ISSN 2041-6210

# UWE Science Communication Postgraduate Papers

**Editor:**
Ann Grand

## 2014 Volume 2

University of the West of England
BRISTOL

bettertogether

## Foreword

This second volume in the *Postgraduate Papers* series has been produced as part of the celebrations of ten years of Science Communication postgraduate programmes in the Faculty of Health and Applied Sciences, University of the West of England, Bristol.

Every year, some fifteen to twenty students undertake a Master's level project as part of their MSc studies. These papers represent just a small selection of the projects carried out between 2009 and 2013 but they persuasively demonstrate the wide range of subjects tackled by our students and the innovative research they conduct.

Bonnie Buckley, Jennifer Garrett and Melanie Davies looked at aspects of science communication in science centres and museums. Bonnie examined the motivations that lead people to be volunteers in science centres; Jennifer investigated how science centres can play a role in communicating environmental sustainability and Melanie explored how science centres can use a range of activities to sustain and develop creativity.

The Internet offers new modes and new routes for dialogue and science communication. Felicity Liggins, Mathieu Ranger and Robin Longdin undertook projects in this dynamic medium. Felicity explored attitudes to blogging in the UK Met Office, while Mathieu looked at the particular challenges faced by science bloggers and Robin investigated whether online interaction with scientists could positively affect school students' attitudes to science.

Amy Seakins, Maya Herbolzheimer and Sarah Venugopal's projects were all based in the lively and diverse world of festivals. Spanning the worlds of traditional and online communication, Amy considered how citizen science projects could make the most effective use of the media; Maya investigated the effectiveness of a Festival of Nature in engaging a wide range of attendees with nature conservation, while Sarah examined the relationship between arts and science at a science event embedded in an arts festival.

The final two papers, by Michal Jane Filtness and Alexander Brown defy grouping but clearly illustrate the variety of audiences our students address. Michal investigated researchers' views of the Pathways to Impact tool created by the UK Research Councils to increase the public impact of research, while Alexander evaluated the impact on school students' attitudes to science among young people who had undertaken work experience placements at a UK research council.

We want to congratulate those graduates whose research is included in this volume and thank them for the time and care they have taken in creating their contributions. Thanks should also go to the graduates' academic supervisors, who are the co-authors on these papers; in particular Dr Karen Bultitude and Dr Helen Featherstone, who are now based at other institutions. We would also like to thank the many organisations whose support made these projects possible.

We are honoured to share in our graduates' success and delighted to have this opportunity to open up their work to a wider audience. We wish all our graduates every success in their careers as science communicators.

Dr Ann Grand and Dr Clare Wilkinson (Programme Manager) April 2014

---

Science Communication Unit, University of the West of England, Bristol, Coldharbour Lane, Bristol BS16 1QY, UK

## Contents

# An investigation of motivations for volunteering in three UK science centres and museums

Bonnie Buckley and Erik Stengler

This paper is based on research carried out by Bonnie Buckley as part of her MSc in Science Communication.

## 1 Introduction

Formally volunteering for an organisation or group involves giving unpaid help that will benefit other people or the environment (Low *et al*., 2007). Motivations for volunteering are affected by personal attributes, social circumstances and the organisations' characteristics. The initial decision to volunteer can differ from the decision to sustain a continued commitment (Measham & Barnett, 2008). Volunteering provides opportunities for people to make a contribution to their communities and get something back (Institute for Volunteer Research, 2004).

### *1.1 Volunteering in science centres and museums*

Over 60 organisations are members of the UK Association for Science and Discovery Centres (ASDC). Collectively, they receive over 20 million visitors annually, who have the opportunity to engage with and enjoy scientific cultural experiences (ASDC, 2012).

Volunteers make extraordinary contributions to science centres and museums. In 2008, the Association of Science-Technology Centers (ASTC) reported there were 77,870 volunteers in 171 institutions world-wide. In 2008, the number of volunteer hours contributed at 166 of these organisations totalled 2,640,983 (ASTC, 2008). Volunteers in science centres and museums can assist with educational programmes and outreach, consult on exhibition development, serve on boards of directors or fill other important roles. They help provide additional services to visitors at minimal cost (Davison, 2001).

Volunteers can offer their real-world experiences and put a personal face on scientific feats; a scientist volunteering for a 'meet the scientist' event has the knowledge and capability not only to share their work but also to enlighten visitors about how the work relates to previous and future research. Volunteers also model exploratory behaviour and science process skills in engaging and non-threatening ways (Grinell, 2003).

This research investigated motivations for volunteering at three science centres and museums in the UK: Thinktank Birmingham Science Museum, Science Oxford and At-Bristol. Volunteers at Thinktank help achieve the museum's goal of showing how science and technology are part of our lives and influence how we live. The volunteers are recruited by task, to match Thinktank's needs with volunteers' skills, knowledge and

experience (Thinktank, 2010). In addition to hosting exhibitions and hands-on activities, Science Oxford has an active public events programme. Volunteers assist in running these events, which include stargazing, adult evening lectures and special theme days (Science Oxford Live, 2012). Volunteering at At-Bristol includes corporate volunteering, internships, 'meet the expert' volunteers, and individual volunteers. The volunteers help support activities in school holidays, in the schools' programme and on special theme days (At-Bristol, 2012).

### *1.2 Aims & objectives*

The aim of this project was to investigate motivations for volunteering from both the volunteers' and organisations' perspectives.

The objectives of the project were to:

- Gather motivations for why individuals choose to volunteer in science centres and museums.
- Collect information from the perspectives of staff members on why science centres and museums have volunteer programmes.
- Compare the results from volunteers and staff to identify similarities and differences in motivations.
- Identify any potential strengths, weaknesses and challenges that are caused as a result of similarities and differences in motivations.

## 2 Methods

### *2.1 Selection of science centres and museums*

Organisations were identified using ASDC's 2012 member list. Those with an active volunteer programme were contacted via email; this resulted in three organisations agreeing to take part: Thinktank, Science Oxford and At-Bristol.

### *2.2 Data collection*

The project used mixed methods. An online questionnaire was developed to gather quantitative data on individuals' motivations for volunteering. Veal (2006) recommends that previous research on the chosen topic should be referred to in designing a questionnaire; therefore, previous volunteer surveys and guidelines from the Institute of Volunteering Research (2004) were consulted. The questionnaire gathered demographic characteristics (e.g. age), volunteer behaviour and volunteer motivations, interest in STEM (science, technology, engineering and maths) subjects and previous visits to the organisation. After a pilot stage, the questionnaire's web link was sent to the primary contact at each organisation, who emailed the link to all active volunteers in the organisation.

To support a well-rounded understanding of the organisations' motivations for having a volunteer programme (Veal, 2006), semi-structured interviews were conducted with

staff members to gather qualitative data. The interviews began with a wide-ranging opening question, to encourage interviewees to begin talking about the volunteer programme (May, 2002). Subsequent questions included probes and prompts that guided interviewees to discuss how these motivations are or are not related to topics defined in previous general volunteering research (Gillham, 2005). The topics for the questions were:

- Motivations for contributing to local community
- Motivations for social interaction
- Motivations for opportunities for personal development
- Motivations for development and expansion of offerings
- Motivations for learning in STEM subject areas

Three staff members were interviewed at each organisation. These included the person responsible for managing the volunteer programme, a person who worked directly alongside volunteers on projects and activities, and one who did not directly work with volunteers but was aware of the volunteer programme. Together, these three staff members provided a representation of the motivations for having a volunteer programme. Each interview was audio recorded and transcribed for analysis.

### *2.3 Data Analysis*

A parallel mixed analysis method was taken to analyse the data. Results from the attitude and behaviour sections of the questionnaire were used to identify motivating factors for volunteering. Comparisons were made between responses in demographic questions and attitudes and behaviour questions to identify any correlations.

The coding of the interview data involved three steps: identifying, organising, and interrelating themes (Osborne, 2008). Key, substantive points were identified and organised into categories, enabling the identification of significant themes.

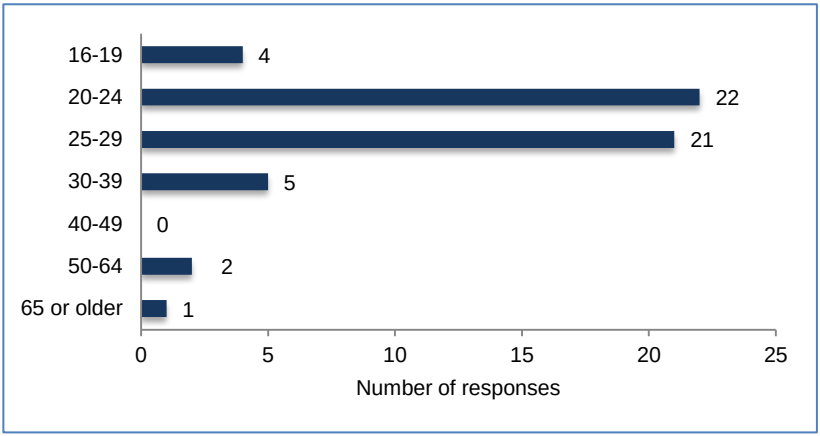
The final step was to compare the two data sets. Motivating factors for both volunteering and having a volunteer programme were found in the questionnaire and interview data. Comparisons were made to identify similarities and differences in motivating factors between the volunteers and the organisations.

## 3 Results

### *3.1 Volunteer characteristics*

Fifty-five volunteers completed the survey, ranging in age from 16 to over 65 (see Figure 1). Volunteers were either interested or very interested in science and technology (98%, n=55) but most (76%) had either never visited the organisation or visited only once before volunteering.

**Figure 1: Volunteers' age range**




*3.2 Volunteer motivations*

Overall, 46 (84%) of respondents said that they sought to personally benefit from their volunteering experience. The greatest motivating factors identified included giving back to others in the community, participating in local events and activities, improving communication skills and interacting with others.

Volunteers were also asked an open-ended question to state more specifically why they chose to volunteer in science centres and museums. Volunteer 10 stated:

> *[I volunteer to] give back to the community. It sustains my interest in science and technology and helps me to inspire younger people in my role as a teacher.*

This interest in giving back to others in the community was a motivating factor for 89% of the volunteers. Similarly, 87% of the volunteers expressed an interest in being able to participate more in local events and activities. Improving communication skills was an additional motivating factor identified through the survey. Volunteer 44 stated:

> *I wanted to be involved in teaching science to the public as I believe science communication is important and this organisation allows me to accomplish this as a volunteer.*

The motivating factor identified by Volunteer 44 was reflected in the whole group: 88% of volunteers expressed an interest in improving communication skills and 95% of the volunteers sought to gain new skills through volunteering.

### *3.3 Staff interviews*

Motivations for having a volunteer programme were identified through the nine staff interviews (see Table 1). The two greatest motivating factors for having a volunteer programme were the desire to enhance and add value to the visitor experience and to have the ability to expand offerings and do more with the available extra hands:

> *The original motivation was to bring in that experience and add that capacity to the organisation which means you can do all sorts of things* (Interviewee 8)

**Table 1: Motivations for having a volunteer programme**

| Motivating factor | Example | Interviewees: |
|---|---|---|
| Enhance and add value to the visitor experience | *...being able to do something additional, something extra on top of what we would normally offer that benefits both the visitors and the volunteers and the staff...* (Interviewee 2) | 9 of 9 |
| Expand offerings / do more / have extra hands | *...to have capable help and more hands...* (Interviewee 6) | 9 of 9 |
| Engage with audiences in a different way | *...allowing people [the volunteers] to engage at a different stage in their life and in a different way with the museum...* (Interviewee 2) | 8 of 9 |
| Widen awareness of organisation | *...it creates a host of ambassadors for the organisation who can talk about it in a positive and knowledgeable way....* (Interviewee 9) | 8 of 9 |
| Build relationships and networks | *...it's a first step in building a relationship...we want people to stick around and help us to create something…* (Interviewee 9) | 8 of 9 |
| Embed the organisation more in the local community | *…giving people in our local communities the opportunities to interact with their local science museum and gain experience...* (Interviewee 1) | 6 of 9 |

An added challenge in being able to expand offerings and increase engagement is the cost of running each additional event and having additional people. Being able to enhance the visitor experience and increase what is being offered but at a minimal cost was identified as a motivating factor for having a volunteer programme:

> *Having more people for no extra money. It sounds kind of harsh but we can maximise our impact and our engagement but at a small cost. We can engage with a lot more people and we can make their experience better and do it on a small budget.* (Interviewee 5)

In contrast, Interviewee 8 stressed that volunteers were not sought to replace paid employees, rather to add value and have a worthwhile experience. They provide something that the organisation is unable to do with paid staff alone. Interviewee 1 described this as:

> *I sort of visualise them as the cherry on the cake almost. The staff are the icing and they are just the extra, the cherry that enables us to give that extra 10%.*

## 4 Discussion and Conclusion

### *4.1 Motivating factors for volunteers*

The greatest motivating factors for the volunteers were identified as:

- To interact with others
- To give back to others in the community
- To improve communication skills
- To participate in local events and activities

Overall, 84% of volunteers sought to personally benefit from volunteering. This was particularly shown in volunteers who were motivated to improve communication skills. These responses can be explained by the age characteristics of the volunteers surveyed: 47 volunteers (85%) were under 30. This reasoning is supported by Ockenden & Russell (2010), who explained that motivations to volunteer can be affected by the stage at which a person is in life. Younger people seek to focus on improving and gaining new skills to increase the potential for opportunities such as future employment.

The motivation to give back to others in the community was shown in 89% of the volunteers. This is supported by findings from The National Survey of Volunteering and Charitable Giving (2007), which observed that altruistic reasons led the decision to become involved as a volunteer. More specifically, the volunteers expressed a desire to share their interest in science and technology with others in the community and inspire younger audiences.

### *4.2 Motivating factors for organisations*

The greatest motivating factors for the organisations were identified as:

- To enhance and add value to the visitor experience
- To expand offerings, do more and have extra hands
- To engage with audiences (specifically volunteers) in a different way
- To widen awareness of the organisation
- To build relationships and networks
- To embed the organisation more in the local community

The nine staff interviewees identified the two greatest motivating factors for having a volunteer programme as the desire to enhance and add value to the visitor experience

and to have the ability to expand offerings and do more with the available extra hands. Extra support from the volunteers supports additional activities, shows and more one-to-one interactions with visitors in exhibitions. More specifically, volunteers who are career scientists offer opportunities for the organisation to hold events such as 'meet the scientist', offering audiences a new perspective.

### *4.3 Comparing volunteers' and organisations' motivations*

Volunteer and organisation motivations have the potential to complement one another. In general, volunteers are primarily motivated to improve communication, interact with others and give back to others in the community. By developing and supporting a volunteer programme, the organisations provide an opportunity for these volunteers to have an experience that fulfils their motivations. The presence of the volunteers allows the organisation to address its motivations for supporting the volunteer programme.

Within science centres and museums, volunteers have the opportunity to communicate with visitors, staff members and other volunteers through the activities, programming and events they are assisting with. Their added presence supports the organisations' motivation to have the capability to do more with the extra hands that are available. The organisation is also motivated to add value to and enhance the visitor experience. Volunteers add to this capacity by increasing the amount of possible programmes, events and day-to-day interactions, while adding their passion and interest in science and technology.

Another matching motivation between the organisation and the volunteer is the desire to do more for the community. The organisation would like to improve its status as a local community resource. It is motivated to have volunteers to do more within the community but also give additional ways in which members of the community can interact with their local science centre or museum. The volunteers seek to give back to others in the community. By getting involved in volunteering, they are given a platform from which they can share their knowledge of science and technology with the community. Together, they are able to embed the organisation within the community as a local resource.

Interviewee 9 expressed initial doubts regarding the volunteer programme and subsequent realisation of the opportunities for excitement, added enthusiasm and experience:

*I have to say I was quite cautious when the whole volunteer programme started, I could easily see what was in it for us but I struggled to see why people would necessarily want to do it and I suppose in a way I think I'd forgotten why I'd initially joined the organisation because it was an exciting place to work where I got to meet a whole hoard of bizarre and interesting people and share the excitement of their day out and having fun. Once you manage to get yourself back there, you remember that when I first worked here I used to really look forward to a day on the floor. Even though it was really tiring and it was really hard work, 99% of people are having fun and you just get to feed off that in a way.*

## 5 References


Association of Science-Technology Centers (2008) *Science Center Highlights*. Washington, DC: Association of Science-Technology Centers Incorporated.

At-Bristol (2012) *Volunteering and Internships*. Available from: http://www.at-bristol.org.uk/volunteer.html Accessed September 2012.

Davison, J. (2001) *Ready, Set, Go! Maximizing Success with Museum Volunteers*. In: Association of Science-Technology Centers (2001) *Dimensions*. Washington, DC: Association of Science-Technology Centers Incorporated.

Gillham, B. (2005) *Research Interviewing: The Range of Techniques*. Open University Press: Maidenhead.

Grinell, S. (2003) *A Place for Learning Science: Starting a Science Center and Keeping It Running*. Washington, DC: Association of Science-Technology Centers Incorporated.

Institute for Volunteering Research (2004). *Volunteering Impact Assessment Toolkit: A practical guide for measuring the impact of volunteering.* London: Institute for Volunteering Research.

Low, N., Butt, S., Ellis Paine, A. and Davis Smith, J. (2007) *Helping Out: A national survey of volunteering and charitable giving*, Cabinet Office: London

May, T. (2002) *Qualitative Research in Action*. London: SAGE Publications.

Measham, T.G., Barnett, G.B. (2008) Environmental Volunteering: motivations, modes and outcomes. *Australian Geographer*. 39 (4) 537.

Ockenden, N., Russell, J. (2010) The volunteer journey: people moving into and out of volunteering over their life course. *NCVO/VSSN Researching the Voluntary Sector Conference*. Leeds, 6 September 2010.

Osborne, J. (2008) Mixed Methods Research in the Social Sciences. *Best Practices in Quantitative Methods.* London: SAGE Publications.

Science Oxford Live (2012) *What's On*. Available from: http://www.scienceoxfordlive.com/whats-on Accessed March 2012.

Thinktank (2010). *Thinktank Birmingham Science Museum Volunteer Policy*. Available from: http://www.thinktank.ac/core/core_picker/download.asp?id=2652 [Accessed March 2012.

UK Association for Science and Discovery Centres (2012) *About Us*. Available from: http://sciencecentres.org.uk/about/ Accessed September 2012.

Veal, A.J. (2006) *Research Methods for Leisure and Tourism: A Practical Guide*. Essex: Pearson Education Limited.

## 6 Acknowledgements

A large thank you to the participating organisations in this research project: Thinktank Birmingham Science Museum, Science Oxford and At-Bristol. Many thanks to each of the 55 volunteers and nine staff members at these organisations who made this project possible by sharing and reflecting on either their personal motivations for volunteering or the motivations for supporting a volunteer programme within the organisation.

Thank you to Dr Penny Fidler and Dr Michaela Livingstone at the Association for Science and Discovery Centres for their assistance in making initial contact with the organisations participating in the project.

---

Miss Bonnie Buckley (bonnie.buckley@at-bristol.org.uk)
At-Bristol, Anchor Road, Harbourside, Bristol, BS1 5DB

# The building as an exhibit: communicating environmental sustainability in science centres

Jennifer Garrett and Erik Stengler

This paper is based on research carried out by Jennifer Garrett as part of her MSc in Science Communication.

## 1 Introduction

### *1.1 Governance of and public engagement with environmental sustainability*

The past two decades have seen a growth in the realisation that our current way of life on the planet is unsustainable. Businesses, organisations and individuals are increasingly moving towards 'sustainable development' for the future. The term can be traced to the United Nations (UN) 1987 *Brundtland Report* of the World Commission on Environment and Development: 'sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987, p.1).

There has been a trend to govern sustainable development at the level of the individual, to encourage behaviour change. Public participation in pro-environmental behaviour is crucial for this to be successful (Barr, Gilg & Shaw, 2011). Despite a wide recognition of key environmental challenges in the UK, public engagement with these issues is varied (Featherstone *et al*., 2009). Perceived constraints to engagement can occur through a lack of awareness, concern or action, and are contextual (Lorenzoni, Nicholson-Cole & Whitmarsh, 2007).

The Department for Environment, Food and Rural Affairs' (Defra) *Framework for Environmental Behaviours* (Defra, 2008) produced an audience segmentation model that identified seven publics according to their willingness to act on 12 pro-environmental behaviours. This model was developed into the *Framework for Sustainable Lifestyles* (Defra, 2011), producing nine priority areas of pro-environmental behaviours and sub-behaviours, covering areas of consumption including food, travel, energy and household products.

### *1.2 Visitor attractions and environmental sustainability*

Environmentally sustainable strategies are of increasing importance to visitor attractions. The World Association of Zoos and Aquariums (WAZA) recently laid out sustainability principles for its members, stating the importance of leading by example. A series of actions for implementing sustainable practices to reduce environmental impact was recommended, including installation of renewable energy systems and use of ethical products (de Herder & Streiter, 2010).

In the UK, science centres and museums are visited by 20 million children and adults each year. The potential for science centres to deliver education for sustainable development is significant. However, there is little evidence of how science centres are adopting sustainable practices and communicating environmental sustainability. Science centres that communicate sustainability tend already to have an environmental focus.

A report by the UK Association for Science and Discovery Centres (ASDC) proposed a framework of 16 'impact' indicators for the sector, one of which included the 'number of people engaged specifically with environmental and sustainability projects' (ASDC, 2010, p.35). However the sustainability of the centres themselves was not referenced. To date there is no set of recommendations for science and discovery centres to implement sustainable practice on site or to engage the public with this.

### *1.3 At-Bristol as an environmentally sustainable science centre*

At-Bristol is a science centre situated in central Bristol, UK. The centre is housed in a renovated Grade II-listed former railway shed. The architects used the original building features and innovative sustainable technologies to ensure the centre consumes as little energy as possible. The cutting-edge low-energy building features and sustainable organisational practices have contributed to At-Bristol winning a number of awards. However, although sustainability is included in the core organisational values of At-Bristol, to date the centre has not communicated this to visitors; the public cannot readily access sustainability information on site.

### *1.4 Aims and objectives*

This study investigated the attitudes and behaviours towards environmental sustainability among At-Bristol visitors and their perceptions of At-Bristol as a sustainable science centre. It also investigated the sustainability communication of environmental science centres. The following objectives were identified:

- Determine the level of sustainability awareness of At-Bristol visitors in general, as well as their knowledge of At-Bristol's sustainability practices specifically, through a survey of visitors.
- Discover how other science centres in the UK communicate sustainable features to the public, through semi-structured interviews with on-site interpretation managers.
- Produce a set of recommendations for At-Bristol to inform on-site communication of the centre's sustainability.

## 2 Methods

This study used quantitative surveys, qualitative interviews and case studies. A survey of visitors (n=82) to the At-Bristol science centre was conducted to investigate their environmental attitudes and behaviour and also their perceptions of At-Bristol as a sustainable organisation. A definition of 'environmental sustainability' was included at the beginning of the survey and three 'sustainability facts about At-Bristol' towards the end.

The survey used mostly closed questions to obtain quantitative, demographic data, as well as two open-response questions that allowed visitors to comment on their own sustainable behaviours and their perceptions of At-Bristol's sustainable practices. Answers to the question: 'Please list examples of how you act environmentally sustainably' were categorised according to nine headline behaviours, key behaviours and sub-behaviours (Defra, 2011). Questions were prepared and piloted with the co-operation and approval of At-Bristol staff.

