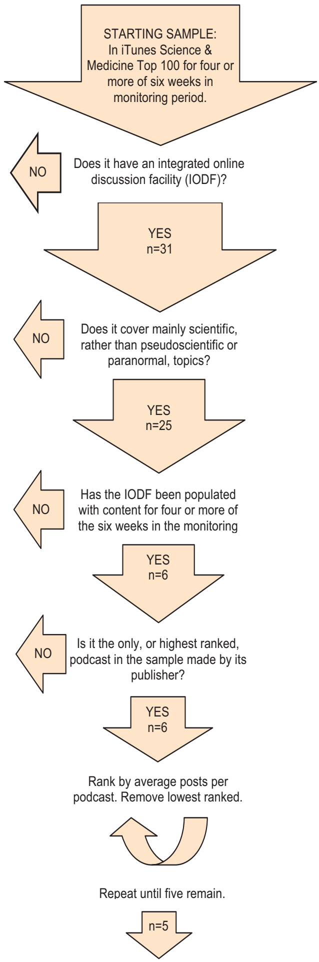


Figure 1: Science podcasts selection scheme. The number of podcasts remaining at each stage is shown.

The final five science podcasts (with associated IODFs) are listed below:

- Astronomy Cast (http://www.bautforum.com/astronomy-cast/ and http://www.astronomycast.com/)
- The Naked Scientists (http://www.thenakedscientists.com/forum/index.php?board=16.0)
- WNYC's Radio Lab (http://blogs.wnyc.org/radiolab/category/podcasts/)
- Guardian Science Weekly (http://blogs.guardian.co.uk/science/category/podcast_1/)
- The Math Factor (http://mathfactor.uark.edu/)

3.1 IODF Analysis

Full comments posted on IODFs during the iTunes monitoring period were analysed. Content analysis is a well-tested approach to studying text-based media (Stokes, 2003) and was therefore considered the most appropriate strategy within this new context.

Discussion on the IODFs was divided into five categories: podcast-related, content-related, IODF-related, other relevant issues and irrelevant issues. To be clear, content-related discussion referred to comments that related to specific topics covered in podcasts. Podcast-related discussion referred to comments about podcasts in general, including positive or negative comments about production factors, suggestions for new content and technical queries. IODF-related content referred to comments about the blogs or forums themselves. Other relevant issues were issues within the relevant field of science but which were not specific to one particular episode. Irrelevant issues included spam and completely off-topic conversation.

In addition, interactivity was measured on each IODF by looking at relationships between comments. Several measures were tested initially, but the most appropriate was considered to be 'response rate' – how often comments referred specifically to previous comments.

3.2 Listener Interviews

Ten interviewees were recruited by asking podcast producers to advertise to their listeners and by sending direct messages to listeners via Facebook listener groups. The sample was stratified by podcast, frequency of listening and contribution or non-contribution to IODFs. As seven of the ten interviewees listened to other science podcasts - podcasts not being studied - the scope of the interview schedule was expanded to science podcasts more generally.

Following transcription, interviews were coded by question and interviewee. Common themes were identified by comparing answers to each question between the listeners. By way of example, all interviewees were asked why they did not contribute to blogs and forums more often. All answers to this question were compared and those in which interviewees cited time constraints or being too busy were grouped together.

4. Results and Discussion

Each of the podcasts studied had a very different format and style, in terms of length, numbers of hosts, subjects covered and structure. The Science Weekly and Naked Scientists podcasts tended to have more complicated, and rigid, structures with a larger number of different segments. The Math Factor podcast, by contrast, had no formal intro or outro and usually covered just one specific mathematical problem. The variation between podcasts made it difficult to compare listener responses on equal terms, but did provide a good basis for identifying variables that may require further investigation.

4.1 IODF Results

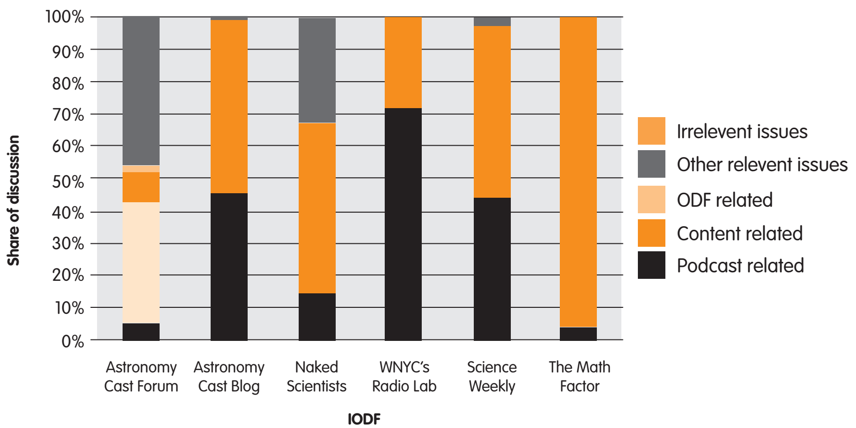
Frequency of posting on IODFs was in general quite low – only a third, on average, posted more than once in the period sampled. The distribution of posts per poster was similar across all podcasts. However, there were a few individuals – notably on the Astronomy Cast forum – who posted more than 20 times.

The nature of discussions, by podcast, is shown in Figure 2. In general, the level of irrelevant discussion was very low, making up less than 1% of the total content across all IODFs. For four of the five podcasts, most discussion was devoted to content-related matters. Radio Lab was the exception, with most discussion consisting of simple remarks on the quality of the show. This type of posting is not particularly conducive to discussion between posters and may explain why repeat posting and response rate or interaction was low on this blog.

As mentioned above, the Astronomy Cast forum, was particularly active, with high levels of interaction between posters and discussion of 'other relevant issues'. Comments on this forum tended to be rather more philosophical than on other IODFs. It is possible that podcasts based on these topics are more popular or generate more discussion in general.

A producer may read all or none of the comments posted on their IODF, but the comments that might be of most interest to a producer are those in the podcast-related category. The majority of these were comments in which posters identified elements of the podcasts they did or did not like. Relatively few suggestions were made for changes, although it is worth pointing out again that these results are based on a sample covering just six weeks. Therefore, on some of the IODFs, through continuous monitoring, a producer might expect to pick up plenty of useful feedback.

Figure 2: The Nature of Discussions by Podcast and Share.



4.2 Podcast Producers

At least some producers do regularly monitor activities on their IODFs, according to producers themselves (Gay, 2008; Green, 2008), and specific contributions to IODFs were in fact discussed in four out of the five podcasts studied. The fact that producers appeared to contribute to IODFs themselves also suggested that they read some of the comments. Producers on comments on IODFs primarily fell into the podcast-related category. These covered technical aspects related to downloading podcasts and answering queries from listeners, for example about missing or malfunctioning content.

> *'all - you'll find that the Science Extra link has now been restored in my original post ([Link] for those of you too lazy to scroll back up).*
>
> Apologies…' Producer B

On the Naked Scientists forum, producers did sometimes involve themselves in content-related discussion. In general, however, producers did not join in with listener debate about scientific topics covered on their podcasts – whether this is a conscious decision is unknown. The high involvement of producers on the Naked Scientists forum (around a third of posts) suggests a more concerted effort to stimulate and perpetuate debate on this IODF.

4.3 Listener Interviews

Nine of the ten interviewees regularly listened to a number of different podcasts, and subject areas ranged from film and literature to politics and religion, suggesting that the wider interests of listeners need to be taken into account when considering how podcasting affects informal learning outcomes. Listeners do not just listen to podcasts about science, so although science podcasts may increase scientific knowledge and interest in science, it would be naive to think that they do this to the exclusion of everything else. In fact, it is possible that listening to podcasts on a variety of subjects helps listeners to make connections between different subject areas.

Most interviewees listened to podcasts whilst doing other things, commonly commuting or walking. Unfortunately, the flexible nature of podcasts seemed to be causing disconnects between listening and contributing to blogs and forums. Specifically, two listeners noted that not being at their computers whilst listening meant they did not think about contributing to forums or blogs. None were regular contributors and those who did occasionally contribute would usually only do so if a topic of particular interest caught their attention. These findings suggest that to encourage people to contribute more often, producers need to provide more creative incentives to drive people to their IODFs or devote more time to highlighting particular discussions within the podcasts themselves.

All listeners said they discussed issues raised on science podcasts with friends, colleagues or family members and that podcasts were valuable sources of information about science. The level of enthusiasm was palpable.

> *'I'm fascinated by podcasts. I think they're an absolutely brilliant invention… I think I know a lot more, because I'm listening to a wide range of things, so I think I've benefited in that way.'*
>
> Interviewee 4

Enthusiasm for IODFs was far less evident, but interviewees saw the benefits of these feedback channels, even if they did not contribute themselves.

5. Conclusion

A strength of the research was its combined approach of content analysis and listener interviews, which allowed the researcher to consider the role of IODFs in a wider context.

Contribution to IODFs was generally infrequent, certainly on a listener-by-listener basis. One possible reason identified for this was the 'spatiotemporal disconnect'. The fact that listeners tended not to be sitting at their computers whilst listening meant most never or very rarely thought about going to the associated blogs and forums to comment. Unfortunately, this problem is directly related to some of the most obvious benefits of the podcast medium - its flexibility and portability, which allows listeners to tune in whilst commuting or doing chores for example. Podcast producers could try to overcome the problem by providing clear incentives to visit IODFs, highlighting comments from individual posters on podcasts and providing a variety of different feedback channels, including via social networking sites such as Facebook and Twitter. Since many internet users visit these sites regularly, they could be considered more 'convenient'.

Content on IODFs associated with the science podcasts studied was highly relevant to the topics discussed on podcasts. Whatever the general trend, this does suggest that users of these particular discussion facilities are concerned with discussing the topics at hand, rather than idle conversation or self-promotion. This strengthens the position of science podcasts, in conjunction with blogs and forums, as legitimate communication tools.

The presence of producers on IODFs and inclusion of listener contributions in podcasts shows that these tools facilitate conversation between the media and the public. Although radio phone-ins do provide opportunities for consumers to contribute to the media itself, IODFs are advantageous in that they allow users more time to consider their input. Further research might seek to establish, through conversations with producers, exactly how feedback from listeners influences the media agenda.

One particularly pertinent question is whether podcast producers should be actively seeking to engage with listeners about content on their podcasts. There is clearly a useful role for producers in answering technical queries, however, if the aim is to stimulate public debate and discussion, should producers take a back seat when it comes to discussing scientific content?

Listeners obviously consider podcasts as valuable sources of scientific information. However, they do not use them in isolation. The true picture is far more complex; individuals' attitudes towards aspects of science may be influenced by their understanding of the social, economic and political factors that interact with them, which in turn are influenced by their media consumption more broadly.

