Integrating Augmented Reality into Live Theatrical Performance: *Moon Man Walk*

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Mediations between Technology and Theater

Reflections on Zoom Theater

My directorial career started in 2021 with a Zoom production of a student play, *St. Valentine's Home for the Forgetful and Lost* by Sam Fisher. The play was adapted to be online and had four live performances, hosted through a Zoom Webinar, to audiences April 23-25, 2021. During that show, actors had to learn and execute the tech themselves. In the show, Detective Edna Mauve broke the fourth wall to articulate her thoughts on the murder mystery. The rest of the characters would "freeze" — the actors would use a black and white Zoom filter to make their video monochrome and pause in their last stance — during these short monologues. This created a spotlight effect, which allowed audience members to know that the characters were still "on stage," but the focus should be on Edna. One actor also used a Zoom filter of a mustache as his character's fake mustache throughout the show. The character rips off the fake mustache at the end with one hand while the actor smoothly turns off the filter with the other. We encouraged audience members to leave reactions and comments about the show with the Zoom Chat feature throughout the show.

The televisionification of theater through Zoom theater helped keep theater going during a time when it was impossible to gather in person to view performing arts. I define "televisionification" as bringing television-like qualities, such as viewing a performance through a screen, to another medium. Auslander (2008) argues that television was designed to replace theater and live performance. While he was talking about the advent of television, his words can be applied to technological approaches to performing arts in the modern era. After months of lockdowns due to the COVID-19 pandemic, artists and technologists tried to find different ways of bringing performance and a sense of community to life digitally. Some groups of artists, like music groups, recorded individual performances, edited the videos, mixed the sound, and then played the finished video on a livestream at a certain time to give people the feeling of liveness as the video was being broadcast. Many artists took to Zoom, adapting or creating pieces specifically to be performed on the video conferencing platform. I define "Zoom theater" as any theatrical production performed live over a video web conference platform like Zoom or its competitors.

For *St. Valentine's,* we easily could have recorded, edited, and posted the performance online for people to watch. However, the actors performing the show live allowed audience members greater proximity and, thus, more intimacy with the piece. Auslander (2008) writes, "Television's intimacy was seen as a function of its immediacy—the close proximity of [the] viewer to event that it enables —and the fact that events from outside are transmitted into the viewer's home." During the height of

the pandemic, Zoom theater became like traditional television. Zoom theater created intimacy with the viewer watching at home since there was less distance between the viewer and the stage and it was broadcast directly into homes. The actors acting live on the Zoom call as the audience watched made the actors and audience share the same (virtual) space, like traditional theater. That feeling of everyone being in a shared space together dually increased the intimacy of viewing the performance.

Zoom's Chat feature created a secondary layer of intimacy between actors and audiences by allowing for more audience engagement. Audience members could type and send their thoughts on scenes or use an emoji to express their feelings to actors and fellow audience members immediately. Television does not offer audience members at home immediate engagement with the actors and other audience members. Theater allows for engagement in a very different way: what you say to the person next to you will not be shared with the entire group of theatergoers, but your laugh may ring through the audience or you may all gasp together in surprise. The Zoom Chat was an interesting medium between the lack of communication between audience members when watching television and the normal ways of audience engagement that theater fosters. The live Zoom Chat allowed for more interaction between audience members as a group and with actors, thus creating greater intimacy and community while watching the show. In a time of seclusion, these digital interactions during performances made people feel connected to the community of people navigating the waves of this experimental art form.

Theater and television have intensified each other over time. As Coates (2017) outlines, intensification between two fields "'augments, strengthens, heightens, and deepens' not only the subject matter, but also both disciplines." This time period of Zoom theater is a strong example of intensification between theater and television. The live production mediated through a screen gave it its televisual quality while allowing a form of immediate engagement that theater provides between actors and audience members through the Zoom Chats.

Zoom theater paved the way for my thesis project by demonstrating how augmented reality could be used in theater. Filters and face effects fall into the category of augmented reality. The use of augmented reality to add elements to Zoom theater that would normally be added through costumes, lights, and projections influenced my desire to use this technology in a live, in-person performance. I was also influenced by the Writers' Guild of America (WGA) and Screen Actors Guild–American Federation of Television and Radio Artists (SAG-AFTRA) strikes this past year. These strikes were partially caused because of fears that technology like artificial intelligence would replace writers and actors (Dalton, 2023). Due to the knowledge of artists' concerns about technology replacing them, I focused on bringing technology to theater on theatermakers' terms.

Virtual Reality (VR) Theater vs. Traditional Theater

In October 2021, Facebook rebranded to Meta and claimed that the metaverse was poised to usher in a new era of digital entertainment with virtual reality. I define "virtual reality" (VR) as the complete replacement of someone's visual and sometimes aural perception with digital aspects such as computer-generated images or videos. A big selling point of the metaverse was it "will help you connect with people when you aren't physically in the same place and get us even closer to that feeling of being together in person." (Meta, 2024). The metaverse attempts to replace Zoom as a platform for digital interactions between people. I will also argue that the metaverse attempts to replace live in-person entertainment itself in the way that television was poised to replace theater (Auslander, 2008). I will argue that the intensification of theater and virtual reality creates a better feeling of connection between people and eases artists' fears of replacement than completely turning to virtual reality itself for live entertainment. With this, theater and virtual reality intensify each other, which leads audience members to feel a greater feeling of connection with the story, characters, and other audience members.