The Eden Project, in England and the Centre for Alternative Technology (CAT), in Wales were selected as case study centres to provide context on how environmental sustainability is currently being communicated to the public. The Eden Project aims to reconnect people with their environments and CAT to empower people to live a more sustainable life. Both are members of ASDC.

People responsible for communicating information about environmental sustainability to the public were interviewed. A semi-structured interview, with open questions, was created to investigate the general aims, current sustainability communication, target audiences and the aims and objectives of current interpretation on site for each centre. The interview schedule was piloted with a member of the At-Bristol staff responsible for exhibition content and then modified to ensure clarity.

## 3 Results

### *3.1 At-Bristol survey*

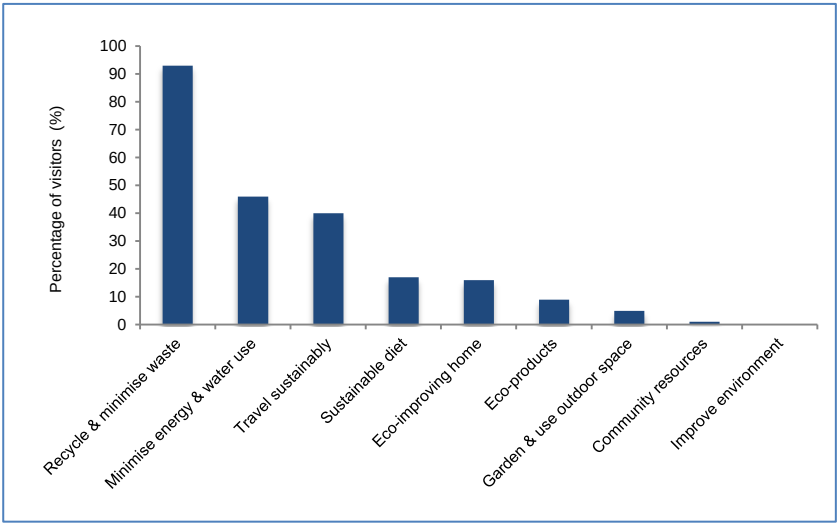
All At-Bristol visitors indicated that environmental sustainability was 'moderately' to 'extremely' important to them in general. Over two-thirds stated that they 'often' (57%) or 'always' (11%) acted sustainably on a daily basis.

Respondents provided a mean average of 2.3 sustainable behaviours, categorised according to the Defra (2011) *Framework*. Almost all (93%) respondents mentioned recycling and waste-related behaviours and nearly half (46%) said that they try to save energy and / or water around the home (see Figure 1).

Around half of visitors (49%) stated that they perceive At-Bristol to consider environmental sustainability somewhat more than similar visitor attractions. However, when asked how At-Bristol acts sustainably, more than a third of respondents answered

'don't know' (35%). A third (33%), said At-Bristol acted 'somewhat more' sustainably than similar visitor attractions. When asked to provide examples of how At-Bristol acted, 50% of those surveyed could not provide a response and 30% stated an example relating to recycling (see Figure 2).

**Figure 1: Visitor examples of sustainable actions (n=82; multiple responses)**




Immediately before hearing sustainability information about At-Bristol, 60% of visitors surveyed claimed they were 'moderately' or 'very' interested in finding out more about the sustainability of At-Bristol. After hearing the information, this increased to 78%. Over three-quarters (78%) agreed that the information had changed their opinion of At-Bristol. When asked how they'd like to access sustainability information about At-Bristol the top three answers were: webpage (59%), hands-on exhibit (52%) and information boards (40%).

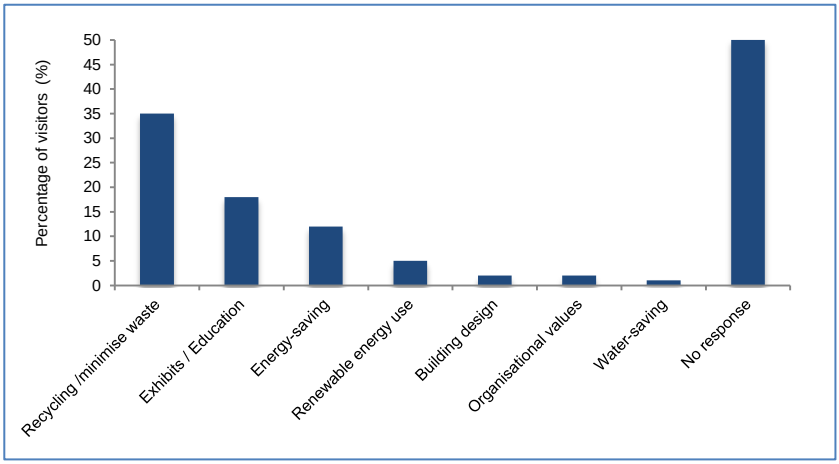
### *3.2 Interviews with staff from environmental science centres*

Interviews with interpretation managers found that they communicate sustainability to their visitors primarily through practice:

> *... it's about showing what we do, how and why we do it. The environmental sustainability permeates throughout the site, because its core to who we are and why we are here.* (Eden Project interviewee)

> *So [sustainability is] in everything we do. How we practice, how we make the lights come on, how we deal with the poo and pee of all the visitors ...* (CAT interviewee)

**Figure 2: Visitor examples of At-Bristol's sustainable actions (n=82; multiple responses)**




The built environment plays a key role in communication at both sites, with sustainable design an important consideration for their buildings. Both sites communicate how the buildings were made, their physical structure and how they work to visitors.

Both centres cited the importance of positive examples of human impact on the environment. Highlighting negative impacts was not a favoured method. Storytelling and site tours were cited as preferred methods of engagement for both, however financial constraints were also pointed out:

> *If we had more resources we'd have more staffing and more people out there talking to people.* (CAT interviewee)

The role of the centre in a wider global mission for sustainability was referenced in both interviews. This was outlined as delivering a sustainability message, with a motivation to inspire visitors to reconnect with their environment but also encourage wider behaviour change:

> *...Eden is about providing the starting point for people to discover and go 'well we live on an amazing planet, it's incredible, I want to find out more about it'.* (Eden Project interviewee)

> *...I think that's something the government should be leading on really, using science and discovery centres to get messages out, because there are some major behaviour change messages the government needs to deliver and this is what we do.* (CAT interviewee)

## 4 Discussion and Conclusion

Science centres and museums have a role in promoting behaviour change, although this is more likely to occur among visitors with values that already match those of the organisation (Featherstone, 2008). This study found that At-Bristol visitors feel that environmental sustainability is personally important; therefore the At-Bristol audience may be a particularly captive audience for on-site information about sustainability.

There is often a gap between self-reported pro-environmental values and actions (Kollmus & Agyeman, 2002). Many respondents said they were concerned about environmental sustainability but most behaviours offered were small-scale and part of a domestic routine, such as recycling. This is reflected in the literature in sustainability communication and behavioural change. Small changes at home are an easy route to a more sustainable lifestyle but key travel and leisure behaviours, such as not flying on holiday, tend not to be considered, despite having much greater impact (Barr, Gilg & Shaw, 2011).

Visitors perceived At-Bristol to hold sustainable values more than similar visitor attractions. However visitors were unsure what At-Bristol actually does to be sustainable, with the exception of recycling. This could be explained by the lack of information available to visitors on site. Although At-Bristol has implemented a sustainability drive, much of this information is not displayed to visitors. Zoos and aquariums are increasingly implementing sustainability plans to reduce their environmental impact (de Herder & Streiter, 2010), and communicating this to the public. To date, there are no guidelines for science centres to reduce their environmental impact or communicate sustainability.

Interviews at the case studies, the Eden Project and the CAT, revealed they both currently communicate their sustainability by communicating through practice, emphasising positive solutions to environmental change and demonstrating the role of the centre in the global picture of sustainability.

Leading by example is a fundamental role of organisations in influencing pro-environmental behaviour (Defra, 2011). If sustainable consumption is to be brought into the mainstream, responsibility must be shared among governments, businesses, communities and individuals. Although a range of sources contributes to environmental learning, science centres have a considerable impact on their local community (Falk & Needham, 2011). Increasing communication about environmentally sustainable visitor attractions may challenge 'externalised' responsibility for the environment and encourage action. By demonstrating sustainable technologies and low-carbon buildings, visitor attractions can show individuals and communities what is achievable (Lorenzoni, Nicholson-Cole & Whitmarsh, 2007).

Both the Eden Project and the CAT use a positive method of sustainability communication, focussing on solutions rather than causes of environmental problems. Research has shown that methods aimed at influencing behaviour using negative scenarios are less successful (Corral-Verdugo, 2012). At-Bristol has won awards for being an environmentally-sustainable business and so is ideally placed to demonstrate to its visitors, and its local community, what is achievable.

By using methods of sustainability communication, At-Bristol can use the building as an exhibit to 'preach what they practice' and demonstrate their sustainability. A list of recommendations was compiled for At-Bristol in the light of this study's findings:

- Expand communication of sustainable technologies and practices to visitors throughout the centre. Sustainability is core to At-Bristol's organisational values; therefore it is appropriate to communicate features to visitors.
- Increase awareness of sustainable features. Expand current communication beyond schools and professionals to other audiences, including members and visitors, and also the wider community at community open days.
- Increase the visibility of the sustainability pages on the At-Bristol website and promote current visitor incentives for sustainable travel to the centre.
- Seek to develop on-site information boards and a hands-on exhibit about the building's unique features.

Science centres should share and review their practices, their responsibilities for reducing their environmental impact and how they communicate the importance of sustainability. Science centres have the potential to contribute an important element to sustainability policy, due to their expertise in communication, as argued by the European network of science centres and museums (Ecsite, 2012) in an address to the United Nations before the Rio+20 United Nations Conference on Sustainable Development. It is recommended that the science and discovery centre community join zoos and aquariums in implementing and communicating sustainable practices to demonstrate their actions to the public:

- The science centre sector should seek to work collaboratively in compiling recommendations and actions to implement sustainable practice.
- Attractions that currently, or seek to, operate with low environmental impact should communicate their practices and technologies to visitors.
- Expertise in communication about sustainability practice should be more readily shared within the visitor attraction sector.

## 5 References

Association for Science and Discovery Centres (2010) *Assessing the impact of UK Science and Discovery Centres: towards a set of common indicators*. Bristol: ASDC.

Barr, S., Gilg, A., and Shaw, G. (2011) 'Helping people make better choices': Exploring the behaviour change agenda for environmental sustainability. *Applied Geography*, 31, 712.

Corral-Verdugo, V. (2012). The positive psychology of sustainability. *Environment, Development and Sustainability*, p.1.

Defra (2008) A framework for pro-environmental behaviours. London UK: HMSO. Available from: http://archive.defra.gov.uk/evidence/social/behaviour/documents/behaviours-jan08-report.pdf Accessed February 2014.

Defra (2011) *Framework for Sustainable Lifestyles*. London UK: HMSO. Available from: http://archive.defra.gov.uk/environment/economy/documents/sustainable-life-framework.pdf Accessed February 2014.

de Herder, J and Streiter, C. (2010) *Sustainability to Implement*. BSc, Van Hall Larenstein University of Applied Science: World Association of Zoos and Aquariums. Available from: http://www.waza.org/files/webcontent/1.public_site/5.conservation/environmental_sustainability/Sustainability_Thesis.pdf Accessed February 2014.

Ecsite (2012) *Science centres and museums: Public partners in Rio+20* [online]. Produced for Ecsite by Small World Stories. Available from: http://www.youtube.com/watch?v=NOPGqY6oplw&feature=youtu.be Accessed February 2014.

Falk, J. and Needham, M. (2011) Measuring the impact of a science center on its community. *Journal of Research in Science Teaching*, 48, p.1.

Featherstone, H. (2008*) Risk Communication of Climate Change: stakeholder objectives and public responses*. PhD, University of the West of England, Bristol.

Featherstone, H., Weitkamp, E., Ling, K., Burnet F. (2009) Defining issue-based publics for public engagement: climate change as a case study. *Public Understanding of Science*, 18, p.214.

Kollmus, A., and Agyeman, J. (2002) Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behaviour*? Environmental Education Research*. 8 (3), p.239.

Lorenzoni, I., Nicholson-Cole, S. and Whitmarsh, L. (2007) Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global Environmental Change*, 3-4, p. 445.

## 6 Acknowledgements

I would like to thank Chris Dunford, Emma Cook and the rest of the staff from At-Bristol for assistance during the project. I would also like to thank staff at the Eden Project and the Centre for Alternative Technology for their co-operation.

Miss Jennifer Mary Anne Garrett (jennifer2.garrett@live.uwe.ac.uk)
c/o Science Communication Unit, Faculty of Health and Applied Sciences, University of the West of England, Coldharbour Lane, Bristol, BS16 1QY

# Encouraging creativity: novel learning environments in science and technology centres

Melanie Davies and Erik Stengler

This paper is based on research carried out by Melanie Davies as part of her MSc in Science Communication.

## 1 Introduction

Despite the contested nature of creativity, there is little dispute that science, technology, engineering and maths (STEM) subjects are inherently creative disciplines, as they require inquiry, experiment, analysis and speculation, and draw on the powers of the imagination. Since these processes result in new understandings and innovative products, the 'critical' driving forces of the UK economy, it is not surprising that encouraging creativity within the STEM subjects has long been an aim of the National Curriculum (Hadzigeorgiou, *et al*. 2012). However, increasing competition from overseas markets (Work Foundation, 2008) and a decline in the number of students pursuing STEM (science, technology, engineering and maths) subjects (Schmidt, 2011), mean there has been renewed effort to allow students greater freedom in exploring the sciences creatively (Hadzigeorgiou, *et al*. 2012). This has included a movement of creativity-encouraging teaching practices from the classroom into science and technology centres. Being freer from the constraints of the National Curriculum and uniquely placed to design congenial environments for creativity, science centres have great potential to encourage creativity within the STEM subjects (Ecsite, 2008). While several studies suggest science centre professionals and visitors feel they encourage creativity and provide inspiration (Ecsite, 2008), to date there has been little research to underpin this introduction of creativity.

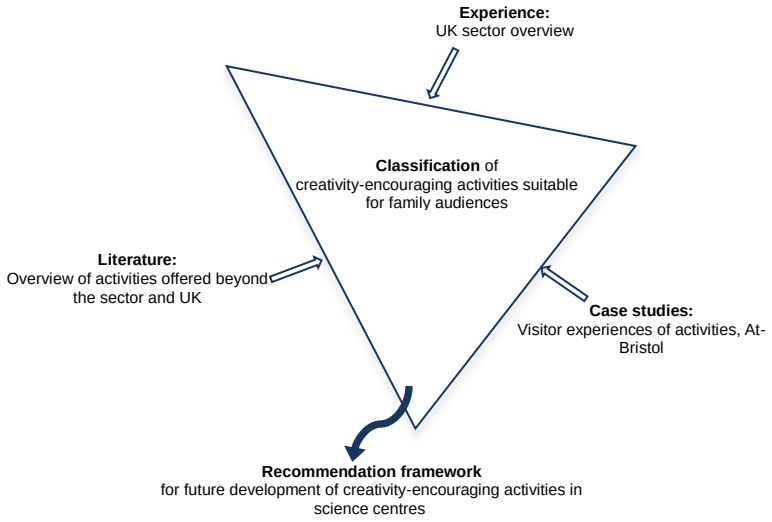
This research project aimed to devise a classification system for the different types of hands-on creativity-encouraging activities, suitable for family audiences, which are available in science and technology centres. By identifying the nature and potential merits and drawbacks of each activity class, the classification system sought to provide a means by which centres can assess the suitability of creativity-encouraging activities for their visitors.

## 2 Methods

For this study, creativity-encouraging activities were defined as hands-on activities in which participants are required to create something original or engage in original lines of scientific inquiry. Originality was defined as something new to the world.

The classification system was designed using a triangulation approach (see Figure 1) consolidated by data from three sources: telephone interviews with UK science and technology centre professionals, a literature review of activities offered beyond science centres in the UK, and evaluation of visitor experiences with activities in At-Bristol.

**Figure 1: Triangulation framework**




### *2.1 Sector interviews*

Structured telephone interviews were conducted with learning team members in five UK science centres to identify the types of creativity-encouraging activities recently offered across the sector. Data relating to the nature, delivery, intended learning outcomes and success were collected for ten activities.

The interviews were recorded and transcribed and analysed manually. Each individual activity was coded for data of interest in accordance with inductive thematic analysis, ensuring data from the activities, not the researcher's existing theoretical interests, determined the design of the classification. Cross-analysis of the activities allowed those showing similar patterns to be grouped. This comprised the preliminary classification system.

### *2.2 Literature review*

A literature review was conducted to identify the types of creativity-encouraging activities recently offered outside the science centre sector and the UK. A wide range of organisations was researched, including those not traditionally associated with STEM

learning, such as children's creativity museums and Maker Fairs, to provide fresh perspectives and open up the potential for more innovative recommendations.

Data relating to the delivery and nature of 26 activities were extracted from online information, articles and project reports, and analysed as for the sector interviews. A new coding framework, driven by the data, was generated, allowing the preliminary classification system to be challenged and consolidated.

### *2.3 At-Bristol evaluation*

Three creativity-encouraging activities were evaluated in At-Bristol to form case studies of visitor experiences. As the case studies were selected, the classification classes were emerging, allowing three activities from different classes to be chosen: K'NEX Bridge Building, Plasticine Modelling and Investigate It: Bernoulli Blower.

At least three family groups were observed unobtrusively as they interacted with each activity and then asked to participate in a short, semi-structured, group interview. Data was collected according to a topical framework based on the Museums, Libraries and Archives Council's Generic Learning Outcomes (GLOs) (see Figure 2). Analysis of the observation notes and interview transcripts allowed a coding framework to be devised based on the GLOs and the data. This provided a means by which important themes and narratives regarding the effectiveness of each activity could be identified.

**Figure 2: The GLO toolkit (MLA, 2008)**


## 3 Results

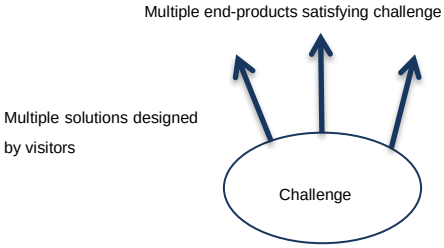
The classification system generated by the research comprised four different types of creativity-encouraging activities: Creative Problem-Solving, Open-Ended Experiment, Talk, Make and Take and Experimental Art.

All the activities displayed Active Prolonged Engagement (APE) features, meaning that visitors decided for themselves what actions to take rather than following instructions, spent extended amounts of time with the activity and were free to try a variety of actions, with each building on the last. All were suitable for broad age ranges and could elicit much enjoyment. All (except Talk, Make and Take) allowed knowledge about scientific concepts to be gained through self-discovery and experiment. All (except Open-Ended Experiments), typically promoted teamwork and family interactions and provided opportunities for participants to display and/or take home their creations.

### *3.1 Creative Problem-Solving*

Creative Problem-Solving activities require participants to create functional objects that attempt to meet a goal or challenge. An example is the Egg Drop Challenge, where participants create protective cases for eggs dropped from a balcony. Challenges can be set by the organisation or decided by the participants. Challenges have many solutions and the design is up to the visitor, meaning end products vary (see Figure 3).

**Figure 3: Basis of creative problem-solving activities**



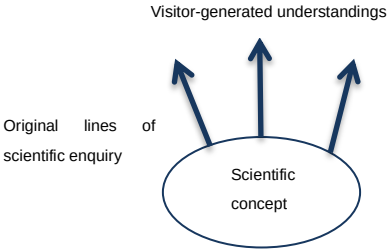

Participants are able to design, build, test and modify as they make their objects. Examples of previous creations or example challenges can be given as prompts, materials are provided that lend themselves to being used in multiple ways and specific opportunities can be presented for testing.

Creative Problem-Solving activities commonly aim to develop interdisciplinary, thematic knowledge about the creative design process and its importance in engineering and innovation. Evaluation of K'NEX Bridge Building found most respondents gained knowledge about 'how to make bridges stronger' but just one expressed awareness of engineers' work being creative. Participants exhibited a wide range of creative skills including fluency, flexibility, novelty and elaboration and practical skills in using tools and manipulating materials. Participants were observed to exhibit analytical and critical thinking skills.

### *3.2 Open-Ended Experiment*

Open-Ended Experiment activities require participants to conduct experiments for which there are no defined questions, procedures or answers (see Figure 4). Such activities require that the relevant scientific concept can be investigated in multiple ways. Typically, large numbers of variables are tested. For example, Bubblology allowed participants to build bubble wands of different sizes and shapes to investigate how their properties affected bubble formation.

**Figure 4: Basis of open-ended experiment activities**



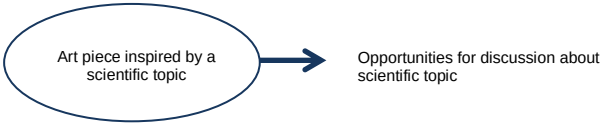

Science communicators facilitated four of six activities observed. The facilitator of Investigate It: Bernoulli Blower was observed interacting one-to-one with family groups, indicating facilitators can have very active roles. An interviewee suggested activities are more successful 'when you … have a member of staff there to engage people with it'.

All activities cited increasing awareness of the scientific method as their principal aim. However just one participant in Investigate It: Bernoulli Blower reported an increased understanding of how experiments are carried out. No activities cited encouraging creativity as an important aim, although observation of Investigate It: Bernoulli Blower found it was capable of promoting fluency and originality. Participants exhibited practical skills in testing objects and taking measurements and thinking skills such as organising information.

### *3.3 Talk, Make and Take*

Talk, Make and Take activities are characterised the creation of aesthetic artworks inspired by scientific topics. While their hands are busy, opportunities are offered for facilitated discussion about the topic (see Figure 5). One example is Insect Mask-Making, where participants made masks while learning about insect physiology and adaption.

**Figure 5: Basis of Talk, Make and Take activities**

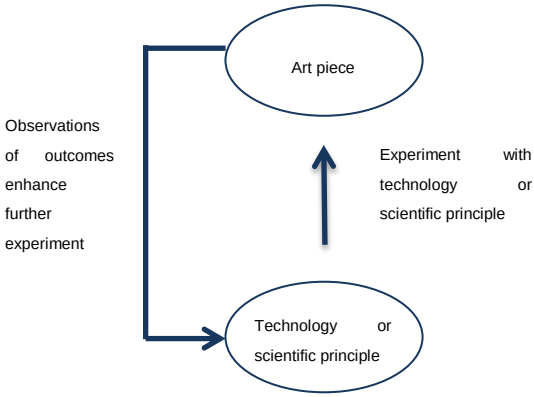



Artworks can be created using various media, traditional craft materials, drawn, painted, sculpted or made digitally. Compared to other activities, a large proportion of Talk, Make and Take activities (five of seven) were facilitated by creative professionals. As well as developing subject-specific knowledge, Talk, Make and Take activities aim to encourage artistic expression and imagination. They often focus on fostering positive attitudes towards making and inspiring further creativity.

### *3.4 Experimental Art*

Participants in Experimental Art activities create artworks through the application of a scientific principle or technology. As they experiment with different variables, they are able to generate many artistic outcomes. By observing the effects of their actions they can raise new questions and experiment (see Figure 6). One example is Light Painting, where participants use different light sources and a camera to create light drawings.

**Figure 6: Basis of Experimental Art activities**




Typically any technologies used are free-access; for example, 'Build Your Own Birmingham' used Google SketchUp. Developing skills in using technology and/or manipulating materials is a commonly-cited aim. Experimental Art activities allow the creative expression of ideas. Participants in Plasticine Modelling exhibited a wide range of creative skills, including fluency, originality, flexibility and novelty, as well as practical skills in manipulating media.

