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Nights at the museum: integrated arts and microbiology public engagement events enhance understanding of science whilst increasing community diversity and inclusion

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Abstract

This study uses integrated art and science events to explore a blended approach in improving public understanding of current scientific topics and widening participation within the local community. The events were a Halloween-inspired microbiology-themed series of interactive exhibitions hosted within a national museum as part of an existing series of adult education evenings. A representative sample of 102 mixed methods exit questionnaires, based on determining (i) audience diversity and (ii) understanding of scientific topics, were analysed by qualitative and quantitative approaches, and a post-attendance focus group was carried out to determine longer term impact of the event. Participants were grouped as 'Science', 'Arts', 'Both' or 'Neither', according to their past experience and engagement. These events welcomed more participants from the Arts and Neither subsections hence engaging a group of people who would not usually visit science public engagement events or comparative events hosted in traditional academic settings, highlighting the importance of venue choice in reaching new audiences and widening participation. An increase in perceived understanding of science was observed by all groups of participants with reported enjoyment focused around the science talks, presentations and blended art-science activities. A putative impact in science capital is observed with participants reporting an increased likelihood of attending science events in the future. Furthermore, increased discussion and awareness of science in society is evidenced by participants. Blended art and microbiology exhibitions enhance the accessibly of science public engagement events and is likely to increase science capital; the impact of this on cognitive polyphasia is also discussed.

INTRODUCTION

There is a growing narrative to engage the public with science in novel ways and to reach new audiences [1–4]. To achieve these aims in informal STEM (Science, Technology, Engineering and Maths) learning is challenging, and despite attempts organisers frequently report seeing a lack in audience diversity and repetitive clientele [5]. Events that are aimed at adults are often criticised for 'preaching to the converted', whereby attendees are those already engaged within the scientific field [6]. Events targeted at families with young children are often limited by venue choice and miss reaching all subsets of the community [7, 8].

Participation in public engagement events often relies on a good exposure to, appreciation or understanding of and aspirations towards STEM (collectively components of existing 'science capital', and/or a pre-existing affiliation with the host venue [9]. Surveys exploring levels of science capital in young individuals (11–15) reveal that it is in part likely to reflect that of their parents resulting in a limited diversity of attendees [10, 11].

Underrepresentation of ethnic minority groups in STEM subjects is evident throughout the UK education system [12] and is recognised globally [13]. The problem carries through into the STEM workforce and also noticeably into senior and managerial STEM positions. The UK government and scientific agencies, Research Councils, professional bodies and businesses acknowledge the issue and have various agendas in place to tackle the problem [14–16]. However, very little has

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Abbreviations: BAME, Black, Asian and Minority Ethnic; STEM, Science, Technology, Engineering and Maths; UTI, urinary tract infection.

changed since it was highlighted in early reviews by Roberts [17] and Sainsbury [18] apart from it moving higher up the political agenda throughout this decade [19].

Selin *et al.* [20] in discussion of the work by Stilgoe *et al.* [21] and Davies [22] argue that the rigid way of viewing public engagement by linking it to science governance ignores the fact that the majority of the public engage in science by informal events such as science cafés. With this in mind, it is vital that public awareness of STEM issues, engagement and participation with STEM events, with a view to increasing science capital, is opened up to all groups within our society [12].

Our further motivation for designing and delivering public engagement events, as for many researchers, is personal enjoyment achieved by recognising the partnership relationship formed with the audiences, rather than a one-way transmission of information [23]. Through a range of original and enjoyable multidisciplinary activities, we can discuss science informally and equalise the relationship between scientist and lay person, and when members of the public have prior knowledge and experience to contribute then all participants in the activity can learn [24]. There has been a shift in how universities deliver public engagement activities in recent years. Events are no longer seen as merely an occasion for scientists to 'educate' the lay person, but an opportunity for two-way dialogue between the 'experts' and 'non-experts' [21, 25, 26]. Furthermore, this reciprocal dialogue, coupled with the informal and formal feedback collected at events enables scientists to make both small incremental changes and larger innovative decisions about future events, with an aim to engage wider audiences, initiatives such as citizen science have been particularly successful in this aim [27].

