Process, Roles, Tools, and Team: Understanding the Emerging Medium of Virtual Reality Theatre

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ABSTRACT
Virtual reality (VR) theatre artists are combining theatre production and game development practices to create live performances in VR. To date, little is known about VR theatre creators’ experiences of this process or how staging a play in VR might affect the audience’s experience. To capture the experience of developing a VR theatre production we interviewed the production team behind the VR play You Should Have Stayed Home. Members of this team felt the process was a learning experience and shared the lessons they plan to incorporate into their future work. We report on the team’s efforts to understand the VR theatre medium, how this team was constructed, and challenges that they encountered. In this paper we present the opportunities that the production team members identified for creating novel experiences for VR audiences, and their own needs as creators.

CCS CONCEPTS
- Human-centered computing → Virtual reality: Interaction design process and methods.

KEYWORDS
Virtual Reality Theatre, Drama, Intermedial Theatre, Design Process

1 INTRODUCTION
Since the times of Aristophanes and Sophocles, plays have been a form of human expression where a creative work is presented on a stage to an audience. Production of a play is a complex and multidisciplinary undertaking, involving roles as diverse as writing, acting, producing, directing, stage-managing, and costume design. A play’s production team works to create an audience experience, incorporating mood, emotion, edification, and entertainment. This live and curated experience is what distinguishes a play from other media such as film or video games.

Processes for managing the creation of a play have evolved over the centuries. While they differ based on size and type of play, budget, and culture, these processes typically follow an iterative approach where all aspects of the play improve incrementally over time: actors learn their lines and presentation, while the set and stage move from prototype to production versions. Throughout this process, the production team works toward a shared creative vision and the play is revealed to outsiders for feedback only late in the process.

Virtual reality theatre is a novel and emerging medium that is dramatically changing both the form and production process of plays. In a virtual reality (VR) play, both the actors and the audience enter the virtual world using a headset such as a Meta Quest [69]. Producers of VR plays have embraced the possibilities of this medium, allowing VR plays to enhance the audience’s immersion by placing them directly in the set, and allowing interactivity where the audience can choose their own location and perspective in the scene. This new form has changed the composition of production teams to include VR designers and developers. In short, VR plays are a form of digital interactive experience, requiring the adoption of techniques from interaction design while retaining the traditions of in-person theatre.

This paper is the first to delve into the issues of presentation of a VR play from the perspective of its creative goals, production roles, and processes. To investigate these issues, we interviewed members of the production team for SpiderWebShow’s VR play You Should Have Stayed Home [12]. To advance the understanding of the emerging medium of VR theatre, we posed the following questions:

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• What roles and processes were involved in the production of this VR play?
• What barriers and challenges did the team face?
• How does the design of audience experience change in this new medium?

Through these questions, we seek to better understand how the very different traditions of dramatic arts and interaction design converge in this new medium.

Thematic analysis of these interviews reveals that VR theatre is grounded in key aspects of traditional theatre, providing a core focus on audience experience within a shared, scripted, and live experience. The affordances of VR change the form of the play, opening new ways of creating an audience experience. The use of VR as a medium therefore changes the composition and forms of work of the play’s production team.

The paper is organized as follows. We first review the brief history of VR theatre, considering its roots in traditional and intermedial theatre. We then describe You Should Have Stayed Home, using this play to introduce the medium and give a sense of how VR was used to create a novel and compelling audience experience. We describe the team’s roles and the process that was used to create this play. We then present our thematic analysis of interviews with 11 members of the play’s production team.

Our central contribution is to increase understanding of an emerging medium that has the potential to become a new distinct art form. This form draws from centuries of traditional theatre while embracing the affordances of the emerging VR technology. Key results include how this team came to understand VR theatre as a medium, and how the use of VR changed how the production team came together in their creative work, what tools they created and wished they could have created, how roles were adapted from traditional theatre, and how new issues arose around the safety of the team.

2 BACKGROUND

VR theatre—scripted live performance in virtual reality—draws from a range of disciplines, both digital and situated in the physical world. In traditional plays, a seated audience watches actors on a stage who present a scripted narrative. VR theatre moves beyond the use of a physical stage, opening new forms of audience experience.

2.1 In-person Theatre

Traditionally, physical theatre has sought to immerse audiences in narratives that are acted out in a performance space. Today, theatre is most commonly presented on a proscenium stage where an archway presents a portal to the world of the play. There are, however, other forms of in-person theatre that are particularly relevant to VR theatre. For example, site-specific theatre overlaps what practitioners call a host site, meaning a location in the real world, with a ghost site, meaning the fictional attributes imbued by the show’s scenography and performance [45, 62]. Similarly, in immersive theatre, artists aim to envelop audiences in a theatrical experience by acknowledging their presence within a fictional world of the play, and by assigning them an active role within the show. Although immersive performance can occur in a proscenium seating configuration [40], immersive artists frequently engage their audiences by inviting them to perform a series of activities such as running, hiding, and dancing to immerse them in the world of the play [1, 22, 37].

For example, Punchdrunk’s Sleep No More invites audiences to don white carnivalesque masks and explore a multilevel warehouse designed to look like a hotel. As audiences move through the space, they stumble upon scenes mid-progress, are pulled into secret rooms for coveted one-on-one performances, and may also be tasked with accomplishing side quests like delivering a fictional letter from one character to another or finding Hecate’s ring [4, 38]. In addition to these theatrical forms, there are also several different approaches to creating theatre that are significant to the development of VR performance. For example, contemporary artists have used a devised theatre practice, in which artists work collectively and share creative roles to create new works [43, 60]. This variety of styles suggests a rich design space of dramatic performances that all share these key elements: they involve live performances; the audience’s primary role is to observe, and the performances are scripted to produce a specific audience experience.

