

## “Space Plague”: an investigation into immersive theatre and narrative transportation effects in informal pandemic science education

---

Lindsay Keith and Wyn Griffiths

### Abstract

Stories are fundamental to human history, culture and development. Immersive theatre has created a landscape where participants have agency within stories, and within this landscape the concept of narrative transportation provides a framework where change within stories creates change in real life. “Space Plague” is a co-designed, fully immersive theatrical experience for young people and families about a fictional pandemic. It was developed using community-based participatory action research (CBPAR) employing a novel model for engaging underserved and under-represented audiences, “SCENE”. Results confirmed that indications of narrative transportation effects were achieved, demonstrating enhanced learning and understanding alongside changing attitudes and indicated positive change when negotiating the COVID-19 crisis.

### Keywords

Informal learning; Public perception of science and technology; Science communication: theory and models

### DOI

<https://doi.org/10.22323/2.19070801>

*Submitted:* 6th July 2020

*Accepted:* 12th October 2020

*Published:* 14th December 2020

---

### Background

“Space Plague” was the title of a fully-immersive theatrical experience for young people and families delivered at The Deptford Lounge, South-East London in February 2020. The performance was the culmination of a programme of Public Engagement (PE) events over 5 years by Keith, Griffiths and a range of collaborative partners. Prior to the creation of Space Plague, they had carried out 4 annual PE events in South East London, and 13 additional one-day events around England, which were semi-immersive in nature. Each event was a science and arts festival (“SMASHfestUK”) which were designed and developed explicitly to engage audiences who are underserved by existing informal science education provision and under-represented in science study choices and careers. The festival has been successful in reaching its target audiences and developing new methods and approaches for engagement. More than 80% of audience figures were drawn from postcodes considered in the lowest 2 quintiles according to the Index of

Multiple Deprivations 2019 and more than 25% of visitors were ‘new audiences’ who reported that they ‘never’ previously visited similar informal STEM events. [McKenzie and Flow, 2015; Jarvis, 2016; Simons, 2017; Simons, 2018]. The underpinning research question for the programme was whether engagement through story and an immersive theatrical approach, driven by the developed SCENE model, would enhance Informal Science Learning.

### **Developing the SCENE model of engagement for previous semi-immersive “SMASHfestUK” events**

Keith and Griffiths developed a co-design-lead process resulting in a novel model for audience engagement. Using community based participatory action research (CBPAR) methodologies the model was prototyped, tested and developed throughout 4 major iterations, with sub-cycles within those iterations, resulting in the final model, SCENE [STEAM, Community, Enquiry, Narrative, Entertainment] [Burns, Cooke and Schweidler, 2011; Keith and Griffiths, 2020]. The model is described in an upcoming paper by Griffiths and Keith, and will be discussed here in summary only. It employed immersion and embodiment of visitors/audience as actors with agency within a disaster-based narrative in which an impending natural disaster threatens world security. The disaster narratives were of an asteroid (2015), a solar storm (2016), a supervolcano (2017) and a flood (2018). Although the festivals were drop-in events, all activities, performances and interactives related directly to the story each year and facilitators were briefed to engage visitors in the story whenever possible, relating the activity they were facilitating or act they were performing, to the overall narrative. This work showed positive changes in attitudes towards science of visitors across four annual events as described in the evaluation reports by McKenzie and Flow [2015], Jarvis [2016], Simons [2017] and Simons [2018]. The logical progression of this work into attitudinal change effected by semi-immersive activities was the development of a fully immersive experience.

### **Rationale for development of SCENE model for fully-immersive experience “Space Plague”**

“Space Plague” was a fully-immersive theatrical experience for young people and families (age 7+) which was developed, produced and delivered in February 2020 spanned three venues; a public square, a community library space adjacent to the square and a school, all in Deptford, South East London cohering them into a single theatrical ‘set’.

The reasoning behind integrating stories into the engagement model is based on research which suggests that storytelling is highly effective at engaging individuals and transforming beliefs, attitudes and behaviours. Studies by Brock and Green observed that these effects are “strong and long-lasting”, while Philips and McQuarrie later reported that this could fundamentally affect attitudes, confirming that “a story can engross the story receiver in a transformational experience” [Green and Brock, 2000; Phillips and McQuarrie, 2010].

Stories are a critical, if sometimes overlooked, element of human communication: in reviewing the role of storytelling in science communication Dahlstrom reflected that “Storytelling often has a bad reputation within science, [...] however, when the context moves from data collection to the communication of science to non-expert audiences, stories, anecdotes, and narratives become not only more appropriate but potentially more important” [Dahlstrom, 2014]. Long before this

## The quest for narrative transportation

however, Roland Barthes noted that “there is not, there has never been anywhere, any people without narrative; all classes, all human groups, have their stories” [Barthes and Duisit, 1975].

Research suggests that the more deeply a person is immersed in a story the further they are “transported” from real life, but that the journey may nonetheless change real life attitudes. Transportation was first explored with regard to storytelling and narratives by Gerrig in 1993, who wrote that “The traveller goes some distance from his or her world of origin, which makes some aspects of the world of origin inaccessible. The traveller returns to the world of origin, somewhat changed by the journey.” [Gerrig, 1993]. He went on to write that “the traveller assumes certain new characteristics (as called for by the narrative) as a consequence of undertaking the journey”, further noting that “narrative transportation” was “virtually unexplored in cognitive psychology”. He suggests that the reason for this could be the prevailing emphasis that readers construct a narrative world, rather than the narrative world viscerally affecting the reader [Gerrig, 1993]. Van Laer, paraphrasing Thompson, clarifies that the relationship between ‘story’ and ‘narrative’ is that “a narrative is derived from a process of attribution of meaning to, and interpretation of, a story” [Laer et al., 2014; citing Thompson, 1997]. Since 1993, although further research has explored the psychology of transportation, the literature is sparse. This was noted by Green and Brock in 2000, who observed that “the persuasive impact of public narratives has been virtually ignored by empirical researchers” and suggest that the reason for this lies in its power. This, they say “has never been doubted and has always been feared. Consequently, censorship has been ubiquitous for centuries” [Green and Brock, 2000].

