Evaluation of the Royal Institution Christmas Lectures – Interim and Final Reports

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Evaluation of the Royal Institution show at the Big Bang Fair

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Summary

This report details the key findings of the evaluation of a Royal Institution (Ri) show, "The "not at" Christmas Lectures – the language of life", at the 2018 Big Bang UK Young Scientists & Engineers Fair (BBF), which took place between 14th and 17th March in Birmingham. In addition, the report includes the complete evaluation kit.
This short evaluation focused on the audiences' engagement with the activities and on the presenters' motivations for participating, the challenges they faced and the value of these activities.

Dr Margarida Sardo, from the Science Communication Unit at the University of the West of England, Bristol undertook the evaluation. The report was prepared by Margarida Sardo, with contributions from Erik Stengler, Hannah Little and Laura Fogg Rogers.

Introduction

About Big Bang UK Young Scientists & Engineers Fair

According to the organisation, "The Big Bang UK Young Scientists & Engineers Fair (BBF) is the largest celebration of science, technology, engineering and maths (STEM) for young people in the UK. The Big Bang Fair is an award-winning combination of exciting theatre shows, interactive workshops and exhibits and careers information from STEM professionals.[1]". The BBF is led by an independent, not-for-profit organisation, EngineeringUK[2], in partnership with over 200 organisations across government, industry, education and the wider science and engineering community.

The BBF state they "aim to show young people (primarily aged 7-19) the exciting and rewarding opportunities out there for them with the right experience and qualifications, by bringing classroom learning to life".

The BBF takes places once a year at the National Exhibition Centre (NEC) in Birmingham.

About the Ri at the BBF

At the BBF 2018, the Ri presented a stage show entitled "The 'not at' Christmas Lectures – The language of life". The show took place on the main stage (Headline Stage) and ran twice a day for the full duration of the event (four days). Each show had a duration of 40 minutes, with one session before lunchtime and one shortly after lunchtime.

The Headline Stage runs several shows daily and can accommodate around 1,000 visitors, between a seated area and a carpeted area immediately in front of the stage. The stage area comprises of a traditional stage with two big screens, one on each side. There is a carpeted area in front of the stage and several rows of chairs behind it. The shows are filmed by a professional film crew.

These shows are on a first come, first served basis, as it is not possible to make bookings. For this reason, there is no available data on who attends the shows. Attendees have to wait outside the seated area until there are allowed to come in.

[1] https://www.thebigbangfair.co.uk/plan-your-visit/about-us/

[2] http://www.engineeringuk.com

Evaluation methodology

This section outlines the methodology used to generate the data. A variety of methods was selected, tailored to the specific event and aiming to capture the experiences of the participants and presenters involved and to assess, as far as possible, the impact of the Ri activities on participants and presenters. The evaluation methodology received ethical approval from the University of the West of England, Bristol.

The evaluation *aimed* to:

- Evaluate the Ri's shows at the BBF, what worked and what did not, and the challenges and benefits of participating, from the perspective of those presenting the shows.

The *objectives* were to assess:

- **Impact on the audience**: levels of engagement, visitors' reactions to the shows, etc.
- **Impact on presenters** involved: motivations for participation, views on the shows, challenges, etc.

Observations

Observation permits an evaluator to contextualise other research data, become aware of subtle or routine aspects of a process and gather more of a sense of an activity as a whole. The evaluator used a standard observation guide to gather data as efficiently as possible, which was used at several events. For consistency, one evaluator conducted all the observations.

The evaluator sat in an unobtrusive location and recorded data such as audience size and composition, audience reactions and questions and environmental data. Every event evaluated was observed in its entirety. The observer made detailed notes during each show, supplemented by additional reflections immediately afterwards. In total, two observations were made throughout the BBF duration.

A copy of the observation schedule can be found in Appendix I.

Interviews with Presenters

Interviews with presenters involved took place shortly after the BBF, via email for convenience and to reduce transcription costs. Interviewees were asked to provide both formal and informal feedback of their impressions of the event. Semi-structured interviews were used, to provide a meaningful discussion of the presenters' experience. Four presenters were invited for interviews and two agreed to participate. The interviews were analysed for common themes.

A copy of the interview schedule can be found in Appendix II.

Secondary data

Secondary data was provided by the Big Bang Fair organisation. The organisation placed a few satisfaction voting stations at the entrance and exit points of the main stage. These were simple and easy to use, with a range of smiley/sad emoji faces.
In addition, twitter mentions (#notatxmaslectures) were analysed.

Findings

The findings described below are drawn from the observation records, interviews with the presenters and some secondary data, all related to the Ri's shows at the BBF 2018.

General information

The Ri's shows took place on the main stage, the Headline Stage (Figure 1). Each show was scheduled to run for 40 min, however both shows observed overran slightly. In one case, the show had a delayed start, as the children were still getting to their seats. It was noted that it takes up to 10 minutes to sit everyone down, as there are only two small entrances to the show area. There were volunteers in charge of manning the crowds and some children came in with their teachers, although the majority came with their classes, but without a teacher.

No pre-problems were noted, such as logistics, accessibility, scheduling or technology.

Figure 1. The Headline Stage at the Big Bang Fair.

Audience and Attendance

Data supplied by the BBF organisation shows that, in 2018, the event had around 80,000 visitors over the four days, of which 4,200 were teachers. On the day the observations took place, 21,021 visited the BBF.

Both shows being observed were well attended, one was nearly full to capacity (around 1,000 combining the seating and the carpeted areas) and the other one was about three quarters full (around 750-800). The show's audience were school children (the vast majority in Key Stage 3), with their teachers or careers. Data from the organisers shows the following breakdown by Key Stage, for the event in general (data not specific for the Headline Stage):

	Key Stage as % of total young people
Primary	27%
KS3	59%
KS4	11%
KS5	3%
Total	**100%**

One show had an estimated 50-50 split in girls-boys attendance, the other one had around 40% girls and 60% boys. These observations are in line with data supplied by the BBF organisers, which states overall equal percentages of girls (51%) and boys (49%).

Format

"The 'not at' Christmas Lectures – The language of life" show is an interactive science show with audience participation. Music, sound, lights and professional presenters are all a big part of this show. The show is fast-paced with a mixture of questions to the audience, plenty of demonstrations, short video clips, calls for action (such as voting, etc.), audience interaction (blow raspberries, kick a giant ball, etc.) and the use of volunteers during some of the demos.

Figure 2. The "Not at" Christmas Lectures.

Engagement

The audience was engaged throughout on both shows. High levels of engagement were observed, and it was noted how easy it was to engage the audience with the RI show. Half-way through both observed shows, the audience was still very engaged, paying attention and clearly following the show. Any call for action was responded quickly, as were any questions. The audience was always quick to react to prompts and stimuli, which confirms the high level of engagement and reaffirms they were following the show without any problems.

Some students were observed taking photos and filming the show, using smartphones and tablets. The evaluator noted several students saying "That's amazing!! (opens mouth)" and "Wow", while looking at those around them in astonishment.

Figure 3. The show starts with hands-on engagement, as the audience is asked to bounce big balls.

The highest levels of engagement were observed when volunteers were on stage actively participating in the demonstrations, when there was something loud or exploding or when interaction was a must. The lowest levels of engagement (should be noted that these were not low levels of engagement, just lower than the ones described above) were observed when the presenters explained some of the concepts, following a demonstration for example. The evaluator noted that these explanations were kept very simple and their duration was always short.

It was noticed that the show after lunch had a slightly smaller audience and that a number of children left during the show, which was not observed during the first show. To add to this, it was also noticed that, although overall the audience keep high levels of engagement and interest, there was less applause and less enthusiasm. This might be due to the lower audience numbers or perhaps an after-lunch dip in the audience's energy levels.

Figure 4. Asking for volunteers was particularly popular.

Secondary data provided by the BBF organization indicates the Ri show was very well received with the following satisfaction scores:

- 76.9% - Positive
- 3.3% - Neutral
- 19.8% - Negative

It was rated as the third most popular show across all stages. Two nature shows scored above the Ri's: Lizzie Daly Wild Adaptations (90% positive) and Nick Bakers Pond Dip (88% positive).

Twitter mentions (#NotAtXmasLectures)

Thirty-six tweets used the #notatxmaslectures hashtag. Of these tweets, more than half (53%) were by the Ri or employees/affiliates of the Ri, 6 (17%) were by non-affiliated science communication professionals in the audience, 8 (22%) were by teachers, 2 (6%) were by students/children and 1 (3%) was by a parent.

The majority of tweeters were science communicators, either affiliates of the Ri (or the Ri themselves) or other science communicators, presumably at the big bang fair implementing their own interventions. The Royal Institution's tweets were either promoting the event beforehand (4 tweets between 22/2/2018 and 11/3/2018), promoting the event during, or

giving "behind the scenes" content including videos both during and after the conference. The top 4 tweets (in terms of likes and retweets) during the time the event was running were all "behind the scenes" style tweets with videos, which suggests this type of content is received well. Tweets from unaffiliated science communications were all positive and supportive of the show. However, twitter accounts by science communication professions are primarily used as a tool for networking, which may bias against reporting of any negative thoughts in relation to such a well-renowned establishment as the Ri.

The second largest group of tweeters were teachers and schools tweeting from the event. Some of these tweets were very positive, such as:

> "Loved the show tonight from @Ri_Science. Always wanted to go to an Xmas lecture - glad we caught #notatxmaslectures"

Some hit a more neutral tone simply reporting on the fact that the event was happening, such as:

> "Ending the day with a bang @BigBangFair with @Ri_Science #notatxmaslectures #STEM"

As a lot of these tweets were from official school accounts, it is difficult to assess how they link to student enjoyment. Twitter accounts by schools are often marketing devices aimed at parents, which would bias against reporting of any negative experience.

There were two tweets from young people about the event, though neither indicated an opinion. The tweets suggest that they are simply using social media as a way of recording life events. Content from younger visitors will have been limited as the majority of social media platforms require users to be 13 years old. The core demographic of the Big Bang Fair is 11-14 year olds. Though there is content at the Big Bang Fair (including "not at the christmas lectures") that can engage people above 14 - the restrictions on age of social media by both the law, and by parents and schools, make activity on social media a poor metric for engagement of the target audience.

All evidence points to the show being a pleasant and engaging experience for those tweeting about it. However, due to twitter primarily acting as a marketing tool for nearly everyone using the hashtag (the Ri, science communicators, schools), this data source is not a good one for assessing enjoyment.

Presenters and their perspective

The presenters came across as relaxed, enthusiastic, confident, energetic and well-prepared. They were dressed casually, which was appropriate for the venue and audience.

Presenters stated they enjoyed delivering the show and the experience of having such a large audience. They also both mentioned it was easy to engage the audience with the show, but added that this was due to good planning:

> *Due to the way the show was written, it was easy. But careful writing went into it to ensure that the presenters found it easy.* (BBS Presenter 02)

The next section presents a series of bullet points highlighting what worked well/positive aspects and what didn't work so well/negative aspects, from the presenters' perspective.

What worked well / Positives:

- Despite some challenges, presenters learnt from the experience, which will feed into future events
- Reaching a potentially new audience
- Having full control of a pre-arranged budget
- Having three presenters who all contributed to stage movements
- Working with the production company on site and having their in-house AV person on site
- Using parts of a pre-existing show, and producing a show where parts will be used in the future.
- Outsourcing some of the prop building.

What didn't work so well / Negatives:

- Delays in equipment arriving
- Few days before show used to open and sort equipment, build props and familiarise themselves with quite complex equipment
- Having a full team who had never done such an event before. Inexperienced team was a challenge to manage
- The team should be more prepared before arriving, props should be ready, proper rehearsals and potentially pilot the show with an audience
- Hiring a van that only one team member could drive
- Not having a runner.

There was a point in which the presenters didn't seem to agree: rehearsing. While one presenter highlighted that having rehearsal times in house prior to the event was a positive aspect, the other presenter mentioned no time for rehearsing "properly":

> *In fact, the first time we properly ran through the show, with props, was in front of an audience. This was far from ideal.* (BBF Presenter 01)

Improvements

Both presenters suggested a number of strategies and improvements that could be implemented in future shows:

- Preparation: this seems to be key. More time needs to be dedicated to prepare, rehearse and test equipment and props. It was also mentioned that inexperienced staff members need to be better prepared for "the hard work that this event will be" (BBF Presenter 01).
- Clarity: roles need to be clearly defined and explained at the start of the planning process.
- Develop an appropriate project plan.
- Produce fully comprehensive callsheet, and emphasise to all staff members the importance of it.
- Practical details such as: having an extra staff member and a van that can have multiple drivers (although there was also a comment questioning the rather large size of the team and its need from a budget point of view).

Reflections and recommendations

In this section, the evaluators reflect on the successes and challenges of the Ri at the BBF and offer some recommendations for the design of similar events in the future.

Successes:

- **Use of audience volunteers** – the vast majority of children literally jumped at the opportunity to be a volunteer and be involved in a demo on stage. There was a lot of excitement, screaming and jumping up and down in an attempt to be the chosen as a volunteer. The use of volunteers was a very successful approach and a big encouragement in keeping the engagement levels up.
- **Kit:** the kit used was very successful throughout, from simple but exciting bits (such as big inflatable balls), to more complex equipment such as the Ruben's tube organ.
- **Presenters:** presenters came across as highly professional, engaged and enthusiastic about the show they were delivering. Presenters were also very effective at adapting and reacting to unexpected events. For example, at one point one of the volunteers was asked to put on latex gloves, in order to take part in a demonstration. This proved to be a tricky task but the presenter handled it with professionalism and sense of humour. It was noted that in the next show the volunteer was not asked to put on any gloves.
- **A feast for the senses:** the combination of a high-paced show, with lights, sound, fire and explosions made the activity a very effective one.

Challenges:

- **No major challenges were observed.** It was noted that there was lots of noise around the Big Bang Stage but this did not interfere with the show. Likewise, the size of the audience was not an issue either. The presenters handled the big crowd very effectively, moving around the seated area and picking volunteers from different locations. The film crew helped too, with cameras moving around and capturing images and the faces of those seating in several different areas.
- **Duration:** the show might be 5-8 minutes too long. It was observed, on both occasions, that towards the end of the show the audience started to suggest lower levels of engagement, with some students starting to lose interest and being observed fidgeting, talking to each other and eating a snack without paying much attention to the show.
- **Finale:** the show finished with a bit of promotion for the Ri and a thanks to sponsors. By then engagement had definitely gone down, and this was clearly noticeable by a lower response to question or reaction to prompts.
- **Link to the Christmas Lectures:** There was a link to the Christmas Lectures, but this should/could be emphasised; although it might not be practical, having leaflets could be

an avenue for further engagement. Leaflets could be distributed as the children enter the show area and/or be available as part of their welcome kits. The leaflets aid in increasing awareness about the Christmas Lectures and around the Debate Kit, as BBF's attendees are a target audience for the Debate Kit.

- The **title of the show** clearly links to the Christmas Lectures, but may not mean anything to those who are not aware of their existence (which may be more than we think –we will find out in other parts of the evaluation). Perhaps it would make sense (and work in favour of promotion of the "Christmas lectures" brand) that the Ri and Christmas Lectures are introduced at the beginning of the show. This would ideally be a very brief introduction and done in a dynamic manner, maybe linked to the distribution among the audience of some merchandise with the link to the website and lectures online.
- **Preparation:** the team needs to be given sufficient time before the show to prepare and rehearse accordantly. This would help all members of the team, including the presenters, feeling more confident and relaxed about delivering the show.

Appendix I

Observation Guide

Please use this guide to record as much as possible about the observation. If unobtrusive circulate around the room/venue whilst observing.

General information
Event name: **Location:** **Date:** **Time (start observation):** **Details about participants** (institutions, roles, etc.): **Estimated Audience Number:** **Estimated Male/Female Ratio:** **Average dwell time:** **Audience Type** (families, groups of friends, couples, etc. and size of groups, multi-generational, age range?): **Any general pre-problems** (accessibility, logistics, weather, scheduling, technology, etc.)?
The Activity **Start Time:** **End Time:**
Activity type: (presentation, discussion, hands-on, etc.)
Environment: (lighting, room size and format, technology available etc.)

Participants' engagement

Engagement level:

☐ High engagement
☐ Average engagement
☐ Low engagement

Easiness of engagement:

☐ It's easy to engage with the participants
☐ It's neither easy or difficult to engage with the participants
☐ It's difficult to engage with the participants

Interaction between participants:

☐ Participants interact with each other
☐ Participants don't interact with each other

Identify any particularly interesting or challenging issues:

Interaction between visitors and the exhibition:

Annotated agenda (Please describe each part of the day, including notes on all activities, break-out groups, presentations, agenda, etc.)**:**

Diagram of Venue: Please insert a diagram of the venue either before/after the observation here

Appendix II

Interview Schedule – Presenters

Questions:
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 your views and thoughts about this activity.

1. How did your experience of the Christmas Lectures go? (Christmas Lectures at the Big Bang Fair)

What did you enjoy?

What didn't you enjoy?

2. What motivated you to participate?

3. What do you think is the purpose of the Christmas Lectures at the Big Bang Fair?

4. Did you have any contact with the audience both during or after this event? If yes, how did the audience respond? e.g. did any of them approach you with questions or comments?

5. How easy or difficult was it to engage the audience in this event?

6. In your opinion, what worked well about being involved in this Christmas Lectures event? (Christmas Lectures at the Big Bang Fair)

7. And what didn't work so well?

8. How would you improve this event? (Christmas Lectures at the Big Bang Fair)

Thank you for your time.

Evaluation of the Royal Institution Unconference for Schools: ‘A matter of privacy’

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August 2018

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Contents

Summary

This report details the key findings of the evaluation of a Royal Institution (Ri) schools' conference. Billed as an 'Unconference', it dealt with the topic of privacy and 'always-on microphones', and sought to give young people the opportunity to have their say on this topic. The event took place at the Ri London headquarters on Albemarle Street, on the 16th May 2018, during the school day. Around 89 young people and eight teachers took part.

Laura Fogg-Rogers, from the Science Communication Unit at the University of the West of England, Bristol, undertook the evaluation, with contributions from Dr Hannah Little and Dylan Casella. The report was prepared by Laura Fogg-Rogers, with contributions from Dr Margarida Sardo and Dr Hannah Little.

This short evaluation focused on the audiences' engagement with the activities and on the perceptions of the activities and the Ri Christmas Lectures. The report includes the complete evaluation kit in the Appendices. The recommendations include:

- Keeping the event experience the same but changing the event timing
- Encouraging whole class group attendance with prior preparation time
- Form teacher networks to advocate for the Ri and advise on outreach work
- Consider more structure for the discussion sessions and feedback, along with more opportunities for young people to feed into science policy
- Encourage more links between all the Ri outreach activities
- Enhance social media promotion of the Christmas Lectures.

1. Introduction

1.1. About the Ri Unconference

The Ri established the schools conference in order to give young people the opportunity to visit the headquarters of the organisation and put forward their views on topics relevant to the Christmas Lectures. The title of an 'unconference' denotes that participants are welcome to contribute to the discussions. The event takes place once a year at the Ri headquarters, and is held in the main Lecture Theatre which can seat 250 guests.

In 2018, the topic was 'a matter of privacy', which relates to the 2017 Christmas Lectures topic of 'the language of life' and more generally about communication. The discussion will centre on the topic of privacy, with discussions exploring privacy in our interaction with technology, human rights and policy, and national security. The Unconference followed on from the privacy debate kits about 'always on microphones'. According to the Ri:

> "We believe that we don't ask young people their opinion often enough, and we certainly don't take those opinions into consideration when we make our decisions. Our unconference will give you [young people] the opportunity to make a real change. But what this change is will depend on what you discuss and what you propose.

Up to 12 young people aged 16-19 years old from each school or college were invited to attend the conference from across the UK. The Ri reported that 153 young people booked onto the event, with 22 adults/teachers booked in to accompany them.

Teachers received an email before the event which included a video of an unconference from a previous year https://www.youtube.com/watch?v=0zVM27vBdpE

Teachers were also given suggested materials to discuss with students before the event, along with a survey link to record their perceptions of student engagement beforehand. The suggested materials can be found here:

http://www.bbc.co.uk/news/technology-43458110

https://www.theguardian.com/uk-news/2017/aug/05/met-police-facial-recognition-software-notting-hill-carnival

http://uk.businessinsider.com/hackers-stole-a-casinos-database-through-a-thermometer-in-the-lobby-fish-tank-2018-4?r=US&IR=T

https://www.theguardian.com/uk-news/2018/apr/17/home-office-destroyed-windrush-landing-cards-says-ex-staffer

1.2. About the Ri I'm a Scientist Debate Kit

These debate kits are a free resource developed by Mangorolla CIC, the team behind I'm a Scientist Get Me Out Of Here (IAS). The kits give teachers everything they need to run a structured debate on the controversial topic of 'always on' microphones. The kits consider the topic from the point of view of eight characters, and students are asked to vote on whether 'mobile phones should always be listening' before the debate, partway through and at the end of the debate. 2323 debate kits were posted and downloaded by schools across the UK and 61 kits sent abroad.

The outputs were collated by the IAS team and fed into the Unconference day. The teachers' suggestions were used to inform the Unconference discussion topics and questions. Suggestions for discussion topics included:

- personal and social privacy
- the use of social media
- the idea of governments listening in on the public
- other devices and/or situations
- apps such as Facebook and targeted advertising.

1.3. Event format

The full timetable for the Unconference day is included in Table 1. The young people assembled in the main Lecture Theatre and were introduced to the concept of the event. They then received presentations from four speakers who prompted different views on the topic. These were:

Chris Darby (M) – Chief Technical Officer of a start-up business called District. His presentation discussed how we define and socially construct secrets.

Monika Kaminska (F) - a doctoral researcher in cyber security at the University of Oxford. Her presentation discussed micro-targeting of campaign videos.

Maria Farrell (F) - an Irish writer and consultant on technology policy, the Internet and politics. She discussed the ethics of how data is collected without internet users' consent.

Cerys Bradley (F) – a PhD student at University College London. Her presentation discussed the dark web.

The students were then invited to discuss their preferred topics in small facilitated discussion groups in break-out rooms. Ideas were recorded by volunteers in discussion rooms, through electronic voting with the online platform Mentimeter, and through recording, transcribing and analysing the delegate's presentations. The Facilitator Guide can be found in Appendix 1. The discussion topics were:

What is a secret and who gets to keep them?

Digital propaganda and political bots

Welcome to the Data-Verse

Privacy vs Security

Self-selected students then reported back to the whole conference about their discussions, which took place in the main lecture theatre. The students presented to a panel of five experts who gave feedback on their comments. These were:

Vivian Lantree (F) – Senior Privacy Lawyer at BT

James Temperton (M) – Digital Editor at WIRED

Wendy Allen (F) – Senior Consultant at EY

Dr Anne-Marie Imafidon (F) – CEO Stemettes

Dr Hannah Little (F) – Lecturer in Science Communication at UWE Bristol

Table 1: Planned timetable for the Unconference

10:00 – 10:30	Students arrive and register	
10:30 – 10:45	Students into theatre	Students will be given the opportunity to vote electronically
10:45 – 11:00	Natasha Simons, coordinator of the unconference and Science Content Developer for the Ri introduces the event.	
11:00 – 12:00	Keynote speeches	Each lasting 15 minutes
12:00 – 12:45	Lunch - students eat lunch in their first discussion room	
12:45 – 13:25	First session: discussion groups of first topic	Discussion in groups of 8-10
13:25 – 14:05	Second session of discussions: students can change rooms/topics	
14:05 – 14:35	Third session: Students consolidate ideas, select presenters and practice	Questions and policy ideas finalised
14:35 – 15:30	Students to present ideas in the theatre for cross examination by the expert panel	
15:30 – 15:45	Closing remarks	Students will be given the opportunity to vote electronically

2. Evaluation methodology

This section outlines the methodology used to generate the data. A variety of methods were selected, tailored to the specific event and aiming to capture the experiences of the participants involved. The evaluation methodology received ethical approval from the University of the West of England, Bristol.

The evaluation *aimed* to evaluate the Ri's Unconference to explore what worked and what did not, and the perceptions of links to the Christmas Lecture series.

The *objectives* were to assess:

- Perceptions of young people: reactions to the Unconference, views on the Christmas Lecture series etc.
- Perceptions of teachers: reactions to the Unconference, views on the Christmas Lecture series etc.

2.1. Observations

Observation permits an evaluator to contextualise other research data, become aware of subtle or routine aspects of a process and gather more of a sense of an activity as a whole. The evaluators used a standard observation guide to gather data as efficiently as possible, which was used in the main Lecture Theatre and the small discussion groups.

The evaluators sat in unobtrusive locations and recorded data such as audience size and composition, audience reactions and environmental data. Every segment evaluated was observed in its entirety. The observers made detailed notes during each segment, supplemented by additional reflections immediately afterwards. In total, six observations were made throughout the Unconference duration. A copy of the observation schedule can be found in Appendix 2.

2.2. Questionnaire for teachers

Questionnaires were emailed out to teachers before the event, and paper copies were handed out at the Unconference. The questions assessed the pre-planning for the event, the event experience, and potential links to the Christmas Lectures. Descriptive statistics were conducted on the questionnaire data, as well as content analysis on the open questions. A copy of the questionnaire can be found in Appendix 3.

2.3. Snapshot interviews with young people

The evaluators conducted snapshot focus groups and interviews with groups of young people, using convenience sampling with students free to chat during their breaks. The questions assessed the young people's event experience, interest in science TV, and potential links to the Christmas Lectures. Descriptive statistics were conducted on the questionnaire data, as well as content analysis on the open questions. A copy of the questionnaire can be found in Appendix 4.