2.2 Virtual & Digital Performance

VR theatre largely adheres to these core principles, but its use of digital technologies allows creators to draw from the design traditions of other digital media to produce novel audience experiences [29]. Intermedial theatre—dramatic performances involving new media—began gaining traction during the 1990s, as theatre artists became increasingly interested in exploring the narrative, aesthetic, and political possibilities of incorporating digital technology and immersive media in their work. For example, Desert Rain [5] is a Gulf War themed mixed-reality game featuring live actors. Players interact directly with performers who situationally intervene in the game to orchestrate its intended audience experience. Like other immersive performances, Desert Rain’s use of a physical performance space and live actors serves to immerse the audience in the experience, while its use of player interaction and traversable rain-curtain displays enabled its creators to integrate elements of game design and theme park ride design [31]. Many other intermedial performances have explored the space of audience experiences afforded by new media. For example, dance performances have integrated augmented reality particle effects that respond to the dancers’ movements [6, 13]; plays have been livestreamed on Zoom [70, 73]; concerts and game shows have been held in online games [20, 26, 33]; and immersive performances have used mixed reality technologies to create out-of-body experiences [51–53] and promote empathy by simulating experiences [29]. Since intermedial theatre can take many forms, it frequently relies on practices from a broad range of disciplines, including film, computer science, and graphic design, as well as a diverse series of performance forms and practices including immersive and site-specific modes of creation, to develop or adapt conventional performance-making practices [18, 28, 44].

Due to VR’s inherent interactivity, many works have allowed audiences to assume a participatory role in the play’s narrative [36, 42, 61, 63, 67, 72]. For example, Tinker [67] has an audience member draw and build toys with an actor playing their grandfather and The Under Presents: Tempest [61] allows audience members...
to manipulate props and non-verbally act out parts of the narrative themselves. Some other works have maintained the audience’s conventional role of observer [14] and in some cases deliberately rejected audience participation to create emotional distance between the audience and the narrative [2]. The interactive possibilities afforded by VR theatre can profoundly influence the audience’s role in the performance, making them both performer and spectator [16, 49].

Much of the technology used in VR theatre was originally developed for digital games and cinema, such as creation and animation of 3D scenes and characters and stereo rendering. For example, interactive immersive theatre experiences present recordings of actors that respond to the viewer’s interactions [41, 46, 47], similar to the full-motion video games that preceded them (e.g., Night Trap [17]). Digital games bear some superficial similarity to VR theatre, in that they involve interaction in a virtual world, often involve a scripted story, and can be written to engender a specific experience. Game design takes on the language of theatre, such as Fullerton’s description of the dramatic arc in games [23]. Pervasive games, such as Can You See Me Now? [15] and Uncle Roy All Around You [3, 39], use interactions with live performers to realize the game’s alternate reality and games involving orchestration improve game content, such as NFC dialogue [10] and narrative arcs [19], during the course of play [25]. While playing some games, such as Dungeons & Dragons over the internet [57], can evoke the dramatic character of intermedial theatre, the process by which games and VR theatre are created are fundamentally different.

2.3 VR Theatre Production

As VR theatre is rooted in the traditions of theatre, teams creating VR theatre adopt traditional processes for creating a play. While game design processes and processes for creating specific forms of theatre (e.g., devised theatre) often involve multiple rounds of open-ended iteration, conventional theatre-making processes are often more hierarchical and prescribed [30, 55]. First, the director meets with the designers to develop the overall aesthetic of the show. During rehearsals, directors work with the stage manager and the actors to develop the blocking—the positions and movements of actors—of the show and shape how it will be performed. Tech week is often held one week before the opening of the show and allows the production team and the actors to rehearse with all the technical elements (lights, sound, etc.). This is usually the first time that these elements are assembled and provides an opportunity for the team to identify those elements that need to be re-worked. Once the show has opened, the show maintains the vision of the show constructed for opening night.

One of the central ways in which intermedial theatre processes differ from conventional theatre-making practices is through the addition of new technical roles and extension of conventional creative roles. For example, as Steve Dixon observes, alongside the conventional set, lighting, costume, and sound designers, intermedial artists also “collaborate with technologists and software designers” to co-design the show [18]. Thus, in intermedial theatre, software designers and developers become essential members of the creative team. For example, creating the show Debussy 3.0 necessitated an augmented reality engineer, who created the AR effects and controlled them during live performances [13]. In presenting Frictional Realities, “stage management” meant wrangling disoriented audience members in head-mounted displays and clearing obstacles that could cause them harm [52]. Thus, the tools used to create intermedial theatre can greatly shape a show’s production and the audience’s experience.

As Weems notes, in intermedial theatre “every week is tech week” [28], meaning that considerable time is needed for the production team to develop and test the tech. While social VR platforms such as VR Chat [66], NeosVR [59, 68], and Sansar [34] provide an almost “plug ‘n’ play” [6] environment to test and present theatrical experiences, creating a VR play necessitates the development of new technologies. Intermedial performances have been created using, for example, novel augmented reality displays that project 3D renderings of live actors in a physical environment [11] and cave automatic virtual environments controlled via a Wii Remote [54] or a full-body action recognition system [71].

Bringing the audience into the scene in VR theatre can introduce the challenge of accommodating larger audience sizes. Some exploration has been performed of hybrid approaches, where some audience members are fully in the VR space while others observe using traditional media [12], and of archiving live performances for later experience by a broader audience [27].

Despite this rich experience in media that involve aspects of traditional plays, it is not yet known how VR theatre’s reliance on and development of new technologies might affect the process of producing a VR play, how traditional roles adapt to the new medium, how a production team can explore the new affordances of VR, or what tools are required to support the mounting of VR plays. In the remainder of the paper, we examine these questions through interviews of the production team of a recent VR play.

3 YOU SHOULD HAVE STAYED HOME - A VIRTUAL REALITY PLAY

You Should Have Stayed Home is a one-man stage play adapted into a live virtual reality performance for ten audience members wearing internet-connected VR headsets. Performing while wearing his own VR headset, playwright and actor Tommy Taylor takes the audience on a guided tour of his experience attending protests at The G20 Summit held in Toronto, Canada in 2010 and his subsequent incarceration as part of the largest mass arrest in Canadian history. Work on the project lasted one year from July 2021 to June 2022.

The play starts with a lighthearted mood as Taylor joins a group of peaceful protesters in a dedicated Free Speech Zone (Figure 1). The mood becomes progressively darker as the protesters are surrounded by riot police, arrested, and detained under oppressive circumstances. The play takes place in virtual reality, where the audience joins the actor (Taylor) as he narrates and walks them through his day.

A sequence of scenes represent a park, an urban street, a police bus, and a detention centre. Taylor (playing himself) guides the audience through these scenes while narrating the day’s events. The audience is free to move within the scenes as they wish, making the play an active experience. Audience members can see and talk with each other. Some events offer audience participation, such as
picking up a sign to join the protest, accepting a slushie from an ice cream truck, or singing along with protesters being detained by police.

