"THE MYSTERY OF THE RADDLESHAM MUMPS": A CASE STUDY FOR COMBINED STORYTELLING IN A THEATRE PLAY AND VIRTUAL REALITY

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ABSTRACT

"The Mystery of the Raddlesham Mumps" is a poem by Murray Lachlan Young, aimed at both children and adults. This poem has been adapted as a theatre play with a short prequel as a Virtual Reality (VR) / tablet app. We used this unique combination to explore the potential interaction between these different media elements for the level of "presence" and "immersion" in the story (i.e. the level to which one can imagine oneself within the story at the expense of the sense of physical time and space).

The theatre audience had the opportunity to play the VR / tablet app in the foyer before the performance started. After the performance, a questionnaire measured participants' level of immersion and presence in the theatre play and their enjoyment of both play and app. The results showed that people of all ages interacted with and liked the app. Ratings for the play were also high and did not depend on prior engagement with the app. However, the play was liked more by adults than children, and the reverse was true for the app, suggesting a potential generation shift in multimedia story telling.

***Index Terms*—** Theatre, Virtual Reality, Storytelling, Presence, Immersion, User Experience

1. INTRODUCTION

Storytelling comes in many shapes and forms and across the ages has been an integral part of human life [18]. During the last century, technological advances have created many opportunities for stories to be told using a broad range of media. The form that theatre practice has taken has continually evolved throughout history from ancient Greek dramatic festivals to live streamed simulcasting and online networked performances. Live performance in front of an audience is still widely perceived as a valuable social occasion and has contributed more than £1.28 billion of box office-generated income to the UK economy according to a recent 2018 report [22]. With the emergence of radio drama in the early twentieth century, a new play format came into existence with the actors performing auditory theatre from a sound-stage instead of a theatre stage [8]. Audio books emerged as another variant of auditory storytelling on a trajectory from spoken word recordings in the 1910s to full-length recordings of novels in the 1930s. The latter migrated from vinyl to cassettes to CDs/CD-ROMS and more recently digital audio books on streaming on-demand services [9]. In audio books, the storytelling takes a slightly different form compared with radio plays – typically using just one voice to narrate prose – but the medium of presenting a story through sound alone is the same. With the emergence of film, actors' performances were reproduced to be screened in multiple venues simultaneously and subsequently television enabled live and prerecorded drama to be broadcast into our homes. Both mediums initially borrowed from, or 'remediated' the conventions of stage theatre and dramatic radio production (meaning to appropriate the content of one medium into another) [4], before they truly became sophisticated storytelling mediums in their own right [5], using visual and audio effects to create highly immersive experiences. Computers brought an interactive element to storytelling that could be experienced at home – from hypertext fiction to role-playing video games – in which audiences, readers or 'players' can become an active part through their navigation and choice-making. And lastly, even though Virtual Reality has been around for several decades, it is only recently that it has become accessible and affordable for the larger consumer market. To some extent, VR is entering our homes and providing a new platform for both passive storytelling, using 360° video, and interactive storytelling where the audience is an active agent in shaping their journey. VR thus provides novel opportunities to contribute an additional dimension of sensory immersion and interactivity to storytelling that could potentially find its way back into theatre buildings to enhance certain elements

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of a play, or extend the reach of a venue's artistic programme. Indeed, since the mid-noughties, scholarship in intermedial performance has sought to highlight theatre's distinctive capacity as a hybrid space, or 'hypermedium', to combine different mediums [13]. VR has the potential to increase the accessibility of theatre, e.g. when a visit to a theatre auditorium in person is not possible, VR could allow for an immersive theatre experience at home. Moreover, expanding the form that theatre practice takes through different platforms provides the opportunity for attracting new audience demographics. For instance, audiences interested in gaming, but otherwise not aware of the experience that theatre may provide, could be inspired to engage more with theatre especially when elements of the story in a play and a game overlap; the expansion of a narrative world across various different media has been termed by Henry Jenkins as 'transmedia storytelling' [12].