In conclusion, the study established an important role for science podcasts, and their associated online discussion forums, in stimulating conversation and public debate about science. At present, however, the use of blogs and forums is somewhat limited.

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Carry on Science: Are hands-on science workshops for families delivered at campsites an effective way to get adults involved in science?

Anna Phlippen and Karen Bultitude

1. Introduction

'Carry on Science' took the novel approach of delivering a hands-on science workshop for families at campsites to investigate whether such workshops encourage adults to become more involved in science events, particularly those with little or no interest in science. In addition, this study identified key features of campsites that are crucial for the success of workshops delivered in these venues.

2. Aims & Objectives

The aim of the project 'Carry on Science' was to investigate whether hands-on workshops encourage adults to become more involved in science events, particularly those with little or no interest in science. Moreover, this study aimed to identify key features of campsites that are crucial for the success of such a project.

To satisfy these aims the following objectives were identified:

1. To develop a hands-on science workshop that is suitable and enjoyable for family groups.
2. To get 70-110 family members (particularly adults with little or no interest in science) involved in the workshop through delivery at three different campsites within one region in the UK.
3. To identify key features for success in delivering science communication activities such as this workshop at campsites.

3. Context of this Project

Before running a science communication event three crucial components have to be identified first: target audience, medium and location. For the project 'Carry on Science', these components were 'adults', 'hands-on science workshop for families' and 'campsites'.

3.1 Target Audience

One of the most commonly cited reasons for presenting science to the public is to enable citizens to play an informed role in their democracy (Gregory & Miller, 1998). Falk et al. (2007) argue that people need to be better supported in their lifelong science learning when they finish school education. In addition, targeting adults is important as they play a key role in forming their children's attitude towards science (McBeth, 1987; Miller, 1987).

3.2 Target Medium

As highlighted by Csikszentmihalyi (1989), people are more likely to take part in an activity if they have an enjoyable experience. This is why enjoyment plays an important role for the success of a science communication event (Burns, 2003).

Participating in hands-on activities together can awaken not only childrens', but also parents' interest in science. This was, for example, one of the outcomes of the School-Home Investigations in Primary Science Project, a family science event organised in cooperation with schools to improve the level of school science knowledge. More than 50% of parents interviewed in this study said that doing hands-on activities together with their children at home reawakened their interest in science (Solomon, 2003). Moreover, museum studies have revealed that adults can benefit from the interaction with their children. For instance, during a museum visit adults tend to contribute more symbolic information gained from reading the labels whilst children tend to share concrete information about operating hands-on exhibits and what they observe (Diamond, 1986; Dierking & Falk, 1994). This can lead to discussions that provide the opportunity for parents to reinforce past experiences. Previous studies on interactive exhibitions have shown that 'adults in family groups are more likely to have a positive frame of mind if the exhibition is perceived to be designed for children' (Caulton, 1999: 27).

3.3 Target Location

According to Ramey-Gassert (1997), informal science education does not only occur behind school walls but can also occur at any other place such as children's playgrounds. Taking this a step further, Lucas (1983) distinguishes between intentional and unintentional sources of informal learning, as well as between accidental and deliberate encounters with informal learning sources. These distinctions help explain how 'Carry on Science' differs from other informal science learning locations. According to Lucas' definition, children's playgrounds represent accidental encounters with an unintentional source of learning, whilst 'hands-on' science centres achieve deliberate encounters with intentional sources (Wellington, 1990). For the genre of 'Carry on Science' it means that workshops delivered at campsites behave similar to science centres. The source at both venues is intentionally designed by the science communicator to be an informal science learning activity. People at both locations have a free choice, a deliberate intention, as to whether they want to take part in the activity or not. Nevertheless, the location itself, campsites, is still different from science centres because these venues are not deliberately developed for the purpose of science communication like the science centres. Campsites can be considered to be 'generic' venues for science communication.

'Generic' venues are locations that represent a public space that participants 'own' and not scientists or science communicators. Furthermore, campsites also fulfill two additional features that make them ideal as generic venues: they allow participants sufficient time to get involved in the activity and provide enough space for the performance (Bultitude, in press; Graphic Science, 2005).

4. Methods

The project 'Carry on Science' contained two major steps, piloting and delivering the workshop.

4.1 Pilot at the London Science Museum

A pilot version of the workshop was delivered at the Science Museum in London to identify which hands-on activities were most suitable and enjoyable for family groups. Within this study 'family groups' consisted of at least one adult and one child between the ages five and fourteen. Based upon the pilot, the three experiments that were identified to be the most suitable activities for the workshop delivered at campsites were: 'cornflour slime', 'Alka Seltzer rockets' and 'lava lamp'.

The evaluation questionnaires were also piloted at the Science Museum, resulting in the decision to design one questionnaire for adults and a separate one for children. The questionnaire for children contained pictures, where applicable, to support those with lower reading literacy. The questionnaire for adults contained an additional set of questions about their family.

4.2 Delivery at Three Campsites

The workshop was delivered three times over the course of one day at each of the three campsites. Each campsite was specifically advertised to be family-friendly, which helped increase the opportunity to get adults involved in this family science event. Data collection at the campsites occurred through questionnaires, interviews and observation.

Questionnaires were distributed to participants after every workshop (total n=138). At every campsite, fifteen group interviews with random families located throughout the campsite were conducted after the last workshop of the day (total n=45). The group interviews allowed data collection from every family member (if possible and applicable) in an informal and relaxed manner.

Basic data about the campsites were also collected from the campsite's owners, for example attendance, location and the current holiday programme. Furthermore, data was collected through observation of the location.

5. Results

5.1. Workshop Participants

148 family members attended the workshop delivered at the three campsites, out of which 138 filled in the questionnaire at the end of the workshop, 45 adults and 93 children. 'Family' members consisted of a member of a group containing at least one adult and one child between the ages five and fourteen.

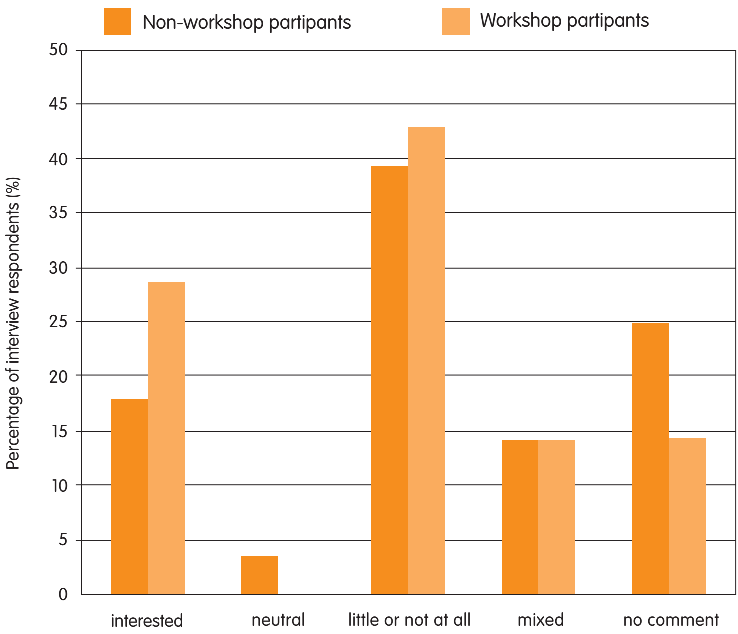
Data about adults' interest in science was collected through both questionnaires and interviews. 51% (n= 23) of adults stated in the questionnaire that they were 'very much' interested in science, whilst 49% (n= 22) ranked their interest in science on a 'neutral level'. No one claimed to be 'not at all' interested in science. In contrast, there were some workshop participants who mentioned a lack of interest in science during the interview. For instance, one mother who came with her daughter to the workshop at campsite 2 responded to the question as to whether she was interested in science:

'My daughter is crazy about science. She is even above average in school ... me? Not really! I am more here for cooking…'

Moreover, data from interviews were used to analyse the difference in the levels of interest in science between people who attended the workshop and people who did not. As interviews were conducted with family groups that mostly consisted of more than one adult, data shown in Figure 1 refers to 'units' of adults from family groups rather than individuals. Adult units who expressed similar attitudes towards science within the family group were correspondingly rated 'interested', 'neutral' or 'little or not at all'. Some family groups, however, contained adults with different interests in science. Those were grouped under 'mixed'. In addition, some adults did not provide a response regarding their interest in science during the interview; these were classified as 'no comment'.

As shown in Figure 1, within the interviews the most common level of interest in science was 'little or not at all', regardless of whether family units took part in the 'Carry on Science' workshop or not.

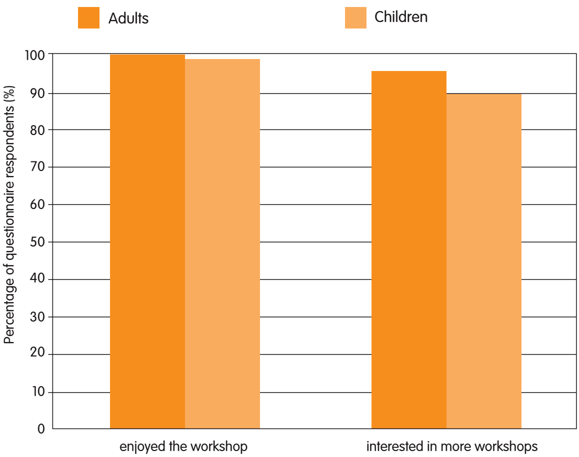
Figure 1. Participants Interest in Science



5.2 Participants' Reactions Towards the Workshop

Data from the questionnaire showed that 100% (n=45) of adults enjoyed the workshop 'very much' whilst 99% (n=91) of children similarly awarded the highest level of enjoyment (see Figure 2). In addition, their interest in participating in another workshop with different experiments was very high (see Figure 2).

Figure 2. Participants Reaction Towards the Workshop



Families approached the workshop in different ways. 88% (n=38) of families did every experiment together. Five families (12%) did not do every experiment together, mainly as the adults joined in later and consequently missed at least the first experiment. Only two adults deliberately decided not to do any experiments together with their children.

Finally, the most frequently cited reason for parents attending the workshop was because it seemed to be fun for their children.

5.3 Features of Campsites

There were four key elements identified in which campsites can differ from each other: location, visitor numbers, current holiday programme and advertising. All of these elements can have an impact on the success of a project such as 'Carry on Science'.

- **Location of the workshop**
  Based upon the location that was provided for the delivery of the workshop, most people who spent their time on campsite 3 were able to see the workshop and its crew in action. In contrast, the locations at campsites 1 and 2 were much more discreet, only allowing clear visual access to a limited number of people.