Essex and Haxton [28] in a recent project were able to highlight the value of running STEM activities in non-STEM settings as a way of accessing those with lower levels of science capital, and this approach has been successfully reviewed in other literature particularly looking at museum-managed events [29]. Recently STEM public engagement and participation events have taken place at music and arts festivals providing access to a novel target audience [30, 31]. Another example of a popular approach is science 'busking' in town centres [32]. Social media are platforms for public engagement and discussion [33, 34]. During development of the current event it was decided that the exhibition should take place outside of the university setting to increase engagement and learning from those who may not feel entirely comfortable within a higher education institution [35, 36]. This would help to overcome the challenge of reaching new audiences and diversifying the demographics of visitors.

In summary, public engagement in science needs to engage the full demographic of society. As discussed, much work has been done to address this, currently however, science outreach fails to connect with many groups in underrepresented groups. Previous studies have focused on increasing participation of science events by hosting them in non-science setting, such as pubs and music festivals to increase accessibility to those with low science capital. Here, we advance this approach by designing a blended art and science event to increase accessibility at both venue level and through the design of the activities within the event itself.

To complement the scientific knowledge base provided by the Biomolecular Sciences Research Centre from Sheffield Hallam University an arts collaborator was sought. Museums Sheffield were obvious partners as they have flexible exhibition sites over several sites in Sheffield city centre and have a pre-existing series of adult-education evenings, termed 'Live Lates' [37]. Our approach was to engage a group of people on topical scientific issues who would not usually visit science-based events by undertaking a blended science and arts exhibition at the museum.

The aim of this work was to evaluate the impact of these blended art and science events and determine if the impact on participants differed based on their previous participation in art and/or science events.

METHODS

Events

The events, 'The Horror Within' (2017) and 'The Science of Science Fiction' (2018), were aimed at informal science learning for adults and involved a mixture of science and arts content. To ensure the events did not become binary, a combined approach was taken to develop hands-on, arts-inspired activities to run throughout.

Across the two events, Museums Sheffield provided: a display of antique medical equipment; ghost tours of the old morgue; still life drawing workshops; performance artists in costumes; body painting of organs; vintage Space Invaders and Avengers pinball games; live pop-up sketching of visitors as superheroes; intelligent robots and B-movie sci-fi short film screenings.

The authors utilised a variety of formats (lectures, stalls, crafts and tours) to introduce several scientific concepts to the participants (Fig. 1). For example, the concept of the microbiome was introduced via a 'make your own poo' station where visitors made poo in artificial gastrointestinal (GI) tracts, with accompanying fake poo in jars to discuss the components of faecal samples. The lightbox displayed agar-art using several selective and diagnostic agars with bacteria from different human microbiotas whilst several short talks included the microbe with talks such as 'Poo transplants, a difficult subject to swallow'. Another example was how epidemiology and diagnosis were introduced in the outbreak zone with the fictional pathogen '*Pseudomonas zombeii*'. This was supported by talks such as 'World-destroying superbug from a parallel universe' and the light box displaying agar-art from a range of pathogenic bacteria.

Exit questionnaire

Exit feedback was collected by a mixed methods exit questionnaire designed using conventional methodologies [38–41]. A mixed methods approach allowed for a range of responses to

