

Psychology of Aesthetics, Creativity, and the Arts

Immersive-360° Theater: User Experience in the Virtual Auditorium and Platform Efficacy for Current and Underserved Audiences

Abigail L. M. Webb, Paul B. Hibbard, Jessica Dawson, Loes C. van Dam, Jordi M. Asher, and Leo J. Kellgren-Parker

Online First Publication, February 26, 2024. <https://dx.doi.org/10.1037/aca0000624>

CITATION

Webb, A. L. M., Hibbard, P. B., Dawson, J., van Dam, L. C., Asher, J. M., & Kellgren-Parker, L. J. (2024, February 26). Immersive-360° Theater: User Experience in the Virtual Auditorium and Platform Efficacy for Current and Underserved Audiences. *Psychology of Aesthetics, Creativity, and the Arts*. Advance online publication. <https://dx.doi.org/10.1037/aca0000624>

Immersive-360° Theater: User Experience in the Virtual Auditorium and Platform Efficacy for Current and Underserved Audiences

Abigail L. M. Webb¹, Paul B. Hibbard², Jessica Dawson³, Loes C. van Dam^{3, 4},
Jordi M. Asher², and Leo J. Kellgren-Parker⁵

¹Institute of Health and Wellbeing, University of Suffolk

²Department of Psychology, University of Stirling

³Department of Psychology, University of Essex

⁴Department of Human Sciences, Institute for Psychology/Centre for Cognitive Science, Technical University of Darmstadt

⁵LIVR LTD, London, United Kingdom

The present study explores the efficacy and social potential of immersive-360° theater—live-captured theater performances filmed for virtual reality (VR) viewing—as a remote platform for audiences to view theater. We obtained survey and structured interview responses from 166 and 30 participants, respectively, self-categorized as regular theatergoers, novices, or underserved audiences. We measured immersion, presence, and emotional arousal in the virtual auditorium, technology acceptance, and social perceptions including platform compatibility with traditional theater and use as a psychosocial and accessibility promotion tool. Findings show that in the immersive-360° theater auditorium ratings for presence and immersion are mixed, and the latter is likely to be influenced by external factors including hardware quality and environmental distractors. For most, immersive-360° theater is regarded as a positive tool for psychosocial aspects and accessibility, but many highlighted the absence of social aspects which are central to the traditional theater experience and cannot be replicated in remote conditions. Despite this, the experience was enjoyable for most participants, and crucially, the majority of participants do not perceive immersive-360° theater as a “threat” to its traditional counterpart. Rather, with certain improvements it is seen as a compatible and complementary offering that has potential for use as a digital pipeline for underserved audiences and recruiting new patrons. Suggestions for improving the quality of the VR theater experience and its potential as an accessibility tool included improving headset quality and resolution, additional accessibility and user controls, and the ability to share the experience with somebody else in real time.

Keywords: virtual reality, virtual theater, theater, digital arts, immersive experience

Supplemental materials: <https://doi.org/10.1037/aca0000624.supp>

Background

Immersive-360° Capture Theater: A Novel Live Theater Experience

Three-hundred-and-sixty-degree capture of theater creates a close living record of a performance. A video rig captures everything happening during the performance, including the view of the stage and members of the audience (see Figure 1). This recording is then streamed to a virtual reality (VR) head-mounted display (HMD),

where viewing can occur at any time and place, such as on demand at home. This asynchronicity and use of a VR headset to view performances differentiates immersive-360° theater from both live-streaming to a screen and real-life theater attendance. Key perceptual qualities of immersive-360° theater viewed through an HMD are that it is immersive, reducing sensory awareness of the physical world outside the HMD and facilitating narrative immersion in the performance, and reactive to the viewer’s head movements (Hibbard, 2023; van Dam et al., 2020). This creates a sense of physical presence: the feeling that one is “really there,” attending, in the virtual auditorium (Schuemie et al., 2001). Together, these qualities of presence constitute necessary precursors to a realistic and immersive experience (Vasser & Aru, 2020).

VR Technologies and Theater: Case Studies to Date

Few studies have explored immersive VR technology for theater. For nonfiction content, VR has been associated with greater immersion and presence, reduced distraction, and the ability to actively explore the environment (Green et al., 2021). It was also associated with notional embodiment, or the Swayze effect—the surreal sensation and feeling of disconnect that comes from the direct eye contact of the recorded

Abigail L. M. Webb  <https://orcid.org/0000-0001-9522-8355>

Open Access funding provided by the University of Suffolk: This work is licensed under a Creative Commons Attribution 4.0 International License (CC BY 4.0; <https://creativecommons.org/licenses/by/4.0>). This license permits copying and redistributing the work in any medium or format, as well as adapting the material for any purpose, even commercially.

Correspondence concerning this article should be addressed to Abigail L. M. Webb, Institute of Health and Wellbeing, University of Suffolk, Waterfront Building, 19 Neptune Quay, Ipswich IP4 1QJ, United Kingdom. Email: a.webb6@uos.ac.uk

Figure 1
A 360° Capture of a Live Performance



Note. A 360° capture of the performance “Dalloway,” performed by Dyad Productions and captured by LIVR. Copyright 2022 LIVR, copied with permission. Participants used the HMD to be virtually placed into the auditorium, with views of the stage and other adjacent audience members who were present at the time of recording. Note that although participants could see virtual audience members, this was a solitary viewing experience, for example, they were alone when using the headset to view VR theater. HMD = head-mounted display; VR = virtual reality.

audience, and the viewer’s knowledge that they do not in reality occupy the same physical space; in other words, creating the feeling of being a ghost in the environment (Green et al., 2021). Participants did however highlight some reservations, including the disconnect with the real world that it creates, vulnerability, and the creation of an antisocial experience (Green et al., 2021). Compared to standard cinema viewing, VR viewing of a play, where the stage, auditorium, and audience members were all visible, was also associated with greater ratings for physical presence and reduced awareness of neighboring audiences (He et al., 2018). The VR experience was also rated as more likely to motivate the participants to attend a real live performance in person, rather than virtually (He et al., 2018). Audience members are passive observers in these examples, whereas in the VR opera *Orpheus*, they influence the development of the narrative, triggering auditory, visual, and haptic components of the experience (Fung et al., 2022). Similarly, during a virtual performance of Dickens’ *A Christmas Carol*, audiences used a virtual torch to explore and illuminate characters. The agency of the audience can also take the form of allowing them to move around freely within the virtual set, and to encounter both the virtual actors and other attendees (Park, 2022).

Presence, Immersion, and Emotional Arousal in the Virtual Auditorium

The potential for immersive-360° theater to provide an enhanced experience compared to the viewing of a performance on a screen relies on the immersive qualities of the HMD, presenting the senses of vision and hearing with a 3D-recreation of the theater, and through this its ability to create a sense of presence. Presence is used in VR to describe the user’s sense of being located within and experiencing the virtual environment. It is a multifaceted concept (Jerald, 2015) that includes the feeling of spatial presence (the sense of physically being in the space of the theater) and social presence (the sense that the other people in the space, including the

performers and audience, are “real” people with whom you could interact). For immersive-360° theater in particular, it is also crucial that audiences experience an emotional connection to the themes and actors within a performance, since emotional impact is a leading motivator for theater attendees (Tait, 2016; Walmsley, 2011). To gauge the potential of immersive-360° as a platform for theater, it is therefore important to understand how immersion, presence, and emotional arousal are experienced in the virtual theater auditorium.

Immersive-360° Theater as a Digital Offering for Underserved Audiences and a Tool for Audience Expansion

Immersive-360° theater offers numerous potential benefits for social inclusion, by providing a pathway to engage with theater for individuals who would otherwise face barriers. This could be especially valuable for underserved individuals who are less likely or unable to participate due to economic, geographic or physical, and mental health reasons. It is perhaps this audience who could most benefit from the psychosocial benefits and sense of belonging associated with theater (Meeks et al., 2020; Walmsley, 2011, 2013). The use of digital tools in the arts is increasingly prevalent, however, a recent report for Arts Council England (Mackey, 2021) stressed that understanding what constitutes an inclusive digital experience is crucial for developing any digital strategy. Similarly, Cogman (2013) explains that to promote social inclusion we must develop a clear understanding of the needs of target groups. Immersive-360° theater could be an ideal candidate for reaching underserved audiences, because it offers a mobile, cost-effective alternative to attendance at traditional theater spaces. However, our understanding of its usability for such populations is currently very limited.

Immersive-360° theater could also be used as a general tool to accrue novel, “fringe” audiences. National Theater Live for example, where audiences stream live-captured performances on a home television, gained increased popularity with a reported reach of 6.5 million

audiences in 2017 (NT Live Press FAQs, 2017). Such digital offerings benefit organizations through greater audience generation at the box office and expanding their virtual capacity to a theoretically limitless degree (Bakhshi & Throsby, 2014), thus providing additional pathways for theaters and theater production companies to generate revenue. National Theater does, however, note that such experiences can “never replicate the experience of actually sitting in the theater,” highlighting a need to develop more immersive and realistic technologies (NT Live Press FAQs, 2017).