- **Visitor number**
  Campsite 2 was the smallest, with 500-600 people compared to campsite 3 with about 900 visitors, and campsite 1 with approximately 1500 people on the day of the performance.
- **Current holiday programme**
  Campsite 1 offered a sophisticated entertainment programme to campsite attendees (at least two events per day) whereas campsite 2 and 3 did not offer any organised entertainment during the day.
- **Advertising**
  According to the questionnaires, it seems that the main way of successfully advertising the workshop at all three campsites occurred through the reception/shop. However, some adults from campsite 2 also received the information from friends. At campsite 3, some adults mentioned that they got informed about the workshop through children and/ or directly through the workshop group. At all three campsites there were still some families who did not attend the workshop because they had not been aware of it. Others did not choose to go to the session irrespective of whether they knew about the workshop or not. Those families suggested that they had not spent time at the campsite during the day due to a field trip or due to their late arrival at the campsite.

6. Discussion and Conclusion

The results of 'Carry on Science' demonstrated that this project was successful and can therefore be seen as a practical contribution to the field of science communication.

Firstly, data from this study showed that the workshop developed for the project 'Carry on Science' fulfilled the first objective: being suitable for a family experience and enjoyable for both adults and children. 100% of adults and 99% of children who filled in the questionnaire enjoyed the workshop, and most family groups (89%) did all the experiments together.

Secondly, the target number of 70 – 110 was exceeded with 148 family members participating. Interview data showed a generally high proportion of adults present at the campsites who had no existing interest in science. This did not only include those adults who did not attend the workshops (their lack of interest may have reduced their likelihood of attending for example) but also adults who had attended the workshops. According to the interviews with participants, it means that the project 'Carry on Science' got some adults with little or no interest in science involved in this science event. In contrast, data from questionnaires, which had been distributed to adults participating in the workshop earlier, showed a relatively high existing level of interest in science amongst them. It seems that some of the adults judged their interest in science during the interview to be lower than they had during the questionnaires at the workshop earlier in the day. This discrepancy between data gathered from interviews and questionnaires indicates that further research is necessary to confirm success in terms of reaching adults that have little to no existing interest in science.

Lastly, through the project 'Carry on Science' some key features of campsites for the successful delivery of science communication activities at such locations could be identified. All three campsites involved in this study fulfilled two crucial features of a successful generic venue. They provided enough space for the performance, and the campsite attendees tended to have sufficient time to participate. However, this study showed that some campsites may still be more suitable than others. Four additional key features could be identified that contributed to the success of this science communication event: location of the workshop, overall visitor numbers, current holiday programme at campsites and advertising methods. Based upon the results from this study, it is recommended to choose campsites that:

- Do not offer any other family activities over the day. Campsite 1 from this study was the one with the greatest offer but with the lowest number of workshop participants.
- Are small so that word of mouth advertising can travel better. According to this study, information seemed to spread over the smaller campsites better than the larger.
- Provide a location for the delivery of the science event that is clearly visible to participants in the surrounding campsite in order to encourage passers-by to join in. The location seems to be one of the main reasons why campsite 3 had the highest number of workshop participants. This campsite provided the most visible space for the delivery of the workshop.
- Are willing to advertise the workshop, for example through a display at the campsite reception. Most adults from all the campsites mentioned the advert at the shop / reception as their key source of information.

Furthermore, the workshop attendees seemed to be interested in participating in similar hands-on science workshops at campsites again. This highlights that there is a potential in continuing projects like 'Carry on Science' in the future. Moreover, data analysis from interviews indicated that in general, most adults at campsites seem to have little or no interest in science. This leads to the assumption that campsites provide science communicators the opportunity to meet those adult groups at such venues.

Three key recommendations have been identified for further research in this field:

1. Different responses were received between questionnaire and interview data regarding the existing levels of interest in science amongst adults present. Further studies should be carried out to investigate the discrepancy.
2. 'Carry on Science' can be seen as a successful case study but to generalise the features of suitable campsites for the delivery of a science communication event a larger set of data should be collected from more campsites.
3. A science communication project like 'Carry on Science' may be even more successful when being delivered for multiple days at the same campsite, particularly when the campsite is small and families start recommending the workshop to others.

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Feeling Good!, an Evaluation of Touchable Exhibits at the Oxford University Museum of Natural History

Joanna Hodges and Clare Wilkinson

This paper is based on research carried out by Joanna Hodges as part of her MSc Science Communication.

1. Introduction

The Oxford University Museum of Natural History (OUM) is a natural history museum in the heart of Oxford, opened in 1860 as a 'cathedral to science' (www.oum.ox.ac.uk). In January 2006 the Vice Chancellor of Oxford University opened a major redisplaying of the museum's collections to reach wider in the community and to better support science education and engagement with the public. The new displays incorporated a series of touchable exhibits entitled 'Feeling Good!'. Undertaken 6 months after their launch, this study focuses on these new touchable exhibits, arguably the most striking element of the project, and the most innovative.

2. Context of this Project

Like many UK science museums, the OUM was developed in the 1800s as a place to display the prowess and achievements of imperial global exploration. These museums developed a reputation as spaces where the middle and working classes would come together to learn. Barry (1998: 100) describes how 'the bourgeois public would participate, and be seen to participate, in their own cultural and moral improvement', while the working classes could learn from and be influenced by them.

By the late 1980s and 1990s the concept of culture was a means of individual improvement' was now conflicting with a newer notion: that culture is a consumer product, and that museums need to work hard to encourage audiences to spend time at them instead of pursuing other leisure activities (Barry, 1998: 101). Loomis (1985) notes that views of traditional museums as too dominated by the concerns of the curators and too dependent on public subsidy gradually forced the traditional science museums to adapt to their new concerns of the 'customer' and visitors' requirements.

Changes in science museums in the mid to late 1980s were largely influenced by the report of the Royal Society, chaired by Sir Walter Bodmer in 1985, which demanded a new trend for helping the layperson to understand, and as a result appreciate, science. It told scientists to 'learn to communicate with the public, be willing to do so and consider it your duty to do so' (Bodmer Report, 1985: 38).

Shortly after the Bodmer report was published, a new type of science gallery started appearing: the Exploratory in Bristol opened its first permanent exhibition, Techniquest opened in Cardiff city centre and the Science Museum in London created Launch Pad, its ever-popular interactive gallery for children.

Then, in 2000, the House of Lords published a report, Science and Society, and with it came a new era of 'engaging' the public (House of Lords, 2000). In the same year, the Wellcome Trust and the Office for Science and Technology surveyed the attitudes of the British public to science, calling for dialogue between science and the public (OST/Wellcome Trust, 2000). Concurrently, £500 million was being invested in Millennium Science Centres opening all over the UK. Around a dozen brand new, often striking looking buildings were opened, frequently in areas of cities in need of redevelopment. If Launch Pad and the Exploratory were rooms with seemingly random scientific experiments, the new Science Centres were constructed as large scale, themed science experiences.

The OUM has had to respond to these challenges too, and over the past five years has updated displays and employed staff in community education and family learning posts. In 2005 it was awarded, jointly with the neighbouring Pitt Rivers Museum, the Guardian newspaper Family Friendly Museum of the Year award. One of its most popular resources are the occasional boxes of small specimens from the museum's collections which visitors can handle.

Object handling is a method being used successfully in many organisations as a way of engaging people in museum settings. A number of studies have shown that touching specimens provides visitors with an increased sense of ownership, contributing to higher satisfaction with their overall visit (Screven, 1986; Swanagan, 2000; Lindemann-Matthies and Kamer, 2005). Involving all the senses, including touch, appears to lead to greater engagement and increased learning, but other factors such as influences of the people around them, the environment they are in and their emotional feelings towards the exhibits all affect a visitor's learning experience (Falk and Dierking, 2000).

'Feeling Good!' launched in 2006 was about opening up the museum's collections for closer scrutiny by visitors. As with many museums, this was in response to a new discourse on the 'democratisation of education', a demand for more independent and individual learning, with reduced intermediaries (Kelly, 1999; Barry, 1998). In practice this has led to the opening up of collections and stores, increasing access to the 'behind the scenes' work of museums and increased opportunities for visitors to interpret exhibits in their own way, and the OUM wanted to find out if allowing visitors to touch certain exhibits would lead to greater satisfaction.

This study used a multi-method approach to build up a picture of how touchable exhibits were being used by visitors in the context of the whole museum experience to find out the value of providing touchable displays.

The main themes of the research questions were:

1. The value of having touchable exhibits: their effect on a family's willingness to visit the museum and on their experience of the more traditional displays;
2. The accessibility of the touchable exhibits, particularly those on the tables;
3. The range of emotional responses to touching exhibits which include dead animals and very ancient and rare objects.

3. Methods

'Feeling Good!' consists of four main touchable areas:

- **'Touchable Tables':** Two large octagonal tables with around 24 objects including a finely-detailed fossil fish, several mineral specimens, birds and mammals, dinosaur eggs and a baby crocodile. Each object on the tables has a label in print and Braille;
- **'Microscope':** Two seats around an interactive microscope with a monitor and large zoom and focus buttons;
- **'Shetland Pony and Cheetah':** A stuffed Shetland pony and a stuffed cheetah on small tables, with labels describing what they are, where they lived and how they died;
- **'The Earth and Minerals Aisle':** Eight large stand-alone touchable examples of rocks, minerals and a fossilised log all displayed in the Earth and Materials aisle with information plaques inviting visitors to touch them.

In addition there are some pre-existing 'Feely Boxes' in one corner of the museum.

The study was carried out during local school holidays in 2006, six months after the launch of the new displays, and used five different techniques:

- **Tracking**
  A crib sheet, based on those utilised by Ben Gammon consultants at the Science Museum (Gammon, 2006) was developed to track a group of visitors around the museum. Their route was marked on a map of the museum and a code indicated each time they carried out one of a number of Engagement Indicating Actions such as stopping, discussing an exhibit, touching, looking closely and reading a label amongst others. Six family groups were tracked in total.
- **Snapshots**
  To provide a quantitative dimension to the tracking, 'snapshots' were taken: over a 5-minute time slot, the location of each visitor in the museum was marked on a map with a dot. A grid dividing the plan of the museum into equal sized squares was placed over the marked plans and the total and average number of visitors in each of these grid squares was calculated. Each square represented approximately 2m x 2m squared.
- **Observations**
  Observations of visitors, based on the study by Ellenbogen et al. (2005) in San Francisco, were carried out at a desk near the 'Touchable Tables', and at another between the 'Earth and Minerals Aisle' and the 'Shetland Pony and Cheetah' exhibits. 60 visiting family groups were timed from when they were within a pre-determined zone and a tally was taken for the number of times someone from the group carried out one of the Engagement Indicating Actions as used for the tracking study.
- **Interviews**
  5-10 minute interviews were carried out with ten families as they were leaving the museum. Basic demographic questions were followed by more probing open questions on their thoughts and feelings about aspects of the touchable exhibits such as clarity of labeling, their suitability for family groups, if they could reach the exhibits and the significance of the

touchable exhibition in the context of their whole visit. In addition four members of staff who were instrumental to the exhibition were interviewed to gain some insight into the exhibits from the museum's point of view.

