

Acting with Technology: Rehearsing for Mixed-Media Live Performances

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ABSTRACT

Digital technologies provide theater with new possibilities for combining traditional stage-based performances with interactive artifacts, for streaming remote parallel performances and for other device facilitated audience interaction. Compared to traditional theater, mixed-media performances require a different type of engagement from the actors and rehearsing is challenging, as it can be impossible to rehearse with all the functional technology and interaction. Here, we report experiences from a case study of two mixed-media performances; we studied the rehearsal practices of two actors who were performing in two different plays. We describe how the actors practiced presence during rehearsal in a play where they would be geographically remote, and we describe the challenges of rehearsing with several remote and interactive elements. Our study informs the broader aims of interactive and mixed media performances through addressing critical factors of implementing technology into rehearsal practices.

Author Keywords

Interactive Performance, Ubiquitous Computing, Theater, Rehearsal, Digital Technologies

ACM Classification Keywords

H.5.3 Group and Organization Interfaces: Collaborative computing

INTRODUCTION

Digital technologies are extensively used in the context of artistic experiences, as they provide a multitude of possibilities for interactive performances combining video streaming with live elements, and for elements of audience interaction, both remotely or from the audience rows. Mixed-media performances have a long tradition, both in terms of taking the performances outside the theater through digital and sensor technologies [6, 16] and through using digital material inside theaters [1, 32]. The blurring of theater, dance performances and games has lead to several research projects, particularly within the space of human-

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computer interaction where interactional practices and sensor technologies have been explored. In ‘Desert Rain’, for example, artists and researchers embedded a computer system and its use by audience members into a dramatic performance and found that continual monitoring and intervention was essential to the success of the experience [20]. Other studies have used video streaming technologies to augment the audience experience during a live dance performance and found this catered to audience members special interests and deeper understanding of the performance [1].

While previous studies have mostly focused on aspects of audience interactions with and within the performance, in this paper we shed light on the mediating role of technology behind the scenes, when the acting and production are being rehearsed. An interesting, and often overlooked, challenge for implementing digital technologies into theater performances is how to rehearse for the actual performances. With technologies often being complex, including live streaming and live production as well as audience interaction, actors are faced with an array of instances and moments that cannot be rehearsed properly before the actual curtain call. This situation resembles what generally happens with traditional theater, where actors in the beginning usually rehearse without props and costumes. Nevertheless, the emerging and often unpredictable practices around the use of digital technologies introduce a number of challenges that for actors become problematic to handle, more than large dresses and breakable china. This paper draws attention to two such challenges, specifically: i) rehearsing without technology, even when the technology itself is a central “actor” of the mixed-media performance, ii) preparing for and managing the audience interaction with the interactive performance.

In this paper we present a case study of two digitally enhanced plays, which we refer to as mixed-media theater. The two plays relate to each other as they were written and directed by the same director, and as they were part of “Women in Science” a trilogy focusing on female scientists. The first play, Lise & Otto, is performed by two actors, located on two different stages, at two different theaters while being connected by real-time streaming. The second play, ADA, makes use of audience interaction through communication technology whereby audience members can send text messages to be displayed on a large screen that is part of the scenography. ADA is a monologue

with only one actress on stage. The two plays were commercially produced and played over three days at a national theater, which separates these plays from many earlier CHI studies of mixed-media performance in which the interactive experience has been staged specifically for the research [1, 15, 25].

Using ethnographic methods, we followed rehearsals for both performances from early readings to final dress rehearsals, observing and interviewing the actors, the set designers, the director and the digital producers. Differently from previous studies investigating the *spectators'* experience of using and participating through technology [1, 16], or designing for live performances [18], we shed light on the *actors'* experience of acting with technology. More specifically, we illustrate the challenges arising during rehearsal when the fully working technology only becomes part of the final performance. Our study provides an increased awareness around these practices and challenges, both to understand these better and to make digital performance designers comprehend the difficult tasks actors and directors undertake within this new performance space. Our findings provide insights on how technology is configured (and not merely designed), and certain feelings (i.e. sense of presence) reproduced when technologies are not used with the goal of efficiency, but rather to evoke specific emotions and “felt” experiences.

BACKGROUND

Recent studies have looked at mixed reality and digital performances, particularly in relation to how interactive technologies can support interactive dramatic experiences, but also how exposed technical infrastructure can be studied in relation to interactive experiences. Some researchers have investigated the use of virtual actors for creating novel theatrical elements [30]. An interesting example of virtual performer is Jeremiah [9], an artificial intelligence avatar that is able to interact with a human performer, as the vision and motion tracking system enable him to see what “happens” on the stage. Other investigations include audience participation in a traditional theater/dance setting [16]. Researchers at Nottingham University in collaboration with Blast Theory have staged large mixed reality performances and games [3, 25], some working as large scale participatory events [5, 12]. Most of these interactive dramas require high levels of participation, from riding a bicycle to running around the city, and sometimes a certain level of bravery for the participant (i.e. trusting a stranger).

