# Physics in the Field

## Evaluation Report

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## Summary

The present work is part of a post-doctoral research project, *Generic Venues: Researching the impact of science communication in non-traditional locations*'. This in-depth public engagement research project involves a thorough investigation of best practice in science communication within 'generic' venues - locations where audiences naturally congregate and have 'ownership' of the site; spaces that are not normally associated with scientific learning. The research is taking place at the Science Communication Unit (SCU) at the University of the West of England, Bristol (UWE, Bristol) and is funded by the Fundação para a Ciência e Tecnologia[1], a Portuguese governmental institution.

This report summarises audience based evaluative data from activities of the programme 'Physics in the Field'[2], an initiative of the Institute of Physics. These activities were used as a case study for the research project mentioned above.

[1] http://alfa.fct.mctes.pt/index.phtml.en

[2] http://www.physics.org/eventarticle.asp?NewsId=52

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# 1. Introduction

'Physics in the Field' involves members and staff from the Institute of Physics (IoP) performing physics 'tricks' (demonstrations) to different festivals throughout the UK to engage families and children with physics. The tricks consist of small scale, simple and entertaining demonstrations that the festival participants can try for themselves. Each of the tricks helps to illustrate an area of physics.

## *1.1. Venue*

In 2009 the Holker Garden Festival took place in Cartmel, near Grange-over-sands (Cumbria) over the weekend of 29th to 31st May. The festival aims to celebrate the best of gardens countryside and food. There was an admission charge for the festival (at the gates daily tickets were £13.5 for adults and £12 for senior and students), with free entrance for children under 16 accompanied by an adult. The Institute of Physics Team set up a 'stall' in the Holker Garden Festival showground (Figure 1).

The stall involved a single marquee displaying bunting with the 'Physics in the Field' logo and a table with the materials for the science tricks (Figure 2). The stall was located in a busy thoroughfare, near the restaurant and separated from the commercial stalls (Figure 1).


**Figure 1.** Map of the festival layout.

**Figure 2.** Images of Physics in the Field at the Holker Garden Festival.

### *1.2. The activity*

Passers-by were approached by IoP volunteers who offered to show them a science trick. The dynamic of the event was based on informal science demonstrations (often referred to as 'science busking'). As people stopped to watch and try the tricks themselves a crowd was gradually drawn. The physics tricks performed were as follows:[3]

- Amazing Marshmallows
- Tame Tornado
- Alka-Seltzer Rocket
- Waterproof Hanky
- Straw Oboes
- Balloon Kebabs
- Gripping Rice
- Inseparable Books
- Cartesian Diver

[3] Additional info about the physics tricks is available: http://www.physics.org/article-interact.asp?id=59

Volunteers targeted mainly families and usually used the 'Balloon Kebab' trick to initially engage an audience. They then demonstrated other tricks and explained the physics behind them. Once a few people gathered around the stall, other passers-by were attracted and also stopped to see the tricks.

## 2. Evaluation methodology

A variety of evaluative techniques were employed in order to judge the effectiveness of the 'Physics in the Field' activity in the chosen venue. Through the application of multiple complementary methodologies a range of both quantitative and qualitative data was collected. Audience reactions to the hands-on activities were collected in four ways:

**- Exit survey -** The reactions of audience members were investigated using self-completion anonymous questionnaires throughout the three days of the event. The questionnaires took the form of a single side of A4 and included both open and closed questions. A copy of the questionnaire is included as Appendix I.

**- Exit interview -** 'Snapshot' interviews (~90 seconds' duration) took place with members of the audience across the three days of the event. 'Snapshot' interviews are specifically designed to capture short and immediate feedback from participants in busy locations. A copy of the audience interview schedule is included as Appendix II.

**- Observations -** The activities were observed by the evaluator, who took extensive contemporaneous notes on the size, composition and reactions of the audience. A copy of the observation schedule is included as Appendix III.

**- Staff interviews** - Interviews took place with staff involved in both managing and delivering the activities. Staff members were asked to provide both formal and informal feedback of their impressions of the event. A copy of the staff interview schedule is included as Appendix IV.

### *2.1. Ethical issues*

Ethical approval for the project was granted by the University of the West of England, Bristol after the submission of appropriate procedural details to the relevant Ethics committee. Participant anonymity was maintained throughout the data collection and analysis phases, and the interview participants provided informed consent prior to participating. In the case of participants under 16 years of age their parents / carers provided oral informed consent prior to any interviews commencing. In addition, notices were placed in conspicuous locations within the stall area whenever observations were taking place.

## 3. Metrics

According to the event organisers the 2009 Holker Garden Festival attracted approximately 23,000 visitors across the three days[4]. The number of people participating in the 'Physics in the Field' activities was estimated by the Institute of Physics as 2,500, mainly in family groups. This estimate is based on the comments left and the numbers of freebies distributed to participants who engaged with the physics tricks.