- **Analysis of Visitor Comments Book**
  The Visitor Comments Book dating back to the launch of the touchable exhibits was also studied - all comments mentioning the touchable objects were recorded and analysed for trends.

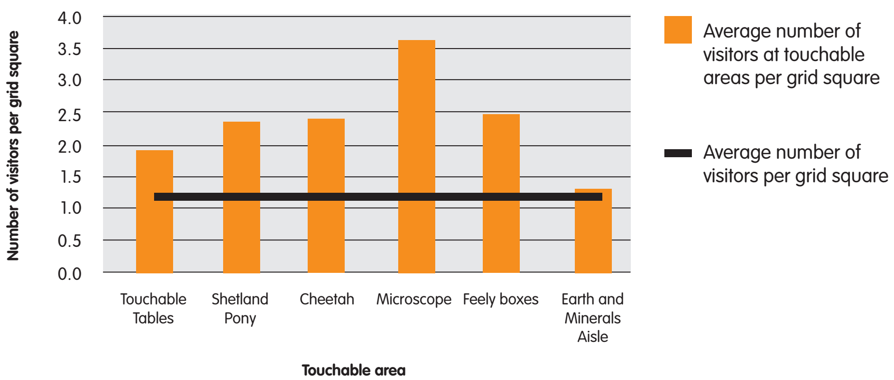
4. Results

The snapshot study revealed that the 'Touchable Areas' are more densely populated by visitors than other areas.

Despite only keeping people's attention for on average less than one minute, the 'Shetland Pony and Cheetah' exhibits were surrounded by many visitors, perhaps partly because of their proximity to and visibility from the entrance.

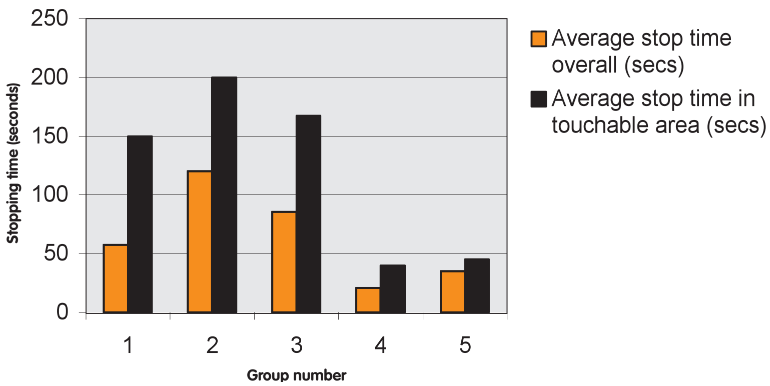
The black line on the graph in Figure 1 indicates the average number of visitors per grid square of the main gallery, which was noticeably higher for all of the touchable areas, including the more established 'Feely Boxes'. The 'Microscope' is particularly high, perhaps because the use of seating and a fairly large screen allowed a greater number of family members to gather around at a time.

Figure 1: Average number of visitors per grid square



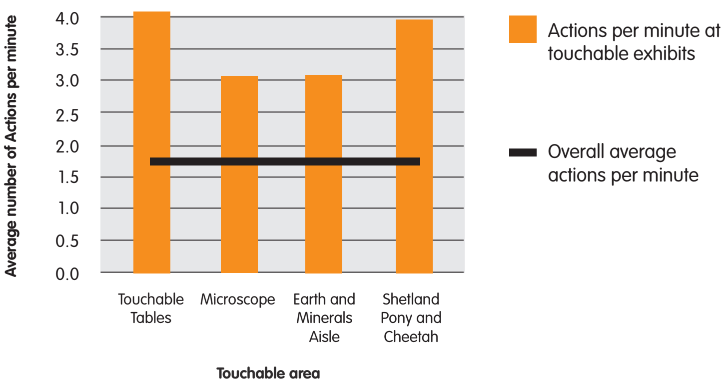
During a visit, the tracking studies showed that visitors stopped an average of 30 times. However, groups varied considerably in size and dynamics. When in the 'Touchable Areas', groups stopped for an average ranging from 40 seconds to 200 seconds. For each family, when in the touchable area they stopped for longer than they did in the rest of the museum as is illustrated in Figure 2.

Figure 2: Average stopping times Overall and in Touchable area



Visitors spent an average of 4 minutes at the touchable tables out of an average total visit time of 49 minutes, but during those 4 minutes they were more active and more engaged, doing around 4 Engagement Indicating Actions per minute at the Touchable Tables, and around 3 per minute at the 'Microscope' and the 'Earth and Mineral Aisle', much higher than the average of 1.8 actions per minute over a whole visit, (shown by the black line in Figure 3.)

Figure 3. Actions per minute at Touchable Exhibits and Overall



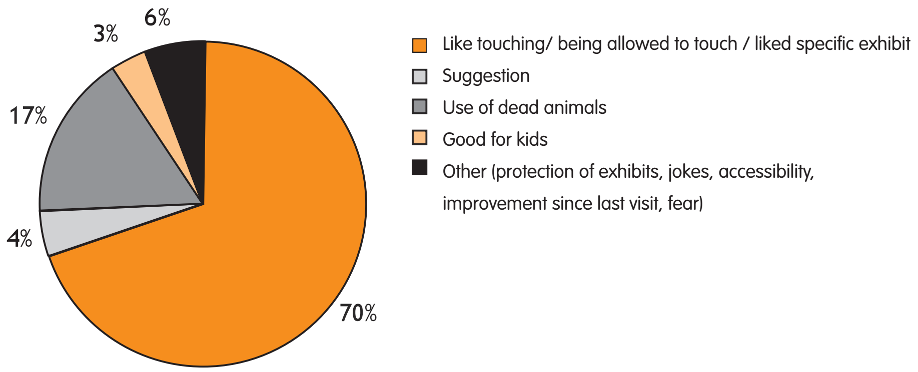
When at touchable exhibits visitors were mainly touching rather than reading or looking. But with increased touching came noticeably increased discussing of the objects with other family members. Indeed, an average of 30% of all discussions about objects took place when in the touchable area, despite only spending under a tenth of the total visit time there.

From the interviews, 7 out of 10 families said the touchable exhibits formed a significant part of their visit. All said it was at least likely that they would come back and 8 out of 10 said touchable exhibits would encourage their return visit.

The Comments Book revealed that 153 comments were made about the touchable exhibits in the six-month period since its launch, from the 200,000 people who had visited the museum over the same period. Most of these were expressing an enjoyment of touching, and over a third of these were specifically appreciative of being allowed to touch objects.

As is illustrated in Figure 4, 3% of the comments made in the comments book said how good the exhibition was for children, and another 4% were making suggestions such as having worksheets or more computer-based interactives. 17% of the comments were specifically about the use of dead animals in the exhibits, which was a key opinion that staff at the museum wanted to hear about. More specifically, 3% of the comments were positive, saying that the use of dead animals made it more real, more interesting or 'cooler'. The remaining 14% of these comments, (21 separate comments), stated a concern, largely about the ethics of killing animals to display in a museum.

Figure 4. Main Themes from Comments Book



5. Discussion and Conclusion

Having touchable exhibits in the Oxford University Museum of Natural History is adding value to a museum visit. Family visitors are noticeably more engaged in the touchable areas of the museum than other areas. They stopped for longer, and discussed the objects more when they could also touch them. This correlates with other studies, such as Lindemann-Matthies (2005), Kelly (1999), and Brody (2002) who all make positive links between touching objects and increased learning by visitors in informal learning environments.

The presence of specific areas with touchable objects is not detracting attention from other parts of the museum. For some visitors, despite appreciating having things to touch, other parts of their visit were more significant, in particular the dinosaurs, which are still a key draw to the OUM.

In all the observations and tracking studies only one object outside of the touchable areas was noticed being touched, despite the concerns of some staff at the museum that non-touchable exhibits would suffer increased damage as a result of having some touchable specimens. Indeed, the sign indicating to touch with one finger brought home that the touchable specimens are delicate and demand respect.

The relatively high number of people commenting on the use of dead animals in the 'Visitor Comments Book' is of serious note, particularly at an Oxford University institution. During the time of this study animal rights activists were holding weekly protests adjacent to the museum against the use of animals for scientific research. In reality, only the specimens collected during Victorian times were killed for display. All newly acquired exhibits, including all the touchable specimens, died of natural causes in zoos, or via road accidents.

The study produced a package of tools which can be used to measure actions, behaviour, attitudes and enjoyment of visitors of the touchable exhibits at the OUM and it is suggested that the museum continue to use these tools now to study other target audiences, such as visitors with special educational needs or visual impairments. To provide more depth and value the observation tool in particular could be used on other non-touchable exhibits to see if there is a substantial difference in visitor actions at these than at touchable exhibits and to gain more conclusive information about damage or touching of other non-touchable specimens in the museum.

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SCIENCE ON THE AIR: Investigating how radio can be used to communicate science in the Maltese Islands

Christopher Bugeja and Emma Weitkamp

This paper is based on research carried out by Christopher Bugeja as part of his MSc Science Communication.

1. Introduction

In a bid to create an infrastructure for research and innovation (R&I) in the Maltese Islands, the Malta Council for Science and Technology (MCST), issued a report in which it outlined its vision for R&I between 2007 and 2010. MCST stated that 'it is strongly argued… that a comprehensive and multi-pronged science popularisation strategy is of fundamental importance' (MCST, 2006: 67).

The multi-pronged strategy sought, amongst other things, to 'launch on-going science journalism and science TV and radio programmes' (MCST, 2006: 67). Science On The Air was a science communication initiative designed to explore the potential for a science-based radio programme in Malta. The project involved developing a pilot 15-minute science radio programme in the Maltese language. A lack of similar programmes and research into their audience appeal in Malta meant that evaluation was an essential component of the study.

2. Context of this Project

The results of Eurobarometer 55.2 (European Commission, 2001), show that as sources of scientific information across Europe, radio ranks third, while the internet ranks sixth, and television leads, according to the level of perceived importance. Unfortunately there are no specific statistics regarding media preference for the general population in Malta. Merzagora (2004) states that people are shifting from television to the internet, but not from radio. According to Merzagora (2004), television time in the European Union (EU) is saturated, while there is still a lot of space for radio to evolve. Science communication has more potential on radio than on any other medium, especially as 'radio… has proven to be very feasible and apt for science communication' (Mazzonetti, Merzagora and Tola, 2005: 22).