## 4 Discussion and Conclusion

All the activities displayed APE features, which have been shown to elicit deeper levels of engagement than exhibits with non-APE features and can cater for visitors with a wide range of understandings and motivations (Humphrey & Gutwill, 2005). The majority of activities allowed very active, rather than passive learning. This too can be regarded a strength, as self-discovery and experimentation has been shown to be a more effective way of imparting knowledge than passive learning (Falk & Dierking, 2008). Many activities allowed participants to display and/or take home their creations. This can enhance a sense of ownership on the part of visitors and help to create memorable experiences (Simon, 2010). Further strengths were that all activities can elicit enjoyment, perhaps simply by engaging participants in the creative process and allowing them to enter a state of 'flow' (Csikszentmihalyi, 1996), develop communication and social skills through promoting teamwork and family interactions, and have broad appeal.

### *4.1 Creative Problem-Solving*

As participants of Creative Problem Solving activities design, build, test and modify their creations, they go through the process of creative problem-solving. This requires the application of a range of creative, thinking, social and practical skills (DeHaan, 2009). Activities can enhance the development of these skills by providing opportunities for testing and/or problem finding, supplying materials that lend themselves to multiple interpretations and providing example creations or challenges as prompts.

Evaluation of K'NEX Bridge Building found that, despite being a primary aim, increased awareness of the importance of creativity in engineering and innovation was limited. While this was not a statistically significant finding, it mirrors the findings of similar schools-based studies (Vind & Kind, 2007), and may be due to the ingrained view many young people have of engineering as a non-creative discipline (Schmidt, 2011).

### *4.2 Open-Ended Experiment*

As participants formulate a hypothesis, design a procedure for testing and generate answers during Open-Ended Experiment activities, they are able to develop a range of creative, thinking, communication, practical and numeracy skills. Development of these skills can be enhanced by leaving the scientific method open to the highest possible degree and providing many variables. There was evidence that this type of activity can intimidate visitors, perhaps because they feel they lack the expertise or confidence needed to conduct coherent, in-depth investigations on their own (Allen & Gutwill, 2009). This suggests that a facilitator, who can help guide and encourage visitors through the investigation, is important.

### *4.3 Talk, Make and Take*

Although Talk, Make and Take activities do not involve active learning, participants are able to engage in conversation with the facilitator and take part in creative processes, actions that have been shown to enhance learning (Evangelou, *et al*., 2010; Cropley, 2001). The creation of purely aesthetic artwork allows the creative expression of ideas, which can encourage imagination and originality and develop practical skills (Craft, 2000). These skills can be enhanced by a professional artist-facilitator and the provisions of scientific objects for inspiration. A common aim of Talk, Make and Take activities is to foster positive attitudes towards making. By allowing participants to display and/or take home their creations and be proud of them, they have the potential to inspire creative confidence and further creativity (Cropley, 2001).

### *4.4 Experimental Art*

Participants in Experimental Art activities have the opportunity to experiment with scientific principles or technologies, which means knowledge or skills can be gained. As with Talk, Make and Take activities, participants can creatively express their ideas, allowing imagination and originality to develop and self-confidence build. Further engagement and creativity at home can be encouraged by the use of freely-accessible technologies.

### *4.5 Conclusion*

Inclusion of some, or all, of the different classes of creativity-encouraging activities in science centres' informal learning programmes can offer many benefits. Unsurprisingly, some activities present challenges, such as high barriers to entry and an enduring difficulty in promoting awareness of the sciences as creative disciplines. These are issues that should be addressed in future development of the activities.

There are no set formulae for activities that will work effectively across all venues and more research is required to determine the extent to which each class can develop specific skills and understandings. However, the classification system seeks to be a framework through which science centres can assess the suitability of creativity-encouraging activities for their visitors and further their creativity-based programming.

By developing their creativity-based programming in ever-more efficient and effective ways, science centres have the potential to become truly unique learning environments, where all members of the community can unleash their creative capacities and develop a passion for inquiry-based and curiosity-driven science.

## 5 References

Allen, S., Gutwill, J. P. (2009) Research report: Creating a program to deepen family inquiry at interactive science exhibits. *Curator*: *The Museum Journal.* 52 (3) 289.

Craft, A (2000) *Creativity across the primary curriculum: Framing and developing practice*. London, UK: Routledge.

Cropley, A. (2001) *Creativity in education and learning. A guide for teachers and educators*. London, UK: Kogan Page Limited.

Csikszentmihalyi, M. (1996) *Creativity: flow and the psychology of discovery and invention.* New York, NY: HaperCollins Publishers, Inc.

DeHaan, R. L. (2009) Teaching creativity and inventive problem solving in science. *CBE-Life Sciences Education*. 8 (1) 172.

Ecsite (2008) *The impact of science and discovery centres. A review of worldwide studies.* Bristol, UK: European Network of Science Centres and Museums.

Evangelou, D., Dobbs-Oates, J., Bagiati, A., Liang, S., Young Choi, J. (2010) Talking about artifacts: Preschool children's explorations with sketches, stories and tangible objects. *Early Childhood Research and Practice.* 12 (2) 62.

Falk, J., Dierking, L. (2000) *Learning from museums: Visitor experiences and the making of meaning*. Plymouth, UK: Altamira Press.

Hadzigeorgiou, Y., Fokialis, P., Kabouropoulou, M. (2012) Thinking about creativity in science education. *Creative Education.* 3 (5) 603.

Humphrey, T., Gutwill, J. (2005) *Fostering Active Prolonged Engagement: The art of creating APE exhibits.* Walnut Creek, CA: Left Coast Press, Inc.

Museums, Libraries and Archives Council (2008) *Inspiring learning: generic learning outcome*. Available from

http://www.inspiringlearningforall.gov.uk/toolstemplates/genericlearning/ Accessed October 2012.

Schmidt, A. (2011) Creativity in science: Tensions between perceptions and practice. *Creative Education.* 2 p. 435.

Simon, N. (2010) *The participatory museum.* London, UK: Museum 2.0

Vind, P., and Kind, V. (2007) Creativity in science education: Perspectives and challenges for developing school science. *Studies in Science Education.* 43 (1) 1.

Work Foundation (2008) *Staying ahead: the economic performance of the UK's creative industries.* London: Department for Culture, Media and Sport.

## 6 Acknowledgements

Thank you to Katy Nehammer, Emma Cook and the Live Science Team from At-Bristol, for their support with this project.

Miss Melanie Davies (mel_tudordavies@yahoo.co.uk)
The Francis Crick Institute, 215 Euston Road, London NW1 2BE

# To blog or not to blog: an exploration of climate blogging at the Met Office

Felicity Liggins and Emma Weitkamp

This paper is based on research carried out by Felicity Liggins as part of her MSc in Science Communication.

## 1 Introduction

> ...Blogs provide a rapid, casual, interactive and occasionally authoritative way of commenting on current issues, new papers or old controversies...
>
> Gavin Schmidt (2008, p. 208)

> ...I thought it was a great idea when mainstream climate scientists started blogging. But then, they came after me..."
>
> Myles Allen (2008, p. 209)

Many challenges face those attempting to communicate with publics about climate science. Issues surrounding trust, balance, news values and scientific literacy, among others, can hinder effective communication in this field. To counter this, communicators of climate science are increasingly using blogs to reach new and existing audiences, interact with other scientists and engage in dialogue directly with the recipients of their message(s).

In 2008, *Nature Geoscience* published commentaries by two noted climate scientists; Gavin Schmidt, climate modeller at the NASA Goddard Space Institute in New York, and Myles Allen, leader of the Climate Dynamics Group at the University of Oxford, went head-to-head on the subject of blogging. Their contrasting views (above) reflect the discussion within the scientific and communication communities about the value of blogs and were the inspiration for this research. '*To blog or not to blog?*' (Liggins, 2011) explores the views of Met Office employees about blogging, specifically engagement with climate science-related blogs.

It should be noted that since the completion of '*To blog or not to blog?*' the Met Office has expanded its communications activities to include social media and has also encouraged and trained staff to engage with external blogs and web discussions. It is likely that if the same research were to be carried out today, some of the findings would differ to those presented here.

## 2 Methods

### *2.1 Literature review*

To set the research in the wider context of science communication theory and practice, the research began with a literature review of peer-reviewed journals, grey literature and corporate/climate science blogs. Existing Met Office communication strategies and other organisational literature were also considered. The literature review was conducted in a reflective way, allowing it to develop as the project progressed (Wisker, 2001).

### *2.2 Questionnaire*

To gather organisation-wide data on employees' views concerning climate science blogging, an Internet-based structured questionnaire was designed. Closed questions gathered quantitative data to collect respondents' profiles and summarise their use of and attitudes towards blogging. More flexible, open-ended questions allowed respondents to explain their answers further or add their own narrative. This increased the possibility of detecting opinions not considered by the researcher during the questionnaire design.

### *2.3 Interviews*

To explore the perceptions of climate blogging in more depth, a semi-structured interview schedule was designed, using a general set of prompts in a format that allowed flexibility to both interviewer and participant. This enabled the researcher to explore more complex issues surrounding blogging than the questionnaire allowed, probing interviewees' answers and exploring new themes.

The interviews were designed to gather informed data from employees likely to hold considered views on communication and blogging. Potential participants were approached based on the researcher's prior knowledge; a purposeful selection method. This ensured good coverage of a wide range of views, with people known to hold contrasting opinions on blogging specifically targeted. However, this meant that the findings of the interviews did not necessarily represent the overall distribution of views held by employees of the Met Office.

### *2.4 Timing of the data collection*

Data collection began on Friday 5th August 2011 and continued for three weeks, coinciding with the start of the summer holiday season. For both the online questionnaire and interviews, this timing reduced the total number of people available to take part in the research. The simultaneous nature of the data collection also meant that the results of the questionnaire could not influence the design of the interview schedule.

### *2.5 Analysing the data and its limits*

The results of the online questionnaire were processed in Excel™. More in-depth statistical analysis was not considered appropriate, due to the low response rate, as confidence in the precision or accuracy of such analysis could be overstated (Bryman, 2004).

The results of the 12 semi-structured interviews were analysed using NVivo. Initially, the coding structure was based on the findings of the literature review and on the researcher's understanding of the topic and organisation. It was refined during analysis, ensuring that the data were objectively analysed without bias introduced by the (Met Office-employed) researcher.

## 3 Results

### *3.1 Questionnaire*

One hundred and thirty-six employees started the online questionnaire; 85% (116) completed it, representing approximately 6% of all Met Office employees. The number of respondents from each Met Office profession was comparable to the total number in each within the organisation as a whole.

When asked to judge their level of engagement with social media, 24 respondents said they had none, while the remaining 92 varied in their levels of engagement, with the groups aged 21–29 and 30–39 engaging more than older groups.

Of the 31 blog-reading respondents, 36% read blogs related to climate science monthly or more, with two-thirds of these in the 'Science & Engineering' profession. Only two respondents said they commented on blogs.

**Table 1: 'Do you think Met Office employees should be encouraged to comment on climate blogs external to the Met Office?'**

| | Number of respondents | Percentage |
|---|---|---|
| Yes | 21 | 18% |
| No | 35 | 30% |
| Maybe | 60 | 52% |

By weighting these results by the relative proportion of overall respondents from each profession, it could be seen that those from 'Science and Engineering' were more likely to answer positively. Respondents from the profession of 'Leadership and Management' (3 people) were the only group that all responded 'No' to this question.

Of the 53 who answered 'Yes' to the question 'do you think the Met Office should have its own blog on climate topics?' 44 had also answered 'Yes' to the question shown in Table 1; interestingly, the remaining nine had chosen 'No'. Unfortunately, it was not possible to explore the reasons behind this discrepancy but perhaps employees perceive a higher level of message-control on a Met Office-owned blog than on external blogs.

**Table 2: 'Do you think the Met Office should have its own blog on climate topics?'**

| | Number of respondents | Percentage |
|---|---|---|
| Yes | 53 | 46% |
| No | 19 | 16% |
| Maybe | 44 | 38% |

Next, all 116 respondents were asked to consider the risks and benefits associated with blogging. Respondents were offered the option to add their own or provide other comments. The top risks identified included exposing both individual staff members and the Met Office to criticism or hostility, alongside the time pressures associated with engaging in the blogosphere. When considering the benefits of blogging, 'Raise the Met Office's profile as an authoritative voice on climate topics' and 'Improve communication of Met Office research to the lay public' were the most selected options.

### *3.2 Interviews*

The 12 semi-structured interviews were processed in NVivo according to the coding scheme developed. The full interview analyses can be seen in Appendix D of Liggins (2011).

## 4 Discussion and Conclusion

Due to the low response rate of the questionnaire, this research cannot offer a comprehensive attitudinal study of Met Office employees' views about climate blogging. However, by reflecting on the results from the questionnaire and the 12 semi-structured interviews (Appendix D of Liggins (2011)), alongside the broader consideration of communication challenges surrounding climate science, a synthesis of respondents' views of climate blogging at the Met Office can be offered.

### *4.1 Positives on blogging*

Where respondents saw blogging as a positive activity, their reasoning typically fell into one or more of the following five categories:

- Publicising Met Office climate science

Within the climate research community, the Met Office is a well-known institution. However, some respondents believe that it needs to become a 'voice of authority' in climate science across more audiences. Some participants see blogs as a beneficial way of doing this:

> *Visibility… we should be able to at least have a discussion on the publications we produce ourselves and potentially have an on-going discussion on publication others have done.* (Interview 01, Climate Scientist 1)

- Increasing transparency / humanity / trust

Recent controversies in climate science, the drive towards open data and the desire to find better ways to communicate have led some climate scientists to enter the

blogosphere (see, for example Schmidt, 2008). Several participants believed that climate blogging could facilitate trust-building, if implemented effectively:

> *I think the view of the IPCC in particular and climate science organisations in general, including the Met Office, is very much one of faceless, bureaucratic monstrosities, within which we're all forced to toe some line and speak to a particular message which obviously isn't true at all. But because people don't see the individuals, they don't see the actual different levels of expertise and different opinions within them, they don't see the people. So I think it would benefit trust…* (Interview 04, Climate Scientist 3)

- Engagement and education

Until recently, climate science communications from the Met Office often followed a deficit model; in recent years this has begun to shift towards engagement and dialogue. As one of the UK's foremost climate research centres, participants said the Met Office should be a leading voice in educating and engaging audiences about climate science, tackling some of the communication challenges widely identified. Indeed, the majority of interviewees saw blogs as one way to improve the Met Office's communications with publics and policy-makers. Most climate scientists interviewed wanted to use blogs to engage with other scientists, while those involved in the commercial activities of the organisation identified the Met Office's customers and collaborators as possible audiences. Interviewees' responses were influenced both by their organisational background and by their current exposure to and use of blogs.

> *…we're a government organisation and you could argue that our main job is to give scientific advice on climate change in particular to the government and also to the people who pay our wages. So scientific papers are all well and good but…one advantage of blogs, it's the communication with the wider public.* (Interview 09, Climate Scientist 5)

- Changing face of peer review

Peer review is a vital part of the scientific process. However, increasingly, the peer review system is regarded as too slow and inflexible to encourage debate, especially with wider publics, as the majority of peer-reviewed journals are not free access. Furthermore, the current embargo system implemented by high-profile publications can discourage open discussion of results and influence media coverage:

> *… if I… run a set of models and I find something interesting... the traditional way to do that is to wait a year or two years and publish it… I think eventually, we need to move to a point where all the science is online, free to everybody… It's not within my interests to put a really interesting piece of science online early because some big journal is going to have an embargo on it.* (Interview 02, Climate Scientist 2)

However, there are concerns about the premature discussion of preliminary results that have not been through a rigorous peer-review system:

> *It's very dangerous when you put something out and you have no control about the follow on, to let people believe that they've got the last word on the story and next week you find something wrong with it, you change your mind, other data comes in, before you've finalised the exercise and you've made it airtight, somebody has left with half-baked information.* (Interview 13, Climate Scientist 7)

- Professional development and recruitment

Although not widely identified as a benefit or covered in the questionnaire, this theme was raised by two interviewees:

> *It's very important to me, for my career, to become known as a scientist and I think having a form of electronic, easy communication to put out my science, and comment on other peoples' science, is going to be crucial for my career.* (Interview 02, Climate Scientist 2)

### *4.2 Concerns about blogging*

Many concerns were voiced about blogging and several participants were eager to ensure that the study reflected these.

- Time issues

One of the most common concerns was about the time involved in contributing to and maintaining a blog. It is recognised that if blogs are not regularly updated, their effectiveness is significantly reduced (Wilkins, 2008). Untimely or missing responses to posts can also elicit hostility from bloggers (see, for example, Betts, 2011). Any blogging, moderation or commenting on blogs would have to be closely monitored by participants and built into their day-to-day work:

> *[Blogs are] a distraction from any deep thinking on any serious topic… it's like email, which everyone complains about… It puzzles me how anybody has got the time to go and read other peoples' blogs. I certainly don't have time to waste on that.* (Interview 10, Climate Scientist 6)

- Protecting the Met Office

If the Met Office encouraged employees to blog, protecting the organisation and its staff would be a major consideration. This was raised by nearly all interviewees and rated as highly important by questionnaire respondents. The issues associated with this fell into three general categories:

a) Protecting the organisation's reputation and scientific integrity.
b) Protecting individual scientists' reputations and well-being, while trusting employees to take responsibility for their actions.
c) The risk that scientists from the Met Office could disagree in a public forum was a concern for many participants. However, others argued that such disagreements highlight the scientific process, showing where scientists agree and where there is still work to be done.

- Moderation

A further consideration surrounds moderation. Discounting those completely opposed to blogging, participants were split between the desire to allow bloggers and readers to engage freely on a blog and the need for the organisation to maintain quality control.

- Identity of the bloggers

When considering the identity of possible Met Office bloggers in the results from the questionnaire, a split was evident between those respondents who thought that any employee should be able to contribute to a blog and those who thought that only Senior Scientists or above should be enabled to engage in this type of communication. However, the majority of interviewees did not back a blog by the Chief Scientist or Chief Executive, in contrast to some of the questionnaire respondents. Interviewees argued that such a blog would impose unrealistic demands on staff time and possibly limit the 'humanisation' benefits of blogging, as a Chief Executive's blog could be deemed just another high-level corporate communication.

An interesting point to note is that no respondents thought that the Communications team or Press Office alone should be responsible for blogging. A preferred option was for scientific specialists to blog. However, unless managed well and resourced appropriately, this would put increased time pressure on certain experts, particularly those regarded as good communicators:

> *The trouble is, in order to put good, credible messages to the outside you need the right people, you need the experts. For the experts to stay experts, they need to do the work, they need to contribute to written papers… to contribute to the IPCC assessments… to advise governments. To engage with this as well… there comes a time where the competition for the experts is too much.* (Interview 13, Climate Scientist 7)

A further suggestion was that a small team of scientists and communicators could be convened to source and manage the content of the blog and carry out any moderation required.

### *4.3 Recommendations for further research*

- Stakeholder engagement

Met Office staff raised concerns about the impact climate blogging could have on the organisation's relationships with its key stakeholders:

> *Climate science is massively polarised of course, and our relationship with government departments makes it particularly sensitive. Whilst I think other organisations… would be able to express views more freely and… provoke less… criticism, it's extraordinarily difficult for the Met Office given our relationship with departments like DECC and Defra.* (Interview 03, Communications Expert 1)

As part of the process of designing a communications strategy, it is important that the Met Office considers the views of organisations such as the Department for Business, Innovation and Skills (BIS), the Department for Energy and Climate Change (DECC) and the Department for Food, Environment and Rural Affairs (Defra). Due to the limited time available for this project, data gathering from these organisations was not possible. It would be beneficial to seek the opinions of such stakeholders, enabling a future communications strategy to incorporate elements tailored to these organisations if required.

- Learning from others

Met Office employees raised concerns that the organisation's position as a government body may limit its ability to engage through blogs:

> *There are too many security issues around the organisation conducting blogging at the moment. It also does not yet fully understand the threats it is exposing itself to... loose words can cause political embarrasment* [sic] *to the government and also affect how well the government climate policies are respected and implemented. (Respondent 3)*

However, many government departments, including the BIS, DECC, Ministry of Defence and the Foreign and Commonwealth Office, already host blogs. Through shared learning with other government departments, particularly those that have to communicate complex scientific or societal issues, the Met Office could develop a blogging strategy. Such clear guidance and delineation of responsibility could help minimise some of the concerns raised during the research.

### *4.4 Conclusion*

*To blog or not to blog?* examined the views of Met Office employees about climate science blogging. The quotes below reflect the wide range of opinions expressed by the 116 respondents and 12 interviewees, with many participants' views lying between these two extremes:

> *The Met Office is well behind the curve in its attitude to Web 2.0… staff* [need] *to be given greater trust and empowerment to use these channels of communication responsibly. Failure to adapt to recent large scale shifts in the way people assimilate information will result in the organisation appearing out of date and unwilling to engage in open, two way communication. Respondent 51*

> *Blogging would be a complete waste of time and effort. Social media is for just that SOCIAL MATTERS *NOT* WORK* [respondent's emphasis]. Respondent 30

Communicators of climate science face a number of significant challenges. If implemented effectively, blogging may be one of the tools that can be used to convey messages to a variety of audiences.

## 5 References

Allen, M. (2008) Minority Report. *Nature Geoscience*, 1 (209).

Betts, R. (2011) *Unthreaded.* Bishop Hill [blog]. September 26 at 8.24pm. Available from: www.bishop-hill.net [Accessed 24 October 2011].

Bryman, A. (2004) *Social Research Methods*. Oxford: Oxford University Press.

Liggins, F. (2011) *To blog or not to blog? An exploration of climate blogging at the Met Office*. MSc. University of the West of England, Bristol

Schmidt, G. (2008) To blog or not to blog? *Nature Geoscience*, 1 (208).

Wilkins, J.S. (2008) The roles, reasons and restrictions of science blogs. *Trends in Ecology & Evolution*, 23(8) 411.

Wisker, G., 2001. *Carrying out a literature review. The Postgraduate Research Handbook*. Basingstoke: Palgrave MacMillan.

## 6 Acknowledgements

First, I would like to thank my UWE supervisor, Dr Emma Weitkamp. Throughout my research project and other MSc modules, she provided invaluable support and critique, giving me confidence in my writing and project outputs. Second, to my supervisor at the Met Office, Dr Carlo Buontempo, thank you for advice throughout the project and for giving me the time to carry it out. Thanks also go to the 116 Met Office employees who completed my questionnaire and to the 12 interviewees who provided such colourful and important data.

---

Ms Felicity Liggins (felicity.liggins@metoffice.gov.uk)
Senior Climate Scientist/STEM Outreach Co-ordinator, Met Office, FitzRoy Road, Exeter, EX1 3PB

# Would my grandmother understand this? The challenges and communication strategies of the most popular science bloggers

Mathieu Ranger and Karen Bultitude

This paper is based on research carried out by Mathieu Ranger as part of his MSc in Science Communication.

## 1 Introduction

The Internet has provided users with many new methods with which to talk about science. With the advent of technologies such as e-mail and instant messaging, the ability to rapidly connect with almost anyone across the globe has become commonplace within developed societies. Recently, new online communication tools, known as social media, have emerged, which provide users with novel ways to create and share content (Hampton, *et al*., 2011).