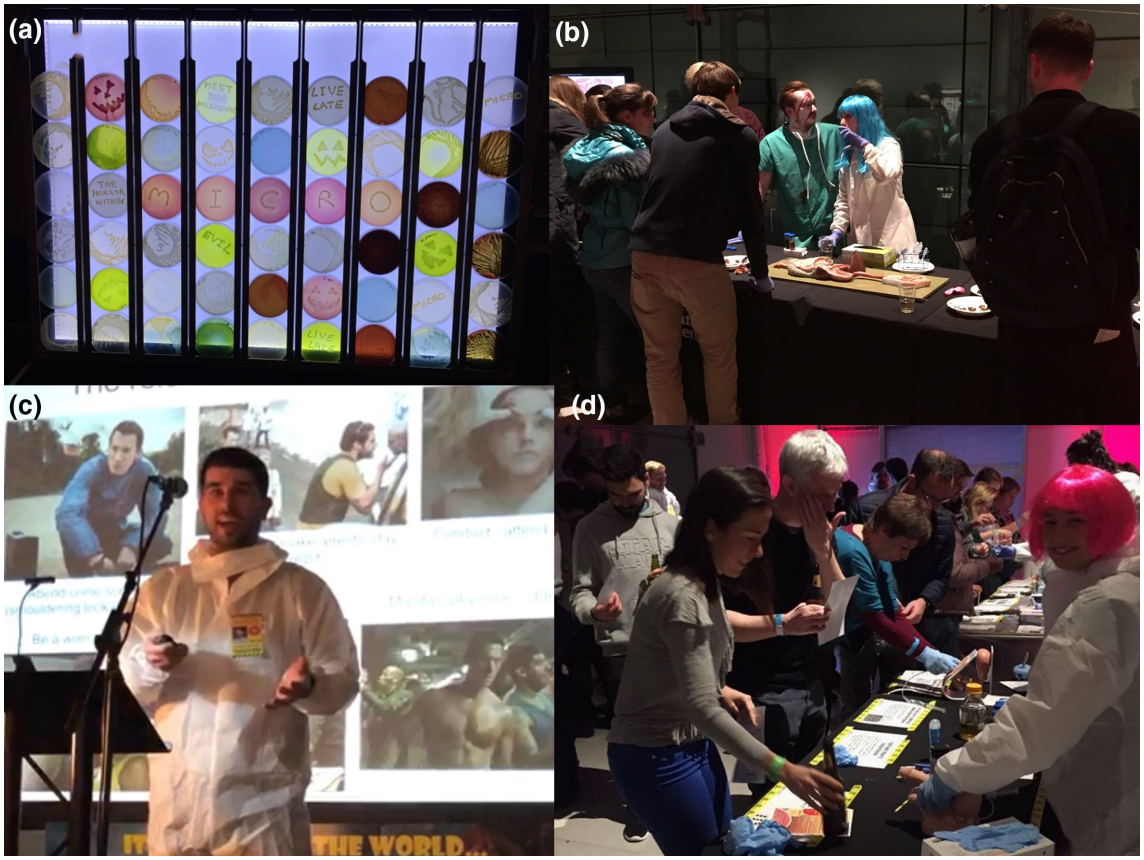

Fig. 1. Variety of activities at Live Lates events. (a) Interactive light box which formed part of the 'meet your microbiome' exhibit, (b) 'making poo' section of the experimental zone; this stall enabled visitors to mimic the digestion process by adding food and chemicals to an artificial stomach and then squeeze out the contents, (c) the mini-lecture series ran parallel to the interactive exhibits and provided the scientific background to the Live Lates, matching the event themes and (d) the urine and urinary tract infection activity where visitors could test simulation urine for markers of disease and infection.

be collected and analysed, without being a burden on participant's time and maximising our response rate.

Analysis

Participant ethnicity for the two events was collated and compared to Sheffield ethnicity data, statistical significance was determined by Chi-squared test. Participants were categorised depending on what type of attractions they had visited or attended in the last 12 months. Visiting an art gallery or literacy festival was defined as 'Arts' whereas visiting a science museum/ science centre, science festival or working laboratory or similar scientific site was defined as 'Science'. A participant was categorised as 'Both' if they had attended both arts and science events or 'Neither' if they had attended neither.

Quantitative analysis of learning outcomes entailed separating responses based on the participant type, determining the average and standard deviation for each content area and then determining any statistical significance on the increase in learning using a Wilcoxon signed-rank test. The qualitative analysis was performed by grouping the free text responses into themes through data driven thematic analysis [42]. These responses were grouped together into similar themes for discussion and analysed by participant type using a Chi-Square goodness of fit test, Wilcoxon signed-rank test or Kruskal–Wallis test.

Focus group

A focus group was held on 13 March 2019 at Sheffield Hallam University, 4 months after The Science of Science Fiction Live Late event. The focus group consisted of four participants of The Science of Science Fiction event willing to give further information on their experience and the impact of the event. Participants were asked a series of open-ended questions and encouraged to have an open discussion [43]. The chair of the focus group was an author not involved in the original event to limit bias [44]. The discussion was recorded with audio recording equipment and sent for transcription and then analysed manually. Briefly, a grounded theory approach was taken with line by line open coding to identify key categories within the data followed by axial coding to identify links between these categories [45, 46]. Direct quotes for each category were then identified.

Table 1. Comparison of participant ethnicity compared to the local population. Self-reported ethnicity of participants from exit questionnaire from The Horror Within (*n*=51) and The Science of Science Fiction (*n*=51) was compared to that of Sheffield (*n*=552698) as described by the 2011 census (Office for National Statistics, 2011)[62].