Two example scenes give a sense of the play. In the first, Taylor and the audience are in a street in downtown Toronto, attempting to walk home (Figure 2). A phalanx of police in riot gear appears on the street on either side of them, blocking any exit. The police appear as static and imposing figures. As Taylor narrates the events, the police move closer until they surround the audience, pushing them into a smaller and smaller area (a process called “kettling”). The scene engenders claustrophobia as the audience feels the police tower over them, eventually culminating in their arrest.

In a following scene, the audience is moved into a prison bus which drives from the downtown to an improvised detention centre (Figure 3). This ride conveys the audience members’ descent from freedom to incarceration. The presentation of the ride becomes increasingly surrealistic, where the realistic streetscape outside the bus transitions to streaming lights, and eventually leads to an aerial view of the detention centre, all while Taylor describes the puzzlelement and fear of the people being transported.

The scenes are based on the layout of downtown Toronto, reproducing the streets and buildings where the events took place. As with traditional theatre sets, some aspects of the scenes are deliberately muted or low-fidelity for poetic effect and so that focus is maintained on the actor and the events he is describing. For example, crowds of people are represented as simple, white figures (Figure 4). Riot police are represented as inanimate large figures (Figure 1). City exteriors visible from the bus are static images to retain focus inside (Figure 3).

In the play, virtual reality affords numerous forms of creative expression that were not available to the stage version of the show. VR enabled an immersive theatre approach to storytelling. The size of a scene is unbounded, allowing the audience to move through a large, organic space, such as the park at the beginning of the play, where the audience walks past several groups of protesters and can directly feel like they are a part of the event. The wide viewing angle of a VR headset allows peripheral awareness of other audience members, providing a sense of group. Spatial audio provides immersion where, for example, the chants of protesters and the booming noise of police loudspeakers can be heard all around. The 3D immersion of VR is particularly effective in oppressive scenes such as the kettling scene described above, where the audience is compressed into a smaller and smaller space as police in riot gear advance, looming above them.

The presence of a live actor is critical to the play’s experience. Taylor engages audience members and talks and jokes with them. He adjusts the script to the audience, giving a slightly different experience in each performance. The audience is provided with the intangible experience of knowing that the actor is a real person who is also experiencing the event. This human-to-human interaction is fundamentally different from the interactive experiences afforded by similar media types, particularly video games. Games may also involve narrative exposition and direct interaction between player and non-player-controlled characters, but lack the human element directing these live experiences.

The play also illuminates limitations of current VR technology. The embodiment of the audience in the scene limits VR attendance to ten audience members. (In production, other ways of attending were provided, including a live stream [12].) Because of concerns of cybersickness [32], the length of the play was limited to 40 minutes. Access to the play in VR is limited to people who are comfortable wearing a VR headset and who are conversant with the interaction techniques afforded by the VR platform.
3.1 The Production Team

The members of the production team for You Should Have Stayed Home had extensive backgrounds in the creation of traditional plays and some experience in creating VR plays. The team involved traditional roles (such as Stage Manager and Playwright), as well as technical roles such as VR Developer. Specifically, these roles were:

**Director:** Managed the artistic vision of the performance.  
**Stage Manager:** Oversaw scheduling and the rehearsal process, and ran the live performances.  
**Dramaturg:** Worked with the Director, Playwright, and other members of the production team to adapt the theatrical script for a VR world. This role was filled by a Head Dramaturg and an Assistant Dramaturg.  
**VR Developer:** Designed and created the virtual set and created tools for use in VR by the Lighting Designer and Sound Designer. The production team included two VR Developers and three part-time student developers from a local university.  
**Playwright / Actor:** Wrote the script and performed as the sole actor in the play.  
**Sound Designer:** Designed the sound effects and original music for the virtual performance space.  
**Lighting Designer:** Designed the lighting effects for the virtual performance space.  
**Computing Consultant:** Oversaw the work of student developers.  
**Associate Producer:** Managed the audience onboarding process, livestreaming, and documentation.

The two VR Developers, Lighting Designer, and Sound Designer had some experience working in the Unity game engine [64]. The remaining team members had no experience working in VR development. All team members had significant professional theatre experience over multiple plays in their respective roles.
3.2 Creative Development Process

The Director established a process for how the team would work together, captured in Figure 5. The first step in the process was to assemble the production team (as described above) and to select the VRChat virtual platform [66] to host the play. VRChat was selected as a cross-platform, third-party service that allows developers to create self-contained 3D spaces called “worlds”. Audience members were asked to create realistic avatars to represent themselves using the Ready Player Me service [48]. Examples of avatars and scenes created in VRChat can be seen in Figures 1 through 4.

The development of the play involved iterative and incremental performance of four parallel steps. First, the script of the play was adapted for virtual reality. This adaptation was incremental, starting with one scene, and then extending over time to the rest of the play, informed at each step by tests in VR. In parallel, the set was constructed as a collection of worlds loaded into VRChat, developed using the Unity game engine and the Udon scripting language [65]. The development was incremental, starting with a single outdoor world (Figure 1). Worlds were then expanded and added to support each scene in the play. The process involved significant learning, as experience with the first world informed the design of successive worlds. Each world was modified through iterations of testing and modification.

In traditional plays, rehearsals are used to help the actors practice their performances and to help the director mould the presentation of the play. In this VR play, rehearsals played this traditional role, but also served as tests for user experience, including identifying usability concerns, software bugs, and hardware performance problems. Rehearsals took place continuously, but with three major checkpoints: Alpha and Beta stages concluded with performances where external friends of the show were invited to watch and give feedback, while the Go stage concluded with four live, public performances.

Alongside these activities, the team created tools for managing live performances. Some mimicked traditional tools used in in-person plays, including for lighting and environmental, interactive, and
individual sound cues. Other tools were specific to the VR environment such as for triggering animations, teleportation, and the operation of video players.

All four of these activities proceeded iteratively and incrementally, where the emerging script informed the requirements in the set, while advances in the set aided in adapting the script; the theatrical tools aided the ability to rehearse, and the rehearsals informed the development of the set, the script, and the tools.