Technology Acceptance: Barriers to Enjoyment and Uptake of Immersive-360° Theater

Technology acceptance refers to the degree to which a technology will be adopted and valued by a particular audience. Here, this refers to if and how audiences will use and enjoy immersive-360° theater. In the original Technology Acceptance Model (Davis, 1985), perceived usefulness and useability are key factors driving technology acceptance. The Virtual Reality Hardware Acceptance Model (VR-HAM) identified enjoyment as an important additional predictor of people’s intentions to use or purchase VR (Manis & Choi, 2019). Assessing immersive-360° theater in terms of technology acceptance is a key part of identifying its digital inclusivity, for use by both existing and potential audiences. We know, for example, that older participants perceive VR as less easy to use (Manis & Choi, 2019), and report less enjoyment of digital storytelling (van Dam et al., 2020). Moreover, younger groups tend to be more optimistic about content digitization, while older people are more likely to perceive it as a threat (Poort et al., 2015). While engagement with theater provides psychosocial benefits for all age groups (Meeks et al., 2018, 2020), older people may thus be less likely to access these benefits through VR. We also know very little about how VR may be received by underserved audiences from different backgrounds, who currently face economic, geographic or physical, and mental health barriers. This issue of accessibility, or inclusivity, is not currently included in the VR-HAM. However, individuals who are more likely to experience preexisting barriers to live theater, particularly those related to mental and/or physical health, may also be limited in their ability to use and enjoy immersive-360° technology itself. This may for example relate to sensory sensitivity, as may occur for example in autism spectrum disorder (ASD) (Robertson & Simmons, 2013), Myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS; Wilson et al., 2015), and migraine (O’Hare & Hibbard, 2016).

Overview of the Current Study

The goal of the current study was to develop, using a mixed methods design, our understanding of the efficacy and perceived value of immersive-360° theater. The topics explored include commonplace themes in VR research, such as presence, immersion, and their interactions, but also relatively new themes relating specifically to immersive-360° theater, on which there is little-to-no background of evidence, to our knowledge. First, survey data explored this across eight key areas: (a) enjoyment, immersion, presence, and emotional arousal in an immersive-360° theater; (b) the relationship between these dimensions of experience; (c) perceptions regarding the usability and perceived ease of use associated with using VR theater technology; (d) variation in the experience across mobile devices used in the present setup; (e) the psychosocial impact of immersive-360°; (f) social perceptions regarding the differences and compatibility of

immersive-360° versus traditional theater, including the impact on attendance and perceived threat; (g) the extent to these factors vary between regular theatergoers, novices and underserved audiences; and (h) suggestions for improving the platform. Second, responses to semistructured interviews are presented according to nine identified themes, including (a) social aspects of traditional versus VR theater, (b) the technology itself, (c) experiencing the virtual auditorium, (d) emotional arousal in the virtual auditorium, (e) theater and psychosocial benefits, (f) perceived comparisons and compatibility between traditional and virtual theater, (g) accessibility and use by underserved audiences, (h) future potential and augmentation of the platform, and (i) impacts on users’ relationship with theater. Together, these methods allowed us to evaluate whether, and in what ways, immersive-360° VR might contribute to audiences’ experience of theater.

Method

Participants

Overall 166 participants completed the study. Participant age ranged between 18 and 79 years (average 35 years), and included 111 women, 52 men, two nonbinary individuals, and one individual who selected “other.” Approximately 59% of all individuals were aged between 18 and 35 years.

The University of Essex Ethics Committee approved the research materials and procedures for collecting data from human participants (reference ETH1920-1787) and risk assessments were approved by the head of the Department of Psychology. All participants gave informed written consent.

Eligibility and Risk Screening

Participants were screened for internet bandwidth and speed requirements using an online survey. Participants were excluded if they indicated at least one of the following: capped data usage allowance, speed of less than 5–7 Mbps, “pay as you go” usage plans, or regular difficulty streaming from multiple devices simultaneously.

Audience Groups

Participants were categorized into three audience groups according to their response to the question “Which option best describes your experience with theater?” Responses included one of four options: “I never go to the theater/I go to the theater rarely (less than five times as an adult),” “I go to the theater occasionally (1–3 times per year),” “I go to the theater often (3+ times per year),” “I go to the theater regularly (7+ times per year).” Individuals who selected either of the first two options were then asked “What is the main factor that prevents you from going to the theater more often?,” to which they could select one of five options: “Financial and economic reasons,” “Theater is not really something I am interested in,” “I would like to go to the theater more, but I am physically (and/or mentally) unable to,” “I do not live nearby a theater,” and “other.” When the data collection period was complete, participants were retrospectively assigned to one of three groups, constituting the final audience group, including regular theatergoers ($n = 91$), encapsulating individuals attending theater three or more or seven or more times per year; theater novices ($n = 17$), encapsulating individuals who never/rarely attended theater if the corresponding reason for this was for interest, geographic, or childcare reasons; and underserved audiences ($n = 58$),

encapsulating individuals who (a) never/rarely or (b) occasionally (1–2 times per year) attended theater, if the reason for this was ability- or restriction-related factors, including caring responsibilities, health, and economic factors. A breakdown of audience groups is shown in Table S1 in the online supplemental materials.

Materials and Apparatus

Mobile Devices, VR Headsets, and LIVR Mobile Application

Mobile devices varied significantly in terms of graphics processors and were retrospectively categorized into five device tiers according to their compatibility with the LIVR application. Tier one denotes ideal compatibility and therefore considered to offer the “best experience,” tier four denotes “not recommended,” and tier five for “unknown devices.” Device tiers are summarized in Table S2 in the online supplemental materials. Importantly, 15 participants were unable to complete the study due to graphics processing unit incompatibility. Regarding audio equipment, 55% of participants relied on their mobile device speaker, 22% used headphones, 22% used earphones, and less than 1% used an external speaker or no speaker at all (e.g., not required).

Participant Surveys

Survey items were 25 questions to address the following: questions regarding performance information, included to prompt memory ($n = 4$); emotional arousal ($n = 1$); enjoyment, immersion (sensory), and presence ($n = 4$); technology experience ($n = 4$); psychosocial benefits ($n = 5$); perceived differences between immersive and traditional theater ($n = 4$); use during the pandemic ($n = 2$); and suggestions for improvement ($n = 1$). Exact survey items are provided in Table S3 in the online supplemental materials.

Participant Interviews

For 30 participants, structured interviews were undertaken, consisting of 15 items to address the following themes: views regarding the use of the VR technology to experience theater ($n = 2$); aspects of emotional arousal within the VR theater environment, including empathic responses to content and psychosocial benefits ($n = 5$); perceptions of compatibility and similarity between VR and traditional theater ($n = 2$), including perceived impact on the arts, barriers, and tools for improving accessibility, and the perceived difference between the two environments for watching theater ($n = 6$). All interview items are provided in Table S4 in the online supplemental materials. Interviews were conducted by Abigail L. M. Webb and Jessica Dawson.

Procedure

Eligible participants were each assigned a code that they would use to register an account with LIVR via the website. Once registered, LIVR distributed a headset to each participant. To view a performance, participants were instructed to sign into their LIVR account using the mobile phone application, insert their mobile phone device into the VR headset, and use head movements to navigate to the performance they wanted to watch. Participants were instructed to complete an online questionnaire about their experience only after “watching at least one performance using the headset and LIVR app.” Interviews were completed using Zoom.

Results

Survey Results

Most survey responses were analyzed using a Wilcoxon signed rank test to determine whether participants’ ratings tended to be more veered toward the agree or disagree side of each statement. The signed rank test compared the distribution of the ratings (1 = *strongly disagree*; 2 = *somewhat disagree*; 4 = *somewhat agree*; 5 = *strongly agree*) against the neutral “neither agree nor disagree” response (=3). This nonparametric test was used because these responses to individual survey items provide ordinal data. Exceptions to this analysis were (a) emotional arousal, as this simply recorded a percentage rating of the strength of arousal, and (b) the time taken to feel present in the performance, as this question provides categorical as opposed to ordinal responses (see Table S3 in the online supplemental materials). To assess response distribution variation between group data (audience group, device tier, and audio equipment), Kruskal–Wallis tests or one-way analyses of variance were used. Data from 17 participants using “unknown” devices were excluded from device tier comparisons.

Enjoyment, Immersion, Presence, and Emotional Arousal in the Virtual Auditorium

Figure 2 shows that most participants (70%) enjoyed watching theater in VR (median rating = 4; $z = 6.08$, $p < .001$, $r = .472$). Findings for immersion were rather polarized, with 41% of participants aware of distractions from the real world around them compared with 45% who were unaware (median rating = 3; $z = -0.505$, $p = .613$, $r = -.039$). Findings for presence were similar; 42% of participants agreed that during the performance they felt as though they really were at a real-life theater, compared to 43% who did not (median rating = 3, $z = -0.723$, $p = .470$, $r = -.056$). Note that in both instances the median response is 3 (*neither agree nor disagree*), but it is important to note here that responses for both statements were bimodally distributed, as can be seen from the proportions reported above.