3. Findings

The findings described below are drawn from the observation records, teacher questionnaires, and snapshot interviews with young people, all conducted on May 16th 2018.

3.1. Audience and attendance

A head-count in the Lecture Theatre indicated that 97 people attended the conference, which consisted of eight teachers and 89 young people. Official figures from the Ri show that these students were from eight state schools, one private school and four apprentices from AWE and Arup. This was a significant drop on those who reserved tickets (175 reservations = 45% decrease), and well below the capacity of the lecture theatre. Of the young people who attended, 35 (42%) appeared to be female, and 22 (25%) appeared to be from a Black and Minority Ethnic background.

3.2. Observation feedback

The Unconference ran largely as planned. The initial speeches slightly ran over the allotted time but all the provocations seemed to engage the young people, and there was good audience engagement. The speakers came across as relaxed, enthusiastic, confident, energetic and well-prepared. They were dressed casually, which was appropriate for the venue and audience.

While some audience members were happy to contribute (even in a large lecture theatre), the use of Mentimeter for Smartphone feedback enabled less vocal participants to also contribute. While some speakers engaged well with Mentimeter and provided jovial discussion while voting took place, others stayed silent while the vote happened. This led to some awkward silences and made those sections feel a bit laboured. The sitting and listening period of the event was just over an hour long, however, some audience members seemed restless and started to yawn about 40 minutes into the session. However, this may be due to concentration limits rather than the speakers at the time.

The discussion sessions were well attended and the engagement in all groups were high. While the students were encouraged to mix up and meet other school groups, the discussion groups were self-selected and so the students stuck together with people they already knew. They also chose the topics that they were already interested in, and so the discussions did tend to result in echo chambers.

The facilitators did encourage movement and cross-fertilisation between groups, however, this was difficult to engender without structured sessions. The groups had to move between rooms to experience two other sessions, but they tended to move around together rather than split up and meet new people.

Within the small rooms the facilitators did seem very dominant in the discussions, and their different styles of interaction meant that some young people got to have less of a say. A power imbalance was also evident as the young people did not lead the direction of the discussions and sometimes appeared reticent to argue against the facilitators or their teachers. However, the facilitators did play an important

role to keep the conversations on track, as otherwise the young people held very free-form discussions. Whilst they did enjoy this opportunity, many seemed to forget that the aim was to produce a report of their discussion to present to an expert panel.

As a result, many of the end presentations were put together by self-selected individuals discussing their own views, rather than reporting on what their groups had discussed. This section of the day felt less organised than the rest, as it felt like the audience wanted to counter some of the arguments made at the front (with audible laughter or 'oohs' heard from the audience), but instead the expert panel needed time to have their say as well.

This section could be improved with more guidance for the end presentations so that the young people know how to present their findings, and who they will be talking to. A smaller expert panel would also be useful, so that each person didn't need as long to have their say, and more time could be devoted to the opinions of the young people.

The feedback the young people provided was recorded and transcribed for a report to the Ri's funders. However, this was not made clear on the day, and so it did not seem that the young's feedback would go further. Given that the aim of the conference was to enable young people to make a difference on this topic, it could have been a useful output for the participants to agree and draft some opinions and ideas which could be presented to Ri leaders or to experts in power, visibly in front of the audience on the day.

3.3. Ri results from the day

Over the course of the day delegates debated the ethics and practicalities of privacy in modern society, giving their feedback orally and via Mentimeter. 89% of delegates voted to say they cared about their online privacy and 60% of delegates had either deleted or considered deleting Facebook due to privacy concerns. The themes that emerged from the discussions are summarised below:

- Choice
- Security
- Trust
- Accountability
- Responsibility
- Manipulation
- Confusion

The Ri accompanying report '2018 Ri Unconference: A Matter of Privacy' describes these themes and results from the Mentimeter in more details. Comments from the day included:

> 'It's very engaging and interesting, as well as extremely topical'
> 'Today has been an overall success allowing me to view other people's ideas on the topic of privacy. Allowed me to branch out my own ideas'
> 'It was interesting to see how technology can be used against you. It was very informative'

'The conference was great and eye opening. It was interesting seeing the views of students my own age and being heard by professionals.
'I think it' really well organised and really useful. I've learned lots of things. Thank you!'
'Really good to discuss and come together with all these other people and share ideas; it was helpful to have the panel to guide questions'

3.4. Teacher questionnaires

Five teachers out of the eight who were present completed and handed in questionnaires (63% response rate). They listed their schools as:

- ADA National College for Digital Skills
- Beechen Cliff School
- Centre Academy London
- Impington Village College
- ARK King Solomon Academy

The reasons the teachers gave for attending the conference with their classes were:

T1 Relevant to their studies on the social implication of computing and the wish to encourage them to become more active citizens.

T2 Visit the institution - Give the student opportunities - Timely event - Stimulate my students

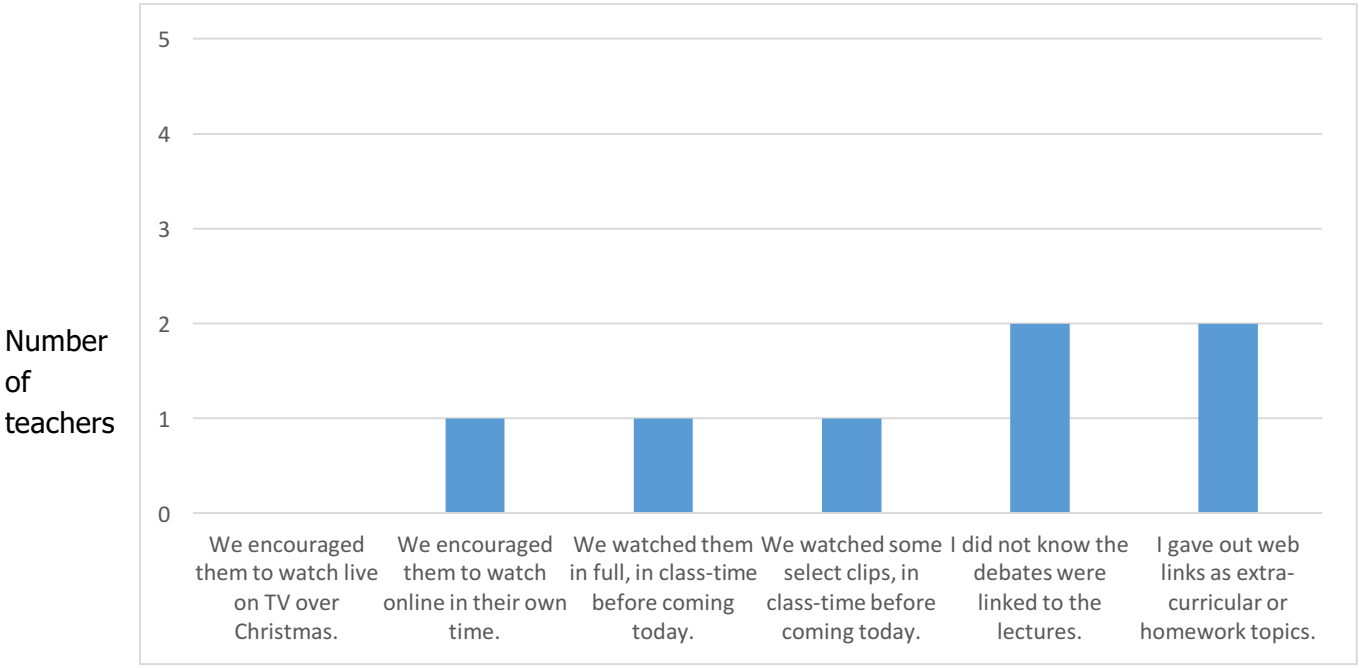
T3 Expose students to impact of social media and privacy issues. Hear from experts and interaction with other students to hear their views.

T4 Important that students are aware of these current relevant issues. Opportunity to discuss their ideas with people from different backgrounds.

T5 Reputation of RI. Focus of day is very relevant. Exposing students to other parts of science.

The teachers did not conduct much preparatory learning before attending the conference. Two of the five teachers had not realised that the Unconference was connected to the Christmas Lectures. None of the teachers had linked the Unconference with the IAS debates, and none had taken part in this beforehand. Some stated that this was because the young people visiting were not a whole class group, and so they gave out the links for the interested students to review in their own time. Others said that they were busy and in the middle of exams beforehand. The types of preparation conducted is shown in Figure 1.

Figure 1 – Preparation for the Unconference with reference to the Christmas Lectures



The teachers gave feedback on the Christmas Lectures and said:

> *T1 I think much more publicity that they are taking place as a lot of students at this event had not realised they were taking place. Possibility to join remotely.*
>
> *T2 Explicit links to curriculum would help justify taking time to watch in class.*
>
> *T3 We were impressed by the few we watched including 'Magic of Chemistry'. Not really sure how it can be improved.*
>
> *T4 [We would need] Information about the content of the Christmas lectures.*
>
> *T4 [We would need] Clear advertising of relevance to 6th form age students.*

However, the teachers saw the relevance of the Unconference as a standalone activity, and thought that meeting and hearing from experts on the topic would be relevant and meaningful for the students. They did suggest it could be improved with more links to the National Curriculum, and more signposting to further activities. They also indicated that cost was a factor, as travel was mentioned by one teacher, and two mentioned that the Ri could produce activities which could be conducted in schools.

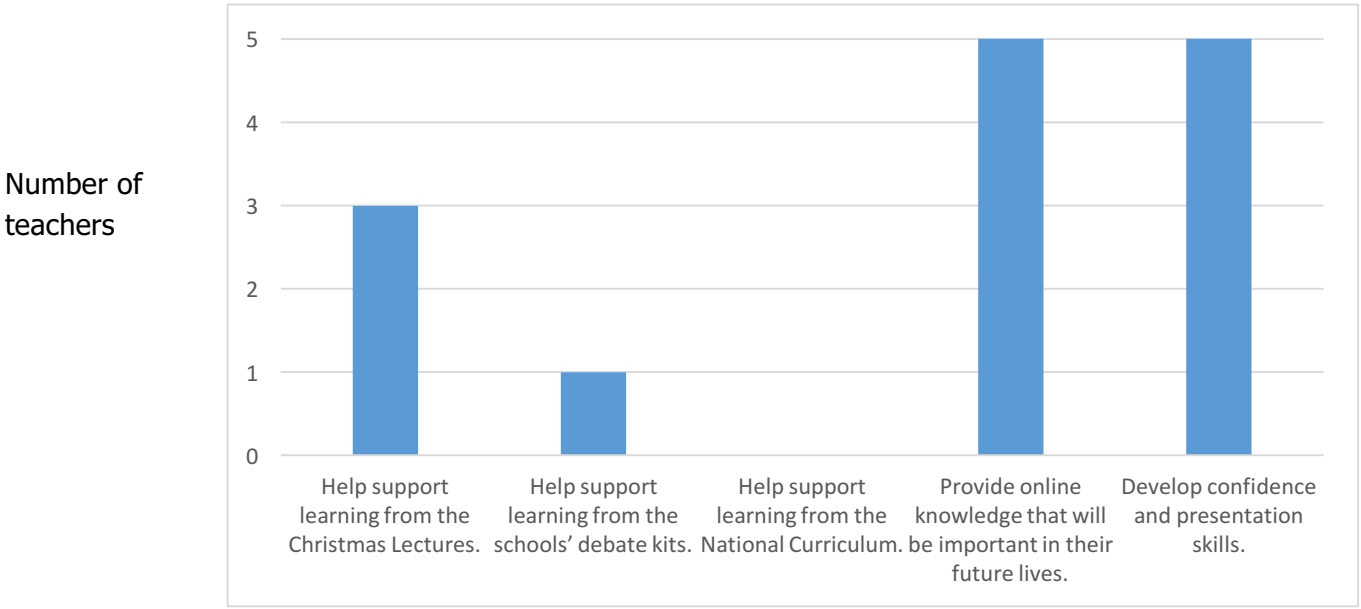
> *T1 [The Ri could support teachers] Possibly by organising in-school speaker visits. The attendance today was lower than I expected and I suspect this is a result of being in the middle of 'exam season'.*

T2 If conference started a little later then much cheaper (off-peak) train tickets would have been available for us for travel.

T4 Send speakers to schools/colleges to facilitate discussions and run sessions with pupils.

The learning outcomes that they hoped their students would achieve can be seen in Figure 2.

Figure 2: Desired learning outcomes from Ri Unconference



3.5. Student interviews and conference perceptions

Snapshot focus group interviews were conducted with 23 groups of students consisting of different sized groupings (due to convenience sampling). In total, 53 students contributed their opinions out of the 89 attending (60% response rate). Of the students who took part in the interviews, 21 were female (39% compared to 42% at the conference) and 24 were from a Black and Minority Ethnic background (44% compared to 25% at the conference).

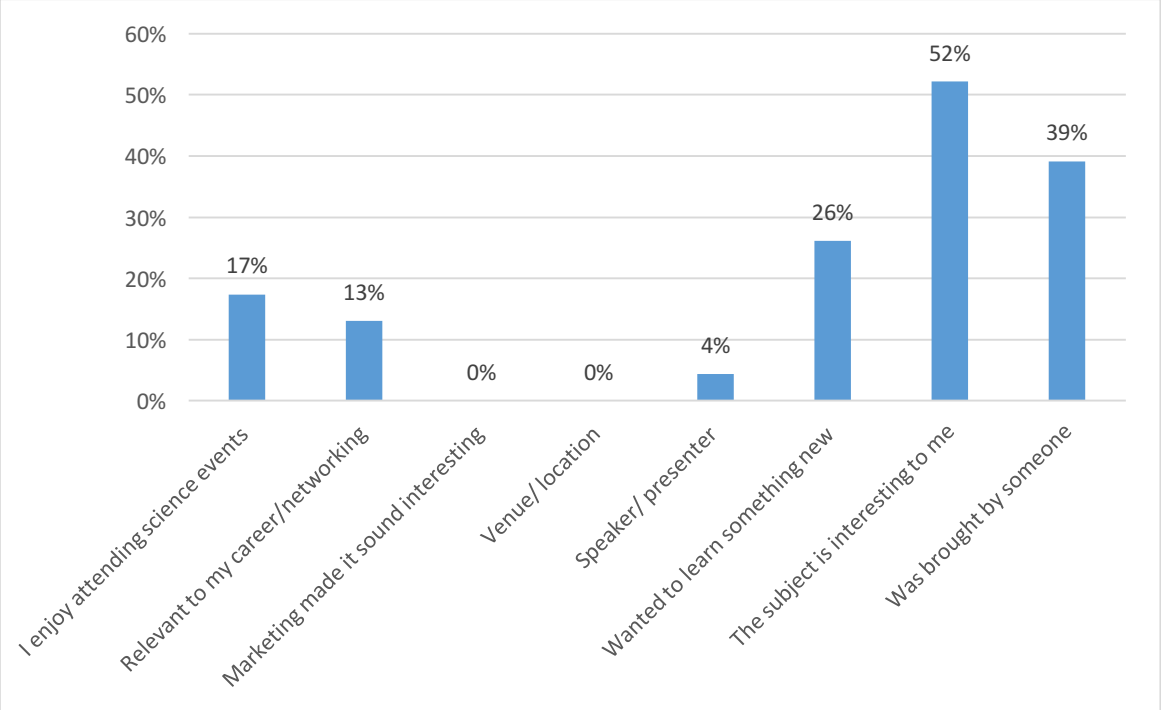
The students sampled were from the following schools:

- ADA National College for Digital Skills
- Beechen Cliff School
- Centre Academy London
- Impington Village College
- ARK King Solomon Academy
- City of Westminster
- The Cooper Company and Coburn School
- Sir Joseph Williamson Mathematical School

- Tunbridge School
- City of London Academy

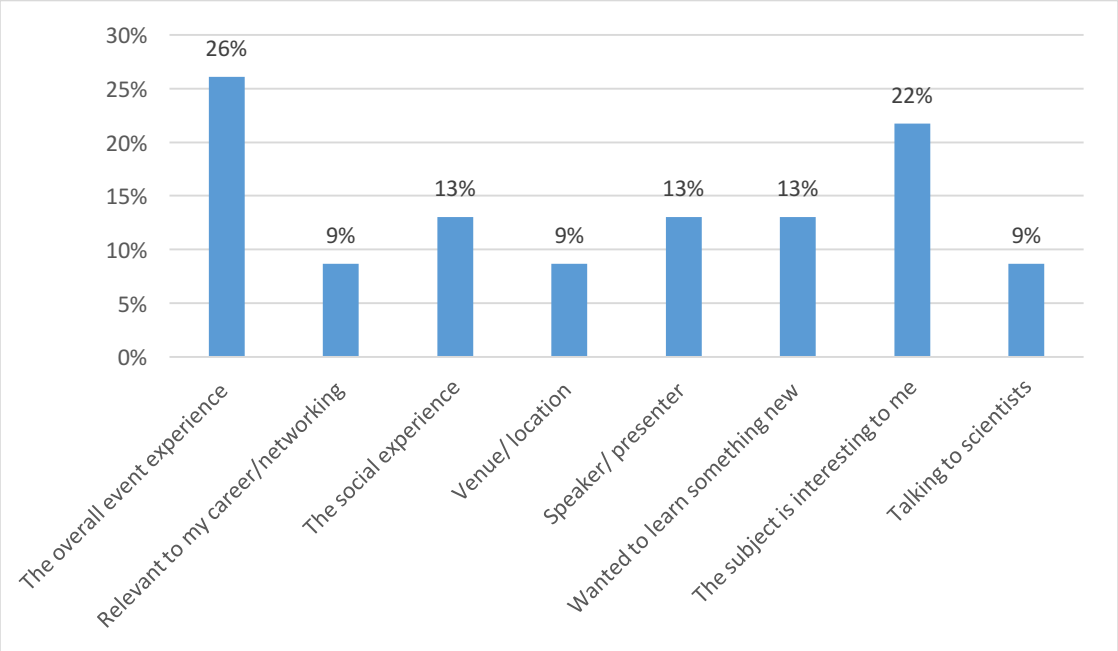
The students were first asked why they were attending, and what they had found interesting. Most students seemed to be taking relevant qualifications and so their teachers had brought them along to further their understanding of the topic. Figure 3 shows the reasons given, with 52% of respondents saying that the topic is interesting to them, and 39% stating that they had been brought by someone (these figures are not mutually exclusive as respondents could choose more than one reason).

Figure 3: Reasons the young people attended the Ri Unconference



Once they were at the event, the young people's responses broadened out, with a variety of reasons chosen for what they had found interesting about the event. The overall event experience was chosen most often (26%), with the subject still being what 22% of respondents found the most interesting, as seen in Figure 4.

Figure 4: Responses given to the question 'what was interesting about the event?'



The young people stated that they had learnt a lot from the Unconference, and thought that more information should be available more widely in the public arena. They stated that they would be far more careful with their online details, and they called for further change as these comments show:

S2: Don't hand out details, strong passwords, don't put info online

S4: Transparency of government - Location of your phone privacy settings - T and C's

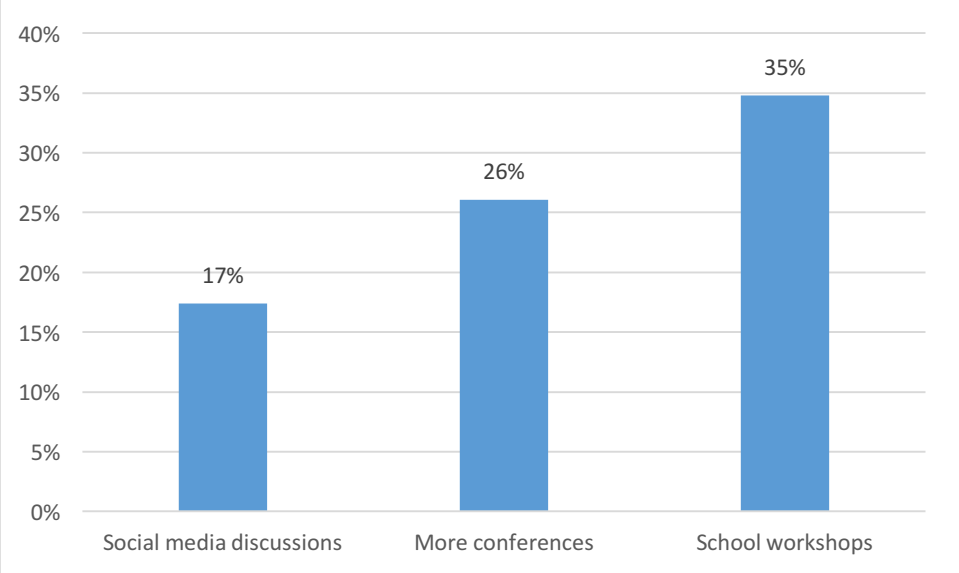
S13: Education for the public is more important than regulation, as it will then feed in

S14: People are educated and become more aware of ways to protect themselves

S20: Universal regulation - Companies not regulated - Policies not keeping up and not going across jurisdictions.

The young people were also asked how the Ri could help them to inform future science policy. They seemed to enjoy the event format, as 26% of respondents stated that more conferences the Unconference could be organised, with representation from industry or Government. However, a further 35% thought that the events should be held in schools, where young people are already based. A further 17% thought that social media would be a good place to host discussions as well. The results can be seen in Figure 5.

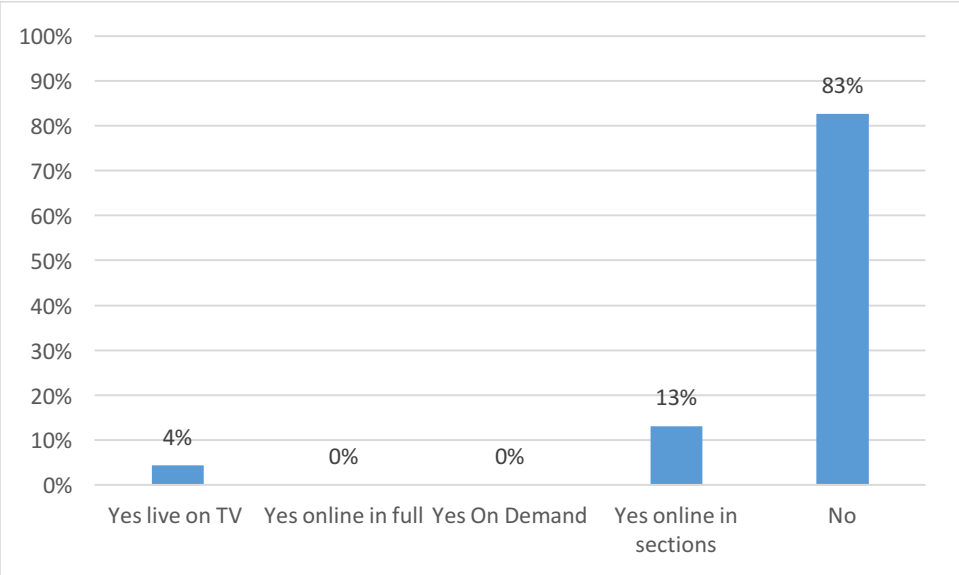
Figure 5: Ideas to help young people inform science policy



3.6. Student interviews and perceptions of the Christmas Lectures

The young people at the Unconference were asked whether they had watched the Christmas Lectures prior to attending the event. Only 17% of respondents had watched the lectures, either live or online before attending, with 83% not having watched them due to not knowing they exist. Figure 6 shows these results in full.

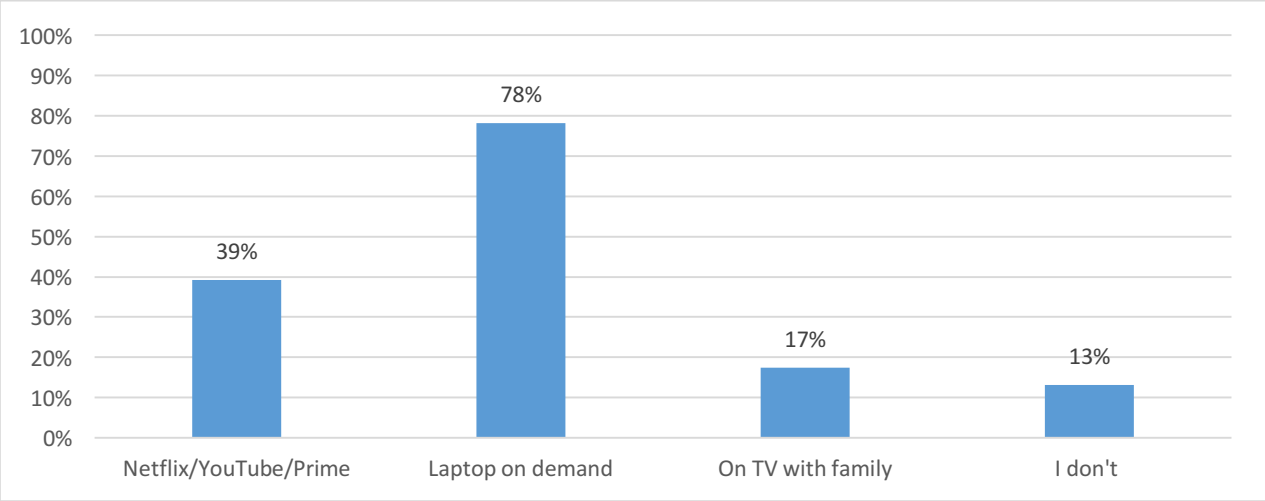
Figure 6: Responses to watching the Christmas Lectures prior to attending the Unconference



The young people who watched the Lectures thought they were good, although there was a mixture of opinions about whether they were too simplified or still too complicated. Some people thought that a jargon buster on the website to accompany the videos would be a good idea.