The metaverse attempts to replace in-person live performances by bringing the outside performance into an audience member's home. There is a video on Meta's website where a person at an in-person concert is joined by a hologram of her friend through the metaverse. This raises many questions: Is the audience member joining virtually paying for the ticket? Does this affect artists' compensation? Does it really give you that feeling of being at a live performance and interacting with people who are also there physically or digitally? Is Meta suggesting that the metaverse would replace the need to be in-person to view a live performance?

During the pandemic lockdowns, this replacement was great! Along with Zoom theater, artists with the means to do so turned to virtual reality spaces like the metaverse and VR systems like the Meta Quest (formerly Oculus Quest) series of headsets for live performances. As Ashmore mentions in Baís Reis & Ashmore (2022), Zoom theater could increase "Zoom fatigue," where being on a video call for long amounts of time could cause psychological strain (Bailson, 2021). Virtual reality theater could give audience members a break from viewing things on Zoom and mimic the tradition of breaking away from your workspace to go to a performance. I define "virtual reality theater" as a theatrical performance that happens in a completely digital environment specifically created for the production. This differs from Zoom theater because virtual reality headsets or other VR devices are used. Virtual reality theater and performance should be analyzed from a social gaming lens as virtual reality's usage started off in gaming (Baía Reis & Ashmore, 2022). Like a social video game, virtual reality theater

places audience members as part of, if not the main driver, of the action. This differs from traditional theater, where audience members passively view and occasionally are drawn into the action.

The gamification of theater, a traditionally passive entertainment form, into an active entertainment form intensifies theater to be even more interactive. It could increase audience members' desire to participate more in or go watch a more participatory live theater performance. Conversely, theater also intensifies the field of virtual reality as it can take from the storytelling techniques and traditions of theater. It expands virtual reality to be used for more than just gaming. While the metaverse and virtual reality theater probably will not completely replace live performance, it could become more popular in the future.

While VR's substitution of live performances was ideal during pandemic lockdowns when people could not meet together in-person, it does not bode well for an already struggling theater industry. Once the lockdowns were over, more people spent time and money on in-person experiences like travel and exercising in gyms, but this has not translated to the performing arts (Gilbert and Bever, 2023). Many theater companies have not returned to their pre-pandemic sales and audience levels, which has led to non-profit theater organizations finding ways to overhaul traditional ways of working and appeal to new audiences to survive (Veltman, 2023). Audience members potentially turning to VR performances could hurt in-person theater non-profits unless these organizations find a way to incorporate new technologies and people's new interest in them into their theaters.

Augmented Reality (AR) Theater and *Moon Man Walk*

My work with *Moon Man Walk* is an example of augmented reality theater. Unlike virtual reality, augmented reality (AR) adds virtual elements to our environment without completely replacing our perception in real time. I define "augmented reality (AR) theater" as in-person theater with augmented reality elements used in the show. AR theater can incorporate audience members as part of the action, like virtual reality theater, while still giving theater artists agency over their performance and the story being told. There is no feeling of replacing traditional theater artists but instead adding another layer of the story for audience members to engage with. It is a viable option for theaters wanting to innovate and stay relevant into the future.

The usage of augmented reality in theater and performance is an emerging field. Dorsey et al. (1991) designed virtual sets for operas with computer-generated projections and suggested the further use of computer graphics in theater. Half Real used Spatial Augmented Reality (SAR) technology to track actors as they moved around the stage and generate procedural content in real time (Marner et al., 2012). More recently, AR has been created for the benefit of both actors and audience members'

experiences. The Augmented Live Interactively Controlled Environment (ALICE) Project's dynamic system allowed a highly-trained performer freedom of movement and the ability to control the AR elements in a production of *Alice in Wonderland* by Lewis Carroll (Lisowski et al., 2023). An adaptation of *What the Moon Saw* by Hans Christian Andersen enabled audience members to have more interaction and agency over their viewing of the performance (Lisowski et al., 2023). AR has also been used in performing arts to enhance choreographers' creativity while working with intermedia art (Brockhoeft et al. 2016) and to make theater more accessible to deaf and hard-of-hearing people through American Sign Language interpretation (Garrett et al. 2022). However, major AR theater productions in the field's canon thus far have not focused on stories that center Black people or modern stories. I also wanted to incorporate AR as a function of a story that comments on modern-day issues and relates to people in my communities.

I chose the play *Moon Man Walk* by James Ijames to implement augmented reality elements because the show deals with the universal experience of the death of a loved one while underscoring the themes of incarceration, family separation, single parenthood, and drug/gang violence, which disproportionately affect Black Americans. *Moon Man Walk* is about a man named Spencer, the only child of a single mother, who relives moments of his life with his mom while planning her funeral. Along the way, he discovers a new meaning of family. This story includes science fiction elements as Spencer was always told that his absent father was an astronaut on the moon, when in truth he was in prison for selling drugs. In this way, Spencer's reality is also "augmented": it is changed to protect Spencer from his father's absence as he grows up. However, the story of his father as an astronaut on the moon is a core part of his character's truth. *Moon Man Walk*'s storyline conceptually lends itself well to the use of augmented reality as a storytelling mechanism.

