Connected Gaze: Understanding the Performer-Audience-Connection in Online Participatory Performance

Performing arts communities have been hit hard by the recent pandemic, leading to shifts in performance form and experience. In this paper, we conducted a first-phase interview to investigate how social distancing has influenced performers and to understand their distant performing experience and their relation with audiences. We propose Gaze, a participatory interactive system for online performance to intervene in the distant performance situation. It allows for engaging audience participation in real-time dance performance by letting audiences take control of the pointing light and perspective of watch online. In the second-phase interview, we examine how this system mediates the relation between performers and audiences and how it influences performers' performing strategies in a distant context. While we provide insights that guide towards interactive technology for distant performance, our prototype illustrates the potential for participatory interactive systems to increase engaging interaction and express artistic concepts that go beyond traditional performance forms.

CCS CONCEPTS • Applied computing → Performing arts; • Collaborative and social computing → Collaborative and social computing devices;

Additional Keywords and Phrases: collaborative dance, online dance. lighting design, real-time dance performance.

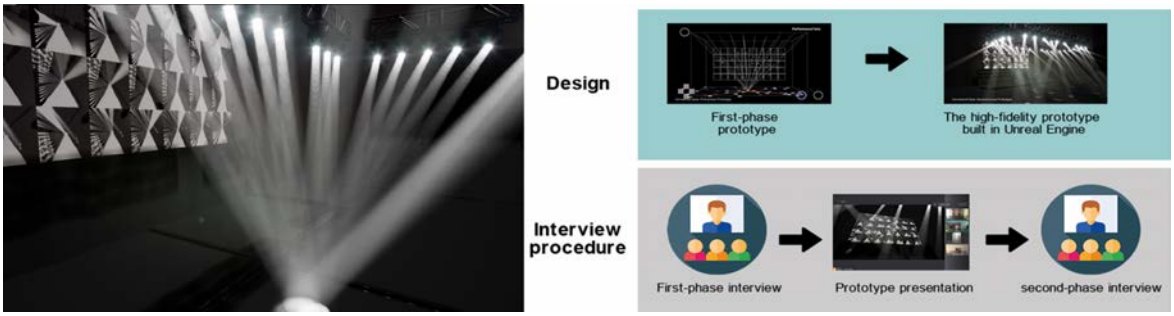

Fig. 1. Prototype view of Connected Gaze (left). Research methodology (right).

1 Introduction

Performing arts communities have been deeply impacted by the prevalence of Covid-19, which leads to decline in revenue and shifts in performance format and experience [27]. Restrictions in gatherings have led to the transition of performing arts from in-person to online [27]. While virtual arts experiences are gradually replacing in-person offerings, technologies and devices play an increasingly crucial role in providing better performing experience both for performers and audiences. Zoom, Facebook, Instagram, and other web-based resources have been the online concert choices for musicians, dancers and bands [14].

This paper looks at how the pandemic has influenced performing artists in terms of performance practice and audience engagement. We follow the findings and prototype a technologically mediated online performing system that allows the embodied participation of audiences. Called Connected Gaze, this system was inspired by the attention of audiences directed towards performing artists during in-person performance. In the next phase, we conducted interviews with the same group of performers to understand how interactive technologies like Connected Gaze can mediate telepresence and intervene to provide affordances of a live performance in the distant performance situation.

In the first interviews we inquire the dance artists about how the pandemic influenced their life and performing practice and how they perceive online performance as a possible approach. We found that the performing online was reshaped by technology because the online platform determines how the performance is presented and how performers can interact with the audience. The deferral in time brought by the technical aspect also affects the performing experience. In terms of interaction with the audience, the sense of being watched and physical touch were lacking during the performance, leading to less engaging experiences.