Ethnicity	The Horror Within (2017)*	The Science of Science Fiction (2018)*	Sheffield census (2011) [41]
White / White British	93.9%	88.5%	83.7%
Black / Black British	0.0%	0.0%	3.6%
Asian / Asian British	4.1%	5.8%	8.0%
Mixed	2.0%	5.8%	2.4%
Other	0.0%	0.0%	2.2%

*Indicates $P<0.001$, Chi-squared test compared to Sheffield Census 2011.

Ethics

Ethics for this study were acquired through the Faculty of Health and Wellbeing Ethics Committee following the Sheffield Hallam University Research Ethics Policy; ER5414813 (The Horror Within) and ER10872482 (Science of Science Fiction). Ethical approval was given after initial scrutiny as no identifiable, confidential or controversial information would be collected.

RESULTS AND EVALUATION

Participants

To determine whether the audience of the adult-orientated blended art and science events were predominantly people who usually target science or arts events exit questionnaires were undertaken; The Horror Within had an uptake of 51 out of 188 visitors whilst The Science of Science Fiction had an uptake of 51 out of 180 visitors. Participants were categorised depending on what type of attractions they had visited or attended in the last 12 months. Visitors were said to be 'Arts' if they had only visited arts events, 'Science' if they had only visited science events, 'Both' as they had attended both science and arts events and 'Neither' as they had attended neither science or arts events. The Science of Science Fiction attracted a higher proportion of Arts participants than The Horror Within (41.2 vs 26.5%), while the Horror Within attracted higher proportion of Both participants (34.8 vs 49.5%). The two events attracted the same proportion of Science and Neither participants (8 and 16% respectively). The types of participants at The Horror Within were not significantly different to the participant types at The Science of Science Fiction.

As Black, Asian and Minority Ethnic (BAME) groups are often underrepresented in STEM, the ethnicities of participants were collected from both The Horror Within and The Science of Science Fiction. The data was then compared to the demographic of Sheffield (Table 1) and were found to have statistically significant poor representation from BAME communities.

Participants' perceived learning

The science content for the events was determined based on the authors' and their colleagues' interests, expertise and current hot topics within their fields, with a focus on perceived taboo topics linked to the human body the first year. This content was categorised into six themes for the Horror Within event: parasitic worms, bacteria in/on the human body, DNA, werewolves and zombies, antibiotic resistance and how poo is made. For The Science of Science Fiction event the content was categorised into five themes: urinary tract infections (UTI), PCR/DNA, bacteria, the immune system, searching for new antibiotics. This information was communicated with participants through a variety of methods including short talks, posters, information sheets and either stand-alone discussions with staff or those which occurred during blended art, science activities or demonstrations. Within the exit questionnaire, when asked 'Did you learn anything new?' on a scale from 1 to 10, the average participant score was 7 (±2), with no statistical difference between the groups for either Live Lates events.

The participants were then asked via the exit questionnaire, 'How much do you know about the following?' before and after the event for the difference science topics covered over the event. To determine how much was learnt in each topic the data were analysed both by types of visitor and by topic (Figs 2 and 3).

Exit questionnaire analysis showed all areas had an increase in perceived knowledge after the Horror Within event; of these Both participants showed a statically significant increase across all topics, Arts participants showed a statistically significant increase across all topics except the werewolves and zombie topics and Neither participants only showing a statistically significant difference in perceived parasite worm learning. At The Science of Science Fiction event, exit questionnaire data showed there was a trend of knowledge increase across all participants in each area, with the exception of Science participants in UTI, which saw a slight decrease in perceived knowledge. The knowledge increase was statistically significant for Both participants in UTI, Bacteria and PCR/DNA. It is worth noting the small sample size of Science and Neither cohorts and thus the impact on the statistical analysis to detect an effect on perceived knowledge. When comparing the perceived increase in knowledge from before to after the events there was no statistical difference between types of participant for the Horror Within event. There was also no statistical difference in knowledge increase between participant types at The Science of Science Fiction event.