Although much of this research addresses different issues around the development and implementation of mixed media theater and performances, fewer studies look into the actual rehearsal practices and challenges around that.

Audience Participation

In terms of more subtle and “traditional” audience interaction we find technologies that can assist in parts of the performance. Audience members can for example play a simple digital game on stage with different colored bats

[23], or affect a “cheering meter” by clapping and cheering louder [2]. However when considering interactive *drama*, many productions utilize audience participation as part of the narrative, and researchers have looked at different ways whereby the audience can *contribute* to making the narrative into what it is [16]. In the play we studied (i.e. ADA), although audience members can interact through text messages, they are not directly affecting the story as such, which means that the narrative is controlled by the writer and the director. It also provides a simpler entry to experiencing the drama compared to a setup where audience members have to give up all their belongings [12] or go riding on a bicycle [25].

Rehearsal with Augmented or Digital Characters

When considering research in relation to rehearsal for mixed-media performance and theater, most of the productions in this space make use of different electronic partners such as robots and virtual avatars, sometimes in combination with human actors, rather than using technology for enabling human actors to act together remotely such as in Lise & Otto.

When performing “virtual theater”, rehearsal can be more flexible and take place at different types of arenas [26]. Early implementations of “remote” acting and rehearsal, for example, include virtual reality technologies connecting remote actors for rehearsal [28]. One important issue is, however, how to obtain “presence”, which we also found to be a challenge for the two actors in Lise & Otto. Reeve [27] experimented with acting through virtual reality and found that obtaining a sense of presence by the actors themselves proved very difficult; his work also pointed out that actors found the practical “work” of entering commands to be distracting from the actual rehearsal, something echoing other findings on the production of interactive performances [13, 27]. Another study involving a performance with an interactive technology element is the one by the Robotics Institute at Carnegie Mellon University [33]. The play included a robot as the second actor, and the rehearsal mainly focused on developing gestures for the robot as well as on practicing the operation from the operator independently of the human actor. One challenge found was how to interpret the director’s instructions, such as “can you say that more hesitatingly?” into technical outputs. The repeatability of the robot was found to be an advantage; as the robot always replied with the same reaction, it helped the actor practicing [*ibid*].

The production process is tightly related to the process of rehearsal. Research has looked, for instance, at the work of orchestrating interactive “spectator interfaces”, an interactive installation based on movable figurines [13]. This interactive game did not include live performers and rehearsal was therefore limited to technology development and planning. And while rehearsals and production were intertwined, the live production was ultimately about producing a live experience in the moment. Finally, a recent

project addresses the challenges of staging interactive costumes in theater productions. The issues arising during preparation was a disjoint between designers and engineers in the theater, leading to complicated collaborations. The researchers also uncovered a lack of continuity of conventional costume design in relation to the interactive costumes [17].

TWO MIXED-MEDIA PLAYS

The two plays analyzed in this paper are part of a trilogy called “Women in Science”, written and directed by Rebecca Forsberg. The trilogy is centered on the lives of three different women who, despite their hardship, have made significant scientific discoveries and contributions. The first play follows the life of Maryam Al-Ijliya, a female Syrian astronomer who lived in the mid-900 AD. It uses location-based technology and is not part of our case study due to it being pre-recorded (a separate study was conducted in relation audience experience [29]). In the sections below we provide a description of the dramas investigated in this paper.

Lise & Otto

The second play in the trilogy is Lise & Otto based on the lives of Lise Meitner and Otto Hahn, the two physicists who worked on radioactivity and nuclear physics eventually contributing to the discovery of nuclear fission in 1938. The two scientists worked closely together from early 1900 through the 30s in Berlin until Lise Meitner had to flee to Sweden in 1938 due to her Jewish heritage. It is commonly acknowledged that while Otto Hahn received the Nobel Prize in 1944, Lise Meitner’s involvement and accomplishments were overlooked in this respect. The play takes place in Stockholm, Sweden in 1946 when Otto Hahn travels to receive the Nobel Prize (after being a prisoner of war while receiving the news that he was awarded the Nobel Prize in 1944) and sees his one-time love interest and close research partner for the first time in 8 years. She picks him up at the train station (scene 1), they have a cup of coffee (scene 2) and they go to the ceremony together, taking the elevator up to the ballroom (scene 3) and Otto Hahn gives his acknowledgement speech (final scene).

The play was written for two stages where the two actors



Figure 1. Lise and Otto meeting by the train. Here, Lise is on stage, Otto is projected in on the background screen. In the remote theater the setup is reversed.

perform their roles remotely and simultaneously. This means that while one actor is on one of the stages, the other actor, performing at another theater, is streamed in on a large screen through fast Internet fiber (see figure 1). The audience members have to choose which theater to go to and will consequently see one of the actors in presence, and the other one on the large screen.