The blog, the focus of this study, is one such tool. A blog can be defined as a user-generated website in which posts created by the user appear on the website in reverse chronological order (Blood, 2002). In recent years the number of blogs has dramatically increased. According to various analytic services there are more than 150 million blogs on the Internet (BlogPulse, 2011; Royal Pingdom, 2010). Technorati, one of the few blog-ranking services that indexes blogs based on category, lists more than 9000 active science blogs (Technorati, 2011). These blogs are typically written by one or many authors, who may be students, scientists, journalists, corporate entities or simply science enthusiasts (Blanchard, 2011). Content-wise, science blogs are used for a variety of purposes, for example to provide breaking news or in-depth analysis of research findings (Francl, 2011). They are also sometimes used to share laboratory experiences and experimental results (Zivkovic, 2006). Some science bloggers make use of blogs specifically to share opinions on issues of science in society or to share humorous science-related content found on the Internet (Colson, 2011; Zivkovic, 2006).

The flexibility and accessibility of blogs make them a potentially powerful tool with which to communicate science. The role of bloggers and communication strategies made use of by bloggers within the science communication field is, however, currently underexplored. An examination of discussions and debates within the science blogging community can partially reveal what bloggers perceive their role to be within science communication. Questions asking whether or not science bloggers can be science journalists (Yong, 2011; Zivkovic, 2009) and if science bloggers should or can make money (Campbell, 2010) have been the subject of various blog posts. This study used semi-structured interviews to delve specifically into the challenges faced by some of

today's most popular science bloggers and the communication strategies these bloggers use to make their blogs attractive.

## 2 Methods

For the purposes of this study, a science blog was defined as any blog which has the majority (more than 50%) of its content dedicated to discussing and/or sharing science-related content. Technology blogs, which predominantly cover consumer electronics, were excluded from this definition, as they tend to focus on the business and consumer side of technology rather than on its science-related aspects.

### *2.1 Identification of the most popular science bloggers*

To establish who the most popular science bloggers were, this study made use of Technorati, a web service that determines blog popularity by ranking blogs based on the number of times other websites link to them. Compared to other services that rank blogs based on the number of visitors received, Technorati provides an indirect measure of blog popularity. However, other ranking services do not distinguish between different topic categories, leading to a degree of subjectivity in sampling.

Technorati rankings of the ten most popular blogs in the science category were collected over one week (April 2–8, 2011). A one-week period was chosen due to time restraints. All blogs that successfully remained in the top positions during the entire week were chosen for analysis. Over that one week, the last two positions in the science category fluctuated between three blogs. The final two blogs in the sample were therefore randomly selected from these three (see Table 1).

**Table 1: The ten most popular science blogs, as used in this study**

| Rank | Top 10 science blogs |
|---|---|
| 1 | PhysOrg |
| 2 | Pharyngula |
| 3 | Wired Science |
| 4 | Bad Astronomy |
| 5 | Watt's Up With That? |
| 6 | Next Big Future |
| 7 | Universe Today |
| 8 | Mike the Mad Biologist |
| 9 | Dot Earth |
| 10 | Not Exactly Rocket Science |

To better understand the bloggers' motivations and strategies, the writers of these top blogs were invited to participate in an interview. Because four of the blogs have multiple authors, 18 people were contacted, of whom seven agreed to participate. The interviews took place during August 2011. Five of the bloggers were interviewed via Skype; the other two by e-mail.

### *2.2 Semi-structured interview schedule design*

To delve into the thought processes of the top science bloggers, a semi-structured interview schedule was prepared. Keeping the questioning open was deemed an appropriate way to allow the participants to share their thoughts without being restricted by overly-specific questions. Semi-structured interviews were chosen as they provide a good balance between obtaining rich, detailed answers from participants and being able to direct the questioning so as to cover topics appropriate to the research project (Harrell & Bradley, 2009). Approximately 25 standardised questions – with relevant probes – were designed. All data were collected according to ethical procedures approved by the University of the West of England, Bristol. Pseudonyms are used in the interview results.

At the beginning of each interview, the interviewer reiterated the details of the consent form, gave details regarding the voluntary nature of the respondents' participation and informed participants that their answers would be audio-recorded. The recorded interviews were transcribed using Express Scribe v5.30.

## 3 Results

Interviews with some of today's top science bloggers provided an opportunity to delve into the challenges faced and strategies used in the science blogging world. The following represents a summary of the key themes extrapolated from interviews conducted with seven bloggers who represented five of the ten most popular science blogs. The themes examined delve into the challenges faced by top science bloggers as well as the science communication strategies they made use of.

### *3.1 Science blogging challenges*

The interviewed bloggers were asked to describe any blogging challenges they regularly faced. One challenge faced by some of the participants was related to the positioning and respect of the blogosphere within traditional media. Sergei expressed this concern; he thought that:

> *Blogging is still seen as a sort of niche, amateur activity*

Thomas reciprocated this feeling, noting that for him:

> *The big challenge is just sort of the lack of respect from the traditional media as well as the traditional press agencies*

These two bloggers appeared to believe that blogging, not necessarily only science blogging, was not seen as a legitimate media tool.

Some of the science bloggers also identified challenges related to funding. Thomas expressed his frustration:

> *The big problem right now is that there's still not a lot of money to be made in this industry and so there's not a lot of resources to be able to do the really good deep investigative reports*

Samuel was similarly frustrated:

> *We can't afford to do features as often as any of us would like to. There's just not enough resources to do 'em*

Perhaps related to the legitimacy issues surrounding blogging, these bloggers encountered funding limitations preventing them from producing the type of content that was of the most interest to them.

Some of the challenges identified by the bloggers appeared to be directly related to the scientific subject matter of their blogs. For example, Joanne indicated that:

> *One of the challenges that I have and some days I wish I didn't have to deal with was that I'm only comfortable writing about science that I understand and that kind of limits me*

Specifically, she mentioned that:

> *[It's] a big load when you need to speak to the primary scientist and you need to speak to outside commenters and you need to read the paper and maybe read up about the subject*

This challenge relates to an issue of comfort level, where some bloggers might not feel comfortable writing about subjects that often require an advanced degree to understand. Kareem, on the other hand, revealed challenges that related to science's slow pace:

> *The challenge is 'well here's this interesting breakthrough that's being made but you know you're not gonna see the results of how it affects us in your everyday life for like five to ten years'*

The ultimate problem, according to Kareem, is:

> *A lot of people are just like 'Oh that's great but how does that affect me right now?'*

Unlike other topics that develop at a rapid pace (for example, celebrity gossip), to these bloggers, science has the perceived disadvantage of lacking the necessary context and immediacy to make it attractive.

### *3.2 Science blogger communication strategies*

To the science bloggers, the slow pace of science is one of many impediments to attracting and retaining audiences to their science blog. Thus, the science bloggers

were asked to share their strategies for overcoming some of the inherent difficulties of science writing. An important strategy implemented by the bloggers was to reduce the amount of jargon. Jack noted that within his blog:

> *We don't write in technical terms. We always try to make it as easy to read as possible*

Similarly, Sergei spoke of his strategy:

> *I make sure that I'm avoiding scientific jargon but also trying to tell stories or trying to make science exciting and as interesting as it is to me to other people*

On a similar note, Sergei offered another simplification strategy:

> *The longer you make* [posts] *the harder you've got to work to keep your reader's attention. So it's got to deserve it*

As another strategy to simplify content, as well as making it more interesting to audiences, Joanne spoke of the use of relevant writing techniques:

> *This week I wrote about a new picture that was released of a nebula and I just saw it and it looked like if a soccer ball and a jellyfish had a baby. So there's something that's a little bit humorous and unexpected without being cheesy*

Joanne showed that analogies and metaphors are successful in helping her communicate science. Sergei shared similar feelings about creating intriguing content:

> *[I'm] trying to tell stories or trying to make science exciting and as interesting as it is to me to other people*

To achieve this goal, Jack made two points, showing how he uses his judgment as a professional writer to avoid a common pitfall inherent to science writing:

> *You have to appeal to the people's sense of imagination … We do not play to the scientists' desires. We play to the audience's desires. A scientist, if you were to give them these articles, they would… get up with style and try to re-write the whole thing. So if we were to play to the scientists' desires, it would be unintelligible*

One approach taken by many of the science bloggers in their attempt to create attractive content was to put themselves into the shoes of their readers. Pat described a common scenario:

> *Sometimes I have to take a step back and sometimes it helps to like hand something over to my husband and say 'Does this make sense to you? Do you understand this?'*

Similarly, Jack asked himself a simple question:

> *Would my grandmother understand this?*

In these examples, it appears that the bloggers are trying to relate to their audience and anticipate their needs. That said, the science bloggers did not assume their audiences to be scientifically illiterate. Thomas indicated that:

> *The nice thing is that because our audience is a fairly sophisticated group we don't have to dumb it down so, you know, we can kind of take this middle road to start with*

Thomas went further, sharing his assumption that audiences like to read high-level content:

> *I think I've learned that people are hungry for it. So I think that there's this common belief that people are stupid and they aren't interested in science and they just want to know what Miley Cyrus is doing but I don't see that. I see people are hungry for it. They love it. They want to talk about it. They want to consume more of it.*

From Thomas' perspective, he would be doing a disservice to his audience by overly simplifying his work to make it attractive to a very broad audience.

## 4 Discussion and Conclusion

This research focused on obtaining insights into the main challenges faced by some of today's top science bloggers, as well as the communication strategies they made use of to bring science to the public.

Two categories of challenges can be identified by examining the bloggers' responses. First, lack of funding and lack of respect towards blogging could be categorised as general blogging challenges, not challenges necessarily unique to science (de Zúñiga, *et al.*, 2011; New York Times, 2009). For many, blogging is a hobby and does not come with the funding and time required for the creation of long-form articles. Perhaps the lack of these types of articles is a factor that contributes to what science bloggers perceive to be a lack of respect for their efforts.

The other two main challenges identified (the requirement for writers to have specialised knowledge and the slow pace of science) could be categorised as challenges more specific to science blogs. Unlike other subject matter, such as sports or celebrities' lives, advanced degrees are often required to gain deep knowledge of science topics, so it can be challenging when a blogger is required to write about unfamiliar topics. That is not to say that writing about advanced scientific topics is impossible without an advanced degree: Thomas creates in-depth astronomy content without a specific academic astronomy background.

With regards to the slow pace of science, here again science differs from other subject matter. A political scandal or the release of a cat video is immediate. Important developments in the world of science, on the other hand, can often take many months or even years to fully materialise. Instead of writing big features that synthesise many scientific developments, science bloggers are often left to write about press releases and other similar immediate developments whose full implications are not yet revealed.

From all these challenges, it becomes clear that what science bloggers want is the time, money and knowledge to be able to create respected content that shows science's long game. In the face of these challenges, what can a science blogger do to create appealing posts that could enhance their reputation within the media world? This study revealed that the top science bloggers use numerous strategies that could help them to overcome the challenges identified. The top science bloggers indicated that they intentionally make use of exciting language, highlight content appropriate for their passionate audiences, use analogies and metaphors to provide colour and imagery and avoid jargon. Together, these strategies could be applied to help overcome the issue of science stories not always being as immediate as other types of stories, by enhancing other elements that can make a science story appealing.

Creating competitive content requires the top science bloggers to overcome numerous challenges. The challenges highlighted in this paper are those that potentially prevent science bloggers from creating their ideal posts: respected, long-form articles. In their attempts to overcome these challenges, this study found that science bloggers consciously make use of numerous strategies to make their content attractive and competitive.

## 5 References

Blanchard, A. (2011) Science blogs in research and popularization of science: why, how and for whom? *In* Cockell, M., Billotte, J., Darbellay, F. and Waldvogel, F. (eds.) *Common Knowledge: The Challenge of Transdiciplinarity*. Lausanne: EFPL Press.

BlogPulse (2011*) BlogPulse* [online]. Available from: http://www.blogpulse.com/. [Accessed: 23 October 2011].

Blood, R. (2002) *The Weblog Handbook*. Cambridge: Perseus Publishing.

Campbell, H. (2010) *Should science bloggers be paid?* [online]. Available from: http://www.science20.com/science_20/blog/should_science_bloggers_be_paid. [Accessed: 20 August 2011].

Colson, V. (2011) Science blogs as competing channels for the dissemination of science news, *Journalism*, 12(7) 889.

de Zúñiga, H.G., Lewis, S.C., Willard, A., Valenzuela, S., Lee, J.K. and Baresch, B. (2011) Blogging as a journalistic practice: A model linking perception, motivation, and behavior, *Journalism*, 12(5) 586.

Francl, M. (2011) Blogging on the Sidelines, *Nature Chemistry*, 3(3),183.

Hampton, K.N., Goulet, L.S., Rainie, L. and Purcell, K. (2011) Social networking sites and our lives, *Pew Internet & American Life Project*, 1-85.

Harrell, M.C. and Bradley, M.A. (2009*) Data Collection Methods: Semi-Structured Interviews and Focus Groups*. Santa Monica: RAND Corporation.

New York Times. (2009) *Talk to the Times: Assistant Managing Editor Gerald Marzorati* [online] Available from: www.nytimes.com/2009/08/24/business/media/24askthetimes.html?pagewanted=all&_r=0. [Accessed: 13 January, 2014].

Royal Pingdom (2010) *Internet 2010 in numbers* [online]. Available from: http://royal.pingdom.com/2011/01/12/internet-2010-in-numbers/. [Accessed: 23 October 2011].

Technorati (2011) *Blog Directory* [online]. Available from: http://technorati.com/blogs/directory/. [Accessed: 15 February 2011].

Yong, E. (2011) *Am I a science journalist?* [online]. Available from: http://blogs.discovermagazine.com/notrocketscience/2011/06/28/am-i-a-science-journalist/. [Accessed: 20 August 2011].

Zivkovic, B. (2006) *Science Blogging - what it can be* [online]. Available from: http://scienceblogs.com/clock/2006/08/science_blogging_what_it_can_b.php. [Accessed: 22 August 2011].

Zivkovic, B. (2009) *Defining the Journalism vs. Blogging Debate, with a Science Reporting angle* [online]. Available from: http://scienceblogs.com/clock/2009/03/defining_the_journalism_vs_blo.php. [Accessed: 24 August 2011].

## 6 Acknowledgements

Completing this research project would not have been possible without the help and support of Dr Karen Bultitude. Her professionalism and dedication helped to make the research experience enjoyable and memorable. For this, I thank her.

I would also like to thank Dr Clare Wilkinson and the rest of the Science Communication Unit at the University of the West of England, Bristol for welcoming me into the programme and helping me to nurture my passion for the communication of science.

Mr Mathieu Ranger (mathieu.ranger@osc.on.ca)
Ontario Science Centre, 770 Don Mills Road, Toronto, Ontario, Canada, M3C 1T3

# I'm a Student, Inspire Me! Can engagement via the Internet positively influence attitudes toward science?

Robin Longdin and Ann Grand

This paper is based on research carried out by Robin Longdin as part of his MSc in Science Communication.

## 1 Introduction

The call for scientists to learn to communicate with the public (DIUS, 2008), stemming from the publication of *The Public Understanding of Science* report (Bodmer, 1985) was undoubtedly the product of a pre-Internet age. The growth of the Internet since then makes timely the discussion of the potential for online science engagement and its role in modern science communication.

### *1.1 The Internet and science communication*

The late 1990s and early 2000s saw the very rapid development and expansion of the Internet into daily life. Despite this, the Internet, as a vehicle for directly engaging young people and improving the uptake of science subjects, is either not mentioned in key publications of the time or mentioned only in passing as an information source. For example, Munro & Elsom (2000) make only brief reference to the Internet as an emerging means for pupils to make contact with holders of higher-level science jobs, to complement more local channels such as former students and governors. Wynarczyk & Hale (2008) also use the word 'Internet' sparingly. Their sole reference to the technology is made in passing along with other, more traditional, methods of inspiring young children, such museums and books (Wynarczyk & Hale, 2008). Although this report makes numerous references to websites, the context makes it clear that the Internet is viewed primarily as a means of disseminating information about science engagement initiatives, rather than as a route for engagement in itself. This suggests that the Internet is currently predominantly used as a vehicle for the 'deficit' model of science communication, one which 'conceptualises the lay mind as an empty bucket into which the facts of science can and should be poured' (Gregory & Miller, 1998, p.89).

Since 2000, a more mutually understanding model of dialogue and engagement has prevailed in the UK, following the publication of the *Science and Society* report (House of Lords, 2000). This model strives not just for the public understanding of science but also the understanding of the public by scientists. The Internet is a medium that could support direct interaction between scientists and members of the public.

### *1.2 The 'I'm a Scientist, Get me out of here' Event*

'I'm a Scientist, Get me out of here' (hereafter referred to as 'IAS') is an online science engagement and enrichment activity, funded by the Wellcome Trust and produced by Gallomanor Communications Ltd. For two weeks, UK students from Key Stages 2, 3, GCSE and 6th Form/A-Level engage with scientists by posing written questions or 'chatting' live (via online text) with scientists in an Internet-based chat room. The participating scientists are grouped into thematic zones (such as energy, space, sports), with approximately five scientists per zone. After their interaction, students may vote for their favourite scientist, resulting in the elimination of one scientist per day until a winner is declared for each zone.

Two IAS events were held during June and July 2012. For the purposes of this project, the two events will be treated as one and hereafter referred to as 'the event'.

The aims of the project were to investigate whether a specific Internet-based engagement initiative could positively influence students' attitudes toward science, and whether factors such as attitudes, age, sex and deprivation influenced student participation and engagement in the event.

## 2 Methods

Four distinct data groups were collected as part of this research project: user data, participation data, attitudinal data and Index of Multiple Deprivation (IMD) data. User, participation and attitudinal data were provided to the researcher by Gallomanor Communications Ltd.

### *2.1 User data*

Users registering on the IAS website were assigned a unique ID and asked to provide information about themselves, including sex, year group and school name. Based on the indicated year group, the respective Key Stage (Key Stage 2, Key Stage 3, Key Stage 4/GCSE or 6th Form/A-Level) was manually added to the data for each user ID.

### *2.2 Participation data*

Website use data (number of questions asked, number of votes cast, number of lines of live chat typed and the number of comments left) were collected for each user during the event. For each user ID, a 'participation score' was calculated, defined as the sum of the number of questions asked, number of votes cast, number of lines of live chat typed and number of comments left.

### *2.3 Attitudinal data*

A four-question survey was used to measure attitudes towards science before and after the IAS event. The pre-event survey was integrated into the student registration process on the IAS website. The same survey was run post-event by Gallomanor Communications Ltd, using an on-line survey system. A modified Likert scale approach

was used, whereby respondents were asked to indicate their degree of agreement or disagreement with a proposition; the use of five response options (to include a neutral response) is typical (Sapsford & Jupp, 2006). Strongly positive responses were scored 5 and strongly negative 1.

A 'pre-event attitude score' was calculated for each student, defined as the sum of the scores for each of the four questions. A 'post-event attitude score' was calculated in the same way for those students who responded to the post-event questionnaire. An 'attitude score' of 4 was the lowest (and most negative) possible, while a score of 20 was the highest (most positive). A score of 12 indicated an overall neutral attitude.

### *2.4 Deprivation data*

To quantify deprivation, Index of Multiple Deprivation (IMD) scores for each school at the Local Authority (LA) level were used. IMD 'combines a number of indicators, chosen to cover a range of economic, social and housing issues, into a single deprivation score for each small area in England' (DCLG, 2010). An increase in IMD score equates to an increase in deprivation.

## 3 Results

### *3.1 Data overview*

A dataset containing 1588 students (794 girls and 794 boys) was created and used for the statistical analyses of pre-event attitudes, deprivation and event participation. A total of 191 responses to the post-event attitude survey was received, 138 of which had complete data and were successfully paired with pre-event survey results.

### *3.2 Pre-event attitudes, participation and deprivation*

Means were calculated for attitude, participation and deprivation scores, the results of which are shown in Table 1. For boys, the mean pre-event attitude score was 15.2, while for girls it was slightly lower at 14.6, indicating that boys had a more positive attitude than girls on average. The Mann-Whitney U Test revealed this difference to be statistically significant.

In contrast to the pre-event attitude scores, the mean participation score was higher for girls (13.3) than it was for boys (12.6), indicating that girls participated in the event more than boys on average. Unlike the pre-event attitude score, however, the Mann-Whitney U Test indicated that the difference was likely to be due to random chance.

Means for the four individual participation measures were higher for girls in each case. The difference from boys was statistically significant for number of questions asked and number of votes cast but not for number of lines of live chat and number of comments.

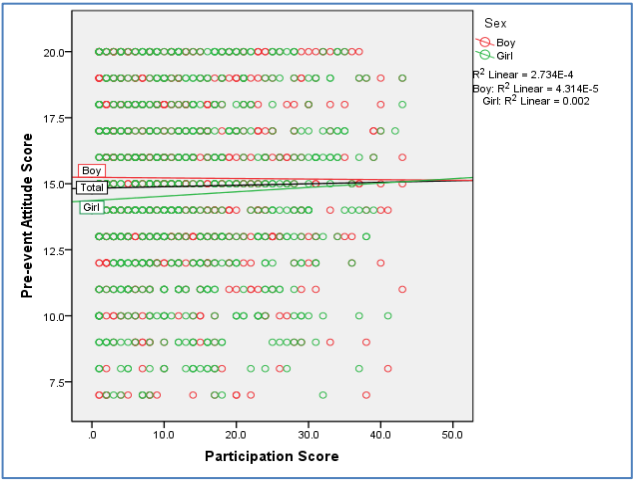
**Table 1: Means and standard deviations**

| | | Mean | SD | Valid N |
|---|---|---|---|---|
| **Pre-event Attitude Score** | Boy | 15.2 | 3.3 | 758 |
| | Girl | 14.6 | 3.5 | 773 |
| | **Total** | **14.9** | **3.4** | **1531** |
| **Q1 Score** ('How does school make you feel about science?') | Boy | 3.8 | 1.1 | 794 |
| | Girl | 3.6 | 1.1 | 794 |
| | **Total** | **3.7** | **1.1** | **1588** |
| **Q2 Score** ('Are you planning to choose a science subject at the next stage of your education?') | Boy | 3.8 | 1.2 | 794 |
| | Girl | 3.7 | 1.2 | 794 |
| | **Total** | **3.7** | **1.2** | **1588** |
| **Q3 Score** ('Do you think jobs involving science are interesting?') | Boy | 4.0 | 0.9 | 750 |
| | Girl | 3.8 | 0.9 | 771 |
| | **Total** | **3.9** | **0.9** | **1521** |
| **Q4 Score** ('When you finish your education, how likely are you to look for a job that uses your science knowledge and skills?) | Boy | 3.3 | 1.2 | 794 |
| | Girl | 3.3 | 1.2 | 794 |
| | **Total** | **3.3** | **1.2** | **1588** |
| **Participation Score** | Boy | 12.6 | 9.9 | 766 |
| | Girl | 13.3 | 9.8 | 742 |
| | **Total** | **12.9** | **9.8** | **1508** |
| **No. Questions Asked** | Boy | 2.3 | 2.7 | 769 |
| | Girl | 2.8 | 3.3 | 744 |
| | **Total** | **2.5** | **3.0** | **1513** |
| **No. Votes Cast** | Boy | 1.0 | 0.7 | 789 |
| | Girl | 1.1 | 0.8 | 774 |
| | **Total** | **1.0** | **0.8** | **1563** |
| **No. Lines Live Chat** | Boy | 8.5 | 8.6 | 757 |
| | Girl | 8.8 | 8.3 | 756 |
| | **Total** | **8.7** | **8.4** | **1513** |
| **No. Comments** | Boy | 0.1 | 0.4 | 770 |
| | Girl | 0.2 | 0.5 | 749 |
| | **Total** | **0.1** | **0.4** | **1519** |
| **LA IMD Score** | Boy | 21.2 | 6.6 | 492 |
| | Girl | 21.1 | 6.4 | 605 |
| | Total | 21.2 | 6.5 | 1097 |

The overall mean IMD score at the local authority (LA) level was 21.2, with the average for boys being 21.2 and girls 21.1. The IMD scores were equally distributed between girls and boys according to the Mann-Whitney U Test.