The process of Figure 5 shows how the development of a VR play combines elements of traditional play production with techniques associated with interaction design. The traditional process of modifying the play’s script through rehearsals now focuses on adapting the script to this new medium of virtual reality. The creation of the set is no longer the domain of carpentry, textiles, and physical lighting, but instead involves 3D design and programming. A complete new set of theatrical tools is required, again requiring interaction design and programming skills. And finally, the forms of testing required now require usability, correctness and performance to be addressed, changing the scope of the traditional rehearsal. In the following sections, we delve into these changes by reporting on interviews with the play’s production team.

4 STUDY DESIGN

To understand how theatre artists and developers can work together to create a VR theatre production, we interviewed the eleven core members of the production team of *You Should Have Stayed Home* and performed thematic analysis of the data we collected. The members of this production team are described in Section 3.1.

Production team members were contacted through the Spider-WebShow Team Slack workspace. In the weeks following the conclusion of the June 2022 performances, each participant took part in a semi-structured interview, approximately one hour in length, about their experiences as a member of the *You Should Have Stayed Home* production team. These interviews asked participants to reflect on the production and design processes that they followed in their capacity as team members. The questions were motivated by our research questions listed above, and covered topics such as participants’ expectations for the project, communication methods used, challenges encountered, and lessons learned. Interviews were conducted online using Microsoft Teams and then transcribed by a hired transcriber. The transcripts were reviewed by the interviewer for correctness.

Transcripts for each of the interviews were analyzed using reflexive thematic analysis [7–9]. Themes were developed inductively, with consideration for the explicit semantic content of participants’ extracts, and from a critically realist perspective. The transcripts were reviewed by two of the authors to develop a list of initial codes using NVivo 12 [35]. The research team revised these initial codes together to create a codebook. The transcripts were re-coded using this intermediate codebook and reviewed independently by members of the research team. Four authors then collaborated to develop themes.

5 THEMATIC ANALYSIS: EXPERIENCE OF THE PRODUCTION TEAM

We set out to capture the experience of *You Should Have Stayed Home’s* production team to increase understanding around the creation of a VR theatre production. The team members were eager to share this experience, with interviews running on average 58 minutes. Although they encountered frustrating technical difficulties, production team members assessed the performance as a success that surpassed their expectations for what a VR show could be. “It was a pretty phenomenal experience. I would say it really surpassed any expectations I had coming into it, in terms of what it would be, what we were able to achieve.” (P2-Playwright/Actor)

Team members reported that creating this show was a learning experience, and following the performance all expressed their intent to incorporate the lessons they had learned into their future work. “I think with any of these projects that are so much at the cutting edge, there’s been a real learning curve. There's been a real willingness to learn and a real willingness to explore.” (P7-Lighting Designer)

The team learned a great deal about how to create a VR play, and indicated that there is still much to learn from them. They felt the group as a whole supported their learning efforts, and the patience they had with one another allowed them to progress. “I think there’s this level of understanding within the team that was the best part of it. And the best part of the production process because I think it actually helped us successfully put on the show.” (P3-Stage Manager)

The themes we present here reflect the team’s observations about what they learned, how they supported one another in this learning, and the practicalities of creating VR theatre.

5.1 Theme 1 – Understanding the Medium of VR Theatre

Team members described how they designed the experience they wished to create for their audience. The team was uncertain how their dramaturgical decisions would impact the audience experience within this new medium. To inform their decisions, the team looked to examples of existing VR theatre to expand their conception of what is possible in the medium. The team considered audience well-being as a key part of audience experience.

5.1.1 Understanding What is Possible. Hosting theatre performances in VR opens up design possibilities that would be impossible or unimaginable for in-person theatre. When production began, the team could not have envisioned the ways in which they would ultimately communicate the themes of the show to their audience members. For example, to convey the vastness of the temporary detention center in which the playwright was held, the audience sees it for the first time from a bird’s eye view through the transparent walls of a flying prison bus.

Even the most experienced people on the production team had only worked on one or two VR shows prior to this production: “This is the third VR live theatre production I’ve been involved with, which is at least two more than a lot of people, I think.” (P4-Developer) Consequently, for most team members, working on a VR show was something new and unfamiliar. “It was such a challenge just trying

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1 Participants in the study are referenced by a participant ID of P1 through P11, as well as by their role, taken from Section 3.1.
to know what is possible and how to imagine... if you’ve worked in theatre for a while you can... look at a dark stage and everyone in theatre can see that and can make something up... but in this world where do you come up with things that could work well?” (P3-Stage Manager)

The seemingly limitless possibility for audience experience in a virtual world made it difficult to determine what experiences would in fact be feasible. “You’re working with very creative spirits that literally don’t have to keep their feet on the ground anymore.” (P2-Playwright/Actor) Team members found viable solutions at the intersection of traditional theatre, video games, and cinema. For example, the dramaturgs turned to video games for inspiration when exploring virtual scene transitions in the show. “[P5-Dramaturg] and I went away and we started to watch cut scenes in video games. And also to play more video games, so that the horizon of expectation with respect to storytelling could expand.” (P8-Dramaturg) Turning to other media for guidance helped the team to design a world that took advantage of the affordances of the VR medium. “You don’t always have to be viewing the action from the same perspective. That’s more difficult in traditional live theatre. If you’re watching a show you can’t just teleport to the other side of the room.” (P8-Dramaturg)

Attending other VR theatre shows as examples helped team members to envision what was possible for You Should Have Stayed Home; this was especially the case for those who were new to VR theatre. “There was a huge turning point when most of us on the team got to go see a VR show... there’s only so many shows to see right now and it’s not like you have an arsenal of many theatre shows that you’ve seen like in real life... for people who have never seen a VR show before... I think that was a huge moment for some people on our team to actually just learn and know how to go forward.” (P3-Stage Manager)

Learning what was possible in VR allowed the team to make better use of the tools that VR affords them as theatre makers. The playwright recognized how the playwriting process for standard plays needed to be adapted for VR: “Beyond being open to what’s going on narratively or in the script, you’ve also got to be very open to what’s going on in a user experience as well... you’re a little bit of a screen writer... but you’re also a user experience writer as well... So, it’s not just about writing things out for actors to do. It’s like... what are my smoke and mirrors here that help me tell my story that makes this an experience and makes the audience say ‘Oh, that’s why I put on a VR helmet for this.’ ” (P2-Playwright/Actor). The team members working on the script had to consider the impact that their choices would have on their audience, or “users” (P2-Playwright/Actor). They needed to plan out a role for the audience members to fulfill inside the virtual space.