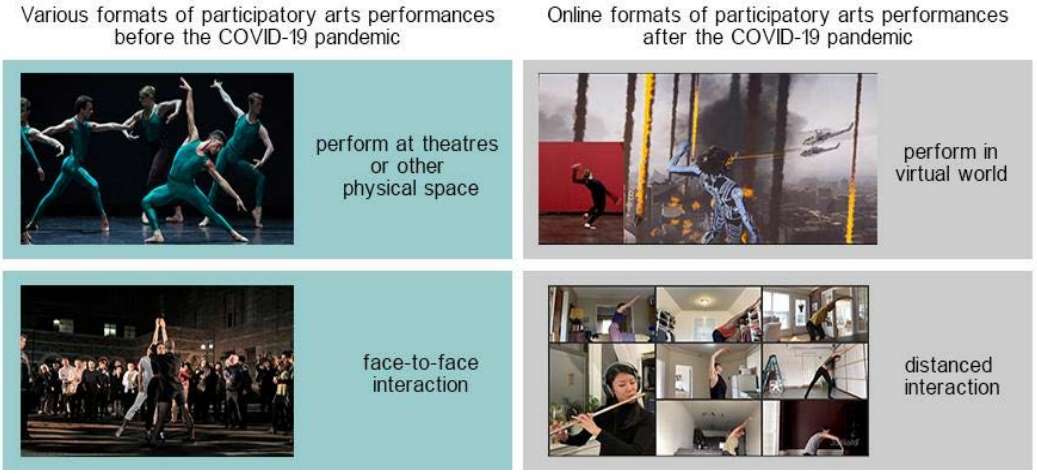

Fig. 2. Summary of the shifts of arts performances before / after the COVID-19 pandemic. A student performance from: In the Middle, Somewhat Elevated. "USC Fall Dance Performance 2019". (Top left); A dance performance from: Exhibit o. " Theater & More: 'Exhibit o'", Daily Burin, 9 Sep 2021 (Bottom left); Screen capture form: The multimedia performance from: Gigant DOKU, Lu Yang.(Top right); The screen capture from: Bolero Juilliard. "The Dance Performances That Have Gone Online", 26 May 2020, Dance Magazine (Bottom right).

Inspired by the first study, we develop Connected Gaze, a participatory interactive system for online performance, which allows for more engaging audience participation in the creative act of dance. This system uses light as the embodiment for the audience. With a camera established on the light, while audiences are changing the pointing direction of the lights, they are also changing the perspective of watching the performance. This system prototype serves as an experimental ground where we conducted a further interview-based investigation to understand the perceptions, practices, and challenges that performers would experience within the form of distanced performance. We found that Connected Gaze produced an enhanced feeling of being watched in the performer. This system provides performers with a more engaging interaction with audiences in online performance and leads to practices that recapitulates live performance. It also incentivizes performers to create improvisation through the dialogue and distraction from the audiences. Ultimately, an alternative role of performers is discovered, who can be the 'dialogue initiator' in a cultural transmission process. The re-definition of performer-audience relation opens up possibilities for audiences' more engaging, embodied approach of co-creating a performance.

The contributions of this work are thus, an interview-based study and research through design that identified i) the practices and experiences of online performance forced by isolation, and how this has impacted performers' living and performing practices, ii) design implications that allow for active performer-audience interaction in online performance, and iii) how performers improvise and engage with audiences in future participatory online performance systems.

2 Background

This study intends to use insights from interviews with professional performers affected by isolation lockdowns to prototype an interactive online performance system.

2.1 COVID-19's impacts on performance art

Studies of social impacts of the recent lockdown found that people in isolation endured negative shifts in their emotion, behavior and cognitive function due to social isolation and loneliness [7]. Creative tools and activities can serve to increase interpersonal communication and connection and alleviate some of the negative effects of social distancing. In particular, Schwender et al. [19] showed that social dance interventions can advance participants' body-awareness and sense of self. Moreover, individuals have the chance to improve their aesthetic standard, interpretation, and psychological diathesis while watching performing arts [24]. With reference to the COVID-19's social impacts on human daily life [9], social distancing has led to the cancellation and decline of physical art performances venues. The performing format and interaction mode in art performances also went through great changes and have relied on online platforms [20]. For instance, several arts performances, dance class and participatory dance performances can only be broadcast live via social media platforms or other online channels. The positive effects of performance and the negative effects of their cancelation imply that careful studies of emerging online format performance is needed.

2.2 Interactive technologies and strategies in dance performances

The combination of emerging digital technologies and live performances reshape dance practices and can increase the connections and interactions between performers and audiences . Audience engagement has always been a significant priority in performance production [4]. Mixed design strategies have been applied to engage audiences in interactive performances [3], so that audiences can gain a better understanding of complex, layered and conceptual works [8]. However, application of performance technologies in dance performance has influenced its choreography and the whole production, since more rehearsal time and processes are needed for integrating these interactive technologies into dance performance [11]. Recent studies have focused on applying interactive or reactive multimedia technology into dance performances and productions. Motion capture has been used to generate digital interaction between audiences and performers [10]. This has led to creation of interactive dance works using live motion capture systems [5,10,28], which can generate fine movement artifacts for subsequent analyses [10]. Another direction of research has explored the application of digital technology in virtual dance. One study found that the combination of virtual reality and motion capture technology creates an immersive experience which enables them to engage with dance performances from different angles and positions and strengthens the sense of tension [26].

The application of such interactive technologies has also developed studies on movement improvisation in live dance performances [2,17,21]. Although improvisational artistry is involved in all live performances, technologies bring uncertainty and new challenges to the production of live performances since performers should make changes according to the performing environment [2]. For instance, Choreomorphy is a novel interactive system which explores the impacts of avatar characteristics of motion capture systems on movement improvisation [17]. Since the interpretive abilities of technology are separated from humans' awareness [12], dancers need to apply strategies to handle degrees of openness in improvisation [18].