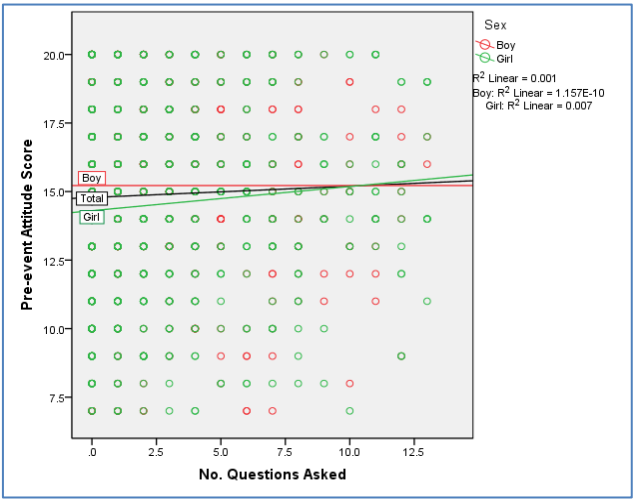
Correlation analyses were carried out to investigate relationships between pre-event attitude, participation and deprivation. The Spearman's Rho test was chosen, since the test does not assume that data are normally distributed, making the test more appropriate for non-normally distributed data than Pearson's Coefficient (Sapsford & Jupp, 2006; Easton & McColl, 1997).

**Figure 1: Scatter plot showing relationship between pre-event attitude scores and participation scores**




No statistically significant relationship was found between pre-event attitude scores and participation scores, although the relationship was positive for girls (correlation coefficient of 0.045), whereas it was marginally negative for boys (correlation coefficient of -0.024) (see Figure 1). That is, for girls, the higher the pre-event attitude score, the

**Figure 2: Scatter plot showing relationship between pre-event attitude scores and no. questions asked**

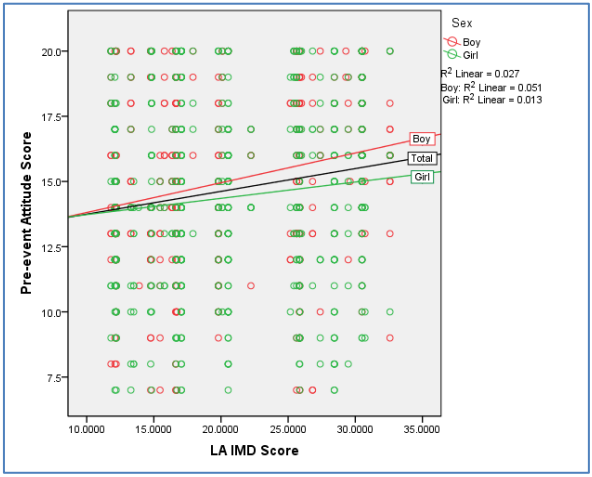


higher the participation score, although this relationship could be due to chance.

A positive and statistically significant relationship was seen between the number of questions asked by girls and pre-event attitude scores (correlation coefficient of 0.079). That is, the higher the pre-event attitude score, the more questions were asked during the event; a relationship that is not likely to be due to chance. For boys, the relationship was marginally negative and not statistically significant (see Figure 2).

Pre-event attitudes scores were compared against the LA level IMD scores. The correlation was positive and statistically significant overall for both boys and girls (see Table 1 and Figure 3). That is, the higher the deprivation scores at the LA level (i.e., greater deprivation), the higher the pre-event attitude scores. The relationship was more strongly positive for boys (correlation coefficient of 0.219) compared to girls (correlation coefficient of 0.110).

**Figure 3: Scatter plot showing relationship between pre-event attitude scores and IMD scores at the LA level**




Participation scores were compared against the LA level IMD scores. A statistically significant negative relationship was seen overall, and for boys separately, but not for girls (see Figure 4).

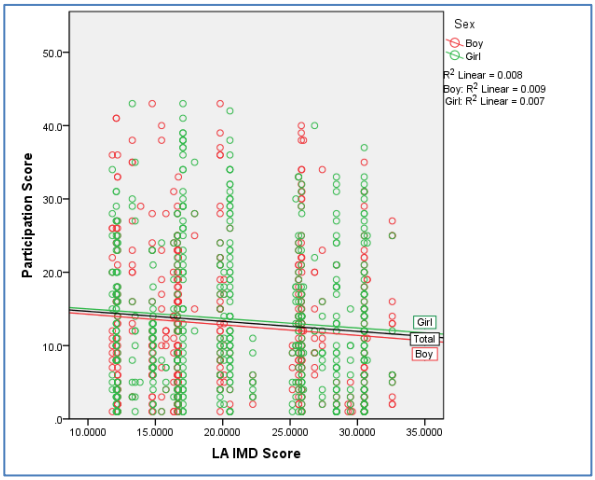
### *3.3 Changes in attitude after the event*

Of the 135 students supplying post-event data, 103 (76.3%) were girls and 32 (23.7%) were boys. The majority of students (106, 78.5%) were at Key Stage 3. The sample was therefore highly unbalanced.

Means for the pre- and post-event dataset are shown in Table 2. Overall, attitude scores increased by an average of 0.60, from 16.3 pre-event to 16.9 post-event. This

suggests that the event positively influenced students' attitudes. Furthermore, the Related-Samples Wilcoxon Signed Rank Test indicates that the increase in mean attitude score post-event is not likely to be due to random chance. The mean attitude score for girls increased by 0.77, while for boys the increase was only 0.03, indicating that girls account for the majority of the increase in attitude scores observed overall. The Mann-Whitney U Test indicates that this difference is not likely to be due to random chance.

**Figure 4: Scatter plot showing relationship between participation scores and IMD scores at the LA level**




## 4 Discussion and Conclusion

### *4.1 Do attitudes affect participation?*

A more positive pre-event attitude among girls was shown to be associated with an increase in the number of questions they went on to ask during the event; an association not seen amongst boys despite, on average, boys having a more positive pre-event attitude than girls. This positive attitude in boys did not translate to increased participation; boys participated less on average in all four measures.

This finding is consistent with evidence that girls are more likely than boys to actively engage in science events. In an American study examining science engagement amongst middle school girls, the authors note that girls traditionally occupy a position of less power in the classroom, and are given less opportunity to answer questions or engage with the teacher. Engagement activities that provided less 'risky' ways for girls to participate helped them to overcome these factors (Barton, *et al*., 2008).

**Table 2: Means and standard deviations (pre- and post-event data)**

| | | Mean | SD | Valid N |
|---|---|---|---|---|
| **Pre-event Attitude Score** | Boy | 17 | 2.6 | 30 |
| | Girl | 16.1 | 2.8 | 102 |
| | **Total** | **16.3** | **2.8** | **132** |
| **Post-event Attitude Score** | Boy | 17.1 | 2.2 | 31 |
| | Girl | 16.8 | 2.4 | 100 |
| | **Total** | **16.9** | **2.4** | **131** |
| **Change in Attitude Score** | Boy | 0.03 | 1.3 | 30 |
| | Girl | 0.77 | 1.5 | 96 |
| | **Total** | **0.6** | **1.5** | **126** |
| **Q1 Change** ('How does school make you feel about science?') | Boy | -0.03 | 0.5 | 30 |
| | Girl | 0.15 | 0.6 | 95 |
| | **Total** | **0.1** | **0.6** | **125** |
| **Q2 Change** ('Are you planning to choose a science subject at the next stage of your education?') | Boy | 0.1 | 0.7 | 31 |
| | Girl | 0.23 | 0.7 | 99 |
| | **Total** | **0.2** | **0.7** | **130** |
| **Q3 Change** ('Do you think jobs involving science are interesting?') | Boy | 0 | 0.5 | 31 |
| | Girl | 0.2 | 0.6 | 95 |
| | **Total** | **0.15** | **0.6** | **126** |
| **Q4 Change** ('When you finish your education, how likely are you to look for a job that uses your science knowledge and skills?) | Boy | 0 | 0.7 | 29 |
| | Girl | 0.07 | 0.6 | 98 |
| | **Total** | **0.06** | **0.6** | **127** |
| **No. Questions Asked** | Boy | 4 | 3.7 | 32 |
| | Girl | 6.5 | 6.1 | 98 |
| | **Total** | **5.8** | **5.7** | **130** |
| **No. Votes Cast** | Boy | 1.2 | 0.8 | 32 |
| | Girl | 1.2 | 0.8 | 98 |
| | **Total** | **1.2** | **0.8** | **130** |
| **No. Lines Live Chat** | Boy | 15.6 | 11.5 | 31 |
| | Girl | 13.2 | 11 | 99 |
| | **Total** | **13.8** | **11.1** | **130** |
| **No. Comments** | Boy | 0.66 | 1.2 | 32 |
| | Girl | 0.7 | 1.5 | 97 |
| | **Total** | **0.69** | **1.4** | **129** |
| **Participation Score** | Boy | 22.8 | 13.7 | 29 |
| | Girl | 23.2 | 14.7 | 96 |
| | **Total** | **23.1** | **14.4** | **125** |
| **LA IMD Score** | Boy | 18.9 | 6.1 | 20 |
| | Girl | 20.5 | 5.5 | 76 |
| | **Total** | **20.2** | **5.6** | **96** |

Stake & Mares (2001) go further, and suggest that science enrichment programs are particularly beneficial to girls specifically because they tend to feel isolated at school. It is perhaps not surprising that in this study, the difference in mean attitude score between boys and girls (3.8 compared to 3.6 respectively) was greatest for question 1 'How does school make you feel about science?' IMD scores have been shown to be equally distributed between the sexes in the sample used for this project; therefore the relationship between deprivation and pre-event attitudes cannot be attributed to the differences in attitude between the sexes.

The *SES and Science Education* report (Royal Society, 2008) shows that a link between socioeconomic status (SES) and attitudes toward science is not conclusively demonstrated, although the general trend would suggest increasingly negative attitudes where deprivation is greater. This is directly opposite to the effect demonstrated by this project; it is possible that one or more confounding variables not accounted for in the analyses, such as the influence of teachers on students' attitudes, influenced the outcome.

*4.2 Does deprivation affect participation?*

In contrast to the effect on attitudes, increasing deprivation is associated with a decrease in participation. The trend is apparent and broadly comparable for both boys and girls, although it is only statistically significant for boys.

Such a trend is well evidenced by available literature. In a study of engagement in 117 middle school English classrooms, evidence was found of lower levels of engagement amongst students with low socio-economic status (Kelly, 2008). The OECD Programme for International Student Assessment (PISA) reports that in the United Kingdom, 'the odds of low participation for students from low socio-economic families… were at least 1.5 times as great as the odds for students from average socio-economic status families' (Willms, 2003, p.40).

There is also evidence that young people of higher socio-economic status are more likely to have access to the Internet, have more years of online experience, and use the Internet more effectively across a wider range of uses (Drouard, 2010; Livingstone, *et al*., 2005). It is possible that access to, and ability to use, the Internet could be a contributory factor to the relationship between deprivation and participation.

*4.3 Were students positively influenced by the event?*

Girls' attitudes were shown to be positively influenced by the event, while attitudes amongst boys were almost unchanged. Statistical analyses indicate that IMD scores at the LA level are equally distributed between the sexes, thus discounting deprivation as a factor affecting changes in attitude.

The sample size for comparing post-event attitude with pre-event data was significantly smaller than the total number of students for which pre-event attitudes were measured. This was driven by the response rate for the post-event survey, where uptake was much lower than for the pre-event survey. It is possible that only those students who participated more in the event were subsequently inclined to respond to the post-event survey. Further, the sample could have been biased by groups of students being encouraged to respond to the post-event survey either by each other or by their teachers.

The relationship between pre- and post-event attitudes is perhaps the area of this project that would benefit most from further work. The limitations of the post-event survey can be addressed by initiating a more thorough and interactive follow-up with students.

### *4.4 Conclusions*

Overall, the 'I'm a Scientist, Get me out of here' online science engagement event was shown to have a positive influence on the attitudes of students towards science, although caution should be exercised in how representative the post-event survey sample was. Students had an overall positive attitude before the event, with those who were more positive going on to participate more in the event.

Significant differences between the sexes were shown throughout. Girls were generally less positive than boys before the event but went on to participate more. Similarly, girls' attitudes became more positive after the event, whereas boys' attitudes didn't change. Factors that could explain these findings include the fact that girls are more likely than boys to actively engage in science events and are better able to express themselves through written communication. They are also more likely to value an opportunity to make new connections with peers and scientists, which they might otherwise feel unable to make in the in normal school environment.

Those students attending schools in more deprived areas tended to have a more positive attitude before the event than those from less deprived areas, but went on to participate in the event less. Parental attitudes, which tend to be less positive toward science in areas of higher deprivation, are a potential influence on their children's attitudes and a potential explanation for students' decreased participation in the event. However, further work would be needed to better understand the relationship between levels of deprivation and pre-event attitudes.

As an Internet-based event, research data were relatively easy to collect but the lack of personal contact can limit the extent and value of follow-up activities such as the post-event survey employed in this project. It can also make interpretation difficult in some cases, where knowledge of the situation in the classroom would have proved valuable. It is therefore recommended that further work should explore better ways to follow-up with participating students, and to understand better the relationship between students and the teacher in the participating classes.

## 5 References


Barton, A., Tan, E. & Rivet, A. (2008) Creating hybrid spaces for engaging school science among urban middle school girls. *American Educational Research Journal*, 45 (1) 68.

Bodmer, W. (1985) *The Public Understanding of Science*, London: The Royal Society.

DCLG (2010) *Communities and neighbourhoods*. [Online] Available at: http://www.communities.gov.uk/communities/research/indicesdeprivation/deprivation10/ Accessed March 2012.

DIUS (2008) *A vision for Science and Society: A consultation on developing a new strategy for the UK*, London: Department for Innovation, Universities and Skills.

Drouard, J. (2010) Computer literacy, online experience or socioeconomic characteristics – What are the main determinants of Internet adoption and Internet usage?. *Communications & Strategies*, 80 (4) 83.

Easton, V. & McColl, J. (1997) *Statistics Glossary* v1.1. [Online] Available at: http://www.stats.gla.ac.uk/steps/glossary/nonparametric.html Accessed September 2012.

Gregory, J. & Miller, S. (1998) *Science in Public; Communication, Culture and Credibility*. 1st ed. Cambridge, MA: Basic Books.

House of Lords (2000) *Science and Society*, London: Her Majesty's Stationary Office.

Kelly, S. (2008) Race, social class, and student engagement in middle school English classrooms. *Social Science Research*, 37, p. 434.

Livingstone, S., Bober, M. & Helsper, E. (2005) *Inequalities and the digital divide in children and young people's internet use: findings from the UK Children Go Online project*, London: London School of Economics and Political Science.

Munro, M. & Elsom, D. (2000) *Choosing Science at 16, NICEC Project Report*: Cambridge: CRAC.

Royal Society (2008) *Exploring the relationship between socioeconomic status and participation and attainment in science education*, London: The Royal Society.

Sapsford, R. & Jupp, V. (2006) *Data Collection and Analysis*. 2nd ed. London: Sage.

Stake, J.E. & Mares, K.R. (2001) Science enrichment programs for gifted high school girls and boys: predictors of program impact on science confidence and motivation. *Journal of Research in Science Teaching*, 38 (10) 1065.

Willms, J.D. (2003( *Student engagement at school; A sense of belonging and participation*, Paris: OECD.

Wynarczyk, P. & Hale, S. (2008) *Improving take-up of science and technology subjects in schools and colleges: A synthesis review, Newcastle upon Tyne*: Report prepared for the Economic and Social Research Council (ESRC) "Science in Society" Team and the Department for Children, Schools and Families (DCSF).

## 6 Acknowledgements

With thanks to Shane McCracken and Rosie Schultz at Gallomanor Communications Ltd, Dr Ann Grand, University of the West of England, Bristol and Quotient Bioresearch Ltd.

---

Mr Robin Longdin (rlongdin@yahoo.com)
c/o Science Communication Unit, University of the West of England, Bristol, Coldharbour Lane, Bristol BS16 1QY

# BioBlitz in the spotlight: citizen science working in and with the media

Amy Seakins and Clare Wilkinson

This paper is based on research carried out by Amy Seakins as part of her MSc in Science Communication.

## 1 Introduction

Citizen science projects involve volunteers working alongside scientists, gathering data suitable for scientific study. There are numerous ways in which citizen science projects can use different media: for example, promotion to relevant audiences, engaging these audiences with science and as a platform for data collection and publishing. The BioBlitz, organised by the Bristol Natural History Consortium, is one example of a citizen science project.

Through interviews with citizen science project organisers, stakeholders in the BioBlitz project, members of the BioBlitz media team and participants, this research explored how citizen science projects were using the media and how they might be more effective. Key issues arising were the need to use mixed channels, making individual projects relevant in a wider context, directing more efforts into promotion and including experts' presence within the media used.

### *1.1 Citizen science*

Three key features of citizen science projects were studied in this research:

- Volunteers collect or analyse data
- Volunteers have little or no formal scientific training
- The results collected or analysed are of use to professional scientific research

Silvertown (2009, p.467), in a brief review of the topic, defines a citizen scientist as 'a volunteer who collects and/or processes data as part of a scientific enquiry'. The Bristol Natural History Consortium (BNHC) defines citizen science as 'an interdisciplinary approach whereby the public and volunteers engage directly with science through its formation, delivery and dissemination, with reciprocal exposure and benefit' (BNHC, 2010). This was the definition of citizen science adopted in this research. Both volunteers and scientists benefit in citizen science projects (Raddick *et al.*, 2009): scientists are able to collect more data, often over a wide geographical area, while volunteers have the opportunity to take part in real, authentic, scientific research, have a fun and social experience and develop their scientific understanding and knowledge of the processes of research (Trumbull *et al.*, 2000; Brossard, Lewenstein & Bonney, 2005).

### *1.2 Citizen science and the use of media*

Research into citizen science has mainly focused on the audiences and scientists taking part, their demographics and motivations and the benefits of participating to all parties. This study, on the other hand, focused on a particular aspect of citizen science projects in more detail: how projects use different media and the effectiveness of different media strategies.

There are considerable and expanding ways in which citizen science projects can use different media and researchers have called for study into which might be more or less effective for different purposes and audiences (Bracey, 2009). Citizen science projects are making use of Internet platforms, such as Google Maps, for data entry and sharing (Bracey, 2009) and of social networks, online fora and blogs to build communities. Local and national traditional print and broadcast media are also important for recruiting participants and building awareness of campaigns (Bell *et al.*, 2008). This research used a number of case studies to explore how they used different media and the effectiveness of various media strategies and offered recommendations for how citizen science projects might more effectively use different media in the future.

## 2 Methods

Working alongside the Bristol Natural History Consortium and using the Bristol BioBlitz as a case study, the overall aim of this project was to establish how citizen science projects can effectively use different media formats for promotion and engagement, and as a platform.

The following objectives were established to achieve the overall aim:

- Categorise how existing UK-based citizen science projects within the last five years use a range of different media formats. Broadcast, print, and online media were all studied as media formats.
- From this categorisation, assess the effectiveness of the media strategies of five to eight case study citizen science projects via interviews with organisers and analysis of existing evaluation and coverage.
- Investigate the wider context of media use of the Bristol BioBlitz, via interviews with BioBlitz participants (30), BNHC stakeholders (five to eight, representing a range of organisations) and individuals working in local media (five to eight, representing a spread of media formats).
- Make recommendations as to how the Bristol BioBlitz can more effectively use the media for promotion, engagement and as a platform, leading into the planning process for the next BioBlitz event.

A review of the relevant literature on the topic of citizen science was carried out at the start of the project, to collate existing knowledge around the use of media in citizen science projects. A project review was also conducted and a list compiled of all the

citizen science projects active in the UK within five years of the review. Basic information was collated on each project; for example what area of science it involved, what the volunteers were required to do and what sorts of media it currently made use of.

Projects were categorised based on their media use (see Table 1). A case study was selected as the focus project in each category. Semi-structured interviews were then conducted to gain qualitative data (Gillham, 2000; King and Horrocks, 2010). For each case study the project organiser or media manager was interviewed, to gain more information about the use of media in their projects. Interviews centred on organisers' experiences of using different media, any issues they came across relating to media and any insights or advice they might give other project organisers.

Interviews were also conducted with three other groups:

- BNHC stakeholders
- Participants at Bristol BioBlitz event
- Individuals working in Bristol local media

The majority of interviews were conducted over the phone, except for those with BioBlitz participants and the BNHC organisers, which were conducted in person. Most of the interviews were audio-recorded but for BioBlitz participants, responses were recorded in a written format by the researcher. Recordings were transcribed in full.

Transcripts were analysed using thematic coding analysis (Boyatzis, 1998; Braun and Clarke, 2006). Themes were noted as they emerged from the data, organised into coding frames and categories and frames and codes were revised as more data were analysed. Content analysis was carried out for the BioBlitz participant responses, which were much shorter and therefore frequencies of response could be calculated more easily (Gillham, 2000). This data was, therefore quantified, to provide a summary of the motivations, interests and patterns of responses of the BioBlitz participants.

## 3 Results

Ten key themes were identified from the interviews with project organisers, stakeholders, media professionals and BioBlitz participants. These themes related to how citizen science projects currently made use of media and the issues and barriers to consider in developing media strategies. Three of these themes are discussed in more detail below. Those not discussed in this paper include existing media evaluation, logistics, current use of media and coverage, how different formats reach different audiences, wider media context, doing science in public and the importance of a clear media strategy.

**Table 1: Categories of citizen science projects**

| Category | Description | Case Study |
|---|---|---|
| Analysis | Entirely online, with some national press coverage but little or no regional coverage. Some use of online social media. | Galaxy Zoo |
| Event | Little or no online presence, event is main platform for information and engagement. Some regional press coverage but no national. | BioBlitz Bristol* |
| Local | Online platform but with no use of online social media. More regional than national press, but both limited. | Big Biodiversity Butterfly Count |
| National | Some extensive national and regional press coverage, with coverage also in magazines. Little or no use of social media. Very mixed platform media use. | BirdTrack |
| Coordinators | Equal amounts of national to regional press coverage. Biggest users of online social media, online platform. | OPAL |
| Other | Little or no coverage and little or no social media use. Online platform with results online. | No project identified |

* The national BioBlitz scheme was also used as a case study, as it co-ordinated the regional events.

### *3.1 Scientific research vs. public engagement*

A dilemma in citizen science is maintaining the balance between public engagement, involving non-experts and actually gaining useful and valid scientific data. As one stakeholder mentioned:

> *to what degree was this [BioBlitz] about public engagement, and what degree was this about scientific research?* (S4)[1]

This informs how much of a priority the media aspect of the project becomes. For a project or event strongly focused on public engagement, media use and coverage may be more of a priority, particularly in terms of promotion, compared to an initiative where the value is placed more on reliable and valid scientific recording.