The writer and director’s idea behind this setup is to illustrate the mental and physical distance between the two characters but also to be able to show two different perspectives: his and hers. The technological was thus conceived as a metaphor of the two characters’ lives: they had been separated in life and were now separated on stage. This means the technology conveyed a symbolic value and was supposed to evoke certain feelings rather than merely enabling a specific functionality.



Figure 2. Lise on stage, flashback scene in the background.

Twice during the play, the sound through the screen is muted, and each actor gives a monologue, explaining the situation from his/her viewpoint. This means that the audience only hears the viewpoint from ‘their’ actor. In the production that we studied, Lise was performing on the national scene in the center of the city and Otto was performing on a smaller scene in a suburb. Production cars were set up outside each theater and streamed to one another, but the main production (cut of scenes, music etc.) was managed live from the larger production bus outside the national scene. The play also makes use of pre-recorded video clips for flashbacks by the actors. In these, they are young and in love¹, but on the scene they are masked older (Lise and Otto were 68 and 67 at the time of the Nobel Prize, respectively). At the end, when Otto is giving his

¹It is well-documented through letters and other sources that the two scientists had a romantic relationship during their early collaborations, but Lise Meitner did not want to get married, possibly because it would have prevented her from continuing her research career as a woman in the early 20th century.

acceptance speech, the cameras on each stage turn to the audience and the audience from each theater is projected onto the screen at the other theater.

ADA

The third play of the trilogy is ADA, recounting the life story of Ada Lovelace, born in 1815 as the daughter of the English poet Lord Byron and Baroness Wentworth. She showed an early interest in mathematics and after meeting Charles Babbage in 1833, they started a life long correspondence about mathematics and logic. When Babbage developed the specifications for the analytical machine, often considered to be the world's first analog computer, Ada Lovelace was a collaborator through her translation work and mathematical input. She died at the early age of 36 from cancer leaving three small children and a legacy of being the inventor of the first general programming language.

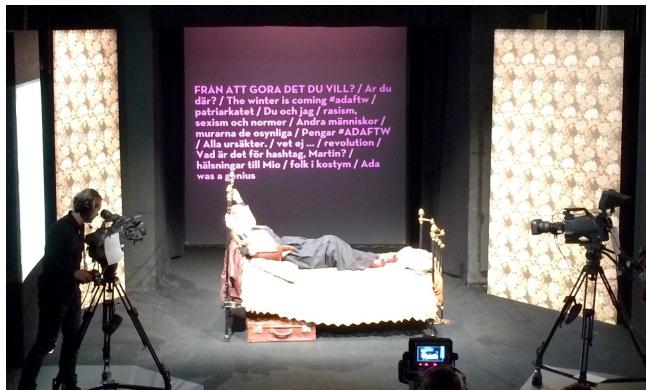


Figure 3. ADA on stage. The text in the background is audience submitted text.

The play is a stage monologue by Ada Lovelace herself; she is the only person on stage as she sits on her deathbed reflecting on her life. The scenography consists of a bed, the wallpaper on the sidewalls and a large digital display in the background (Figure 3). Digital and interactive elements in this play are through audience interaction and live-streaming of the play. Audience members and remote viewers are able to text, tweet or enter in an online form comments and answers to posed questions, which are then published and projected to the background screen. Two cameras are present for recording and live-streaming of the play (Figure 3). In ADA, the choice of the technology, and the design of the interactivity it enables were made considering the audience members – and not the actors – as the main users of the technology. More specifically, the interactive participation was designed around the use of mobile phones and tablets, now common devices in most people's everyday life. During the performance, audience members are encouraged to use their mobile devices to reflect upon their own experiences by answering a number of questions that are presented in the end of each scene. This technological setup was also supported by the underlying assumption that using them during the

performance would not hinder the audience's engagement with the dramaturgical narration (which it actually did. See [10]). Similarly to Lise & Otto, the play is live broadcast through the production bus parked outside the theater where the play is performed (see figure 7).

METHOD

To study how actors and producers rehearse for mixed-media performances, we followed rehearsals from the start of collocated rehearsals. That means we did not follow the actors' initial individual rehearsal in which they memorize scripts and practice by themselves or the production planning with the producer team; we started observing when the actors got together (Lise & Otto) or when they started practicing on stage with the digital production in the background (ADA). The rehearsals were planned such that Lise & Otto was rehearsed for one week, then ADA was rehearsed for one week, then Lise & Otto was rehearsed for two days and performed for three days (Thursday, Friday, Saturday) and the week after the same for ADA. That way actors and producers were able to fully focus on one play at a time while performing the plays less than a week apart.

Data Collection

Our case study made use of ethnographic methods, more explicitly observations and informal interviews were carried out over a period of four weeks. Data collection was conducted by the first author who spent the full four weeks with the crew and the actors, immersing herself in the theater setting and talking informally with the actors. Table 1 lists the data collected from each play's set of rehearsals.