5.1.2 Designing an Audience Experience for Live VR. The team’s goal was to create a live theatre production to be experienced by an audience in VR. Audience Experience (AX) design is the process of designing how the audience will engage with a live performance. AX for an in-person play considers the tone of the piece and how the content of the performance will be communicated to the audience. AX encompasses the anticipation of the event, participation in the dramatic arc, and release from the event. For this VR play, the production team needed to determine how to curate the audience experience in virtual reality. This meant that AX would encompass elements of audience agency in the virtual space, what virtual objects audience members would be allowed to interact with, and the role that an audience member would be asked to play in the performance. The team sought to understand how AX in VR might differ from AX in an in-person production. They learned how to design a VR audience experience experimentally, through the act of creating the production.

The team had to decide what role to assign the audience — whether to cast them as an observer (or “witness” (P8-Dramaturg)) in traditional theatre, or to leverage the digital medium to make them more active. “Staging this particular play in VR offers audiences a more immersive way of engaging with the story that [P2-Playwright/Actor] is telling. We made a decision... that the position of the audience is going to remain as one of witness.” (P8-Dramaturg) This decision was driven by ethical concerns: “There was a moment early on in the process we were thinking about casting the audience as people at the protest. Re-enacting what would have happened when you were thrown into the jail cell, as though it was happening to you in the moment... we decided not to do that because it felt ultimately unethical to be playing at being incarcerated, especially given the trauma a number of people experienced at this particular event.” (P8-Dramaturg) Thus, despite the interactive affordances of the virtual world, the dramaturgs did not assign the audience members the identity of a detainee whose experiences they would take on.

The virtual world was manipulated to provide the audience with aspects of Taylor's experience while they act as a witness. The creators controlled the speed at which the audience could walk, placed barriers to guide the audience’s movement, and eventually removed the ability to move altogether. This caused the audience to experience the progressive loss of agency experienced by Taylor as he moved from protest, to arrest, to incarceration: “Being in the reconstructed spaces that [P2-Playwright/Actor] was talking about, and going from a position of—sense of—expanded agency at a protest to having that agency curbed more and more and more and more as you proceed towards the kettle and eventual arrest.” (P8-Dramaturg) Through experimentation, the creators refined the virtual space to engender in the audience the feeling of a loss of agency as the show progressed.

In addition to influencing the audience’s agency, the VR world emphasized other aspects of the playwright’s experience. The production team had many options for how to present the critical pieces of the story. An example is the presence of static riot officers, who could have been presented as lifelike animated characters, or through soundscape alone. Instead, the playwright found that the representation that captured his feelings about the experience was to present the officers as a wall of statues—taller than any of the audience members’ avatars. “Things like the riot officers—when your avatar actually gets up close to them, they’re like a foot, foot and a half, two feet taller than everybody else. And that wasn’t something I really registered until very late in the rehearsal process because that’s exactly what it felt like. I’m a tall guy. I’m a big guy. I must have been taller than some of the officers, but I only remember looking up at them all.” (P2-Playwright/Actor) In this way the VR world was used to create an experience for the audience that emphasized the experience of the playwright. “Playing with the world like that rather than... we have two actors who are plants that come out as SWAT teams and start pushing and yelling at everybody... we don’t need...
that.” (P2-Playwright/Actor) VR afforded the team the ability to shape the experience through the construction of the world of the play. Emphasis was placed on allowing the audience to understand the emotional experience the playwright wished to convey, while maintaining a critical distance through the role of witnesses.

5.2 Theme 2 – Building a Creative Virtual Collective

The virtual environment allowed production team members to work as distributed artists collaborating across time zones. Team members expressed that communication around creative tasks was complicated by the virtual setting, and adopted varied communication media to reduce miscommunication. Team members found themselves adjusting their behaviour to each mode of communication, and described adaptations they made while in VR to better express themselves through virtual avatars.

5.2.1 Real People in Virtual Spaces. The use of the VRChat workspace fundamentally changed the team’s experience in rehearsals. Leading and attending rehearsal in VRChat was described as fun due to its video game feel: “Rehearsals are not boring because you’re playing a video game the whole time. So it’s a blast... I just personally find it more enjoyable [than running an in-person rehearsal hall].” (P3-Stage Manager) Team members reported incorporating these playful associations into their rehearsal process. “A lot of our production team members would jump off the CN Tower5 [in VR] to just see what it felt like to fall that far... the VR environment was a lot of fun to explore.” (P11-Associate Producer)

Even though the team members could not make physical contact, they still reported feelings of closeness when together in the virtual space. P8-Dramaturg found this particularly impactful during the COVID-19 pandemic, when real-world connections were limited. “I remember being in the [VRChat] world with other team members and when I would get close to them in the space, feeling a sense of physical presence and closeness that really surprised me. There was a moment where [P7-Lighting Designer], who I just met, our lighting designer, reached her hands out to touch my hands... And I found it unexpectedly moving to be with this other avatar body at a moment where I couldn’t physically be with other people in that way.” (P8-Dramaturg) The team members were able to communicate effectively through their avatars, and generate feelings of presence with one another in the space.

Although these avatars were chosen to reflect their users’ real-world appearance, the crew still found themselves adjusting their behaviour when cultivating an avatar. To make up for expressions that were not captured by the VR headset, team members exaggerated their physical movements to communicate more clearly in VR. “After a while all of us were adapting and using larger gestures with our avatars, not in a conscious way, I don’t think, but it just kind of became part of how we were all behaving to have cleaner communication.” (P6-Sound Designer)

5.2.2 Multimedia Virtual Communications. The production team used a set of tools to collaborate, including VRChat to work in the VR scene, Zoom for traditional video conferencing [74], and Slack for text messaging [58]. Zoom was used to reduce the amount of time team members needed to spend in VR. Those who had already worked in VR theatre projects reported an unexpected benefit of being able to see their teammates’ faces in Zoom, as opposed to working only in VR with cartoon-like avatars: “Being able to see people face-to-face is really important, I think, and that is not something that has necessarily been intuitive on other projects. There are people that I’ve worked with [in earlier projects] that I have no idea what they look like.” (P7-Lighting Designer)