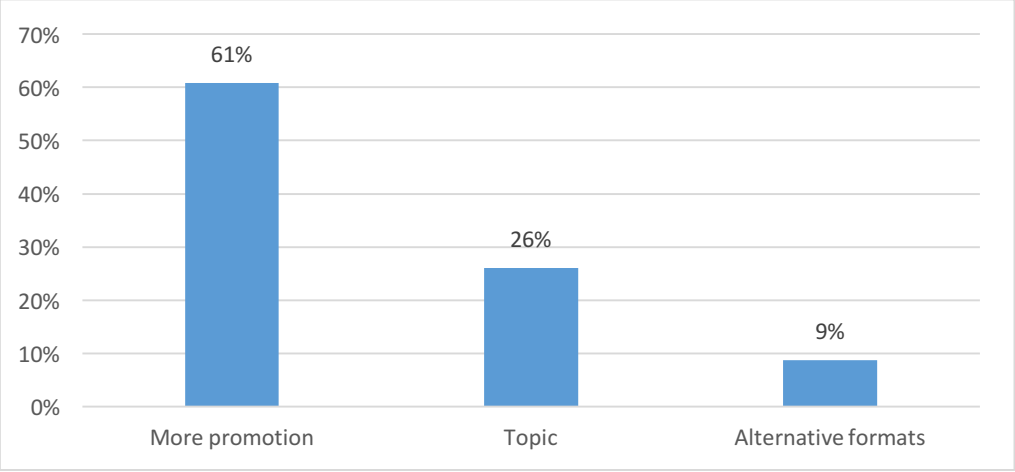
The young people were asked how they normally accessed TV for leisure purposes, and the responses were mixed. Most of the young people questioned rarely watched 'traditional TV' in real-time, and instead 39% watched streaming services, with 78% accessing this and other internet clips on their laptops. This represents a shift in viewing habits and needs to be taken into account when planning future Christmas Lectures, as shown in Figure 7.

Figure 7: Indications of how young people access TV clips



When asked what might help the students watch the Christmas Lectures, 61% said that more promotion was needed. They suggested promoting the Lectures on social media channels that young people access, as well as through YouTube channels that they already watch, or via presenters that they care about. They also suggested posters in schools, or through their teachers suggesting that they should watch it. A further 26% thought that the topic and the presenter was very important, and only 9% thought the format was critical, as seen in Figure 8. However, many did suggest producing clips which could be played on YouTube or social media as well.

Figure 8: Ideas to improve viewing of the Christmas Lectures



4. Reflections and recommendations

The Unconference format appears to be valuable for both students and teachers. Teachers are key gatekeepers to access young people who do not already have high science capital, and are critical to bringing new young audiences to the Ri. This section discusses what worked well about the event and how it could be improved.

4.1. Successes

- **Teachers bringing young people to the Unconference:** most young people came to the event because their teachers recruited them and organised the trip. These connections should therefore be enhanced, with teachers made to feel connected to the Ri, or with trip logistics organised to suit their needs.
- **Expert provocations:** the young people enjoyed hearing from the expert speakers and finding out cutting-edge information. They felt they had learnt a lot and wanted to tell others about what they had found out. The teachers also felt that their intended learning outcomes for the day had been achieved.
- **Young people having an opportunity to speak:** the young people enjoyed speaking to other young people, and some relished the chance to present their findings in front of others. They stated they would like more opportunities to influence societal outcomes or policies.
- **Mentimeter interaction:** the interactive software enabled those who were too shy to speak up a chance to get involved in the voting.
- **Event experience:** Overall, the event ran to time and seemed well organised. The young people enjoyed being in the Ri venue and the chance to connect with experts.

4.2. Challenges

- **Prior preparation time:** the teachers reported that they had not found time to do any pre-preparation work. Many had not connected the event to the Christmas Lectures or to the IAS debate kits.
- **Event timing:** The event was held in 'exam season', which could be a reason why several people who booked on to the event did not turn up. Some teachers also stated that a later start time would help with cheaper travel.
- **School trip costs:** Some teachers mentioned travel costs into Central London as a factor. Also, as the event only allowed 12 pupils per school, this meant that additional teacher cover would be needed for the children remaining in school. Furthermore, many teachers and young people mentioned holding future events in their schools so that they do not need to travel.
- **Organisation of the discussion feedback:** The young people were reluctant to move away from their friends or to self-organise their sessions. More structure may be needed to ensure that they mix up, and to ensure that they reach some final recommendations for the panel.
- **Expert feedback:** The experts wanted to have time to have their say, as well as the young people. Fewer experts on the panel may help with this, as well as the young people agreeing their presentation feedback as a group, rather than individual reflections.

- **Policy recommendations:** The young people's feedback was not captured in any visible way. It might be useful to signpost a tangible outcome for the students to work towards. For instance, get the young people to reach some discussion feedback conclusions which could be given to industry or Government experts in power. These should be presented in summary on the day so that people can see that their feedback is going somewhere. While the official report is very interesting along with the Mentimeter results, these were not presented on the day and we believe these were not emailed to the schools afterwards.
- **Connections to other aspects of Ri outreach:** The teachers and young people were not aware of the other aspects of the Ri outreach work. They were not aware that the Unconference connects to the Christmas Lectures, and they were not encouraged to watch them either beforehand or afterwards.
- **Participation from already engaged students:** Many of the students were from specialist computer colleges or were doing computing as an A-Level. Given that digital privacy (and likely future topics of Ri Unconferences) is something that affects everyone, it is appropriate to attract students with broader interests as well as those with a specific interest in the subject at hand. This creates a conflict with teachers wanting the event to link more closely with the curriculum, which indicates a desire to bring students already specialising in the subjects being discussed.

4.3. Recommendations

- **Keep the event experience the same:** The young people enjoyed visiting the Ri and being able to hear from experts, as well as give their opinions to the speakers.
- **Change the event timing:** In order to encourage more schools to attend the event, the date should be moved outside of exam season. Possibly timing the event for November, June or July could help with this. The event could also be held slightly later in the day to help reach schools attending from outside of inner London.
- **Encourage whole class groups:** More schools may participate if they can attend with their whole class and their 'normal' teacher, as this means they don't need to pay for supply cover. This would also enable preparation to form part of normal class work and would enhance the learning outcomes.
- **Form teacher networks:** To help with promotion of the Christmas Lectures and other activities, relationships with interested teachers should be encouraged. These teachers could be teacher advocates for the Ri, or could act as advisors to decide on event timings and promotions. They could also help to form National Curriculum links to the Christmas Lecture topics, so that more teachers can take part.
- **More structure for the discussion sessions and feedback:** Young people need formalised procedures to get out of their comfort zones and meet people from other schools. The feedback section also lacked clarity, and so a clear task and outcomes might be needed to encourage full participation. This would also enable a clear conclusion to the event with tangible outcomes for policymakers.
- **Consider more opportunities for young people to feed into science policy:** The young people stated that they wanted to give their feedback to people who can make a difference –

either to industry or Government policymakers. They also suggested that connected school workshops could provide opportunities to schools who cannot make it to Central London.

- **More links between all the Ri outreach work:** All the outreach activities could be branded the same, with more cross-promotion between the events. For instance, the IAS debate participants could be encouraged to attend the Unconference, and the Unconference attendees could continue their discussions in the classroom through the Debate Kits. All the participants should be encouraged to watch the Christmas Lectures. The teachers taking part in the activities are the Ri's biggest advocates and could be provided with information packs and marketing materials to promote the activities.
- **Make links between the subject of the Unconference and the Christmas Lectures clearer:** It was clear that the young people were not aware there was a link between the Christmas Lectures and the Unconference. While this seems to stem mostly from not being aware of the Lectures at all, there also seemed to be a slight lack of consistency between the top of the Lectures, which focused on animal and human communication, and the topics of the Debate Kits and the Unconference, which were focused on digital privacy. In order to make the link clearer in future years, more consistency between the topic of the Lectures and associate activities would make them easier to promote as a package.
- **More social media promotion of the Christmas Lectures:** Young people are increasingly watching video materials in different ways to traditional TV. The Christmas Lectures therefore need to be promoted through the channels which young people use, and in ways that they consume media. This could mean providing shorter promotional clips which could be shown on social media and YouTube (on channels which young people follow), in order to link to the Christmas Lectures. Other options would be to edit the Christmas Lectures into smaller chunks which can then be released on streaming platforms.

We hope that this report and its recommendations have been useful. These reflections will feed into the further evaluation of the Christmas Lectures in 2018.

5. Appendix

5.1. Ri Unconference Facilitator guide

"We want to start a conversation with students across the UK debating the topic of privacy, so we have had students taking part across the UK using our Privacy Debate Kit and have organised the Unconference for students across London to take part in a discussion on the wider context of data privacy. A really important part of this is the discussion groups we are organising in the building, where we will encourage the students to discuss their ideas, come to conclusions, summarise and hone their recommendations.

As a facilitator you will help keep event and discussions on track, both in time and topic. You will be supported by a volunteer who will help record the student's ideas throughout the sessions, and generally help with the logistics of managing the groups. Remember, it takes time for people to move about the building!

We have put together a structure in the form of a checklist on the next page: let the students know what the plan is for each session and how long it will last as this will help them guide their own discussions. Ideally we want an interactive and comfortable environment where we ask open questions, stay neutral and help the volunteers record the student's thoughts and recommendations".

12:45 – 13:25 First session: discussion groups of first topics

- Start with 10 minutes Feedback from students (suggestion: when asking the questions in this initial stage, you can get the students to discuss in pairs their answers for a couple of minutes before getting feedback from the whole room)
    - What jumped out at them from the talks? What surprised them?
    - What do they want to discuss?
    - Was there anything that was missed out?
    - Who are the winners and the losers? (opens talk on diversity)
- For the next 20 mins should get the students to be discussing in small groups
    - Work out who is talking about what
    - Suggest movement between tables if appropriate
    - Feed conversations in from other tables (or get students to do it)
    - Volunteers should roam and record students thoughts
- (10 minutes) Check in and summarise points (suggestion: you can ask your volunteer who has been scribing their ideas to contribute some themes to start this off: "So, Bob, you were moving around the room listening to several groups: were there any themes that came out for you?"). Students also need to change rooms in this time if they wish

13:25 – 14:05 Second session: discussion groups of second session – similar format

- Start with 10 minutes Feedback from students
    - What jumped out at them from the talks? What surprised them?
    - What do they want to discuss?
    - Was there anything that was missed out?
    - Who are the winners and the losers? (opens talk on diversity)
- For the next 20 mins should get the students to be discussing in small groups

    - Work out who is talking about what
    - Suggest movement between tables if appropriate
    - Feed conversations in from other tables (or get students to do it)
    - Volunteers should roam and record students thoughts
- (10 minutes) Check in and summarise points, ideally students remain in same room

14:05 – 14:35 Third session: Students consolidate ideas, select presenters and practice

- (5-10 minutes)
    - Students start to bring together some concrete recommendations
    - During this time try to identify 'volunteers' to do the feedback
    - Get students to write up conclusions
- (15 minutes) presenters get together and given some space
    - rehearse and produce any materials
    - hone down to three or so recommendations

  During this time organise the other students (non presenters) to work again in small groups
- 5-10 minutes students move to theatre ready to present

Students all need to be back in theatre and ready to present by 14:35 at the latest!

5.2. Observation Guide

Please use this guide to record as much as possible about the observation. If unobtrusive circulate around the room/venue whilst observing.

General information		
Event name:		
Location:		
Date:	**Time (start observation):**	
Details about participants (institutions, roles, etc.):		
Estimated Audience Number:		
Estimated Male/Female Ratio:		
Average dwell time:		
Audience Type (families, groups of friends, couples, etc. and size of groups, multi-generational, age range?):		
Any general pre-problems (accessibility, logistics, weather, scheduling, technology, etc.)?		
The Activity	**Start Time:**	**End Time:**
Activity type: (presentation, discussion, hands-on, etc.)		

Environment: (lighting, room size and format, technology available etc.)

Participants' engagement

Engagement level:

☐ High engagement

☐ Average engagement

☐ Low engagement

Ease of engagement:

☐ It's easy to engage with the participants

☐ It's neither easy or difficult to engage with the participants

☐ It's difficult to engage with the participants

Interaction between participants:

☐ Participants interact with each other

☐ Participants don't interact with each other

Identify any particularly interesting or challenging issues:

Interaction between visitors and the exhibition:
Annotated agenda (Please describe each part of the day, including notes on all activities, break-out groups, presentations, agenda, etc.)**:**

Diagram of Venue: Please insert a diagram of the venue either before/after the observation here

5.3. Schools Conference Questionnaire for Teachers

Science Communication Unit
University of the West of England
Coldharbour Lane, Bristol
laura.foggrogers@uwe.ac.uk

This project aims to evaluate the RI Christmas Lectures and related events. The project is led by the University of the West of England, Bristol and was funded by the Royal Institution.
You have been invited to take part in this questionnaire as a teacher attending the RI Schools Conference. The questionnaire should take no more than ten minutes to complete. Returning the questionnaire to us indicates that you consent for your answers to be used in the study. Your answers are anonymous and will be grouped thematically with other comments. Data will be stored in locked or password protected methods. Overall outcomes from the evaluation will be published in a report to the Royal Institution and communicated where possible.

This study was given ethics consent on the 20th March 2018 by the Research Ethics Committee of the Faculty of Environment and Technology, chair Alistair Clark, Alistair.clark@uwe.ac.uk.

Thank you for your time.

We are interested in your views as a teacher running this activity within school/college time, and how it links to your students' learning. Please fill in this questionnaire from your own personal viewpoint, but do feel free to represent the opinions you may have heard from other teachers in your school/college as well.

1) **What school/college are you from?**

   _____

2) **What motivated you to take part in this event with your students? A few key words are fine.**

3) This Schools Conference links in with the RI Christmas Lecture programme, which this year focussed on Communication. Did your class watch the Royal Institution Christmas Lectures before attending today?

		Please tick all that apply.
Yes	We encouraged them to watch live on TV over Christmas.	○
	We encouraged them to watch online in their own time.	○
	We watched them in full, in class-time before coming today.	○
	We watched some select clips, in class-time before coming today.	○
No	I did not know the debates were linked to the lectures.	○
	We don't have time within the school day to do this.	○
	I don't think my students would be interested.	○
Other		

4) This question will inform future development of the Christmas Lectures.

a) If you watched the Christmas Lectures, how do you think they could be improved to appeal to a wider audience?

b) If you did not watch the Christmas Lectures, what would encourage you and your class to watch them?

5) The debate topic of Online Privacy forms part of a schools kit developed by 'I'm a Scientist Get Me Out of Here'. Did your class take part in the 'I'm a Scientist' live chats before attending today?

Please tick all that apply.

Yes	We took part in the chats with scientists in class-time.	○
	We ran the debate kit in class-time.	○
	I ran other classroom activities linked to the topic.	○
	I set this as extra-curricular or homework topics.	○
No	I did not get time.	○
	I do not think it is necessary	○
Other		

6) What learning outcomes are you expecting your students to achieve today?

Please tick all that apply.

Help support learning from the Christmas Lectures.	○
Help support learning from the schools' debate kits.	○
Help support learning from the National Curriculum.	○
Provide online knowledge that will be important and relevant for students in their future lives.	○
Develop confidence and presentation skills.	○

Other:

7) What advantages do you think a live event like this has over watching the Christmas Lectures at home or in class-time?

8) What advantages do you think watching the Christmas Lectures on TV has over live events like this?

9) Finally, please let us know any other ways you feel the RI Christmas Lectures programme could support learning in schools/colleges.

Thank you for your time.

5.4. Interview Script: RI Christmas Lectures Evaluation

We would like to invite you to take part in a short interview/questionnaire of around 5 minutes. The research will be used to improve events like this by understanding what audiences are looking for. All the information you give is anonymous, we will not record your name or anything that could identify you, and your views are grouped with other participants.

This information will be stored securely in accordance with the terms and conditions of the 2018 GDPR.

By participating in the interview you are giving the University of the West of England and the RI consent to use this information in the research.

If you would like to take part then please continue.

Participant No:_____ Date of interview: Location of interview:

1. **What made you come to this event today?**
   Circle any that the interviewee mentions……

I enjoy attending science events	Relevant to my career/networking	Marketing made it sound interesting	Venue/ location	Speaker/ presenter
Wanted to learn something new	The subject is interesting to me	Was brought by someone		

Other:

---

2. **What (if anything) did you find interesting about this event?**
   Circle any that the interviewee mentions……

The overall event experience	Relevant to my career/networking	The social experience	Venue/ location	Speaker/ presenter
Wanted to learn something new	The subject is interesting to me	Talking to scientists		

3. **What would be your main suggestion for online privacy after this event?**

---

4. **Do you have any suggestions for how the Royal Institution can help young people inform wider science policy?**

---

5. **This Schools Conference links in with the RI Christmas Lecture programme, which this year focussed on Communication. Did you watch the Royal Institution Christmas Lectures before attending today?**
   Circle any that the interviewee mentions……

Yes live on TV	*Yes online in full*	No – why?	
Yes On Demand	*Yes online in sections*		

6. **This question will inform future development of the Christmas Lectures.**

   a) If you watched the Christmas Lectures, how do you think they could be improved to appeal to a wider audience?

---

   b) Please tell us about how you usually watch TV/videos?

---

c) **If you did not watch the Christmas Lectures, what would encourage you and your class to watch them?**

_____

The final questions are about you.

7. **What school or college do you go to?**

8. **Gender** □ Male □ Female □ Transgender □ Prefer not to say

9. **How old are you?** *Tick one….* □ 16-19 □ 20-24 □ 25-29

10. **Which ethnicities do you identify with?**

The Royal Institution aims to create programmes that are non-discriminatory and accessible to all. This question helps us to assess this.

White (British, Irish, etc.)	□	Black/Black British (African, Caribbean, etc.)	□	Asian/Asian British (Indian, Pakistani, Bangladeshi, etc.)	□
Mixed (White & Black Caribbean, White & Asian, etc.)	□	Other, please specify	□	Prefer not to say	□

Interim Report n3

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Contents

Summary

This interim report details some of the findings of the evaluation of the filming of the Royal Institution (Ri) Christmas Lectures, "Who am I?". The filming was spread across three days (11th, 13th and 15th December 2018) and it took place at the Ri London headquarters on Albemarle Street. In total, 863 young people and 330 adults took part. It also details the key findings of the evaluation of the live broadcasts of the 2018 Royal Institution's Christmas Lectures, in several science centres across the UK. Every year, the Christmas Lectures are performed to a live audience within the Royal Institution (Ri). The lectures are filmed and then typically, in their current format, edited to 3 hour-long programmes to be broadcast at a later date on the television, currently on BBC FOUR.

For the first time, in 2018, the Ri supported the ability to live-stream the lectures as they were being recorded. This extended the ability to experience the lectures live to an audience beyond those physically present in the auditorium.

Dr Hannah Little, Dr Margarida Sardo and Dr Laura Fogg-Rogers, from the Science Communication Unit at the University of the West of England, Bristol, undertook the evaluation and prepared the report.

This short evaluation focuses on the live audiences' engagement with the activities and the live broadcast of the Christmas Lectures at selected science centres. The evaluation also focuses on the strategies that each venue used to organise the event and perceptions of how the specifics of the individual events impacted on the experience of visitors. It also explores perceptions of the lectures themselves, and how they were experienced by the audience watching the live-stream in external venues. The report includes the complete evaluation kit in the Appendices.

1. Introduction

1.1. The Royal Institution Christmas Lectures

> *The Christmas Lectures are engaging and mind-expanding television programmes for all ages but particularly children and young adults.* (Ri website)

The Royal Institution Christmas Lectures are a lecture series intended for a general audience that are given on a single topic each year. The Christmas Lectures are an internationally known landmark of the Science Communication landscape. Physicist Michael Faraday initiated this series that has run since 1825 without interruption, except during the World War II. The lectures were first broadcast on television in 1936, and have been on television every year since 1966.

The event takes place every year in mid-December at the Ri headquarters, and is held in the Faraday Lecture Theatre which can seat 413 guests: 296 seats downstairs (for children) and 110 seats upstairs (for adults). The Lectures are then broadcast on BBC FOUR immediately after Christmas. This means that historically, before they were broadcast on television, only a very small number of people were able to witness the lectures. However, as more people came to own televisions, and as technology has developed to allow for video hosting on the internet, there has been increasing opportunities to make the lectures available to more people. This availability and accessibility has grown both by increasing who has the means to access the lectures, but also the flexibility in how and when they are able to be accessed.

Figure 1. Professor Alice Roberts and Professor Aoife McLysaght presenting the 2018 Christmas Lectures.

In 2018, the topic was "Who am I?" with Christmas lecturer Professor Alice Roberts and Genetics Society guest lecturer Professor Aoife McLysaght. Alice Roberts is a biological anthropologist, author, broadcaster and a professor of Public Engagement in Science at the University of Birmingham. Aoife McLysaght is a geneticist and Head of the Genetics Department at Trinity College Dublin. It was the first time the Lectures were presented by a lecturer and a guest lecturer.

1.2. Filming

The Christmas Lectures are a series of three lectures on a single topic each, each broadcast on different days. The Lectures are broadcast on BBC FOUR at 8pm on three consecutive days. The filming is split in three parts as well, and spread across three days (Table I).

Table I. List of Lectures and details.

Title	Filmed on	Broadcast on
Part 1. Where do I Come From?	11th December 2018	26th December 2018
Part 2: What Makes Me Human?	13th December 2018	27th December 2018
Part 3: What Makes Me, Me?	15th December 2018	28th December 2018

Figure 2. Interaction with the audience during the Lecture What Makes Me, Me? (Part 3).

While it is important that the lectures be accessible to as many people as possible, it is also true that the experience of seeing the lectures live is a markedly different experience than seeing the lectures on the television. Live events can offer increased interaction and interactivity and offer a bigger, more memorable experience. The Ri know this is true, and so have implemented several initiatives over the last few years to offer this live experience to individuals. These efforts have included the roll out of live shows based on the Christmas Lectures to events like the Big Bang Fair in the UK (evaluation of the 2018 event is covered in Sardo, 2018), as well as shows internationally in Singapore and Japan.

To supplement these existing efforts, in 2018, for the first time, the Ri live streamed the Christmas Lectures as they were being recorded to several venues across the UK. This live stream created a new audience who were able to experience the lectures live beyond those physically present in the Ri.

1.3. Live Streaming the Christmas Lectures

Five venues broadcast the livestream of the lectures in 2018. The opportunity to stream the lectures was limited, as this was the first year that this service was available to institutions outside of the Ri. These venues were selected by the Ri to have a good geographical spread, though some venues were chosen based on existing ties with the Ri, making organisation easier.

The participating venues who hosted the lectures, and the lectures they hosted, are as described on Table II.

The Ri provided the live stream, but gave the controls of how to run the event over to the venues themselves. As such the live-stream events feature a diverse range of approaches towards marketing, ticketing and the running of the event.

No one from the Ri was present at these events. However, Dr Hannah Little, from the Science Communication Unit at the University of the West of England, undertook an evaluation to assess these events. In order to evaluate approaches used by each venue, we conducted a series of semi-structured interviews with staff from the venues after the events had taken place. These interviews asked questions about the running of the events, the experience of visitors and perceptions of the lectures themselves.

Table II. List of live broadcasts and details.

Science Centre	Lecture	Live broadcast	Format
The Science and Industry Museum, Manchester	Part 1. Where do I Come From?	11th December 2018	(unable to contact MOSI)
Cambridge Science Centre, Cambridge	Part 2: What Makes Me Human?	13th December 2018	£1 on top of entrance to fee to centre. Tickets sold on eventbrite (46 tickets sold, 30 showed up, seating for 50). No additional activities but people were allowed to interact with exhibits and they had alcohol, soft drinks, mince pies.
University of Central Lancashire, Preston	Part 2: What Makes Me Human?	13th December 2018	Ticketed but no charge (120 tickets sold, 54 showed up, capacity 450). No additional activities.
W5, Belfast	Part 3: What Makes Me, Me?	15th December 2018	Not tickets (3 showed up, capacity 200). No additional activities.
Imperial College, London	Part 3: What Makes Me, Me?	15th December 2018	Ticketed but no charge (62 showed up, seating for 80). In house researcher present to give additional information and run experiment boxes with attendees.

2. Evaluation methodology

This section outlines the methodology used to generate the data. A variety of methods were selected, tailored to the specific event and aiming to capture the experiences of the participants involved. The evaluation methodology received ethical approval from the University of the West of England, Bristol.

Methods were restricted by time and staff constraints. As the live-streaming events were happening at the same time as the lectures were being performed at the Ri, our evaluators could not attend both events and so we opted to use post-event interviews with staff who were present at the live-stream events. Please note that this interim report analysis and discusses some of the evaluation data. The remaining data will be presented and analysed as part of the final evaluation report.

The evaluation *aimed* to evaluate the filming and the live-streaming events associated with the Christmas Lectures to explore what worked well and what the organisers would change if they were to run similar events in the future, as well as what the Ri might change in order to maximize the success and impact of similar events.

The *objectives* were to assess:

- Perceptions of young people: reactions to the filming, views on the Christmas Lecture series etc.
- The organisation and running of live-streaming events: practical problems occurring during the organisation or the event itself.

2.1. Observations

Observation permits an evaluator to contextualise other research data, become aware of subtle or routine aspects of a process and gather more of a sense of an activity as a whole. The evaluators attended the three filming days and used a standard observation guide to gather data as efficiently as possible, which was used in the main Lecture Theatre.

The evaluators sat in unobtrusive locations and recorded data such as audience size and composition, audience reactions and environmental data. Every filming session was observed in its entirety. The observers made detailed notes during each session, supplemented by additional reflections immediately afterwards. In total, three observations were made throughout the Christmas Lectures filming.