The fact that the BioBlitz generates 'real science' and participants can engage with 'real scientists' was widely seen as a strong pull for both participants and media. A participant at the BioBlitz, asked about how he chooses things to do in Bristol, said:

> *I like learning from specialists and I like it to be something unique. I like learning on the spot with creatures right there* (P39)

### *3.2 Operating in a crowded media market*

The wider context of an event or project affects its media coverage, in what is a very crowded market. Initiatives are constantly competing for media attention and in turn the media is inundated with stories and ideas. For example, some case studies experienced problems due to their launch being around the same time as a general election in the UK, meaning media attention was much harder to achieve:

[1] Codes in brackets represent individual participants, to maintain anonymity. S indicates a BNHC stakeholder, O indicates a project organiser, P indicates a BioBlitz participant and M a media professional. Numbers correspond to individuals.

> *You can imagine a project failing because you launched it on a day when something else happened* (O2)

It is not only a crowded market for projects in terms of securing media coverage; participants and audiences are busy people and there is a lot of competition for their time and attention:

> *Are people just getting bombarded with too much information in this area, and they're like 'well should I do that one [event/survey] or should I do that one?'* (S2)

### *3.3 Users and legacy*

Some projects used media to engage audiences with the science, results and experts working on the research. For example, the Galaxy Zoo organiser discussed how the users of their forum engage with the results from the project:

> *It has become, in a way which we didn't expect, a sort of collaborative place as well, so there are groups of users on the forum carrying out their own research projects using the site and using the data we give access to* (O2)

Media use is also seen as one way to create a project's legacy. Media coverage and media use is seen as a way to record or document the project for others to look back on:

> *It's a way for people to follow what's going on, whereas if they weren't able to make it, it's a great way for them to track the event… throughout the two days* (O3)

This extends the number of people who can engage with the project:

> *What it means then is that that coming together of people, of experts and members of the public, has a longer life than it would have, and it has a wider life, if you like because more people can engage with it* (M2)

The findings under the ten themes identified provided a detailed picture of how different projects were using media and how the effectiveness of the media strategy of citizen science initiatives could be improved.

## 4 Discussion and Conclusion

From the key findings, a number of recommendations were suggested to support the effective use of different media formats within citizen science projects for promotion, engagement and as a platform:

- Define where the project sits on the balance of public engagement vs. generating real scientific data. Establish this early on, together with a clear idea of key messages that media coverage needs to promote.
- Direct efforts into ensuring media interest in the BioBlitz continues by linking it to relevant political or social developments. This will ensure that the BioBlitz remains prominent within a wider context.
- Allow time for media promotion of the project and expand on previous promotion efforts. Use many different media avenues, for both promotion and as a platform, to reach diverse audiences.
- Use the presence of experts or naturalists as a key media pull, for both engagement and promotion. Use media to highlight the presence of real experts, through videos, interviews, blogging, forums and also during the event. Naturalists validate media messages, giving stories an element of authority and also provide crucial interactions with participants, who can then engage with nature at a much higher level.

The recommendations above have important implications for other citizen science projects, not just the Bristol BioBlitz. The conclusions of the research are most relevant for projects within the same category as the BioBlitz, as they will share common aims and current media habits. However the recommendations also highlight themes which all citizen science projects could consider. In particular, all projects need to clearly define where they feature in the balance between public engagement and generating valid science before defining a media strategy.

## 5 References

Bell, S., Marzano, M., Cent, J., Kobierska, H., Podjed, D., Vandzinskaite, D., Reinert, H., Armaitiene, A., Grodzińska-Jurczak, M. and Muršič, R. (2008) What counts? Volunteers and their organisations in the recording and monitoring of biodiversity, *Biodiversity Conservation*, 17, 3443.

Boyatzis, R. E. (1998) *Transforming Qualitative Information: Thematic Analysis and Code Development*. London: SAGE publications.

Bracey, G.L. (2009) The developing field of citizen science: a review of the literature, submitted to *Science Education*.

Braun, V. and Clarke, V. (2006) Using thematic analysis in psychology. *Qualitative research in psychology*, 3, 77.

Bristol Natural History Consortium (2010) *Citizen Science*, e-mail to A. Seakins (amy2.seakins@live.uwe.ac.uk).

Brossard, D., Lewenstein, B. and Bonney, R. (2005) Scientific knowledge and attitude change: the impact of a citizen science project, *International Journal of Science Education,* 27(9) 1099.

Gillham, B. (2000) *The Research Interview*. London: Continuum.

King, N. and Horrocks, C. (2010) *Interviews in Qualitative Research*. London: SAGE publications.

Raddick, M. J., Bracey, G., Carney, K., Gyuk, G., Borne, K., Wallin, J. and Jacoby, S. (2009) Citizen science: status and research directions for the coming decade, *The Astronomy and Astrophysics Decadal Survey Position Papers*, 46, 1.

Silvertown, J. (2009) A new dawn for citizen science, *Trends in Ecology and Evolution*, 24(9) 467.

Trumbull, D. J., Bonney, R., Bascom, D. And Cabral, A. (2000) Thinking scientifically during participation in a citizen science project, *Science Education*, 84(2) 265.

## 6 Acknowledgements

I would like to thank the Bristol Natural History Consortium, Savita, Lauren, Harriet, Sara and Penny, and everyone else who worked on the BioBlitz project for all their help and for including me in their great team.

---

Miss Amy Seakins (amy.seakins@kcl.ac.uk)

King's College London, Waterloo Bridge Wing, Franklin-Wilkins Building, 150 Stamford Street, London SE1 9NH

# Popularising nature: an evaluation of the effectiveness of the 2009 Bristol Festival of Nature in engaging with a wide range of attendees in nature conservation

Maya Herbolzheimer and Helen Featherstone

This paper is based on research carried out by Maya Herbolzheimer as part of her MSc in Science Communication.

## 1 Introduction

Science festivals (SF) are becoming increasingly popular throughout the UK and Europe, ranging from local one-off celebrations of science to week-long national activities (for example, National Science and Engineering Week). In 2006, 15 festivals occurred in the UK that spanned this wide range of scales, forming a highly visible part of the Public Engagement with Science and Technology (PEST) landscape. While each SF is unique in terms of budget, objectives and audience numbers (OST, 2006), they have a common aim: to 'excite the public about the wonder of science and technology, to provoke curiosity about scientific progress and to help the public relate science to their lives' (OST, 2006, p.3), as well as to encourage informal learning around the subject.

This study used the Bristol Festival of Nature (BFON) as a case study to examine whether SF achieve this aim. The BFON is typical in that it is a free annual event attracting 23,000 visitors, with over 100 organisations, businesses and agencies taking part either directly with stalls on the site, or indirectly through their support of the event (BFON Operational Report, 2008). The BFON is organised by the Bristol Natural History Consortium (BNHC) and claims to be the UK's biggest celebration of the natural world' (BNHC, 2009)

### *1.1 Aims and objectives*

The aim of the study was to evaluate the effectiveness of the 2009 BFON in engaging a wide range of attendees with a particular science-related topic: nature conservation (NC).

The two main research objectives were:

- To analyse audience profiles, motivations and attitudes towards NC at the 2009 BFON.
- To evaluate the BFON's effectiveness in engaging attendees in NC.

*1.2 Context of this project*

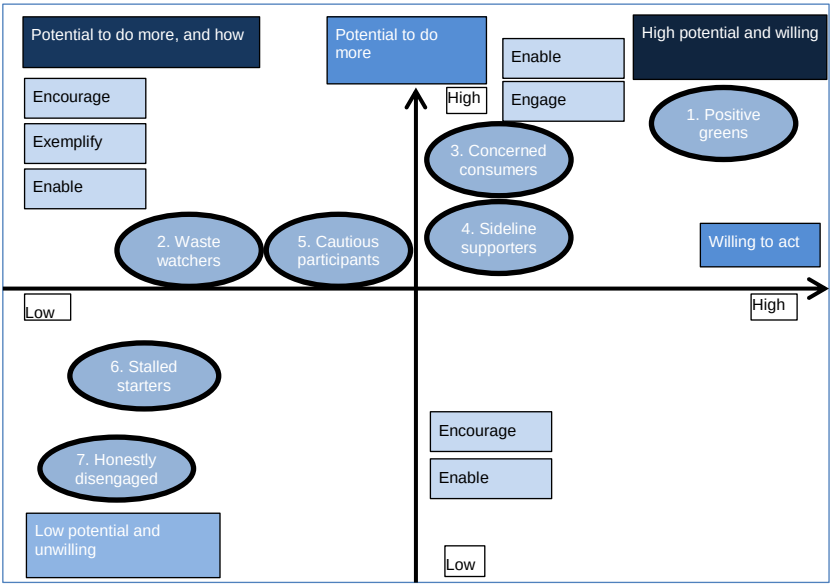
SF vary in how they conduct their evaluations. Some arrange external consultants to carry out research, such as the Manchester Science Festival in 2008 (Northwest Culture Observatory, 2009). However, this is not the norm. According to the findings of a global science events survey, only a third of those surveyed had carried out a formal external evaluation (Bultitude & Custead, 2009). Many SF are small, one-off events that may not have the means to carry out a major evaluation but those that do, such as the BFON, mainly focus on issues of process and organisation based on immediate, quick responses from the public (Grant, 2004; Rooke, 2006). These lack in-depth, detailed qualitative data on the public's motivations and engagement levels at the festival.

Engagement was defined by Lorenzoni, *et al*. (2007, p.446) as a 'personal state of connection' with an issue that goes beyond simple knowledge, where people 'must need to care about it, be motivated and able to take action'. Therefore, engagement can be considered as three separate aspects of change in an individual: knowledge, attitude and behaviour.

This emphasis on personal change links engagement to learning, meaning that tools and insight from the education and informal learning sectors can be used to understand PEST at the BFON. However, engagement levels are notoriously difficult to measure because of the wide variety of different activities involved and a 'relatively open agenda, the content of which can change, in a process not strictly time-bound' (Trench, 2008, p.130). As a result, 'the development of measurement tools that are fit for the task of establishing the terms of good practice, evaluating outcomes, assessing impact, and demonstrating value for money are complex' (Hart, *et al*., 2009, p.6). No single set of evaluation tools/frameworks exists for PEST activities. This study draws on three generic models relating to engagement and learning to inform the development of the research tools and data analysis. The models address engagement at three tiers: national, event and individual.

*Audience Segmentation Models* (ASM) divide the population into groups according to pre-defined common characteristics, forming a standardised measurement tool to help target specific audience categories and identify those absent (Featherstone, 2008). The Department for Environment, Farming and Rural Affairs's (Defra) 2008 ASM summarises the UK public's attitudes and behaviours in response to the environment. The model groups the public into seven different categories according to distinct sets of attitudes and behaviours, with different motivating factors for behaviour change (Defra, 2008, p.8).

**Figure 1: The seven population environmental segments, showing willingness, potential and ability to act for each section. (Source: Defra (2008))**




Falk's *Museum Visitor Experience Model* (2009) suggests that visitors to museums (and arguably other informal learning environments) hold one of five identities. These identities can be used to predict how visitors will behave in a museum and what they will take from the experience:

- 'The Explorer' – seeks interesting things; wanders around the museum with periods of intensive looking and pointing at objects, labels and exhibits.
- 'The Facilitator' – seeks interesting things for others (such as children or parents) rather than their own personal learning goals or desires.
- 'The Experience Seeker' – searches for the most famous or important things in the museum.
- 'The Professional Hobbyist' – goes straight to the exhibits he/she is interested in.
- 'The Re-charger' – re-visits the museum to seek a contemplative or restorative experience and soak in the atmosphere.

Falk's model suggests that visitors attend museums and PEST events 'to build on and reinforce their own prior knowledge and interests rather than as a vehicle for generating 'new' knowledge and interests' (Falk, 2009, p.175).

.

The *Generic Learning Outcomes* (GLO) toolkit was developed by the Museum, Libraries and Archives Council to provide a framework for measuring the impact of visitors' informal learning experiences in a museum, library or archive setting. The toolkit outlines five learning outcomes to help identify what people gain from informal learning. The model was developed to help review and improve performance by providing a standardised evaluation tool.

**Figure 2: The GLO toolkit (Source: Inspiring Learning (2009))**


## 2 Methods

All data collection took place during the 2009 BFON weekend (6th and 7th June) in the Bristol Harbourside area. A mixed methods approach was used to build a complete picture of the research topic:

### *2.1 Questionnaires*

The questionnaire consisted of a mixture of 13 open and closed questions (see Table 1). Half of the questionnaires were conducted by a team of 12 festival volunteers recruited by the BNHC through the festival website. The volunteers used random systematic sampling, approaching one in ten visitors; they read out the questions and helped respondents complete the answers. This ensured that visitors who did not read or write English or had a visual impairment could take part. The second half of the questionnaires was placed on seats at screenings and talks for visitors to complete in their own time. A total of 286 questionnaires was collected over the festival weekend. This comprised 147 forms collected by volunteers on the festival grounds and 137 from the seats in talks and screenings in At-Bristol.

**Table 1: Breakdown of questions**

| Question no. | Closed/open | Content | Model | Data analysis |
|---|---|---|---|---|
| 2 and 5 – 10 | Closed | Information based on audience demographics | — | Microsoft Excel 2004 – graphs and charts |
| 4 | Closed | Identify audience types and ascertain attitudes towards the environment | Seven categories from Defra's ASM (2008) | Microsoft Excel 2004 – graphs and charts |
| 11 | Open | Chart perceived levels of informal learning at the festival | Five GLO categories | Code frame relating to five GLO categories |
| 12 | Open | Word association – three words that best describe the BFON to visitors. For information about visitors' attitudes towards the BFON | — | Open coding |
| 1, 3, 13 | Open & closed | Questions devised for benefit of BFON organisers, no relevance to research objectives | — | n/a |

### *2.2 Snap-shot interviews*

Sixty on-the-spot, snap-shot interviews (SSI), lasting around 90 seconds, were conducted with festival visitors by one of the authors (MH) and two volunteers. Three straightforward, open questions were posed to allow people to think quickly and encourage a high response. Each question corresponded to one of Lorenzoni's three engagement categories: knowledge, attitude and behaviour. Random systematic sampling was employed and locations and times were rotated throughout the weekend. The interviews were recorded using a Dictaphone and the volunteers noted the time, location, number of people in a group, sex and approximate age of each interviewee. The recordings were later transcribed.

### *2.3 Graffiti Wall*

A Graffiti Wall (GW) was created to qualitatively explore the BFON's role in inspiring informal learning around the topic of NC, whilst allowing some creativity, entertainment and interactivity in the evaluation process (Patton, 1987). This method was chosen to include a wider range of participants, including children, as it offers the option of drawing if writing skills are limited. Although drawings can be used in combination with written comment to aid analysis, they can be challenging to interpret without questioning or mediation (Inspiring Learning, 2009).

The public was asked to write or draw their thoughts in response to a prompt question: 'The Bristol Festival of Nature inspires me to...' Providing a phrase for people to complete can be useful when assessing the public's pre-conceptions of NC before the

festival, their attitudes and possible resulting behaviour change (Inspiring Learning, 2009). The written comments were transcribed and the drawings were electronically scanned.

**Figure 3: The graffiti wall**



*2.4 Analysis*

The SSI transcripts, qualitative responses in the questionnaires and the GW data were analysed using open and axial coding as suggested by Strauss & Corbin (1998). The five informal learning GLO categories and Falk's Visitor Experience Model (axial coding) were used in conjunction with additional open codes that emerged from the data.

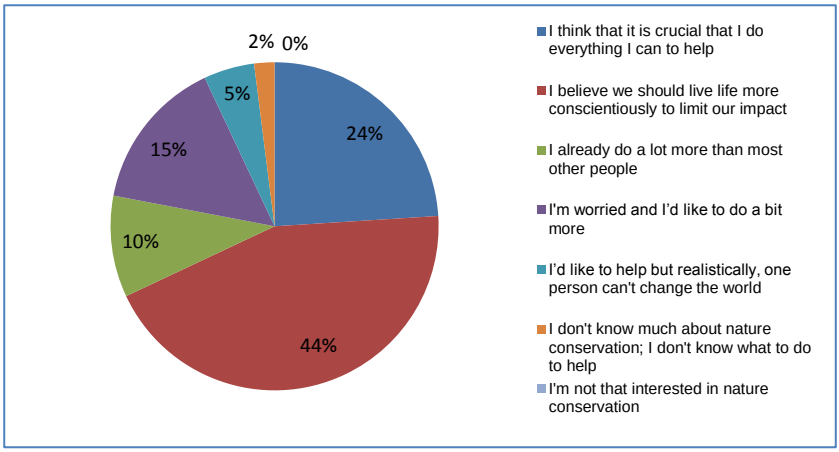
## 3 Results

An overwhelming 94% of respondents at the BFON were white and non-disabled. This is higher than the 2001 census figures for Bristol, where 91.8% of the population is from a white ethnic group and 17.8% has a limiting long-term illness/disability (Bristol City Council, 2003). More women (57%) than men (42%) attended the festival. The most prevalent age group was between 20 and 49.

Analysis based on Falk's Museum Visitor Experience Model (2009) provided further insight into people's reasons for attending the festival. All but the Experience Seeker category were present at the festival, including the Explorer category:

> *I found the tents with all the different stalls and activities going on around Bristol very interesting. Lots of agencies I didn't really know existed …* (SSI, Sunday, 15:50, PN 47)

**Figure 4: Attitudes towards nature conservation (Defra's 2008 ASM)**




Responses to questions relating to Defra's ASM in the questionnaire (see Figure 4) showed that 93% of visitors came to the festival with a pro-environmental attitude and only 2% did not know much about NC. However, these results could show bias, as the visitors may have adapted their answers in an attempt to please the interviewer, given that pro-environmental behaviour was socially desirable in this festival context.

### *3.1 Knowledge*

Most festival attendees were already knowledgeable about nature and environmental issues and were there to deepen their general understanding around the topic or learn about new local initiatives:

> *I didn't know there was a botanical garden in Bristol and I've also learnt about other local things to do in the area...* (SSI, Saturday, 15:00, PN 31)

Television and radio programmes, such as *Springwatch*, were often mentioned, suggesting that visitors were making connections to previous knowledge about some of the NC issues presented at the BFON.

Those that did manifest a change were mainly children, who had little prior knowledge about environmental issues or their relevance before their visit. Results showed that a high proportion of festival attendees were there with and for their children, suggesting that family culture could influence levels of uptake or rejection of informal science learning.

**Figure 5: The life cycle of a frog, by Matthew, aged 6 (Graffiti Wall, Saturday)**

*3.2 Attitude*

When asked how the BFON made visitors feel towards NC, most felt positive, encouraged and inspired as a result of their visit. Responses from the word association in the questionnaire showed that the most popular words to describe the BFON were Fun (69), Interesting (66) and Informative (44).

There was a sense of pride in Bristol, and people enjoyed interacting and communicating with like-minded people, sustaining their interest and re-enforcing existing beliefs:

*It makes me think about what I do already. (GW, Saturday)*

Communication between festival-goers was especially apparent on the GW, which served as a popular place for attendees to express and share their worries, opinions and advice on issues regarding NC through words and drawings. This demonstrates the strong community and celebratory feeling that the BFON supports, enhancing the existing positive attitudes towards NC and encouraging further action amongst the pro-environmental community.

*Go out and enjoy our world. You need to walk but leave time to stand and stare.* (GW, Saturday)

### *3.3 Behaviour*

Many visitors claimed to be already adopting pro-environmental behaviours before their festival visit, so there was little indication of deeper long-term behavioural change as a result of the BFON. It wasn't possible to determine participants' pro-environmental behaviour at the festival but people did talk about actions they claimed already to be doing or that they intended to do after the festival. These were mostly small-scale actions, such as recycling, changing to energy saving light bulbs, buying more organic food or cycling to work. Domestic and gardening projects were particularly popular:

> *Create a bee and butterfly haven in our garden* (GW, Sunday)

Behaviour change communications among festival attendees were a common feature on the GW, including advice on small-scale actions and pledges to each other to keep up the good work in building a more sustainable and environmentally friendly future.

**Figure 6: Graffiti Wall, Saturday**



## 4 Discussion and Conclusion

Overall, the results indicated that the 2009 BFON mostly attracted an homogenous audience that was white and non-disabled, which does not reflect the wider Bristol community. In addition, Defra's ASM demonstrated that most attendees fell under a pro-environmental category, having an existing interest and knowledge of NC before their festival visit.

The festival was effective in engaging visitors in NC by creating a space where the topic was discussed and celebrated. Given that many visitors claimed to already be interested in NC issues and taking action of some form, it is difficult to measure change in their PE levels, since there may have been little or no change to their original levels as a result of the festival. Other science communication events have reported similar problems of 'preaching to the converted' (OST, 2006, p.3). However, there could be an

argument for placing value on events and activities that nurture and sustain interest in a particular issue, reinforcing newly-emerging identities, particularly amongst those who may be relatively unengaged with the issue at the time of their first encounter.

### *4.1 Measuring public engagement*

Lorenzoni's model was chosen to measure PEST due to its simplicity and ease of use, which was deemed to be appropriate to the time-scale and scope of this study. In this context, it was expected that the behaviour element of this model would be pro-environmental. However, it was clear that speaking about NC was a behaviour that participants valued. This could suggest a deep ownership of NC as visitors discussed it without the need of an expert or researcher to contribute knowledge.

The GLO toolkit was used to allow comparison with other informal learning initiatives. However, in this study the GLOs were awkward and complex to use. For example, many attendees could not distinguish the 'skills' category from the 'knowledge and understanding' category in the questionnaire. Coding the data according to one specific GLO category also proved awkward at times, as the meanings overlapped among different categories.

Television and radio programmes, such as *Springwatch*, were often mentioned as having informed attendees about some of the NC issues presented at the festival. This serves to demonstrate the difficulty in determining what learning and engagement has taken place at the festival and what has been caused by other external experiences such as television programmes, experiences in school or looking at web pages (Falk, *et al*., 2007). Visitors spend far more time engaging with activities outside the festival, so we are looking for 'a small signal against a very large amount of background noise' (Gammon, 2009, p.27).

Due to these difficulties and shortfalls, it could be argued that there is a need for more sensitive tools and research approaches to help highlight the impact of PEST initiatives at a particular location over a set period of time. Furthermore, Gammon (2009, p.28) stated that a more robust theoretical model should be developed for this purpose, as presently 'we do not know what we are looking for, how to look for it or really why we are conducting these studies'. This could apply to the bigger picture of science communication events and activities as a whole.

## 5 References

Bristol Natural History Consortium (2009) *The Bristol Festival of Nature* (online). Available from: http://www.festivalofnature.org/ (Accessed 16 March 2009).

Bultitude, K. and Custead, S. (2009) *Global Science Events Survey 2008 – Preliminary Findings*, EUSCEA 2009 Annual conference, Perugia, Italy, pp.1–31.

Defra (2008) *A framework for Pro-Environmental Behaviours.* London: Department for Environment, Food and Rural Affairs.

Falk, J. H., Storksdieck, M. and Dierking, L.D. (2007) Investigating public science interest and understanding: evidence for the importance of free-choice learning. *Public Understanding of Science* 16 (4) 455.

Falk, J. H. (2009) *Identity and the museum visitor experience*. Walnut Creek, CA: Left Coast Press, Inc.

Featherstone, H. C. (2008) *Risk communication of climate change: stakeholder objectives and public responses*. PhD Thesis, Faculty of Life Sciences, University of the West of England, Bristol.

Gammon, B. (2009) 'Assessing long-term impact of science engagement: can it be done yet?' In: Bultitude et al (2009), eds.

Grant, L. (2004) *Evaluation of Cheltenham Festival of Science 2004* (online). Available from: http://www.lauragrantassociates.co.uk/Resources/Resources/6/Cheltenham%20festival%20evaluation%202004.pdf (Accessed 26 September 2009).