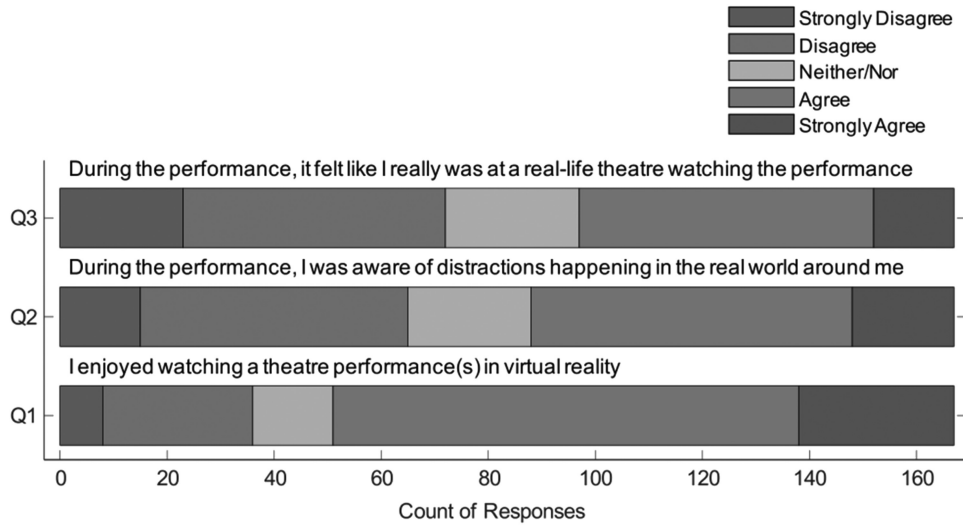
In terms of the point at which participants felt like they “really were at the theater,” the median response was “the feeling came and went” (34%), followed by 19% who reported “never” feeling present in the environment. For 16%, 17%, and 14%, presence occurred “within the first 5-min of the performance,” “within the first 10-min of the performance,” or “20+ min into the performance,” respectively.

Figure 3 shows a broad spread of selected emotional descriptors. Participants were free to view any of more than 70 performances available on the platform, and given the variety of genres, we did not expect to observe any trends for a particular category of emotion. Rather, responses to these measures show that the experience of immersive-360° theater is sufficient to elicit a broad range of emotional arousal in audiences, and scale rating responses show that the intensity of these felt emotions was positively skewed toward higher levels of arousal, with a median value of 60 out of 100.

Relationship Between Enjoyment, Presence, Immersion, and Emotional Arousal

A Spearman’s rank correlation between ratings for presence and awareness of real surroundings showed a significant, inverse relationship ($\rho = -.277$, $p = .003$), where greater presence was associated with a reduction in awareness of events occurring outside of the headset and thus greater level of immersion. There were also significant positive

Figure 2
Overall Experience of Enjoyment, Presence, and Immersion



Note. Ratings for enjoyment (Q1), immersion (Q2), and presence (Q3) in an immersive-360° theater environment.

relationships between enjoyment and emotional arousal ($\rho = .304, p \leq .001$), and enjoyment and presence ($\rho = .413, p \leq .001$), and a significant negative relationship between enjoyment and awareness of real surroundings ($\rho = -.207, p = .007$). Together these findings show that greater presence experienced in the virtual auditorium is associated with a decrease in awareness of the outside world and greater enjoyment. Moreover, enjoyment is also associated with a decrease of awareness of the outside world, as well as greater emotional arousal.

Perceived Enjoyment, Usability, and Setup of the VR Technology

Figure 4 shows participants’ appraisal of the technology used to deliver the theater experience, including use of the headset and

app, and general ease of setup. Overall, 54% agreed that they enjoyed using a headset to view theater (median rating = 4; $z = 2.60; p = .0092, r = .202$). Sixty-six percent and 63% agreed that they found the headset (median rating = 4; $z = 5.41; p < .001, r = .420$) and the LIVR app (median rating = 4; $z = 4.90; p < .001, r = .380$) easy to use, respectively. Sixty-nine percent agreed that the setup was straightforward (median rating = 4). The majority of participants (76%) also, however, agreed that they would have enjoyed the experience more if the VR hardware had been of better quality (median rating = 4; $z = 9.05; p < .001, r = .702$).

Mobile Device Variation

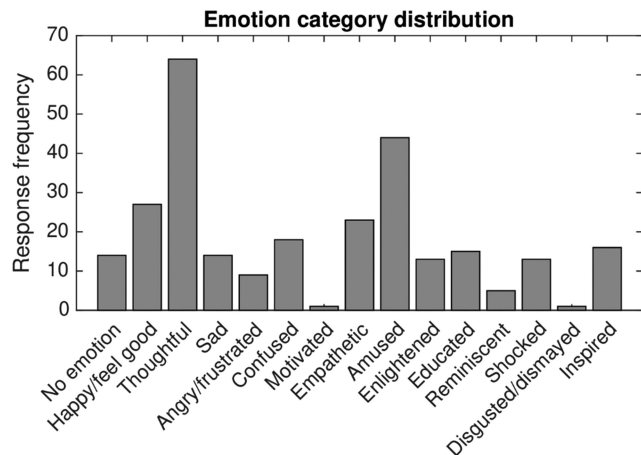
We also compared responses across the tiers of devices (“best experience,” “good experience,” and “okay experience”) using a Kruskal–Wallis test. The only significant difference across device tiers was for engagement ($p = .010, \eta_p^2 = .239$), where higher tier devices were better able to maintain engagement in the performance. We also assessed whether the experience was affected by whether people listened to the performance via headphones or their phone speaker. This had no effect on overall enjoyment ($p = .413, \eta_p^2 = .02$), presence ($p = .900, \eta_p^2 = .001$), or immersion ($p = .856, \eta_p^2 = .001$).

Psychosocial Benefits

Participants were asked five questions related to focus and engagement, individual well-being, and the social aspects of immersive-360° theater. In terms of the social impact of the experience, it is important to highlight that participants could only experience immersive-360° theater alone, as only one headset per household was permitted for the study.

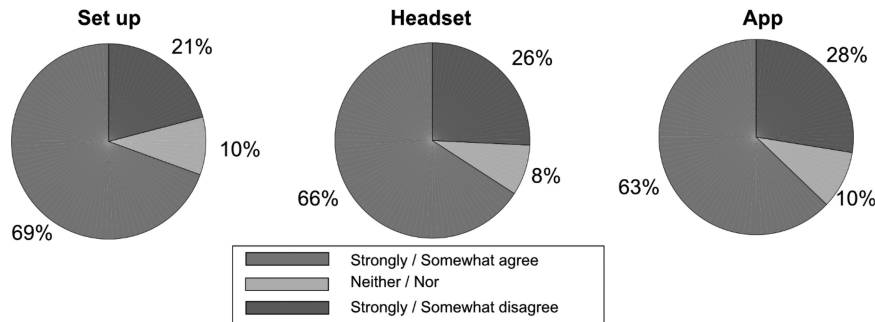
Sixty-one percent of participants agreed that they were able to maintain focus and engagement while watching the performance (median rating = 4; $z = 4.66; p < .001, r = .361$), and 77% agreed that it was a “positive distraction from other things” (median rating = 4;

Figure 3
Distribution of Emotional Response Categories



Note. Selection of emotional descriptors provided by participants. Participants could select any number of descriptors.

Figure 4
Perceived Ease of Setup and Ease of Use for the Headset and Application



Note. Distribution of ratings for the perceived ease of use relating to the setup of the technology, the headset itself, and the LIVR application.

$z = 8.72$; $p < .001$, $r = .677$). The majority did not, however, report talking about the performance in conversation afterward (43%; median rating = 3; $z = 0.21$; $p = .834$, $r = .016$), and the experience had only a small effect on reducing feelings of social isolation for 37% of participants (median rating = 3; $z = 1.96$; $p = .05$, $r = .152$). These limited social benefits are likely explained by the fact that participants completed the study alone, without a “viewing partner,” verified by the majority (72%) who agreed that they would have enjoyed the experience more if they could have watched it with another person (median rating = 4; $z = 8.45$; $p < .001$, $r = .656$). These findings are illustrated in Figure 5.