Some team members described building different impressions of their coworkers through the different modalities of Zoom and VR meetings, where in the former, faces were visible, and in the latter, others’ gestures and movements could be seen. These in turn differed from the impression they received when finally meeting one another in person at the play’s premiere: “It was weird standing in the room in real life with all of these people that I’ve been standing in a room virtually with for the last month... like, ‘Ohh. Now I have like two people in my brain for who you are, but you’re actually just this one person, right?’ ” (P11-Associate Producer)

5.2.3 Designing Tools for VR Theatre. Without existing tools for theatre creation in VR, the Lighting and Sound Designers’ access to the virtual performance space was limited by what tools the developers could create in the available time. “There’s no lighting tools, there’s no set design tools. There’s no tools in-world. So, the chaos for us, or the challenges, came from building those systems... We want to turn lights on live, now we have to build the entire infrastructure for that from the ground up.” (P7-Lighting Designer)

When developing tools, the team was constrained by restrictions of the VRChat platform. “We were building a system that would bolt onto VRChat and so we had to be using their API and whatever they allowed.” (P6-Sound Designer) The team encountered several restrictions imposed by VRChat, including safety features limiting sound volume that were never resolved. Unexpected software updates also required the team to scramble to repair and update their tools.

The lighting designer described the importance of established theatre standards in the creation of these tools: “I learned for sure the next time... whoever is building the lighting system needs to sit with me in a physical-world theatre with a lighting programmer so that they can see what we do. ... we have spent 50 years figuring out computerized controlled lighting and we’ve got it down to a science... we have a language, we have the UI, we’ve got all of it. ... we do it in a pretty similar way everywhere in the world and there’s a reason for that.” (P7-Lighting Designer)

Alternatively, value was seen in rethinking tools for the new VR setting. As explained by P4-Developer, “How closely do we stick to the real world [traditional tools] for the sake of intuitiveness, and how much do we change it for the sake of taking advantage of the fact that we have much more control over our reality? And also just from a development perspective, making something that’s perfectly analogous to the real world takes development time and effort, and that’s not free.”

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5 A prominent landmark in Toronto, Canada and reproduced in the play; the CN Tower is a tall telecommunications tower.
5.3 Theme 3 – Creating Theatre in VR

The team needed to develop and adopt new production practices for VR theatre. These new practices affected their creative experience. Unlike in traditional theatre, the play’s script and the virtual world influenced each other, requiring them to evolve together. This caused the team to learn how to include the developers in the team’s highly iterative creative processes. Furthermore, crew members were limited in how long they could spend in-headset, impacting their ability to work together.

5.3.1 Coevolution of Script and Set. The play’s script was adapted to, and shaped by, the unique affordances of VR. The playwright and dramaturgs had no experience with script writing for this medium. “We didn’t know how much we could do with the technology…we know how to write a script, but we don’t know how to write a script for VR.” (P3-Stage Manager) To develop a VR script, the Dramaturgs and Playwright relied on the VR Developers to advise on what ideas would be possible to implement. “We didn’t want to go to the playwright until we knew [the idea] was even possible, because we didn’t want to say, ‘Let’s do this.’ And then the developers respond, ‘Yeah, we can’t do that.’” (P3-Dramaturg) The writers needed information from developers about what was possible and needed to see the evolving scene to help structure the script, while the developers needed a script to know what to build. These elements of script and set needed to evolve in concert: “We need the world to look like something so that the script can narrate what comes, but then we also need the script to exist so that the world can be designed.” (P3-Stage Manager)

The team adopted an iterative development model to navigate the interdependencies of the script and the VRChat world. “The thing about VR rehearsals, particularly narratively, is it’s gotta be done in phases because people need time to build things and take the notes away and come back with a redesign or new function or new tools to explore new ideas.” (P2-Playwright/Actor) The dramaturgy team iterated the script to incorporate exploratory ideas from developers, and the developers responded to suggestions from the script with new features in the VR world. This is not typical of in-person theatre production. The assistant dramaturg described this as working in reverse, by beginning the rehearsal process with a virtual world built by the first VR Developer: “But with VR, we actually started in the fully created space…[P1-Developer] just made the world…he added things and tweaked things as the story evolved…which is a reversal from how we would normally do it.” (P5-Dramaturg) No single person in this project had a background in both theatre and programming that would allow them to visualize the play from one iteration to the next. The coevolution of the VR script and set was dependent upon an iterative development cycle that could alternate between incorporating new concepts into the virtual setting and allowing the script to change and respond.

5.3.2 Developers Needed in Creative Iteration. The tools used to modify the virtual workspace were not easily accessible to artists and designers, requiring developers to assist other team members. This had the biggest impact on the Light and Sound Designers, as their workflows became intertwined with the development process. “[Working on the play] confirmed that we need everybody all the time…we need the developers and the dramaturgs and the designers. Because everything is so deeply connected to each other, that information that the developers may hold about what’s possible can impact what the dramaturgs are looking at, and questions that they’re asking are actually potentially things that designers can answer.” (P7-Lighting Designer) Coming up with solutions to problems encountered during the production was not possible without artists and developers present for discussion: “I found that that often happened where the solution couldn’t actually be enacted until we had the developers there working things out with us.” (P8-Dramaturg) This slowed the pace of production while the Stage Manager struggled to predict how long development tasks could be expected to take: “If I were to do a live theatre production in Toronto, I could probably know how long it takes you to hang the curtains or put up the lights…But in this it’s like you have no idea….at the end of the day, I don’t know how long it’s gonna take our developers to do things.” (P3-Stage Manager) This necessary integration of developers into creative workflows had a significant impact on the Designers’ independence. It also added to the difficulty of preparing a working production in time for the show’s first live performance. “We still pulled it off. It just required some late nights… and a lot of forgiveness and tolerance.” (P4-Developer)

5.3.3 Physical Impacts of Virtual Work. A professional theatre contract in Canada typically requires eight hours per day of work, six days a week. This was a challenge when working in a virtual set, as prolonged VR use can lead to cybersickness [32]. This was a safety concern for the team’s stage manager: “You can kind of build up your tolerance but even if you are experienced as a VR user, you can still get motion sickness and vertigo.” (P3-Stage Manager) Recognizing the toll that in-headset work took on the crew, the team limited synchronous rehearsal time to three hours a day. This need for shorter work periods in the VR space significantly impacted the project organization: “What does it mean to shift the VR process from a traditional process where you could rehearse for six to eight hours a day to having to rehearse in three-hour chunks? It requires a lot of thought and organization.” (P8-Dramaturg)