2.3 Participatory dance and performance research in HCI

The nature of participatory performance has emphasized a transference of the audiences' role from observers to producers [29]. In the HCI realm, studies have analyzed the tension and interaction between dancers and participants through an interactive installation [25], finding that dance performance is a mechanism which can encourage participants to actively engage with the interactive installation and experience tensions during the facilitative process. After that, mobile technologies have further been explored by a study using the Radical Choreographic Object (RCO) to investigate audiences' participation in dance performances using gesture-based interactions, finding that that participants transfer their interaction modes and feelings from obeying it to re-interpreting and re-appropriating it [1]. This suggests that audiences can become active agents of online performance situations, providing an interactive experience for both performers and viewers.

3 Research Methodology

To evaluate the effectiveness and interaction of our proposed system and explore the performer-audience-connection during the online performance, we conducted semi-structured interviews with 9 experienced performers or dancers via Zoom (5), Tencent Meet (2), and in person (2).

3.1 Data Acquisition and Analysis

We recruited participants with performance experience through a convenience sampling. We chose only interviewees who have participated in at least one online (socially distant) performance in the past year. Institutional research protocols were approved and followed strictly during the interview process. We found performers by direct messaging and posts on WeChat, WhatsApp, Weibo, and Instagram. All performers were of Chinese ethnicity. Each interview lasted between 45-60 minutes. All interviews are audio-recorded and transcribed into English after removing the information that refers to personal and identifiable data. In total, the 9 participants (1 male, 8 female) were interviewed from July to September 2021 (see Table 1). Two performers were interviewed in-person due to availability [23].

Table 1. Summary of interviewees' information

ID	Gender	Occupation	Age group	Research directions in performance art
P1	Female	Performer	26-30 years old	cantonese opera, performance technology
P2	Female	Dancer	21-25 years old	chinese dance, ballet
P3	Female	Student	25-30 years old	professional dance practice
P4	Female	Dancer, performer	31-40 years old	dance instructor
P5	Male	Dancer	21-25 years old	modern dance
P6	Female	Dancer	21-25 years old	classical dance, dance instructor
P7	Female	Performer	31-40 years old	performance art. dance teacher
P8	Female	Performer	26-30 years old	chinese dance
P9	Female	Performer	21-25 years old	participatory performance

3.2 Interview Questions

To better understand performers' need in online performance during the pandemic time and design an effective and useful participatory online performance system, we divided the interview into two phases. In the first phase, the interviews included questions about their practices and experiences in performing online, the effect of shifts caused by social distancing on their practice, their perspectives on how people are performing during quarantine times, the difference between conduct performance online or in a physical place, and how they expressed themselves in online performance. In the second interview with each of the same individuals, we presented the prototype of the Connected Gaze, and encouraged interviewees to imagine their choreography strategies and the possibilities of interaction with audiences. Interviewees were asked about the online performing experience with audiences' participation through this computer-mediated system: How will performers interact with the light that is controlled by the audience? Will it

increase a sense of engagement for performers or it destroys the performance instead? Where will the interaction between the audiences lead the performance to? How would performers react to audiences' collaborations or conflicts? etc.

3.3 Data collection and analysis

We applied coding to process and analyze the transcriptions. First, we conducted four interviews and obtained the possible codes based on literature review and early data. One researcher took notes during the interviews and transcribed data into text. All researchers conducted the interviews and two researchers classified codes based on different themes [22]. Finally, all three researchers analyzed the codes together.

4 Design

To gain insight into the way performers deal with limitations of online performance and create novel ways of engaging with audiences who are gazing at the performance, we prototyped a system called Connected Gaze to probe performers' perceptions about online performance in semi-structured interviews on Zoom. Though online performance disables the physical interaction in the live performance, it opens up possible space for interactive technology to redefine and mediate how audiences and performers interact in cyberspace, and makes location an important variable in the interaction.

4.1 Artistic and theoretical intentions

Connected Gaze is an interactive participatory system designed for online dance performance. Within this system, the choreography unfolds according to the behavior of the audience and the improvisation of the performers. This system serves as the medium to connect the audience and performer, and creates a brand new experience both for audiences and performers in the context of online performance.

This system invites the audience to participate in an online performance by connecting to a server online through their mobile phone or PC. To let the audience participate in the performance, an audience is able to control the angle of a laser light on the stage on a webpage. By controlling the light, the audience is also controlling the camera built on the light, which changes the perspective that the audience watches the performance. Each light on the stage is controlled by one audience online. Thus, the constantly changing and moving light serves as a physical visualization of the Connected Gaze of an audience. Through this lens, this system enables the audience to change the perspective of watching performance the same as they do in an offline performance. At the same time, the audiences participate and influence the performance by changing the light on the stage, which is one of the essential parts of stage art.