Immersive-360° Versus Traditional Theater: Differences, Perceived Threat, and Impacts on Attendance

Most participants felt that watching a performance in a VR environment was either “rather different” or “extremely different” (37% and 31%, respectively) to real-life theater (median rating = 4; $z = 8.56$; $p < .001$, $r = .667$). Consistent with this, the majority (60%) did not feel that immersive-360° theater threatened live theater through becoming a replacement for real-life theater or auditoriums (median rating = 2; $z = -3.91$; $p < .001$, $r = -.303$). Conversely, the majority (64%) felt that this experience with VR made them more likely to attend a live performance in the future (median rating = 4; $z = 7.95$; $p < .001$, $r = .617$), and to engage with virtual events hosted by their local theater (median rating = 4; $z = 9.53$; $p < .001$, $r = .740$).

Although immersive-360° theater was not perceived in general as a replacement for live theater, it was nevertheless seen by 71% of participants as a useful substitute for those who could not attend, due to accessibility or other reasons (median rating = 4; $z = 6.12$; $p < .001$, $r = .480$), and for use during times where theater auditoriums are closed, (83%) such as during the COVID-19 pandemic (median rating = 4; $z = 10.61$; $p < .001$, $r = .823$).

Audience Group Comparisons: Do Findings Differ Between Regular Theatergoers, Novices, or Underserved Audiences?

For findings presented thus far, participant responses were compared across all three audience groups: (a) regular theatergoers, (b)

theater novices, and (c) underserved audiences. The only group differences observed were for emotional intensity ratings, $F(2,163) = 3.78$, $p = .025$, $\eta_p^2 = .044$, and whether participants felt that enjoyment would have been improved by watching it with another person ($p = .045$, $\eta_p^2 = .133$). Regular theatergoers reported a higher emotional intensity than underserved audiences and were also the most likely to have felt that sharing the experience with another person would have improved their enjoyment. No other statistically significant audience group differences were observed.

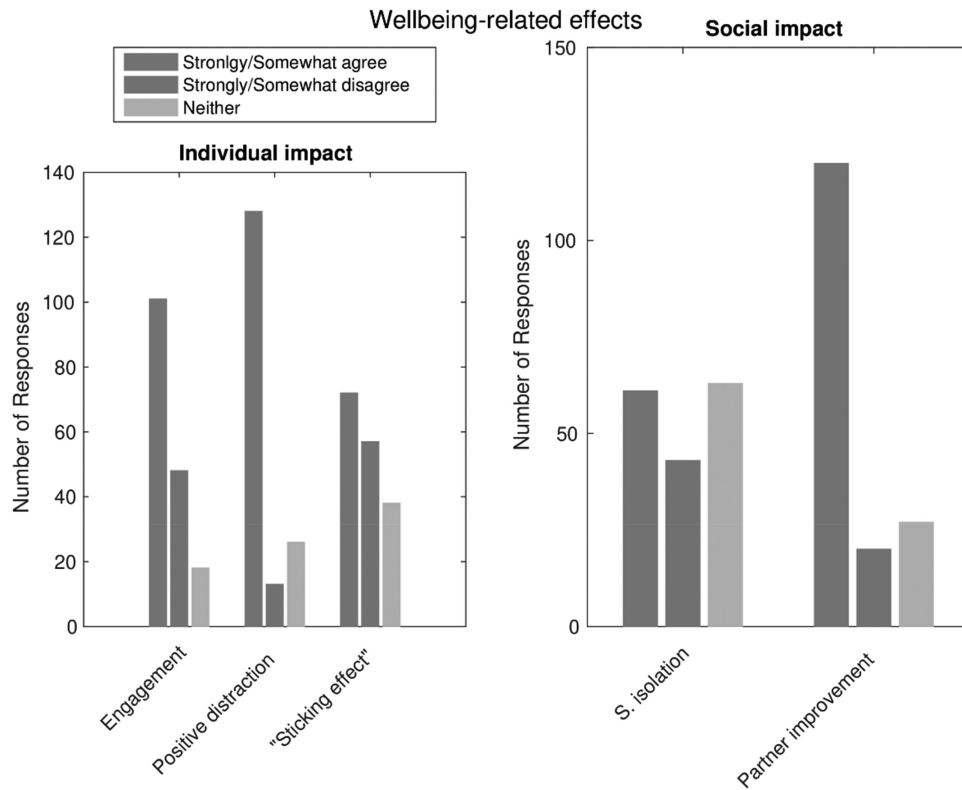
Suggestions for Improvement

The majority (73%) of participants responded “yes” to the question “Could anything about the experience have been improved?.” Free-text responses were coded into 16 categories, listed in Figure S1 in the online supplemental materials. Leading suggestions included the quality of the headset (33%), the screen resolution (20%), and improvements to the application (10%).

Interview Findings

Thematic analyses were conducted in-line with the guide provided by Braun and Clarke (2006), in the following steps: (a) data were familiarized through transcription from source to anonymous text format by Abigail L. M. Webb and Jessica Dawson, (b) broad themes (initial codes) were identified separately by Abigail L. M. Webb and Paul B. Hibbard for 20% of interview transcripts, and then (c) reviewed by both authors by way of calibrating identified themes, accordingly themes were renamed and corresponding definitions identified to distinguish themes from subthemes, (d) themes and subthemes were reviewed by Abigail L. M. Webb for the remaining 80% of interview transcripts, and (e) the ongoing checks for theme and subtheme revisions were undertaken by Abigail L. M. Webb, though not necessary in the case of broad themes, and finally (f) themes, subthemes, and relevant extracts were selected by Abigail L. M. Webb for report production, and Abigail L. M. Webb and Paul B. Hibbard both edited and drafted the write-up of interview findings, and decided the inclusion of relevant quotations. Nine broad themes were identified including (a) social aspects of traditional versus VR theater, (b) the technology itself, (c) experiencing the virtual auditorium, (d) emotional arousal in the virtual auditorium, (e) theater and psychosocial benefits,

Figure 5
Psychosocial Benefits of Immersive-360° Theater



Note. Left: ratings for individual effects of immersive-360° theater on engagement, offering a positive distraction and “sticking effect,” for example, participants found themselves discussing the content and/or experience with others. Right: ratings for social effects of immersive-360° theater on reducing feelings of social isolation, and the extent to which participants agreed that they would have enjoyed the experience more if they had shared it with someone else.

(f) perceived comparisons and compatibility between traditional and virtual theater, (g) accessibility and use by underserved audiences, (h) future potential and augmentation of the platform, and (i) impacts on users’ relationship with theater. These are presented below.

Theme 1: Social Aspects of Traditional and Immersive-360° Theater

Theater Is a Social Event. Sixty-seven percent of participants said that the experience of immersive-360° theater would be improved by the ability to watch it with another person: “theater as a shared experience is an experience of greater impact and value than the solo experience.” This would go some way to allowing it to emulate the importance of theater as a social event. Eighty percent spoke of traditional theater as a social event, “it’s an interactive thing [...] a shared experience,” and that this was absent in VR “that’s what I felt it missed, [...] that collective feeling is very strong in real-life theater.” The terms “collective,” “shared,” and “communal experience” appear frequently. Traditional theater is also considered as an “event,” or an “outing” that is accompanied by social rituals surrounding dining and drinking: “the whole experience of going to theater, there’s a lot built around it, it’s the experience of going out, going to a new place.”

Social Features of Theater That Do Not Translate to the Virtual Auditorium. Sixty percent of participants referenced specific social behaviors typical of traditional theater settings that are missing from the VR auditorium. These include interacting with their viewing partner during and after the performance and behaving as part of the audience: “that’s what I like about going to a show with somebody [...], you’ve got that person to then discuss it with afterwards,” “there’s always that lovely bit when you’re driving home afterwards and talking with whoever’s gone with you about what you’ve just seen and process [the performance].” One participant commented that they missed “laughing as a member of the audience,” and 10% referenced physical behaviors typical in traditional spaces but not VR, including “prodding” a viewing partner, and “[looking] at each other and then having a little laugh about it.” Notably, however, 23% appreciated the privacy of the experience: “it sat differently with me afterwards [...] it’s really kind of stuck in my brain like a little earworm now, to force me to think of my own unbiased reaction to this [performance],” “[the headset] allows you to be less guarded with your feelings [...], there isn’t that fear that you’re being watched.” This reiterates the conclusion that, while the VR auditorium is not able to recreate the social experience of live theater, it provides an alternative, complementary experience for some users.

Theme 2: VR Theater Technology

Positive and Negative Feedback. Fifty-three percent of participants reported positive interactions with the technology, referring to the headset as “comfortable,” “super-easy to use,” and “allow[ing] you to really get into [the performance],” while navigation of the application was “intuitive” and “simple.” Thirty-seven percent said that initial difficulty with the setup or becoming familiar with the environment were soon overcome, “the way things move within your field of vision, [...] when I got over that it was super comfortable to use.” However, for two participants, technology-related issues prevented any consistent enjoyment at all, and 80% reported technology-related obstacles, where 33% of those interviewed explicitly stated they would have enjoyed the experience more if the quality of the technology was greater. The most common issues reported referred to the headset (63%) for example, general discomfort, weight distribution, poor fit, and compatibility with glasses. Other issues included “drifting,” a calibration issue that results in recentering and frequent readjustment (20%) and resolution issues including “blurry” images that resulted in “eye strain” (33%).