Important for any kind of storytelling, however, is that it should have the audience at the heart of it. That is, storytelling needs to "touch" the audience in some way in order to entice them to engage with it. Writer and story analyst Lisa Cron contends that a story is not primarily about 'plot' or 'what happens', but rather how we change; stories 'grab us only when they allow us to experience how it would feel to navigate the plot', sending us on an internal journey [6]. The extent and quality of subjective engagement is often referred to as presence and immersion in a story, but it is important to note that these terms can have different meanings in different areas of media-related research. In virtual reality research, spatial presence relates to the feeling of really "being there" inside the virtual environment (this term is also used in the same way for other media-types such as film [23]) and immersion relates to the extent to which the senses are engaged by the virtual environment at the cost of becoming less aware of the actual physical world (sensory immersion). In the VR literature "immersion" is therefore often linked to the technology used rather than the subjective experience [1, 7, 21]. However, the same ideas of losing awareness of the physical world, in favour of the story world, can also be attributed to a strong and engaging narrative (narrative immersion) [1, 3, 25] and the audience's imagination or immersive tendency [24], which is a more cross-medium definition of the term "immersion" that we will adhere to here. Using these definitions presence and narrative immersion can be seen as flip-sides of the same coin, where immersion is related to the extent to which awareness of the physical world is lost (sometimes also referred to as involvement in the VR-context) and presence is related to the extent to which we feel ourselves to have been transported to the scene of the story. The question is however, how different medium types may interact for creating a strong and captivating sense of presence and immersion in the story.

The present project developed and assessed the use of VR as a way of augmenting and enhancing the play "The Mystery of the Raddlesham Mumps". Our goal was to help to build a VR app as part of the overall Raddlesham Mumps experience. Our primary aim in this was to create an app which enhanced, rather than distracted from the play itself. To this end, we created an interactive game as a prequel to the play, which could be experienced either in the theatre foyer or at home, rather than as during the live performance. Our second goal was to ensure that the app was an experience that works for all, since the play is aimed at a family audience of all ages. This in itself created two challenges. The first is that VR headsets are typically restricted to be used only by those aged above 13. The second is that a fully-immersive VR experience, while creating a high degree of presence in the virtual world, isolates the user from the physical world. This would potentially detract from the social dimension of a visit to a live family play.

To address these challenges, we developed an app as a prequel to the play, running in both a VR headset and on a tablet. This ensured that it could be experienced by people of all ages; at home or at the theatre; and either alone or in a group. We researched the reception of The Mystery of Raddlesham Mumps prequel as it was experienced in the app, and the extent to which using the app directly prior to the play interacted with overall enjoyment, and feelings of immersion and presence during the live theatre performance. These effects were captured retrospectively, via subjective ratings from audiences aged between 6 and 80 years.

2. METHODS

2.1. Materials

As the materials we used the theatre production of the play "The Mystery of the Raddlesham Mumps" by Murray Lachlan Young ([27]), a story that was previously published both as a book [26] and an audio-album [28] (for further details see `http://raddleshammumps.co.uk/`). "The Mystery of the Raddlesham Mumps" tells the gothic tale of 7-year old Crispin, the heir of the Raddlesham Mumps. After the double funeral of Crispin's parents, Crispin finds himself in his ancient ancestral home that he has now inherited: the Raddlesham Mumps, with only the 100-year butler Kenilworth for company. Kenilworth begins to recount the tale of how each of Crispin's very eccentric ancestors died in mysterious, bizarre and often hilarious circumstances before an epic battle ensues between "the old" and "the new". The play is set at the ruins of the Raddlesham Mumps, where this story is told and acted out by a storyteller and his companion. The production was aimed at "children of all ages between 7 and 107+". The production was particularly aimed at family audiences, which allowed us to collect responses from both children and adults.

The story has a short prequel in the VR/tablet app by the same name [14], in which you as Crispin explore the attic of the Raddlesham Mumps, just before the funeral of Crispin's parents, and find several artefacts that relate to the mysterious deaths of Crispin's ancestors. In the theatres this app could be

played either on android tablets that were displayed on plinths in the foyer of the theatres in which the play was performed, or on one of several Oculus Go headsets for the full VR experience. The story of the app was the same in both cases.

The wider audience could also access the Android version or Oculus Go version of the app at home for free, from the Google Play Store or Oculus Go store, respectively.

To date, the Raddlesham Mumps play has been performed 34 times in 22 venues, reaching an audience of nearly 3000. There have been more that 1700 downloads of the Oculus Go app, 725 downloads of the tablet game, and the audio book has been listened to more than 1200 times.