The interviews focused mainly on the actors' rehearsal experiences, particularly the challenges related to the use of digital technology in such a setting. The questions focused on the actors' acting practices and their strategies for communicating their role and presence on stage and through the camera. We also inquired into the actor-director relationships and how it was transformed by the inclusion of various digital media in the performance. Interviews were informal conversations, and due to the fluid process of the rehearsal practices and ethnographic nature of the study, there was no prepared interview schedule except for notes that the researcher wrote during rehearsal observation and then inquired into immediately after. Themes for exploration emerged through observations and provided basis for the interviews. Interviews with other people involved in the production focused on their specific task during rehearsal and final production such as the moderator who had to look over each text string submitted by an audience member and decide if it was appropriate to display it on the large screen. A total of 6 interviews (plus short recorded conversations of 3-10 min after each performance) were carried out; they were all recorded and later transcribed. All interviews were conducted in English.

The observations focused on structures and attributes of the rehearsal. More specifically, emphasis was on how the actors and director addressed the interactions between the

actors, given that in the final performance they would be acting at a distance (Lise & Otto), the potential interaction with the audience (Lise & Otto and ADA), and how the actors practiced without the media clips in their final format. Observations also focused on how the director coped with technology, media production and live actors. Being actors and used to perform in front of others, they did not report being affected by having one more “audience member” at the rehearsals, rehearsals that are often already semi-public as producers and theater workers walk in and out of the audience area.

	Lise & Otto	ADA
Observations	One week of 3 hours/day, actors together (notes, pictures) Three days of 3 hours/day, actors apart (notes, pictures)	One week of 2 hours/day (notes, pictures) Three days of 3 hours/day stage rehearsal with semi-deployed technologies (notes, pictures)
Interviews	Two 30 min conversations with the two actors about their rehearsal experiences. Short interviews after each performance with the actress playing Lise	Interview with actress about presence (15 min) Interview with actress about her experience with technology (45 min) Interview with set designer (15 min) Interview with moderator of the audience text input Two 15 min clips from dress rehearsal 10 min from technology rehearsal Two 15 min clips from production bus during rehearsal
Video	None	

Table 1. Overview over the data that was collected

Analysis

We analyzed the data as ethnographic data using qualitative methods for comparing and categorizing the themes that we identified. First, we read through all the notes and looked through the transcribed interviews for the two plays in turn. Broad themes were written down in attrition to examples of how these themes were illustrated. The pictures and videos were held up next to the other material for more concrete materialization. Secondly, the themes for each play were compared and we collapsed themes that held up for both plays. The results are therefore presented in terms of themes for both plays, however, one theme was only prevalent for Lise & Otto due to the distinction that there were two actors “on stage” and that they were apart. The data analysis was recursive. We firstly identified themes such as problematic issues around rehearsal and the actors’ practices of

rehearsing together for being apart; then more detailed categories were determined, separating all the detected problems into sub-categories and splitting the different rehearsal practices into smaller categories.

Participant Observation and Previous Knowledge

When adopting ethnographic methods, an essential element of the fieldwork and analysis is the observer’s pre-knowledge and point of view [22]. Subjective analysis is what makes ethnographic methods relevant and powerful, and although an outside perspective is often taken to describe practices in question, it is impossible to take the preliminary experiences out of the ethnographer; in essence the analysis is embedded in the embodied experience of the observer. In our project, an important part of our analysis was the occasional comparison to traditional theater and filmmaking rehearsal due to their relatedness. Yet, the researchers did not actually want to compare directly by observing another movie production or traditional theater production, which would have introduced a bias in terms of topic, type of play and would have required enormous additional time investments. Instead the authors relied on the first author’s previous experiences with theater and film production. The first author (and observer of the rehearsals) had not only trained as an actress herself previously, but also part-taken in several international film and theater productions; when comparing to traditional rehearsal practices, we are therefore often drawing on actual previous personal experiences rather than documentation or second-hand experiences.

RESULTS

The weeklong rehearsal period for Lise & Otto took place in a rehearsal room at the national theater where it was later performed (theaters often have large rooms away from the scene for this purpose). The room was empty except for a dozen chairs for visitors and the director, and the props for the scene. When the observations began, the actors knew their lines by heart and the individual scenes were practiced in detail, sometimes several times in a row before going on to run through the full play from the beginning to the end. At this point the mixed media elements such as video clips, music and other effects were included into the rehearsal. The weeklong rehearsal of ADA was very similar, except that they used a bench as the bed (which was a very prominent piece of the scenography in the final production). As the performances came near, a production bus was parked outside the theater, with cables drawn through the windows into the cameras and microphones on stage. The production bus was central as it contained all the technological artifacts needed for the live broadcasting. The inclusion of the live broadcasting meant that the rehearsal also involved three producers who were mixing the plays real-time and controlling the music, in the production bus (see figure 7). Over half the time of these last two days was spent rehearsing non-actor-centric issues such as the timing of the video clips, music and other effects as well as the video production of ADA (which would be streamed online

live during the show each evening). The director therefore spent significant time communicating with both the bus bound production crew, the camerawomen and the actors.