A copy of the observation schedule can be found in Appendix I.

2.2. Feedback cards

For each of the three live lectures, the evaluators also used an autonomous tool, feedback cards, which did not disrupt the flow of the event. The cards had the following instructions:

> "**What do you think of the Christmas Lectures?**
> After the event, please write three words that best describe your experience today
> (feel free to leave longer comments if you wish!)"

Members of the audience were encouraged to add their thoughts and suggestions and post the cards in a strategically located box. Cards were placed under all the seats before the audience arrived and they were made aware of the cards during the introduction and housekeeping. The audience was reminded about providing feedback on the cards at the end of the event, before exiting the Lecture Theatre. After each lecture, staff also recovered cards that had been left behind in the lecture theatre and saved those that had feedback included on them.

Across the three filming days, 863 cards were distributed. A total of 257 cards (29.8% return rate) was filled in by the audience, both containing individual feedback words and longer comments.

A copy of the feedback card can be found in Appendix II.

2.3. Semi-structured interviews

Semi-structured interviews were conducted over the telephone or through Skype with relevant staff from Science Centres. They were asked to provide both formal and informal feedback of their impressions of the event. All interviews were conducted within one week of the relevant event taking place, on the 18 and 19th December 2018. Contact details for the organisers of each event were acquired from the Royal Institution. All venues were approached for interview and interviews were carried out for all venues who responded to this request (4 out of the initial 5). Five interviews were conducted in total (two for the same venue). The questions assessed how the event was organised and set up, the motivations for hosting the event and audience response. Informed consent for recording interviews was acquired by email before each interview and also established verbally before each interview. The interviews were transcribed in full and analysed for common themes.

A copy of the interview schedule can be found in Appendix III.

2.4. Additional Data

In some places, marketing materials for the events was found online to supplement knowledge of how each event was marketed and ticketed.

3. Findings

The findings described below are drawn from the observation records, feedback cards and interviews with Science Centres.

3.1. Christmas Lectures Filming

3.1.1. Audience and attendance

The Ri reported that the lectures sold out every night except the first, when they had 25 spare seats downstairs. This means that, across the three days, a total of 863 young people (aged 8 – 18) and 330 adults attended the event. Of the young people who attended, around 50% appeared to be female, and only a very small number appeared to be from a Black and Minority Ethnic background. This was the case across the tree filming days.

During Lecture 2, the audience was asked if they have attended a science show before and around ¾ responded they did. Around 1/5 stated they had attended a TV show filming before.

3.1.2. Observation data

The filming ran largely as planned. The speakers came across as knowledgeable, relaxed, enthusiastic, confident, energetic and well-prepared. They were dressed casually, which was appropriate for the venue and audience. Guests were also knowledgeable, friendly and enthusiastic.

Across the three filming days, high levels of participants' engagement were observed and that level remained high well into 2/3 of the lecture. It was easy to engage audience members with the lectures, they were keen to participate and enthusiastically volunteered whenever there was a call for volunteers. Towards the end of the three filming sessions, some audience members seemed restless and started to yawn. However, this may be due to concentration limits rather than any other reasons. During the third and last filming session (Lecture 3) there was a substantial amount of repetition at the start of the filming to get shots that were missing from previous lectures, which caused the audience to be slightly restless. This is to be expected and difficult to avoid.

The interaction between the volunteers and the presenters was very positive and nice. The presenters were made to feel comfortable and it was clearly explained what was expected from them, which meant the demonstrations ran smoothly.

3.1.3. Feedback cards

Of the 257 cards received, the vast majority of words listed were very positive. In the table below are the words that appeared more than 10 times on the cards. More than a third of respondents wrote "interesting" and "fun".

Word	Frequency
Interesting	95
Fun	94
Amazing	52
Exciting	39
Interactive	25
Fascinating	25
Educational	23
Informative	20
Inspiring	19
Funny	18
Cool	16
Good	16
Enjoyable	13
Awesome	12

Of the 257 cards, 254 were at least partially positive. Where feedback was less positive or raised suggested improvements, we have collected them under themes below.

- **Audience Participation**

A lot of the comments centred around audience participation. As well as "interactive" being the 5th most used word on the feedback cards, some audience members left longer positive comments about the amount or interaction with the audience:

"I liked how they got the children who were there involved and had volunteers."

"There were lots of interactive parts where people came down from the audience (lots of demonstrations)."

"Amazing experience, which was greatly enjoyable and super interactive."

However, others felt there could have been more interaction or more volunteers:

"I would have liked more practical demonstrations involving the audience but overall an excellent lecture."

"It was really informative but have more interactions with the audience."

"Not enough science, more flashy demonstrations would be preferable."

"It would be nice if there were more opportunities to go on stage."

"A few more volunteers."

"Didn't get picked"

"We did not get filmed."

A lot of these comments stem perhaps from a more personal perspective (not getting chosen to go on stage) rather than as a global perspective on the amount of participation.

- **Audience Design**

Some longer comments focused on perceptions that the lectures were not appropriate for older audiences:

"A little bit young for me (age 16), however still enjoyable."

"Almost as if aimed at 6-10 year olds. Lecturers have no emotion/enthusiasm. Interesting ending but still childish. Would be good, but advertise for 8-12 year olds, not for year 10 and above."

"I felt like it pandered to the younger people in primary school and year 7 than to those older than 12/13."

"For younger audiences"

"A bit too childish."

- **Wider awareness of the Christmas Lectures**

Some longer comments mentioned the bigger tradition of the Christmas Lectures and feeling excited to be a part of that:

"It was amazing. I had wanted to watch it in person for years."

"My step-dad has always wanted to come here, it is a childhood dream he had. Thanks, it was the second best day of my life, thanks."

- **Presenters**

There were positive comments about the presenters:

"One of my favourite people to watch."

"The two lecturers were both good."

"Alice and Aoife were really interesting. The opening man was great too."

> "I think it was a beautiful performance. They communicated and worked with the audience. Good at expressing emotion."

- **Other Comments**

There was also a small piece of specific feedback about the choir segment in lecture 3:

> "When you say celebrate diversity please don't immediately bring on a group of people that are all the same race. Good choir though, a less cringe worthy song would be better though."

3.2. Christmas Lectures live-stream

3.2.1. Motivations for hosting the streaming events

Venues reported various motivations for wanting to host the streaming events. It was clear across venues though that much of the instigation had come from the Ri offering the live-streaming as an opportunity. One venue noted:

> "I don't think we'd sought to do anything like this before, it was knowing the opportunity was available and then saying, we want that."

Some venues highlighted that they felt the event would be a draw for visitors with an existing interest in the Ri or similar science events:

> "An extra opportunity to bring people to [our venue] that you know, would be interested in the Royal Institution that they may not have come across [our venue] and its work before, so I suppose there was an interest that it would attract more interest that way.

> "From our widening participation and access, we generally have a commitment to opening access to higher education, and we've a strong commitment to STEM subjects, so we also host the [local] Science Festival, so we thought it would be similar audiences that would be interested. So it just fit with our overall aims I suppose."

> "[We] thought it would attract more visitor numbers."

Another noted that the lectures may create awareness of their venue:

> "[Our] motivation was to spread awareness of our venue and also spread awareness of the Christmas lectures."

Another motivator was the idea that this was a special event and the first of its kind:

"We felt it was kind of nice as this was the first time the Royal Institution had tried this, so it was a really special opportunity and it was a nice message to share with the relationships that we've made with community groups."

"We felt that because it was close to Christmas as well, we'd tie it in with mince pies and make it feel fun and special."

Other motivators were specific to venues. For example, one venue were keen to try out facilities that may not otherwise be used:

"I would say that the rest of the team were also quite keen to run an event at our Invention room that has only just opened. We'd done some events in there in the past but this seemed like a really good opportunity to try something new out in our new facility.

3.2.2. Organisation

Venues were sent information before the events explaining how to access the stream, as well as a script of the lecture they would be streaming. Nearly every venue stated that the stream was very well explained and easy to access:

"I think the access to the stream was really, really easy from our end, so knowing that I didn't have to set up anything too technical and didn't have to set up anything last minute was good."

"It was a simple process, the stream worked well otherwise so I would say the simplicity of it worked well."

"I think it was streamed very well, it was very clear."

"The information that we got beforehand I thought was clear, so having the holding slide and access to the link and the timing of everything was clear."

There was one venue who noted that they hadn't been provided with a test screening, but still noted that the stream had worked fine:

"So we had initially been told that we would have a test stream a day before. We weren't given a test stream. We were basically just told to go try out on a, like a live stream of YouTube so it was fine but I knew our university connection would work. You know we've streamed things before in lecture theatres and both ways."

There was a suggestion to make it clearer when the live stream would start:

"I don't know if there could be a countdown done via the stream or something that that and then we all knew definitely when we were gonna go live"

Some venues used the information in the script to influence the design of their event while others did not. One venue used the script to organise the activities that went alongside, including getting in voting cards so their audience could play along with voting happening in the Royal Institution. However, using the script caused some problems as this changed quite close to the event:

> "We had planned to do some experiment boxes for the gaps and we based it on a draft script and then all of the demos changed and all those demos that we'd planned to link to came out. So we got a new script the week before and again, we were like, oh never mind, that's fine, we won't do those other ones, we'll try and find some more with a week's notice"

> "I think it would have been good if the RI could have sent us a brief and suggested some activities because we were working just with the script and then the script changed quite late on. We had one version of the script for quite a while and then on the Monday or the Tuesday, I think it was, the script had changed again, so we had to work quite quickly."

Another venue simply used the script to establish timings:

> "I went through [the script] to see if there were timings or if there was going to be a break, so from the script I was pretty certain there wasn't going to be anything unexpected cropping up. Once it was going, the girls were going to get on with the lecture, and there might be re-takes as and when needed, but I didn't really take too much from the script."

Outside of the information given in the script, there was some confusion about the timings of the live-screening and venues felt more information would have been useful:

> "We didn't know how long it would be until the next demonstration so it made it very difficult to leave for comfort breaks or anything like that, but I don't think we were maybe – we weren't given necessarily the same warning as people in the studio might have been given."

> "[Someone contacted us] who had a slightly different understanding of what was going to be delivered and at what time. He said about there maybe being a warm-up act and someone else mentioned there might be a break in the middle. I thought, I'm pretty sure this isn't happening, but at the last minute there were a couple of other things that were thrown in."

> "If there were to be other directions, like having a break, or knowing that Dan was going to do certain bits as and when, or when there might be demos that might be more controversial, that could have been quite handy to know. I know that with the paper aeroplanes in lecture two, obviously that took a lot more clearing up and so people sat there waiting for the clear-up before things carried on, so it would have been nice to know that was a nice break if you needed to pop to the toilet."

> "I turned it on at half past 'cause it was when we could get in the venue but then for the first 10 minutes, there was no audio. They said they'd play music. For the first 10 minutes there was no audio so our audio hadn't started by the time audiences – like by the time I wanted to start letting people in and it wasn't entirely clear when it would start. And then I was also quite

concerned the music seemed quite loud but then I didn't have any indication of kind of what noise levels were going to be like when it started and I was quite concerned that I didn't want people to walk into loud music."

As well as confusion over timings, there were also some errors sent to venues in relation to the events:

"I also got emails for events saying it was the wrong day, for example they said, good luck for Thursday, and I thought, I know it's on Saturday."

There was some feedback that communications with the Ri were difficult:

"We got contacted by different people at the Ri at different points with no introduction. So I'd got a press person trying to contact me, it was like a few different people contacting me from the RI and they probably found it similarly confusing because actually we had quite a few people. I introduced their technical person there to my technical person, but they kept contacting me about technical issues, so a problem for me was they were sending the link for the live recording, and they had to send it last minute for whatever reason, and they sent it to me and I wasn't working. So I'd introduced them to my technical person but somehow in the ether of all these different people, that got lost."

However, there was also positive feedback on the clarity of communications from the Ri:

"The communications from Kate and Dominic were great, they were all really clear and spot on, but I had a couple of other things later on that threw me off a bit, but I don't think that was from the organising team. I think the organising team were great and like I said, the ease of the access to the link, knowing that was coming that morning and that it was going to go live on its own, that was really handy."

One venue mentioned it might have been useful to have one briefing-sheet, rather than have all information on multiple emails:

"Everything was done on email, what we really needed was a bit of a briefing sheet, this is the way it's going to work, this is what is going to happen, this is the way it's going to happen. Just the one page saying these are the contacts at the Ri, this is what we're expecting, with like a press release around about this date, you're not going to get the link until this point. There was nothing co-ordinated or organised like that. If we run an event here, we've got an event briefing sheet that we hand around to everybody involved, it's got all the key data on it. That came in email and flung from different people and we're uber busy in here at the moment, and so that was quite difficult for us to piece all these little bits together."

Another mentioned that the event would run more smoothly in future with the experience of this year:

"I think knowing now the format and the information that we had, once it was happening, saying how it was going to go down, I think running it next time will be much easier, on our part, because we hadn't done anything like that before."

3.2.3. Ticketing

The venues took a diverse approach to ticketing ranging from changing for tickets, to free tickets, to no tickets at all.

One venue, a science centre, charged the audience the normal price to enter the centre and engage with their exhibits with an additional £1 added to watch the live-stream of the lecture. They ticketed through Eventbrite. They sold 46 tickets this way, but 16 attendees did not turn up.

Another venue didn't charge people anything to attend as they saw the event as part of their family programme which has a strong emphasis on widening participation and charging entrance might create an access issue for some families. They also mentioned that their venue does not have many ticketed events, and so they did not have the infrastructure set up to sell tickets and so decided that the admin involved in setting this up would not be worth the extra effort, or worth the money if they'd used an external ticketing service (like Eventbrite) who would have charged a percentage of ticket sales. The venue also mentioned the fact that they were not offering additional activities alongside the lecture, and so thought that it would not be fair to charge money, stating:

> "I wouldn't want to charge for tickets for what audience came for. I think we'd have had a disappointed audience if we'd charged for tickets for it."

However, they did ask people to pre-register their attendance (essentially as free tickets) through Eventbrite in order to get a good idea of how many people to expect on the evening.

Another venue also saw the lectures as part of their widening participation programming and so did a ballot for local residents who were entered into a ballot to receive tickets if they were in a specific postcode. They marketed this through a community newsletter and through some youth services. They also had a different event taking place at their venue that day, so some young people from that event were invited to stay for the livestream.

One venue didn't use tickets at all, or charge for entrance. This was the venue who had perhaps the most problems with attendance, with only 3 attendees.

3.2.4. Marketing

Each venue managed their own marketing using the connections they had. This was done through venue-based mailing lists and calendars, community newsletters, social media, local press and word of mouth. Some venues noted the relationship between where the event had been organised and the audience they got in. One venue, that had an audience of older adults (40+) explained:

> "It went out via our university "what's on" calendar so kind of retired, interested parties I suppose and some university staff."

Another venue noted that using venue-based mailing lists brings in those already with a strong interest in similar events:

> "We have quite a big audience through our science festival and that reaches various things but there wasn't an effort to target kind of an underserved audience I suppose."

The venue with very little attendance (3 attendees) advertised the event on their website and advertised it though Facebook and Twitter. They also advertised it at the ticket desk when people were coming into the science centre. However, they noted that they had given very little explanation of exactly what the event was, as they themselves didn't know what to expect. Other venues had more success with marketing, but still felt like they could have done more to sell tickets:

> "We'd push it more and try and advertise it further but I suppose you always feel like you can do more marketing, more media, that way. It got picked up by some of the local newspapers and things through the press release which we think definitely drove registrations."

Other issues with marketing came internally. One venue had prepared a press release but had some issues knowing where it had gone due to a change in their marketing manager the week before the event:

> "It was more of an issue our end, but it was difficult to chase it up and see where [the press releases] had gone, so next time it would be nice to know exactly where those releases were taken, how we could market it better and how we could sell more tickets to the right kind of people. "

3.2.5. Attendance

Nearly every venue had problems with attendance at their events, though this ranged in its severity. One venue, was not used to hosting screening events and so kept seating limited, as they were unsure about their capacity:

> "We had not done an event like this before and we didn't know what our seating capacity would be, so we had it quite low, and rather frustratingly, we had a lot of people purchase tickets but then they didn't turn up. Almost a third of ticket sales didn't show, which was quite frustrating because we only had a small capacity compared to the other venues, so it's good to know for next time to oversell a bit more or have stricter requirements on the tickets"

16 out of 46 tickets did not turn up and the venue set out around 50 seats, meaning around 20 seats were left empty. This venue had also put a price on tickets, so this was not simply the normal short-fall that you would expect from a free event. When asked why they thought so many people had not turned up, the venue remarked:

> "I don't know whether it was a timing thing or whether it was the time of year, so maybe people had a bit more on. The people that didn't turn up were a mixture of both families, individual adults, groups of adults, so it was a real mix, and it wasn't as if there was one group of audience

> ticket types that didn't come, it was a mixture across the board, so I'm not quite sure what the reason behind it would have been. The only thing I can think of is the time of year and people coming down with illnesses or other commitments cropping up."

Another venue also noted that the time was not great for family attendance:

> "6 o'clock isn't the ideal time for – I suppose if it's a family audience, it is but for the audience we attracted. Even for a family audience on a weekday evening putting anything at 5.30 is difficult for people to travel out to I would say so you know, we couldn't go earlier than 6."

Another venue, who did not charge for tickets, had space for 450 people but had a comparatively low turnout:

> "We didn't have an unexpectedly large turnout. I want to say maybe 60. I think the actual count was 54 and we had I think about 120 pre-register and we do for those free events, we typically get a 50 percent drop off."

One venue, had a big problem with attendance with only 3 people attending in a lecture theatre that seats two hundred people, and those who did attend left after about 15 minutes. They also thought this maybe have also been down to the timing of the lecture:

> "We're a science and discovery centre for children so while people are clearly interested and would have been interested in coming, I just feel that at 4 o'clock on a Saturday evening, people were not going to – you know people were kind of finishing up for the day. People weren't going to come and sit for two hours, especially people with children."

3.2.5. Additional Activities

Venues put on varying amounts of things extra to the streaming, this includes extra entertainment in the form additional speakers, activities and exhibitions as well as refreshments. The ability to recourse to things other than the lectures proved important when there were pauses and resets within the Ri, and so in this section is a summary of the additional activities the venues put on, as well as suggestions for engagement both within venues and from the Ri.

Additional Activities within the Science Centres

A couple of venues offered basic refreshments to purchase including alcohol, soft drinks and mince pies.

One venue had provided extra entertainment in the form of an additional speaker, who is a scientist, in the venue to give extra information during down-time and answer questions during and after the event, as well as activities on the tables in the form of "experiment boxes". The venue noted that they felt this extra entertainment was very much needed:

> "I think having one of our researchers in the space to fill those awkward gaps for us was really good. Definitely having something to do in the physical space, like our little demo boxes, that

was like a bit of conduit in the space and that worked well. People stayed behind afterwards to talk to our researcher, so that was good."

Other venues did not put on additional activities, though one venue allowed the audience to explore their existing exhibits. This was possible as the space used for the screening was the space that they typically use for activities additional to the permanent exhibitions. However, other venues hosted the screenings very much in a space separate from their exhibitions and did not have additional activities, but felt that it would be beneficial to do with if they were to host a live-stream again:

> "We did think about whether we would put on like additional activities around it. Due to the timescale and kind of staffing resource this time, we didn't do that but that might be something we'd consider in the future."

> "I think it would be interesting if we're able to offer more either whether that be something hands on in actually the Young Scientist centre that was right next door, kind of a little hands on demonstration that way so then we could I think that would be something that would attract a more varied family audience if there was a lecture and a like a hands-on activity suitable for families."

> "[Extra entertainment was needed] because of how many resets there were and it was a little bit dry in places, so it was a struggle. People stayed, only a couple of people left but you definitely needed something for those who stayed."

One venue suggested a nice activity may be trying to replicate some of the experiments from the lectures live in the live-streaming venues or have some ongoing activity as the lecture progresses:

> "Maybe some of the hands-on activities in the main lecture could be replicated at our venues."

> "There could be one activity you could do throughout and build something throughout, or just more activities that worked directly with what Alice or whoever was doing."

Other venues felt that they would host extra activities if they had more information about the timings of the lectures:

> "I think for us we would like to consider putting on – I think if we knew how long those timing gaps were going to be in a more accurate timing, we could work on either putting something before or after, like maybe followed up by a relevant presentation from somebody here or a discussion panel you know 'cause we could have somebody here but then we couldn't do anything about the timing of it –

One venue noted it was helpful to see what other venues were doing for their live streaming:

> "It was quite nice to know what the other venues were doing. I could see what the Science and Industry Museum in Manchester had planned, because I could see their event listing and it said they were going to have carol singer and mince pies, etc., so it was nice to see the plans in

other places as well. Maybe next time, we could have communicated more with other venues to try and run something that was more aligned. It was nice that we were independent but if there were other things, like we were all going to do mince pies or we were going to have this or that, that would have been nice."

Engagement with External Venues from the Ri

Several venues noted that more could have been done to engage the people in the live-streaming venues from within the Ri:

> "There was a moment when it suddenly started streaming but there wasn't a welcome and now we're streaming out to these other centres. It was just kind of in the middle of a previous conversation – we saw kind of a bit of a middle conversation of something that had just happened with the audience and then he introduced the centres so yes, it was interesting that they were looking into it but I don't feel like there was a level of inclusion that there could have been."

> "I think if the compare guy could make more of a two-way connection between the live lecture and the satellite venues, that could work really well. I think that would be something to look into next year, maybe."

> "I suppose what it came down to for us… is that there was no two-way interaction really apart from occasionally saying hello out."

> "You know how the audience had to vote? You could include all of the satellites in that vote. We still had that within the script, so we just had little voting cards in the room, but if there was a compare who could say, are you all voting out there and have you got your cards? So our researchers did that in the room, it was like, hold your cards up."

There was also feedback specifically about good engagement during resets and gaps in filming:

> "I think there was some points where the either presenters or Dan managed to, like there was an effort to engage with the audience in those swap over times and when there was that, it was better."

Though there was also suggestions that the compare using charades as a way to entertain the audience in the Ri did not translate well to the live-streaming venues.

> "We took the sound down and got our researcher in at that point because we couldn't really join in with that. What I think might have been a good idea is if there was more of a science communicator doing that comparing, they do exist, I promise you, that could basically carry on with a bit more of the science aspect, so it would seem a bit more fluid. So instead of pure comedy entertainment, you've got those science communicators out there that could give entertainment and carry on from what Alice Robert's is saying about genetics maybe, or something like that, because it felt a little bit staggered. It would be good if you kept that

continuity of the fun science, and definitely had that science element running throughout, I would say."

One venue suggested the Ri could come up with an activity to run during the resets:

> "I think having one activity that people could build on throughout the lecture, like if they could have just one activity that they could dip in and out of to do a bit more, then you're back in the lecture and then during any re-sets you could do some more of it. Then by the time it's finished, you've got something to take home."

> "Another colleague of mine suggested that you know in those scheduled breaks and where they know they're going to happen, could a pre-recorded video be played or another RI video or something and then thinking also because people would get up and they wouldn't know how long."

3.2.6. Practical Issues and Resets

There were some small technical problems:

> "[The Ri] had trouble connecting us before the lecture started so that we could hear Dan speak as well, so having him adlibbing and talking beforehand would have been nice for our audience as well."

Pauses in the broadcast that were due to resets and repetition of scenes were a big source of disengagement among the venues. A few venues linked people leaving during the event with the gaps caused by the resets and prop setup:

> "It's really special if you're there and you're in the theatre, but it's not as special and it's not the same if you're not there, and if there's also breaks in the programme and you don't know when those breaks are going to be and how long they're going to be, that's really hard to fill."

> "People stayed, only a couple of people left but you definitely needed something for those who stayed. They muted the sounds as well, so it was a bit like you're invited to engage but then it stopped and then it started again."

> "We did have a few people leave part way through which often happens in the changeover of the settings. So we had, I would say, there was about three people that left about 40 minutes in so kind of just less than half way through and then there was a small crowd again that left in the longer delay just towards the end. There was a tech issue with one of the pieces of equipment and they did foresee that was going to be a bit of a longer delay."

> "I would say in the downtimes, audiences became disengaged. Just from the audience, people were on their phones, that type of thing, people would go out wander to the vending machine."

"I spoke to the three people when they were leaving, and all of them said the same thing that because it was a live recording of a show that number one, they didn't know how long it was going to go on, and number two, they were just watching the same scenes over and over again."

"It was meant to run for an hour and ten minutes, but with all those re-sets it was two hours. It felt very long and when I looked around the room there were people on their phones. I think they felt a little bit disjointed and consumed, because the first 45 minutes was pretty much used to record the end of another lecture, which I think should be avoided really and I think it confused the audience. It made the session for the audience disjointed, so there was maybe a little bit of confusion there. They didn't anticipate any re-sets, perhaps."

3.2.7. Audience Demographics

The demographic of the Christmas Lectures is families, which substantially overlaps with the demographics that science centres aim at. One venue found that this was indeed the demographic that the live-streaming events attracted:

"It was mainly families and they brought their children to come and see the lectures, which was nice, to show them the tradition of the lectures. It definitely had a family focus where we were."

However, at other venues the vast majority of the audience were much older, with a small number of children:

"I would say [the audience were] predominantly adults. From a quick count I think we had about four or five children in the audience that were probably kind of key stage two age. But then otherwise I would say, the audience was all adults and probably a demographic it was all kind of 40 plus."

"I think it was maybe more an adult audience and our target audience is families and parents with children so I'd say that's why the audience was so small."