2.2. Questionnaire

Before the play started the audience had the opportunity to play either the tablet or the VR version of the Raddlesham Mumps app using the equipment in the theatre foyer (on the plinths or using an available Oculus Go). Next, the audience enjoyed the live performance of the play in the auditorium. Upon leaving the auditorium, members of the audience could volunteer to fill in a short paper questionnaire to tell us about their experience of the play and the app. These questionnaires were handed out by two production assistants who were not otherwise involved with the research itself. There were 6 questions in total, which were as follows:

Q1: How old are you? This question was used to obtain the age of our participants. Participants could report any number.

Q2: Did you like the play? This question was used to measure enjoyment of the play and was presented on a 5-point Likert scale ranging from "No" (score of 1) to "I loved it" (score of 5).

Q3: Could you imagine yourself being at the Raddlesham Mumps? This question was used to measure presence in the play's settings. This question was presented on a 5-point Likert scale ranging from "No" (1) to "Totally" (5).

Q4: During the play did you notice the people sitting in front or behind you? This question was used to measure immersion as a reverse scale using the logic that the more immersed in a play or story people are, the less aware they tend to be about their direct surroundings and vice versa [19]. This question was presented on a 5-point Likert scale ranging from "Not at all" (1) to "All the time" (5) to indicate awareness of surroundings. For the analysis the scores were reverse coded to transform awareness of surroundings scores into immersion scores.

Q5: Did you try the Raddlesham Mumps app before the play? This simple yes-no question was included to be able to group participants according to whether or not they had interacted with the app before the play.

Q6: If you tried the app, how much did you like it? This question was used to measure enjoyment of the app and was presented on a 5-point Likert scale ranging from "No" (1) to "I loved it" (5).

The questionnaire was deliberately kept short and light so as not to interfere with the overall theatre experience.

2.3. Participants and data entry

Participants for the short in-theatre paper questionnaire were visitors to the theatre production. After the play they could volunteer to fill in the brief in-theatre questionnaire containing the questions listed above. Information about the study was on display in the theatre foyer for those audience members who wanted to know more about the study. In total 228 attendees across 8 separate performances in 4 venues across London and the East of England volunteered to fill in the questionnaire. Table 1 provides a break-down of participants across the separate performance venues.

Theatre	Performances	Participants
Lakeside Theatre (Colchester)	3	159 (12)
Jubilee Hall (Aldeburgh)	1	9 (2)
Quay Theatre (Sudbury)	1	12 (2)
Wilton's Music Hall (London)	3	48 (4)
Total	8	228 (20)

Table 1. Theatres at which data was collected in April 2019 including the number of performances at this location, and number of participants at those theatres (number of excluded participants in brackets). The total number of participants included in the data analyses was N=208. The total audience size across these four locations was 1165.

The paper questionnaires were labeled and numbered per theatre in order to identify individual questionnaires. Next the data from the paper questionnaires was entered into computer files by three people independently (2 authors, LvD and AW and a student volunteer interning with LvD). After each person entered the complete data, the resulting data files were compared to catch potential mismatches and typos. Any mismatches between any of the three data entries were caught by comparing the three separate files and mismatches were either resolved by looking up the original questionnaire, or if the issue remained unresolved the particular entry was treated as missing data.

Some issues at this stage led to the removal of participants. We used two different criteria. The first arose because some participants did not report their age. Since a large portion of our data analysis revolves around differences between different age groups, participants who filled in anything other than a number for their age were removed from the dataset. This led to the removal of 15 participants. Five further participants were removed because they ticked more than one

response for one or more questions in the paper questionnaire (4 participants) or did not fill in any other question (1 participant). The final dataset used for further analysis thus contained 208 participants.

3. RESULTS

Our analysis focused on the 208 valid entries as described in the Methods section. Figure 1 shows a stacked histogram of the different ages in our sample as well as an indication of the number of people that interacted with the app as a function of age. The bimodal nature of the age distribution, with peaks at roughly 10 years and 45 years, suggests that the audience mostly consisted of children and their parents. There were 119 children in our sample (i.e. participants younger than 18) and 89 adults (18 years old or older). Of the children in our sample, 43 had used the app (36.1%) and of the adults 21 had used the app (23.6%). From these percentages it would seem that children interacted with the app a little bit more than the adults did, but these proportions did not differ significantly (χ^2-test for contingency tables: $\chi^2(1) = 3.76$; $p = 0.053$). This shows that both adults and children interacted with the app in roughly equal proportions.