[4] http://www.holker.co.uk/metadot/index.pl?id=3187;isa=DBRow;op=show;dbview_id=2335

## 4. Questionnaire results

Participants' responses within the questionnaire are included in this section. In total, 39 participants completed questionnaires over the course of the Holker Garden Festival. This is a low number in relation to the total participants number: in the busy festival environment it was difficult to recruit large numbers of participants. The questionnaire aimed to evaluate four aspects:

a) Audience demographic

b) How the audience enjoyed the activities

c) The educational value of the activities

d) Whether the activities had an effect on the audience's attitude towards science

### *4.1. Audience demographics*

Of the 39 questionnaires completed, 31 participants (80%) were under 15's. As demonstrated in Figure 3 the most common ages were within the range 9-12 (n=20; 52%). It is notable that there were no respondents from within the 20-29 and 50+ age groups. The gender balance of respondents was 20 males and 18 females (one respondent did not complete this question).

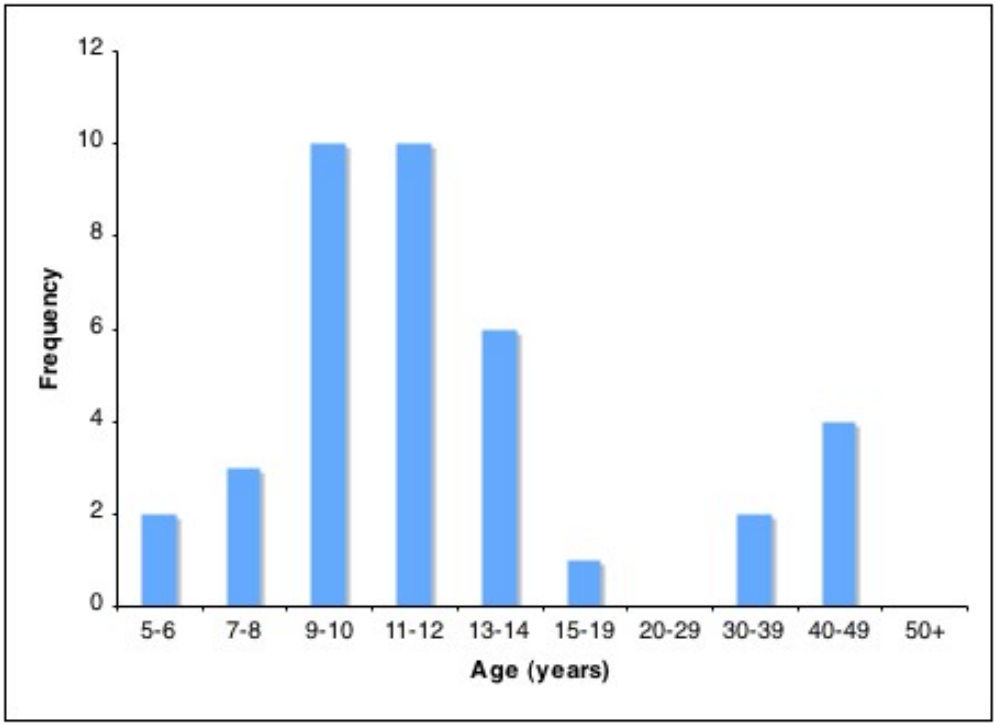


**Figure 3.** Audience age ranges.

In order to provide an indication of the geographical reach of the event participants were asked for the first part of their postcode. From Table I it is clear that the highest proportion of respondents (n=19, 49%) were from the host county, Lancashire. A further 18% of respondents did not complete this question hence it is not possible to comment on the wider geographical reach of the activity.

**Table I.** Geographic distribution of the audience.

| Postcode area name | Frequency |
|---|---|
| Lancashire | 19 |
| Greater Manchester | 5 |
| West Yorkshire | 4 |
| Other | 4 |
| Missing answer | 7 |

Most participants were from the Lancashire postcode area, which includes parts of Cumbria and Lancashire counties.

### *4.2. Qualifications in science*

Figure 4 outlines participants' highest science qualification. Most participants (74%) have no qualification in science and this is related with their age range, since the majority were under 15.