In their paper they explore the ability of both fictional and non-fictional narratives to transport audiences/readers and report that narrative-based beliefs lead to stronger and more persistent changes than rhetoric-based beliefs, that is to say that the power of stories is stronger than the art of persuasive talking. Their theory is underpinned by two paradigms: a) the universal affinity of humans for narratives as the preferred mental structure for organizing and retrieving thoughts, b) cognitive contributions to the formation of opinions and that attitudes formed in this way are more persistent [Edwards, 1990; Rosselli, Skelly and Mackie, 1995; Fabrigar and Petty, 1999]. In the paper which addressed how transportation could influence public narratives, Green concludes that “Narrative Transportation Theory proposes that when consumers [of a story] lose themselves in a story, their attitudes and intentions change to reflect that story.” [Green, Kass et al., 2008].

Immersing audiences in stories has been explored both practically and academically in theatre and performance studies. One of its central tenets is the relationship between performers and audience with the presence of an audience broadly considered as “central to the definition of theatre”. However, throughout the 20th century, the relationship between audiences and performance space has evolved [Freshwater, 2009]. Positions have included the traditional proscenium arch, where “Naturism” saw audiences watch passively in seats and not observed by the performers, through to Brecht’s ‘verfreundeseffekt’, or ‘alienation effect’ with which he distanced audiences from narrative and characters, making them observe and think rather than empathise. In this method, the fourth wall of the theatre is broken, allowing direct audience address, signalling to the audiences that

they are in a fictitious plot. More recent iterations of this evolving relationship include participatory, site-specific and promenade works. This is sometimes referred to as “immersive” [Brecht, 1964; Woods and Banham, 1996; Machon, 2013]. This form of promenade and site-specific theatre notably became commercialised in the U.K. in the early 2000s with Punchdrunk theatre company’s, acclaimed production; “Sleep No More”; a visceral reimagining of Macbeth where the audience engage as if guests, roaming freely through a 1950’s noir-styled ‘hotel’ and encountering the action [Biggin, 2017].

Josephine Machon states that “The very nature and activity of [immersive theatre] evolves the idea and the practice of audience or spectator beyond the conventional attitude and action of ‘listener’ and ‘viewer’ into a decision-making collaborator in the work.” [Machon, 2013]. Others distinguish it from traditional theatre by “the sensory acts that it demands of audiences, such as touching and being touched, tasting, smelling and moving — this latter often (but not always) being characterized by freedom to move within an aesthetic space.” [White, 2013]. There is also an acknowledgement that the phrase “Immersive theatre” is “an inviting but faulty term to use to describe the phenomena it currently designates” and that “to a limited extent, all such acts are, or at least can be, present in other modes of theatre spectatorship.” [Alston, 2013]. Further critics suggest the term “immersion” is hijacked for purely commercial goals [Lopes Ramos et al., 2020]. Machon does, however, attempt to unify these disparate definitions of immersion by suggesting “Although diverse in form and outcome, what is clear is that all immersive theatres produce shared qualities of experience that involve some degree of immediacy; that can engender the epic in the intimate and uncover the intimate in the epic.” [Machon, 2013]. For the purposes of this paper we will refer to the “Space Plague” production as “immersive theatre”, by which we mean a form of participatory, interactive and promenade theatre in which the audience are themselves characters in the story, and perform tasks to solve scientific puzzles which progress the narrative.

There is little in the literature to date exploring the role of narrative transportation in immersive theatre, nor of immersive theatre being used explicitly as a vehicle for ISL for young people. There have been a number of immersive theatrical productions for adults focussed on creating conversations in this space: Deadinburgh — a sci-fi production for adults by the Enlightenment Cafe recreated a zombie apocalypse in Scotland’s capital city and explored the science and ethics of medical responses to disease outbreak, while, Yomi Ayeni’s Clockwork Watch — an episodic transmedia steampunk themed saga, explored the effects of colonialism and racism through the lens of an alternative reality [Girdwood, 2013; McMillan, 2013]. There are, however, parallels between ‘narrative transportation’ effects and immersive theatre; White writes on the latter: “The practices of audience participation temporarily re-shape our social being [. . .] and perhaps, on occasion, allow us to perceive ourselves anew” and Josephine Machon reflects that “The active decision-making and sensual involvement that is required in this work can be. . . radically transformative; transforming an individual psychologically or ideologically.” [Machon, 2013; White, 2013]. The potential, therefore, for the use of narrative transportation in immersive theatre for ISL is tantalising, but should not be considered without regard to ethical consideration, as described by Freshwater, who cautions that there needs to be “an acceptance that genuine participation has risks as well as potential rewards” [Freshwater, 2009].

Space Plague drew on these influences to incorporate immersive narrative, contextual and collaborative problem solving, which would engage audiences emotionally and could result in some degree of narrative transportation.

### Event delivery

Audiences entered in groups of 10–12 people. The event was free, but ticketed. The experience duration was around 75–90 minutes. The cast of actors, facilitators, scientists, producers and volunteers was gender balanced, diverse and reflected the local community demographics which are around 40% BAME.