The play takes place in the present and the past, most notably 1980s Philadelphia. It was important to me to do a show where the plot has a Black character struggling because of their humanity, not just their Blackness. However, the play does not ignore race or the socio-political issues that affected the character's life, but elegantly weaves the issues into the plot through the death of his mother and the astronaut allegory. By using augmented reality in *Moon Man Walk,* I want to show how black scientists, artists, and stories can be at the forefront of new developments in technology usage in theater.

This production of *Moon Man Walk* by James Ijames was produced by Heritage Theater Ensemble (Adérónkẹ́ Adéjàre, Artistic Director) and AJ Walker at the Saybrook Underbrook Theater at Yale University from February 29 to March 2, 2024. It was directed by Adérónkẹ́ Adéjàre, scenic design was by AJ Laird, projections design by John Horzen, props design was by Sam Fisher, costumes

design was by Zara Belo, lighting design was by Nire Oloyede, sound design was by Suraj Singareddy, and the stage manager was Alicia Deng. The cast was as follows:

Spencer.....Prentiss Patrick-Carter

Esther (Flight Attendant/Nurse).....Aabi Whyte-Spence

Petrushka.....Ruth Ogunribido

The Astronaut (Funeral Guy/Flower Guy/Kesi).....Layla Felder

My primary research question is, "How does AR enhance the storytelling of a theatrical production?" I will explore this by examining the questions: Can people connect with the plot of the story more by using AR? Do audience members understand the story better or differently than if they watched it without the AR? Do they feel more active and a part of the story and production process with the AR? Do people feel more immersed in the story with AR?

Choosing What to Make in AR

The augmented reality elements were chosen because they give more depth to Spencer's character and allow the audience to see the show from his wonder-filled perspective. They give the audience insight into the idealized version of his world. I detail the process of designing the augmented reality and getting input from the cast and crew of the production in my Computer Science senior thesis project, "Tech Portraying Emotion: Designing Augmented Reality Assets for *Moon Man Walk*" (Adéjàre, 2024). Here, I will summarize why each AR aspect was chosen.

In the play, Spencer picks up a box that "contains multitudes" (Ijames, 2018). I interpreted that as the multitude of experiences in Spencer's life and of life in general, so I edited a video with archival videos from 1980s Philadelphia, the 1969 moon landing, and natural elements like flowers and animals to be overlaid on a physical box with augmented reality (Adéjàre, 2024). From here on, I will reference the video as the Box of Multitudes video.

Figure 1

Box of Multitudes

a)  b) 

a) is the physical box that the video was mapped onto. b) is a still image from the Box of Multitudes video covering the physical box

The Astronaut Helmet was created because Spencer had such a strong image of his father being an astronaut on the moon, so I really wanted this to come through in a cool way. Originally, the design was going to be a full astronaut suit replacing the costume, but after collaborating with the costume designer Zara Belo, we decided it would be best as just a helmet.

Figure 2

Astronaut Helmet

A picture of the Astronaut Helmet on Layla Felder (Astronaut) before the asset was adjusted to fit their head correctly.

The script included the map of the solar system as stage directions for the Astronaut to draw it so Spencer could find him one day. This could have been interpreted as timed projections, but I thought it would be better as augmented reality for this production.

Figure 3

Map of the Solar System

a)  b) 

a) is the whole solar system b) is a picture of the solar system during the performance while Felder “draws” it

The idea of the Daisy Wreath first started out as a picture frame inspired by Kehinde Wiley's portraits to frame Esther at the funeral (Adéjàre, 2024). Some funerals have a picture of the deceased person near the pulpits where eulogies are given, so I wanted something to frame Esther in the scene where Spencer gives his eulogy. Due to technical difficulties, it became a flower wreath to give that same effect and, more specifically, a daisy wreath because daisies were mentioned as Esther's favorite flower in the script (Adéjàre, 2024).

Figure 4

Daisy Wreath

The Daisy Wreath over Aabi Whyte-Spence (Esther), who sits next to Layla Felder (Astronaut) during a performance of *Moon Man Walk.*