According to the Maltese Broadcasting Authority (Axiak, 2007), there were 13 radio stations operating on a nationwide broadcasting licence during the year 2006-2007. The Broadcasting Authority (Axiak, 2007), also states that during 2006-2007 there were 27 community radio licences on a continuous basis, and 26 other community radio licences for a period less than 4 weeks. This equates to a total of 40 radio stations holding an on-going licence. In a country with a population of 404,962 in 2005 (NSO, 2007), this equates to a radio station for every 10,124 people.

With such a high concentration of radio stations in Malta it might be surprising that thorough research about programme content has never been carried out. In spite of this, the Malta Council for Science and Technology (MCST) states that in Malta 'the only access to the fascination of S&T

[Science and Technology] is probably the Discovery Channel' (MCST, 2006: 67). This can be taken to signify that science does not feature regularly in the Maltese media – radio included. Science only features sporadically on Maltese radio under the guise of medical issues, environmental problems and ecological or natural disasters.

The main goals of this research were to answer the following research questions:

- Is there an audience for science radio programmes in the Maltese language?
- What are the characteristics of the audience for such radio programmes?
- How would the listeners respond to the content and the format of the science radio programme proposed?

For these research questions to be investigated, a pilot radio programme about science, presented in the Maltese language, with content aimed at a local audience, was produced and made available online.

3. Methods

3.1 The Radio Programme

The topic for the programme was selected according to the newsworthiness criteria based on the CINPPUT acronym (Mercieca, 2004) which are in use in most newsrooms in Malta. This acronym stands for: Conflict, Impact, Novelty, Proximity, Personality, Uniqueness, Timeliness/ Temporal proximity. The better a story fits these criteria, the more newsworthy it is. The topic of Wind Energy fitted these criteria well as for such a small archipelago a wind farm would have an impact on the entire population. Any wind farm development would be visible from almost every part of the islands, impacting on the limited countryside landscape and the seascape around the islands. Wind farms would also have an economic impact on the country due to their direct cost, and to related costs such as the upgrading of the electricity infrastructure, and the linking up of the local grid to the European electricity grid via submarine cables. Wind energy was the subject of on-going very low key debate in all levels of the Maltese society, at the time of subject selection. Moreover, the EU had issued targets for the use of renewable energy sources across the Union (EurActiv, 2007).

The main idea behind the programme was to create something that is essentially a pocket tutorial for radio. According to Joyce (2002), science journalists in other media are required to produce 'pocket tutorials' about the concepts they convey, but stop short of exploring the potential of producing these for radio. The 'pocket tutorials' mentioned by Joyce are short and concise articles or audio-visual clips conveying the main points on a topic. Thus the reader or viewer will be get an overview of the subject in a very short time and with minimal effort. Joyce (2002) states that a well-written radio story should eschew pocket tutorials. This programme was designed to challenge this theory and was designed as a pocket tutorial with only a few short chapters, mini-tutorials in themselves. The listener receives an overview of the prospects of future wind energy exploitation on the Maltese Islands, throughout the 15-minute duration of the programme.

For a pocket radio tutorial to be successful, a good structure needed to be developed, one that increased the chances of the listener remembering the main points of the programme. The structure that best fitted these requirements was the one used by RAI (Radio Audizioni Italiane/ Radiotelevisione Italiana), the Italian public service broadcaster. The programme was divided into three-minute sections of information, followed by a few seconds of music (Ciampa, 2004). Radio programmes in Malta mimic BBC broadcasts (especially BBC World Service), during which there is a lot of speech and a sparse use, or a total lack of music. Thus, the RAI programme structure was also selected to make the programme stand out in the crowded radio programme arena. Joyce's (2002) argument compares radio programmes to a train, in that once the listener stops listening (alights the train) they cannot resume listening to the programme (board the train) again. The final programme structure, together with the use of summaries for the main sections were aimed at challenging this theory. The frequent pauses and summaries offered numerous opportunities for the listener to 'hop on again.'

Research in psychology about the primacy and recency effects on the recall of data (eg. Atkinson and Shiffrin, 1968; Baddeley, 2000; Wiswede, Rüsseler and Münte, 2007) was used during scripting. Memory recall and understanding were deemed to be important for radio programmes in general, and for radio programmes about a science subject in particular.

The 15-minute programme was divided into six parts: an introduction, four sections, and a conclusion. The introduction gave an outline of what the programme was about. This was then followed by a few seconds of music and the main four sections (Table 1). The programme concluded by giving an overview of the main points discussed.

Table 1: Short Description of the Four Main Sections of the Programme.

Section №	Short Description
1	Contained a justification of the topic chosen, and explored eolic energy in relation to other sources of renewable energy. It then continued with some basic information about eolic energy, and ended with a 30 second summary.
2	Overview of the local situation. Climatic and geographical issues were presented and analysed. This section ended with a short summary.
3	A short feature where popular myths about harnessing wind energy were debunked and truths were clarified.
4	In this section the delicate areas of tourism and the environment were tackled. The listeners were given an idea of how wind farms might impact, positively and negatively the environment and tourism.

The programme also included two guest speakers. The main guest speaker was given time to briefly talk about what was being done at his faculty at the University of Malta in regards to eolic energy. Editing of both interviews occurred sympathetically so as not to distort the interviewee's message. The programme was made available to the interviewees who could point out any distortions in their message before the final version was uploaded to the website.

Tourism, although not a scientific topic was important to cover as it is a key aspect of the Maltese economy. Also, this could have helped the listeners to view the science of wind farms in a wider perspective, and show that scientists can be interested in the broader implications of their work.

3.2 Evaluation

The radio programme was made available on a dedicated website and an audience recruited by convenience sampling, in the form of 'snowball sampling' (Wimmer and Dominick, 2003). In this way, the sample had a degree of autonomous selection, as would happen with people choosing to listen to a radio programme or a podcast. Participants had to be aged 16 or over. To take part in the research, participants were required to visit the site on which the programme was hosted, listen to the programme, and fill in a questionnaire.

An online questionnaire was designed to collect data about the participants. It was made up of 12 questions followed by a demographics section. The questions evaluated the programme, positive and negative aspects, language used, information recall and clarity of message. It also examined broader issues such as attitudes towards science and technology, in relation to other common activities and the existence of an audience for similar programmes.

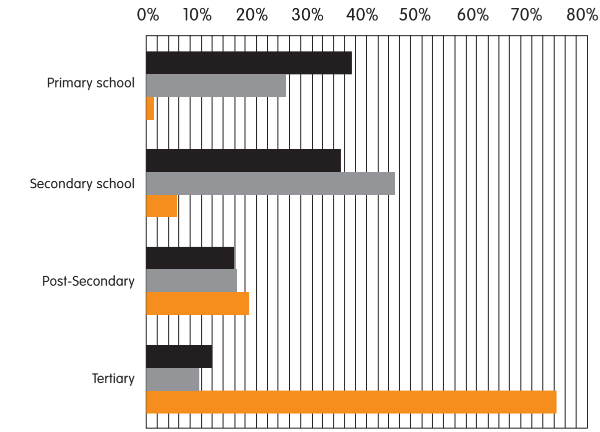
4. Results

In total, 256 respondents took part in the research. During data collection, the website received 891 visits, by 670 unique visitors (1 visitor = 1 computer). Most (75%) of the visitors were non-returning. There were 45 downloads of the programme. The response rate to the questionnaire cannot be reliably calculated as the number of unique visitors does not necessarily equate to the larger number of potential listeners.

4.1 The Audience

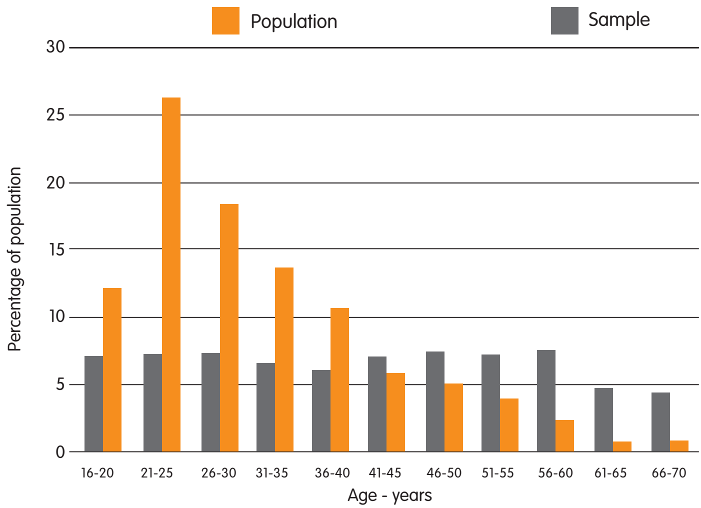
The gender distribution in the sample of participants (52% females; 48% males) is representative of the general population of the Maltese Islands (50.4% female; 49.6% male) (NSO, 2007). Three out of every four respondents (see Figure 1) had a university level of education, which was considerably higher than the average for Malta at one in ten (NSO, 2007). Listeners' age was also not representative of the general population; it mainly comprised of people aged 16 to 40, with pronounced peaks in the twenties and early thirties, as can be clearly seen in Figure 2.

Figure 1. Education of Sample



	Tertiary	Post-Secondary	Secondary school	Primary school
People in education - (NSO, 2007)	11.91%	15.86%	35.24%	36.98%
Highest completed level - (NSO, 2005)	9.60%	16.50%	45.30%	25.50%
Participants n=255	74.50%	18.80%	5.50%	1.20%

Figure 2. Age of Sample Plotted with Age of Population



4.2 The Programme

According to the audience, the programme was interesting (98%). The majority of the respondents also said that the level of detail in the programme was just right, verging onto slightly too detailed (Table 2).

Table 2: The Programme was Too Detailed - Not Detailed Enough

	Frequency	Percent	Valid Percent	Cumulative Percent	Cumulative Percent
Valid	-2 (Not Detailed Enough)	2	0.8	0.8	0.8
	-1	7	2.7	2.8	3.5
	0	98	38.3	38.6	42.1
	+1	120	46.9	47.2	89.4
	+2 (Too Detailed)	27	10.5	10.6	100.0
	Total	254	99.2	100.0	
Missing	-9	2	0.8		
Total	256	100.0			

All the participants (256) rated the programme as informative (Table 4). The majority of the participants also rated the programme as 'easy on the ear' (91%) and well structured (95%). The majority of the participants (96%) found the topic of the programme interesting. The other 4% comprised those who rated the topic as neutral (2%) and those who rated it just slightly not interesting. Clarity of explanations is an important aspect of radio production, especially when the topic at hand is complex. Almost all respondents (96%) said that the explanations were clear while 2.8% were neutral.