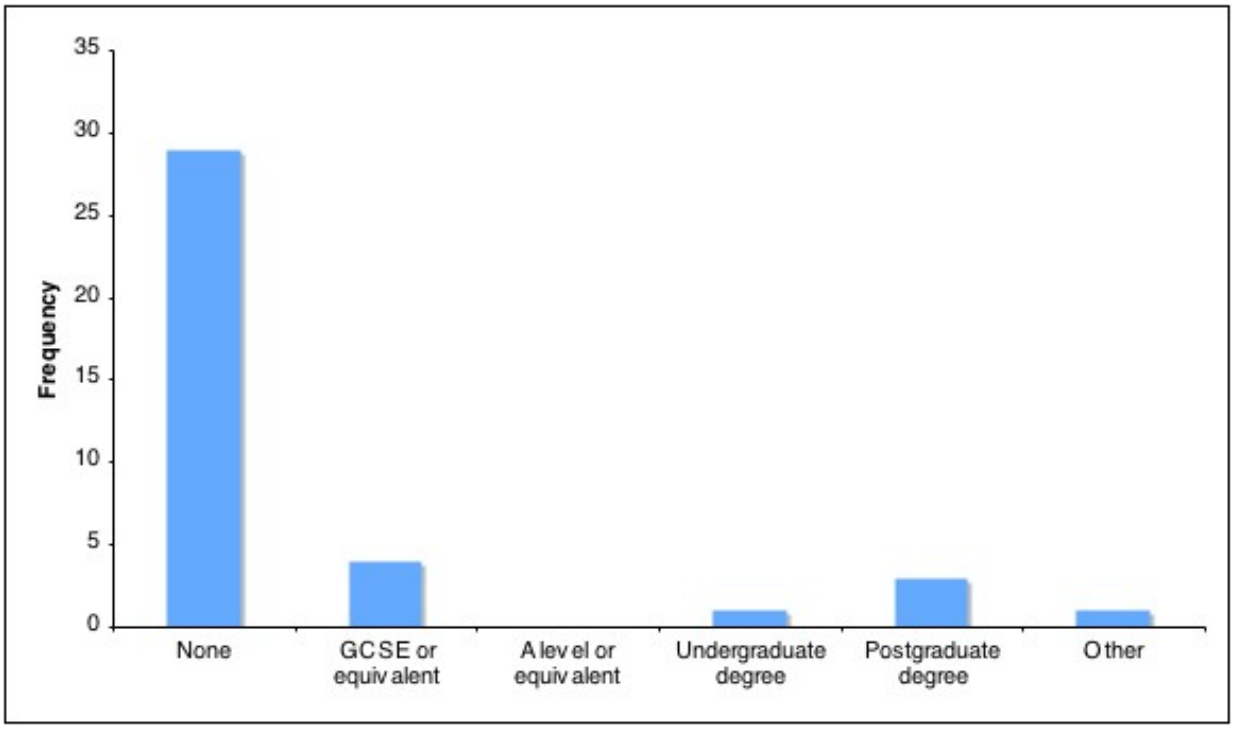


**Figure 4.** Science qualifications of the audience.

### *4.3. Enjoyment*

The participants' enjoyment of the activity was investigated via a series of inter-related questions:

1. *Did you enjoy this activity?*
2. *Would you recommend this sort of activity to others?*

3. *Which part of the activity have you enjoyed the MOST?*

4. *Which part of the activity have you enjoyed the LEAST?*

Results on levels of audience enjoyment were very positive (Figure 5): 62% of the participants said they 'loved' the activity and 38% 'liked' it. No one felt neutral, disliked it or hated it.

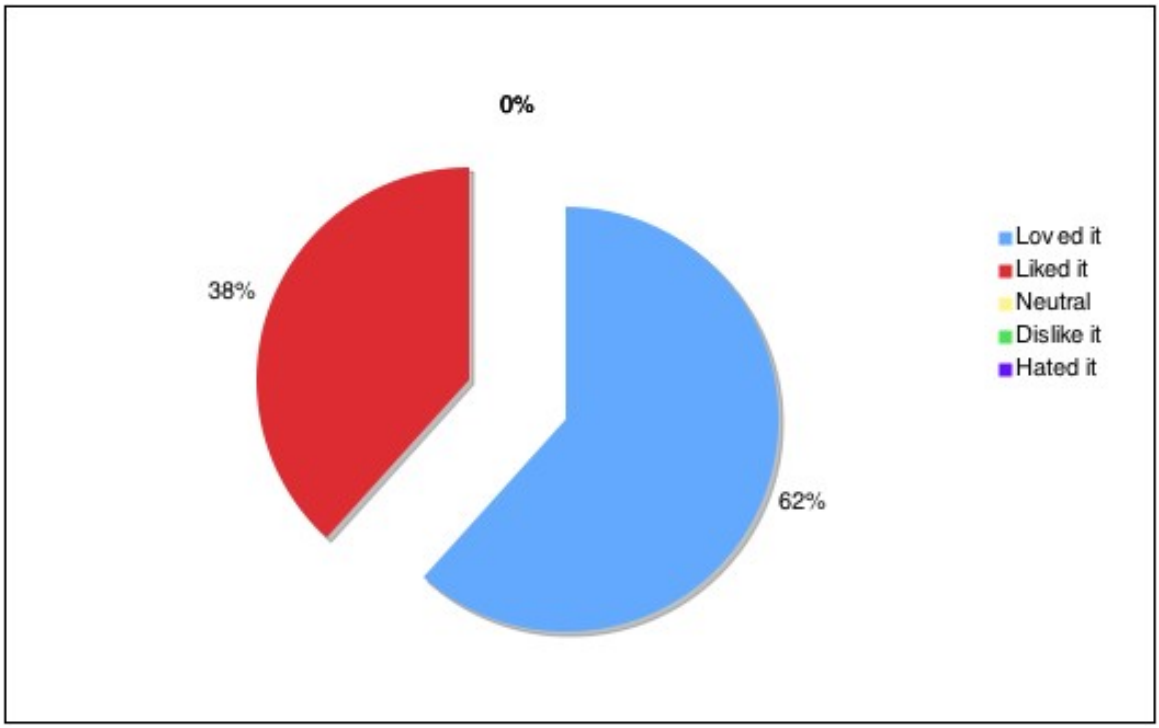


**Figure 5.** Audience enjoyment of the activities.

The majority of participants (95%) stated they would recommend this sort of activity to others, with the remaining 5% answering 'maybe'.