The performers, on the other side, are the agents of such an open, self-organized scenario. They linger between their set design patterns and the improvisation inspired by audiences' behaviors embodied by the lighting. This system enables the performers to feel the existence of the audience and have an enhanced sense of being watched. This system allows the performer to control the lighting pattern to be either dispersed or aggregated. In the dispersed pattern, the lights' position is represented by audiences' original control of the light. In the aggregated pattern, all the lights gather at the same point and look at the same position. The point's position is the comprehensive calculation result of each light position controlled by each audience, by calculating the average position of each light's position. The performer has the control to mediate the lighting system to be from fully dispersed to completely aggregated according to the need of choreography.

Eventually, this system mediates the interaction between performers and audiences in the context of an online performance. On the one hand, this system mimics the watching experience in offline performance -- where the audiences control the perspective of watching with their head turning -- by controlling the camera that looks at the stage on a webpage. At the same time, the audiences can participate and influence the progress of the performance by changing the pointing angle of the light. On the other side, the performers physically sense the existence of the audiences' Connected Gazes and react to the behaviors of the audiences with their dance patterns. The audiences then

have another layer of behaviors when they see the reactions of the performers. Thus, a looping dialogue is created between these two groups, which leads to a performance that all interactions are possible and all unexpections are welcomed.

4.2 Prototyping the Connected Gaze

We first created an interactive wireframe in Touchdesigner as a rapid prototype to visualize our concept. The box represents the stage, the lines stand for the lights, the white circles connected to the straight lines embody the light spots on the floor. The lights are programmed to move randomly to simulate a state of "chaos"—the audiences control the lights to move while looking around curiously. We also introduce visual contents on the floor and the wall behind the theatre in this prototype. The mediums of visual contents are screens and projections on the physical stage. The content displayed on the wall behind the theatre is a grid of real-time screens captured by all the cameras installed on the light fixtures, which resembles a video wall. On the one hand, we design the visual content to make the audience aware that other audiences are watching the stage from different angles at the same time. On the other hand, we envision the visual content to potentially enhance the performer's sense of being watched on the sensory and conceptual levels.

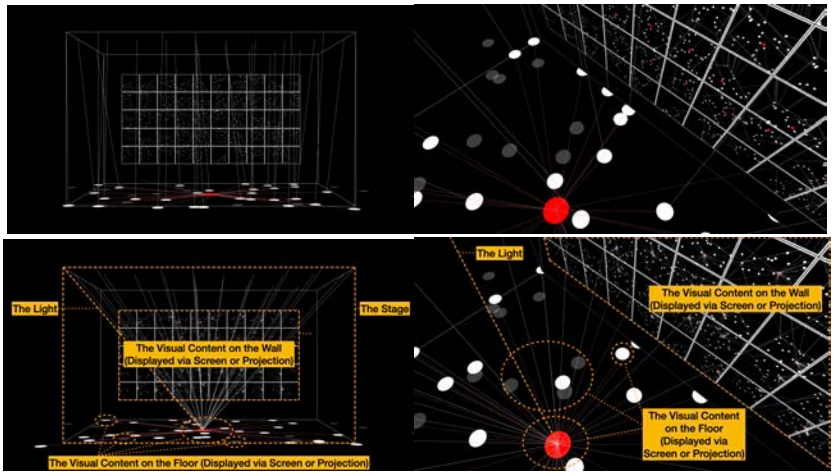

Fig. 3. First-phase prototype: Objective watching angle, the lights point to their original positions. (top left); Objective watching angle, the lights point to a calculated position. (bottom left); First-person watching angle, the lights point to a calculated position. (top right); First-person watching angle, the lights point to a calculated position (bottom right).

.

In the first-phase prototype, our design of the visual content on the floor contains two parts: 1) the white circles are the virtual spots of the light respectively controlled by each audience, and 2) the grey circles are in offline state because they are not accessed by the audience and 3) the red circle is a calculated result of all white circles' average positions. The visual content altogether is interactive as a result of all the audiences' participation. The audience participates in the system through a desktop web page where they can use keyboard input to switch the viewing perspective between the objective angle (in front of the stage) and the first-person angle (from the camera installed on the light fixture). We showed this prototype to the interviewees in the later interviews to introduce the system design. Since it is a wireframe prototype, we found that it was not effective enough to let the interviewees comprehensively understand the system. Therefore, we then use the game engine to develop a higher-fidelity prototype to present a realistic rendering of the stage and lighting system to provide a more understandable introduction to the prototype in the following interviews.