### Space Plague Story

Visitors were “onboarded” by induction into the Emergency Response Team (Figure 1), who were actors and facilitators dressed in branded Hazmat suits (Figure 2), who asked each audience member to get dressed in a hazmat suit themselves and fill in a short questionnaire. The questionnaire was interwoven into the story as a way to collect evaluatory and demographic data, with permission and consent obtained.



**Figure 1.** Space Plague ‘Emergency Response Team’ participant badge.



**Figure 2.** ‘Emergency Response Team’ heading to briefing room.

A mock news report explained that a novel disease linked to a local meteorite shower was spreading locally, causing “zombie-like” symptoms. In the ‘Meteorite Analysis Laboratory’ the audience had to predict meteorite impact positions from incomplete co-ordinate records using mathematical triangulation before being urged to an ‘Emergency Field Hospital’ where a “medic” took the patient history of a “zombified” patient (Figure 3). Using logic and inference the audience narrowed the symptoms until they were confident the cause was ‘Space Plague’. An ‘Epidemiology Laboratory’ saw the audience plotting patient addresses on a map to identify disease clusters, leading them to also plot “outlier” clusters of disease unrelated to meteor impact sites but close to water, leaving them to deduce that a water-borne insect vector may be spreading the disease further. Real larval microscopy, followed by DNA barcoding puzzles, and protein transcription from DNA sequences lead the audience to deduce a peptide sequence which was to be subjected to (mock) x-ray crystallography in a (model) ‘particle accelerator’ to determine its 3-dimensional shape. The successful solving of the protein provided a false climax, as the result indicated a vaccine candidate but that it would take 10 years to manufacture. The audience were then taken to a ‘Crisis Room’ to make public health decisions. This took the form of a live action role playing game



(LARP) with two actors trained in public health facilitation, and involved making decisions regarding what drugs therapy could be made available, or developed, the relative costs and also decisions around social and resource control measures — such as whether to impose quarantine “lockdown” procedures. The experience climaxed with the guided decision-making allowing the audience to ‘save the world’ and a film communication, the ‘Hero’s Return’, from ‘central government’ celebrating the role the audience played in saving of the world (Figure 4).



**Figure 3.** “Emergency Field hospital” where audiences carried out differential diagnosis of a patient.



**Figure 4.** Public Health “Crisis Room”, with participants watching themselves revealed in the ‘Hero’s Return’ film upon completion of the experience.

## Methodology

The evaluation utilized front-end and summative methods that were able to both capture quantitative comparative data whilst allowing for qualitative reflection. The evaluation used an in-depth researcher-administered entry and exit questionnaire (using both closed and open-ended questions) for adults and an adapted form of the same questionnaire for children (encompassing visuals). This questionnaire was framed as part of the story. It took the form of a briefing and de-briefing document for the ‘Space Plague Emergency Response Team’ volunteers — the audience. The evaluation data confirmed the effectiveness of this approach, with 238 of the 274 participants (80 adult, 158 children) completing the forms (87%).

The evaluation was successful in collecting outcome, output and impact data from audience/participants: with regard to the overall response, when asked whether they had enjoyed the experience, with a choice of responses (Brilliant, Good, OK, Not Good, Awful) — 98% of the respondents were positive, with 73.5% of those respondents rating it ‘Brilliant’.

In this paper, we are focusing on 4 questions from the questionnaire, which correspond to insights into 3 categories: “immersion and story”, “learning” and “embodiment”. Of the four questions one was open-ended, one was a composite of closed and open-ended and two were closed five-way choice; (“really agree, agree, no change or about the same, I don’t think so, no”). The four questions respectively were:

1. “Do you think the story and immersive aspect of Space Plague helped you, and your family, understand science/engineering processes and research? Please explain your answer.”

2. "Tell us one new thing that you learned today"
3. "I learned new things about science today/Taught my children new things about science".
4. "I felt like a real scientist today/[The experience] Made us feel like real scientists today"

While 238 participants completed the forms, full completion of all questions varied, as noted in the sections below.

Response to the open-ended part of Question 1 and Question 2 were evaluated through thematic analysis, using an inductive approach to identify emergent themes. Stage 1 codification of responses elicited 12 and 10 working categories, which were reviewed and distilled into three themes in both cases. Thematic Analysis was chosen as an established method for "systematically identifying, organising and offering insight into patterns of meaning (themes) across a data set." [Braun and Clarke, 2012]. The data set from the two qualitative question responses within this study was relatively small — Q1: 52 answers of one to three sentences; Q2: 187 answers of one to three sentences, responding to tightly framed aspects of the overall research question.

A rigorous six phase approach was applied following practice defined by Braun and Clarke [2012] as:

1. Familiarising yourself with the data, 2. Generating Initial codes, 3. Searching for themes, 4. Reviewing potential themes, 5. Defining and naming themes, 6. Producing the 'report' (this article). The coding strategy employed a hybrid '*In Vivo*' (actual words) and 'descriptive' (basic topic in phrase) approach, with hierarchical reassembly of the disassembled codes — clustering initially identified codes to produce transitional higher-order codes, leading to refined and finalised 'themes' [Braun and Clarke, 2012]. Each of the two questions resulted in 3 themes, detailed below:

1. Immersion and Story

Adult visitors (only) to the event were asked at the end of the experience: "Do you think the story and immersive aspect of Space Plague helped you, and your family, understand science/engineering processes and research? Please explain your answer."

Of 80 adults who completed questionnaires, 21 did not supply an answer to this question, but the 59 respondents all answered in the affirmative. Seven respondents simply answered "Yes" but the remaining 52 expanded their answers.