This latter venue said that if they were to host the lectures again they would move to a less family-orientated venue.

There was some feeling that the audience were very much already engaged in scientific events, or specifically, the Christmas Lectures:

"I feel like I recognised a few of them and that's great, they love coming to us and we've built a relationship with them, but we can work harder to get more diverse people in. I don't know really about the reach of the RI lectures."

"We did have one specifically and this might become relevant later, that they've actually since sent us an email and they travelled over an hour's drive and it was a lady with her grandson and

he is a junior member of the RI but not old enough to enter into the ballot for the live streaming so they were very excited and actually travelled over to us a considerable distance."

3.2.8. Response to Live-Streaming Event

There was a range of responses regarding perceptions of how much the audience enjoyed the event. Much of the feedback was positive, though there were several caveats around disengagement, fitting with previously mention issues with attendance and leaving early:

> "I think they really enjoyed it. It was quite difficult in that some of the people who had come as a family found it an awkward time because they wanted to have dinner and some of them had to leave slightly earlier because they'd come with younger children or they had other commitments like picking up other children at certain times. Other than that, the people that stayed really enjoyed it and we had a couple of adults that came without children that said they really loved the opportunity to see it as well."

> "The people who came absolutely loved it."

> "I think they enjoyed it, like the novelty, and I think particularly when reference was made to them, that felt like a little bit more inclusive"

> "They were very thankful that we'd hosted it. They made comments of yes, it's something different, it's nice that we can access this. Also, the point of view that it was interesting to see behind the scenes and see the set up that way."

> "There wasn't always a high level of engagement with it and I don't know if some people were slightly disappointed to that end but people seemed, you know the reactions at the end were positive of the people that walked out."

3.1.10. Wider awareness of the Christmas Lectures

In previous sections, it has been noted that audiences had a pre-existing interesting in science events, and awareness of the Christmas Lectures. This was highlighted by people making it clear that knowledge of the Christmas Lectures had been the pull for them, or people asking about broadcast dates:

> "I would say that everybody came to ours knew what they were or were with a friend that knew what they were."

> "Yeah, a lot of people were asking me when they were going to be broadcast on the BBC, so I think a lot of them had watched them or were definitely aware of them. For people who weren't aware of the lectures, they obviously wouldn't have bought the tickets to come and see it. It was a self-selecting audience, so they were people who had definitely seen it before, watching them on the BBC had been a point in their Christmas holidays and they know and remember, those were definitely the people that had brought the tickets. They were very aware of the fact they

were going to be broadcast on the BBC and were asking after it. It's catching those people that maybe aren't as aware that would be nice for next time."

"I think the people that we attracted were all people that knew the Royal Institution lectures existed already and then came to it probably because of the way they were advertised. I don't think we attracted anybody the other way around that was maybe interested in a science event and then came to that to discover the RI or somebody that was interested in us that discovered the RI or a local person. I think everybody – from the descriptions and because it was very much led with, it's the Royal Institution Christmas lectures, I think that was what attracted people to the event not necessarily another way which we could look at from our end."

"The local residents knew about the lectures and they were really excited to come along. It was mainly families and they brought their children to come and see the lectures, which was nice, to show them the tradition of the lectures. It definitely had a family focus where we were."

4. Reflections and recommendations

This section analysis and reflects on the filming and live-streaming events.

4.1. Christmas Lectures filming

The filming of the Christmas Lectures appears to be valuable by children in the audience. The filming sessions were well organised and ran like a well-oiled machine. This section discusses what worked well about the event and how it could be improved.

4.1.1. Successes

- **Event experience:** Overall, the event ran to time and seemed well organised. The young people enjoyed being in the Ri venue and the chance to watch live, interactive science.
- **Lectures were described as interesting and fun:** The vast majority of feedback was positive
- **Wider awareness of the lectures supplements the experience for some**
- **Presenters received very positive feedback**: comments covered their humour, emotion and how interesting they were.

4.1.2. Challenges

- **Age of children the lectures are targeted at:** There was some feedback that older children felt like the show was pitched at an audience much younger than them.
- **Audience participation and interaction:** Some feedback was centred on children requesting more opportunities for participation, as well as more audience interaction.

4.1.3. Recommendations

- **Keep the event experience overall the same:** The young people enjoyed watching the live Lectures at the Ri and being able to hear from experts, as well as having the opportunity to volunteer and do the demonstrations.
- **Age of children the show is targeted at:** This could be resolved by lowering the age of children the tickets are targeted at, or testing material beforehand with older audiences.
- **Audience participation and interaction:** While it's true that not everyone can be a volunteer and come up on stage, there are ways to increase the participation of everyone by doing more activities where everyone in the room can join in. There were some of these sorts of activities across the lectures, but perhaps ensuring they are spread out across all lectures evenly would ensure a consistent experience of involvement.

4.2. Christmas Lectures live-stream

The live broadcasts of the Christmas Lectures certainly have the potential to be a valuable experiencing broadening the experience of the live lectures beyond those in the Royal Institution. However, there are several considerations required to make these events successful in terms of organization, attendance and engagement. This section discusses what worked well, or not so well, about the events and how they could be improved for future years.

4.2.1. Successes

- **Simplicity of set-up:** Venues reported that the live stream was easy to set-up
- **Opening the opportunity to enthusiasts those who can't go to the main lecturers:** Attendees at the live events had an awareness of the Christmas lectures and were happy that they had the chance to experience the live phenomenon.
- **Individual ownership of events:** Each venue organised their own event giving them ownership of their efforts.
- **Activities run alongside the lectures:** Those venues who did run activities alongside the lectures reported that this helped with audience engagement during times when there was pauses in the lecture.
- **Interaction with live-streaming venues:** The venues reported that it was nice to be said "hello" to from within the Ri.

4.2.2. Challenges

- **Reaching the target audience:** There were several challenges to reaching the target audience of children including marketing strategy, presence of accompanying activities at an appropriate-level and the time of the event.
- **Timings for families:** Some families found the timing of the evening events difficult because it fell when they would typically have dinner or finished later than when they might put younger children to bed.
- **Communicating the timings of the event:** There was some confusion over what the exact structure of the event would be, including information about the warm up act, intervals and resets.
- **Poor attendance:** A couple of the venues experienced very low attendance and one venue even reported that only 3 people turned up, one venue found that a third of people who bought tickets (at cost) did not use them, and another venue reported that more than half of those who'd registered for free tickets did not turn up. This was possibly due to the event being at a busy time of year for families (leading up to Christmas), coupled with the challenges of evening events for families.
- **Visitors leaving midway:** Most venues reported problems with audience members leaving part-way through the recording, though this seemed to be more of an issue in venues where they had not put on additional entertainment.
- **Technical problems:** One venue noted that the stream didn't start immediately so they missed some of warm-up act at the beginning.

- **Resets and engagement:** Multiple venues mentioned the pauses and resets as a problem that caused disengagement among the audience, in some places leading to some audience members leaving.
- **Interaction with the live streaming venues:** There was some effort to say "hello" to the live-streaming venues, but the audiences weren't actively included in any of the activities within the Ri. This ranged from responding to questions to playing charades in the downtime between retakes and set-ups. This is particularly pertinent as venues indicating this downtime was a big source of disengagement in the live-streaming venues.

4.2.3. Recommendations

- **Organisation:** Provide a briefing sheet explaining the contact details for people with different roles at the Ri, as well as details around what the event is, the schedule for the event and details to manage expectations around live-broadcasting.
- **Marketing:** The Ri could provide a media plan for marketing the events, including a template press release, and making clear the intended audience for the events so the venues can make good choices of where to focus marketing.
- **Ticketing:** All venues experienced problems with attendance, but this was especially marked at the venue that did not ticket. Tickets can provide a sense of value through giving them a cost, or through making them seem rare (for example, via a ballot). It is notable that even the venues that charged money had a substantial number of absentees. Advice should be given to venues to expect a substantial number of people not showing up, which may be due to having the events so close to Christmas.
- **Exchange of ideas between venues:** Allow venues to communicate between themselves about what they are planning, or if they have run a live-stream before, communicate about what went well or badly. This would both create a sense of community between venues and allow for useful idea exchange.
- **Entertainment during pauses and resets on the stream:** Provide entertainment within the Ri during pauses and resets that translates well to those watching on the live stream**.** One venue suggested this could have more of a scientific emphasis than what was provided by the compare during the filming.
- **Activities during pauses and resets in the live-streaming venues:** The Ri could provide suggestions for some activities, crafts or experiments relevant to the lectures that could be done to fill gaps during the lectures at the external venues.
- **Timing:** It was noted that the timing of the event coincided with typical eating times for families. Changing the time may be difficult to allow for constraints the audience have getting to and from London. Perhaps a good compromise to this would be encouraging live-streaming venues to provide catering.

We hope that this report and its recommendations have been useful. Further data will be presented and discussed as part of the Final Report, due at the end of April 2019.

5. Outcomes from Outreach Activities

This section presents a document put together as requested by the Royal Institution. Where we present a short literature review on the outcomes from outreach activities.

5.1. Introduction to education outreach

Education outreach focuses chiefly on enhancing and improving education in schools, homes, and communities, with interventions outside the formal education system. In this context, we use it to refer to scientists and engineers engaging with young people aged 4-19 years old. The Concordat for Public Engagement has been pivotal for encouraging Higher Education Institutions to engage with a range of publics; indeed it is now considered as an indicator of research impact in the UK funding system (RCUK, 2010).

In a Royal Society survey on attitudes to science communication, 61% of researchers highlighted schools and pupils as a very important audience to engage with (TNS, 2015). However, the dominant reason for engagement was to 'promote public understanding of science' (34%), which can be aligned with traditional transmission styles of public engagement ('Deficit Model'). Only 15% of respondents highlighted their aim as to discuss the 'implications, relevance and value of science', which can perhaps be aligned with the dialogue style of public engagement (Bucchi, 2008).

Although often taking place in a formal educational context, education outreach programmes can share many of the characteristics of informal science learning opportunities, in that they are not bound by the constraints of the curriculum and school timetabling and can provide access to resources (people and equipment) which are not otherwise available in schools. Several frameworks provide a basis to explore impacts from education outreach, this paper describes three of those in more depth.

5.1.1. Scientific Literacy

Scientific literacy is a term used to refer to a body of knowledge thought to be necessary to engage with scientific information and issues throughout life. While debates exist in the science communication literature about the validity of this construct, it is widely used in formal education pedagogical research to determine the level of an individual's knowledge of and about science. Teachers and schools work towards scientific literacy to develop scientifically engaged citizens. The construct highlights that literacy is influenced by context, attitudes and competencies, and not just knowledge. We have included information on the construct in Figures 1 and 2, as it is useful to develop thinking around the impacts of education outreach.

The Programme for International Student Assessment (PISA) definition of scientific literacy is:

- Scientific knowledge and use of that knowledge to identify questions, acquire new knowledge, explain scientific phenomena and draw evidence-based conclusions about science-related issues
- Understanding of the characteristic features of science as a form of human knowledge and enquiry
- Awareness of how science and technology shape our material, intellectual, and cultural environments
- Willingness to engage in science-related issues and with the ideas of science, as a reflective citizen

(OECD, 2006) p23

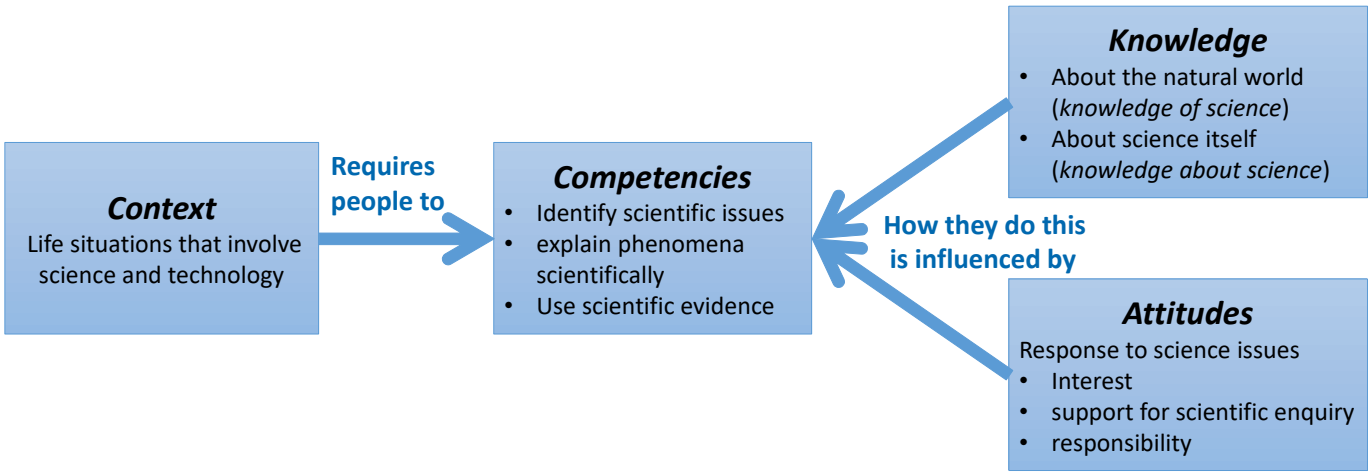

Figure 1: *Inter-related Aspects of Scientific Literacy* (OECD, 2006)

Contexts linking science to society
- Health, Disease & Wellbeing
- Natural Resources
- Environment
- Hazards
- Frontiers of science and technology

Levels of engagement:
- Personal: Self, Family, Peer Group
- Social: School, Community
- Societal: National, Regional, Global

Figure 2: *Components of Scientific Literacy to consider in learning programme design (Contexts and engagement levels adapted from OECD, 2006) (Bay, 2013)*

5.1.2. Generic Learning Outcomes

Within informal learning contexts (such as museums or science centres), the term 'Generic Learning Outcomes' (GLO) is used to describe how interactions may have an impact on the audience. Learning may involve the development or deepening of skills, knowledge, understanding, values, ideas and feelings (Museums Libraries and Archives Council, 2014). The construct is highlighted in Table 1. Different interactions will have different outcomes; not every outcome can be achieved through each interaction and they are designed to be adapted for different contexts. The outcomes can be adapted for teachers, pupils and the school community.

Many education outreach activities are short-term or one-off interventions, but there is an assumption that these individual fragments of engagement will coalesce into something more substantial; for example a positive impact on young people's aspirations and achievement in science. Indeed, it is argued the informal learning sector is well placed to embed scientific ideas within a wider context

(Stocklmayer, Rennie, & Gilbert, 2010), which is important for consolidating and contextualising learning (Bandiera & Bruno, 2006). Studies suggest that science outreach activities can increase interest and engagement with science and change pupils' views of scientists (Wilkinson & Sardo, 2013), while teachers also value expert contributions to scientific knowledge (Laursen, Liston, Thiry, & Graf, 2007).

Table 1: Generic Learning Outcomes from ISE (Museums Libraries and Archives Council, 2014)

GLO domain	Example of outcomes
Knowledge and Understanding	▪ Knowing what or about something ▪ Learning facts or information ▪ Making sense of something ▪ Deepening understanding ▪ Making links and relationships between things
Skills	▪ Knowing how to do something ▪ Being able to do new things ▪ Intellectual skills ▪ Information management skills ▪ Social skills ▪ Communication skills ▪ Physical skills
Attitudes and Values	▪ Feelings ▪ Perceptions ▪ Opinions about ourselves (e.g. self-esteem) ▪ Opinions or attitudes towards other people ▪ Increased capacity for tolerance ▪ Empathy ▪ Increased motivation ▪ Attitudes towards an organisation ▪ Positive and negative attitudes in relation to an experience
Enjoyment, inspiration, creativity	▪ Having fun, ▪ Being surprised ▪ Innovative thoughts ▪ Creativity ▪ Exploration, experimentation and making ▪ Being inspired
Activity, behaviour, progression	▪ What people do ▪ What people intend to do ▪ What people have done ▪ Reported or observed actions ▪ A change in the way that people manage their lives

Researchers may also gain from public engagement; indeed the National Coordinating Centre for Public Engagement define engagement as a two-way process (National Coordinating Centre for Public Engagement, 2014). In this context, the GLO may equally be applied to indicate the domains where researchers may experience benefits from undertaking education outreach.

A series of recent position papers highlight these benefits as:

- Gaining confidence and skills for communicating with diverse publics
- Widen research horizons and gain new insights into their research
- Inspiring the next generation of researchers
- Securing and sustaining research base and UK economy
- Dialogue on relevance of research to science and society

(Research Councils UK, 2010) and (National Coordinating Centre for Public Engagement, 2010)

5.1.3. Informal education and behaviour change

These categories were further refined by the US National Science Foundation Working Group on informal education (A. Friedman et al., 2008). Whilst it is necessary to know about a topic (awareness and knowledge) and have positive attitudes towards it, it does not follow that behaviour change will necessarily occur. This is because there may be many environmental or habitus issues which are preventing behaviours following through. This is further explored in behaviour change literature, such as the Behaviour Change Wheel framework (Figure 3) (Michie, van Stralen, & West, 2011). It has also been developed further into the Science Capital Framework, as described by Archer, Dawson, DeWitt, Seakins, & Wong (2015) and in this video https://www.youtube.com/watch?v=A0t70bwPD6Y.

Table 2: Impact categories as they relate to public audiences (A. Friedman et al., 2008)

Impact category	**Generic definition**
Awareness, knowledge or understanding	Measurable demonstration of assessment of, change in, or exercise of awareness, knowledge, understanding of a particular scientific topic, concept, phenomena, theory, or careers central to the project
Engagement or interest	Measurable demonstration of assessment of, change in, or exercise of engagement/interest in a particular scientific topic, concept, phenomena, theory, or careers central to the project
Attitude	Measurable demonstration of assessment of, change in, or exercise of attitude toward a particular scientific topic, concept, phenomena, theory, or careers central to the project or one's capabilities relative to these areas. Although similar to awareness/interest/engagement, attitudes refer to changes in relatively stable, more intractable constructs such as empathy for animals and their habitats, appreciation for the role of scientists in society or attitudes toward stem cell research
Behaviour	Measurable demonstrations of assessment of, change in, or exercise of behaviour related to a STEM topic. These types of impacts are particularly relevant to projects that are environmental in nature or have some kind of a health science focus since action is a desired outcome.
Skills	Measurable demonstration of the development and/or reinforcement of skills, either entirely new ones or the reinforcement, even practice, of developing skills. These tend to be procedural aspects of knowing, as opposed to the more declarative aspects of knowledge impacts. Although

	they can sometimes manifest as engagement, typically observed skills include a level of depth and skill such as engaging in scientific inquiry skills (observing, classifying, exploring, questioning, predicting, or experimenting), as well as developing/practicing very specific skills related to the use of scientific instruments and devices (e.g. using microscopes or telescopes successfully).

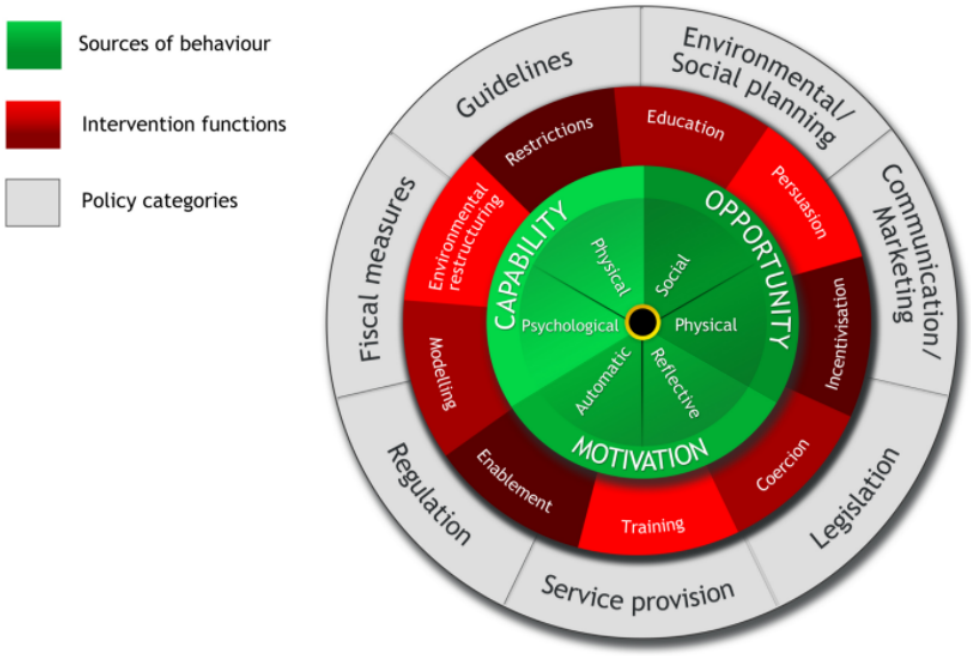

Figure 3: The Behaviour Change Wheel indicating the complexity of behaviour change factors (Michie et al., 2011)

5.2. Impacts from education outreach

There is little research evidence combining these three constructs to highlight impacts from education outreach for all participants. In Table 3, the outcomes identified by the different constructs are synthesised into broad categories; these are then used to identify possible outcomes that could be achieved from participation in education outreach by each of the identified beneficiaries.

It is not expected that we will see evidence of change in every category of impact, and for all participant groups, as education outreach activities vary in their objectives and approaches and hence what they can achieve. However it is expected that with training and increased participation in education outreach, we would see changes in some of these domains for each participant group.

Table 3: Potential outcomes from education outreach activities (table adapted from Dierking, 2008)

<table>
<tr><th rowspan="2">Category of Impact</th><th colspan="3">Potential indicators of impact</th></tr>
<tr><th>Scientists and engineers</th><th>Teachers and school community</th><th>Young people (pupils)</th></tr>
<tr><td rowspan="3">Knowledge or understanding of STEM concepts, processes or careers</td><td>Knowledge of formal learning pedagogies and curriculum topics in research area</td><td>Teaching, learning and pupil motivation in non-specialist subjects</td><td>Knowledge of specific STEM research area and related curriculum concepts</td></tr>
<tr><td>Understanding of different views and perspectives on research</td><td>Understanding of multi-disciplinary working for relating subjects in the real world</td><td>Understanding of different views and perspectives on specific STEM research</td></tr>
<tr><td>Understanding of communication with different audiences</td><td>Knowledge of contemporary science</td><td>Enhanced understanding about ‘working scientifically’, or how science works</td></tr>
<tr><td rowspan="2">Enjoyment, inspiration, engagement and creativity in STEM concepts, processes, or careers</td><td>Enjoyment of public engagement</td><td>Real-world experience of current science</td><td>Enjoyment of STEM subjects</td></tr>
<tr><td>Creativity in communicating research concepts</td><td>Hands-on experience of curriculum concepts</td><td>Inspiration for studying or continuing to study STEM subjects</td></tr>
<tr><td rowspan="3">Attitudes and values towards STEM-related topics or capabilities</td><td>Awareness of perspectives of science in society</td><td>Variety of role models for pupils</td><td>Awareness of how the specific STEM research area is viewed in society</td></tr>
<tr><td rowspan="2">Increased self-efficacy for engagement</td><td rowspan="2">Raised aspirations to widen participation for STEM subjects in school and university</td><td>Increased self-efficacy for STEM subjects</td></tr>
<tr><td>Raised aspirations in STEM</td></tr>
<tr><td rowspan="3">Behaviour</td><td>Participate in more education outreach opportunities</td><td>Book more education outreach or informal science education opportunities</td><td>Choose to continue studying STEM subjects</td></tr>
<tr><td>Change styles of outreach with more understanding of pedagogies</td><td>Connect science into wider society opportunities</td><td>Participate in out of school science learning opportunities</td></tr>
<tr><td colspan="3">Change behaviour in wider lifestyle as indicated by the STEM topic e.g. drive car less to reduce air pollution</td></tr>
</table>

5.3. References

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Appendix I

Observation Guide

Please use this guide to record as much as possible about the observation. If unobtrusive circulate around the room/venue whilst observing.

General information
Event name: **Location:** **Date:** **Time (start observation):** **Details about participants** (institutions, roles, etc.): **Estimated Audience Number:** **Estimated Male/Female Ratio:** **Average dwell time:** **Audience Type** (families, groups of friends, couples, etc. and size of groups, multi-generational, age range?): **Any general pre-problems** (accessibility, logistics, weather, scheduling, technology, etc.)?
The Activity **Start Time:** **End Time:**
Activity type: (presentation, discussion, hands-on, etc.)

Environment: (lighting, room size and format, technology available etc.)

Participants' engagement

Engagement level:

☐ High engagement
☐ Average engagement
☐ Low engagement

Ease of engagement:

☐ It's easy to engage with the participants
☐ It's neither easy or difficult to engage with the participants
☐ It's difficult to engage with the participants

Interaction between participants:

☐ Participants interact with each other
☐ Participants don't interact with each other

Identify any particularly interesting or challenging issues:

Interaction between visitors and the exhibition:

Annotated agenda (Please describe each part of the day, including notes on all activities, break-out groups, presentations, agenda, etc.)**:**

Diagram of Venue: Please insert a diagram of the venue either before/after the observation here

Appendix II

Feedback card

What do you think of the Christmas Lectures?

After the event, please write **three words** that best describe your experience today (feel free to leave longer comments if you wish!)

(once completed, please leave this card in the feedback box)
Thank you.

Appendix III

Interview Schedule

Science Communication Unit, University of the West of England
Coldharbour Lane, Bristol
0117 328 7602
margarida.sardo@uwe.ac.uk

My name is (*interviewer state your name*) and I am asking for opinions about the live broadcast of the Christmas Lectures.

We would like to invite you to take part in a short interview of around 15 minutes. The research will be used to improve events like this.