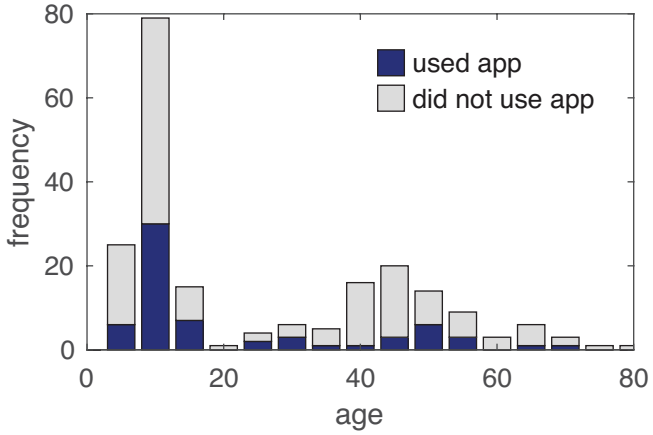

Fig. 1. The age distribution of our participants presented as a stacked histogram also indicating app-usage as a factor of age.

Both the play and the app received high enjoyment scores (liking the play, liking the app ratings) mostly in the 4s and 5s along the 5-point Likert scale (see Figures 2 and 3 top two panels). We were however mostly interested in whether using the app or not had any effect on the appreciation of the play and the levels of presence and immersion experienced when watching it. Figure 2 shows the proportions of the different Likert-scale ratings provided by those that had used the app in blue and those that did not use the app in red. What can be seen is that these lines are largely overlapping for liking the play, presence and immersion, suggestion that app-usage did not influence any of these measures. This was confirmed using an ordinal regression with the Likert-scale measures as the ordinal dependent variable, and age category (child versus adult) and app-usage (whether the participant had interacted with the app before the play or not) as independent categorical variables. The odds of app-users liking the play more than non-app users was 1.29 (95% CI, 0.81 to 2.08), which was not a statistically significant effect (Wald χ^2 = 1.15; p = 0.28). The odds of app-users experiencing more presence or immersion were 1.17 (95% CI, 0.83 to 1.65) and 0.75 (95% CI, 0.53 to 1.07) times that of non-app users, respectively, neither of which represents a significant effect (presence: Wald χ^2 = 0.81; p = 0.37; immersion: Wald χ^2 = 2.49; p = 0.11). This analysis shows that app-usage before the play did not influence the ratings for any of these measures. This means that playing through the prequel of the story using the app, directly before seeing the play, neither enhanced the theatre experience nor, critically, interfered with it.

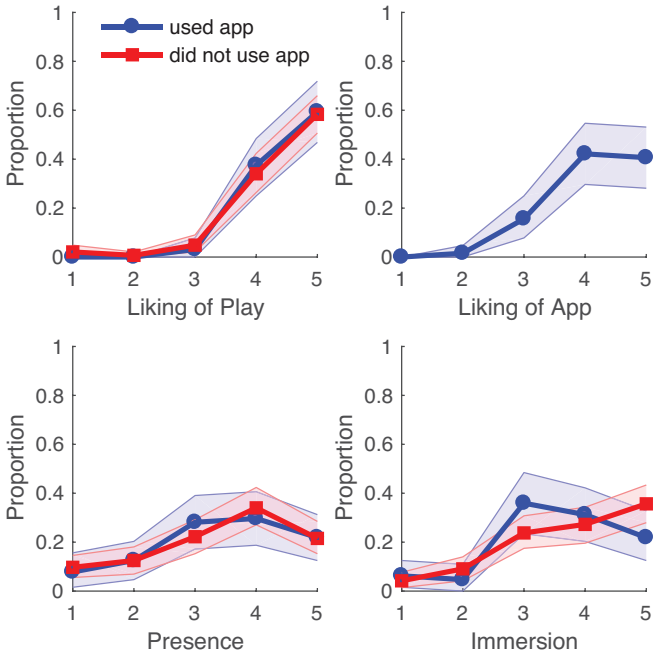

Fig. 2. Ratings given by our participants for liking the play, liking the app, presence and immersion, split by whether or not the participant had interacted with the app. Shaded areas indicate 95% confidence intervals obtained through bootstrapping the observed proportions in a Monte Carlo simulation.