The analysis resulted in the definition of 3 themes:

- A. Immersion
- B. Process
- C. Problem solving

- A. Immersion:

100% of respondents agreed that the immersive aspect of the experience had been important and comments suggested that the visceral nature of

immersion made the experience more effective, writing; “It was very good being able to be involved in all that was going on and seeing science visually rather than in a textbook.” Others suggested that immersion was critical; “I think the immersive aspect was the most important. The kids were constantly engaged and it helped get the message across,” inferring that it engaged young people for a duration which other activities might not have. Another respondent suggested that immersion helped to anchor and embed their children’s learning writing; “Immersing [...] increased their engagement and ultimately their knowledge and understanding” and one emphasized how immersion in the story made sense of otherwise complex science and engineering saying, “The contextualising of the science/engineering concepts helped greatly to understand the elements of the science and engineering and how they are applied”.

#### B. Process

Responses to the same question suggested that the immersive experience had facilitated a cognitive understanding of the scientific processes which are undertaken during the outbreak of an infectious disease and that this had helped them understand how such events might unfold in real life. Comments included; “The stages we were taken through helped the girls to understand the scientific process to research,” and “I think it helps us to understand how the science work when a disease starts”. Interestingly, several picked up on the interdisciplinary nature of scientific responses to crisis situations, with one respondent saying “It helped me understand the process scientists put in place when a catastrophe breaks out. It helps lots with understanding the whole process from start when crisis occurs to the end when you can find solution”. And another saying “Great to have a context linking all the different areas of science/engineering together to show us how important they are and exciting story to keep us interested”. Several respondents replied with answers suggesting that they were empowered as actors or agents in the story, for example “It has taught us about outbreaks, how to stop it spreading, how to treat it and also eliminate it”, but some also responded empathically to the work of scientists and clinicians, saying “[it] helps us understand how the disease can easily spread and how hard the medics work to solve the problem”.

#### C. Problem solving

The final category into which many questionnaire responses fell was that of “problem solving”. For respondents who focused on problem-solving answers ranged from “because it created an atmosphere and urgency to propel our desire to problem solve”, suggesting that the plot and environment was creating a sense of transportation which encouraged the drive to progress through the narrative, to those whose responses suggested that the whole experience as a progression was compelling; “it showed the sequence of things that, needed to be solved and help bring science to life in a really exciting way” and “we were able to see the different ways of discovering how diseases are spread and analysing samples, diagnosing patients”.



## 2. Learning (open ended)

The second question we have focused on for this paper concerned the effect of the experience on learning and learners, and what insights might be gained by assessing the effect of immersion on learning. The question asked, of both adults and children, was “Tell us one new thing you learned today?” to which 187 participants responded.

The analysis resulted in the definition of 3 themes:

- A. Knowledge: (Biological Sciences, Medicine, Engineering, Technology, Mathematics, Cosmology, Cartography)
- B. Process: (Scientific Methods, Philosophy of Science, Clinical Medicine, Team working)
- C. Problem solving: (Public Health, Epidemiology, Drug Discovery)

### A. Knowledge

Comments capturing knowledge assimilation covered numerous elements of scientific knowledge shared with audiences across the storyline. Examples of responses included drawings of bacteria, “we learned about proteins and antibodies”, “how DNA is built” and “that there is such a thing as a synchrotron. Some responses suggested high level understanding, for example “[how] specific base pair groups map to specific amino acids” and “how a synchrotron works” and some had been impacted by the public health role-playing section of the experience, for example “I learnt a lot about quarantine”.

### B. Process

Comments captured under this question “Tell us one new thing you learned today” regarding the scientific process included many comments suggesting that previously opaque or not well understood processes had been elucidated and clarified. Comments included: “How diseases grow and how much goes into research”, “How you would deal with an outbreak as a professional”, “How medicine is developed”. Other comments reflected on the role of the individuals involved in responding to a crisis, for example “[I learned] what an engineer means and how to be a scientist”, “the important role of all scientists” and, “have learnt new things a scientists does”. Some comments clearly showed the embedding of knowledge directly relating to an infectious disease outbreak such as COVID-19. For example, “how much effort goes into curing a disease and how long it could take to save hundreds of people”, “if you get the [fictional] virus go straight to the hospital”. And an understanding of the enormity of a pandemic situation: “how much effort goes into curing diseases”.

### C. Problem solving

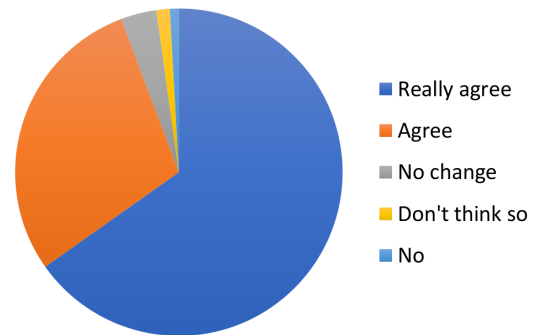
Comments captured in response to this question which related to problem-solving included meta-level answers, such as “How to keep people safe in a difficult situation like this” and “How to contain an outbreak of disease”, but there were also generalised responses that were not specific to the story including, with reference to the collaborative problem solving required to progress through the experience, “How important teamwork is” and the recognition that such collaborations are vital to pandemic responses: “every element of research is dependent on each other — everyone has to work together”.

### 3. Learning (closed question)

Children and adult visitors were asked to rate their response to the question, “I learned new things about science today / Taught my children new things about science”, by ticking one of five options (Really agree, Agree, No change, Don’t think so, No) and 228 participant responses were recorded (Table 1, Chart 1). The results show that an overwhelming majority agreed or really agreed that they had learned new things about science, or that their children had, where respondents were adults.