As shown in Figures 6 & 7, audience reactions to the tricks were overwhelmingly positive, with most of the demonstrations mentioned as the aspect they enjoyed the most by at least one respondent. Almost one third (n = 12, 29%) of the participants highlighted the 'Amazing Marshmallow' trick as the aspect they enjoyed the most, whilst 17% (n = 7) preferred the 'Balloon Kebab' trick. Two people (5%) specifically mentioned the engagement of the children as the most enjoyable aspect and another 5% liked 'all' the activities.

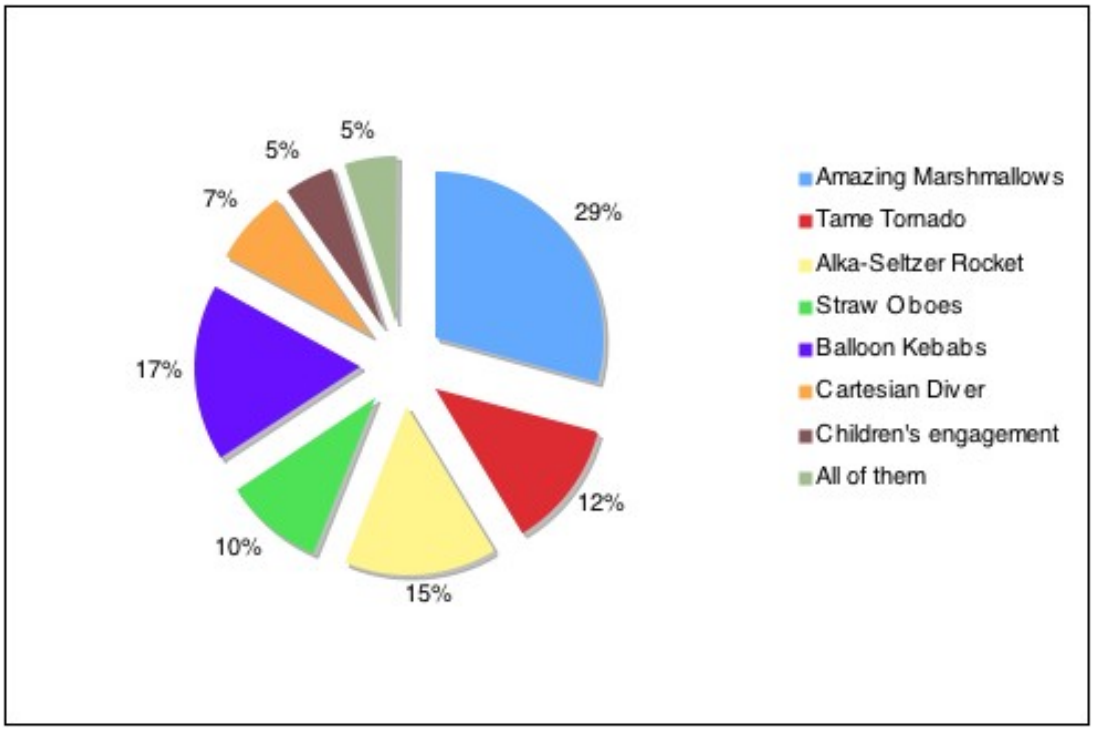


**Figure 6.** Most enjoyable aspects of the activity

Participants were also invited to leave open comments to explain the aspects they enjoyed the most. Responses included:

*'The rocket because that was exciting'* (11-year-old male)

*'The engagement of my 2$^{1/2}$-year-old child'* (30-39-year-old female)

*'All the experiments were informative + fun'* (40-49-year-old female)

When asked to identify the aspect of the activity that they enjoyed the least the majority of participants (n=21, 55%) either responded 'none' or indicated answers along the lines of 'it was all good' 11% (n=4) did not answer this question (Figure 7). The Gripping Rice trick was mentioned by 11% (n=4) of the participants as the aspect they enjoyed the least, with free-form comments indicating that this was due to the fact that the demonstration did not work.