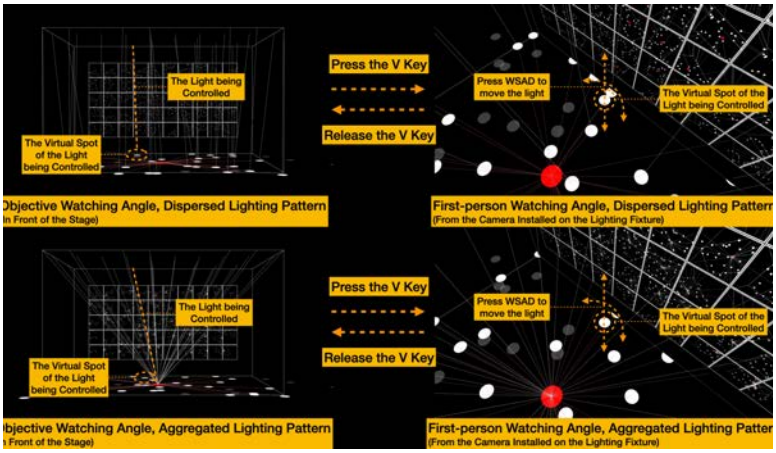

Fig. 4. First-phase prototype: Interactive process flow for the audience. Objective watching angle, dispersed lighting pattern (top left); First-person watching angle, dispersed lighting pattern (top right); Objective watching angle, aggregated lighting pattern (bottom left); First-person watching angle, aggregated lighting pattern (bottom right).

We used Unreal Engine (DMX plugin) for rapid live show previsualization and for testing lighting pattern design and choreography. We created a web server in Node.js and a web page (omitted due to anonymity), allowing one to control the movement of the lights in the prototype through a virtual joystick. Pixel Streaming plugin for Unreal Engine was used for online interviews where there is a need to show prototypes remotely.

In the interviews, we enable the performers to use keyboard input (a,w,s,d) to move freely on the rendered stage in a first-person perspective. During the interview, the participants play the role of real performers by controlling a first-person perspective character on the stage while imagining the scenario and envisioning the strategies. We play the role of the audience and control the lighting through the web page to simulate the interaction and communication between the performer and the audience during a performance.

5 Findings

In this section, we present the results of the two-stage conversations with performers. The first stage focuses on changes in performance practice caused by pandemic regulation; the second stage reports on performers' experience interacting with the proposed online performance system.

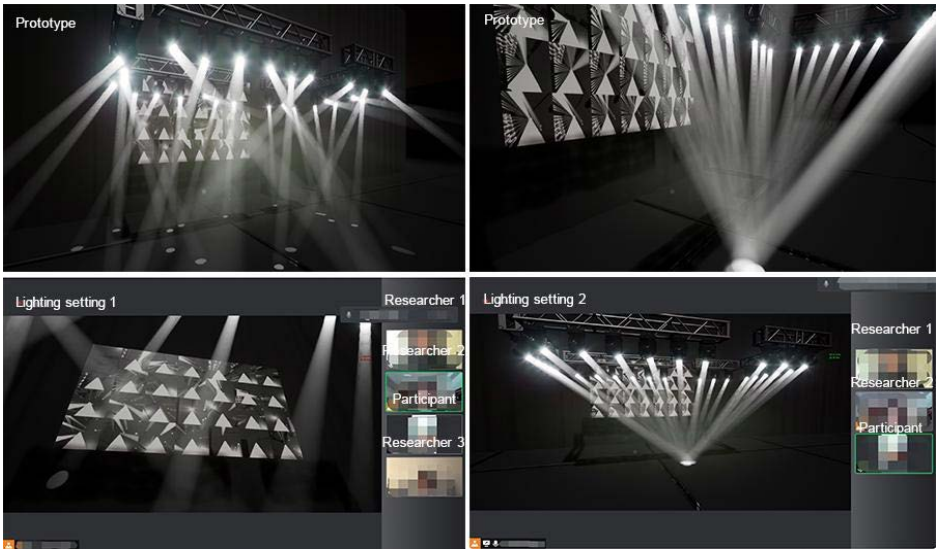

Fig. 5. Second-phase prototype: a high-fidelity prototype built in Unreal Engine to present a realistic visualization of a stage and lighting system. Objective watching angle, the lights point to their original positions (top left). Objective watching angle, the lights point to a calculated position (top right). Interview procedure for Zoom and Tencent Meet setups: showing different lighting designs and interactive formats in the proposed system for one interviewee. The lights pointed at the original position (bottom left). The lights pointed at a calculated position (bottom right).

5.1 First phase interview

We found that online performance leads to the performers' altered relationship with technology. Our main findings were a redefined performance mediated by technology, and a change in the temporal dynamics of the performance we are calling "deferral." There's a further shift in the relationship with audiences in terms of being watched, the ability to improvise, and physical touch, but professional performers use these creative constraints as adaptations for their practice.