Team members needed to complete all the work involved in creating a piece of theatre, while performing less together in the shared rehearsal space. Between each synchronous rehearsal, members of the team completed independent work in preparation for the next meeting. Even with in-headset time limited to three hours, working in VR was found to be creatively challenging: “From a creative standpoint, working with VR is exhausting, is absolutely exhausting. It takes a huge amount of energy when you are inside the headset for three hours per day.” (P8-Sound Designer) Team members were adamant that these accommodations in project management and scheduling were necessary for their safety as VR theatre-makers. “During rehearsal phases, you can do a max like three hours a day because everyone’s brain will melt otherwise.” (P2-Playwright/Actor)

6 DISCUSSION

Through reflexive thematic analysis of interview data, we have presented the experience of a team of people developing a virtual reality play. We found that this VR theatre production differed significantly from that of traditional theatre presented in-person. The VR production process required the You Should Have Stayed Home team to learn how to work creatively in a new medium,
adapting their team building and their artistic work to a virtual workspace. The VR medium opened new forms of audience experience to theatre creators. This required the team to decide how to use the VR medium to evoke specific experiences, often with few prior examples to build from. This revealed a need for tools that could allow VR theatre makers to rapidly experiment while maintaining their creative agency. The team encountered challenges that forced them to adapt their behaviour and approach from those they had traditionally used. They adopted multiple collaboration modalities, focused on the well-being and creative capacity of team members, and maintained a deep consideration of and respect for the audience’s experience.

We now revisit our original three research questions, discussing what our analysis reveals about each.

6.1 RQ1: Roles and Processes

Our first research question asked what roles and processes were involved in the production of this VR play. The team largely adopted the roles of a traditional theatre production, as listed in Section 3.1. A new role emerged, however, of VR Developer, who over the course of the production became full-standing members of the creative team.

The team identified several ways in which the production process changed for a VR play and found that VR brought a playful aspect to rehearsals. Considerable thought was required to establish which remote collaboration tools to use and to determine what activities each would support.

6.1.1 Developers Have a Creative Role. The success of the production relied on developers adopting a creative role. The VR Developers (P1 and P4) were required to bring expert knowledge from the field of computing to design, build, and implement the virtual performance space of the play. As described in Section 5.3.1, other elements of the production were dependent upon the structure of this performance space. Rather than developing a specification, the VR Developers were given significant creative latitude around the set design and how the Lighting and Sound Designers would be able to interact with the space.

This autonomy broke down the traditional theatre hierarchy because team leads needed to release control to the developers. The developers needed to meet this responsibility by making design choices that supported and stimulated the creativity of other team members. A special form of developer is required to fulfil this role, similar perhaps to that of a technical artist in game development.

The transition to a virtual world therefore required the Director to rely on creative input from developers to enact his artistic vision. As stated by the Director (P9), “[P1-Developer]’s ability to give feedback and implement solutions in an artistic manner that didn’t require too much sandpaper really allowed us to adapt quickly.”

The roles outlined in Section 3.1 give an example of this team’s distribution of responsibilities; however, this is only one example of how the traditional theatre hierarchy may be adapted for use in a VR setting. For example, the Developers took on responsibilities from the domain of Light and Sound Design. In the future, as these responsibilities evolve, new roles may emerge. VR theatre roles may evolve to combine traditional theatre skills, rather than directly adopting traditional theatre roles.

6.1.2 Relation to Interaction Design Processes. The process adopted by the production team combines elements of traditional theatre production and interaction design. The traditional roles of theatre (Dramaturg, Playwright, Lighting Designer, etc.) were carried through to the new medium, while the process itself draws from interaction design. As shown in Section 3.2, the design process is incremental and iterative, where key artifacts (script, set, tools) coevolve under feedback obtained through rehearsal. The process as a whole is a form of agile development, with sprints leading to major rehearsal checkpoints. These attributes are consistent with modern agile processes incorporating interaction design [21].

As the medium evolves, so too will the roles that are needed in a VR production team. Distinct responsibilities of designers and developers may mix and eventually constitute new roles.

The process is also a form of participatory design [50], in that all members of the team have the ability to contribute creatively, including those in the new role of VR Developer. However, the process excludes the fundamental aspect of participatory design of including users (or in this case, potential audience members) in the design team. This is because theatre is an art form, guided by the collective vision of its producers. This differs starkly from commercial film, where audience opinion trumps artistic vision, and the end of a movie can be changed as the result of test screenings [24].

Feedback on the audience experience was gained from people close to the production at the sprint end points. The team did find a need to more formally test usability of navigation of the virtual environment and use of its facilities. This required the team to reconcile the desire to exclude the broader audience from artistic decisions with the need to perform usability testing around core technologies.

6.2 RQ2: Barriers and Challenges

Our second research question asked what barriers and challenges the team faced. A primary barrier was not knowing what was possible in VR, due to lack of experience working in VR, and due to few available prior examples of VR plays. The team needed to identify and experience other media to help develop understanding of emerging capabilities and conventions of VR. Relatedly, the team identified that the lack of tools for creating VR theatre hindered progress, including, for example, runtime tools for lighting a scene.

Another barrier came directly from the VR medium, that the potential for cybersickness restricted the time available for live rehearsals and other work in the VR scene.

6.2.1 Tools Are Required to Empower Creative Work. The team’s progress was slowed by the tools available for VR development. Team members who did not have a background in programming tools such as Udon and Unity lacked the ability to improvise and perform their own creative experiments. Team members relied on developers to create virtual assets and perform uploads and maintenance on the virtual performance space. The team expressed concern that they would not have the opportunity to incorporate their existing design methods into tools that would allow them to overcome these barriers. They advised that the tools be designed with the people who would eventually use them to craft dramatic experiences.
This illustrates a tension in the design of tools for VR theatre. Tools are required today so that each new production is not required to build their own tools from scratch. But there is a danger of tools imposing standards that limit audience experience: design decisions embedded into tools today may constrain the future of the medium. It is therefore important to balance ease of use in tools, accessibility to domain experts (e.g., in lighting or sound), and flexibility for unexpected use as the medium evolves. As P6-Sound Designer said, "I [P6-Sound Designer] think that there needs to be a lot more conversation around form and VR and what that means and when we are copying real-world gestures and approaches, and when are we deviating and why? ... I think it will inform how we develop the tools and how we talk about it to ‘audiences’." The Light and Sound Designers are aware that their real-world tools will not be perfectly replicated in VR, but want to influence how the VR tools are developed.