However, when we looked at the results in terms of age, and more particularly child versus adults comparisons, we did find an influence of age-group in the ratings. Adults were 2.94 (95% CI, 1.79 to 4.82) times more likely than children to give higher ratings for liking the play (Wald χ^2 = 18.30; p = 0.000019); 2.38 (95% CI, 1.22 to 4.62) times more likely to give lower ratings for liking the app (Wald χ^2 = 6.51; p =

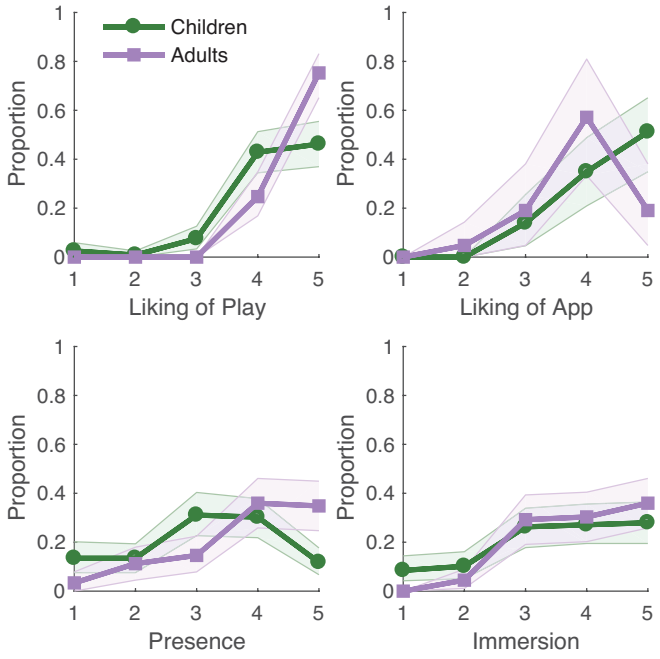

Fig. 3. Ratings given by our participants for liking the play, liking the app, presence and immersion, split by age group (children versus adults). Shaded areas indicate 95% confidence intervals obtained through bootstrapping the observed proportions in a Monte Carlo simulation.

0.011); and 2.22 (95% CI, 1.58 to 3.10) times more likely to give higher ratings for the sense of presence during the play (Wald $\chi^2 = 21.59$; p = 0.000003). The only measure for which the ordinal regression indicates that age did not play a significant role was our measure of immersion (odds of adults giving higher immersion ratings than children = 1.26; 95% CI: [0.90,1.78]; Wald $\chi^2 = 1.80$; p = 0.18). These differences can also be observed in Figure 3 which shows the proportions for the ratings on the Likert-scales split by age group (children versus adults). For liking the play (Figure 3, top left) and presence (Figure 3, bottom left) there is a clear shift towards higher ratings for adults compared to children. For liking the play (Figure 3, top right) this shift is towards adults giving lower ratings than children. These results suggest that though both play and app received high ratings from both children and adults, adults liked the play more than children did, whereas conversely, when compared to adults children gave higher ratings for the app. Interestingly, it seems that this effect may largely be driven by the adults in our sample. When comparing ratings for liking the play and liking the app for the same group of adult participants who had experienced both, it seems that adults gave significantly higher ratings for the play compared to the app (non-parametric Wilcoxon signed rank test: W(N = 21) = 91.0; p = 0.0002). A similar analysis for the child participants who experienced both the play and app led to a non-significant result (W(N = 43) = 213.5; p = 0.28)

One remaining question was whether immersion and presence can indeed be considered two sides of the same coin given that they, for instance, did not depend on age group in the same way. That is, to what extent is the feeling of being at the scene of the story really linked to the extent to which we grow less aware of our immediate surroundings. To get an understanding of this possible relationship, we determined the proportion of participants for each possible combination of immersion and presence ratings as shown in Figure 4. What can be seen is that particularly for the higher ratings there seems to be also some consistency along the diagonal. That is, the yellow colour in the top-right of the graph indicates that participants who gave a rating of '5' for immersion also often gave rating of '5' for presence (though note that ratings of '4' and '3' for presence in combination with '5' for immersion also often occurred). This correspondence is stronger for ratings of '4' for both immersion and presence and grows a little weaker again when going more to the bottom left of the graph where there are also lower proportions of participants altogether. This relationship between immersion and presence ratings was confirmed by a correlation analysis across all participants (Spearman's $\rho = 0.25$; p = 0.00036) and also when looking at children and adult groups separately (children, $\rho = 0.197103$; p = 0.032; adults, $\rho = 0.24$; p = 0.025).