Hart, A., Northmore, S. and Gerhardt, C. (2009) *Briefing paper: Auditing, benchmarking and evaluating public engagement* (online). Available from: http://www.publicengagement.ac.uk/our-research/literature-reviews-and-research (Accessed 18 September 2009). National Co-ordinating Centre for Public Engagement (NCCPE).

Inspiring Learning (2009) *Generic Learning Outcomes* (online). Available from: http://www.inspiringlearningforall.gov.uk/measuring_learning/learning_outcomes/why_do_we_need_glos/_217/default.aspx?flash=true (Accessed 23 March 2009).

Lorenzoni, I., Nicholson-Cole, S. and Whitmarsh, L. (2007) Barriers perceived to engaging with climate change among the UK public and their policy implications. *Global Environmental Change*, 17 (X) 455.

Office of Science and Technology (2006) *UK Science Festivals: PEST or Not?* (online) Available from: http://www.britishscienceassociation.org/NR/rdonlyres/1B7E3D24-6178-4747-AD3F-ED4324D9BA5E/0/OSTreport.pdf (Accessed August 2009)

Patton, M. (1987) *Creative Evaluation*. 2nd ed. Thousand Oaks, CA: Sage Publications.

Strauss, A. L. and Corbin, J. (1998) *Basics of Quantitative Research: Techniques and procedures for developing grounded theory. 2nd ed*. Thousand Oaks, CA: Sage.

Trench, B. (2008) 'Towards an analytical framework of science communication models'. In: D. Cheng, M. Claessens, T. Gascoigne, J. Metcalfe, B. Schiele and S. Shi (eds) *Communicating science in social contexts. New models, new practices*. Springer Netherlands.

## 6 Acknowledgements

Dr Helen Featherstone, from the University of Exeter, for guidance and advice throughout the project.

Savita Custead, Angela Congedo and Harriet Martin, from the Bristol Natural History Consortium.

All 2009 Bristol Festival of Nature volunteers, in particular Jen Parsons, Julia Anna Photopoulos, Ellen Dowell and Liz Ralph.

---

Miss Maya Herbolzheimer (maya.herbolzheimer@prm.ox.ac.uk)
Pitt Rivers Museum, University of Oxford, South Parks Road, Oxford OX1 3PP

# Einstein's Garden: an exploration of visitors' cultural associations of a science event at an arts festival

Sarah Venugopal and Helen Featherstone

This paper is based on research carried out by Sarah Venugopal as part of her MSc in Science Communication.

## 1 Introduction

The concept of public engagement with science (PES) has emerged over recent decades and it is now clear that 'coming out of the laboratory to not only discuss emerging (and potentially contentious) research but also to listen to affected publics, is now key to the moral economy of modern science' (Davies 2008, Cronin 2010, cited in Porter, *et al*., 2012, p.409). The drivers for this are complex and include creating legitimacy for science, addressing misunderstandings, justifying value for money and extending the reach of science (Porter, *et al*., 2012).

Cavell, Dawson & Featherstone (2011), in the report of their meeting with practitioners and academics that explored the impact of informal learning in Science Discovery Centres, cite cultural implications as a reason for PES. They suggest that this cultural motivation stems from science being 'a key achievement of our society and […] therefore worthy of being included in cultural establishments' (Featherstone, Wilkinson & Bultitude, 2009, p.14). Other cultural arguments for PES are that events that celebrate science are of importance (Durant & Ibrahim, 2011) and science is an integral part of human history and should therefore be given cultural context and celebrated (Driver, *et al*., 1996).

The report to the Science For All Expert Group (Featherstone, Wilkinson & Bultitude, 2009) summarised potential platforms for PES, and identified festivals as one. In professional practice, PES at festivals can often be successful, as demonstrated by organisations such as Guerrilla Science (Guerrilla Science, 2012) and initiatives such as *Einstein at Glastonbury* (Graphic Science, 2005).

This research begins to explore the relationship between culture and science and how this relationship is affected at sites where the two are manifest and visitors can enact this culture. Visitor research shows that motivations for attending cultural events map on to this enacting of culture, where people go to enjoy and express interest in a subject. Festivals are unique environments where this celebration occurs but they are often single-themed, for example a specific genre of music, literature, food or science.

A festival where two themes are addressed, such as science and the arts, can allow science to reach audiences that wouldn't normally interact with it, for example at a single-themed science festival. This approach also puts the science in a cultural context

with which the visitor is familiar. What then are the impacts on the visitor when one theme is embedded in the other, in this case, science at an arts festival? Do these contrasts of cultures complement or clash? It is this area of science communication that this research hopes to explore: understanding the experience of visitors to a science area of an arts festival and investigating where such an experience is located within the range of cultural activities in which they would normally engage.

Currently, PES practitioners are conducting events at cultural events, such as festivals, to reach publics not currently interested in science. However, these are often small-scale and therefore hard to assess in any depth. To explore this idea in professional practice, a larger and well-established instance of science in an arts festival, which has a suitable permanent science and nature area as part of its normal festival offering – the aims of which are to engage visitors with scientific topics in a variety of informal ways – must be chosen. Thus, Einstein's Garden at the Green Man festival was selected as a representative case study. Einstein's Garden is a 'fusion of science, art and nature' (Green Man festival, 2012) within the Green Man festival, an independent folk, music and arts festival held annually in Wales. A range of activities occurs within Einstein's Garden, such as wildlife and nature walks, stand-up comedy and workshops.

## 2 Methods

This research was conducted under the notion that the human world is socially constructed and it is impossible to conduct research in this context without it either affecting the participant or being affected by them; this should be capitalised upon rather than minimised (Denzin & Lincoln, 1994). To maximise the value of the interactivity of the researcher and the researched, a qualitative research approach was adopted.

The interview is an active and emergent process (Fontana & Frey, 2000).Qualitative interviewing techniques were chosen, as they allow for a naturalistic conversation to occur and meaning to be constructed between the interviewee and interviewer. Interviewees were identified as those who left one of five case study activities after more than five minutes of interaction. This meant that the participants could speak about the activity they had just done with confidence and from experience. Four participants were interviewed from each representative activity; 20 in total. A semi-structured interview was used to allow for openness to changes in the sequence of themes covered within the interview and to allow follow-up questions to be formed in response to participants' stories (Kvale, 1996).

Participants were adults (over 16), as this is an important audience group represented both at the Green Man festival and Einstein's Garden and because of the ethical constraints of interacting with children.

A grounded theory approach was used for analysis of the data, to reflect the interactive and emergent nature of semi-structured interviews (Kvale, 1996). Transcripts were analysed using an emergent coding framework to allow the full range of themes to emerge from the data whilst maintaining depth. A second researcher checked the coding to ensure accuracy and consistency.

## 3 Results

This report explores one element of the visitor experience; that of difference. Further elements, such as learning and motivations, were explored in Venugopal (2012).

To understand where visitors would place Einstein's Garden on their spectrum of cultural events, questions were asked in the interview to gauge the context in which visitors perceived Einstein's Garden. When asked about what a cultural event meant to them, many participants found it hard to articulate an answer or could not think of anything at the time:

> *I don't know. I mean if you give me some examples, I can say yes or no, but I can't really think of any off the top of my head* (A2)

> *If you go to the theatre it's not about learning the play, it's about experiencing it and being involved in it* (E3)

> *Something where lots of different people who wouldn't normally socialise with each other learn something or see something you wouldn't normally see* (B1)

> *I live in Bristol and there is quite a lot going on, but I wouldn't necessarily call them cultural events because you know what you're getting. So… I'm not sure.* (E3)

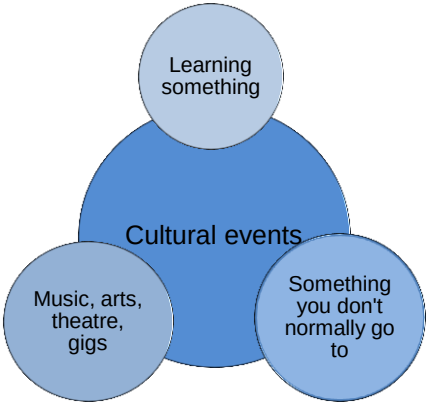
This, as well as nuances in the language used by individuals, suggested that the idea of a cultural event was quite abstract and indeed, meant different things to different people. To discuss and compare themes across cultural events and Einstein's Garden in particular, a diagram (Figure 1) was created to represent themes that emerged when discussing cultural events in general and some frequently-cited examples of cultural events participants usually liked to attend. This process of organising the research data into themes started during the interview process, so emerging themes or ideas could be probed within later interviews with participants.

Participants recognised elements of learning both at Einstein's Garden and at general cultural events they attended:

> *I guess something that you can go to where you learn something but you can be entertained at the same time. Something that you don't normally go to, something that you can gain from that you can't gain from just sitting at home watching TV* (A4)

*It's something I really enjoy doing and it's something I think is a good thing to do anyway. It gets you away from the tv… actually going out and finding new things that you didn't think you liked before* (E2)

**Figure 1: Framework of cultural events, showing the three key themes that emerged when exploring the participant's perceptions of cultural events they like to attend and what this means to them.**
(It is worth noting that these themes were not discrete and that participants often cited more than one idea in the interview. Other, less frequently-cited, ideas around cultural events were also mentioned in the interviews.)




The second quote from E2 touches upon a further, stronger theme that emerged: that of doing something different or something that you wouldn't normally do. Einstein's Garden has been part of the festival offering at Green Man for five years and although the loyal Green Man audience had seen Einstein's Garden before, many still saw it as being different or an alternative to the other parts of the festival:

*I don't know, it's just something different to do, normally if you are going to festivals you are just going to see bands so it's nice to be able to just come to something like this* (C1)

*I guess this bit is separate but I'm not sure really. In terms of the festival as a whole I think this is a separate bit but it's my favourite bit* (B4)

*I think that there is more peace and quiet here; it's a completely different dimension to the rest of the festival. It's in a walled garden away from the rest of the festival so it's like an escape from the rest of the festival in here. You can come in here and forget that you're at a festival for a few hours.* (A3)

When asked to think about festival experiences in general, many would not automatically expect science to be part of a festival experience. None of the participants

mentioned science-themed events or activities in relation to cultural events, despite the interview occurring within a science, nature and environment area at a music festival (which was mentioned several times):

> *I suppose occasionally things like farmers' markets or craft-orientated stuff but I think with a less educational twist on it* (D3)

> *Not that many at all to be honest. I mean, I like music festivals, I like gigs, that's about it really* (A2)

This suggests that although there are elements of Einstein's Garden that are similar to visitors' other cultural experiences, the science theme causes a sense of dissociation of Einstein's Garden from these events. However, as the question of audience was not asked outright, visitors perhaps thought solely about cultural events that were specifically relevant to them when answering.

Although many participants did not make reference to science when discussing cultural experiences, those who mentioned arts educational backgrounds or science communication interests did:

> *I wouldn't say it was separate, I think the activities they have got are like interactive art almost. It's not art, electronics and science stuff can have an art feel. It's next to the main stage and going from there to Einstein's Garden doesn't feel different. It flows, I suppose.* (E1)

Another individual described the nature of the inclusion of Einstein's Garden in to the festival with the simile of a banquet:

> *I think it's as big as the main stage but in just a completely different way, and I love the fact that you can pick and choose. It's like an amazing banquet that you can pick and take a bite out of each cake on the table, it's really good.* (D3)

However, D3 still describes Einstein's Garden as being part of a cultural experience 'in a different way'; perhaps suggesting that it is different to the rest of the festival.

For the Einstein's Garden audience, Einstein's Garden has elements of cultural activity or experience, such as the ability to learn something or gain a skill or knowledge and the opportunity to do something that they would not normally do in a culturally-diverse environment. These aspects allowed visitors to place elements of Einstein's Garden on the spectrum of cultural events they normally like to attend. Although science, nature and environment are the three key themes of Einstein's Garden, these did not seem to have an effect on perceptions of Einstein's Garden as a cultural experience. Many participants did not mention science at all when talking about cultural events in a holistic manner. For almost all the participants, Einstein's Garden added value to the Green

Man experience and enhanced many visitors' experiences in ways that were different to the rest of the festival; science was part of this.

## 4 Discussion and Conclusion

This research explored the value of an arts festival as a platform for the celebration of science, allowing synthesis of visitors' perspectives of an event within a festival where both science and culture were manifest. The research started to examine a case study of current professional practice within this context and the findings both support and challenge current thinking in the area of public engagement with science.

### *4.1 Science, culture and context*

Visitors to Einstein's Garden recognised that the area offered an alternative experience, adding value to their festival experience as a whole. The way in which this experience was 'alternative' varied from person to person. It is in this variation that the true nature of visitors' perception of the science-culture paradigm is revealed. Two key findings relating to this idea were examined: first, the recognition by many people that an arts festival can be a cultural experience and second, the notion held by many people that Einstein's Garden is about science and is therefore an alternative to the arts festival/cultural experience.

A minority of participants thought that there was an overlap between science and the arts, supporting the findings of the *Public Attitudes to Science* survey (Ipsos MORI, 2011) that both are practices concerned with interpreting the world creatively, challenging the traditional perceptions of arts and science. It can be argued that for this minority, Einstein's Garden facilitated validation of their thoughts about a possible relationship between art and science and successfully integrated itself into the fabric of the arts festival within which it occurs. Thus, for these people, Einstein's Garden has not only succeeded as a PES event but also in embedding itself into a wider cultural context. This successful engagement at an individual level supports the work of many researchers in the field (Davies, 2009) and also is an example of the personal experience of the individual leading to construction of meaning (Falk & Dierking, 2000).

When one theme, science, is injected into another, an arts festival, inevitably the boundaries between the two genres will be defined in places and blurred in others. Einstein's Garden undeniably aims to celebrate science the way Durant & Ibrahim (2011) intended but whether it succeeds in embedding science in cultural experience remains very much in the perceptions and cultural context of the people engaging with and experiencing it. Thus, it can be suggested that for these people, although science is present at an arts festival and is embedded in the festival environment, it is still seen as an alternative to the rest of the festival. It suggests that the theme of science may even cause this dissociation from a cultural experience, although it should be noted that this

idea has been derived from nuances in the language used by individual people when comparing Einstein's Garden with their other experiences of cultural activities.

### *4.2 The value of PES events at festivals*

Regardless of the caveats that are addressed within the research, it was clear that at an individual level, Einstein's Garden added value to the experience of the Green Man festival. This value can be transferred to other similar events in the science communication field.

Featherstone, Wilkinson & Bultitude (2009) suggest festivals as a possible platform for PES and this research has gone some way to support that. Regardless of the individual's perception of a cultural activity, visitors recognised that Einstein's Garden had enhanced their festival experience in some way. The festival benefited from having a science area to give its visitors an alternative to the music and the opportunity to have an experience of learning, which visitors openly enjoyed.

### *4.3 Limitations of the study*

A variety of factors could have affected this study. It was noted that approximately a quarter of participants had science communication or science backgrounds. This could have steered these respondents towards having a generally positive attitude to the event or even suggests that Einstein's Garden may only attract those who already have an interest in PES in cultural settings. However, the majority of participants did not have such a specialist interest. It could be also argued that the idea of specialist or non-specialist is redundant in the celebration of science: both are part of cultural enactment in this context. However, if the purpose of PES events at arts festivals is to reach non-interested publics, this limitation is important.

Visitors are fundamentally at a festival for enjoyment and conducting a research study in such an atmosphere affects both the environment of the visitor, the interviewer and the interview. However, this effect need not be negative and no participants appeared to be adversely affected by participating in the research; it appeared that most enjoyed the interview.

### *4.4 Concluding comment*

The case study of Einstein's Garden has allowed exploration into the value of the festival as a venue for the cultural celebration of science, establishing festivals as a valuable environment for public engagement with science. Einstein's Garden goes some way to facilitate the association of science and culture within individual people but ultimately the success of this association depends on the experiences, perceptions and motivations of each person.

Einstein's Garden has managed to establish an almost mutual relationship between itself and the festival within which it occurs, enhancing the festival experience for visitors as a whole, whilst itself being enhanced by the unique festival environment.

## 5 References


Bultitude, K., McDonald, D., Custead, S. (2011) The Rise and Rise of Science Festivals: An international review of organised events to celebrate science*. International Journal of Science Education, Part B: Communication and Public Engagement.* 1 (2) 165.

Cavell, S., Dawson, E., Featherstone, H. (2011) *Roundtable for Advancing the Profession: Assessing Impacts of Science and Discovery Centres*. At-Bristol [online] Available from: http://www.at-bristol.org.uk/assets/files/At-Bristol%20RAP%20report.pdf. Accessed November 2012.

Davies, S. (2009) Learning to engage; engaging to learn: the purposes of informal science-public dialogue. In: Holliman. R., Whitelegg E., Scanlon, E., Smidt, S., Thomas, J. (Eds) *Investigating Science Communication in the Information Age*. Oxford: Oxford University Press.

Davies, S., McCallie, E., Simonsson, E., Lehr, J.L. and Duensing, S. (2009). Discussing dialogue: perspectives on the value of science dialogue events that do not inform policy. *Public Understanding of Science*. 18 (3) 338.

Denzin, N.K., & Lincoln, Y.S. (1994). *Handbook of Qualitative Research*. Thousand Oaks, CA: Sage Publications.

Driver, R., Leach, J., Millar, R., and Scott, P. (1996) *Young people's images of science*. Bristol, PA: Open University Press.

Durant, J., and Ibrahim, A. (2011) Celebrating the Culture of Science. *Science*. (331) 1242.

Falk, J.H. and Dierking, L,D. (2000) *Learning from museums: Visitor experiences and the making of meaning*. Lanham, MD: AltaMira Press.

Featherstone, H., Wilkinson, C., Bultitude, K. (2009) *Public Engagement Map: Report to the Science for All Expert Group*. Bristol: Science Communication Unit, UWE.

Fontana, A., Frey, J.H. (2000) The Interview: from structured questions to negotiated text. *In*: Denzin, N.K., & Lincoln, Y.S. (Eds). *Handbook of Qualitative Research*. Thousand Oaks, CA: Sage Publications. 2nd Edition.

Graphic Science (2005) *Einstein at Glastonbury: Final Report*. Bristol, UWE: Graphic Science Unit.

Green Man festival (2012) *Einstein's Garden*. [online] Available from: http://www.greenman.net/area/einsteins-garden Accessed May 2012.

Guerilla Science (2012) *Guerilla Science* homepage. [online] Available from: www.guerillascience.co.uk Accessed November 2012.

Kvale, S. (1996) *InterViews*. Thousand Oaks, CA: Sage.

Ipsos MORI (2011) *Public Attitudes To Science 2001: Main Report*. Available from: http://www.ipsos-mori.com/Assets/Docs/Polls/sri-pas-2011-main-report.pdf UK: BIS. Accessed December 2013.

Porter, J., Williams, C., Wainwright, S. and Cribb, A (2012) On being a (modern) scientist: risks of public engagement in the UK interspecies embryo debate. *New Genetics and Society* 31 (4) 408.

Venugopal, S. (2012) *Einstein's garden: an exploration into visitors' motivations, perceptions and cultural associations of a science event at an arts festival*. MSc, University of the West of England, Bristol.

## 6 Acknowledgements

This research programme was carried out in collaboration with Ellen Dowell, curator of Einstein's Garden. Many thanks to Dr Helen Featherstone for her invaluable advice, encouragement and expert supervision. A huge thank you to the twenty Green Man festival-goers who generously offered their time at the festival to take part in an outdoor interview in the great British rain. Thank you finally to Mel Davies, a fellow science communicator who braved the weather in the name of social research and to help a friend.

---

Sarah Venugopal (sarah.venugopal@hotmail.co.uk)
66C Huron Road, London, SW17 8RD

# Pathways to Impact: an analysis of the challenges and opportunities for applicants applying for UK Research Council funding

Michal Jane Filtness and Clare Wilkinson

This paper is based on research carried out by Michal Jane Filtness as part of her MSc in Science Communication.

## 1 Introduction

This paper is a summary of an analysis of 'Pathways to Impact' (PtI), a tool/method used by UK Research Councils (RCUK, 2013a) for increasing economic and societal impact from research grants. The project considered the benefits and problems of PtI from the user's perspective.

Since 2009, all research grant applications submitted to UK Research Councils must include Pathways to Impact. PtI are documents in which applicants describe the pathways or processes they will use to increase the impact of their work. Applicants may request additional funds to help support their plans and Research Councils have dedicated funding streams to finance them (RCUK, 2013b).

### *1.1 PtI and science communication*

Pathways to Impact are, essentially, plans for science communication. By mandating PtI, the UK government has ensured that all grant applicants have at least thought about communicating their work and many use PtI funding to create beneficial and long-lasting impact from their research. Science communication facilitates the transfer of knowledge from research to industry, government and society more widely. This creates new businesses and jobs, leads to new developments and advances and can improve the economy, the social wellbeing and the health of a nation.

Pathways to Impact are intended to aid science communication by providing researchers with the finances and resources to run, for example, outreach activities, liaise with the general public and industry and hold consultations with relevant communities. Researchers can also learn by sharing best practice and through peer review of PtI. This can increase their science communication knowledge and skills.

### *1.2 The importance of impact*

As well as the benefits that science communication and impact can have on society and the economy, the Research Councils also use PtI as evidence for continued funding. The Research Councils are directly funded by the UK government's Department of Business, Innovation and Skills (BIS), which is ultimately funded by UK taxpayers. For the Research Councils to secure financial support from BIS, they need to demonstrate the impact of the research they fund. In this way, impact is used by the Councils as

evidence for continued government support. The government in turn uses impact to justify continued investment to taxpayers. The continuing and growing need for impact as evidence and the many advantages it can bring therefore make impact and PtI a high priority for the Research Councils.

### *1.3 Aims and objectives*

Although science communication and creating impact are important, it does not necessarily mean that PtI are the best method for their creation. The overarching aim of the project was therefore to determine how PtI users (that is, the research community) regard Pathways to Impact and to use their views and opinions to provide feedback and advice to the Research Councils on how PtI could be improved. The specific objectives of the project were to:

- Through the use of questionnaires, poll a representative sample of the research community about PtI.
- Draw from the questionnaire the top five opportunities arising from PtI.
- Draw from the questionnaire the top five issues or problems with PtI.
- Assess how effective PtI are as a tool for science communication.
- Formulate advice for RCUK on PtI.

## 2 Methods

### *2.1 Questionnaires*

To assess the attitude of the research community towards PtI, it was essential to communicate with them directly. The most suitable tool for this was a questionnaire. Questionnaires allow direct communication with a representative user community and allow a range of valuable data (both quantitative and qualitative) to be gathered in one session. They can also facilitate an exchange of knowledge and information between participants and researchers and enable data to be gathered electronically, anonymously and in confidence (Lietz, 2009).

### *2.2 Participants*

The group selected to take part in the study comprised environmental science researchers, specifically, those environmental scientists belonging to the Natural Environment Research Council's (NERC), Peer Review College (PRC). Despite this being a rather specific group, they were considered representative of the wider research community due to the commonalities of PtI and RCUK policy across the Research Councils. That is, any opportunities or problems with PtI facing environmental scientists were likely to be common to all Research Council-funded researchers.

The questionnaire for the project was created using Survey Monkey™, an online tool. A link to the survey was emailed to participants, together with an information sheet, by the Peer Review College Manager. Ethical approval was granted by the University of the

West of England, Bristol. The survey was open online for two weeks, from Monday 20th August to Monday 3rd September 2012.