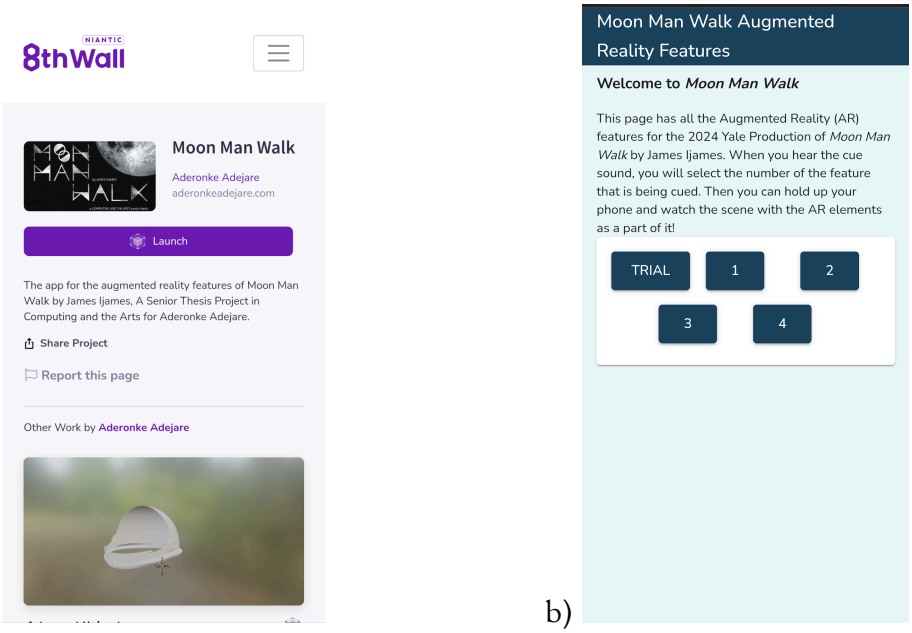
All the augmented reality elements were combined into one web app, which is accessible via this link: https://www.8thwall.com/aderonkeadejare/moon-man-walk. The link was in the digital program and in a QR code that audience members could scan at the theater.

I added a button to the app labeled "Trial" that directed users to the Astronaut Helmet element but with a front-facing camera so the audience could practice using the AR after being cued with a sound. I also added a camera button that allowed audience members to take, save, and share a picture with the Astronaut Helmet on their faces.

Figure 5

The Moon Man Walk *App*

a) b)



a) is the first web page the audience is taken to when they scan the QR code. b) is the first version of the app's home page.

Implementing AR in Tech Process and Performances

Tech Week

Early in the design process, I knew that I wanted lighting or sound to cue the augmented reality elements. Once we had our sound designer, Suraj Singareddy, I talked with him about how to cue the AR and whether we should have one or two different sounds to cue bringing out your phones for the

AR and putting them away. At paper tech, he brought in a nice ascending shimmering sound to cue audience members to bring out their phones for the AR and a similar descending shimmering sound effect for audiences to tell audience members the AR moment is over.

We did our first full run with the lighting, sound, and projection cues only and then did our second full run in the theater the next day with the augmented reality and costumes. After our second full run-through of the show, I decided to change when and how frequently audiences would bring out their phone to see the Astronaut helmet. Initially, the astronaut helmet would be cued any time the Astronaut came on stage before Spencer met him in prison in the second to last scene of the show. However, I reduced the frequency of the helmet being used to only once: when Esther was telling Spencer the origin story of the Astronaut.

Many reasons influence this decision: it may be too distracting and laborious for the audience to be pulling out their phones for almost every scene the astronaut is in and holding them for the duration of those scenes. Also, the other scenes with the Astronaut are before Spencer is born, so it does not make sense for him to be perceived the way Spencer perceives him. I initially was only going to have the AR effect used twice: during the bedtime story scene and the Astronaut's monologue. After watching Felder perform the monologue in the theater, I decided against that. Felder moved about the stage in a quick, frenzied manner as the Astronaut became more panicked about being stranded on the moon. Gustav Holst's "The Planets, Op. 32: Saturn the Bringer of Old Age" underscoring this scene made the passionate speech more tense and urgent. I did not want to distract the audience from this solemn moment or limit Felder's movement by incorporating the augmented reality helmet as a part of it. Thus, the Astronaut Helmet AR was only cued when Esther told Spencer the bedtime story of the Astronaut being his father. In the scene, Felder moves around the stage slowly, as if bouncing on the moon, and gives audience members a lot of time to see the AR helmet appear on her head.

Performances

As audience members came into the theater, QR codes with the AR app were printed on posters hung outside and around the theater. The house manager and ushers told audience members to scan the QR codes and connect to the internet before the show. Once all audience members were seated, I gave a short speech at the beginning of the show to advise audience members on how to use the AR. I introduced myself, explained augmented reality, and gave audience members time to connect to the Internet and try out the app before the show. Then, we played the sound that would cue audience members to bring out their phones and the one to put their phones away. Audience members then tried out using the cue with the "Trial" button in the app.

Figure 6

A snippet of Audience On-Boarding Speech

We ask that you only bring out your mobile device during the parts of the show that use augmented reality, which will be cued by this sound (sound) and to please put your devices away when you hear this sound (sound). Please silence your devices and do not use them otherwise during the show, out of respect for our cast and crew.

...

So let's try it out! Once you have the website open, click Launch. Then click Trial. (moment) You should see an astronaut helmet on your face! You can also take a picture or video with the AR with the button at the bottom of the screen. (moment) Please follow the numbers throughout the show to see the different augmented reality features.

If you are having trouble accessing the website because of Internet issues, do not worry! The show can still be enjoyed without the Augmented Reality features.

After the performance, we strongly encourage you to fill out the Audience Feedback Form about your experience, which can also be found in your program. It will help me a lot as I continue my thesis research.

Thank you so much for taking the time to try this experience and enjoy Moon Man Walk.

During the trial point, I waited and heard audience members gasp and laugh when they saw the Astronaut Helmet on their heads. A few friends immediately texted me their pictures, and two posted their pictures with the Helmet on Instagram.