Over half of the sample (90%) agreed with the statement that the language used was easily understandable, while only 3.5% disagreed or strongly disagreed. One out of every five respondents was neutral about the amount of difficult words in the programme. Only 9% felt that the programme contained many difficult words.

The majority of participants (90%) agreed or strongly agreed that the interviewees were well chosen. Only a small proportion (10%) of the respondents were neutral or disagreed with the statement 'the interviewees were well chosen.'

4.3 Attitudes Toward Science Programmes on the Radio

When asked if they felt that there was a need for radio programmes similar to the one being evaluated, most respondents (89%) strongly agreed or agreed. A few respondents (10%) were undecided or neutral, while 2% of the respondents did not see a need for such programming. The results can be seen in Table 3.

Table 3: There is a need for Similar Programmes on Radio

	Frequency	Percent	Valid Percent	Cumulative Percent	Cumulative Percent
Valid	-2 (Strongly Disagree)	0	0	0	0
	-1	4	1.6	1.6	1.6
	0	25	9.8	9.8	11.4
	+1	64	25.0	25.1	36.5
	+2 (Strongly Agree)	162	63.3	63.5	100.0
	Total	255	99.6	100.0	
Missing	-9	1	0.4		
Total	256	100.0			

The participants were asked to state their agreement with the statement: 'should there be similar programmes on the radio I would listen to them.' Table 4 shows that most of the audience members were willing to listen to similar radio programmes. Those who were neutral or undecided constitute 16% of the sample. Only 5% of the respondents stated that they would not listen to similar programmes.

Table 4: Should There be Similar Programmes on Radio I would Listen to Them

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-2 (Strongly Disagree)	5	2.0	2.0	2.0
	-1	9	3.5	3.5	5.5
	0	47	18.4	18.4	23.8
	+1	90	35.2	35.2	59.0
	+2 (Strongly Agree)	105	41.0	41.0	100.0
	Total	256	100.0	100.0	

4

Responses to a qualitative question about what the audience liked about the programme covered a range of aspects. These included the amount of information, structure and organisation, use of summaries, explanations and its local feel. A number also commented on the programmes impartiality, honesty and balance. Far fewer responded to a question on the negative aspects, writing that they liked all aspects of the programme. However those that did suggested that the programme sounded scripted at times, used difficult words, used English language and was not at an adequate level for broadcast. A small minority also suggested the programme was not balanced.

5. Discussion and Conclusion

The programme was well received. The amount of information, the level of detail, the topic, and the structure were highly rated. The programme was described as interesting, informative, and easy to listen to. The explanations were clear, the language used was easily understandable, and the amount of difficult words used was appropriate. Most participants in this sample agreed that there was a need for science radio programmes in Maltese, and should such programmes be broadcast, suggested they would be willing to listen to them. This thus shows that there is scope for similar programmes in Maltese. This study also suggests that similar programmes in Malta would have a highly educated audience aged between 16 and 40.

The online recruitment strategy used in this study skewed the sample of participants. It excluded people with no internet access at home or at work. Thus, some citizens with a low income, low level of education, and the majority of the elderly were excluded. Internet use in EU25 (the first 25 countries to join the European Union) in 2004 is positively related with level of education and that people aged 15 to 24 use the internet more than other age groups (Ottens, 2005).

Future research in this field could explore further the audience for such programmes, for example, whether listeners are opinion leaders as this would influence the wider impact of such programmes in the community. Any future research seeking to deepen the insight about the audience of science radio programmes in Malta would benefit from being carried out over the duration of a programme series and using programmes aired on national and community radio stations, rather than the internet.

In light of the results of this study, it is recommended that future science radio programmes retain the structure that was used for this pilot, as it has proven successful. Finally, science communication via Maltese radio stations should not be overlooked as a feasible and well suited means of science communication (Mazzonetti, Merzagora and Tola, 2005).

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4

Demographics and Impact of Communications Training for Public Engagement with Science, Technology, Engineering and Maths

Joana Silva and Karen Bultitude

This paper is based on research carried out by Joana Silva as part of her MSc Science Communication.

1. Introduction

Science is an integral part of every aspect of modern life and in today's society public engagement with science is seen as of extreme importance (RCUK/DIUS, 2008).

In the UK, the communication of science, dialogue, public involvement, public engagement and science's social and ethical implications have become key aspects of science policy (OST/MORI, 2005). At the turn of the millennium the UK Office of Science and Technology (OST; now under the umbrella of the Department for Business, Innovation and Skills) emphasised that public perceptions of science play an increasingly important role in policy development (OST/The Wellcome Trust, 2000). More recently, it has been recognised that communication of research results can have a significant impact on members of the public, leading to changes in their views, attitudes and behaviour (The Royal Society, 2006a).

For this reason, key actors in science – researchers and explainers– are being called to engage directly with the public. In addition, recent research commissioned by Ecsite-UK (2007) argued that science and discovery centres are being increasingly seen as important locations for science and society to interact.

Several training programmes for public engagement with Science, Technology, Engineering and Maths (STEM) have been developed to provide researchers, alongside science and discovery centre staff ('explainers') with the support and direction they need to communicate more effectively. As described more fully in Silva and Bultitude (2009), these training programmes vary greatly in breadth, duration and focus, resulting in a wide range of opportunities for potential participants but also a lack of clarity as to what approaches best meet trainees' needs.

This research focused on two key groups of people who have a prominent place in science communication – researchers and explainers. In addition, the opinions of existing course trainers were also solicited in order to identify similarities and differences in their perceptions of the courses relative to those of their trainees.

1.1 Trainee Types

Active researchers (scientists, engineers, etc.) are the obvious gatekeepers of scientific knowledge to be communicated to members of the public; their direct knowledge of the subject matter and personal enthusiasm – often passion – for the topic is unparalleled. An OST/MORI poll showed that 'scientists are one of the most valued sources of information, support or advice about science' (OST/MORI, 2005:11). Furthermore, in the UK there is an 'apparent demand for more direct communication about science from scientists on their research' (RCUK/DIUS, 2008:5).

Simultaneously, many scientists recognise the importance of communicating their research to the public (OST/The Wellcome Trust, 2000), but also acknowledge their need for guidance and skills development (The Royal Society, 2006b).

A recent report on Public Attitudes to Science in the UK highlighted that a fifth of the population said they had visited a science museum or science centre in the 12 months prior to the survey and a quarter had visited a zoo (RCUK/DIUS, 2008). This means that the staff who 'facilitate the visitor's experience' at these venues (Rodari and Xanthoudaki, 2005) – explainers – have an important role in engaging public audiences with science and technology. Arguably, by improving the training and effectiveness of explainer-visitor interactions a substantial impact on society could be accomplished (DOTIK, 2007).

1.2 Research Focus

Very little is publicly known about the impact of the various existing training programmes on either researchers or explainers. Whilst many programmes do incorporate evaluation of the sessions into their structure, it is rare (usually for understandable reasons relating to commercial competitiveness) that these reports are made publicly available to enable wider learning. To date there has also been a lack of a wider investigation into the profiles of the people who attend STEM communication training programmes and the participants' perspectives on the effectiveness of those programmes. This research aims to fill that gap.

In order to provide an element of comparability a deliberate decision was taken to avoid programmes relating purely to media and PR (public relations) skills within the training programmes investigated. All the training programmes reported here involved direct (face-to-face) engagement with public audiences, which is a relatively unique feature of STEM subjects. This approach led to a focused sample that was of sufficient size to result in meaningful results.

This paper investigates the profile of delegates who attended such training courses, as well as their motivations and perceptions of the effectiveness of the training they undertook. Information on identified best practice in training methodologies and the impacts of such training is reported elsewhere (Silva and Bultitude, 2009). Whilst the overall sample size is too small to be able to claim generalisable findings, some interesting trends emerged which can be used to inform and enhance best practice in this area.

2. Methods

A combination of quantitative – online survey – and qualitative – semi-structured interviews – methods were used in this project. This approach is often referred to as mixed methods research and aims to provide more informative and complete research results (Johnson et al., 2007). The combination of a survey and interviews aimed to provide both breadth and depth to the research findings. The in-depth analysis afforded by the interviews complemented the broader overview provided by the survey results. For further methodological details, including the analysis approaches, see Silva and Bultitude (2009).

The online tool SurveyMonkey was used to design and run the survey. In order to reach a wide and geographically diverse audience in a timely manner the survey was advertised electronically on three major international science communication mailing lists: Psci-com, Big-chat and PCST-L. The survey link was initially distributed via group email, with a follow-up reminder sent out 11 days before the survey closed.

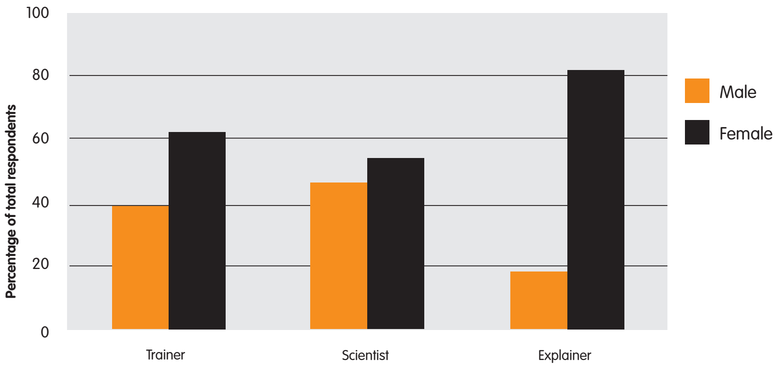
3. Results

The online survey was completed by 87 respondents in total: 39 trainers; 26 scientists; and 22 explainers. In total, 47 different training courses were covered. Not all respondents answered every question; for this reason the number of respondents (n) is indicated on each of the figures provided below.

3.1 Respondent Demographics

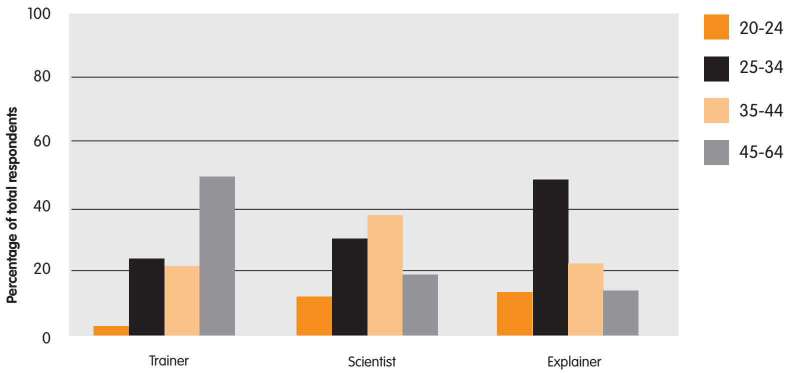
In all three groups there were a higher percentage of females responding to the survey than males. The greatest difference was observed for the explainers group, where 80% of the respondents were women (Figure 1).