**Table 1.** Responses to learning question (closed).

Response	n	n as %
Really agree	148	64.9%
Agree	66	28.9%
No change	8	3.5%
Don’t think so	3	1.3%
No	2	0.9%



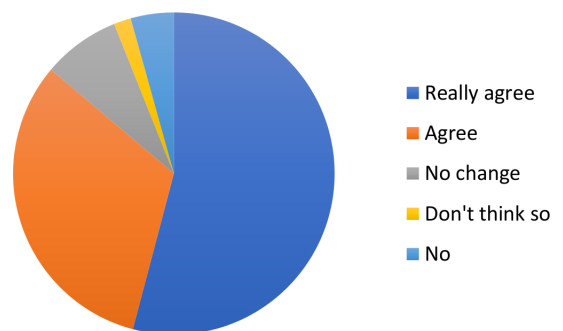
**Chart 1.** Responses to learning question (closed).

### *Embodiment and presence (closed)*

The final question to be discussed in this paper was “I felt like a real scientist today / (The experience) Made us feel like real scientists today”, which, as previously had 5 answer options: (Really agree, Agree, No change, Don’t think so, No). 232 participants (both adults and children) responded (Table 2, Chart 2). The responses clearly showed that the experience had made the audience feel “like real scientists” with the combined results from all visitors asked at the end of their experience showing that almost 85% of people felt like they were real scientists after the event had taken place.

**Table 2.** Responses to embodiment and presence question (closed).

Response	n	n as %
Really agree	125	53.9%
Agree	74	31.9%
No change	18	7.8%
Don’t think so	4	1.7%
No	10	4.3%



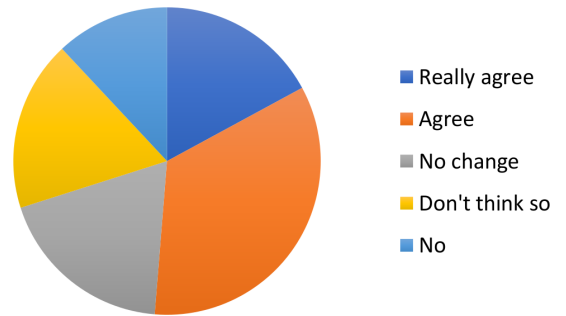
**Chart 2.** Responses to embodiment and presence question (closed).

One subset of audience members, comprising 117 individuals was subjected to the same question both before and after the experience and the difference in the results here was striking. This audience segment was asked to rate how strongly they

disagreed or agreed with the statement “I feel like a real scientist” before the event (Table 3, Chart 3), and then again at the completion of the experience (Table 4, Chart 4).

**Table 3.** Responses to embodiment and presence question before activity.

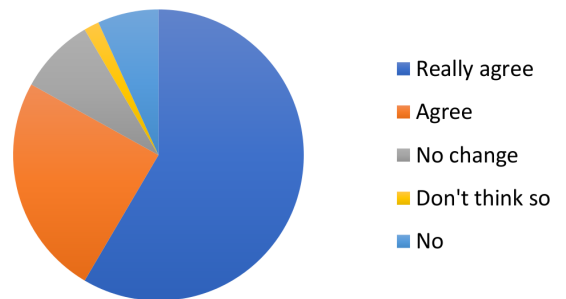
Response	n	n as %
Really agree	20	17.1%
Agree	40	34.2%
No change	22	18.8%
Don't think so	21	17.9%
No	14	12.0%



**Chart 3.** Responses to embodiment and presence question before activity.

**Table 4.** Responses to embodiment and presence question after activity.

Response	n	n as %
Really agree	69	57.5%
Agree	29	24.2%
No change	10	8.3%
Don't think so	2	1.7%
No	8	6.7%



**Chart 4.** Responses to embodiment and presence question after activity.

These striking changes in attitudes suggest that the immersive experience and embodiment as scientists within a narrative has changed how the respondents felt about themselves with regard to being or feeling like a scientist. The number of respondents who “really agreed” that they felt like scientists rose by 238%, whereas the percentage of those who did not feel like scientists reduced significantly.

## Discussion

The timing of the Space Plague event (February 2020) coincided with the very first cases of COVID-19 in the U.K. (but before any deaths had been recorded there) and before the COVID-19 outbreak had been officially declared a pandemic by the World Health Organisation (WHO). Although worldwide news media had been covering reports of the outbreak, the total number of infections were, at this time, only in the single thousands and worldwide deaths still in the low hundreds, with the majority of cases confined at this stage to China and the WHO designated ‘Western Pacific’ countries. Nonetheless, it was clear that this was a growing global risk which threatened to achieve pandemic status, which it did, just a few weeks later. The producers and organisers of Space Plague did take advice and discussed extensively the ethical implications of proceeding with a storyline that was being mimicked so closely in real life.

As the rationale for the immersive approach to informal learning and the results laid out in the previous section fell thematically into four clear elements, these will be discussed in turn in this section.

### 1. Effectiveness of Immersion and Story in Learning.

Evaluation of the Space Plague experience shows that audience members responded well to being immersed within a story in which they had to physically interact and take on the responsibility of problem-solving in order to progress the experience through to the final goal, (finding a treatment and “saving the world” [from a ‘deadly’ pandemic]). To our knowledge this is the first fully immersive theatrical performance for young people and families with the explicit aim of providing an educational experience about pandemics. The results strongly suggest that immersion and embodiment has a positive effect on the audience with regard to whether they feel like “a real scientist”. Before the Space Plague experience, less than half of respondents answered that they felt like a real scientist, but after the experience more than 85% reported that they felt like a real scientist. According to the hypothesis on the role of Science Capital by Archer et al, one of the main differences in those who choose to study STEM subjects at school and beyond and those who do not, is a feeling that science is, or is not, “for people like me”, however this work suggests that the transformative experience of immersive theatre may have the power to change these attitudes [Archer et al., 2013]. Whether the effect of this attitudinal change is temporally sustained will be the subject of a later paper.