Figure 7

Pictures of Audience Members with the Astronaut Helmet

Three pictures of audience members with the Astronaut Helmet around their faces, included with their permission. The middle picture is posted to Instagram. The Astronaut Helmet was not dynamic so it did not change to adjust to audience members' head or hair sizes.

After this moment, I reassured audience members that if they have difficulties viewing the augmented reality elements the show can be enjoyed without them and told them to fill out the Audience Feedback Form after viewing the show. I thanked them, took my seat, and then the show began. After the show, I playfully reminded audience members to fill out the Audience Feedback form before they left. Following the first performance, our dramaturg led a talkback, which included myself and Aabi Whyte-Spence, who played Esther.

Figure 8

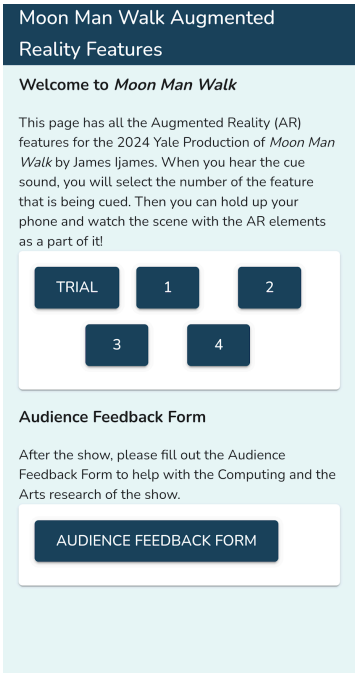
Audience Off-Boarding Speech

Thank you so much for watching Moon Man Walk! Please make sure to fill out the audience feedback form on your way out so I can graduate. Thank you and have a great night.

The Audience Feedback Form received only seven to eight responses after the first two performances, so I added a button to the app to lead users directly to the form. The number of immediate responses doubled after the last two shows. In total, there were 31 responses to the form.

Figure 9

The Moon Man Walk *App with the Audience Feedback Form Button*



The home page for the app after the Audience Feedback Form link was added.

Challenges

There were some challenges in implementing augmented reality in this production due to Niantic 8th Wall, the internet, and time constraints.

Niantic 8th Wall was not built for augmented reality to be used in a theater. Most Niantic 8th Wall AR experiences are designed for users to be close to the objects they are viewing in AR. However, some audience members were further away from the objects due to the seating arrangement of the theater. I considered having a three-quarters thrust staging of the theater, but then I would have had to adapt the AR to work from the left and right sides of the theater. I ultimately decided on proscenium staging because the story was best experienced in that arrangement. Staging is an important consideration when trying to implement augmented reality in a production and there can be major trade-offs depending on the arrangement chosen.

The fixed positioning of AR assets did not help during the performances, since audience members sat in different positions in the theater. Instead of seeing the Daisy Wreath on Esther, at least one audience member saw it on the Astronaut, and at least one other audience member saw it on Spencer. Also, audience members who were sitting further away from the stage may not have seen the Astronaut Helmet on the Astronaut because the outer camera face filter does not work as well from further distances. For the Box of Multitudes, the video was on a 2D rectangular plane. There were some difficulties during tech viewing it when the target object was further away. I tried changing the target object so the plane could just appear on its own, but Niantic 8th Wall currently does not allow for horizontal planes to be in AR that is not tied to a target image or a vertical object. An AR program that is specifically designed for theater can make the integration into the show smoother and the storytelling more consistent for audience members.

The Underbrook Theater originally did not have an internet router, so many audience members had difficulty accessing the website where the AR elements were hosted on the opening night of the show. The next day, I called Yale IT Support to get a new router installed in the Underbrook Theater. Afterward, the internet worked well, and the app loaded quicker on audience members' phones, making it easier to use the AR features for the remaining performances. Ensuring that the theater has the proper infrastructure for the AR to work is essential for an ideal viewing experience.

In the future, I suggest the Augmented Reality Designer be its own independent role so the designer can really focus on teching and perfecting it. I did not have as much time to work out the kinks in the AR theater setting because I was also directing and only had four days of residency before

opening night. However, I am glad to have been both the AR designer and director for this show because both roles informed each other and I had different perspectives on how to tell the story.

Audience Feedback

After each performance, the audience was asked to fill out a digital survey that was distributed via QR code on the program, near the exits of the theater, and inside the AR viewing web app. The questions are detailed in **Figure 10** below.

Figure 10

Audience Feedback Form Questions

1. What do you remember the most from the show?
2. Did you try to use the Augmented Reality (AR) features of the production?
3. Which AR features worked for you? (Check all that apply)
    a. Trial Astronaut Helmet
    b. Box of Multitudes Video
    c. Astronaut Helmet
    d. Map of the Solar System
    e. Daisy Wreath
4. How did the AR features affect your viewing experience of *Moon Man Walk*?
5. Did the AR features enhance your understanding of the story?
6. How did the AR features affect your understanding of the story?
7. Did you enjoy using the AR features?
8. Would you go to an AR theatrical production again in the future?
9. Any other comments?
10. Why did you not use the AR elements?
11. What could cause you to use AR features in a theatrical production in the future?