Participant enjoyment

The main aim of the project was to increase science knowledge within the public; especially those who do not normally seek

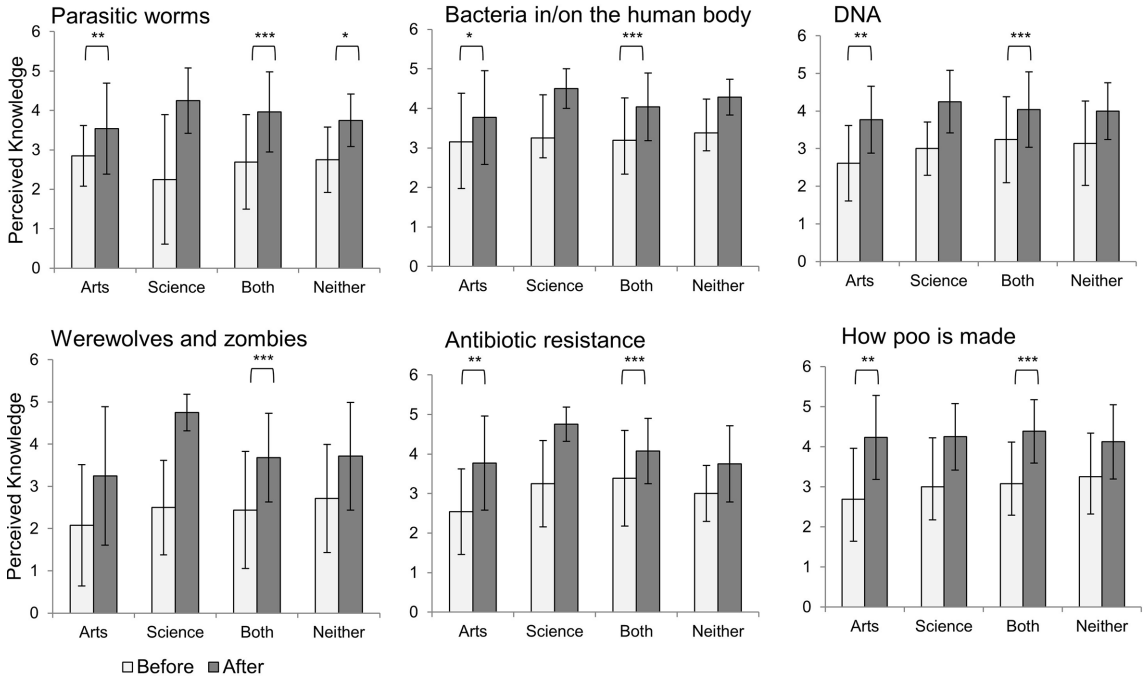

Fig. 2. Effect of visiting event on perceived knowledge, Year 1. The amount of perceived knowledge participants gained during The Horror Within event in the six science content areas was ranked from 1 (nothing) to 5 (a lot). Responses were categorised by participant type: Arts; *n*=13, Science; *n*=4, Both; *n*=26, Neither; *n*=8. Data shown are mean±standard deviation, * indicates *P*≤0.05, ** indicates *P*≤0.01, *** indicates *P*≤0.001 in a Wilcoxon signed rank test.

out science events. Although an increase in perceived scientific knowledge is demonstrated in Figs 2 and 3, it is known the level of learning is likely to increase if the individual is engaged in a topic or activity [47], thus if the participants found the blend of science and art enjoyable was next determined using a qualitative approach.

The responses to the exit questionnaire question 'Tell us something … that you found particularly interesting' were systematically searched through, grouped into themes and enumerated across both events (Table 2).

These responses show an overwhelmingly positive response to the event with the largest number of participants (24 responses) specifically identified the science talks and presentations. In addition, 22 participants found blended art-science activities specifically interesting and 13 participants commented on the arts activities showing all elements of the event were valued by the audience and thus the effectiveness of the approach taken. Furthermore, there was no difference in the type of response given in the free-text enjoyment question when analysed based on the type of participant (Arts/Science/Both/Neither) and as such, the type of participant showed no preferences of the activities based on their own identified area of previous experience.

Indications of future engagement

To determine whether the public who engaged in the event would return to similar events exit questionnaire participants were asked 'I am likely to return to a future Live Late', from The Horror Within event, 56% responded strongly agree, 36% agree and 8% neither, from The Science of Science Fiction event, 53% responded strongly agree, 35% agree and 4% neither. When asked 'I am likely to return to Sheffield Hallam events', from The Horror Within event, 56% responded strongly agree, 38% agree and 6% neither, from The Science of Science Fiction event, 51% responded strongly agree, 35% agree and 6% neither. There was no statistical difference in the participant group. This demonstrates not only that the events were successful, but also that participants were likely to attend future events by both the arts partner, the provider of the Live Lates programme, and the science partner, Sheffield Hallam University.