We now present our findings, structured according to four themes we discovered during the analysis.

Rehearsing Mixed-Media Performances: The work to make the digital technologies work

Implementing digital performances, as well as performing a play that includes mixed-media, introduce a number of challenges that both the actors and the director have to juggle during rehearsal. During the observations, such challenges emerged as the extra work required to make the technological layer work. While the technology needs to be planned and designed, the actors and director need to consider the actual human-technology interaction of the final performance during rehearsal. In our case, this entailed for instance the challenge inherent in acting at distance (i.e. feeling the presence of the other actor), and in acting while the audience members directly contribute to the scenography. This extra work presents different characteristics that we describe in the following sections, in relation to the director and the actors, respectively.

Directing with technology

One aspect that became noticeable during rehearsal was the sheer amount of work the director had to do, in regards to the technology orchestration, in addition to the directional work of the actors. As the use of interactive media also had to be practiced by the director, its orchestration often resulted in a problem of focus for the director who had to give instructions to the actors as well as juggle the digital elements of the play.



Figure 4: The rehearsal stage of Lise & Otto with screens in the background. One Screen is outside the picture.

For the early rehearsal of Lise & Otto, the director was located in the same rehearsal room with the two actors. Here, she used a computer equipped with a set of external speakers of fairly decent size and quality, in order to be loud enough for the large rehearsal room. The room was also equipped with three large fabric covered (non-digital) screens, exactly as the final stage would be, to indicate the screens where the other actor and flashback video clips would be projected to (not unlike rehearsals for traditional

theater where part of the scenography is set up), see figure 4. The director kept all the video clips of flashbacks and the sound files on her computer in a file browser and opened each up when the script called for such clip. As the play alternated elements of live acting and pre-recorded media (both video and audio), it was not possible to merge each clip and music into one large timed file; instead, for the final production, the production crew would have to start each part. This meant that the director had to follow the acting, but also keep focused on the file browser to manage the different files and the audio system. In one episode, for example, the actors started rehearsal from the beginning of the play but to everybody's surprise no sound came out of the speakers. The actor playing Otto, then went out of his role, walked over to plug in the speakers, then back into his role and continued the rehearsal of the scene without comments. Only the director commented on her embarrassment.

While all performance rehearsal in general requires a lot of effort from all people included, this duality of attention on technology and directing lead to occasional problems for the actors. This was particularly true during the last three days of rehearsal, when the production bus managing the production and live streaming of the play was set up. This meant, for instance, that the director moved to the production bus for the majority of her time to check that the cameras were properly angled, not unlike directing for film, or that she was satisfied with the overall scene that would be broadcast to the other theater. As illustrated in the quote below, the two actors referred to the bus as the "control room", the place where the technological layer of the play was ultimately being orchestrated. Although both actors had a positive attitude towards the technology in the play, and they were curious about experimenting with their acting "at distance", they expressed frustration and found it challenging and to a certain extent a bit lonely, particularly in final rehearsals: [Actor playing Otto]: *She [the director] has to sit in the control room [production bus] [...] and that is weird for you because then suddenly you have no director to help you out.* This point was also corroborated by the actress playing Lise, who explained that from an acting point of view, the focus on technology "*takes away the relationship with the director.*"

During the final rehearsals, when the actors and production team had access to the actual stage (it is very common that only final rehearsals take place on the actual stage due to lack of access), the rehearsal effort became much more focused on the technology, not unlike a movie production where more than half of the time is usually devoted to setting up cameras and other boundary work. Similarly to the episode recounted above, when the actor playing Otto took the initiative to handle the speaker problem, the temporary absence of the director meant that the actors had to try to solve the problems emerging during rehearsal themselves. For instance, the actor playing Otto explained that towards the end of the rehearsal, when he moved to a

stage of a different size (at the remote theater), he realized that elements of the performance were not working in the same way anymore – i.e. the lightening and the dancing parts – due to a different space organization. Thus, while the director was on the production bus, making sure the broadcasting worked, he had to be creative and take the initiative to introduce some changes to make his acting fit to the new settings.

Another characteristic of the directing work was the focus on timing the live acting with the digital media of the performance and with the elements that were broadcast live. Even during early rehearsals, the director was running the full video clips that would be shown in the final production. These video clips showed events the two characters had lived and experienced in the past (flashbacks, see figure 2). When the pre-recorded media were displayed in the final performance, the two actors sat quietly at the stage, still in character. Running the whole clip was therefore a way for the actors to get to practice their “pauses” and the time they would have to wait. In between the clips and the live acting, the director read the action text from the manuscript, such as “Camera on Lise”, or “train in the background”. The reason for reading the action script was to give the actors an awareness of the images, scenes and angles that were being broadcast live to the theater where the other actor and the other stage were located. This meant that the actors had to combine their focus on live acting and having an audience watching from the pews, with their ability to consider cameras angles and media effects, not unlike directing for movie scenes. We will return to this in a future section.