### 2. Learning and Knowledge.

The results again suggest that immersion has positive results on learning, and that the learning is not only concerned with specific facts, for example, “I discovered what a phage was”, but also aided the conceptualisation of processes and procedures, with many people reporting that they better understood the methods and processes involved in elucidation of scientific facts than they had done previously. The audience progression through the experience took them through a number of steps in each room. Firstly, an immediate problem was presented in a meaningful “real world” context. Secondly, they were encouraged to elucidate the mechanism for problem-solving through inference and deduction, before finally enacting that mechanism to resolve the problem, which would result in new information, leading into the next problem. The results suggest that this was an effective method of allowing the audience to experience the complexity of the scientific process in a way that was engaging, comprehensible and immediate.

### 3. Embodiment, Presence and Narrative transportation.

The intention for Space Plague, was to create a piece of immersive theatre through which audiences could not only learn about pandemic science, but also have a change affected in their own attitudes towards and beliefs about science. The intention was not only to raise science capital by encouraging young people and families to see themselves as real “scientists” or “engineers” but to give them agency within this role to carry out active, problem-solving mechanisms and thought processes. The purpose was to achieve some form of narrative transportation with the story such that the attitudes of audiences towards pandemic science and science in general may be changed. The results concerning attitudinal change as a consequence of narrative transportation are very encouraging, with intriguing resonances in the responses to the question, “tell us one thing you learned today”. Two examples of responses were “that I AM a scientist” and ‘that I am a hero’ begin to suggest that the agency afforded in audience members by narrative

transportation can be empowering and may affect attitudinal change in real life. In addition, a 236% increase in the number of respondents saying they “really agree” that they “felt like a scientist” after the event in comparison with the “before” results was striking.

If this is indeed a true form of narrative transportation the effects can be explained by the work of Green and Van Laer who describe how a participant can be transported into the story and can become part of the story. Van Laer identified in the literature that “story receivers become transported through two main components: empathy and mental imagery. Empathy images of the story plot so that they feel as though they are experiencing the events themselves” [Green and Brock, 2002; Slater and Rouner, 2002; Laer et al., 2014].

The narrative transportation indicators identified in the research, and in preliminary follow-up data (see next section) suggest enhancement of engagement, information retention, empathy, science (STEM) identity, and attitude change beyond the traditional ‘information exchange’ approach, and align with the work of Luong, et al., who, in studying immersion in stories in science films, have shown that “the positive impacts of science-related entertainment narratives are not restricted to people with high interest in science” and suggest that “Popular entertainment narratives with embedded science content offer a promising way to reach low-interest audiences who would benefit the most from more informal science learning” [Luong, Moyer-Gusé and McKnight, 2020].

## Follow-up

In-depth follow-up research will be carried out within the next few months, but preliminary data suggests that the “Space Plague” experience was helpful to parents who then found themselves in a real pandemic. Several have indicated a direct and lasting effect on participants in responding to the COVID-19 crisis: one parent commented: “I think that it provided a helpful context within which to explain the pandemic to children (aged 7 and 4). Space plague could be used as a reference point given it had been a recent experience, which they enjoyed thoroughly. It assisted, for example, in explaining that it was a disease for which there was currently no cure and that certain aspects of life would need to be different until there was a treatment/vaccine (which they had helped to develop in the Space Plague experience)”. Another parent (of children aged 9 and 11), reported that it provided knowledge of disease types, especially of viruses, understanding of the scientific processes happening in response to the COVID pandemic, and insight into the public health requirements of the response and thus she had found it “enormously helpful” as it prepared her children both cognitively and emotionally for the reality of the ‘lockdown’.

## Conclusion

This partial study of the results and evaluation of the effect of an immersive theatrical experience in informal pandemic learning has shown that physical immersion within a story/play can lead to transformations by the audience experience of living through the story. Our results suggest that the learning is strong around concepts and processes, as well as specific facts. It further suggests that immersion and embodiment in the story as scientists or engineers can potentially change attitudes, as well as enhance learning and understanding. This



reinforces Luong's reflection that "Potentially, informational versus persuasive outcomes may be more strongly influenced by different processing variables: transportation, narrative engagement, and identification may be able to fully account for attitudinal impacts because such information is more likely to be processed along with the narrative content" [Luong, Moyer-Gusé and McKnight, 2020].

Follow-up research will clarify the effect of this experience on permanence of learning and explore whether the striking attitudinal changes reported are a short-lived or long-lasting effect. In conclusion we suggest that immersive theatre is a highly effective mechanism for informal science learning. There are, therefore, ethical complexities to consider, if this is the case. Gallagher concludes that "Storytelling as method is here to stay. This is as it should be. But more careful consideration of the work that stories do in our research accounts, the judgement they provoke, the openings they foreclose, and the fixities they guarantee remains a central challenge." [Gallagher, 2011]. In this particular case, although the timing was coincidental, Space Plague worked well as a fictionalised analogy to the COVID-19 pandemic. The results suggest that this has been a successful mechanism through which almost 300 individuals were able to understand the science behind, and come to terms with the real-life response to, COVID-19. The stories behind other productions would need the equivalent careful co-creation with diverse stakeholders to be meaningful, relevant and inclusive. On a practical level, the drawback of a fully immersive experience is the requirement of considerable resourcing (both human and physical) for a limited number of audience members. The next iteration of the Space Plague story will, therefore, be a digitally accessible experience, with some elements in VR, to explore whether similarly transportative effects can be achieved by bigger audiences by using a digital platform for delivery.