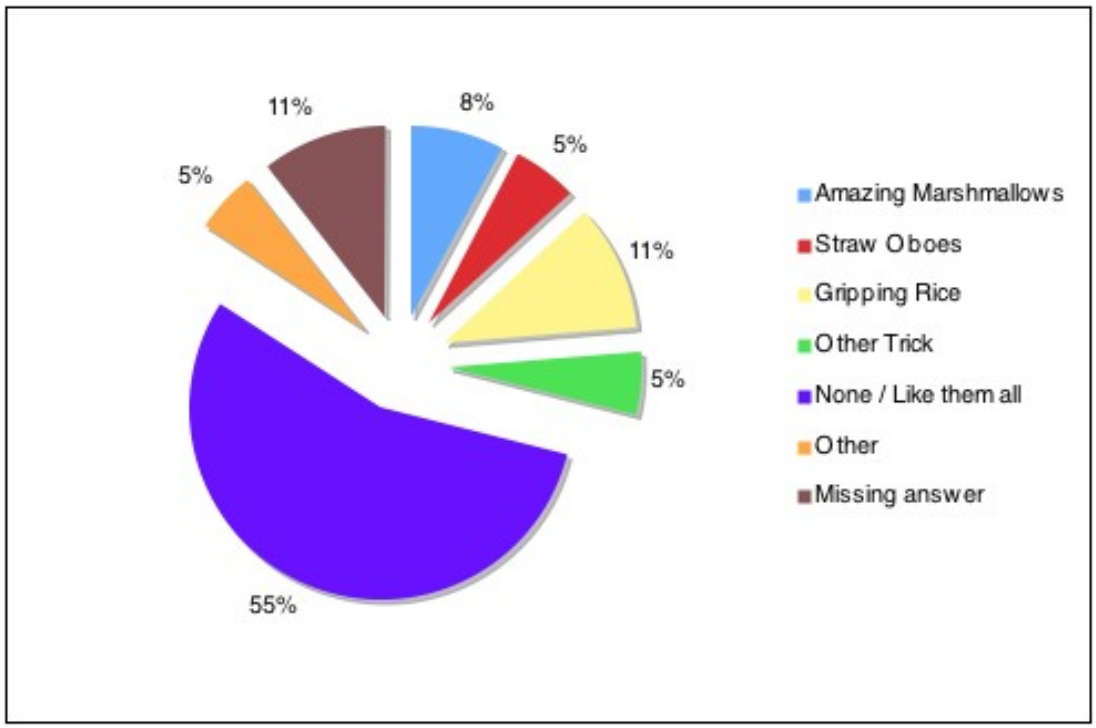


**Figure 7.** Least enjoyable aspects of the activity.

Some comments in the open section of this question included:

*'Rice thing (it didn't work)'* (14-year-old female)

*'Liked them all'* (11-year-old male)

*'Trying to pick up the rice up with the pencil because I couldn't do it!' (*10-year-old female)

*'None! All were well done + interesting'* (40-49-year-old female)

*'When it finished'* (9-year-old female)

### *4.4. Learning*

When asked if they had learnt something from the activity, 87% (n=34) said 'yes' and 13% (n=5) 'no'. Probing this further to investigate what form that learning took resulted in comments including:

*'Bicarbonate + vinegar mixed together make a rocket because of $CO_2$'* (11-year-old male)

*'Marshmallows are full of air'* (8-year-old female)

*'There is lots of pressure in the bottle of water'* (10-year-old female)

*'Friction is a great force'* (11-year-old male)

*'To stick a stick though a balloon'* (12-year-old male)

### *4.5. Attitudes towards science*

The participants' attitudes towards science both before and after the activity were investigated via separate questions

> *6. What did you think about science before today?*
>
> *7. Do you think that this activity has changed your attitude towards science? If Yes, in what way?*

Figure 8 demonstrates that the majority (n = 26; 66%) 'loved' or 'liked' science before this activity, but 15% (n = 6) 'disliked' it or even 'hated' it. A further 13% (n = 5) were neutral towards science prior to participating in the 'Physics in the Field' activity.