Figure 5: The director reading from the script the day before the premiere, to help the production team adjust sound

During the rehearsal of ADA, that was to include a live film production during the play, the rehearsal work included sound testing, camera angle testing and testing of the Internet broadcasting of the actual production. But to save the actors’ time, the director had to be creative in her rehearsal work, which also led to a lot of extra work on her part. The director would, for example, be reading the script on the stage doing the ‘work’ for the actress and at one point, she sat on her knees for 15 minutes reciting part of the script so the technicians in the production bus could

adjust technical aspects such as sound and camera angles, see figure 5.

Acting with technology

In terms of work, the implementation of mixed-media and interactive technologies also introduced more complex issues for the actors during rehearsal, particularly in relation to imagination and choreography. In Lise & Otto, the actors had their own monologue on each stage, which would take place at the same time, and they therefore had to practice them being the same length. Because the actors did not wear earpieces during the final show, they would not know when the other’s monologue had finished. If they finished too quickly, they would have to wait quietly before the production team, who could hear both monologues, and then start the next video clip. This challenge was addressed with an old-fashioned timer that the director used to time each monologue.

In general, the actors expressed a need to be more choreographed in their acting, to fit the digital parts of the production. Since neither of them had trained for film, this was fairly new. The actress playing Lise expressed that she felt she needed to be more constrained in her expressions and the actor who played Otto said: *“it’s more like choreography, it is more like a dance you do, “okay now it is this part, and now it is this...” It is like choreography... you take step by step.”* He added that he felt it was a bit “schizophrenic” to move between camera and audience, a challenge we return to when looking at rehearsing for audience interaction.



Figure 6: final stage of rehearsal where the actors rehearsed on each side of the stage in order to practice being apart

Maintaining Presence Between Remote Actors

The biggest challenge for the actors of Lise & Otto was the fact that they would be remotely located during the live performance. To our knowledge few, if any, live theater productions have made use of such dual stage setup and this was certainly the first time the actors were to perform in such way. The director wanted to make an allusion to a certain level of closeness between the characters because their previous close friendship (and romantic relationship) and it was therefore important that the actors could project this despite being apart. They therefore started out rehearsing very close to one another, almost touching each

other. As rehearsal progressed, they moved further away from each other, and the last few days they were at each side of the room, despite the final production showing them less than a foot apart, see figure 4 and 6.

When inquiring the actors about how they felt on stage after the first show, the actors acknowledged that it was still difficult to convey presence because they are talking to a screen where they cannot see their co-player yet have to make it look like they are talking directly to one another. The actress playing Lise explained: “*...I feel that I take a chance. When I look there [at the spot in front of the screen where Otto is projected], it's like, I don't know. Maybe it's not right, but I rather look there [...]. I hope that if I don't do it right, then the director will tell me.*” To help them project a connection between two remote actors, their intense rehearsals had enabled them to sense the presence between them each other. The actress continued explaining how she felt during the play: “*I sense his presence. When we are in the dialogs and we are at the green screen, it's like as if he's there, sort of. [...] My experience of acting is that you are always there with a distance, so that isn't different. [...] I think that the listening part is even bigger now. You have to concentrate on listening to him so you feel his presence. It sounds religious [laughs].*” The other actor similarly said that he still felt they were on the same stage.

Rehearsing for Audience Interaction

One major challenge in the play ADA was the potential reaction from the audience to the displayed text in the background scenography that was not visible to the actress playing Ada Lovelace. Opposite preparing for a remote co-actor, the actress explained that it was impossible to prepare well for potential text messages on the screen, which in turn made it virtually impossible to react to it. She explained to us, after the first performance, that she had to work hard on ignoring the laughs that occasionally came from the audience, well knowing that they were not necessarily meant for her performance but instead reactions to humorous text on the background of the set. Where most actors are trained in pausing for laughs and applauses, we observed during the live performances that the actress playing Ada was not as capable of doing that (for laughs), due to the occasional disjoint between displayed text and the actual play. As such, the blending of media was not an unproblematic success at the actual performance [10]. The actress explained how she was explicitly not thinking about the questions posed in the background for the audience to answer via text on their mobile phones: “*I don't... I go with my story, what I'm going to tell about Ada and... because the questions are a bit abstract in my [head] [...] it would only complicate things in the story about Ada if I also thought about the questions and now the audience is answering [...] I can't think about...it wouldn't do good to Ada I think.*” She continued using the analogy of thinking about what the other characters in a traditional play would think about, emphasizing that this is not good for the portrayal of a role.

The issue of rehearsing for audience interaction reflects back on the tightly choreographed notion of both plays, that the actors felt the need to have. They lacked the freedom from more traditional theater where small elements of improvisation are not uncommon. Here technology was at a higher priority, a point we will return to in the discussion.