## Funders List

Science and Technology Facilities Council, Royal Academy of Engineering, Arts Council, England, The British Science Association/UK Science Festivals Network.

## References

- Alston, A. (2013). 'Audience participation and neoliberal value: Risk, agency and responsibility in immersive theatre'. *Performance Research* 18 (2), pp. 128–138. <https://doi.org/10.1080/13528165.2013.807177>.
- Archer, L., DeWitt, J., Osborne, J. F., Dillon, J. S., Wong, B. and Willis, B. (2013). *ASPIRES Report: Young people's science and career aspirations, age 10–14*. London. URL: <https://www.kcl.ac.uk/ecs/research/aspires/aspires-final-report-december-2013.pdf>.
- Barthes, R. and Duisit, L. (1975). 'An Introduction to the Structural Analysis of Narrative Roland Barthes'. *New Literary History: On Narrative and Narratives* 6 (2), pp. 237–272.
- Biggin, R. (2017). *Immersive Theatre and Audience Experience: space, game and story in the work of punchdrunk*. Palgrave Macmillan. <https://doi.org/10.1007/978-3-319-62039-8>.
- Braun, V. and Clarke, V. (2012). 'Thematic analysis'. In: *APA handbook of research methods in psychology, Vol 2: Research designs: Quantitative, qualitative, neuropsychological, and biological*. American Psychological Association, pp. 57–71. <https://doi.org/10.1037/13620-004>.

- Brecht, B. (1964). *Brecht on theatre: The development of an Aesthetic*. Ed. by M. Silberman, S. Giles and T. Kuhn. Macmillan.
- Burns, J., Cooke, D. and Schweidler, C. (2011). *Participatory A Short Guide Asset Mapping to Community Based Participatory Action*. URL: <https://hc-v6-static.s3.amazonaws.com/media/resources/tmp/cbpar.pdf>.
- Dahlstrom, M. F. (2014). 'Using narratives and storytelling to communicate science with nonexpert audiences'. *Proceedings of the National Academy of Sciences* 111 (Supplement 4), pp. 13614–13620. <https://doi.org/10.1073/pnas.1320645111>.
- Edwards, K. (1990). 'The interplay of affect and cognition in attitude formation and change.' *Journal of Personality and Social Psychology* 59 (2), pp. 202–216. <https://doi.org/10.1037/0022-3514.59.2.202>.
- Fabrigar, L. R. and Petty, R. E. (1999). 'The Role of the Affective and Cognitive Bases of Attitudes in Susceptibility to Affectively and Cognitively Based Persuasion'. *Personality and Social Psychology Bulletin* 25 (3), pp. 363–381. <https://doi.org/10.1177/0146167299025003008>.
- Freshwater, H. (2009). *Theatre And Audience*. 18th ed. Houndmills, Basingstoke, Hampshire, U.K.: Palgrave Macmillan.
- Gallagher, K. M. (2011). 'In search of a theoretical basis for storytelling in education research: story as method'. *International Journal of Research & Method in Education* 34 (1), pp. 49–61. <https://doi.org/10.1080/1743727x.2011.552308>.
- Gerrig, R. (1993). *Experiencing Narrative Worlds: On the Psychological Activities of Reading*. New Haven, U.S.A.: Yale University Press, pp. 10–11.
- Girdwood, A. (2013). 'A Review of Clockwork Watch: The Arrival'. *GeekNative*. URL: <https://www.geeknative.com/40230/a-review-of-clockwork-watch-the-arrival> (visited on 16th September 2020).
- Green, M. C. and Brock, T. C. (2002). 'In the mind's eye: Transportation-imagery model of narrative persuasion'. In: *Narrative impact: Social and cognitive foundations*. Mahwah, NJ, U.S.A.: Lawrence Erlbaum Associates Publishers, pp. 315–341.
- Green, M. C. and Brock, T. C. (2000). 'The role of transportation in the persuasiveness of public narratives'. *Journal of Personality and Social Psychology* 79 (5), pp. 701–721. <https://doi.org/10.1037/0022-3514.79.5.701>.
- Green, M. C., Kass, S., Carrey, J., Herzig, B., Feeney, R. and Sabini, J. (2008). 'Transportation Across Media: Repeated Exposure to Print and Film'. *Media Psychology* 11 (4), pp. 512–539. <https://doi.org/10.1080/15213260802492000>.
- Jarvis, P. S. C. (2016). 'SMASHfestUK 2016: 'Solar Storm!'' *SMASHfestUK evaluation report*. URL: <https://gala.gre.ac.uk/id/eprint/19844/>.
- Keith, L. A. and Griffiths, W. (2020). 'Human centred design as a Method for social inclusion, increasing diversity and widening participation in informal science education'. *Research for All*. in preparation.
- Laer, T. van, Ruyter, K. de, Visconti, L. M. and Wetzels, M. (2014). 'The Extended Transportation-Imagery Model: A Meta-Analysis of the Antecedents and Consequences of Consumers' Narrative Transportation'. *Journal of Consumer Research* 40 (5), pp. 797–817. <https://doi.org/10.1086/673383>.
- Lopes Ramos, J., Dunne-Howrie, J., Maravala, P. J. and Simon, B. (2020). 'The post-immersive manifesto'. *International Journal of Performance Arts and Digital Media* 16 (2), pp. 196–212. <https://doi.org/10.1080/14794713.2020.1766282>.
- Luong, K. T., Moyer-Gusé, E. and McKnight, J. (2020). 'Let's Go to the Movies... for Science!' *Journal of Media Psychology* 32 (4), pp. 200–215. <https://doi.org/10.1027/1864-1105/a000272>.