Participation is entirely voluntary. Your answers will be grouped thematically with the other interviewees so that you are not personally named. This information will be stored securely in accordance with the terms and conditions of the General Data Protection Regulations. You can withdraw your participation at any time during the interview. **By participating in the interview, you are giving the University of the West of England and the Ri consent to use this information in the research.**

Would you like to take part?

If the person responds positively, the interviewer continues……..otherwise, thank you / end here.

Christmas Lectures Live Broadcast – 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 your views and thoughts about the live broadcast of the Christmas Lectures.

1. Can you please briefly describe your role in the organisation of the live broadcast of the Christmas Lectures?

2. Can you please briefly describe the event you hosted? (Was this ticketed? Free to attend? Part of a bigger event? Was there any other activities in addition to the live broadcast?)

3. What motivated you/your Science Centre to host the broadcast of the Christmas Lectures?

4. How did the audience respond to this event?

5. In your opinion, what worked well?

6. And what didn't work so well?

7. How would you improve this activity?

8. Would you like to host a similar event again in the future?

9. Is there anything else you would like to add about the Christmas Lectures and their national reach?

Thank you for your time.

Evaluation of the Royal Institution Christmas Lectures – Final Report

Margarida Sardo, Hannah Little and Laura Fogg-Rogers

Science Communication Unit
University of the West of England, Bristol

May 2019

UWE Bristol | University of the West of England

Contents

Executive Summary

This report aims to detail the key findings of the evaluation of the Royal Institution Christmas Lectures and its relevance to the Ri. It brings together the findings from the three interim reports previously produced and showcases new evaluation data. Evaluation methods used include:

- **Semi-structured interviews:** aiming to collect feedback from children attending the filming at the Royal Institution (Ri).
- **Online surveys:** aiming to reach science enthusiasts who may or may not watch the Christmas Lectures.
- **Twitter feed/social media analysis:** aiming to explore reactions and feedback to the broadcast of the Christmas Lectures

The report notes key findings and makes recommendations for action within the Christmas Lectures. It includes the complete evaluation kit, in the Appendices.

Dr Margarida Sardo, Dr Hannah Little and Dr Laura Fogg-Rogers, from the Science Communication Unit at the University of the West of England, Bristol, undertook the evaluation and prepared the report.

Key Findings

Live Event

- Attending the filming had a big impact on the children who have that experience. Those interviewed reported higher interest in science at school, as well as engaging with science in other ways (such as buying science magazines, joining science clubs at school, etc.).
- Those attending the filming in 2018 plan on watching the Lectures again in 2019, with some also planning on entering the ballot.
- Highlights of the live filming in 2018 were the experiments and demonstrations, live animals, the presenters, being able to see and understand how a live show is filmed and being at the Ri (which feels special and exciting).
- From the audience perspective, suggested improvements for the live filming experience were less time queuing and more opportunities to be picked as volunteers for experiments and demonstrations.

TV viewing

- Those who watched the 2019 lectures on TV mainly reported on Twitter that watching the lectures is a pleasant and engaging experience. There was evidence of children being engaged, ranging from the age of 5 to 17, and adults also reported finding it very enjoyable.
- Participants on Twitter and the Survey indicated that the 2019 lectures on TV were inspirational to younger people, specifically young girls, due to the two presenters being women. There was a lot of evidence to suggest that people treat the lectures as a family tradition.
- Younger Survey participants were less aware of the Christmas Lectures; indeed all 18-24 years olds who had never watched the lectures stated this was because they did not know about them. Many of the older survey participants also indicated that the Lectures needed to be better advertised and promoted, with activities and learning links to continue learning.
- The Survey showed that the younger generation is less likely to watch live TV as they watch short videos on demand either through a television, on a tablet, or on social media.
- Qualitative feedback in the Survey indicated that participants thought the Lectures were aimed at children. However, younger participants thought that they were aimed at adults. There was therefore widespread discussion about who the Lectures are aimed at.
    - Older adults indicated that they thought the language, content, and style of the Lectures had been 'dumbed down' over the years to aim at young children.
    - Many participants indicated that they would like a Lecture specifically for adults, upping the science content and societal questions at the end.
    - The format of a live lecture on TV was described by one participant as 'watching people watch a live lecture'. Many Survey participants also indicated that the Lecture format in the traditional Faraday lecture theatre contrasted with the needs of modern-day video production for social media. Some thought that the Lectures should move around the country to engage more regions.
    - Many participants also indicated that to truly appeal to young people, the Lectures would need to either be featured on more youth-oriented TV stations, or be cut up into smaller sections in order to be promoted on social media.

Key Recommendations

- Keep the engaging, interactive and high-quality demonstrations, undertaken by two presenters who are skilled at science communication (as well as being practicing scientists) – these are a highlight both for those attending the filming, as well as those watching the broadcast.
- In the Live Lecture format, increase the opportunities for audience participation during the filming, making it possible for more people to play an active role in the lectures.

- Re-evaluate who the lectures are aimed at for the TV broadcast.
    - If they are aimed at younger viewers and families then they need to be on a more familiar TV station, at a more appropriate time slot, with better marketing.
    - The people currently watching the lectures (in the Survey) are actually a committed science enthusiast middle-aged audience. Efforts need to be made to ensure these viewers are not excluded, perhaps by introducing an extension lecture aimed at adults.
    - The largest audience is reached through the filming. Re-evaluate how live lectures differ from the needs of filming for video clips. Consider introducing different segments of filming from other regions around the UK.
    - Reconsider the title 'Lecture', as this puts many young people off from watching.
- Consider cutting down the lectures into short video clips which can be viewed on social media or YouTube, as this is how young people consume video material. Consider providing extended learning links to enable schools to show the short videos to introduce learning on a topic.

1. Introduction

The Ri Christmas Lectures are a series of three lectures on a single topic, each broadcast on BBC FOUR at 8pm on three consecutive days during the Christmas period.

After discussions with the Ri, the evaluation team sought to collect reactions and feedback of those attending the filming at the Royal Institution central London venue (via interviewing young people), as well as those watching the Lectures on BBC FOUR (via analysing posts on Twitter).

We were also interested in exploring the thoughts and views of 'science enthusiasts', those who label themselves as having an interest in science and who may or may not watch the Christmas Lectures. We were particularly keen on investigating their STEM leisure-time activities and how they consume STEM-related video material. Finally, we wanted to explore how the Christmas Lectures fit into these habits and preferences.

2. Evaluation methodology

This section outlines the methodology used to generate the data. A variety of methods were selected, tailored to the specific event and aiming to capture the experiences of the participants and presenters involved and to assess, as far as possible, the impact of the Ri activities on participants.

The evaluation methodology received full ethical approval from the Research Ethics Committee of the University of the West of England, Bristol UK.

2.1 Semi-structured interviews with attendees (children)

Interviews with those who attended live filming in 2017 and 2018 took place shortly after the broadcast of the 2018 Christmas Lectures. As the evaluators were keen to collect feedback from children attending (not accompanying adults), a general email was sent out by the Ri to those who bought tickets. Parents and guardians received the email from the Ri and were asked to directly contact the evaluator. There was also a note about the evaluation in the Ri's newsletter, asking those interested to contact the evaluator.

The semi-structured interviews were designed to be short and were conducted either over the phone or Skype (audio only). Semi-structured interviews were used, to provide a meaningful discussion of the attendees' experience. Interviewees were asked to provide both formal and informal feedback of their impressions of the event. Eight attendees agreed to

participate, one from the 2017 audience and seven who attended the filming in 2018. The interviews were transcribed in full and analysed for common themes.

A copy of the interview schedule can be found in Appendix I.

2.2 Online surveys

A mixed methods survey was developed, aimed at reaching people who are enthusiastic about science but who have not regularly or previously watched the Ri Christmas Lectures. Online surveys are a convenient method to gather participants' views and thoughts about events and activities and enable us to reach a much higher number of people.

The survey included rank list, drop box, and Likert questions about the participants' engagement with science, TV, and the Ri Christmas Lectures. Respondents could select more than one option, so percentages do not add up to 100%. Open questions were included to allow participants to express their own views as well.

The survey was set up online using the platform Online Survey (previously BoS) and it was publicised on the Ri Twitter and the SCU Twitter accounts in September 2018 – January 2019, as well as Linked In and PsciCom Mailing Lists. Common #scicomm hashtags were used to reach people who were interested in science but self-identified as not regularly watching the Ri Christmas Lectures. The survey was adapted for UWE students and emailed out to undergraduates in December 2018.

Descriptive statistics were used to analyse the closed questions, and content analysis was used for the open questions.

A copy of the questionnaires used can be found in Appendix II and Appendix III.

2.3 Social Media analysis

The advanced search engine on Twitter was used to create a dataset of tweets. Results were filtered by dates and keywords. Initially, the dataset only included tweets using the #xmaslectures hashtag. However, to get a wider sample of opinion from less engaged individuals (who may be less likely to use the hashtag), the dataset was broadened to include tweets including the key phrase "Christmas Lectures". Tweets were collected from the period between 1/12/2018 and 31/1/2019.

A total of 1718 tweets (not including retweets) used the #xmaslectures hashtag in this period, and 1122 used "Christmas Lectures" in the same period, though a lot of these will be duplicates using both.

Tweets were manually filtered to exclude those by the Ri themselves, as well as employees of the Ri, the presenters and affiliated organisations and science communicators. This exclusion was meant to ensure the dataset was relevant to insight from the viewing public. Tweets were further filtered based on whether they provided specific insight into:

- Who was watching
- Why they were watching
- How they were watching

As well as specific items of positive and negative feedback, rather than general praise or criticism. This filtration created a manageable dataset that could create useful insights to inform our recommendations. Using the dataset, themes were identified and tweets were compiled into a summary of examples illustrating the themes.

3. Findings

The findings described below are drawn from the interviews with attendees, observation records, online surveys and social media analysis, all related to the Christmas Lectures.

3.1 Live Audience Perspective and Engagement

> *"Way better than watching it on telly! The atmosphere, the excitement, the fact that it was live and all that sort of leading up to an amazing experience."*

(Attendee 2017-01)

As reported in the Interim Report 3, across the three filming days, high levels of participants' engagement were observed and that level remained high well into two-thirds of the lecture time. It was easy to engage audience members with the lectures, they were keen to participate and enthusiastically volunteered whenever there was a call for volunteers.

Our interviews with attendees of the 2017 and 2018 filming days confirm the above, with attendees describing the excitement of attending a live show and how much they have taken in from the event, as well as exploring how the event could be made better and their plans regarding watching the Christmas Lectures in the future.

3.1.1 Reasons for attending

There were only two reasons given for attending the filming of the Christmas Lectures: attendees were either recommended to enter the ballot by friends and family or they had a keen interest in attending and were offered a place this year.

> *"I've been watching them on the TV for a long time because I really like science and then I really wanted to go so then my Mum and Dad just went and they got it all sorted out."* (Attendee 2018-07)

> *"My grandparents introduced the Ri to me and I really really wanted to do it, to be a member so I joined, and then I saw the Christmas lectures and it looked really interesting so I went."* (Attendee 2018-04)

It is clear that families have a big influence on the decision to enter the ballot and attend the Lectures. The Ri should continue to focus on recruiting families as members, as well as providing activities and engagement opportunities tailored to families, throughout the year.

3.1.2 What worked well

Young people interviewed were very positive about their experience of attending the filming of the Christmas Lectures. They were very specific about naming their favourite parts, although some mentioned the whole experience was great and it was difficult to point out a favourite. Here we present what worked well, in the young people's opinions:

- **Experiments/demos:** those attending the filming loved watching the experiments and demonstrations that the presenters showcased. These added richness, value and interest to the lectures and made the young people remain engaged. The statements by the young people are supported by the observations done during the filming, as well as the feedback cards collected after the filming, where attendees stressed how they had enjoyed the interactive element of the Lectures.
- **Call for action and audience participation:** This was a popular comment with the interviewees, as well as those who left comments on feedback cards. A considerable amount of young people has requested more audience participation, which the Ri should consider. This is one of the elements that makes the experience of attending the filming very different from that of watching the broadcast of the Lectures.

> *"I like knowing that there's a possibility that I could be featured in their experiments. I mean I wasn't this year but I like going there and knowing that I could be one of*

those kids that's on TV doing all the cool experiments." (Attendee 2018-03).

- **Live animals:** Having live animals on stage was the highlight of the experience for some of the interviewees. While some mentioned it was something fun and exciting, one attended stated having the opportunity to look at live animals help them understand some of the concepts being communicated:

  "They are really useful to help me understand the similarities between animals and humans." (Attendee 2018-02)

- **Seeing how it is made:** lots of comments about the excitement of attending a live TV show, with cameras, crew etc., and being able to grasp how a TV programme is made.
- **Presenters** were also mentioned as one of their favourite aspects of attending the filming:

  "The presenters were quite interactive with the audience which I enjoyed." (Attendee 2018-05).

3.1.3 What did not work so well

Interviewees were candid and honest about which aspects of the events did not work so well for them. Overall, it was a very positive experience for those attending, with three interviewees stating there was nothing they did not like. Other participants raised the following issues:

- **Not being picked to participate:** not being picked was mentioned by a few interviewees, who pointed out to the fact that those sitting at the front have more chances to be picked to participate:

  "Even though it was sort of tried not to, I still think a lot of people on the front row and sort of near the front were picked and there was sort of people further back had less chance to be involved in the activities." (Attendee 2017-01)

  "You know that you're probably more likely to get on TV if you sit near the front but that means you have to get there really early and you have to sit there and queue for hours and hours." (Attendee 2018-03).

This is, of course, difficult to manage, as only a small number of attendees get the chance to participate. In the future, more effort could be made to ensure that presenters picked participants from all parts of the lecture room, in an attempt to make it feel fairer.

- **Queuing and waiting:** This was a 'popular" least favourite aspect of the experience, queuing and waiting, although young people acknowledged it is not specifically part of the filming. 62% (n=5) of those interviewed mentioned this aspect as their least favourite part.
- **Reshooting scenes:** as for queuing and waiting, attendees understand reshooting scenes is part of attending the filming of a TV show and needs to be done. Nevertheless, they mentioned it as one of the least favourite parts. One interviewee however, acknowledged that albeit tedious, it was useful to watch some scenes more than once:

> *"Not boring exactly, just a little bit frustrating but it was useful to re-remember and recap."* (Attendee 2018-02).

3.1.4 What could be better

Young people were also asked how the Christmas Lectures could be made better for them. Many had to think a little harder about it, since at first sight, it was difficult to think how such a great experience could be made better.

- **Improving queueing** was the issue mentioned the most (62%, n=5). Attendees would like to see the queue better organised and moving faster. They also mentioned that it was uncomfortable at times, since it was quite a hot space they had to wait in. They suggested that perhaps refreshments would make queueing a bit better.
- Feedback shows that **participants are keen to be involved** and would like to see even more people from the audience involved in the demonstrations. Knowing the theme of the lectures before entering the ballot was also mentioned as something which would improve their overall experience.
- Other issues/suggested improvements were that the **screen was hard to see** sometimes, with things in the way (this might be challenging to improve, due to the layout of the lecture room).

3.1.5 Being at the Royal Institution headquarters

Interviewees were asked how being at the Ri headquarters made them feel. Words such as "cool" and "exciting" were used to describe the experience:

"Really cool; enjoyed being there physically." (Attendee 2017-01)

"Exciting with cameras around!" (Attendee 2018-01)

Some participants showed a great understanding of the importance of the Ri:

> *"It's really special because I know I'm going there to learn about science which I love and also it just feels like a really special place to be for scientific achievement in the UK".* (Attendee 2018-03)

3.1.6 Past experience and looking at the future

Seven interviewees (88%) had watched the Christmas Lectures before, while only one interviewee had not seen the Lectures before attending the filming. Of those who had watched it in the past, one had actually attended the filming twice before. When asked where and with whom they usually watch the Christmas Lectures, 75% (n=6) watch it live on BBC with family (parents, siblings and grandparents) and 38% (n= 3) watch it on iPlayer (either by themselves or with family). Only one interviewee stated they had watched the Christmas Lectures on YouTube before (and not on BBC).

Regarding plans of watching it again this year (2019), all interviewees stated they are planning on watching the Lectures. 50% (n=4) plans to watch them live on BBC, and only one child mentioned they are planning on watching it on iPlayer.

Interestingly, 63% (n= 5) plan on entering the ballot again for a chance to watch the filming.

3.1.7 Attitudes towards science after the filming of the Lectures

Attendees were asked how they felt about science since attending the filming and if attending the filming had changed the way they felt about science. The answers were all overwhelmingly positive, from enjoying science more to producing better school work.

- **Increased enjoyment and interest in science:** 50% (n=4) have said they enjoy science more after attending the filming:

  > *"Yes, I think I enjoy it a bit more now because I never liked science particularly that much but I found the lectures really interesting and I sort of enjoyed it a bit more."* (Attendee 2017-01)

"I'd say for things like anatomy and genetics I feel much more excited about I used to have no interest in anatomy." (Attendee 2018-02)

- **Increased knowledge:** some attendees reported an increase in knowledge around evolution and genetics.
- **Increased engagement with science at school:** connecting with science at school was mentioned by five interviewees (62%). This evidences the deep impact that attending the filming of the Christmas Lectures had on these children. One child has since joined the science club at school and another joined the dissection club, while others reported higher levels of engagement than pre-Lectures:

  "I've done some school work on Evolution. I wouldn't have done that without the Christmas lecture." (Attendee 2018-01)

  "I've kind of got more into science in school like I said before. We often ask our teacher questions and she'll answer them so sometimes I'll ask more questions in class to find out about the subjects that we're doing." (Attendee 2018-05)

- **Opened new areas of interest:** interviewees showed a high interest in science, with some stating that the lectures have opened up new areas of interest within science:

  "It's really opened up my understanding of Evolution. I've never really known that much about Evolution past Darwin's basic theories but sort of seeing how much we have in common in terms of like genes and bones and things like that, and especially the tree of life thing, I learned a lot from that." (Attendee 2018-03)

  "Science was still my favourite subject after [the lectures] so there wasn't a negative, and like it was so much fun, really interesting because biology - I don't really like biology that much but then seeing the lecture and it being more of a biology-based lecture, it has really opened me up to biology more." (Attendee 2018-04)

- **A glimpse into the complexity of science**: attending the Christmas Lectures gave some participants a good understanding of how complex science is and that there is just now one right answer or absolute knowledge:

> *"I always knew it was quite complicated in a way, but it's become even more interesting, like there's no simple thing that's right or wrong, there's always more you're going to find out and you can always have a deeper knowledge of something."* (Attendee 2018-07)

Asked how they had connected with science since attending the filming, only two attendees stated they did not connect with science in any ways since attending the event. All other children we have spoken with mentioned they did engage with science in different ways, including being more interested in it at school, buying science magazines and attending science related events, such as Family Fun Days.

3.2 Science Enthusiasts

In total, 420 people completed the surveys (46%M:45%F). The main survey was completed by 354 participants, of whom 52% identified as male and 46% identified as female. Most of the sample (75%) had studied and/or worked in a STEM related career. However, 25% of the sample said that they were just interested in STEM topics. There was a very broad age range of participants (Figure 1) with the mode age category being 35-44 years old.

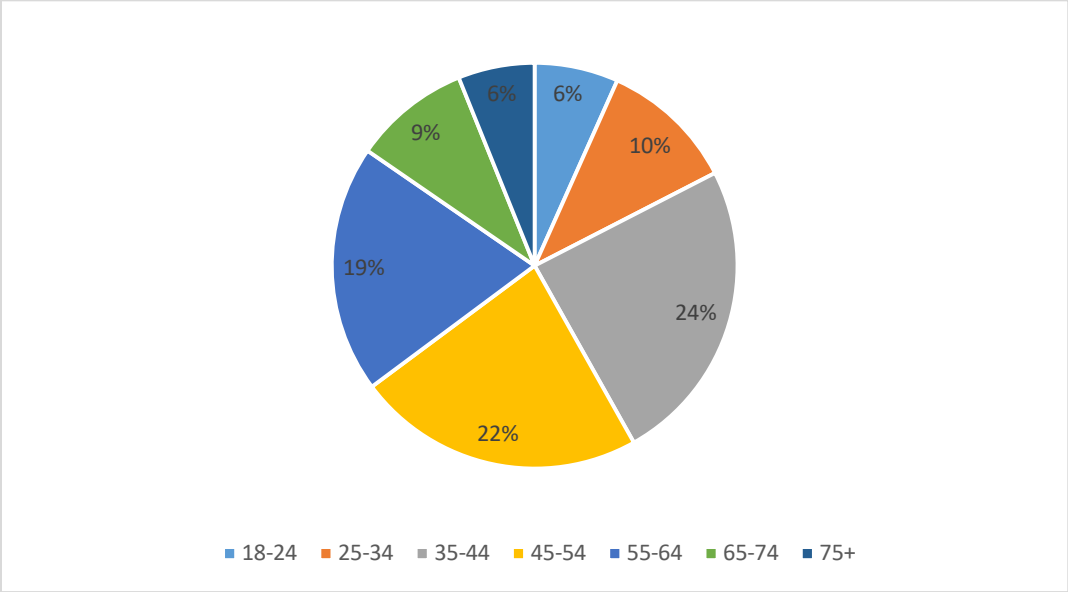

Figure 1: Age range of participants in the Ri Christmas Lecture Survey 2018

In total, 66 students completed the UWE Bristol survey, of whom 59% identified as male and 41% identified as female. Most of the participants were from a Physical Sciences or Engineering background (68%) while 32% were from a Health Sciences background. The participants were mainly aged 18-24 years old (80%).

3.2.1 Leisure-time STEM activities

The majority of respondents reported watching science documentaries on TV in their leisure time; 90% of general respondents and 83% of younger student respondents. The next most popular activity for the older general survey respondents was visiting science centres or museums (80%), while younger student respondents next preferred option was following science social media outlets (68%). However, general survey respondents also reported following social media as well (70%). There was a large difference in engagement with public lectures and events, with 60% of older respondents reporting this activity, whilst only 26% of students did the same. The other activities were similar in profiles of engagement (Figure 2).

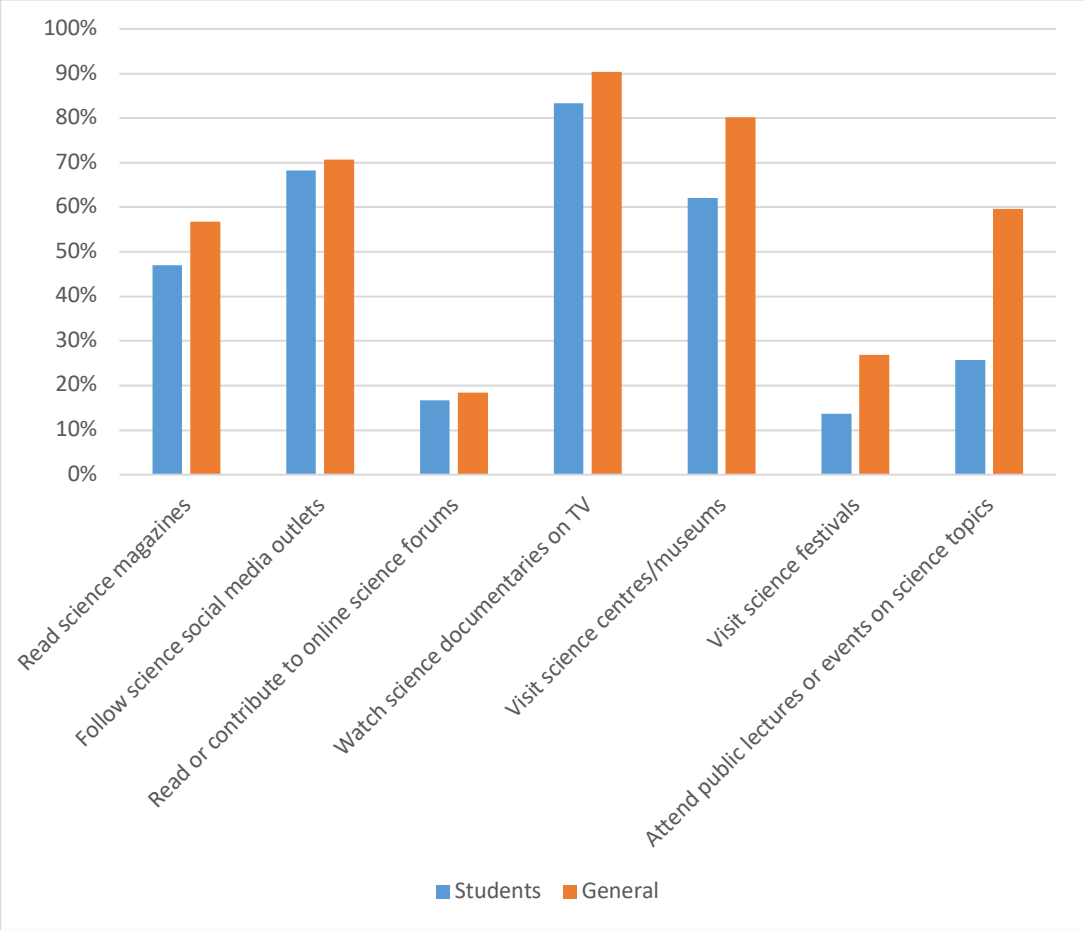

Figure 2: Leisure-time STEM related activities

Both the general respondents (96%) and the student survey respondents (95%) indicated that the main thing they like about engaging in STEM activities in their leisure time was learning about new things, as well as re-engaging their interest in science (58% general; 59% students). General survey respondents were twice as likely to report enjoying igniting interest for other people in science (49% general compared to 27% students), as well as

meeting/chatting to other people (37%:18%) or scientists (34%:23%) which may reflect their older age profile. Other reasons are shown in Figure 3.