Longer term impact

To determine longer term impact a focus group was held 4 months after The Science of Science Fiction event. Open questions were asked around the themes of knowledge the participants had retained, the impact of the event on their perception of science as well as the impact on their science capital. Responses fell into four main categories (Table 3).

Participants engaged well with the hands-on elements of the event and had impactful interactions with the displays. Attendees also enjoyed the relation between the real science and the dramatised science seen in the media. This allowed them to compare what they thought they knew about

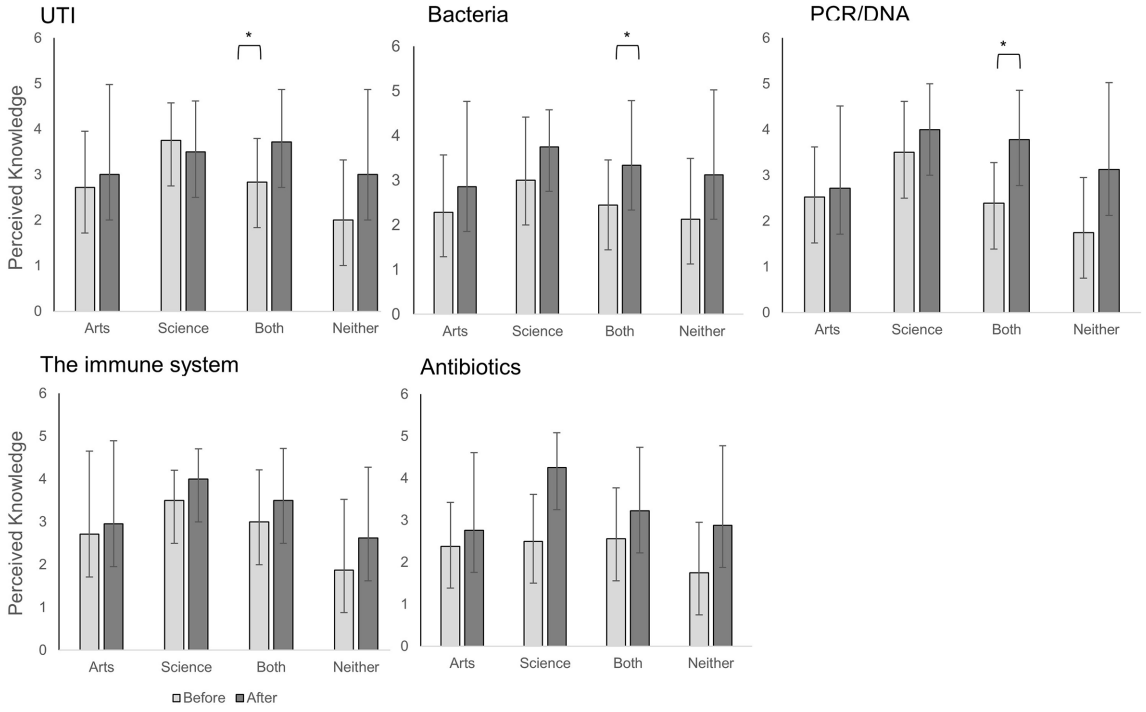

Fig. 3. Effect of visiting event on perceived knowledge, Year 2. The amount of perceived knowledge participants gained during The Science of Science Fiction event in the five science content areas was ranked from 1 (nothing) to 5 (a lot). Responses were categorised by participant type: Art; *n*=21, Science; *n*=4, Both; *n*=18, Neither; *n*=8. Data shown are mean±standard deviation * indicates $P \leq 0.05$ in a Wilcoxon signed rank test.

science to real life, up-to-date research. The educational element of the event increased participants' confidence in science, they felt more comfortable discussing science with others and felt they had interesting points to discuss. Participants felt it increased their science engagement and made them question science they see in the media more than prior to the event. The accessibility to science was also a positive factor. The event had encouraged them to look out for similar events in the future.

Table 2. Qualitative analysis themes. Comments from both events were blinded, coded into each category and enumerated. Example comments are given for each theme (*n*=104).