Technology Accessibility: “It Removes Barriers and Creates New Ones.” Seventeen percent of participants highlighted accessibility-related barriers with the technology, all but one of whom had categorized themselves as facing accessibility-related obstacles to traditional theater. Four categories of barriers were identified: (a) the physical logistics of using a headset, (b) resolution requirements, (c) sensory hyperexcitation, and (d) application accessibility settings. A participant with little-to-no functional use of their left hand explained that the process of adjusting the headset was “frustrating” because it could not be achieved “independently,” while another explained that headset weight makes it unusable for physically restricted audiences: “would not have been able to wear [the headset] for that length of time without her head being supported.” For two hearing-impaired participants, the visual clarity was insufficient for lip reading, sign reading, and facial expression reading, “the resolution that I need for lip reading in order to supplement my hearing, the problem was that the recording was of people’s faces but not necessarily in focus,” “seeing the BSL (British Sign Language) interpretation was difficult [...] because it was limited to that one camera in that one space, it made it difficult to see certain signs [...] also the facial expressions, because it’s such a big part of any sign language, sometimes I’d say ‘right, I’m not sure what she’s signing, let’s go back and see what her face said’ and sometimes that didn’t work.” Participants with multiple sclerosis (MS), ASD and attention deficit hyperactivity disorder (ADHD) reported sensory hyperexcitation because of technological factors, including “the hiss of the audio,” where “bright lights at the top of the screen” meant that without any noise canceling effects the participant “felt quite crazy towards the end of [the performance].” A participant with MS explained that the immersive experience was especially difficult to enjoy: “almost cut off your whole peripheral vision and kind of shut it down into that kind of little theater experience [...] I didn’t take to the headset very well, I found it really disorienting and I struggle with depth perception anyway, so I actually found it more difficult than I thought I would have to constantly be in that kind of ‘bubble’ [...] I think I would have found it even harder if I’d used headphones [...] had I used earphones or headphones, I think I wouldn’t have coped at all. It felt claustrophobic.” Finally, absence of inbuilt

accessibility options was highlighted as a barrier: “I saw no access options [...], audio description, subtitling, captioning, signing, those options which will be quite simple to provide.” This feedback aligns with the 40% of participants who claimed that VR theater has the potential to be an effective tool for reaching restricted audiences providing aspects of the technology are improved, and 16% who specifically said they would like to see options for subtitles included with the content.

Theme 3: The Experience of Being in the Virtual Auditorium

Immersion. Sixty-three percent of participants described feeling immersed in the environment: “you were completely immersed in it, it did actually cut out everything around you,” “stopped noticing that I had this [headset] on my head,” “it’s like you forget that you’re watching it on the screen and not part of the action.” But for 73%, feelings of immersion were inconsistent, where 60% pointed to technology and environmental factors as inhibitors of immersion: “did feel alien from [the performance] because of the technology,” “sometimes those feelings of being part of the audience, they were fleeting when I suddenly felt the weight of the headset and the physical sensations came back into my mind.” Participants were also concerned about “being interrupted”: “it’s harder to connect with things slightly if you’re aware you’re in your own house and you can hear people going about their usual business or you’re like ‘oh,’ I should really put a wash load on.”

Spatial and Social Presence. Thirty-seven percent of participants described feeling present in the environment: “you do feel, because of the way the headset is, like you’re there,” “midway through the show you realise it feels as if you’re sitting there watching a [real] show and you’re not thinking of everything else that’s going on.” Conversely, a lack of presence reflected a feeling of being distanced from the performance: “the experience was less different than I expected it to be but you do feel slightly distant from it,” “[it’s like] looking at a snow globe, the idea that you were looking in on something rather than being part of it.” There was also an important contribution of the virtual audience to the creation of social presence: “I felt as if I was in an audience [...], you know, ‘I’m here and we’re all watching the same thing,’” “it really felt like there were people next to you, and you kind of got absorbed into that feeling.” This social presence was reported by 17% of participants: “in the virtual setting you’ve got the crowd and stuff next to you, it just doesn’t feel like they’re there [...], you don’t feel like you’re part of the performance.” This feeling of disconnect between the sensation of being congruently present with virtual audiences, yet knowing this not to truly be the case, aligns with the concept of notional embodiment, or the “Swayze effect” (see Introduction; Green et al., 2021), whereby in the present example the participant experiences a sense of alienation between themselves and the audiences they can see.

Theme 4: Emotional Arousal in the Virtual Auditorium

Fifty-seven percent of participants described emotional responses including “moving,” “frustrated,” “cathartic,” “impactful,” feeling a “sense of tension,” and generally describing the experience with emotion: “I found it quite emotional [...], that real kind of ‘grabs you in the tummy’ feeling about just what was happening.” A feeling

of connection to the themes and/or performers, including “empathy” and “sympathy,” was reported by 50% of participants. Moreover, 13% reported reduced feelings of connection compared to real-life theater, and 17% highlighted an absence of any connection to the themes/performers: “I was less connected than if I’d been in a theatre watching it [...] something that is created for live performance can actually fail if it’s simply filmed and presented in that format.” “I really do connect with the characters [in traditional theatre] and I didn’t feel like that at all whilst watching this in VR [...], something was missing.” The extent to which immersive-360° theater can evoke emotional responses including empathy and a sense of connection to its content is therefore relatively mixed, and these findings from interviews reflect the average emotional arousal rating of 60 (out of 100) reported across participant surveys.

Theme 5: Immersive-360° Theater as a Tool for Psychosocial Benefits

Seventy-eight percent of participants reported a positive psychosocial effect of immersive-360°. Themes surrounding becoming “lost,” such as “[VR theatre] completely takes you away [...], it’s been really nice to have that escape,” and the ability to “switch off from all the negative things that are happening” were reported by 20% of participants. Twenty-three percent highlighted positive feelings related to engagement: “[it can] really help by taking you out of yourself and putting you into a different sphere and thinking about other people,” “lighten up someone’s evening, or allow them time to reflect [...], something for them to chat about.” Others referenced positive feelings of creativity, “it perked me up in terms of thinking about stories and creative media,” “my interest in watching recorded theater has been reignited [...], got me excited again.” Finally, 27% said that immersive-360° theater could be a useful tool for well-being if improvements were made to the technology, for example, comfortable headsets and resolve of app-related issues. These findings suggest that the extent of psychosocial benefits of immersive-360° theater differ according whether it impacts engagement, creativity, focus, or escapism. Collectively, this amounts to the majority of participants, but it is important to highlight here that only 37% of surveyed participants agreed that the experience reduced feelings of isolation.

Theme 6: Traditional and Immersive-360° Theater: Comparison and Compatibility

Seventy-three percent of participants were not concerned about a negative impact of immersive-360° theater on traditional theater: “live theater can’t really be replaced. It’s a good substitute (VR theater), but it can never replace the real thing.” Reasons for this lack of concern fell into three categories, outlined below.

The Importance of “Being There”: Abstract Features of Traditional Theater That Are Missing in the Virtual Auditorium.

These features were highlighted by 70% of participants, especially the importance of “really being there” (37%): “[you don’t] get the same personal connection and overall feeling that you do sitting in a live theatre and sitting around 500 other people in a room- that sort of collective experience,” “watching it virtually loses some of the sort of the grandeur of the event of going to the theatre.” Interestingly, 60% cited abstract features of real-life theater including

the “atmosphere,” “hush,” “buzz,” and even “soul” and “magic” associated with the real auditorium: “there’s a magic to going to the theatre that doesn’t translate necessarily to the technology. There’s something about being in that hushed room and laughing as a member of the audience that you don’t necessarily pick up even though you’re fully immersed in the [LIVR app],” “that moment in the theatre where the lights go down and you have that hush [...] I think virtual theatre misses some of that magic because it just doesn’t translate,” “I do think that something is lost in the soul of nature of the engagement in VR.” The intimacy of real-life theater was also missing, “the atmosphere is different, you get a sense of how everybody else is feeling about it and [traditional theatre is] more emotional,” “the laughter, the audible responses from the audience also contribute to the experience of live theatre, there’s a degree of emotional reinforcement, if you like, from the rest of the audience.”

Others noted the absence of sensory experiences associated with real-life theater: “the sights, the sounds, the smells, I don’t think that you’re ever going to kind of match that in a VR setting,” “you can’t beat the smell of the grease pit and the roaring crowd.” Acoustics were also important: “you don’t feel it as much because if you have a theatre setting and you’ve got all of the vocals and the music and everything, it sort of resonates in your chest almost with some of the base, you don’t get that with VR.”