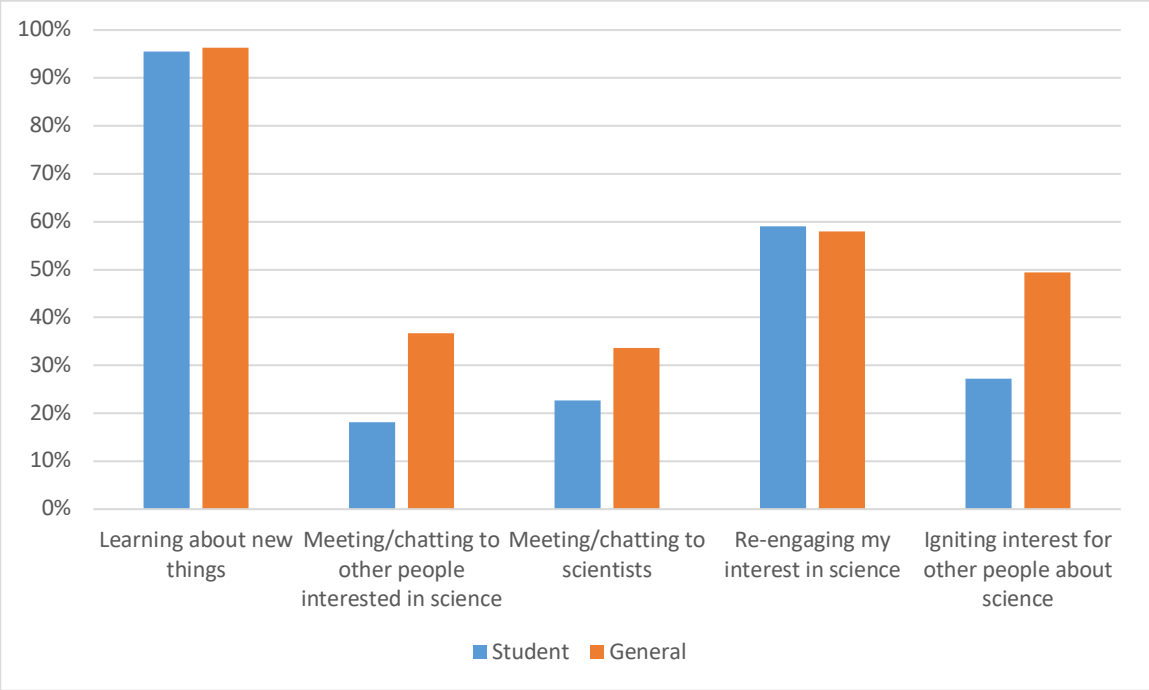

Figure 3: Reported benefits of leisure-time STEM related activities

3.2.2 Video material

The most reported method for watching TV for the **general survey**, with an older age profile, **was live (76%) or on demand (76%) through a television**. **Students** however, were more likely to report that they watched **videos through short clips on social media** (80%). Whilst the general survey respondents also watched social media videos (63%), students were much less likely to watch live TV on a television (53%). They did however, watch videos on demand through a television (74%) or tablet (74%) (Figure 4).

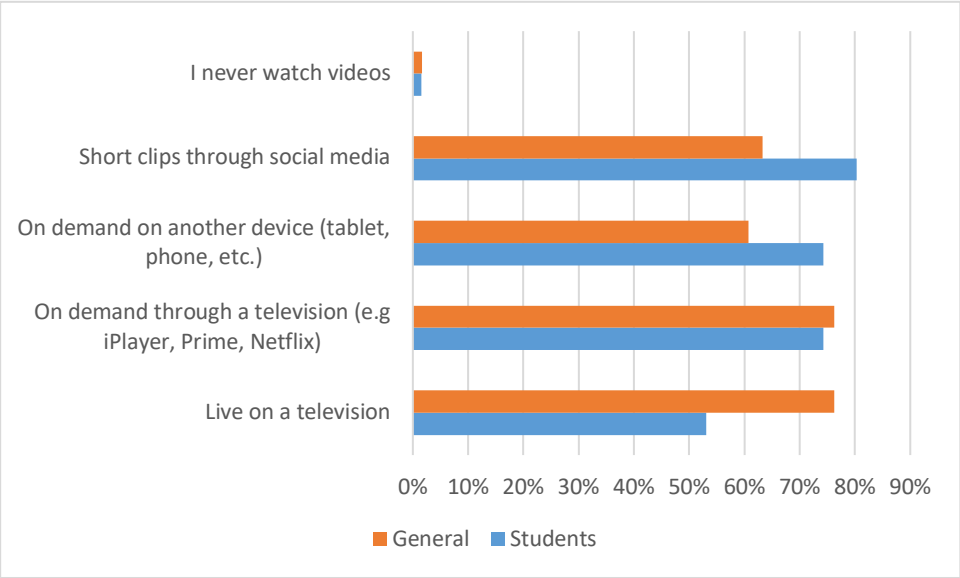

Figure 4: Methods of watching videos

3.2.3 Royal Institution Christmas Lectures

In total, 48% of all 420 people surveyed watched the Ri Christmas Lectures every year, while 25% watched when the subject interested them. However, this clearly varies hugely across age demographics (Figure 5). In the **student survey, only 27% of respondents reported having watched the Christmas Lectures at all**, while 73% had never seen them. In the general survey with a much older age profile, 56% reported watching the Christmas Lectures every year, and only 8% had never seen them.

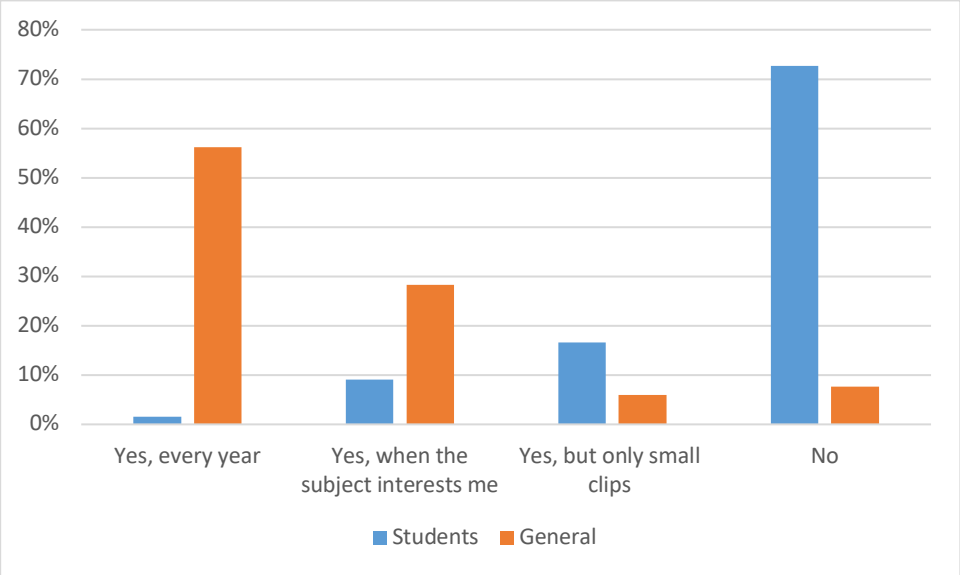

Figure 5: Reported frequency of watching the Ri Christmas Lectures

General respondents who had watched the lectures were much more likely to watch them live on TV (69%) or after broadcast on BBC iPlayer (71%). Of the 27% of student respondents who had seen the Christmas Lectures, the main way of watching them was in **short clips on YouTube** (72%) (Figure 6).

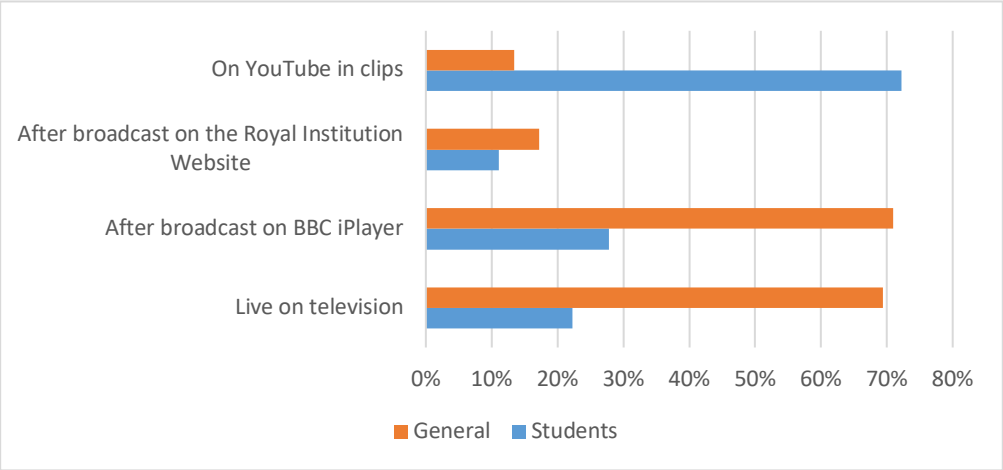

Figure 6: Method of watching the Ri Christmas Lectures

Respondents who had seen the Ri Christmas Lectures mostly reported that they watched them on their own, in both the general survey (54%) and the student survey (83%). However, respondents also indicated that the lectures were family viewing, with 33% of students watching with their parents, and general respondents viewing with their spouse (39%) and/or children (24%).

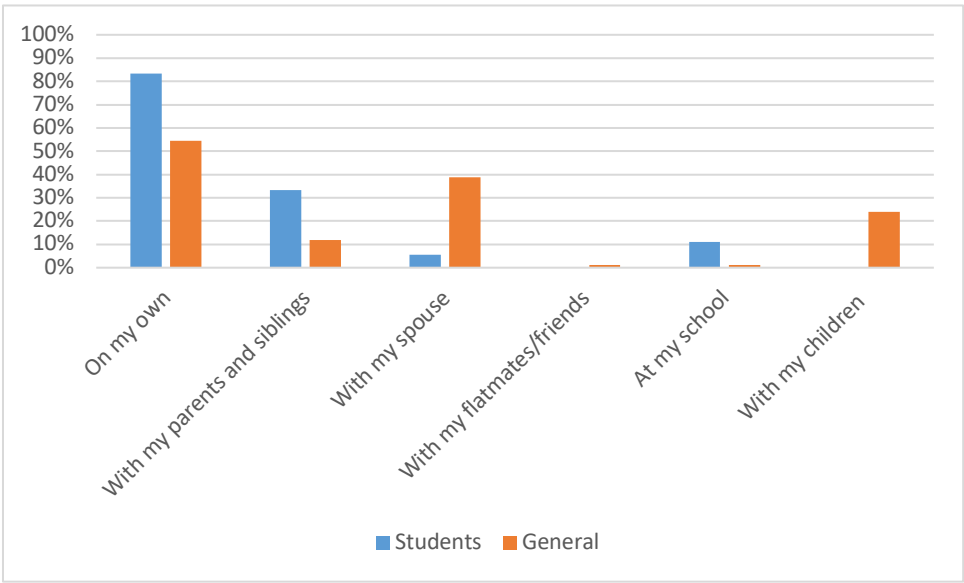

Figure 7: Viewing habits for the Ri Christmas Lectures

Respondents who had not watched the Ri Christmas Lectures were asked why they had not done so, given their interest in science leisure activities. **All of the students who had previously not watched the lectures (73% of the survey respondents) were not aware they existed.** Indeed, 61% of those student respondents did not know what age group the lectures were aimed at, while 50% guessed that they were aimed at 16+ year olds.

Amongst the general survey respondents, 44% indicated that they were not aware the lectures existed. The remaining respondents indicated that they don't have time to watch television (26%), they don't have time to watch a long programme (22%), or that they feel the lectures are not aimed at them/the topics don't interest them (26%) (Figure 8).

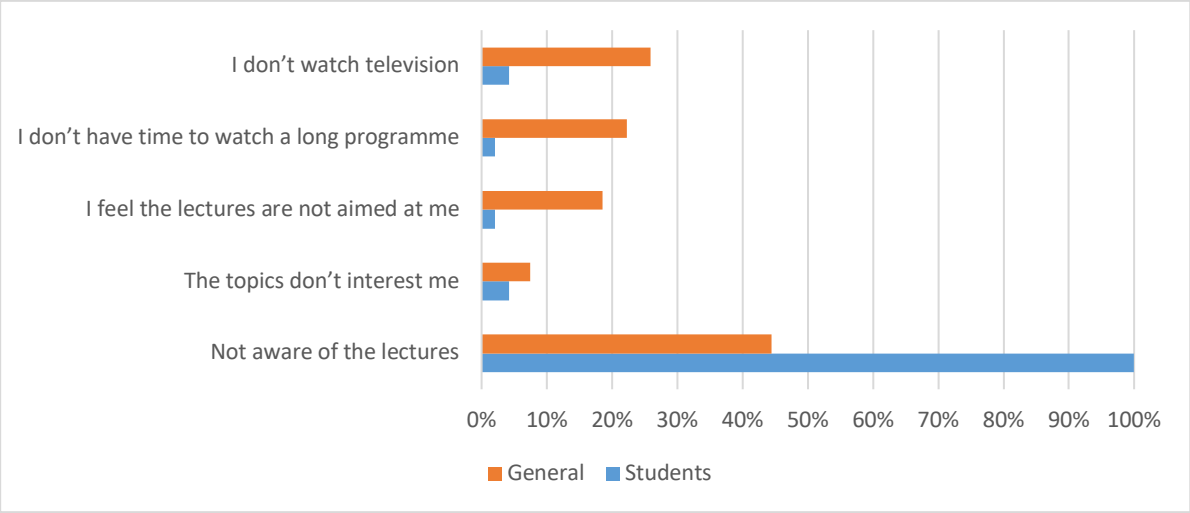

Figure 8: Reasons given for not watching the Ri Christmas Lectures

3.2.4 Improving the Christmas Lectures

"They can throw in as many explosions or elephants' toothpastes as they like but the format will always limit the audience. Format or audience. They get to prioritise one". Male survey participant, 25-34 years

In open questions, participants who had watched the Christmas Lectures were asked how they would improve them, while participants who had not watched them were asked what would encourage them to do so. The qualitative data was analysed using the content analysis method, giving rise to the themes in Table 1 on the following page. In general, participants thought the lectures could be improved by:

- More advertising to attract new audiences
- Re-evaluating who the lectures were aimed at, as whilst they appear to be aimed at young people, the length of the lectures is too long and on a TV channel which does not appeal to young people.

- Editing the lectures into smaller sections to be made freely available on YouTube and/or be shown on a different TV channel aimed at young people.
- Including a lecture, or extension material, which is aimed at adults, enabling adult Ri members to participate in the flagship series.
- Scientific topics and narratives which tackle current issues and which end with open questions to illustrate how science works.
- More diverse presenters who do not talk down to audiences (Alice and Aoife were praised for being inclusive and not talking down).
- Re-evaluating the benefits of a lecture in the Ri with the possibilities of TV recordings. Possibly including segments from scientific venues across the UK to broaden the regional appeal.

Table 1: Summary of content analysis for improving the lectures

Theme	Number of responses	Theme Description	Example quotes
Advertising	45	These participants indicated that they thought advertising for the lectures was not reaching the intended audiences. Some asserted the lectures should be more widely promoted to enhance visibility of the flagship series. Others thought the marketing was not striking the right tone or in the right formats for the intended audiences.	*"The content is great but even as an interested audience I sometimes forget about them so I'd like to see better/more advertising- to a range of audiences". Female, 18-24 years* *"Maybe have linked material available or advertised - previous series (or highlights from them) or stand-alone items with related topics. All to answer the question "why are this year's lectures worth viewing?" Or get some of those attending to talk in news magazine programmes before/after with their school friends". Male, 65-74 years* *"Advertise more widely, I had never heard of them until my girlfriend introduced me!" Female, 25-34 years* *"I don't think you could improve the lectures. You could improve methods of promoting them to the public". Female, 55-64 years*
Audiences	90	Many participants thought there was a conflict between who the lectures were aimed at, and who wants to watch them. Older participants thought the lectures were aimed at children, and had been dumbed down as a result.	*"Depends on whether you're trying to reach children, young adults or older people.... But don't dumb them down". Male, 55-64 years* *"More challenging material. Some years have dumbed down the subject so far that children switch off - they want to be amazed not taught". Male, 45-54 years* *"Go a bit deeper into the science with less "gee-whiz" slightly patronising demonstrations to young kids". Male, 75+ years*

		Many thought they were therefore missing dedicated adult audiences as a result.	*"They've been dumbed down to the point that as a holder of 2 science degrees I now find them more frustrating than engaging. Why do all science programs on TV now need to go for mass appeal and make the assumption that the audience knows nothing about the subject, but arts and history programs don't?" Male, 45-54 years* *"Maybe be presented from a different location that isn't as fuddy duddy (old-fashioned) and off-putting? Hard to say because I love science but I just don't watch them all that often because they're quite long and rarely stretch my knowledge. Plus, it's for kids, right?" Female, 25-34 years*
Lectures	78	These participants thought that the lectures were a flagship series which had an iconic status, with demonstrations and activities being a seminal feature of the format. However, many wondered if the needs of a live lecture and a TV programme were being confused. Others suggested that the series could tour around the country in order to make the most of a TV programme.	*"A 'lecture' is always going to be of limited appeal. The format is carried on tradition and location and not on the most effective means of communication. If the lectures are to be primarily designed to target the audience not in the room then they need to be produced with that in mind. No modern media uses an hour-long lecture format for mass entertainment/education. They can throw in as many explosions or elephants' toothpastes as they like but the format will always limit the audience. Format or audience. They get to prioritise one". Male, 25-34 years* *"The RI (much as it is the original home of the lectures) no longer feels like a good/relevant forum for the TV audience. It feels cramped and small; the camera angles aren't great and the viewer feels like they're just watching other people watching something instead of being part of it. This might be the nature of the Christmas lectures but it no longer feels current or inclusive". Female, 45-54 years* *"A lot of people who usually aren't into STEM in general tend to hear the word 'lectures' and run a mile!" Male, 25-34 years*

			"On TV they are competing with very many other science type programmes that have a far greater budget and scope [other countries, visits to labs, interviews with other scientists]. Like the Reith lectures that now travel to different venues, it might appeal to more if it was based in places like Birmingham/Manchester/Belfast - say at their science museums - with tickets given to the local schools - if it was not impossible you could take the iconic Faraday desk from the lecture theatre with you". Male, 65-74 years *"Some of the recent lectures have included demos or effects which make a bang or a flash that may be good for the theatre audience but actually provide little science content. Likewise, some of the participation moments. They slow down the show and don't do much for a viewer". Male, 55-64 years* *"A bit less time spent getting children out of the audience and thanking them for their contribution. It seems to break the flow of the lectures and makes them feel disjointed". Male, 35-44 years* *"They appear very elitist - small audience of already engaged young people from certain demographic groups. Although the Ri is a fabulous and iconic venue FOR SCIENTISTS, the lectures need to get out on the road to other parts of the country and reach other groups. OR do as the Proms etc do and have satellite performances all over the country". Male, 55-64 years*
Extension	16	These participants wanted to see more lectures over a longer period, perhaps with some aiming specifically at adults. Some people thought additional linked	*"The inclusion of children and teens is wonderful, but it can feel exclusionary for older audiences, making science something "for kids". Perhaps include adults in the target audience?" Male, 25-35 years* *"More episodes as in the old days of Laithwaite and Porter. 4 or 5 is optimum". Male, 65-74 years*

		resources would also encourage extended learning.	*"Although the Christmas lectures are aimed at children and that is great, a second Xmas lecture Aimed at a more mature audience (think TED talks) would be great". Male, 25-34 years* *"Link to the school curriculum so that there is build up in schools prior to the lecture on topics around the main topic". Male, 35-44 years*
Presenters	31	This theme refers to the fact that the presenting ability of the scientists is critical to the lecture's success. Alice and Aoife were roundly praised for their performance in 2018.	*"There was an amazing improvement this year. The energy and passion of the two hosts was incredible. They did not dumb anything down or patronise the audience and kids. The demonstrations were all fun and easy to understand as well". Female, 18-24 years* *"Presenter quality and performance skills are variable to say the least. Presenters should be evaluated and if necessary trained in basic performance skills as part of the preparation for the lectures". Male, 55-64 years* *"I do think we could do with some ethnic diversity in terms of the main presenters. Until recently I would have said we needed some gender equality too, but the last few years have seen some great lectures by women, e.g. Sophie Scott and this year's utter triumph with the Alice Roberts and Aoife L. Double act. That was the best I have seen for a long time, and the standard is very high. So, I wonder if more co-presenting might help?" Female, 55-64 years* *"The last Lecturers were the finest of the last 5-6 years as I have been watching the Lectures. Today, you need two lecturers representing our diversity as a species. Women, folks of colour, millennials and seniors with gusto. All scientists. Perhaps the Two Professors were so successful as they both were public*

			presenters of STEAM (Science Technology Engineering Arts Math)". Male, 55-65 years
Story	43	The topic and narrative of the lectures were raised as critical to attracting viewers to watch the series.	*"Ensure a) a strong narrative thread b) not dumbed down c) leaving an open-ended science issue at the end of each lecture - which used to be the case but doesn't seem to happen now". Female, 55-64 years* *"This year's was the best for many, many years, I think because it felt like a lecture with demonstrations added to it. Recently it has felt as though some good demos were found and then a lecture written to link them all together". Male, 45-54 years* *"The narrative arc of some of the lectures has also been poor - largely because there is a tendency to include too much stuff, and some stuff gets included because it allows the staging of a really cool demonstration, even if it's really a bit tangential to the subject matter and narrative of the show as a whole". Male, 55-64 years* *"They tend to lack storytelling and narrative and become a series of experiments which often can't match the exciting nature of the kind of external/pre-recorded video inserts audiences are now used to". Female, 45-54 years*
TV viewing	46	The format of the lectures was discussed in the light of current video viewing habits. Many participants stated they would not watch an hour-long programme, and so they	*"Create a shorter version that could be shared on social media". Female, 25-34 years* *"Move them away from BBC4 to a channel that kids actually watch, maybe even Netflix?" Female, 25-34 years*

		wanted the lectures to be cut into small video sections that could be shared on social media. Many thought that the lectures needed to be on more appropriate channels/media if they wanted to reach young people.	*"More freely available. Not always easy to find and also edited into smaller clips that can be used in education". Female, 45-54 years* *"I suspect that the target audience will want to watch it on You Tube etc. rather than live". Male, 65-74 years* *"While I enjoy the full-length versions, offering repeats of each episode split into three or four shorter mini episodes might be attractive to a wider audience and be ideal for platforms such as YouTube". Male, 65-74 years* *"Short teaser videos with quotes and inspirational questions. Promote as a way to open minds, start conversations around the kitchen table/with family members and inspire scientists of the future!" Female, 35-44 years*

3.3 Twitter Analysis

As well as the online surveys, there was also a wealth of data available on Twitter from members of the public sharing their thoughts about the Christmas Lectures. 1718 tweets (not including retweets) used the #xmaslectures hashtag during the months of December (2018) and January (2019). More still tweeted about the "Christmas Lectures" without the hashtag. A large number of tweets were from the Royal Institution themselves, as well as employees of the Ri and affiliated organisations and science communicators. For the purposes of this report, these tweets were not included in the analysis as we are interested in the perceptions of the public, specifically regarding any information about:

- Who was watching
- Why they were watching
- How they were watching

As well as other positive and negative feedback.

3.3.1 Who was watching

Age

The Christmas Lectures is marketed as family viewing, and there was a good amount of evidence on Twitter of families watching together, both with children and without (see Table 2 for quotes). There was evidence in the sample of children engaging all the way from age 5 to late teens. In the sample, nearly every mention of a child was accompanied by their age in brackets (see Table 2 for quotes). This is perhaps indicative of parents wanting to illustrate some point about the precociousness or studiousness of their child at a specific age and these motivations should be kept in mind when interpreting this data.

There were also many comments from adults watching, though these tweeters were often aware that they were engaging with something they perceived as being meant for children. Though there was also evidence of adults watching as families without any commentary on not being the target audience.

And many comments indicating people felt that the lectures were accessible while not dumbing down the material, making them appeal to "all ages". Some made the point that it was the lectures this year (2018) that were specifically suited to all ages, perhaps indicating that people feel this isn't always the case.

Perceptions around who the lectures are for also influenced one person's ideas about the time and venue they are shown:

> *"Hey @BBC, generations of kids have been turned on to science by @Ri_Science Christmas Lectures. It's really disappointing that they've*

been shoved out to 8pm on @BBCFOUR. The target audience are at least getting ready for bed by then"

Class

As well as age, there are other perceptions around who the lectures are for. These include issues of class. Only two tweets mentioned class (see Table 2), but both seemed to indicate a historical or lingering perception that the lectures were for middle class audiences.

Gender

There was also a lot of commentary focusing on gender. Historically, the Christmas Lectures have been dominated by male scientists and it has only been recently that women been invited to give the lectures, with the first woman lecturer not being until 1994. 2018 was the first year to feature two scientists who are women. Many comments focused on the scientists being good representations of scientists and role models for those watching, especially young girls.

3.3.2 Why they were watching

Tradition

One of the main themes for those tweeting about why they were watching the lectures was tradition and the habit of doing so every year. Tweets mentioned this as a tradition for individuals, and parents were especially pleased they could now share that tradition with their children.

A change in tradition

There was also some indication that the lectures this year had created some change that caused some that typically don't watch to tune in:

"I remember watching the @Ri_Science #xmaslectures as a kid and always loves them. I stopped watching them around 15 years ago as, for me, they lost their edge. Thank you @theAliceRoberts and @aoifemcl for restoring my interest in these lectures!"