Theme	Response frequency	Free text example
Enjoyment of arts event or activities.	13	*'I loved the ghost tour! Very entertaining and interesting. …Brilliant!'* *'…the still life drawing'.*
Enjoyment of art-science blended activities.	22	*'…the DNA extraction necklaces'* *'how interesting mimicking the physiology of the GI tract can be'* *'knitting terry the tapeworm'.*
Enjoyment of science themed talks and presentations.	24	*'the parasite talk'* *'zombie ant talk was cool'* *'the lecture about poo'.*
Useful, new or applicable ideas.	3	*'…I can take ideas back to my work'* *'…engaging for both the scientist and lay person. So enjoyable'.*
Enthusiasm of staff and success of format.	9	*'overall the exhibition was wonderful, not just for the people who knew the things there'* *'utterly fantastic use of resources'.*

Table 3. Categories of impact from attending The Science of Science Fiction event. Focus group with four participants of The Science of Science Fiction event was undertaken 4 months after the event. A grounded theory approach was used and open coding was used followed by axial coding to determine categories. Sample quotes are representative of those from focus group transcript.

Category	Example quote
Direct participant engagement in the event.	*I enjoyed …where you fed the pipe down and blow it up and then try and take some of the fluid… That was interesting to see sort of, how things work* (Describing catheter insertion into genital models, used to start dialogue about UTI).
Comparison of real science and the dramatised science seen in the media.	*So it was good again to have a comparison of, like, real research that's going on here but then… compared to a CSI, which is obviously- some of it is- little bits of it are accurate but most of it is over exaggerated.* (Describing talk given by Sheffield Hallam Lecturer).
Increase in accessibility of science and science capital.	*It was good that it was very understandable; it was relatable and not like you were being talked down to.* *I feel like I've had more to say in conversation. You know, if someone's talking about [science].* *[I] just don't accept what the film is saying…… So a bit more querying as opposed to just believing everything you see.*
Impact on accessing science events.	*Whenever I go to a new city, The science museums… is always one I make a beeline for.* *I'd definitely go to more events if they were being put on in the museum as well.*

DISCUSSION

The event described here was based upon a collaboration with a local museum with an established clientele that was markedly different to those the researchers had previously engaged with. The event was successful, both in terms of perceived increase in knowledge for visitors and enjoyment. Both The Horror Within and Science of Science Fiction events reflected the Sheffield City region demographic of White / White British being the most prevalent ethnicity, and Asian / Asian British being the most prevalent group of BAME. However, BAME participants were underrepresented at both The Horror Within and The Science of Science Fiction Live Lates events when compared to the overall population of Sheffield. This reflects the national picture where white individuals are more likely to visit museums and galleries (53.1%) than those who are non-white (48.2%) [48, 49]. In addition, those from BAME backgrounds are likely to have lower science capital [50]. The underrepresentation of participants from BAME backgrounds is found both within our study and the wider literature. Addressing this endemic underrepresentation of a section of society is key to increasing understanding of science and diversity within STEM [19, 51]. Whilst it was not an explicit aim of these events to increase BAME engagement, a strategy to ensure events are reflective of our whole society will certainly be embedded within our future outreach events. Thus, it is recommended that the current audiences of a potential public engagement collaborator are carefully scrutinised before an event, particularly if a specific audience is being targeted.

Participants at the event reported a perceived increase in knowledge in exit questionnaires. This is typical of public engagement events that have been designed with the aim of increasing knowledge, with examples such as posters, attending science festivals and public science workshop [52–54]. Here, participants indicated increased likelihood of attending a future event. This is often outside the realm of studies but when is reported our findings are in line with what has previously been seen within public engagement events [5, 28, 55]. Taken together, this indicates that public engagement events increase the public's understanding of science and increase science capital. Here our analysis of the different types of visitors adds to the narrative by ascertaining these increases in science capital are not linked to previous experiences.

Science has historically found itself classed as a discrete entity and on the basis of this it was argued by Snow in his 'The Two Cultures lecture' of 1959 that two cultures exist - 'literary intellectuals at one pole—at the other scientists' [56]. This idea may subconsciously influence how the public are perceived and interacted with, there are members of the public that are 'sciencey' and already well informed, and those that are 'arty' and are difficult to engage. Public engagement strives to challenge perceptions such as these and, ideologically, engage all of the public in science [21]. Here the event was successful in widening participation in science public engagement by reaching participants who had not previously sought out science events (Arts or Neither participants). Such a binary approach, science versus art, is most likely an oversimplification, with perhaps unintended consequences. Shein *et al.* [57] proposed four cultures, mirroring the categories used in this work, 'science only, art only, neither, or both'. The concept of cognitive polyphasia, where different type of knowledge or ways of thought can coexist within an individual – specifically relating to public engagement – is introduced as a narrative to describe those interested in both art and science [57, 58].