5.1.1 Relationship with the technology

5.1.1.1 Redefined by technology

The online performance pushed our participants to rethink their relationship with audiences and with the technology. With our professional performers, online performances occur most often on platforms like Youtube and Zoom, where action takes place in front of a web camera. "*This kind of intimacy between the devices and myself is one interesting point I'm thinking about*"(P1). Another said "*we're closer to rethinking what technology is in our life and also how we as a human being as a species should carry on*"(P5). Previously in live performance, they can directly see the audiences and the "*concentration was mostly on human behaviors and reactions*"(P2). In the online context, the performance is represented through abstraction instead of directly being watched. P1 notes that "*Zoom meeting setting defines who we are*" and how performance is presented. They "*became more intimate with technical devices*"(P1), namely the camera, and "*less intimate with audiences*"(P1). Once the camera becomes the only media that connects the performers and the audiences, "*it dominates the performance*" as well. One participant said that "*the camera determines the perspective of the audience, the space that I can dance is also limited*"(P3) in case they are out of view. Another participant felt that there were no significant differences in performing between online and offline, but "*the quality of performance in terms of detail differs in live show and online performance.*"(P4) One performer incorporated remote texting itself into her performance practice,

creating a work that uses audience texting to add interactivity to her work in an effort to overcome the lack of intimacy in online performance (P9).

In summary, we found that professional performers perceived the single-watching lens of online performance to be less intimate and more dominating than live performances where audiences are individuated and participatory.

5.1.1.2 Deferral

Participants mentioned "deferral" as another main situation brought about by the online performance. "*There must be some kind of delay in terms of the technical aspect so you're always seeing something that is different*"(P1). Two of the participants were often frustrated by the delay in online performance when performing online to instruct the students. "*It often leads to unsatisfactory teaching results when many students learn the wrong rhythm due to the deferral.*"(P4) One participant has a different opinion of deferral who regards the deferral as the "*desire for something to happen*"(P1). Instead of feeling the deferral to be against her performance, she "*would like to develop it further in her [my] later life*"(P1). Deferral is an interesting point about technology and online platforms because "*the deferral in time doesn't happen in real life*". It pushes the participant to think how this kind of frustration can be "*transformed into another layer of meaning*" regarding how they use technical devices in online performance and how it changes human behaviors and perceptions. (P1) related the temporal deferral in the micro scale of the delay in online performance to her own performance practice, where subscriptions and scheduled shows have been canceled, noting that "*the online performance has a delay that is like a metaphor for how our lives have been altered.*" She notes that the online situation has "*changed the way we spend time together*," but finds it to be "*an opportunity to adapt.*" (P1)

In summary, performers found the delay in time of online performances to be a source of hindrance that also serves as a constraint that can lead to creative adaptations.

5.1.2 Interaction with audience

5.1.2.1 Being Watched

The online performance redefines how performers interact with audiences. Previously in live performance, performers were being watched in the flesh by the audiences and they "*could immediately get audiences' feedback"*(P2) *and could have "emotional communication and feedback*"(P3). This real-time feedback "*triggers energy*"(P2) inside their bodies when they perform. Through this process, a dialogue loop was constructed in the air between the performers and audiences. "*When I was doing the live performance, the fact that I'm being watched motivates me and energizes me. And I enjoy the process of transforming this energy into my dance as a response to the audience.*"(P2) One participant said "*it was the audiences' cheer that really opened up me.*"(P8) Audiences respond to the performance with their physical and emotional reactions, and performers react to the feedback through dance patterns. However, in online performance, audiences' gaze can not be perceived by the performers, "*especially when they turn off their camera, I feel like I'm performing to myself, and that feels awkward*"(P4). "*Online performance is like making a movie.*"(P4). The performance was well prepared beforehand, the performers "*just present it*"(P8) to the audiences online. "*There is no communication in between.*"(P7) Another participant said "*I have to do everything by myself, and I got no response from the audience.*"(P6) The lacking feeling of being watched is the primary concern brought by most of the participants "*because I think that performance is meant to be watched.*"

In summary, the online format forces performers to adapt a single-lens, asynchronous approach in regards to the audience, creating a situation where they feel like they are performing to one abstract viewer like a camera lens as opposed to a collective interaction as it is found onstage.

5.1.2.2 Improvisation

The ability to improvise during performances creates a sense of agency for both the performer and the audience [2]. Due to the lack of live audiences providing *"energy for performance*,"(P2) online performance creates a situation where "*we play to the camera with a previously determined routine*" instead of improvising (P4). This is consistent with the view

that in online performance, the performer does not have a model of the individual viewer, but rather can only focus on a single abstract viewer. Thus she cannot find ways of improvising with the audience since she cannot know what the audience is feeling "out there."(P6) Interestingly, we found that performers also take this constraint itself as an opportunity to improvise.