Figure 7: the production bus from the outside and inside

Dealing with Dual Audiences

An observation that we found to be distinctly relevant for mixed-media performances was the difficulty with which the actors had to rehearse (and then act) with two different audiences in mind: the live audience in the theater and the remote audience they knew they would have at the other location, and for ADA, the audience in the cameras watching the streamed live production (see figure 7). When suggesting that the play was both theater and film, the actress said, with respect to Lise & Otto: “*I feel it's weird because it's much thicker anyway [than film] and you have an audience. We both have to [know] everything because [of the] camera but we do have an audience. Now, we decided, or I have decided to think that the audience is [in the camera]. It's film or tv-theater mostly [...] except that they don't see everything [compared to the live audience].*” She continued talking about the live audience as a ‘third camera’: “*When [we rehearsed,] we talked about the cameras when you look straight. We have a third camera that's in front now that is like the audience camera.*” The actress had similar concerns for ADA, when she had to rehearse with respect to a live audience but still be aware it was a film production as well (see figure 3).

DISCUSSION

In the following discussion we highlight three issues: i) *challenges for rehearsal* ii) *rehearsing presence* and iii) *the overwhelming role of technology*. These points allow us to deepen our understanding of the actors' experience of rehearsing with and for technology, and of their experience in managing audience interactions in the context of mixed-media performances as well as highlighting implications for structuring rehearsal for mixed-media performances.

Rehearsing for mixed-media performances is challenging. The actors in *Lise & Otto*, for instance, felt that the technology took the director away from the stage, as she had to spend significant time in the “control room” (the production bus) to orchestrate the technology. As we have seen, both for the director and the actors, the technology became yet another “actor” to tune acting with, and that required a mind shift to be able to engage with collocated audience members and at distance ones. To integrate the digital media into the final performance, the rehearsal sessions sometimes focused on practicing how to *ignore* the digital media, such as the text messages audience shared during ADA. Another example is the final scene of *Lise & Otto* where Otto gives his acceptance speech. This scene blended the actor in (projected into one theater) with a live video streaming of the audience in the *other* theater than the one the audience was sitting in. The rehearsal for this was only able to include numerous empty seats and not the reaction of surprised audience members.

Rehearsing Presence

Mixed-media performances have already experimented with ‘beaming’ in actors or avatars from afar [9, 26]. However, there is a major difference between human actors being ‘beamed’ in, and acting with each other through an avatar. Where the avatar actors were not likely to feel much sense of presence, and maybe it was not crucial they would do so, it was pivotal to our actors to be able to feel each other’s presence while located on the two different stages. We could observe, for instance, that presence was rehearsed by first practicing next to each other, and then progressively moving away as days went by. As recounted in the interviews, the actress playing Lise described sensing presence during the final performance almost as a supernatural experience, meaning that it had more to do with a way of feeling than with the physical presence of a material body, and it emerged from listening intensively rather than from establishing an eye contact. Interestingly, sensing presence at distance was regarded – and approached by the director – as an acting skill to be learned and developed through practicing. Comparing this to remote collaboration in work settings provides an interesting insight. Early studies of video conferencing and remote collaboration comparing this to in-person work, found that “the [collaboration] process [...] changed, however, to require more clarification and more management overhead.” [24, p. 152] Similarly, our data show how the actors had to practice a more ‘tight’ choreography, receive

more specific instructions from the director, and had fewer options of ad-hoc adjustments in the final production.

In the plays presented, the sense of presence conveyed by the actors was also intertwined with issues of mixed audiences. With audience members present at the theater and the ones watching the play at distance, the actors were sometimes forced to make a choice rather than rehearse for both simultaneously. The sense of presence that live theater performance is based on, is then adjusted to the mixed-media setting through preparing to give no attention to elements of the setting as well.

The Overwhelming Role of Mixed-Media

The mixed-media technologies enabled the actors to develop a unique way of rehearsing, yet sometimes the technology became very prominent and experienced as constraining. It took the director away from the actors and it disturbed the otherwise stable structure of rehearsal by sometimes requiring extra focus and attention. Although it is easy to suggest that mixed-media rehearsal simply needs more (wo)man-power in terms of assistants and helpers, this would only potentially reduce the number of mishaps and not improve rehearsal practices when they did happen.

As illustrated, the actors had developed their own personal strategies to manage their focus and attention. The actress playing ADA had consciously chosen, for instance, to ignore the dynamic scenography of text in the background, as she felt that a complete immersion in the role was needed to give life to Ada Lovelace. This finding resonates with other studies of mixed-media performances carried out, however, from an audience’s perspective. This aspect has been characterized, in fact, as an issue of “understanding unity” [19] between the use of media and representations within performances, and as an issue of fragmented experience between the acting layer of the performance and the technological layer enabling the audience members’ participation [10]. Introducing technology brings about changes and sometimes complications. Studies of interactive performances and experiences describe the seamful elements that easily emerge and have to be addressed [4, 8, 11]. However, as illustrated in our findings, as the audience is not there yet, there is not a real possibility to explore and experience the audience’s participation during rehearsal. Instead time is spent figuring out how to smooth or ignore the ‘seams’ of the technology.