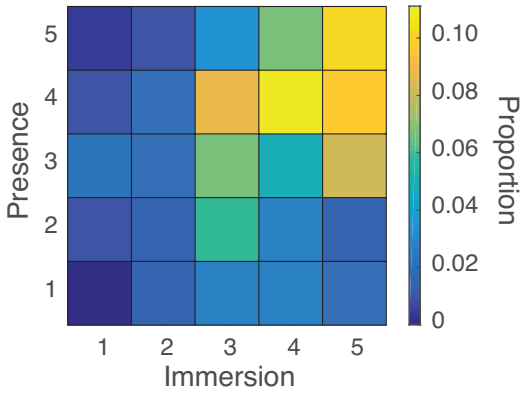

Fig. 4. Relationship between presence and immersion ratings. The colours in this graph correspond to the proportion of participants giving the specific combination of immersion and presence ratings. Yellow colours indicate a large proportion and blueish colours a small proportion.

4. DISCUSSION

In this study we took the opportunity of the combined media experience of an interactive app (story prequel) and a theatre play (main story) and look at the potential interactions between these types of media for appreciating the theatre play. The results show that both the play and app received high enjoyment ratings indicating that both were well liked by the

general audience. However, playing the app just before the play did not affect the enjoyment or experience of the play. This means that playing the app neither enhanced nor interfered with the enjoyment of the play, or the level of presence and immersion that was experienced during the play. Instead, age-group, in terms of adults and children, was found to play a role in how the app and the play were experienced. Enjoyment of the play was rated more highly by adults, who also provided higher ratings for their sense of presence during the play compared to children. Enjoyment of the app, however was rated more highly by the children compared to adults. These differences suggest a change in how the separate generations experience the same type of creative entertainment medium differently and potentially a shift in preference for different forms of storytelling content.

This difference is consistent with previous findings showing differences between age groups. For instance, younger adults have been found to, for instance, stream live-to-digital theatre content more than older adults do [17] whereas attending Event Cinema appears to be more consistent across age. Together with the present findings it would seem that "younger" generations are more accepting of some of the recent digital innovations in the entertainment industries. In the present study this acceptance of digital innovations by younger generations emerged in the result that children gave higher ratings for the app when compared to adults, and the reverse was true for the play. This suggest that different audiences may also naturally engage with some forms of story telling above others and through their choices audiences also have a say in which forms of story telling will be more successful and further developed. This is also the conclusion of a recent report [11] that focuses on immersive environments, such as VR, and provides an overview of the areas of research where development is necessary for us to better understand the reception and impact of art in general and art as experienced through this media type in particular. Future research could look into whether this change in digital entertainment consumption can be used to create an interest and perhaps even a new market for theatre productions.

One concern in comparing the ratings of adults and children, however, is the possibility of differences in the experimental demand characteristics such as the 'good participant' effect [15]. This is the potential for participants to provide the result that they think the experimenter would "prefer" and this effect has the potential to vary with age (see e.g. [2] for age group differences in responding to leading questions). In the present study, this might, for example, materialise in one age group generally being more likely to provide positive ratings than another. However, such general age-group related biases cannot account for our results, in which the effect of age on ratings was in the opposite direction for the play and the app. Likewise, absentmindedly filling in the questionnaire by ticking all the same boxes (all at the low end or all at the high end) cannot account for our results. If participants had done this the ratings for immersion would have been been very low as this scale was presented through a reverse-coded question (asking about awareness of environment instead of immersion directly).

Another concern could be whether the audience fully understood what was being asked in some of the questions. People from across different age groups have been shown to give "sensible" answers to what could be considered bizarre questions, by adding in a missing context themselves [10, 16]. This has been a particular criticism for research around presence [20] where it is not necessarily clear to the general public what the term "presence" means. In the present study we were therefore careful in the phrasing of our questions and avoided terms that might be ambiguous or lead to confusion. In Q3 (which measured presence) we, for instance, avoided the term "presence" altogether, but rather asked whether the participant could imagine themselves at the Raddlesham Mumps. Moreover, we checked the consistency between presence and immersion, which are often found or assumed to be linked [19, 25], and found a good correspondence between these measures also within the present study. We therefore expect that such factors of question understanding played only a minimal role here, if any.

To conclude, our study suggests that a story can easily be extended by adding a different media component (here the app) without affecting the enjoyment of the original story (here the play). However, there does seems to be a generation shift in storytelling medium preferences, with the younger generation being more receptive of the digital app component and vice versa for the play.

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