"*During our livestream, the audience is not ideal [and we] need to refocus, but the contradiction pushes me to improvise, … it's like being constantly distracted online."* (P1)

In short, even though performers don't see the audience online well, especially with video-off conference calls, they find the reduced information load to be not necessarily a hindrance, but rather a creative constraint. In (P1)'s case, she uses the distractions from random audiences on zoom as a way to improvise her practice during the performance: *"I learned how to distract [myself] away from the distractions online.*" For (P7), "*I'm appreciative of being able to perform in person again*," because working in zoom has been *"exhausting because I cannot adapt to my audience*." Her practice has been to improvise her participatory performances without rehearsal, because she wants to change her actions based on the surprises that audiences bring her. This is only possible in the live space with an engaged audience.

In summary, professional performers found it difficult to improvise online without full vision of responsive audiences, but some have used these constraints as opportunities to adapt.

5.1.2.3 Human touch

The physical interaction between performers and audiences are lacking in the online performance. One participant said the most concern was "*the fact that humans cannot touch each other*"(P1), in which the "*temperature*" is lacking in the performing experience. "*People would come close to look at and touch the makeup on my face after the performance.*"(P1) However, in online performance, "as a performer I need to think how to reach the audience."(P1) Similar to how another participant said "*there was always a screen, a separation between the performers and the audiences.*"(P3) Previously in the live performance, "*I often walk into the auditorium and invite the audience to join the dance by taking their hands.*"(P2) The intimate touch and bodily interaction "*is an important part of my performing experience*"(P2) that can incentivize the participant to create different improvisations and provoke inspiration "*for my next choreography creation*"(P1). The participant claimed to be a "*body researcher*"(P5), to perform is "*to study your own body through body language and to learn about others' bodies through somatic interaction.*"(P5) The lack of physical connection would be "*a missing part in the process of my art creation*"(P6) in the online performing context. However even the inability to touch and feel the temperature of someone has been used by performers as creative constraints. For example, (P9) uses emojis and touch-based visual feedback in her text to the audience during the performance to "*simulate being touched, not by your hands but by your mind.*" (P1) also notes that even though she cannot feel the audience individually, the rhythm of the audience online as they come and go, turning on and off, etc, gives her a sense of being physically present like being touched by music.

In summary, physical touch is a limitation of online performance for particular examples like participatory performance, reducing engagement and improvisation.

5.2 Second phase interview

In this section, we report on the second-phase interview conducted based on the proposed design system Connected Gaze. We showed the interactive prototype during the interview, and asked interviewees to envision their choreographic techniques and the potential for audience involvement. An enhanced feeling of being watched was the primary finding from these interviews. The proposed system also provides multiple watching perspectives as well as dissolution of identity in terms of audiences. The created dialogue loop, the distraction were reinforced in terms of performer-audiences interaction. A potentially new format of generative performance was created based on these interactions.

5.2.1 Being watched by the lights

5.2.1.1 The Lights, The Gazes

This system physically visualizes audiences' watching behaviors through the moving light, which composes an important part of the performance. Connected Gaze enhanced performers' sense of being watched. One participant said that "*the audiences exist in this space in another way*"(P2), another said " *I can actually feel them [watching] me*"(P4). It creates a new feeling of being watched, because the performers "*can actually see the [audience] gaze and observe where they move*"."*It is really interesting that I can visually know how I am being watched, and I like to see that*"(P3), according to one participant. The light serves as the "*personification of the audience*"(P8), which makes the participants feel that they are "dancing with the audiences"(P6). Through the concretization of audiences' perspectives in Connected Gaze system, 7 out of 9 participants claimed to have an increased feeling of attentiveness and recognition of value. Being watched is an essential element of the performing experience for performers, because "*to perform is to be seen*"(P2), according to one participant. "*It makes no sense when nobody is watching your performance.*"(P2) The sense of being watched will incentivize the performers to give feedback through their body language. The knowledge of where the audiences are looking also "inspire me about how to express myself and where to extend"(P8). A participant said "*to perform is to have a dialogue*"(P6). The system completes a performance in an online context, because the embodiment of light makes up the element of audiences in a performance dialogue, and performers react to it through their body movement.