Questions 2, 5, 7, and 8 are Yes/No questions, 3 is a multiple-select question, and the rest are open-ended responses. Audience members only answered questions 3 through 9 if they selected "Yes" to question 2. They answered questions 10 and 11 if they answered "No" to question 2. An optional section at the end allowed audience members to leave their contact information if they were open to being asked more about their experience.

Around 200 people attended one of the performances over the course of four days. There were 31 responses to the audience feedback form, which was open from the invited dress rehearsal (February 28) to nine days after the final performance (March 11).

Out of 31 responses, 20% mentioned augmented reality in response to the first question, "What do you remember the most from the show?" This is exciting because it means that the augmented reality elements were one part of the storytelling that stuck with audience members. For context, half the responses to this question included the projections — especially the use of the mirrors with the projections for the moon and the funeral scenes — 30% mentioned the acting, and some mentioned specific scenes or themes of the play. Some people also answered multiple of these production aspects in their responses, so the total does not add up exactly to 31. Augmented reality was a memorable aspect of the viewing experience of these audience members.

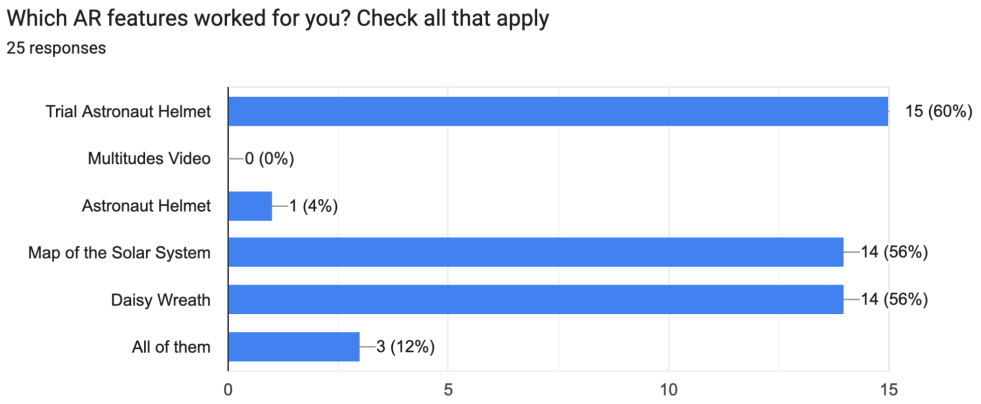
Three respondents indicated they did not use the augmented reality features. Of these responses, two were from the invited dress and all three were before the new internet router was installed in the theater. Two mentioned the connection and the pages not loading in time for the scenes as to why they did not use it. They said a better connection in the theater would cause them to use AR features in the future. The other respondent said they were not "technologically savvy enough" to use the AR features. They said in order to use the AR features in the future, they "will be better prepared for such in the future and thus can plan on using it." Extra attention to older and not as "tech savvy" audience members should be given so they can enjoy the show with augmented reality too. Giving more time for audience onboarding and helping out individual audience members before the show begins may help alleviate this issue.

There were 28 respondents who tried to use the AR in the show. Of these, at least eight were at the Thursday performance, which was the one with the internet issues. This is based on the timestamps of when they submitted the form, since the questionnaire did not ask which performance the audience member attended. One of these respondents was at the invited dress, but saw the show again after a new router was installed.

In response to "Which AR features worked for you?", all elements worked for three people, the trial astronaut helmet worked for 15 people, the box of multitudes video did not work for anyone, the outer-facing Astronaut Helmet worked for one person, and the Map of the Solar System and Daisy Wreath worked for 14 people. Three people left the question blank, which could mean none of the AR elements worked for them during the show.

Figure 11

"Which AR features worked for you?" Bar Graph



Many people responded that they felt more engaged with the show when using the AR while watching in response to the question, "How did the AR features affect your viewing experience of *Moon Man Walk*?". This suggests audience members' participation in the show increased with using the AR. Some audience members listened more intently to the whole performance. Respondent 8 said, "Having your own cues as an audience member made me more actively listen and enjoy the play" and respondent 12 said they "anticipate[d] the next sound cue to be able to see the [AR] features." Needing to listen for the AR sound cues made audiences more attune to what was happening in the show. In this way, the audience members also become a part of the show. Like the stage manager, they are listening to execute cues and thus become an integral part of the live production. This also involves audience members in the production digitally like virtual reality experiences do.

Similar to virtual reality, many audience members said the AR added visually to the experience. Respondent 4 said it added "a cool technological and surreal element to the show" that was "really in line with the themes and space concept of the play." Respondent 12 commented the AR added "flourishes" and to "the space and futuristic vibe". The augmented reality aspects add to the themes and storytelling signifies that it could be a very relevant and necessary part of a play.