Figure 1. Gender of the respondents, grouped by role in science communication. Trainer n=39; Scientist n=26; Explainer n=22.



The age distributions across the three groups were quite different. Within the trainers group the age of the respondents was skewed towards the older age ranges; half of the trainers were in the 45-64 age group, with age groups 25-34 and 35-44 accounting for 20% of the respondents each. The scientists' group is predominantly between 25 and 44 years old (69%). The explainers group is the youngest group, with 50% of respondents being in the 25-34 and 23% between the ages of 35 and 44 (Figure 2).

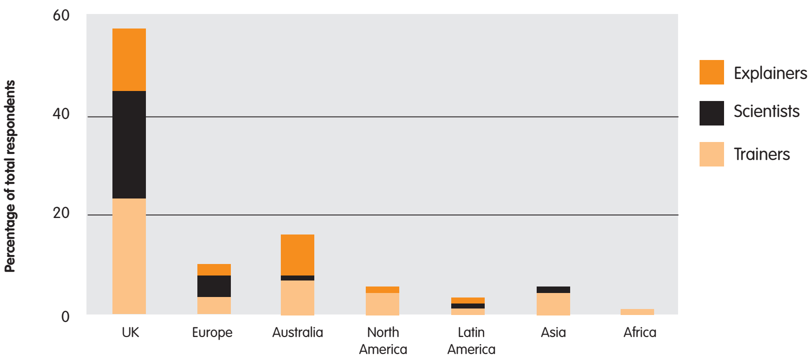
Figure 2. Age group of the respondents, grouped by role in science communication. Trainer n=39; Scientist n=26; Explainer n=22.



3.2 Geographical Location

While the majority of respondents for all groups were from the UK (58% across the three respondent types 'explainer', 'scientist' and 'trainer'), it is interesting to note a significant presence within both Australia (16%) and Europe (10%) (Figure 3).

Figure 3. Geographical distrubtion of the respondents. Trainer n=39; Scientist n=26; Explainer n=22.



3.3 Motivations

Within the survey respondents were asked to provide an open-response answer to what their motivations for attending training were. The majority of trainees (17 scientists and 17 explainers) attended training courses for personal development, as put by one respondent: 'to be a better science communicator'. In addition three scientists indicated that the training had been a requirement of their job, while seven explainers had more externally-oriented motivations relating to their audiences rather than to themselves personally, for example:

> *'To learn how to better apply communication skills in reaching the public and engage an audience.'*

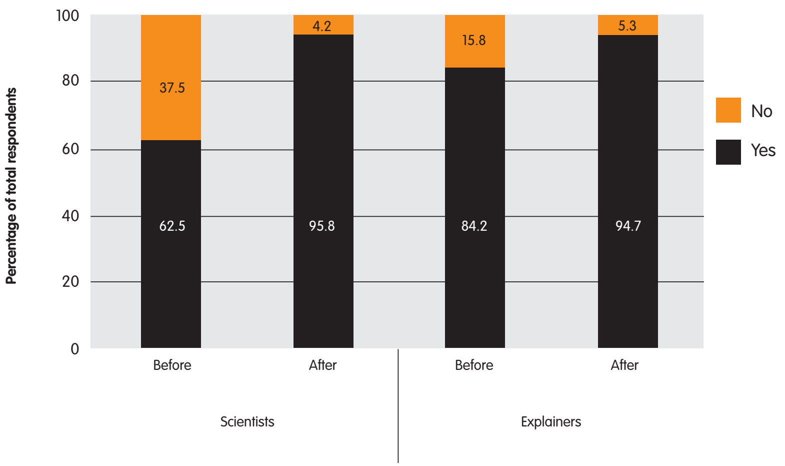
3.4 Participation in Science Communication Events

Although the percentage of scientists that had participated in public communications events before doing a training course on public engagement was already quite high (63%) there was a 33% increase in this percentage after attending the training (Figure 4). Only one scientist had not participated in public communication events after the training because:

> *'It's not been mentioned as an issue. This had made me think that it might be time for a refresher.'*

Most explainers had been involved in public communications events prior to the training (84%), however an increase was still registered (Figure 4). The one explainer who had not participated in public communication events after the training highlighted that they had only just finished the course, but that they intended to become active in the immediate future.

Figure 4. Participation in public communications events before and after attending the public communication training course. Scientists n=24; Explainers n=19.



4. Discussion

Trainees are motivated to attend training courses in public engagement and find them useful and helpful in improving their skills. This research identified a positive increase in participation in science communication events by trainees, reflecting their increased confidence and skills in engaging with the public.

4.1 Demographics

In all groups, the respondents were predominantly female (Figure 1), which follows that which was observed by Miller (2008) with regards to the science communication community (69% female). However, where Miller (2008) observed the community to be fairly young, with 73% between the ages of 20 and 40, this research yielded slightly different results based on role (Figure 2). While explainers tended to fall into a similar age distribution, the same cannot be said for trainers, where half (50%) of respondents were between 45 and 64. This can be explained by the experience one needs to gather before becoming an established trainer. Furthermore, the scientists' age distribution (predominantly between 25 and 44 years old) can be seen as a reflection of the age at which scientists begin their careers and start considering their responsibility and options as communicators of their research. It is also possible that the recruitment mechanism used in the research (online mailing lists) may have skewed the sample towards younger, more technologically literate individuals (PewInternet, 2009).

The explainers' age distribution within this research differs from that observed in a 2001 survey of explainers in the UK (Love-Rodgers and Kelly, 2001), with a shift towards a somewhat older demographic. Where the 2001 survey identified 33% of explainers in the 25 to 34 year old bracket, this study noted 50% of explainers within that age range. The same survey showed that in 2001, 30% of explainers were between 19 and 21 years old; in the current research only 14% were between 20 and 24 and none younger than 20 years old. Considering the time gap between the two studies, one explanation for this apparent discrepancy in age distribution might be that explainers are now staying on at their centres longer, with further career development opportunities available. The 2001 survey highlighted that interactive centres tended to employ people at the start of their careers, who were not so dependent on pay; this perspective may have changed in the intervening years. Another possible explanation would be the bias posed by the recruitment approach of this research (mailing lists), where only more established explainers, and thus older, are likely to be registered on the appropriate mailing lists.

All continents were represented in the survey. While this was not a foreseen scenario, it draws attention to the true international reach of the science communication mailing lists and shows the collaborative spirit of the science communication community worldwide. However, interestingly, 'trainers' strongly outweighed other respondents in North America, Asia and Africa – possibly indicating that while the very active experienced science communicators tend to subscribe to international mailing lists, trainees tend to be more at home with services that are related to their national perspective.

4.2 Motivation

The majority of trainees attend training courses on public communication for personal development. This result was also observed in explainers and scientists attending the DOTIK and Meet the Scientist programmes respectively (DOTIK, 2007; Webb and Mist, 2007). Motivation is key to the success of training (Reece and Walker, 1997) and the fact that trainees undergo training with a personal motivation is in itself a positive point that strengthens the courses. Linked to motivations for attending the course, trainees mentioned that acquiring new skills was an important benefit of undergoing training. Trainees also valued the opportunity to come into contact with different points of view and being presented with ideas they could transfer directly to their own work.

4.3 Participation in Events

Even amongst the small sample size participating within this survey there was an increase in involvement in science communication events after attending a training programme. This increase was observed for both scientists and explainers (Figure 4) although is more noticeable in the former group due to the higher proportion of participants who had not participated in science communication events prior to the training. This is a very positive message about training and the impact it has on promoting public engagement with science through scientists and explainers.

Also interesting was the variation in levels of previous experience amongst trainees (Figure 4). This indicates a real mixture of people attending training courses, including some who have experience of delivery along with complete newcomers (especially in the case of scientists). This has important implications for planning training sessions to suit both groups and supports the suggestion by Silva and Bultitude (2009) of tailoring the courses to the trainee group.

4.4 Improvements

Key recommendations regarding best practice in communications training for public engagement with STEM have been previously presented in Silva and Bultitude (2009). Whilst the trainees were generally positive about the overall programme content, there were some potential improvements that were identified. Some trainees particularly requested increased coverage of logistical concerns such as first aid and health and safety. From the interviews there was evidence that this was linked to a sense of empowerment that would allow them as deliverers to focus solely on their task. Covering these sorts of mundane but risk-related topics can make trainees feel more empowered to deal with the unexpected, and therefore more comfortable. In this scenario the trainees would then be able to focus more on their delivery rather than have to think what to do in the case something goes wrong.

5. Conclusion

The majority of trainees are female and tend to be younger than the course trainers. Trainees have mixed experience levels in public communication which must be accounted for within the course, further encouraging the tailoring of course content specifically to the groups involved. In addition to communications skills, some courses could benefit from including more logistical aspects such as health and safety or first aid.

This research reveals that trainees are generally personally motivated to attend training courses in public engagement with STEM, and there is good evidence of learning new skills and practical ideas. They find the courses useful and helpful in improving their skills and performance. Following training, the study shows an increased participation in science communication events.

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Can Interdisciplinary projects reduce the Science-policy gap?

Sharon Hall and Clare Wilkinson

This paper is based on research carried out by Sharon Hall as part of her MSc Science Communication.

1. Introduction

Effective science-based policymaking relies upon the effective communication of research outputs from scientists to policymakers and other societal groups. Scientists may lean towards a deficit model of knowledge transfer in the belief that good transmission of information leads to a reduced 'deficit' in knowledge (Lewenstein, 2006). However, a more appropriate model might be the public engagement model, which aims to engage citizens in active policymaking (Lewenstein, 2006).

2. Context of this Project

Policymakers cannot possibly have in-depth knowledge about every scientific area; therefore they are dependent on the people who inform them in order to achieve evidence-based policymaking (EBPM). Policymakers are under severe time pressure, particularly when responding to a new risk (such as that associated to a new disease) and need to process information quickly. A process hindered by the fact that the timing of research and policymaking cycles do not always match (Pawson, 2001).

The use of scientific jargon can impede communication between researchers, policymakers and the public. If scientific knowledge is not communicated effectively this can contribute to a science-policy gap, which has been defined as 'the difference in levels of confidence for a given scientific finding expressed by the scientific community and by society' (Bradshaw and Borchers, 2000: 3).

An additional challenge at the science-policy interface is that large-scale issues, such as climate change, do not map onto a single scientific discipline (Hinrichs, 2008). Interdisciplinary research (IDR) brings together different disciplines and is considered to be a good way to tackle such challenges (Shove and Woulters, 2006). It has been suggested that IDR programmes may also provide science policy that is more convincing to the wider public due to a wider expertise basis (Weingart, 2000).