In Theme 5.2.3, Developer-P4 suggests that deviations from theatre tradition in the design of VR theatre tools may allow the team to take advantage of the greater control over reality afforded by the medium. New means of manipulating the virtual performance space, and tools enabling this by performers, would support new experiences for audiences. Reeves’ et al. propose that a “magical” performance is one in which all manipulations are hidden [49]. In this production, all manipulations are hidden by the use of code, and therefore magical: e.g., scenes transition seamlessly, without stagehands visibly moving props. The production team searched in video games and existing VR theatre performances for examples of manipulations they could use in VR, rather than attempting to recreate existing theatre practices (Theme 5.1.1). Finding new ways to invite audiences into the behind-the-scenes manipulations of VR theatre is yet another part of the medium that is still evolving.

6.2.2 Combining Communication Tools Fosters Creative Teamwork. Ideally, the team would have worked and collaborated solely within the play’s virtual world, using VRChat. This would have replicated traditional work on set, while rehearsing in VRChat gave the team opportunities to observe how their actions came across to a person observing from within the platform. Consistent with observations by Schwind et al., the use of realistic avatars (Section 3.2) enhanced feelings of presence [56]. It was not possible to work exclusively in VR, however, as prolonged exposure led to cybersickness (Section 5.3.3).

Surprisingly, the team found that the necessity to adopt other collaboration tools brought unexpected benefits. Zoom was used to discuss changes to the script, providing benefits of face-to-face direct communication. VRChat was used for rehearsals and experimentation. Slack was used for organization and keeping track of the flow of ideas across these channels, as well as keeping track of the evolving requirements of the performance space.

The team benefited from the combination of multiple communication tools. Rather than working exclusively in VR, ideas were cultivated in the channel that best suited the needs of the team members. This implies that as VR improves, teams may still find benefit in other collaboration modalities in addition to pure VR work.

6.3 RQ3: Audience Experience

While our other research questions addressed how the VR play was created and how the production team worked together, our third question raises the significant issue of how the VR medium can impact the form of play that is possible. The team considered what role audience members should take, before concluding that the audience would act as witness, while still engaging in interactions such as traversing the set. VR opened new possibilities in the use of audio, video, and cutscenes to engender emotion. The team restricted the play to 40 minutes due to concerns for audience comfort in VR.

Theatre focuses on the creation of an audience experience. As we have seen, this includes establishing a role for the audience, making choices around the mood and tone of the piece and how the narrative is presented, and manipulating the agency of audience members. Past VR theatre performances that have experimented with the audience’s level of participation (Section 2.2) already demonstrate widely varying approaches to creating audience experience.

The You Should Have Stayed Home team explored how virtual reality can provide new ways of shaping an audience experience. The team used agency as a palette, allowing the audience different shades of agency (less at some times, more at others) throughout the performance. For example, the audience is free to roam a large portion of downtown Toronto early in the performance, but when arrested and placed on a prison bus is not free to move at all. The production team could choose a level of agency that would paint the scene as more or less restrictive, both literally and figuratively. The VR platform further expands the horizon of possibilities for engaging audiences in a theatrical performance. The team considered asking audience members to act as protesters or to play the leading role of the playwright recounting his experience. Instead, they chose to keep the audience in the role of a witness (described in Section 5.1.2).

VR gives theatre makers the opportunity to change the rules of the universe, as illustrated for example by the flying bus (Figure 3). This power unlocks other methods of creating an audience experience, such as teleporting the audience to change their perspective of a scene. The dramaturgs recounted looking to video game cutscenes for ideas about how to conduct a scene transition in VR. Despite drawing inspiration from existing media about how to use their new powers, the team sought to maintain the fundamental critical distance traditionally provided to theatre audiences. Audience members are considered witnesses to the performance, not players of a game. The audience does not drive the action forward, but rather is guided through a live scripted experience. The ephemeral quality of live performance, combined with the decision to hold audience members at a distance in their role as witnesses, generates a theatrical experience that embraces qualities and capacities that are unique to VR.

Dalsgaard and Hansen [16] identify three roles that a user of an interactive system must play, where a user is “simultaneously operator, performer, and spectator when interacting.” When the production team made the decision to place the audience in the role of a witness (Theme 5.1.2), they considered this combination of performer, spectator, and operator. Audience members bore witness to Taylor’s performance, as well as operating their own VR avatar,
allowing them to see and be seen by other audience members. This consideration of the role the audience member will play during a performance, as well as recognizing that not only will they be performing a role but also acting as an operator and spectator, provides an area of VR theatre performance rich for exploration with future audiences.

6.4 Limitations
This was a study of the production process for a single play in which we captured the experience of one team of 11. In our analysis, we have highlighted the challenges that this particular team encountered, and have shared the solutions that they employed. Our focus is on providing insight into the evolution of VR theatre practices through the experience of this single team. It is challenging to generalize the results of this study to other possible team makeup or sizes, since this represents one of few VR theatre productions to-date. As the field grows, more study will be possible, allowing the creation of general guides to best practices, and capturing broader experiences of VR theatre production teams.

7 CONCLUSION
We have studied the creation of a virtual reality play from the perspective of its production team. The team’s experiences fall into three themes, including how they advanced the understanding of the VR theatre medium, what methods they adopted for building and maintaining a creative virtual team, and how they structured their work. The team behind You Should Have Stayed Home identified their needs as VR creators and their need for tools to create the audience’s experience. Based on our analysis of the team’s experience, we have discussed how VR theatre production differs from traditional theatre production, and how theatre production practices inform creative development. The medium of VR theatre is nascent, and by sharing the lessons learned from this analysis we aim to support the creation of future VR theatre performances.

We are perhaps on the cusp of widespread adoption of VR as a tool for theatre-making. This paper has allowed us to identify opportunities for better supporting the medium around its processes, roles, audience experience design, and balancing of the traditions of in-person theatre with the demands of interaction design.

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