Implications For Mixed-Media Performance Rehearsal

Investigations of mixed-media performances have focused on the orchestration of interactive experiences that change through the audience’s journey and where audience members can actively contribute to the evolution of the story [14, 20]. The productions we studied did not present elements of audience interactions, which meant that the rehearsal practices were structured, not as much in regards to unpredictable audience members’ actions, but instead towards acting on stage with ‘invisible’ actors – i.e. the producers and the controllers of the digital media broadcast

(Lise & Otto and ADA) and the text messages enabling audience members to participate in the performance (ADA). Essentially, rehearsal did not focus on getting the technology to work but on fine-tuning it and on *learning to act with it* (i.e. how to convey a sense of presence remediated by broadcast media). This meant that the technology became yet another actor to relate to and to practice with. This has important consequences for designers and producers as the focus on technology during rehearsal is not merely to get it to work, but rather to provide an opportunity to rehearse with it, to experience how it feels to act with it, or to learn to perform a new character.

The production of the performances did not include any design iteration and the technology was designed and developed prior to the rehearsal rather than throughout it. For example, the application used for the audience interaction in ADA took much longer to develop than the actual rehearsal. In this play, the absence of the technology during rehearsal was also related to the fact that it was conceived as a tool for the audience; its role and its potential impact was not extensively considered during rehearsal. Another interesting factor was that the creative team did not include digital artists as such; instead all the technologies were envisioned by the director. The team was in fact made up of people with defined and fairly traditional roles: actors, directors, set designer, producers, technicians and the developers of the app (ADA); the latter not present during rehearsal. This point is interesting as it suggests that restructuring rehearsal for mixed-media performances would require more than merely introducing a new production role. We argue instead that this would entail a more holistic reconfiguration of the rehearsing process.

We introduce two points that help us frame implications on how to structure and organize rehearsals of mixed-media performances: One main suggestion in reconfiguring rehearsal is to adopt participatory methods enabling the inclusion of actors in the early stages of technology design. In both our cases, and arguably other studies [9, 30], the design of interactive performances often draws on technological experimentation rather than on the understanding of actors' practices and experience. The issue at stake here is the interplay between the functional aspects of the technology and the creative tension inherent in conveying and evoking a certain feeling through the technology – i.e. presence and closeness. As seen in the analysis (i.e. Otto adjusting his movements to the smaller stage), the actors' professional skills, and their ability to go about emerging problems are highly embodied and situational. This means that it might be difficult to anticipate and recount problems through pre-performance interviews. Another important issue is that the actors' skills evolved with the technology and because of the technology (i.e. learning to feel presence or ignoring the audience text messages). This means that prototyping methods should be complemented with experience-centred methods (i.e.

bodystorming or dramaturgical scenarios) enabling to account for contextual factors, bodily, sensorial and emotional aspects emerging when acting with technology [31]. Relatedly, despite the challenges related to the implementation of the technological and digital setup of the performance, it would be misleading to read the related findings merely as problems that could be solved by a better (re)design. The rehearsing for the technology was in fact a way for the actors to develop their acting skills in this new setting. As we pointed out, in Lise & Otto the complete final technological setup was not available during rehearsal, while in ADA it was impossible to predict the form that the audience interaction would take. If we look at our findings through a design lens, a lot of the work the actors and the director engaged, resembled what we would do with a low fidelity prototype, in which the potential interactions with the technology are described in an envisioning scenario. For instance, three large displays in the rehearsing room were used to mark where they would be positioned on the final stage, to rehearse the actors' position on the stage and the exact time they would have to be still in front of the camera (to be broadcast to the other stage), while the actor at distance was talking. Contrary to what one could expect, they were not used to rehearsing presence. Designing for artistic settings requires a shift of focus towards the whole experience, rather than the technical qualities of interactive technologies [21]. When rehearsing for mixed-media performances, this means, for instance, that even low-fidelity prototypes and mockups should be available at the rehearsal stage, allowing the actors and the production team to gain insights on the qualities emerging from the mutual interactions between actors, technologies, and all the other non-human elements present on a stage.

CONCLUSIONS

Rehearsing for mixed-media performances is a subject rarely addressed within HCI, where most interactive performance and experiences have been studied from the audience perspective. We have provided a description of the unique challenges the actors and the director encountered during rehearsals for two mixed-media plays; the challenges included practicing for remote presence, practicing for dual audiences, and managing media and technology control while directing actors in a traditional sense. We pointed out how these challenges lead to a set of implications for structuring rehearsal for mixed media performances. In particular, technology should be viewed as yet another actor for early inclusion of 'prototyping' for the actors and the directors to rehearse with. Finally, our study contributed to a more detailed understanding of structures and practices around rehearsal for mixed-media performances.

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