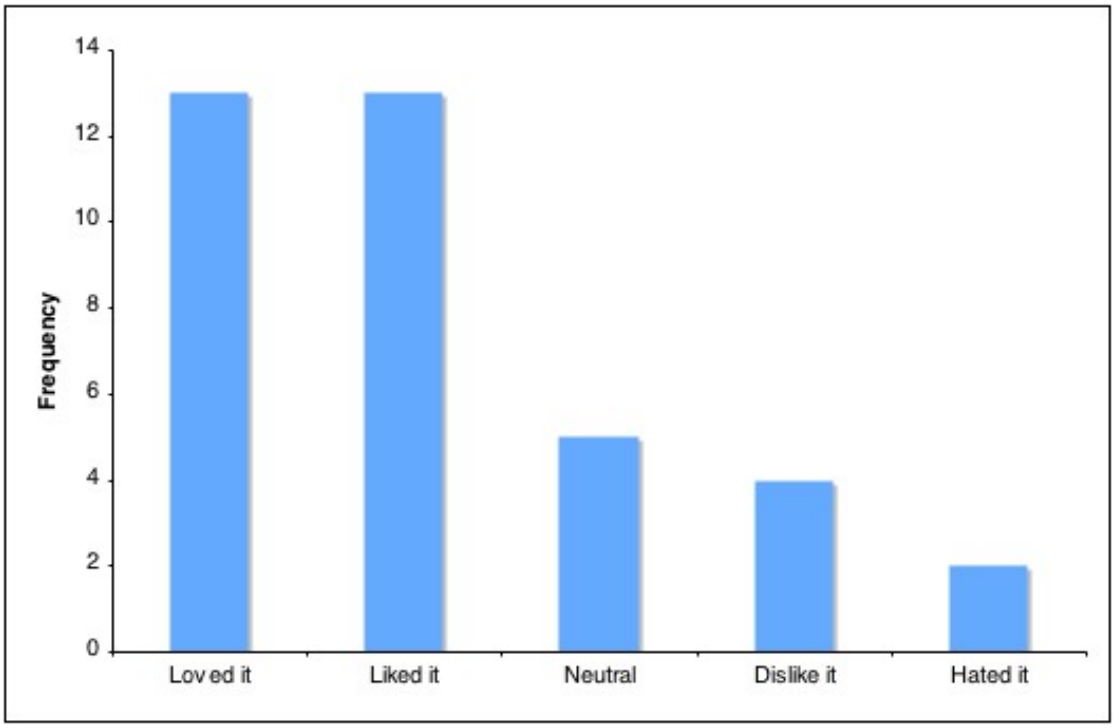


**Figure 8.** Participants' answers to the question '*What did you think about science before today?*'.

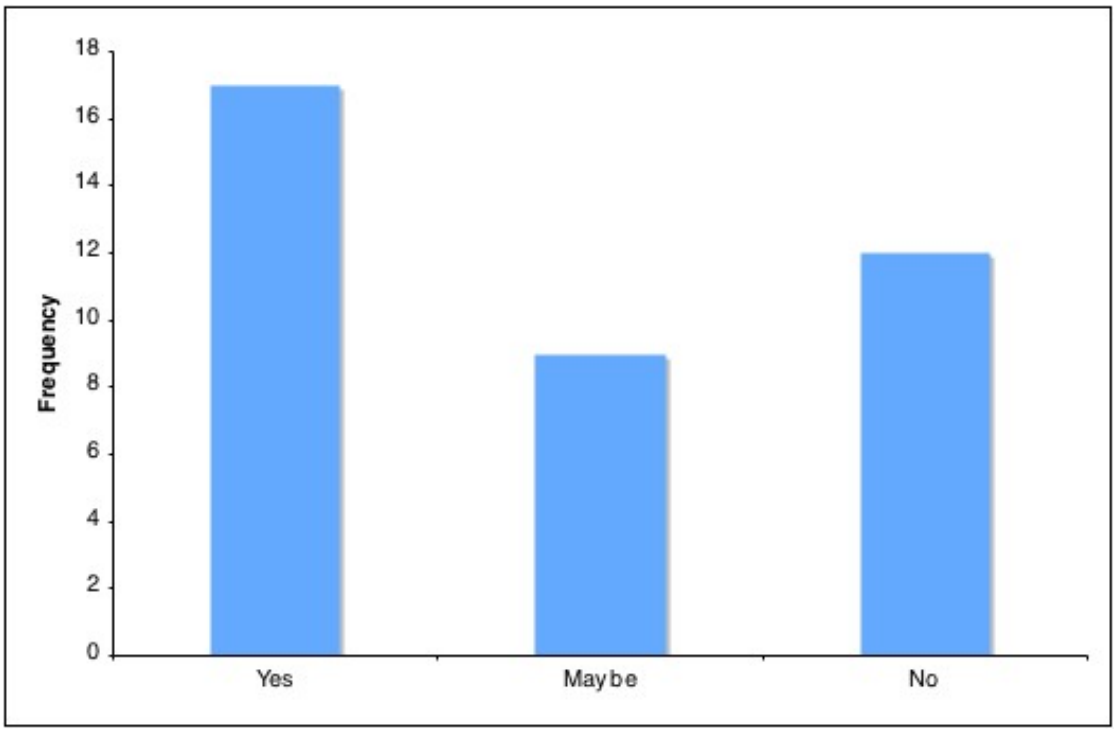


**Figure 9.** Changes in participants' attitudes towards science.

44% (n=17) of the participants said that the event had changed the way they felt about science (Figure 9) whilst 31% (n = 12) said it had not. When asked to further explain the way in which the event changed participants' attitudes, responses included:

'*I didn't think it was fun now I know it is fun'* (11-year-old female)

*'I find it more interesting'* (10-year-old female)

*'To enjoy it'* (11-year-old male)

*'It has taught me that science can be fun'* (10-year-old female)

Whilst in general the event served to stimulate those who already enjoyed science, within the open questions there was a clear increase in participants' recognition that science can be 'fun', 'interesting' and 'enjoyable'. Attitudes towards the activity were generally very positive, and the event even succeeded in changing some people's attitudes towards science, including their dislike.

## 5. 'Snapshot' interview results

34 snapshot interviews were conducted over the course of the three-day festival, based on a semi-structured interview schedule and using an audio recorder. Once transcribed the interview contents were analyzed to identify common themes.

### *5.1. What attracted visitors*

Members of the public engaged with the activities for different reasons. Common reasons are summarized in Table II.

**Table II.** Reasons participants stopped at the 'Physics in the Field' stall.

| **What attracted you to this stall?** |
|---|
| Saw it from a distance |
| Was passing by |
| Because it's physics |
| Because other member of the family wanted to come |
| I'm interested in science or other member of the family is |
| I read about it in the brochure |

### *5.2. Overall satisfaction*

The feedback for the 'Physics in the Field' activities was very positive. Answering the question 'How did you enjoy this activity?' participants responded:

- *'Brilliant, just brilliant.'*
- *'I liked it, it was a good stall and I enjoyed all the activities'*
- *'I really enjoyed it and so did my son, really, it opened his eyes.'*
- *'I enjoyed it very much! I was impressed by the demonstrations.'*
- *'It was good, it was really good.'*
- '*Good, you learn something while doing something fun.'*
- *'It was very informative.'*
- *'It was great fun.'*

As their favourite part of the activity, participants pointed out a specific science trick (such as Amazing Marshmallows, Balloon Kebabs, Tame Tornado and Cartesian Diver) and the fact the activities were simple and easy and/or fun.