Within this event the hands-on activities were designed to allow a playful approach to science learning, embedded with

informal discussions with volunteers and supported by the mini lectures. The arts activities provided by the museum were designed in a similar vein, and as such the arts and science elements of the event were blended together. As there was no difference determined in the collected data between Arts, Science, Both or Neither participants, and how they interacted with the event, perhaps the previous experience of individuals is less important than their willingness to increase their science capital in a safe setting. It is possible our events were blended in such a way that participants from different groups felt no specific affinity for different activities / topics or that the four cultures hypothesis of Shein *et al*., is still too discrete.

Science capital is a person's combined science related experiences, knowledge resources and attitudes. Increased science capital is beneficial as it empowers individuals to engage with science, importantly that which is relevant to society [10, 11]. The necessity for the public to be engaged in science, have trust in science and understand the scientific process has been exemplified throughout the COVID-19 pandemic [59, 60, 61]. Within the events described here the participants perceived themselves to have increased their knowledge, and thus it is tempting to speculate we have increased the science capital of an adult cohort, some of whom may not have specifically sought it out, this was supported by the focus group analysis. If this is the case, it could be said that participants in the Arts group had increased their cognitive polyphasia, and as such, those in attendance had not only shifted to the Both group but may also have an altered identity regarding their interest in science.

In this work we have categorised individuals into four groups based on previous experience and the literature; a better method would be perhaps to (1) directly ascertain an individual's science capital and (2) their perceived culture (art or science) and then further investigate how events designed to expand public engagement audiences alter these statuses. A hypothesis could be that a spectrum is present between arts and science, and where individuals place themselves on this spectrum could be indicative of a barrier to engagement or high engagement in science public engagement.

CONCLUSION

Exit questionnaires and longer term focus groups were undertaken with the participants of the blended Arts and Microbiology events. A large proportion of participants had not visited a science based event in the previous 12 months highlighting the importance of event design in engaging groups that have not previously engaged in science public engagement. Participants had a perceived increase in scientific knowledge, irrespective of previous engagement with science events, indicating that participation in blended arts and microbiology activities increased accessibly to scientific content. Science capital was possibly increased with participants stating that they weremore likely to attend science public engagement events, they had increased discussion of science in their lives since the event and had an increased awareness of science in society. Overall, our findings indicate that blended arts and microbiology events increase that accessibly of science public engagement in new audiences and is both enjoyable and impactful.

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Author contributions
C.D., conceptualisation, methodology, investigation, writing – original draft preparation, writing – review and editing, supervision and project administration. ORCiD 0000-0002-6845-1890 @DuckettSanders. K.R., resources and writing – original draft preparation. ORCiD 0000-0003-3926-2238 @venom_girl. L.A., project administration and funding. ORCiD 0000-0001-8579-7730 @liz198. S.F., resources, project administration, funding and writing – review and editing. ORCiD 0000-0002-8361-6390 @SarahForzou. K.H., methodology, formal analysis and writing – original draft preparation. ORCiD 0000-0002-2714-0850. K.R., methodology, writing – review and editing, supervision and project administration. ORCiD 0000-0002-1055-6518 @KathyRawlinson. H.S., formal analysis, investigation, writing – original draft preparation and visualisation. ORCiD 0000-0001-6093-9392 @OiHollie. M.L., conceptualisation, methodology, formal analysis, writing – original draft preparation, writing – review and editing, visualisation project administration and funding. ORCiD 0000-0003-0997-0217 @MelMLacey. H.S., is now affiliated with the School of Clinical Dentistry, University of Sheffield. K.R., is now affiliated to Barnsley NHS Foundation Trust as a Biomedical Scientist. K.H., is currently based in the Emergency Department at Rotherham Hospital (also South Yorkshire).

Conflicts of interest
The authors declare that there are no conflicts of interest.

Ethical statement
The authors confirm that where individuals are identifiable in photographs within the manuscript, consent to use that image has been granted by the individual concerned.

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