Five responses mentioned that the Augmented Reality elements distracted from their viewing experience. This was mostly due to trying to get the augmented reality elements to work. Some people noted that while trying to get the AR to work on their phones, they missed hearing lines or did not pay as much attention to them, so then it became a bit more difficult to follow the plot. This suggests that augmented reality can detract from the viewing experiences of audience members if it is not properly working. The job of the augmented reality designer becomes all the more critical to ensuring the AR

works smoothly so it does not divert the audience's attention. One respondent said that because they were in awe by the AR they became distracted from the performance. AR should not be used in very intense scenes unless it adds to the intensity because it could distract from the message of the scene. As AR is a new part of theater, artists should be patient as audience members are still getting used to using augmented reality during a performance.

Forty-three percent (43%) of respondents thought the AR enhanced their understanding of the story. For some of them, it did not hinder their understanding and was helpful in understanding some actions happening on stage. Some people felt more a part of the story. Respondent 24 said, "The helmet in particular made me feel more connected to Spencer's childlike fascination with space." These responses range from "They added another layer to the world, but didn't really shape my basic understanding" to "It greatly supplemented my understanding of the story and helped create a more cohesive and complex storyline". Like other technical elements of theater, AR can have different levels of impact on audiences' viewing and comprehension of a story.

In hindsight, the question, "Did the AR features enhance your understanding of the story?" should have been posed as a question on a 7-point Likert scale rather than a Yes/No question. I consider "enhanced understanding" as getting a more in-depth perspective to the story. I did not provide this definition to audience members in the form so their interpretation of this phrase may have widely differed. From evaluating the written responses with my definition, half of the respondents' viewing of the show was enhanced. This indicates that AR can be a powerful method of storytelling in theater.

Eighty-two percent (82%) of respondents enjoyed using the augmented reality features. The majority of people who said "No" to the question "Did you enjoy using the AR features?" had difficulty getting the app to work in general, and all of them also said it did not enhance their understanding of the story. Impressively, all 28 respondents said they would go to another show with augmented reality. Even if people did not have the best experience this time, it does not deter their desire to go to another theatrical experience with augmented reality. This is exciting as it suggests there is an interest and a market for AR theater performances.

Audience members also watched augmented reality scenes through other audience members' phones if they could not get it working on theirs. These could have been people they knew and were sitting with or strangers sitting in front of or near them. One person said, "[F]rom viewing other people's phones it made the story come to life and added details that complemented the props, the background, and the performers' outfits". Another person who viewed some AR elements through another person's device said it made the setting clearer for them. These examples prove that even

audience members do not completely miss out on the AR theatrical experience if the AR is not working on their device. While proximity-wise, they may not have had the closest experience of the augmented reality, at least they did not miss out entirely. This could also build a new sense of community as they watch with another person. It also suggests audience members can still get an enhanced viewing experience through watching the AR on other people's devices.

Augmented reality can also help audience members connect more to the actors and fellow audience members during the show. Respondent 7 said the AR "allowed for interaction between the audience and the performers in a way that goes beyond what can be conveyed on the stage." Rather than passively viewing or occasionally interacting with the performers, audience members can become part of the action with AR. Being included in the action changes the audience member's relationship with the performers and the story as a whole. This respondent also said they "felt more engaged with the performance," which "made the play much more enjoyable to watch." Respondent 13 said, "The AR features helped me feel connected with the rest of the audience in the experience." Especially after the pandemic, there is an extra craving for in-person experiences and connections with other people. AR in a production can help foster affinity between audience members through sharing an experience together.

Post-Show Cast Feedback

About a week after the production closed, I interviewed the cast about their experience with the AR in the show. These were approximately 20-minute interviews conducted over Zoom. The questions I asked are detailed in **Figure 12** below.

Figure 12

Post-Show Interview Questions

1. How did it feel to be watched by the audience through a phone at some points during the show?
2. Did you look out into the crowd during AR moments? If so, did seeing audience members on their phones affect your acting? How?
3. Did you ever do theater over Zoom?
    a. If yes, what did you do? How did this interaction between technological devices and theater compare to that experience?
4. *For Layla Felder:* How was your experience acting with technology in show compare to your acting with technology in film?
5. How did your own preparation with the AR elements (exposure, experimentation, watching

other scenes of your colleagues in rehearsal) inform your performance before an audience?
6. Would you work on a show with AR again? Why or why not?
7. What advice would you give to actors/crew members working on a show with AR?

In response to the first question, all the actors said audience members watching them with phones during the show did not affect them much. They were focused on the scenes at hand, the stage lights were very bright, or their scenes did not have any AR, so they did not notice the audience on their phones so much. These responses signify that the addition of AR to a theatrical production does not hinder the actor's performance ability. Of course, this can vary by actor, but it is promising for future augmented reality theatrical productions that AR does not pose a high barrier to actors doing their job. For the second question, one actor noted that since they knew the purpose of the AR, it did not distract them too much, but the phones did make it "a little harder to play off [the audience] while talking to them." If phones are the devices used for augmented reality in a production, actors may have to work harder to connect with audience members in fourth-wall-breaking scenes due to the physical barrier the device places between them.