Real-Life Theater Is More Immersive. Immersion was different, or less than, real-life theater for 33% of participants. Technology-related issues were highlighted that “wouldn’t happen to you in a real-life theater.” Thirteen percent of participants highlighted the “on demand” experience for example, pausing or rewinding, as impacting their ability to sustain attention: “I know I can just pause it [...] or skip through the video [...], although I’m choosing to do it, it changes the experience a lot,” “there’s no responsibility on the spectator or the audience member because they have the ability to turn it off and detach themselves [within the application], whereas theatre is live and you have to address those emotions if they come up.”

Immersive-360° Theater Is Distinct From Traditional Theater: “It Doesn’t Compare But It Scratches the Itch.”

For 43% of participants, immersive and traditional theater “do not compare,” and few participants (23%) felt that the experiences were “not that different,” that VR could offer a “pretty similar experience,” and that it “feels probably as close as going to the theater as you can get at home.” These differences appear to drive the perceived compatibility of the two mediums: “it was really brilliant, but obviously it’s never quite the same as watching real theatre, so I would say it’s great as long as you don’t expect it to be the same,” “virtual reality I think will have a place [...] it might add a different experience [...], those kinds of enhanced experiences, I think that VR could be a different art form in itself, rather than replacing [traditional] theatre.” Two regular theatergoers said that immersive-360° theater is similar though not realistic enough to be on par with traditional theater, “if live theatre is not available then it was an interesting substitute rather than a satisfying substitute,” “it doesn’t compare, but it scratches the itch.”

Perceived Compatibility. Participants overwhelmingly (93%) suggested that immersive-360° theater could be treated as an additional, separate pipeline, operating alongside, or even supporting traditional theater. Suggestions for ways in which such platforms could support

traditional theater formed three categories: (a) accruing novel audiences and income pathways, (b) VR technologies in creative development, and (c) hybrid options. Thirty-three percent believed that immersive-360° theater could be used as a pipeline to financially benefit theaters, artists, and playwrights: “if it was set up as a complementary thing, something like this could be used to build audiences that don’t already exist that will then [go on to] access other forms of theatre at different points in their lives,” “a way of reaching more people potentially [...] people more interested in VR will have a chance to sample theatre and therefore might be tempted out to real theatre,” “experience things that they possibly wouldn’t pay to go and see, that they would then enjoy and think ‘well actually I would pay to go and see that, and I would like to go and see that [in a traditional setting].’” The appearance of suitability was important, too: “[VR theatre] takes away that fear for people that think they’re not going to fit in at the theatre [...] I think it might actually break down some of the barriers that people think somehow theatre’s not for them.” In terms of creative development, participants highlighted that immersive-360° theatre is well-placed to do what the traditional cannot: “[VR theatre] gives people the opportunity to experience theatre in a different way,” “[Art shared in] very interesting spaces or obviously doing it with different technologies, it made me think about how much more there is to be done with theatre than most people might see regularly or think about.” One participant, a playwright, explained about the novelty for the artist as well as the audience of a performance: “not just as the audience member consuming the piece, but also as the creative behind the scenes, I would know that my audience is different, I would be excited about ‘Oh, someone you know across the world could watch this exact same production that I’m watching’, [...] that’s exciting to me.” Finally, 17% of participants specifically referred to a “hybrid,” or “blended” option for theater: “run parallel and be an additional offering rather than a competition,” “develop own content for VR devices and building upon what you cannot do in physical theatre, rather than replacing it.”

Theme 7: Accessibility and Underserved Audiences

All participants said that immersive-360° theater was in some way a positive platform for broadening accessibility: “I think it’s an incredibly valuable thing for people who would find going to the theatre to be difficult for any reason,” “I can see it helping a lot of other people, perhaps like the elderly, [or people] in hospital,” a “viable alternative for those who can’t get to an actual theatre and I definitely think it’s a step up from, as I say, just watching it on a laptop screen in terms of like a live stream.” Comments are divided below into five categories.

Feedback From Underserved Audiences. Participants of the study who personally faced accessibility-related barriers to traditional theater commented that: “I’m disabled myself, so when I go [to physical spaces], that is a real issue for me [...], this would be brilliant for someone who was disabled, or perhaps they’ve got children or they’re a carer.” A participant with ASD and ADHD explained that “which theatre I can go to is quite restricted in terms of what I know about it and the journey, [...] [a VR platform] gives it this extra option which means that instead of having to get to everything, I can try and get to one [performance] every so often, and I can keep up with the conversations [...], so it sort of keeps someone like me within a group regardless of the varying [health] condition.” Another participant, whose son has ASD, explained that VR theater gave their son the opportunity to

“experience things through the VR system, then that might give him some new tools to actually have a look at things in a safe space when he’s at home, and when, if it gets too much, it’s just a case of taking the headset off.” The idea of VR theater as a “safe space” was also highlighted by two other participants, a “valuable thing to be able to bring to people in their own safe environments,” “I suffer with bouts of depression and it prevents me going out sometimes, and so if I was able to sit at home and watch a play, and sort of get lost in it, that would be really good [...], it’s given me a way of having the experience without the anxiety I feel sometimes.”

The economic benefits of immersive-360° theater were also highlighted: “I don’t have very much money to go to theatre as much as I’d like, and as in a lot of cases [...] it’s quite hard to get to places to go to the theatre and so this would be a really wonderful substitute,” “much more affordable [...] two tickets and dinners, travel [...] for a lot of people just isn’t achievable,” “shows that are inaccessible to so many, especially the working class.”

Improving Platform Accessibility. Forty percent said that immersive-360° theater could be a positive tool for underserved audiences provided improvements were made: “if you’re unable to visit a live theatre and you haven’t got anything then of course it’s better than nothing, but it could be a lot better [...] the quality needs to be upped in order for that to be really positive, so people shouldn’t be subject to second best.” One participant who experienced sensory hyperexcitation explained that “there was an added barrier [of the technology issues], but then other barriers were taken away. I was able to watch the performance, and I was able to take a pause, I was able to watch it at my own pace [...], there was no pressure to watch it amongst other people [...], I could skip, go slightly backwards or forwards at any time, so all of that was a positive side to watch [theatre] that way.” Two hearing-impaired participants stated that the method of filming and stage lighting needed to be adapted to maximize the visibility of BSL interpreters. For a participant with MS, the inclusion of optional breaks was also important: “it was really difficult, it was difficult to stay in it, and I actually didn’t manage to stay in it the whole time I had to stop it and kind of come out and take a break [...] it’s enclosed, and that’s where I had the issue, it was too difficult to stay in that environment.”

Accountability: Immersive-360° Should Not Allow Theaters to Be “Let Off the Hook.” However well-improved, 13% of participants were clear that a digital offering should not be interpreted as the solution to improving theater accessibility: “I don’t want it to be a substitute for theatre, because it feels like it’s letting theatres off the hook in terms of accessibility, if you do that [make digital platform strictly for restricted audiences] then you’re relegating people to some other place,” “a lot of theatres are quite inaccessible, but that situation shouldn’t be accepted, they should be becoming more accessible, and [VR theatre] is one tool in that, but it shouldn’t be the only thing, there needs to be an understanding that the physical place has to be as accessible as much as possible as well, and that [digital theatre] is an extra.”

An immersive platform still provides a socially inferior alternative to real-life theater: “I still come back to the issue of [immersive-360° theatre] being a solo rather than social experience and I think it loses a lot.” This is unsurprising, given that 47% said that the experience could be improved by enabling a shared experience.

Immersive-360° Theater During Auditorium Closures.

Overall, 83% of participants agreed that the platform could be an effective way to reach audiences at home during pandemic-related lockdowns and auditorium closures. It was described as an “attractive alternative,” especially for supporting theaters and artist streams, “support artists if you can’t get to their show right now [...] if we want a world post-pandemic to be one that we enjoy, we need to find some way to support what we want, so I like the idea of being able to virtually support immersive theater,” “if social distancing is going to have to last for a while, and the capacity of in-theatre audience has to be much reduced, I think it could be a very viable way to basically keep theatres going.” For participants who turned to TV streaming during lockdowns, the immersive-360° platform offered a novel alternative, “I’ve watched lots and lots of live streams and various things and I think the VR headset was a very exciting step-up in that process,” “it felt like something new in this never-ending Groundhog Day of lockdowns.”

Theme 8. Future Potential and Augmentation

Creating a Sociable, Sharable Experience. Forty-seven percent of participants said that they would like to see the platform adapted for a more “social immersive experience”: “if the app gave me the option to watch it simultaneously with others, whether it’s someone across the world, or even my partner sitting in the same room next to me with their own headset, I would appreciate that a lot more, it would feel more like a shared theatre experience, which is what people go to the theatre for,” “I really would have enjoyed being able to watch it all together [...], it adds a whole other layer of that sort of sense of secrecy but also community.”

Creating a Sense of Occasion. Enhancing the experience beyond simply communal viewing was suggested by 7% of participants: “it could learn some lessons from some of the theatre that’s been streamed online [during COVID-19], things like starting at a specific time so that you get a bit of a build up before the performance begins, the sense of a countdown,” and 13% explained the importance of “real-time” viewing that was missing from the experience: “you could start the performance at any time, there was no feeling that you’re watching it at the same time as somebody else.”