"For the first time in years I've not got lost part way through the @Ri_Science Christmas Lectures. I think it's because @theAliceRoberts is a TV presenter as well as a scientist. She & @aoifemcl obviously had such fun working together, it made great TV."

There were also some negative comments from people who might typically watch to turn off:

"Royal Institution Christmas lectures were always an island of geekiness in a sea of entertainment; the sea is washing over them now. Disappointing."

"The Royal Institute Christmas lectures has gone a bit naff seems to be all wiz bang & with not a lot of substance shame"

How were they watching

The vast majority of tweets (65%) over the two-month sample happened during the three-day period where the lectures were broadcast (26th-28th December 2018), and mostly during the time period when they were being broadcast. This indicates that many people were watching as they were broadcast live on television. However, there were also people tweeting to report they would "catch up" or had just "caught up" with the lectures on BBC iPlayer.

Presenters

Almost all tweets in the sample were very positive, but not many identified specific reasons for the enjoyment. One thing that several people did mention very favourably this year was having more than one presenter (see Table 2).

Criticisms

Despite an almost overwhelmingly positive response, there were some tweets which raised some concerns. One was the use of animals in the show:

"Loved the #XmasLectures this year, Profs Alice and Aiofe were brilliant (wish I had fabulous female role models when I was young!) BUT no more live animals for entertainment please. They all looked terrified"

"Lots of scared looking animals on the @Ri_Science #xmaslectures tonight. Not sure it's entirely necessary to stress animals out for these things."

This raises an interesting issue, as the children attending the filming enjoyed having live animals on stage, with some stating it had helped them understand better what was being explained.

There were also some concerns about playing a musical tune on the replica skulls of our ancestors:

"BBCFour's RI Christmas Lecture from last night was very good. (I did anthropology at school so have a passing interest) Until ...the closing

moments. Whoever thought that was tasteful, respectful or appropriate should be sacked. #xmaslectures"

"Not entirely convinced by the final demo of tonight's Christmas lecture. Something slightly disturbing about hitting skulls to play music. #xmaslectures"

Table 2: Summary of twitter analysis

Theme	Theme Description	Example quotes
Family viewing	These tweeters indicated that they were watching the lectures together as a family.	*"It was a joy to watch with my family and for my children to take on board the lessons from the lectures. Thank you. #xmaslectures"* *"This was superb! Full of great science, fun demos and thought-provoking ethics. Fantastic job. My whole family loved it. #xmaslectures"*
Children viewing (with family)	Many tweets showed evidence of children watching at home, as well as evidence for the age of those watching.	*"My kids (5&7) enthralled by parts 1&2 #xmaslectures is a masterclass in joyful #STEM learning. Well done @aoifemcl & @theAliceRoberts & all involved."* *"Loving the Christmas Lectures. Had my kids 6 & 12 sitting in silence last night, a first this Christmas. Think they might be starting to love science nearly as much as me !!"* *"Just finished watching the final #xmaslectures with @theAliceRoberts and @aoifemcl with my 8 year old. She loved it, but her eyes lit up when she realised she can avoid eating her veggies and blame it on genetic variation, so thanks for that. Apart from that, great job."* *"Madam is fascinated by the #XmasLectures well done to @theAliceRoberts and @aoifemcl for making something very complicated accessible for all to understand (Madam is 11 and has a mild learning disability)"*

		"I loved tonight's lecture, really looking forward to the next 2 - my son (16) was absolutely riveted, even put his iPad down!! #xmaslectures" *"We all enjoyed the first lecture very much. Whole family watched and the youngest is 17. The Christmas Lectures are a long-standing family tradition with us."*
Adults viewing (with family)	These tweets come from self-identifying adults who are watching and enjoying the lectures with other adult family members.	*"Sat & watched with my youngest (23 yr old) son. Thoroughly enjoyed. What superb delivery you both have. Looking forward to the remaining 2 p.s tonight's was the first full #XmasLectures I've watched. My brother always watched them but they never appealed to me. They do now x"* *"@aoifemcl thanks for the # xmaslectures. I am 51 and watched them with my son, who is in his 2nd year studying biochemistry at @uniofeastanglia . with his and your help I am up to speed on DNA. better than any school science lesson"*
Adults watching with an awareness that the lectures are meant for a younger audience.	These tweets come from self-identifying adults who are watching and enjoying the lectures, but who indicate an awareness that the lectures are meant for an audience of children.	*"Catching up on the @theAliceRoberts Christmas lectures on iPlayer. I know they're for kids but they're still great."* *"I'm not the target audience but I've been watching for over 40 years and this year's with @theAliceRoberts make me wish I was young enough to be starting to choose an education, a career."* *"Loving watching @theAliceRoberts making science accessible for kids on the @Ri_Science Christmas lectures. Fascinating, even to this 38 year old child. #WomenInSTEM #stemettes"* *"Watching @theAliceRoberts christmas lectures and SO jealous I'm 43 and too old to be in the live audience for stuff like this. Humph."*

		"Really enjoyed tonight's Christmas lectures, fascinating as always! We've watched them for years and I look forward to sharing them with my children in the next couple of years" *"Once again the highlight of my seasonal TV viewing has been the Royal Institution #xmaslectures & I'm left wishing (a) it was all year round and (b) grown-ups could go too"*
Suitable for all ages	This theme refers to tweeters who felt the lectures were successful in appealing to a wide audience of both adults and children.	*"Nearly the end of the #xmaslectures - It's been a fascinating series for us adults as well as children!"* *"Personally felt this year's awesome #xmaslectures were engaging for most ages (not always the case). An excellent balance of science, fun, explanation and an enthusiasm for the subject."* *"Thank you @theAliceRoberts and @aoifemcl for absolutely wonderful #XmasLectures Great demonstration of how to communicate - to all ages!"* *"@theAliceRoberts at last, RI Christmas Lectures that don't dumb down the topic! #xmaslectures"* *"The Royal Institution #xmaslectures this year are great - brilliant example of STEM outreach that can attract and hold attention of both adults and children."*
Class	These tweets mention the audience of the lectures in relation to class.	*"@theAliceRoberts could not agree more, I didn't start watching the Christmas lectures till my mid thirties as I was a council house child and didn't know they existed! Hope that has now changed and it is reaching a wider audience."* *"@theAliceRoberts I really do enjoy the Royal Institution Christmas Lectures...sadly the audience is always so representative of middle class privileged children, not a realistic representation of society! #educationforall #stimulateallminds"*

Gender	These tweets mentioned the 2018 scientists being good representations of scientists and role models for those watching, especially young girls.	*".@aoifemcl and @theAliceRoberts smashing the #XmasLectures . Like @sophiescott before them, they show youngsters that a Professor looks nothing like the stereotypical old white dude. "* *"2 incredibly inspirational women - fantastic role models for my 16 yr old daughter who wants to be a scientist @theAliceRoberts @aoifemcl #xmaslectures"* *"@aoifemcl @theAliceRoberts, #xmaslectures. Thank you so much for these lectures. Not only were they brilliant to watch with my 9 year old daughter. They gave me an opportunity to show her there are no limitations to what she can achieve with her life. One day she can be like you."* *"Just 'caught up' with #xmaslectures and the amazing @theAliceRoberts and @aoifemcl. Totally brilliant. The 12 year old is now 'definitely' a biologist. Thank you for inspiring a generation. #girlpower"* *"I'm in the enjoyed camp. One of the reasons I grew to love science so much; @Ri_Science #XmasLectures have always had great presenters covering fantastic topics. And it's so cool to have such incredible women in sci like @theAliceRoberts and @aoifemcl as examples for my daughter."* *"If you haven't watched this year's #xmaslectures yet then you're in for an absolute treat. Two wonderful role models for any young person (especially girls) interested in science. So many good lessons too about diversity, from start to finish. I shed a tear at the end."* *"Everyone should watch this year's @Ri_Science #xmaslectures Some really key ideas for GCSE and life in general. Fascinating stuff - plus @theAliceRoberts and @aoifemcl are great role models for all wannabe scientists."*

Tradition	One of the main themes from tweets was tradition and the habit of watching the lectures every year.	*"Christmas wouldn't be Christmas without the Royal Institution lectures. Quite different from my childhood with the likes of Prof. Eric Laithwaite and Heinz Wolff but just as entertaining and educating. #xmaslectures #bbcfour"* *"So fun! [] continuing my tradition of watching #XmasLectures this Xmas with both kids. Happy days"* *"My dad a physicist would get the family around to watch #xmaslectures everyone single xmas & would record them on VHS to go over the STEM with me. This year I reminded my dad to record them! @TheIET @Ri_Science @STEMglasgow proud to be a #engineer @TheIET @STEMLondonHub @AFBE_UK"* *"I've watched the @Ri_Science #xmaslectures since I was a kid. I think this years could be the best I've seen yet. I'm thorough enjoying them @theAliceRoberts @aoifemcl"* *"Watching the #xmaslectures is becoming a firm tradition in our house, and we look forward to them each year. This is how we inspire the next generation - absolutely amazing @theAliceRoberts & @aoifemcl"* *"Just got through watching @theAliceRoberts and @aoifemcl on the Royal Institution (@Ri_Science) #xmaslectures. My daughter was captivated (and giggling her head off). She loves anatomy. Another family tradition passed on successfully."* *"I thoroughly enjoyed this year's lectures, as I've enjoyed them for the last 25 years beginning when I was a young child watching them with my dad. Thank you and well done! #xmaslectures @Ri_Science -- you've set yourselves high standards to maintain! :)"*

		"I've been watching the #xmaslectures with my Father for 50 years and we both think that the 2018 lectures with @theAliceRoberts and @aoifemcl rank among the very best. Fun, thought provoking and not afraid to tackle important issues. Fantastic."
More than one presenter	Another theme that several people mentioned was having more than one presenter in 2018.	*"I thought the double act worked extremely well in allowing very natural expansion, clarification etc. Thank you!"* *"Really enjoying the double-act of two awesome women scientists on #XmasLectures. It feels so conversational and engaging! @theAliceRoberts does keep making me laugh though - top cell-merging of that placenta "* *"Dual presenter format for this year's #XmasLectures is really great. Obviously the fact that @aoifemcl and @theAliceRoberts are already great by themselves helps."* *"The sample also contained a lot of tweets complimenting the scientists on their outfits. Without a dataset for comparison, it's not possible to say that this was a feature of the social media commentary which was gendered, but it's possible."*

A note

The evidence and feedback collected from Twitter is overwhelmingly positive. However, Twitter, as with most social media, is a highly self-selecting audience of those wanting to broadcast some identity-defining information about themselves or their children. This causes statements to be bound to a signal about identity, and we need to interpret the feedback garnered from this dataset through that lens, understanding that many people less bound to an association with the lectures and the Ri may not choose to broadcast their experience of the lectures on a public platform.

4. Reflections and recommendations

In this section, the evaluators reflect on the successes and challenges of the live filming and broadcast of the Christmas Lectures.

4.1 Recommendations from live audience

1) Keep the engaging, interactive and high-quality demonstrations, as there are much loved by the audience.
2) Increase the opportunities for audience participation, making it possible for more younger people to play a more active role in the lectures.
3) Improve the queuing and waiting experience. Perhaps the audience could come in in a phased manner or there could be activities, leaflets or other materials available while they wait to get in the lecture room.

4.2 Recommendations from Twitter analysis

- Keep the broadcast on the television as the vast majority of watchers seem to be engaging live and value the tradition of watching live and as a family.
- Consideration of target audience and time and venue. One tweeter felt that 8pm on BBC4 was too late for younger audiences and not a typical channel to show content for children.
- Keep the level the same – people reported that the level of science and entertainment worked for them.
- Consider two lecturers for future instantiations of the lectures – this had very positive feedback.
- Endeavour to continue featuring women, as well as men, in the field of science.

4.3 Recommendations from survey

- Re-evaluate who the lectures are aimed at. If they are aimed at younger viewers and families then they need to be on a more familiar TV station, at a more appropriate time slot, with better marketing.
- If the lectures are aimed at younger people, the focus needs to be much more on cutting down the lectures into short video clips which can be viewed on social media or YouTube, as this is how young people consume video material.
- The current audience appears to be science-interested older audiences (35-44 years) who may also watch the lectures with their families. If the Ri want to keep and interest

this audience, some of the lectures need to be made less child-like, possibly with the inclusion of a lecture just for adults.

- Consider the possibilities offered by TV recordings, perhaps with segments from scientific venues across the UK to broaden the regional appeal.

5. The full evaluation: key findings and recommendations

Here we present several tables which bring together the key findings and recommendations across the four reports (three interim reports and the current final report). This is organised by event type, as is likely to be more useful for the Ri.

Event	Key findings	Recommendations
Live shows (not at the Ri) – **Big Bang Show** (for details, see Interim Report 1: "Evaluation of the Royal Institution show at the Big Bang Fair")	Use of audience volunteers was very successful and key in keeping the engagement levels up. Presenters: highly professional, engaged and enthusiastic. Link to the Christmas Lectures is not clear.	Continue to use audience volunteers. Consider cutting down the show by 5-8 min to keep engagement levels up. A better link to the Christmas Lectures should be establish, perhaps through leaflets (distributed as the children enter the show area and/or be available as part of their welcome kits). Enhance promotion of the Christmas Lectures and the Debate Kit (as the audience is the target audience for the Debate Kit). Presenters and the wider team should be given sufficient time to prepare and rehearse.

Event	Key findings	Recommendations
Schools Conference (for details, see Interim Report 2: "Evaluation of the Royal Institution Unconference for Schools: 'A matter of privacy'")	The young people enjoyed hearing from the expert speakers. The young people enjoyed speaking to other young people, and some relished the chance to present their findings in front of others. The interactive software Mentimeter enabled those who were too shy to speak up a chance to get involved in the voting. Travelling into central London and only allowing 12 children per school to attend is a limiting factor to wider school participation.	Keep the event experience the same but change the event timing. Encourage whole class group attendance with prior preparation time. Form teacher networks to advocate for the Ri and advise on outreach work. Consider more structure for the discussion sessions and feedback, along with more opportunities for young people to feed into science policy. Encourage more links between all the Ri outreach activities. Enhance social media promotion of the Christmas Lectures.

Event	Key findings	Recommendations
Live filming of the Christmas lectures (for details, see Interim Report 3)	The filming of the Christmas Lectures was valued by the young people in the audience. The filming sessions were well organised and ran like a well-oiled machine. The young people enjoyed being in the Ri venue and the chance to watch live, interactive science. Lectures were described as interesting and fun. Presenters received very positive feedback: comments covered their humour, emotion and how interesting they were. The high-quality demonstrations are one of the highlights of the filming. Attending the filming presents extra value to young people, when compared to watching the lectures on TV. Attending the filming led to increased enjoyment and interest in science, increases knowledge and increased engagement with science at school. It also showcases how complex science is.	Keep the event experience overall the same: the young people enjoyed watching the live Lectures at the Ri and being able to hear from experts, as well as having the opportunity to volunteer and do the demonstrations. Increase opportunities for audience participation and interaction. Make sure the content is not too childish, as this might put off some of the older members of the audience. Improve the waiting time and queuing experience to get in the lecture room.

Event	Key findings	Recommendations
TV broadcast	Watching the lectures is a family tradition with all ages engaged. The 2018 lectures were perceived as inspirational to younger people, specifically young girls due to the two presenters being women. People who had not watched the lectures had not heard of them. Some older audiences are put off by the 'dumbed down' demonstrations and language. The lecture venue can be perceived as off-putting to those who do not have cultural capital.	Keep the broadcast on the television to ensure the tradition of watching live and as a family. Keep two lecturers for future instantiations of the lectures – this had very positive feedback. However, consider the target audience, timings and venue. Many felt that BBC4 in the evening is too late for younger audiences and not a typical channel to show content for children. Consider segments of the show coming from regional scientific venues. Consider a lecture just for adults with more detailed content. Consider editing the lectures into shorter clips for social media. Consider much wider advertising to broaden the appeal of the show.

Event	Key findings	Recommendations
Live broadcast at Science Centres (for details, see Interim Report 3)	Those venues who did run activities alongside the lectures reported that this helped with audience engagement during times when there was pauses in the lecture. Venues reported that the live stream was easy and simple to set-up. Attendees at the live events had an awareness of the Christmas lectures and were happy that they had the chance to experience the live phenomenon. This has opened the opportunity to enthusiasts who can't go the main lectures. Each venue organised their own event giving them ownership of their efforts. This was perceived as very positive.	Provide the science centres with a media plan for marketing the events. Allow venues to communicate between themselves about what they are planning, and exchange ideas. The Ri could provide suggestions for some activities, crafts or experiments relevant to the lectures that could be done to fill gaps during the lectures at the external venues. With the event happening so close to eating times for families, perhaps a good compromise to this would be encouraging live-streaming venues to provide catering.

Appendix I: Interview Schedule – live audience

Science Communication Unit,
University of the West of England
Coldharbour Lane, Bristol
margarida.sardo@uwe.ac.uk

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 the Christmas Lectures filming you attended in December 2017/December 2018 *[state appropriate date]*.

- What made you attend the filming?
- What was your favourite aspect about attending the Christmas Lectures filming?
- And what was your least favourite aspect of attending the Christmas Lectures filming?
- How did you feel about attending the Royal Institution headquarters in London?
- Before attending last year's filming, have you ever watched the Christmas Lectures?
    - If yes, please provide details: where (BBC, iPlayer, YouTube), with who?
    - If no, why not?

Thinking about <u>what happened after</u> you attended the filming:

- How do you feel about science since attending the filming?
- Have you connected with science in any other ways after attending the filming? Did you, for example, attend more science-related activities or watched more science-related content on TV, online, etc.? Or got more engaged with science at school?
- How could the Royal Institution make the Christmas Lectures better for you?
- Are you planning on watching the Christmas Lectures this year, and how will you watch them?
    - Please explain your answer.
    - If no, what would make you watch the Lectures?
- Is there anything else you would like to add about the Christmas Lectures?

Thank you for your time.

Appendix II: 'Science enthusiast' questionnaire

Science Communication Unit
University of the West of England, Bristol

Do you love science activities? Then tell us what you think about the Christmas Lectures!

This project aims to evaluate the Royal Institution Christmas Lectures and related events. The project is led by the University of the West of England, Bristol and was funded by the Royal Institution.
You are invited to take part as someone who is a science enthusiast. You need to be aged over 18 years old and live in the UK.

The questionnaire should take no more than ten minutes to complete. Returning the questionnaire to us indicates that you consent for your answers to be used in the study. Your answers are anonymous and will be grouped thematically with other comments. Data will be stored in accordance with the General Data Protection Regulation.

Thank you for your time.

This study was given ethics consent on the 20th March 2018 by the Research Ethics Committee of the Faculty of Environment and Technology, chair Alistair Clark, Alistair.clark@uwe.ac.uk.

1. **Do you take an interest in science and STEM topics (science, technology, engineering, and mathematics) in your leisure time?**

Yes	◯
No	◯

2. **What sort of STEM-related activities do you participate in during your leisure time (at least once per year)? Please tick all that apply**

Read science magazines	◯

Follow science social media outlets	◯
Read or contribute to online science forums	◯
Watch science documentaries on TV	◯
Visit science centres/museums	◯
Visit science festivals	◯
Attend public lectures or events on science topics	◯
Other, please specify:	

3. **What do you like about the STEM activities that you do take part in? (please tick all that apply)**

	Please tick all that apply.
Learning about new things	◯
Meeting/chatting to other people interested in science	◯
Meeting/chatting to scientists	◯
Re-engaging my interest in science	◯
Igniting interest for other people about science	◯
Other, please specify:	◯

1) **Please tick all the ways that you watch video material. Please indicate which method you most often use, by placing a 1 beside it.**

Live on a television	◯
On demand through a television (e.g. iPlayer, Prime, Netflix)	◯
On demand on another device (tablet, phone, etc.)	◯
Short clips through social media	◯
I never watch videos	◯
Other, please specify:	

4. **What STEM-related video material do you watch in your leisure time? (naming just a few is fine)**

5. Have you ever watched the Royal Institution's Christmas Lectures?

Yes, every year	◯
Yes, when the subject interests me	◯
Yes, but only small clips	◯
No	◯

3a) If you answered Yes above, do you watch the lectures:

Live on television	◯
After broadcast on BBC iPlayer	◯
After broadcast on the Royal Institution Website	◯
On YouTube in clips	◯

3b) If you answered yes, who do you usually watch the lectures with?

On my own	◯
With my parents and siblings	◯
With my spouse	◯
With my flatmates/friends	◯
At my school	◯
With my children	◯
Other, please specify:	

3b) If you answered No above, why don't you watch the lectures?

Not aware of the lectures	◯
The topics don't interest me	◯

I feel the lectures are not aimed at me	◯
I don't have time to watch a long programme	◯
I don't watch television	
Other, please explain:	

2) This question will inform future development of the Christmas Lectures.

a) If you have ever watched the Christmas Lectures, how do you think they could be improved to appeal to a wider audience (a few words are fine)?

b) If you have not watched the Christmas Lectures, what would encourage you to watch them (a few words are fine)?

About You

3) Gender

□ Male □ Female □ Other □ Prefer not to say

4) Do you have any links to science, technology, engineering or mathematics study or work?

No, I am just generally interested in these topics	◯
I studied these topics at degree level	◯
I teach (or taught) Science, Technology, Engineering or Mathematics	◯
I work (or worked) in a Science, Technology, Engineering or Mathematics field	◯

5) How old are you?

□ 18-24 □ 25-34 □ 35-44 □ 45-54 □ 55-64 □ 65-74 □ 75+ □ Prefer not to say

9) What is your postcode?

_____

Thank you for your time.

Appendix III: UWE students questionnaire

Science Communication Unit
University of the West of England, Bristol

Do you love science activities? Then tell us what you think about the Christmas Lectures!

This project aims to evaluate the Royal Institution Christmas Lectures and related events. The project is led by the University of the West of England, Bristol and was funded by the Royal Institution.
You are invited to take part as someone who is a science enthusiast. You need to be aged over 18 years old and live in the UK.

The questionnaire should take no more than ten minutes to complete. Returning the questionnaire to us indicates that you consent for your answers to be used in the study. Your answers are anonymous and will be grouped thematically with other comments. Data will be stored in accordance with the General Data Protection Regulation.

If you leave your email address at the end of this questionnaire, you will be automatically entered into a free prize draw. **There is one £50 Amazon voucher to be won.** The winner will be selected at random from all entries received and will be contacted on the 15th January 2018.

Thank you for your time.

This study was given ethics consent on the 20th March 2018 by the Research Ethics Committee of the Faculty of Environment and Technology, chair Alistair Clark, Alistair.clark@uwe.ac.uk.

- **Do you take an interest in science and STEM topics in your leisure time?**

Please tick all that apply.

Yes	◯
No	◯

- **What sort of STEM-related related activities do you participate in during your leisure time (at least once per year)? Please tick all that apply**

Read science magazines	◯
Follow science social media outlets	◯
Read or contribute to online science forums	◯
Watch science documentaries on TV	◯
Visit science centres/museums	◯
Visit science festivals	◯
Attend public lectures or events on science topics	◯
Other, please specify:	

- **What do you like about the STEM activities that you do take part in? (please tick all that apply)**

	Please tick all that apply.
Learning about new things	◯
Meeting/chatting to other people interested in science	◯
Meeting/chatting to scientists	◯
Re-engaging my interest in science	◯
Igniting interest for other people about science	◯
Other, please specify:	◯

6) Please tick all the ways that you watch video material. Please rate which method you most often use in the box below.

Live on a television	◯
On demand through a television (e.g. iPlayer, Prime, Netflix)	◯
On demand on another device (tablet, phone, etc.)	◯
Short clips through social media	◯
I never watch videos	◯

Other, please specify:

- **What STEM-related video material do you watch in your leisure time? (naming just a few is fine)**

- **Have you ever watched the Royal Institution's Christmas Lectures?**

Yes, every year	◯
Yes, when I was younger	◯
Yes, when the subject interests me	◯
Yes, but only small clips	◯
No	◯

3a) If you answered Yes above, did/do you watch the lectures:

Live on television	◯
In school/college	◯
After broadcast on BBC iPlayer	◯
After broadcast on the Royal Institution Website	◯
On YouTube in clips	◯

3b) If you answered yes, who do you usually watch the lectures with?

On my own	◯
With my parents and siblings	◯
With my spouse	◯
With my flatmates/friends	◯
At my school	◯
With my children	◯

Other, please specify:	

3b) If you answered No above, why don't you watch the lectures?

Not aware of the lectures	◯
The topics don't interest me	◯
I feel the lectures are not aimed at me	◯
I don't have time to watch a long programme	◯
I don't watch television	◯
Other, please explain:	

- **What age group do you think the lectures are aimed at (tick all that apply)?**

<10	◯
10-13	◯
13-16	◯
16-18	◯
18 +	◯
Don't know	◯
Please explain:	

- **This question will inform future development of the Christmas Lectures.**

  a) If you have ever watched the Christmas Lectures, how do you think they could be improved to appeal to a wider audience (a few words are fine)?

  b) If you the Christmas Lectures, what would encourage you to watch them (a few words are fine)?

About You

- Gender

□ Male □ Female □ Other □ Prefer not to say

- What Faculty are you currently studying in at UWE?

Health and Applied Sciences	◯
Environment and Technology	◯
Arts, Creative Industries and Education	◯
Business and Law	◯

Please state your course:

- How old are you?

□ 18-24 □ 25-34 □ 35-44 □ 45-54 □ 55-64 □ 65-74 □ 75+ □ Prefer not to say

- Please leave your email address if you wish to enter the prize draw:

Thank you for your time.