Only Ruth Ogunridibo acted in a Zoom theater production during the COVID-19 pandemic lockdown. Two other actors had recorded monologues or video auditions over Zoom but had never performed live on the platform. Two of the actors had done a showcase of work that was pre-taped, edited, and then live-streamed on a video-sharing platform. In comparison to those experiences, actors said that augmented reality theater was better because they were still performing live in front of an audience. Because they could not share the same space with the audience members, one actor said Zoom theater felt "soulless," and another actor said they could not gauge audience members' reactions or bounce off the audience's emotions. Aabi Whyte-Spence watched a Zoom theater production during the pandemic and said it "just felt like the next best option," and there was always the feeling of wanting to experience the performance in person lingering underneath. However, the actors' experience with augmented reality theater was much better than their experiences with Zoom theater. Layla Felder said, "Even though it was technology and theater, it was not at the expense of what makes theater 'theater'." Actors feel that augmented reality theater does not replace traditional theater but instead intensifies it, as I described earlier in this piece.

Felder has also worked in film and television, so I asked about her experience working with technology through this project versus through those media. She mentioned how with AR, she is perceived and interacted with in real time with a camera and digital effects, while in film, the effects are added in later. For both experiences, Felder is being viewed by "digital eyes," so the sensation of being watched through cameras while performing does not feel too different. Actors who have experience

acting in film may have less of a learning curve than actors who just have stage acting experience when AR is implemented in a theatrical production.

Augmented reality did affect how Felder acted during the performance. Felder specified since she knew the augmented reality Astronaut Helmet would be used during the bedtime scene, she made some conscious decisions in her acting. She knew how light and distance could affect the audience seeing the AR, so she came closer to the audience and walked on both sides of the theater so all audience members could get a good look at the Astronaut Helmet on her head. Practicing with augmented reality elements in rehearsals can help actors connect their motions with what people are seeing on their phones. Once actors are equipped with the knowledge of how this technology best works, they can perform to the best of their ability so audiences can have the ideal performance experience.

Three actors excitedly said they would work on a production with augmented reality again. Felder said the AR does not feel "invasive" and "does not inhibit their job as an actor," so it was easy for them to work with. Whyte-Spence also said it does not change anything and adds "an interesting layer" to the storytelling. Ogunribido said the concept seemed "really cool," and she wished she even got to watch the show with the AR. One actor noted that they would only work on another full-scale theatrical production with augmented reality if a play were written with the intention of including AR. Otherwise, they would probably only work on a short-form, more audience-interactive performance piece with AR. The excitement and willingness for these young actors to work on another augmented reality theater production shows there are artists interested in continuing to work with this new evolution in theater. This encourages theatrical pieces that intentionally include augmented reality in the script to be written and performed in the future. AR theater could become a staple of performing arts.

Advice for actors in future productions with AR from the actors of *Moon Man Walk*: be prepared. AR was widely perceived as another element of the tech part of the theater like props and scenery. Felder said that actors should know what AR elements are being used in their scenes so they can align their movements through the scene to work best with the AR. Ogunribido says it may be "overwhelming" to see many cameras pointing at you and that actors should anticipate audience members coming closer to the actors to see the AR element appear on them, which can be distracting. Whyte-Spence said not to be afraid of the phones and how the phones should not change the relationship with the audience in a negative way. Felder echoed not fearing the phones and said actors should do what they need to overcome their apprehension, whether having friends point their phones at them while they practice or looking into the stage lights during the show. Actors that prepare to work with augmented reality in their production will be fine with the art form once it is time for

performances. Stage actors are used to the other tech elements of theater, so it is important for them to get used to AR in theater. Dedicating time throughout the production process for rehearsals and discussions with AR can ease actors into performing with AR.

Conclusion

While Zoom theater may be an art form people want to leave as a relic of the COVID-19 pandemic lockdown, there can still be a lot learned from this experimental art form. Lessons from my own experiences doing Zoom theater led to my interest in using augmented reality in traditional in-person theater. Augmented reality theater can strike a balance between the user-driven experience of virtual reality theater and the production-driven experience of traditional theater. This can lead to audience members feeling more engaged in watching augmented reality theater without coming at the cost of traditional theater makers' artistry.

This paper details the process of implementing augmented reality elements in theater, from the tech process to the performances, and outlines the challenges that arose. It builds from my Computer Science senior thesis project, which focuses on collaborating with traditional theater makers to create augmented reality elements for James Ijames' *Moon Man Walk* (Adéjàre, 2024). This paper also analyzes how audience members reacted to using AR in a theater setting and how actors adapted to the new medium. Ensuring that the AR functions well and is suited for a theater setting will help to improve audience members' experiences. Half of audience respondents had an enhanced experience of watching the play while using the AR, which means that AR could heighten theatrical storytelling. 82% of respondents to the audience feedback form enjoyed using the augmented reality features and 100% of respondents would go to an augmented reality theater production again in the future. This suggests a promising future for augmented reality theater for both artists and audiences.

In the future, I suggest playing the aural cues for audiences to bring out their phones during the transitions between scenes. This can provide audience members with extra time to bring their phones out and adjust them before the scenes happen. Ideally, it would also lead to less distraction from the story once AR is added. I would also want a visual way to cue the audience members to bring out their phones to make AR usage more accessible to deaf and hard-of-hearing people.

Augmented reality theater can be a very powerful storytelling medium. This could help a struggling post-pandemic theater industry draw in new audiences. More importantly, it can help bring meaningful diverse stories to life. I hope to continue making augmented reality theater productions well into the future.

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