Utilize the Full Potential of VR Technology. Thirty-three percent said that the “technology is underutilized,” or that “wasn’t really using the opportunity of VR”: “I think for it to work for performance, the work would have to be developed in a way that suited VR rather than simply being filmed,” “as a tool I think it’s better to develop it in its own uniqueness [...], not just recording on a 360 camera, I think it has to be a specific content that uses the advantages of the VR devices,” “if you really took advantage of the VR capability by giving me the ability to experience this from within the environment rather than being outside the environment, that this would translate into an entirely new class of experience.”

Theme 9. Impacts on User Relationship With Theater

The majority (90%) of interviewed participants said that they would still prefer to attend a real-life theater, and/or that the immersive experience hadn’t reduced their intention to attend real-life theater: “it all made me appreciate theatre even more, that we can do so many things

with it,” “it reaffirms how important [theatres] are.” Thirty-three participants felt an increase in interest and/or engagement in theater, or the arts generally: “it reminded me that there are lots of ways that you can experience theatre and live performing arts generally, that is not specifically going to the place,” “[VR theatre] gives you the chance to experience different types of theatre [...] that maybe in real life you might not actually go and see,” and “[VR theatre] gave me the opportunity to discover different types of content.”

Discussion

Summary of Findings

The present study explored the efficacy of immersive-360° theater as a remote platform for both existing and potential audiences to view theater. Taken together, our findings suggest that immersive-360° theater can be an engaging and positive experience for most audiences, but that its potential as a tool for psychosocial benefits, social belonging, and eliciting emotional charge are limited if experienced alone. This could be substantially improved by the ability to share the viewing experience with another person at the same time, particularly in more advanced ways where the technology is adapted for a more substantial, social experience. The virtual environment in itself is sufficient to elicit emotional responses from audiences but ensuring that users consistently feel immersed and comfortable in the environment will likely require technology improvements, primarily in terms of the headset comfort, resolution, and calibration.

Participants generally feel that immersive-360° theater could be effectively used as a complementary, side-by-side offering, providing certain improvements are made to the comfort and quality of the headset. Crucially, participants generally view immersive-360° theater as something in and of itself, distinct from traditional theater and without attempting to replicate or synthesize it. This is especially important when we consider the usefulness of the platform for underserved audiences. While the majority of participants agreed on the usefulness of this application, it is important to highlight that for restricted, or underserved audiences themselves, specific improvements are required for the tool to be useful and usable. A caveat to this is that restricted audiences do not want digital offerings to be utilized as a “second best” option, on the basis that they can offer little social advantage and are likely to promote social exclusion.

Immersive-360° Theater: Accessibility and Usability

Immersive VR has an important potential role to play in providing an opportunity for an experience of live theater that overcomes economic and accessibility barriers. If this potential is to be achieved, it is important to ensure that one set of barriers is not replaced by another. For example, while VR streaming can reduce many of the costs associated with theater attendance, it requires access to a reliable internet connection, which in itself is a significant economic consideration (Mackey, 2021; Philip et al., 2017). We are aware that this was an issue even within this study, in that it was necessary to screen participants to ensure that an adequate internet connection was available and that the streaming did not come with a financial cost to the user. The usability of the technology itself is also an important factor, especially for audiences with specific sensory needs. For example, the present findings are relevant to ongoing discussions regarding the suitability of VR in art therapies for ASD, where providing a “safe space” to explore can also promote social seclusion (Hacmun et al., 2021).

Sensory sensitivity is also a barrier for individuals with migraine (O'Hare & Hibbard, 2016; Wilkins et al., 2007) and ME (Wilson et al., 2015), where overwhelming sensory experiences can result in distress, discomfort, pain, and/or fatigue. It is therefore imperative that the platform itself does not introduce new barriers that further compound participation and uptake for already-restricted audiences. Although VR technology is becoming increasingly prevalent as a health and education tool, discussions surrounding the accessibility and inclusivity of VR technology are comparatively slower. While suggestions for accessibility improvement have included diversifying user input (e.g., eye gaze motion dictation) and reducing heavy hardware components (Mott et al., 2020), a greater understanding about the sensory suitability and limitations is required (Hibbard et al., 2020; Pladere et al., 2022).

Improving the Social Impact of Immersive-360° Theater

Our findings highlight the social importance of theater and demonstrate that digital technologies for theater are likely to be limited by viewers' ability to "share" the experience. This is unsurprising, given the social and community value of theater, and its psychosocial benefits (Klich & Rowson, 2022). While the social impact of immersive theater could be enhanced by communal rather than singular viewing, there is something important about the experience of theater with others that occurs in real time that this would not capture. Live-captured, or prerecorded content offers a distinct experience compared to that of the "real thing". Way (2017) suggests this different experience of "liveness" has different outcomes for the audience, where we exchange the importance of really being there with broader audience reach and participation. However, for participants in the present study, the "sense of occasion" was an important feature of theater, and it is likely that a social immersive-360° theater experience occurring in real-time would be more enjoyable and beneficial for audiences.

A Novel Platform: Bespoke Immersive Experiences

By using VR technologies, immersive-360° theater is well placed to go beyond what is possible in traditional theater and basic 2D streaming of moving images. Using VR technologies to supplement arts engagement activities has yielded positive results but is underexplored within the context of theater. Some projects have combined multiple platforms to create an "ecosystem" as a way to ensure that each manifestation makes the best use of the attributes of each platform used. For example, "Vera," an adaptation of a short story by Katherine Mansfield, has been created as a traditional film, a noninteractive 360° film, a radio drama, a holographic VR experience, an interactive role-playing game, and a printed book (Pietroszek, 2020). A similar approach was taken for the *Mystery of the Raddlesham Mumps* (van Dam et al., 2020). This verse ballad by Murray Lachlan Young has been produced as an illustrated book, a stage-play, an audio CD, and an interactive VR game for both tablet and HMD. Cocreation of bespoke immersive experience can furthermore be of great value in health care, for example, 360° films for people living with dementia (Abraham, 2020), computer-generated experiences for young people with a serious illness in hospital (Balfour et al., 2022), and live role-play to give people greater understanding of the experience of living with dementia (Berezina-Blackburn et al., 2018). Some participants in the present study highlighted that VR technology for immersive-360° theater is currently

underutilized, and that it could be especially useful in creating a more sociable experience.

Limitations of the Present Study

As discussed above, one of the key limitations of the study was the requirement to confine participation to individuals whose mobile phones and/or internet access met the criteria for the study. Another limitation was the lack of validation of both quantitative and qualitative findings. As far as the authors are aware, this is the first investigation of immersive-360° theater as a substitute and/or pipeline for traditional theater, and such virtual environments and platforms are not yet an established medium for academic study. Because of this, there were little-to-no published resources available in terms of evaluation materials and scales for examining user experience within this context. The present survey items are therefore not previously validated, or validated as part of the present investigation for example, via member checking or factor analysis. This is the case for both quantitative survey data and qualitative data obtained via interviews.

Conclusions

Immersive-360° theater has the potential to provide a valuable cultural experience that complements, rather than threatens or replaces, traditional live theater. While enjoyment and engagement with immersive-360° theater was very positive, there are marked differences from the experience of a traditional performance. A key part of this difference is that live theater provides a rich social experience, in which participants feel a sense of belonging with the audience, interact with their viewing partners, and engage with an event that is located in space and time. Developments of immersive-360° theater could address some of these factors, including allowing a shared presence with other people within the virtual auditorium, and live-streaming of events. However, the individual, asynchronous experience studied here provides an experience that is distinct from a traditional performance, and its unique characteristics were clearly valued by some participants.

An important application of this technology is in increasing the accessibility of theater for underserved audiences. For some, VR at home can provide a "safe space" for people who may be unable to engage with a traditional audience experience. For others, however, it is important that technology is not used as a way of neglecting the need for theaters to be accessible for all who wish to attend. It is also important that the barriers to participation in live performances are not replaced by others that are introduced by the technology itself. Here, the sensory experience within the headset, and the need for access to stable and affordable data connections are key considerations.