Many participants could not point out the least favourite, as they enjoyed the all activity:

- *'I loved all to be fair. I thought it was amazing.'*
- *'I don't know really, I enjoyed all of them.'*
- *'They were all interesting.'*
- *'I didn't have one, I liked them all.'*
- '*Just how easy was to understand what was going on, once it was demonstrated.'*

The Gripping Rice was the activity mentioned most often as the least favourite, and one participant mentioned the physics 'talk':

- *'Having all the physics talk, because it just goes straight out of my head.'*

### *5.3. Purpose of the activity*

During the interviews, audience members were asked what they thought the purpose of the event was. Common themes and specific comments are summarized in Table III.

**Table III.** Perceived purpose of the activity.

| Common themes | Example comments |
|---|---|
| To learn/teach things | *'So people can learn things.'*<br>*'To show people and help them learning about physics.'*<br>*'To teach people about different aspects of physics.'* |
| To engage with science/physics | *'Is to engage children and interested them in science.'*<br>*'I suppose to engage them in science but I think it's a bit of magic.'*<br>*'Making the little ones more aware of physics, how the world goes around, etc.'*<br>*'Trying to get the children more interested in sciences, because it is lacking unfortunately.'* |
| To make physics more approachable | *'To make physics more approachable for the general public. People think physics is something like nuclear reactors and crazy scientists.'* |
| To show it is fun | *'To show kids about how fun science can be.'*<br>*'Just make people realize that physics can be fun and it is not all boring.'* |
| Other | *'To help other children that may not have the chance to do experiments like these.'*<br>*'To get more people to do new things.'*<br>*'To get ideas for mom and dad do and play.'* |

### *5.4. Attitudes towards science/physics*

Answers to the question *'How do you feel about science/physics more generally?'* can be grouped into 6 overarching categories:

- Love it
- Like it
- It is cool / fun
- It is interesting
- I work / study in the field
- I don't like it / Never liked it

Some specific comments:

*'I think it's interesting, but it was never my strong point at school.'*

*'I love it!'*

*'I do like science quite a lot. I don't really like when we have to write down loads of things, I like experiments, the more practical stuff.'*

*'Having earned my living based on a science degree I can only endorse it.'*

*'It's fun and you can do it in so many ways!'*

*'I was never that good at school.'*

*'Science and physics interests me to a certain point but there's an awful lot of it that I reach a certain point that I just don't get it.'*

### *5.5. Future events*

All the participants said that they would like to participate in a similar activity again in the future. Some people expanded their answers:

*'Yes. When I'm at these events, particularly with youngsters yes, we usually make our way to these stalls.'*

*'Yes, absolutely, I would love to.'*

*'Yeah, that would be interesting.'*

*'Yes, definitely, great fun.'*

*'Yeah, I would. Something more grand, bigger scale.'*

## 6. Staff interviews results

As part of the evaluation process, 3 staff members (involved in organising and/or delivering the activities) were interviewed in order to collect their feedback. In total, three IOP employees and five volunteers were involved over the 3 days. The main findings from this process were:

- **Enjoyment:** all members interviewed enjoyed being involved in the activities.
- **Motivation:** staff interviewed like to communicate and are interested in taking physics to '*free learning environments'*.
- **Purpose:** in their opinion the purpose of the activity was to promote physics, to attract more people to science and physics and to engage people that normally wouldn't engage with such subjects.
- **Visitors' reactions:** staff members were very pleased with the audience reactions and felt they were very interested in the activities. They also felt it was very easy to engage the audience with the activity.
- **Favourite aspect of being involved:** Aspects mentioned by staff were people's reactions; to communicate with people and to attract young kids; to make physics more interesting and to be able to explain physics to people.
- **Least favourite aspect of being involved:** 2 of the 3 members interviewed mentioned standing up for long periods of time as their least favourite aspect of being involved in the activities.
- **Improvement:** The main suggestion was to include a wider range of activities, since staff can get tired of repeating the same tricks all day. One staff member had new ideas for experiments and was very keen to contribute with those.

- **Future participation:** All members interviewed would like to participate again in similar activities.

# 7. Successes and challenges

### *7.1. Successes*

- The activities were very well received with significant interest shown in following up on the demonstrations. Many parents asked where they could find more information about the activities and staff involved gave the parents several brochures that explain how to perform the activities and the science behind them. Some children also asked for brochures so they could show them to their teacher and colleagues at school.
- The activity strengthened the public engagement expertise within the local physics community and inspired the volunteers to become involved in further events in future.
- The location of the 'Physics in the Field' stall was excellent (large numbers of people going past and located away from the commercial stalls) and worked really well, since there were always passers-by (to the restaurant or to the toilets).
- The method of offering free giveaways in exchange for a post-it note comment worked well in encouraging participation, particularly amongst children.
- The stall presentation and the use of colourful and attractive materials ensured that passers-by were naturally attracted.
- Staff involved were generally very enthusiastic, friendly and very engaged with the activities and audience. Some participants commented on the fact that they stayed for longer because the staff member was very engaging:

  *'And the gentlemen was quite good at explaining it, both to the adults and to the little boy.'*

- Participants felt very comfortable while engaging with the activities and with IoP staff. Participants did answer questions posed during the activities and also provided their own questions and comments. The overall feeling was that participants wanted to know more and had a very active approach to the experience.