- Machon, J. (2013). *Immersive Theatres Intimacy and Immediacy in Contemporary Performance*. Basingstoke, U.K.: Palgrave Macmillan.
- McKenzie, B. and Flow, A. (2015). 'SMASHfestUK2015: 'Asteroid!'' *SMASHfestUK evaluation report*. URL: <http://gala.gre.ac.uk/id/eprint/19848>.
- McMillan, J. (22nd April 2013). 'Theatre review: Deadinburgh, Edinburgh'. *The Scotsman*. URL: <https://www.scotsman.com/arts-and-culture/theatre-and-stage/theatre-review-deadinburgh-edinburgh-1578325>.
- Phillips, B. J. and McQuarrie, E. F. (2010). 'Narrative and Persuasion in Fashion Advertising'. *Journal of Consumer Research* 37 (3), pp. 368–392. <https://doi.org/10.1086/653087>.
- Rosselli, F., Skelly, J. J. and Mackie, D. M. (1995). 'Processing Rational and Emotional Messages: The Cognitive and Affective Mediation of Persuasion'. *Journal of Experimental Social Psychology* 31 (2), pp. 163–190. <https://doi.org/10.1006/jesp.1995.1008>.
- Simons, N. (2017). SMASHFestUK 2017 Evaluation report. URL: <http://sciencefestivals.uk/wp-content/uploads/2016/02/SMASHfestUK-2017-evaluation-report.pdf>.
- (2018). 'SMASHfestUK2018: 'Flood'''. *SMASHfestUK evaluation report*. URL: <http://gala.gre.ac.uk/id/eprint/28766>.
- Slater, M. D. and Rouner, D. (2002). 'Entertainment-Education and Elaboration Likelihood: Understanding the Processing of Narrative Persuasion'. *Communication Theory* 12 (2), pp. 173–191. <https://doi.org/10.1111/j.1468-2885.2002.tb00265.x>.
- Thompson, C. J. (1997). 'Interpreting Consumers: A Hermeneutical Framework for Deriving Marketing Insights from the Texts of Consumers' Consumption Stories'. *Journal of Marketing Research* 34 (4), pp. 438–455. <https://doi.org/10.1177/002224379703400403>.
- White, G. (2013). *Audience Participation in Theatre: Aesthetics of the Invitation*. Palgrave Macmillan U.K. <https://doi.org/10.1057/9781137010742>.
- Woods, R. D. and Banham, M. (1996). 'The Cambridge Guide to Theatre'. *Hispania* 79 (4), p. 800. <https://doi.org/10.2307/345343>.

## Authors

Dr. Lindsay Keith BSc PhD, PGCertHE Lindsay is a multi BAFTA nominated film-maker, festival producer, writer and creative research fellow at the University of Greenwich. After completing her PhD in Infectious Disease at Imperial College London, she worked in broadcast TV, producing and directing specialist factual and observational documentaries, and mainstream factual-entertainment programmes for BBC1&2, Ch4, five, Sky, Discovery, and History channels. In 2011 she founded creative production company, The Refinery and in 2014 co-founded SMASHfestUK, an award-winning immersive science and arts festival for marginalized young people and families. Since 2015 she has also worked as a research fellow at the University of Greenwich where her research specialism is embodiment and behavior change through immersive narratives. In 2019 and 2020 she co-created, scripted and produced a mixed-media fully immersive work "Space Plague" exploring embodiment and presence in immersive theatre and the role of narrative transportation in changing real-life attitudes. E-mail: [l.keith@gre.ac.uk](mailto:l.keith@gre.ac.uk).

Mr. Wyn Griffiths BA, MSc, FRSA, Senior Lecturer, Middlesex University, Department of Design Engineering and Mathematics, School of Science and Technology. Wyn is Principal Investigator for the STFC Nucleus Award funded 'Space Plague' project, researching immersive theatre and narrative transportation effects in informal STEM education, and teaches in Product Design and Product Design Engineering. His work spans many sectors and a disparate range of public engagement arenas, including event, installation, experience and exhibition design, build and management. His recent work includes conceiving, founding and running SMASHfestUK, with The Refinery; creating large scale mechanical installations such as the Globe of Dislocation, exhibited in the Royal Observatory Courtyard in 2014/15 as part of their Longitude Punk'd Exhibition and the Stained Glass "Car of the Future" — a physical thought experiment with designer Dominic Wilcox for BMW, Mini and Dezeen and designing and running 'Robot Overlords', an immersive robotics experience, exploring the perception and reality of robotics technology and social penetration for London Design Festival 2015.  
E-mail: [w.griffiths@mdx.ac.uk](mailto:w.griffiths@mdx.ac.uk).

## How to cite

Keith, L. and Griffiths, W. (2020). "'Space Plague': an investigation into immersive theatre and narrative transportation effects in informal pandemic science education'. *JCOM* 19 (07), N01. <https://doi.org/10.22323/2.19070801>.



© The Author(s). This article is licensed under the terms of the Creative Commons Attribution — NonCommercial — NoDerivativeWorks 4.0 License.  
ISSN 1824-2049. Published by SISSA Medialab. [jcom.sissa.it](http://jcom.sissa.it)