IDR programmes have additional communication challenges as each discipline develops its own 'jargon' to rapidly communicate ideas within their own research groups. This can impede communication between researchers of different disciplines, policymakers and the public (Bracken and Oughton, 2006, Stilgoe et al., 2006). In IDR projects there is a need for research team members to translate between these different disciplinary languages, whilst keeping the research challenge as the focus (Shove and Woulters, 2006). In this paper we investigate if this translation process occurred within one project, the RELU Biopesticides project and if this improved knowledge transfer.

3. Methods

The Biopesticides Project was funded under the Rural Economy and Land Use (RELU) programme between 2004 and 2010. The RELU programme aims to encourage social and economic vitality of rural areas and promote the protection and conservation of the rural environment.

3.1 Semi-structured Interviews with an Identified Network

A series of semi-structured interviews sought to examine the contribution of IDR to knowledge transfer and communication with policymakers and other stakeholders. In total 6 semi-structured interviews were carried out, including interviews with a natural scientist (Natural Scientist 1) from the RELU programme, a natural scientist from the Biopesticides project (Natural Scientist 2) and one who had roles both as a natural scientist and a liaison between growers, suppliers and supermarket chains (Natural Scientist 3). In addition, interviews were carried out with a Social Scientist (Social Scientist 1), a representative of RELU (Representative 1) and a policymaker (Policymaker 1), who was a representative of the Pesticide Safety Directorate.

The semi-structured interviews evaluated the effectiveness of a wider range of communication strategies used by RELU; the impact of the Biopesticides project and the effectiveness of EBPM. Interviewees were sampled by the identification of a network and a snowball sampling approach, relying on referrals from initial subjects to generate additional subjects. The interview questions were open-ended and a pilot test was performed with two people not involved in this RELU project. Modified questions were then asked to all interviewees. Interviews were recorded and fully transcribed, before being coded on the basis of reoccurring themes emerging from the data. 26 themes were identified in total, each of which fell under 6 larger themes:

- Impacts of the RELU programme and RELU projects
- Evidence-based policymaking
- Effectiveness of the IDR approach
- Role of language modification within projects and with stakeholders
- Audience-Stakeholder groups
- Role of supermarket retailers

In this paper we will be examining the themes related to the effectiveness of IDR approaches and their contribution to effective communication, knowledge transfer and policymaking.

4. Results

4.1 IDR research in RELU

5 out of 6 interviewees referred to the IDR approach as a key aspect of the RELU programme's successful approach to tackling rural issues. Three interviewees referred to the success of the RELU programme as a whole, describing it as 'a shining example of how well they managed to bring together the information and get the outputs out to end-users' (Natural Scientist 1). Natural Scientist 2 described it as being the 'most successful' programme in terms of drawing together researchers from natural and social science backgrounds:

'I think there is an onus on [Natural] scientists to be socially responsible and that means being educated and working with social scientists as well. There is also a tradition when social science has seen itself as being commentators on natural science …… not engaging with them, but criticising them. Criticising them downstream, rather than working with them at the very beginning. I think RELU has addressed that.'

(Natural Scientist 2)

In general, it was felt that IDR underpinned EBPM and that IDR was 'the only effective way of influencing policymaking' (Representative 1). It emerged that a key aspect of the effectiveness of IDR was that it brings together diverse research groups and that 'big challenges' such as climate change 'can only be tackled effectively using a combination of social science and natural science' (Natural Scientist 2).

Bringing these diverse groups together necessitated the creation of relationships, for which 'trust' and 'rapport' were repeatedly referred to as being essential for effective IDR:

'We actually put a lot of effort into developing trust with some of our key stakeholders…[In other] projects we've always focused our work on getting stuff done in the lab, whereas I have now realised doing this project, actually doing stakeholder engagement is just as important.'

(Natural Scientist 2)

From the policymakers perspective the level of trust had built up to such an extent within the Biopesticides project that a project member was asked to deliver lectures on behalf of Pesticides Safety Directorate at a European conference. It was felt that the relationship-building that is a necessary part of IDR led to 'opening up communication and building that trust' (Policymaker 1), creating a strong sense of 'collaboration' and that doing this in a less 'formal' environment (which was created at the project's workshops) made it easier:

'Getting to meet people face to face, finding out their expertise and there being an element of the social side after the formal presentations, there was a chance to talk ….. I know there are people here that now have contacts, that if they have questions, they would be happy to contact someone.'

(Policymaker 1)

Another positive aspect of IDR is that it improves understanding between researchers of different disciplines and helps scientists 'formulate their questions in a relevant way, that the policymakers might understand, rather than just pursue their own individual 'ology' interest' (Natural Scientist 3). The social scientist interviewed similarly commented that:

'You need more than one disciplinary perspective in order to understand the problem and in order to think systematically about what possible solutions might be… [policymakers] think [the IDR approach] gives them a greater range of information, more integrated information and often a set of particular tools which they can [use to] address their policy problems.'

(Social Scientist 1)

4.2 Instigating the formation of a common language

IDR projects dictate that researchers of different disciplines have a dialogue about research challenges. They should gain a common understanding of those challenges and how their particular expertise can contribute to overcoming them. A common theme expressed by interviewees was the role that language modification played in communication amongst researchers of different disciplines and between researchers, policymakers and other stakeholders:

> *'There is a lot of quite complicated science, which needs to be conveyed, and we need to find the language to get that over. So that its not science boffins saying its right. The GM debate just proved that. If we don't get the message right and the way we explain that message right, then scientists will fail. So it [effective communication] is very important'*

(Natural Scientist 3).

The specific language of different disciplines was thought to act as 'an entry barrier to cooperation' (Social Scientist 1). All interviewees referred to having to understand 'jargon' used be researchers in different disciplines and that it was necessary to develop a 'common language' or a 'shared vocabulary' in order to communicate within projects and with stakeholders. Specifically referring to communication with policymakers it was stated that:

> *'They definitely need to change language on both sides. I think that is one of the fundamental problems; particularly natural scientists have with policymakers. They don't speak the same language at all'*

(Natural Scientist 3).

However developing the 'common language' would make it possible to 'reach out to those people who engage in the policymaking process' (Social Scientist 1). The social scientist interviewed went onto describe how the formation of a 'common language' between researchers from different disciplines had also challenged the way they approached their research, with the natural scientists making their work more 'deductive and theoretical' and Natural Scientist 2 agreed:

> *'I think, the social science component did influence how we used our biological work as well and we ended up focusing much more of our ecology work on how it impacted on environmental risk assessment… It's allowed me to develop my science thinking and it's been fun. I have done things I wouldn't have imagined of doing before the project started. I think I have grown as a person because of that.'*

(Natural Scientist 2).

4.3 The impact of the Biopesticides project on policy

It was generally felt that by influencing the Pesticides Safety Directorate the outputs of the Biopesticides project will play a role in the in the development of new regulations for Biopesticide approval and use, which could ultimately impact on policy. However issues were raised around the timing of research cycles and policymaking cycles, that policy can be 'slow to develop' and that this could mean that policymakers 'have their policies in place and then they look round for evidence to reinforce them' (Natural Scientist 2). It was stated that 'if people want their research to have an impact, then they have got to have direct links with the policymakers' (Natural Scientist 3), alluding to the importance of engagement with this appropriate stakeholder group, in this case the policymakers at the Pesticides Safety Directorate.

5. Discussion and Conclusion

RELU was funded between 2004 and 2010. It was established in the context of:

> *'major policy and institutional developments that together represented a qualitative change in the way that government thought about and dealt with rural issues and which in turn demanded an accompanying step change in research'*
>
> (Lowe and Philippson, 2006: 170).

The objective of this paper was to investigate if IDR approach used in the RELU Biopesticides project facilitated communication with Policymakers (and other stakeholders) and if this could lead to more effective EBPM. IDR approaches are generally driven by political goals in order address new challenges (Weingart, 2000). It is too soon to tell if the Biopesticides project will impact on policy development, although it was felt that it would contribute, along with other activities such as the REBECA (Regulation Of Biological Control Agents) project, to the formation of new regulations for biopesticide use.

Communication between researchers, policymakers and other stakeholders cannot be achieved if the language causes confusion due to the use of jargon (Bracken and Oughton, 2006; Stilgoe et al., 2006). In IDR projects, 'developing a common language and introducing colleagues from other discipline to one's own perspective, are described as key problems of interdisciplinary cooperation' (Thompson Klein 2000: 123). From the semi-structured interviews in this study it emerged that in the Biopesticides project, the natural and social scientists had to construct a 'shared vocabulary' in order to work together. This is necessary for IDR approaches and time should be incorporated into project design to allow for this (Shove and Woulters, 2006).

The 'Common Ground' Theory (Thompson Klein, 2000) suggests that communication presumes that a common frame of cognitive reference is found during an interaction between parties. It is further postulated that this will occur when the parties involved in dialogue mutually believe that they have understood what was meant during that dialogue, 'well enough for current purposes' via the process known as 'grounding' (Clark and Brennan, 1991). In IDR projects difficulties arise in finding a common ground when researchers discover that they use the same concepts with different meanings or conversely they have different terms for approximately the same concepts (Thompson Klein, 2000). Bracken and Oughton (2006) use the term 'dialects' to describe this and state that dialects, metaphor and articulation, are 'three overlapping aspects of language which play an important role in developing understandings between different disciplines' (Bracken and Oughton, 2006: 371).

Bracken and Oughton (2006) state that 'active listening' should accompany formation of a common language between disciplines, leading to a common understanding of the shared vocabulary and an added benefit evolves. The research becomes more understandable by policymakers and other stakeholders a point highlighted by the representative of RELU:

> *'I think the advantage of trying to get scientists from different disciplines to talk to each other is that they are forced to be more accessible and that makes it easier for the rest of us, because if they have to talk to each other in a common language and think about the words they use, it makes communication easier.'*

(Representative 1)

In this way IDR projects may produce more useful communication means for EBPM. Furthermore, in IDR projects 'conceptual links' are developed using 'the perspective in one discipline to modify a perspective in another discipline' (Thompson Klein, 2000: 6), apparent in the interviewees discussion of changing approaches to research challenges as a result of IDR.

The participants in the semi-structured interviews repeatedly talked about trust, rapport and relationship-building as a fundamental part of IDR approaches. It has been suggested that this is achieved through common understanding, derived from a shared language (Bracken and Oughton, 2006). The common understanding found in the RELU Biopesticides project improved communication between the interdisciplinary researchers and their key stakeholders, at the Pesticides Safety Directorate. The IDR approach encouraged by RELU facilitates the formation of 'common ground' language, which can improve knowledge transfer to, and communication with, stakeholders.

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Notes

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