References

- Abraham, N. (2020). Wonder VR: Interactive storytelling through VR 360 video with NHS patients living with dementia. *Contemporary Theatre Review*, 30(4), 474–489. <https://doi.org/10.1080/10486801.2020.1812591>
- Bakhshi, H., & Throsby, D. (2014). Digital complements or substitutes? A quasi-field experiment from the Royal National Theatre. *Journal of Cultural Economics*, 38(1), 1–8. <https://doi.org/10.1007/s10824-013-9201-2>
- Balfour, M., Cattoni, J., Sextou, P., Herbert, A., Seear, L., Lobwein, G., Gibson, M., & Penton, J. (2022). Future stories: Co-designing virtual reality (VR) experiences with young people with a serious illness in hospital. *Research in Drama Education: The Journal of Applied Theatre and Performance*, 27(4), 458–474. <https://doi.org/10.1080/13569783.2022.2034496>

- Berezina-Blackburn, V., Oliszewski, A., Cleaver, D., & Udakandage, L. (2018, November 3–7). *Virtual reality performance platform for learning about dementia*. Companion of the 2018 ACM conference on computer supported cooperative work and social computing, Jersey City, NJ, United States (pp. 153–156). <https://doi.org/10.1145/3272973.3274043>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Cogman, L. (2013). *Audience development toolkit*. AMA CultureHive. <https://www.culturehive.co.uk/resources/audience-development-toolkit/>
- Davis, F. D. (1985). *A technology acceptance model for empirically testing new end-user information systems: Theory and results* [Doctoral dissertation]. Massachusetts Institute of Technology.
- Fung, S., Jacobson, K., & Pike, J. (2022). PXR2020: Re-seeing the possibilities of theatre in virtual, augmented, and mixed reality. *Canadian Theatre Review*, 189, 73–75. <https://doi.org/10.3138/ctr.189.013>
- Green, D. P., Rose, M., Bevan, C., Farmer, H., Cater, K., & Fraser, D. S. (2021). ‘You wouldn’t get that from watching TV!’: Exploring audience responses to virtual reality non-fiction in the home. *Convergence: The International Journal of Research into New Media Technologies*, 27(3), 805–829. <https://doi.org/10.1177/1354856520979966>
- Hacmun, I., Regev, D., & Salomon, R. (2021). Artistic creation in virtual reality for art therapy: A qualitative study with expert art therapists. *The Arts in Psychotherapy*, 72, Article 101745. <https://doi.org/10.1016/j.aip.2020.101745>
- He, L., Li, H., Xue, T., Sun, D., Zhu, S., & Ding, G. (2018, November 28–December 1). *Am I in the theater? Usability study of live performance based virtual reality*. Proceedings of the 24th ACM symposium on virtual reality software and technology, Tokyo, Japan (pp. 1–11). <https://doi.org/10.1145/3281505.3281508>
- Hibbard, P. B. (2023). Virtual reality for vision science. In C. Maymon, G. Grimshaw, & Y. C. Wu (Eds.), *Current topics in behavioral neurosciences* (pp. 131–160). Springer. https://doi.org/10.1007/7854_2023_416
- Hibbard, P. B., van Dam, L. C., & Scarfe, P. (2020, December 15). *The implications of interpupillary distance variability for virtual reality*. International conference on 3D immersion (IC3D), Brussels, Belgium (pp. 1–7). <https://doi.org/10.1109/IC3D51119.2020.9376369>
- Jerald, J. (2015). *The VR book: Human-centered design for virtual reality*. Morgan & Claypool.
- Klich, R., & Rowson, J. (2022). *Theatres beyond the stage: The recovery of regional theatres as placemakers in the East of England*. [https://repository.essex.ac.uk/33674/1/Theatres Beyond the Stage Published Report.pdf](https://repository.essex.ac.uk/33674/1/Theatres%20Beyond%20the%20Stage%20Published%20Report.pdf)
- Mackey, J. (2021). *Digital inclusion and exclusion in the arts and cultural sector*. Good Things Foundation. <https://www.artscouncil.org.uk/digital-inclusion-and-exclusion-arts-and-cultural-sector>
- Manis, K. T., & Choi, D. (2019). The virtual reality hardware acceptance model (VR-HAM): Extending and individualizing the technology acceptance model (TAM) for virtual reality hardware. *Journal of Business Research*, 100, 503–513. <https://doi.org/10.1016/j.jbusres.2018.10.021>
- Meeks, S., Shryock, S. K., & Vandenbroucke, R. J. (2018). Theatre involvement and well-being, age differences, and lessons from long-time subscribers. *The Gerontologist*, 58(2), 278–289. <https://doi.org/10.1093/geront/gnx029>
- Meeks, S., Vandenbroucke, R. J., & Shryock, S. K. (2020). Psychological benefits of attending the theatre associated with positive affect and well-being for subscribers over age 60. *Aging & Mental Health*, 24(2), 333–340. <https://doi.org/10.1080/13607863.2018.1534082>
- Mott, M., Tang, J., Kane, S., Cutrell, E., & Ringel Morris, M. (2020, October 26–28). “I just went into it assuming that I wouldn’t be able to have the full experience” understanding the accessibility of virtual reality for people with limited mobility. Proceedings of the 22nd international ACM SIGACCESS conference on computers and accessibility, Virtual Event, Greece (pp. 1–13). <https://doi.org/10.1145/3373625.3416998>
- NT Live Press FAQs. (2017). <https://www.nationaltheatre.org.uk/about-the-national-theatre/press/nt-live-faqs>
- O’Hare, L., & Hibbard, P. B. (2016). Visual processing in migraine. *Cephalalgia*, 36(11), 1057–1076. <https://doi.org/10.1177/0333102415618952>
- Park, J. (2022). Shakespeare in cyborg theatre: Immersive VR theatre and the cyborg-subject. *Contemporary Theatre Review*, 32(2), 177–190. <https://doi.org/10.1080/10486801.2022.2047031>
- Philip, L., Cottrill, C., Farrington, J., Williams, F., & Ashmore, F. (2017). The digital divide: Patterns, policy and scenarios for connecting the ‘final few’ in rural communities across Great Britain. *Journal of Rural Studies*, 54, 386–398. <https://doi.org/10.1016/j.jrurstud.2016.12.002>
- Pietroszek, K. (2020, April 25–30). “Vera”—Crossing the fourth wall. Extended abstracts of the 2020 CHI conference on human factors in computing systems, Honolulu, HI, United States (pp. 1–4). <https://doi.org/10.1145/3334480.3383178>
- Pladere, T., Svarverud, E., Krumina, G., Gilson, S. J., & Baraas, R. C. (2022). Inclusivity in stereoscopic XR: Human vision first. *Frontiers in Virtual Reality*, 3, Article 1006021. <https://doi.org/10.3389/frvir.2022.1006021>
- Poort, J., Akker, I., Rutten, P., & Weda, J. (2015). Perspectives of creators and performers on the digital era. *New Media & Society*, 17(5), 666–690. <https://doi.org/10.1177/1461444813511309>
- Robertson, A. E., & Simmons, D. R. (2013). The relationship between sensory sensitivity and autistic traits in the general population. *Journal of Autism and Developmental Disorders*, 43(4), 775–784. <https://doi.org/10.1007/s10803-012-1608-7>
- Schuemie, M. J., Van Der Straaten, P., Krijn, M., & Van Der Mast, C. A. (2001). Research on presence in virtual reality: A survey. *Cyberpsychology & Behavior*, 4(2), 183–201. <https://doi.org/10.1089/109493101300117884>
- Tait, P. (2016). Introduction: Analysing emotion and theorising affect. *Humanities*, 5(3), Article 70. <https://doi.org/10.3390/h5030070>
- Van Dam, L. C. J., Webb, A. L., Jarvis, L. D., Hibbard, P. B., & Linley, M. (2020, December 15). “The Mystery of the Raddlesham Mumps”: A case study for combined storytelling in a theatre play and virtual reality. 2020 International conference on 3D immersion (IC3D), Brussels, Belgium (pp. 1–7). IEEE. <https://doi.org/10.1109/IC3D51119.2020.9376391>
- Vasser, M., & Aru, J. (2020). Guidelines for immersive virtual reality in psychological research. *Current Opinion in Psychology*, 36, 71–76. <https://doi.org/10.1016/j.copsyc.2020.04.010>
- Walmsley, B. (2011). Why people go to the theatre: A qualitative study of audience motivation. *Journal of Customer Behaviour*, 10(4), 335–351. <https://doi.org/10.1362/147539211X13210329822545>
- Walmsley, B. (2013). “A big part of my life”: A qualitative study of the impact of theatre. *Arts Marketing: An International Journal*, 3(1), 73–87. <https://doi.org/10.1108/20442081311327174>
- Way, G. (2017). Together, apart: Liveness, eventness, and streaming Shakespearean performance. *Shakespeare Bulletin*, 35(3), 389–406. <https://doi.org/10.1353/shb.2017.0031>
- Wilkins, A., Huang, J., & Cao, Y. (2007). Prevention of visual stress and migraine with precision spectral filters. *Drug Development Research*, 68(7), 469–475. <https://doi.org/10.1002/ddr.20216>
- Wilson, R. L., Paterson, K. B., & Hutchinson, C. V. (2015). Increased vulnerability to pattern-related visual stress in Myalgic encephalomyelitis. *Perception*, 44(12), 1422–1426. <https://doi.org/10.1177/0301006615614467>

Received December 15, 2022

Revision received June 12, 2023

Accepted June 25, 2023 ■