### *2.2 Data analysis*

The quantitative data were analysed using standard statistical techniques (for example, percentages, averages, etc.) and used first to build a profile of the average participant and second to determine their 'attitude' towards PtI. This information was then cross-correlated to identify any common influences on their attitude.

The qualitative data included free text answers, so an open-coding technique was used. This was based on the work of Strauss & Corbin (1990) and involved a detailed analysis of each line of free text to identify code-specific issues, ideas and opinions that were then used to build a coding scheme. The identification of themes was driven by the data rather than the researcher and when complete, the number of responses in each category was compiled and ranked. This analysis enabled the main advantages and disadvantages of using PtI to be determined and to gather collective opinions on any aspects which could be changed.

## 3 Results

### *3.1 Sample size and success rate*

At the time of study, the NERC PRC had approximately 400 members. A statistically representative sample of this population would have been 196 people (Gomm, 2004). During the two weeks that the questionnaire was open, a total of 95 people completed questionnaires, giving a response rate of only 24%.

### *3.2 The average participant*

The results showed that the 'average participant' was male, middle-aged and in a senior position. They had experience with research grants, were usually funded by either NERC or AHRC and had limited experience of PtI or training in science communication. They did, in principle, support science communication (73%, n=95) but only 18% (n=95) thought Pathways to Impact was a good mechanism for creating and funding impact.

### *3.3 Advantages and disadvantages of PtI*

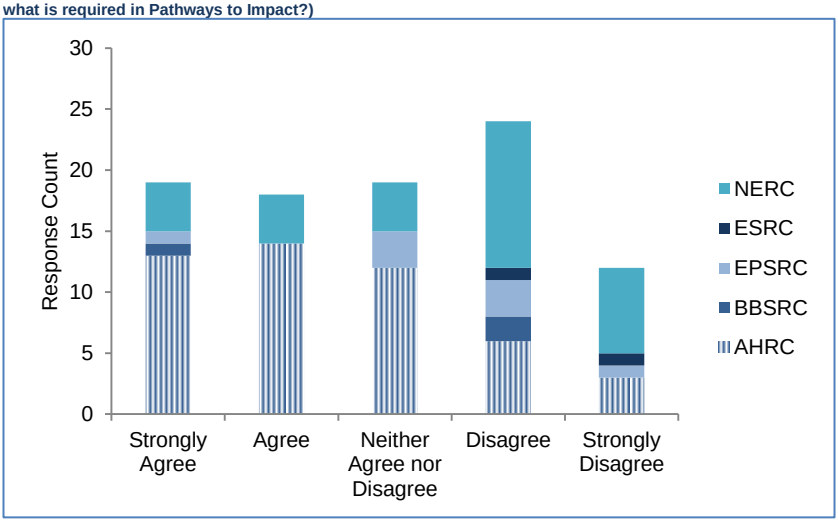
The top five advantages and opportunities arising from PtI, as identified by participants, were found to be:

- Opportunities and support for *Public Engagement* (17 participants).
- Opportunities and support for *Networking* (10 participants).
- A *Policy* that allows understanding of the wider relevance of impact and science communication (8 participants).
- A method that creates *Impact* (8 participants).
- A method or policy which increases *Awareness* of science communication and impact-generating techniques (7 participants).

The top five disadvantages or problems with PtI were found to be:

- The *Inflexible Policy* of PtI, which does not account for different types of research and its ability to create impact (22 participants).
- The lack of *Inspiration* for ideas to use in PtI and to create impact (16 participants).
- The *Unpredictable* nature of research (14 participants).
- Difficulties with *Networking* (13 participants).
- That the concept of PtI and asking researchers to create impact is *Absurd* (10 participants).

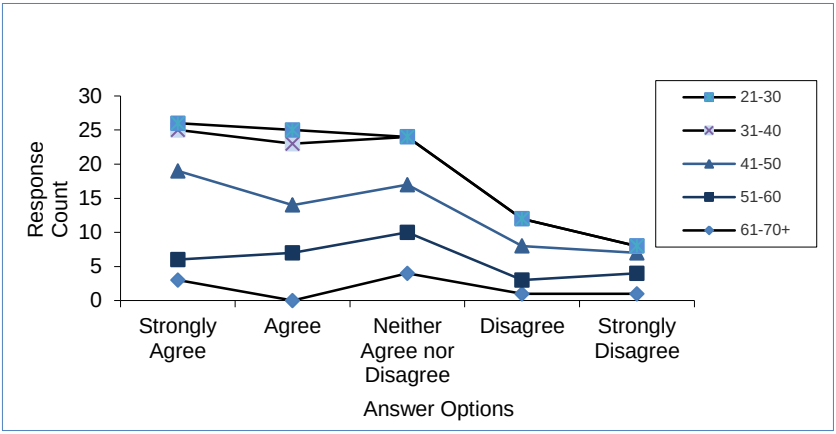
**Figure 1: Cross-correlation of data showing that comparatively, researchers funded by AHRC understood the requirements of PtI the least (Q: To what extent do you agree with the statement 'I do not understand what is required in Pathways to Impact?)**




*3.4 Overall opinion on PtI*

The results showed that overall the majority of participants had a very negative view of PtI and did not support it as a mechanism for creating and increasing science communication and impact. The cross-correlation showed no obvious influences or biases on attitude toward PtI. However, the results did show that comparatively, researchers funded by AHRC understood PtI the least (see Figure 1); the youngest age group were the ones most stuck for inspiration for PtI (see Figure 2); and previous training in science communication, age and sex made no difference to participants' attitude towards PtI (see Table 1).

**Figure 2: Cross correlation of data showing that comparatively, the youngest age groups were the ones most stuck for inspiration for PtI. (Q: To what extent do you agree with the statement 'I struggle to find inspiration and ideas to use in Pathways to Impact'?)**




### *3.5 Recommendations for improvements*

A large number of participants suggested abolishing PtI altogether as they did not support it at all. However, some participants also suggested improvements. The top five recommendations were:

- Make the rules and guidelines more flexible to take account of different types of research (12 participants).
- Change the format so that different features can be included, discounted or given more flexibility (9 participants).
- Acknowledge that for some research impact is impossible to predict and allowances made for this (6 participants).
- Change the assessment process for PtI so that it is more fair and balanced across different types of research (6 participants).
- Change the grant system for supporting impact-related work (6 participants).

## 4 Discussion and conclusion

### *4.1 An unexpected result*

The results showed that a high number of participants usually received their research funding from the Arts and Humanities Research Council (AHRC). This was unexpected, given that the survey was targeted at the NERC Peer Review College.

The unexpected bias may have been caused by two emails which were received from participants during the time the survey was open. Both participants requested permission to circulate the questionnaire to their colleagues who were not on the PRC.

Since their colleagues were, however, members of the wider research community (which the survey sought to represent), permission was granted and the selection bias introduced considered acceptable. Indeed in some respects it was advantageous, as the results represent a wider audience that included arts and humanities researchers as well as environmental scientists.

**Table 1: Cross-correlation of data indicating that sex, age and previous training in science communication made no difference to the attitude of participants towards PtI (Q: To what extent do you agree with the statement 'I find Pathways to Impact to be useful and beneficial?')**

| | Sex | | Age | | | | | Training | |
|---|---|---|---|---|---|---|---|---|---|
| **Options** | **Male** | **Female** | **21–30** | **31–40** | **41–50** | **51–60** | **61–70+** | **Yes** | **No** |
| Strongly agree | 4 | 1 | 0 | 2 | 2 | 0 | 1 | 3 | 2 |
| Agree | 7 | 3 | 0 | 0 | 6 | 3 | 1 | 3 | 7 |
| Neither | 9 | 8 | 0 | 5 | 7 | 5 | 0 | 4 | 13 |
| Disagree | 13 | 5 | 1 | 7 | 5 | 5 | 0 | 6 | 12 |
| Strongly disagree | 36 | 9 | 2 | 13 | 15 | 8 | 7 | 10 | 35 |

### *4.2 An over-riding opinion*

The results indicated that overall, PtI were very unpopular. The main problems, and presumably the main causes for the negative attitude, were not understanding and/or agreeing with the impact policy, finding ideas and inspiration for creating impact and that research cannot be predicted in advance, thus making PtI extremely difficult. Specifically, some participants felt that PtI:

> *… allows scientists to swell and distort the real impact of their research, with those who shout the loudest and can lie with no remorse having a strong advantage over the others.*(Participant 12, Q. 21)

> *[PtI is]… a beautiful example of the way in which a bloated bureaucracy impedes scientific progress and more generally the benefits of science or technology for society.* (Participant 7, Q.23)

### *4.3 Attitude towards science communication*

Although the results raised many problems with PtI, none related to science communication in general. The results indicated that the majority of participants were supportive of engaging the public with their research and disseminating knowledge of their work. For example:

> *Communication of science and results is hugely important – both between scientists and to the public.* (Participant 52, q.25)

> *I think that dissemination of scientific knowledge is essential for any society. Otherwise we will be back in the middle age very soon.* (Participant 62, q.25)

Although it is encouraging that science communication in principle is supported, there is a risk that any unsuccessful government method of science communication may discourage and deter science communication in general. A decrease in science communication could have damaging effects on society, on people's well-being and on the economy. The inflexible policy of PtI and the fact that some research cannot be predicted in advance presents major problems for researchers and in the eyes of some, makes PtI unfit for purpose.

The general feeling and attitude of participants, if genuinely representative of the attitude of the wider research community, presents an important problem which needs to be addressed quickly. If not, there is a danger that enthusiasm and support for science communication across the UK research community will be damaged.

### *4.4 Conclusion*

The study achieved its primary aim and determined the attitude of some of the research community towards Pathways to Impact. Among this small sample of researchers, their attitude was negative and they did not support it as a mechanism for creating impact. This is an important finding, which needs addressing, as there is a risk this negative attitude could affect the community's overall attitude towards science communication and thus in the long-term have a detrimental effect on society and the economy.

The study identified the top five positive and negative aspects of Pathways to Impact and the top five suggestions for ways to improve PtI. Moving forward, these findings can be used to identify features that should be retained in any new impact policies and the issues and problems which need to be addressed.

### *4.5 Next steps*

RCUK could either consider whether to abolish and replace PtI with a completely different method for creating impact (results indicated this was the preference of the community) or how to make PtI more flexible in terms of policy and format. RCUK could also consider the assessment and administration system and discuss methods such as applying impact policies on a more strategic level rather than to individual grants or by convening expert panels to judge PtI and so on.

If RCUK retain PtI, then the recommendations from the project are:

- RCUK and the Research Councils could revise their guidance and support to help the community understand what is required in PtI. This support could be particularly targeted at AHRC researchers and those with training in science communication.
- RCUK and Research Councils could strive to help researchers find inspiration and ideas for creating impact. This help could be particularly targeted at young researchers.

- RCUK and Research Councils could strive to make PtI more flexible to allow for the unpredictable nature of research and allow that some areas of research are more applicable to creating impact than others.

If PtI are to be replaced with a new system, then RCUK may:

- Retain the benefits already available from PtI, namely opportunities and advantages for public engagement, networking and understanding the wider context of impact policy.
- Overcome the same issues associated with creating impact from research that PtI faces (for example, the unpredictable nature of research).

If the recommendations and findings from this report are taken into account in future plans for creating impact, then hopefully over time a mechanism/policy can be devised in which science communication and impact are increased in quality and quantity, bringing improvements and benefits for all.

## 5 References

Gomm, R. (2004) *Social research methodology, a critical introduction*. Basingstoke: Palgrave Macmillan.

Lietz, P. (2009) Research into questionnaire design: a summary of the literature. *International Journal of Market Research*. 52 (2) 249.

Strauss, A., & Corbin, J. (1990) *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. Newbury Park, CA: Sage Publications.

RCUK 2013a. *About the individual Research Councils*. Available from: http://www.rcuk.ac.uk/about/Aboutrcs/Pages/home.aspx [Accessed October 2012].

RCUK 2013b. *Pathways to Impact*. Available from: http://www.rcuk.ac.uk/kei/impacts/Pages/home.aspx [Accessed October 2012].

## 6 Acknowledgements

I would like to thank the Natural Environment Research Council (NERC), for its help and support on this project.

---

Dr Michal Jane Filtness (milt@nerc.ac.uk)
Natural Environment Research Council, Polaris House, North Star Avenue, Swindon, SN2 1EU

# ‘More dynamic than expected’: assessing STFC Rutherford Appleton Laboratory’s work experience placements

Alexander Brown and Erik Stengler

This paper is based on research carried out by Alexander Brown as part of his MSc in Science Communication.

## 1 Introduction

The importance of high-impact public engagement with science cannot be underestimated. In difficult economic times, advocates of increasing public research budgets must prove the value of such research to society. Accordingly, the Science and Technology Facilities Council (STFC) is conducting a Council-wide evaluation of its public engagement programmes to establish where its strengths lie and what requires improvement.

As potential future contributors to research, school students represent a key investment for engagement efforts. Apart from school classes, there are a number of opportunities for them to engage with science subjects. Indeed, 80% of a child’s waking hours are spent outside the classroom (Bell, *et al.*, 2009). Furthermore, it can be difficult to establish how in-class and out-of-class science learning are linked. For instance, when teachers (as opposed to students) try to connect science learning to real-world experiences, this can have *negative* outcomes (Tran, 2011).

The data presented here were gathered as part of a project seeking to evaluate several of the outreach activities run by STFC’s Rutherford Appleton Laboratory (RAL); specifically those targeting school students in Oxfordshire. In this paper, we focus on the week-long work experience placements offered by STFC RAL personnel to students in their last three years of school. The aims of the work experience programme are to give students an accurate impression of what working in a laboratory entails as well as encouraging them to pursue science, technology, engineering and mathematics (STEM) subjects beyond school, whether in an apprenticeship or in higher education.

## 2 Methods

### *2.1 Student surveys*

The aims of STFC RAL’s schools outreach programme are primarily concerned with outcomes for students. Thus, the principal evaluation tool used in this project was a pair of surveys administered to participating students before and after their placements.

The purpose of the pre-placement survey was to establish a baseline for students’ attitudes to science. It was administered to students carrying out work experience placements during July and August 2012 (n=25). Students were asked to submit basic demographic information and to indicate their level of agreement (strongly disagree,

disagree, neither agree nor disagree, agree, strongly agree) with seven statements about their experience of science lessons in school. (Further survey items investigated questions not discussed in this paper.) Finally, a comments section allowed students to express any views which had not been covered by the previous questions.

The post-placement survey was distributed in September 2012 to 91 students who had undertaken STFC RAL work experience between March and August 2012. This was done to maximise the amount of data being returned, as students who had completed their placements might not feel compelled to complete a questionnaire. Indeed, only 11 post-placement surveys were completed.

**Table 1: Students' (n=11) views of the work experience programme (post-placement survey)**

| Statement | Strongly agree | Somewhat agree | Neutral | Somewhat disagree | Strongly disagree |
|---|---|---|---|---|---|
| I learnt new facts in science. | 7 | 4 | | | |
| It was fun. | 8 | 3 | | | |
| I learnt new things about how research happens. | 8 | 2 | 1 | | |
| My supervisor was good at communicating with me. | 10 | 1 | | | |
| It made me want to look for more information about science outside of school. | 6 | 5 | | | |
| I think my placement will be useful for my school work. | 2 | 6 | 1 | 1 | |
| I would like a career in science. | 10 | | 1 | | |
| I would like to do another placement at STFC in the future. | 6 | 2 | 3 | | |
| I would recommend work experience at STFC to my friends. | 9 | 2 | | | |
| I would like to study science after I finish school. | 11 | | | | |

The post-placement survey asked students to give details about their placement, in addition to demographics. It also asked for students' opinions on the appropriateness of the length of the placement, as well as an open question about the most important thing they learned during the placement. The survey offered a series of statements (see Table 1), with the same five-point scale as in the pre-placement survey. As in the pre-

placement survey, where appropriate, students were asked to give details about their answers. Once again, a final section for open comments was included.

A coding frame was established for each open-ended survey question. Answers were grouped based on similarity of the concepts expressed.

### *2.2 Supervisor interviews*

To complement this data set, interviews were conducted with STFC RAL staff who supervised students during work experience placements. Supervisors are uniquely placed to assess the value of placements for students.

Three supervisors were recruited for interview during a post-placement feedback session organised by STFC RAL's outreach team in October 2012. The supervisors approached were among those who showed the most enthusiasm during the feedback session and were thus most likely to accept the invitation. The interviews lasted approximately 15 minutes. The interviews were semi-structured and consisted of questions about their perception of placement students' experiences and exploration of other relevant points that were mentioned in discussion.

## 3 Results

### *3.1 Work experience placements*

All the respondents to the pre-placement survey indicated some level of agreement with the statement 'I enjoy science at school' (somewhat agree 11, strongly agree 14).

Eighteen respondents agreed to some extent (somewhat agree 9; strongly agree 9) that they had/ had had an inspirational teacher; four were neutral, two somewhat disagreed and one strongly disagreed. Nineteen participants indicated they sought additional information about science outside the school environment. The most commonly cited sources for such information were magazines (10), books (8) and the Internet (8).

Eleven students responded to the post-placement survey. Students were presented with a series of statements and asked to rate their agreement on a five-point Likert scale (see Table 1). There was strong agreement across the spectrum of statements, with the exception of the item regarding usefulness of placements with respect to school work. When asked about the most important thing they learned during they placement, students gave answers relating to the world of work (for example 'that if you need help you should ask, that some work takes time and to be adaptable to different situation' (Student 32)), to procedure-based science ('The importance of computer modelling in science.' (Student 29)) and fact-based science ('Lasers are capable of a lot more than I initially thought.' (Student 28)).

### *3.2 Supervisor interviews*

Supervisor 1 felt that the value of the placement varied greatly as a function of the maturity and independence of the student. Where a student needed a lot of guidance, this presented a burden for their small working group; a 'multi-supervision' model had had to be developed to cope with this. None the less, they said that the highlight of work experience from what they had seen in their students was 'teamwork and responsibility in a group, which is something you don't get in school'.

Supervisor 2's main recommendation to programme staff was to include a report as a requirement for students and for students to keep a notebook of their experiences. These tools, they felt, would enhance students' learning and provide useful tools for future involvement in science.

As a former apprentice, Supervisor 3 was keen to show younger students the possibilities which lie in alternatives to the traditional A-level/university route, saying 'We treat it as a kind of long-term recruitment exercise. Even if they're not particularly interested or enthusiastic, at least we can hope they work out this isn't the career for them'.

## 4 Discussion and Conclusion

### *4.1 Student surveys*

Pre-placement survey results showed that students taking part in the work experience programme tended to have generally positive attitudes towards science in school and actively seek out additional information about science in their own time. It is therefore not surprising that they should take part in a programme such as STFC's. In agreement with previous studies, there was a strong level of agreement that science teachers can be inspirational (Wellcome Trust, 2012).

> *I really enjoyed my work experience placement and could not have wished for a better week. I would like to thank again very much my supervisor and those who worked with/ alongside me.* (Student 28)

The work experience was seen by students as a positive contribution to their science learning experience. They gained skills, knowledge and understanding, as well as having fun. Although the numerical data presented here are few, they suggest a broad satisfaction with the programme. However, this may be due to an effect of a self-selecting sample; students left nonplussed by their experience may not have felt motivated to complete a survey about it.

Knox, *et al*., (2003) found that hands-on learning of this kind can bestow a number of advantages on participating students, both in terms of scientific knowledge and skills, and with respect to their understanding of the world of work; experience not easily gained in school or through other extra-curricular activities. The authenticity of the

laboratory experience is important for achieving positive engagement (Van Eijk & Roth, 2009; Hsu, *et al.,* 2010). The similarity of work experience placements to real science is limited by the nature of such programmes. However, this aspect of the STFC RAL placements seems to be fulfilled, as can be seen in the high frequency of world-of-work lessons learned by students and the strong level of agreement with the statement 'I learnt new things about how research happens'.

### *4.2 Supervisor interviews*

The small sample size (n=3) does not allow for great extrapolation. However, the objective of using this source of information was not to quantify supervisors' views, but rather to gain practical advice from them to feed back to the STFC staff in charge of organising and co-ordinating the work experience programme.

The interviews with supervisors suggest that while much has improved in the organisation of placements over the years, more could still be done to improve the process. There is great heterogeneity in how supervisors manage their students' work. Greater comparability of placements is desirable, leading to more robust evaluation data and a stronger evidence base on which to found recommendations. This could be achieved, for instance, by asking all students to write a report before gaining a certificate of their participation (this would also allow for higher rates of survey completion post-placement).

### *4.3 Conclusion*

The data presented here concerning STFC RAL's work experience programme fit with existing theories about such programmes, that is, that they can give some additional motivation to students already engaged with science.

Overall, the summer work experience programme at STFC RAL fulfills its main aims reasonably well. There is room for improvement, particularly from a logistical point of view. However, the fact that these suggestions are drawn from supervisors, rather than students, further confirms the broad satisfaction with the programme in its current form.

## 5 References

Bell, P., Lewenstein, B., Shouse, A. W., and Michael A. Feder (eds.) (2009) *Learning Science in Informal Environments: People, Places and Pursuits*. Washington DC: National Academies Press, cited in Wellcome Trust (2012) *Exploring the impact of informal learning.* Infographic. Available from: http://www.wellcome.ac.uk/stellent/groups/corporatesite/@msh_publishing_group/documents/web_document/wtp053989.pdf Accessed February 2014.

Hsu, P., van Eijck, M., & Roth, W. (2010). Students' representations of scientific practice during a science internship: Reflections from an activity-theoretic perspective. *International Journal of Science Education*, 32(9) 1243. Cited in Regan, E. (2011). *Does authentic science activity enhance students' understandings of scientific practice? Reflections from student science internships: An ISE research brief*

*discussing Hsu et al.'s, 'Students' representations of scientific practice during a science internship.'* Available from: http://www.relatingresearchtopractice.org/article/87 Accessed February 2014.

Tran, N. (2011). The relationship between students' connections to out-of-school experiences and factors associated with science learning. *International Journal of Science Education*, 33(12) 1625. Cited in King, H. (2011) *Connecting in-school and out-of-school learning: An ISE research brief discussing Tran's, 'The relationship between students' connections to out-of-school experiences and factors associated with science learning.'* Available from: http://www.relatingresearchtopractice.org/article/229. Accessed February 2014.

Knox, K., Moynihan, J., and Markowitz, D. (2003) Evaluation of Short-Term Impact of a High School Summer Science Program on Students' Perceived Knowledge and Skills. *Journal of Science Education and Technology* 12 (4) 471.

Van Eijck, M. & Roth, W-M. (2009). Authentic science experiences as a vehicle to change students' orientations toward science and scientific career choices: Learning from the path followed by Brad. *Cultural Studies of Science Education*, 4, 611. Cited in Van Horne, K. (2011). *Authentic science experiences – why are they important for all science learners?: An ISE research brief discussing van Eijck & Roth's, 'Authentic science experiences as a vehicle to change students' orientations toward science and scientific career choices: Learning from the path followed by Brad.'* Available from: http://www.relatingresearchtopractice.org/article/186. Accessed February 2014.

Wellcome Trust (2012) *Review of Informal Science Learning*. Available from: http://www.wellcome.ac.uk/stellent/groups/corporatesite/@msh_peda/documents/web_document/wtp040862.pdf Accessed February 2014.

## 6 Acknowledgements

Thanks are owed to Jo Lewis, Sophy Palmer and Chris Duff at the Science and Technology Facilities Council, as well as to the survey participants and interviewees for their help with this project.

Mr Alexander Brown (alexander.brown@bath.edu)
c/o Science Communication Unit, University of the West of England, Bristol, BS16 1QY