### *7.2. Challenges*

- A visual display explaining, in a simple way, what 'Physics in the Field' is would be very helpful. Many people didn't understand who the staff members were and where they came from.
- Some members of the public were attracted to the stall, but because all staff members were engaged with participants, they just walked away. Finding a way to increase capacity during busy times, or encourage audience members to come back at a later point in their visit would be beneficial.
- Some periods of the day were extremely busy and that led to staff feeling very tired.

## 8. Conclusions

In a venue where participants pay an entrance fee, science busking activities work well and have a great potential for success. Audience members want to be entertained and are attracted to anything that looks different. The IoP team were able to attract and engage with members of the public in an informal venue, where science related activities are not expected. The evaluation shows that there is an interest in more activities like ‘Physics in the Field’, and that this view is shared by the participants and the staff involved in the activities. The event was overall very successful and was able to engage with a high number of members of the public.

## APPENDIX I - Questionnaire

*Thank you for taking the time to complete this questionnaire. It shouldn't take long to complete, and will help improve the activity in the future. Completing this questionnaire indicates that you give consent for this data to be used in this research study. All data will be treated anonymously and confidentially.*

**1. Did you enjoy this activity?**

☐ loved it ☐ liked it ☐ neutral ☐ disliked it ☐ hated it

**2. Would you recommend this sort of activity to others?**

☐ yes ☐ maybe ☐ no

**3. Which part of the activity have you enjoyed the MOST?**

**4. Which part of the activity have you enjoyed the LEAST?**

**5. Did you learn something from the activity?**

☐ yes ☐ no **If YES, what have you learnt?**_____

**6. What did you think about Science before today?**

☐ loved it ☐ liked it ☐ neutral ☐ disliked it ☐ hated it

**7. Do you think that this activity has changed your attitude towards Science?**

☐ yes ☐ maybe ☐ no **If YES, in what way?**_____

**8. What is your gender?**

☐ male ☐ female

**9. What is the first part of your postcode?**_____

**10. What is your age?**

☐ under 15 – please write your age here:_____

☐ 15-19 ☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ 50+

**11. What is your highest science qualification?**

☐ none ☐ GCSE or equivalent ☐ A level or equivalent ☐ undergraduate degree ☐ postgraduate degree ☐ other:_____

Please keep this pen, it's yours!

**Thank You!**

## APPENDIX II - Snapshot Interview Schedule

Thank you very much for agreeing to participate. It won't take very long and I'd appreciate it if you could be as honest as possible about what you think about this activity.

- What attracted you to this event?

    - What about this specific stall?

- How did you enjoy the activity?
- What was your favourite aspect of the activity?
- What was your least favourite aspect of the activity?
- What do you think the purpose of this activity was?
- How do you feel about science / physics more generally?
- Would you like to participate in this sort of event again?

Thanks very much for participating. Please accept this free pen to say thanks for being involved.

## APPENDIX III - Observation Schedule

Location:_____
Time:_____

Record the following observations over a 10-15 minute time window:

<table>
<tr><td>General Problems?<br>(accessibility, logistics, weather, scheduling, etc)</td><td></td></tr>
<tr><td>Audience Males</td><td></td></tr>
<tr><td>Audience Females</td><td></td></tr>
<tr><td>Audience Type (size of groups, multi-generational, age range?)</td><td></td></tr>
<tr><td>Staff:<br>(Age, appearance, confidence, enthusiasm)</td><td></td></tr>
<tr><td>Engagement:<br>(How were they attracted to the stall? Do they get involved or just observe (watching, asking q's, touching equipment, taking brochures))</td><td><table><tr><td></td><td>Count Observers:</td><td>Count Participants:</td></tr></table></td></tr>
<tr><td>Dwell time:<br>(How long are they staying?)</td><td></td></tr>
<tr><td>Group dynamics<br>Are they talking to each other? Is conversation about the activity? Are they working together or as individuals?</td><td></td></tr>
<tr><td>Comments made or questions asked:<br>(lecture / discussion?)</td><td></td></tr>
</table>

## APPENDIX IV - Staff Interview Schedule

Thank you very much for agreeing to participate in this interview. It won't take very long and I'd appreciate it if you could be as honest as possible regarding what you think about this activity.

**1. Did you enjoy participating in this activity?**
Why?

**2. What motivated you to participate in this event?**

**3. What did you think was the purpose of the event?**

**4. How did the visitors respond?**

**5. How easy of difficult was it to engage the audience in this activity?**

**6. What was you favourite aspect of being involved in the activity?**

**7. What was your least favourite aspect of being involved in this activity?**

**8. What sort of feedback did you get from the audience?**
e.g. did any of them approach you with questions or comments?

**9. How would you improve this activity?**

**10. Would you like to participate in a similar event again in the future?**

Thanks very much for participating.