5.2.2 Center of the attention

5.2.2.1 Multiple Perspectives

The sense of being watched also leads to increased awareness of themselves. They feel that they need to pay more attention to every moment of the dance. Previously in live performance, the performers were watched from one perspective, and "*we can relax our facial expressions a bit when we turn back to the audiences.*"(P2) In this system, one participant said that "there is nowhere to hide"(P7), since the cameras are set at multiple positions, looking at them from almost every perspective all the time. To be watched from every angle will "*make performers feel nervous*"(P7). The multiple perspectives of watch remind one participant of "the gaze of god, the erotic look"(P7). Connected Gaze reinforces a sense of "tendency" because "the watching angle is not necessarily suitable"(P7). While one participant felt that "*it's like a surveillance system*", other participants had different objectives. The system is different from traditional performance because each audience *"might have a different understanding of the performance due to watching from different angles.*"(P8) The system suits well with one participant's performing experience because "*the characteristic of my performance needs to be watched from different angles, which is hard to achieve in real life.*"(P8) It is particularly valuable and meaningful for this participant to be watched from all the perspectives.

5.2.2.2 Dissolution of individual

Even though the light enables the performers to feel the Connected Gazes, it also dissolves the individual and abstracts the identity. "*It would be better if I could see their (audiences) faces.*"(P3) While Connected Gaze increases the individual participation of the audiences, its disappointment lies in the standardization of personality. The performers could

observe the facial expression, body movement and voices of the audiences in a live performance. It is the difference between each audience that makes them "*human*". (P5) said "*it makes no big difference with being watched by a machine.*" Another participant also denied the feeling of being watched, "*the light is industrialized, they don't have personality.*" (P7)

5.2.3 Incentivized Improvisation

5.2.3.1 Loop

This system creates a dialogue loop between performers and audiences in an online context. The participants said they would start the performance with their prepared dance pattern following the music while observing audiences' behaviors for the start. Then they would improvise based on the lights' movement. For example, one participant said "*I might follow one trace of the light with my hands or body movement.*"(P1) Another said "*I might try jumping from one spot light to another, like Hopscotch.*"(P2) "I might want to dance with four or five partners in a circle, each reacting to a different group of lights (audiences)"(P8) The movement of the lights represent the response of the audiences to the performance, then the performers react to different behaviors of the audiences with improvised body language. (P6) stated that the system enables "*close communication*", claiming that "*I'm physically immersed in audiences' behaviors and perspectives of appreciation.*" The behaviors, reactions and improvisation are entangled and mediated by the system, thus creating a dialogue loop between performers and audiences. It is the loop that pushes the interaction between the two beyond the traditional performance and produces better performing experience.

5.2.3.2 Distraction

Different participants have different attitudes towards this unknown experience mentioned above. 6 out of 9 participants raised the concern of the lighting system to be "*chaotic*". Once every light is controlled by a different individual, the visual lighting effect will be "erratic and unstable". "*There are too many lights in this system*"(P7), which leads to distraction in "*vision*". One participant said the disorderly lighting effect "might cause distraction" to the dance and the thinking process. 3 of 9 participants claimed a feeling of uncertainty about the lighting system. In a performance, lights play an important role "to *lead audiences' gazes so that they know where to look*". Once the power of the control is transferred to others, the "*mystery is missing*", the storytelling of a choreography is "*disrupted*". One participant said, "*I'm not sure yet whether the participatory lights will improve my performing experience or distract me from the present.*"(P7) However, one participant said that this distraction can be "*something to play with*"(P1) that inspires the performer to dance in an unusual way. It pushes the participant to think "*how to distract yourself away from distractions*"(P1). A distraction dialogue will be created among the performers and audiences, thus leading to alternative formats of performing arts.

5.2.4 Generative art of performance

Within this system, the performance outcome is unpredictable due to the unpredictable behaviors of the audiences and the way performers' onsite improvisation can build on top of these behaviors. The participants recognize the online performance under this system to be a "*dance adventure*", an "*unknown choreography*", which incentivises them to perform something unexpected. "*You will never know what will happen before the performance, everything is unknown, the lighting movement, the audiences' feedback, and my improvisation based on that*". Similarly, another participant said "*you have to be there to know what will happen, the whole situation is unpredictable*"(P4). However, one participant regarded the random light to "reduce the serenity of the performance"(P7). The participant stated that "*I'm not sure about transfering the control of the light to the audiences, it'll be hard to express the concept of a choreographed work.*"(P7) Gaze triggered 6 out of 9 participants' interests in participating in the online performance, because "*I really want to see what will happen there. I would like to see how a generative performance will turn out to be.*"(P6) This system explores an alternative form of performing arts that is real-time generated. One participant said, "*it reminds me of a generative art piece, every particle is real-time generated by algorithms. It's never the same.*"(P2) We envision the system to create a generative performance, which is powered by the participation of the audiences and the improvisation of the performers.

6 Discussion

6.1 Image mediated by technology

6.1.1 The performers

We were able to observe from the interview that online performing arts are largely determined by technologies and their allowable interactions. The performing arts is mediated by the transmission medium, e.g., live stream platform or zoom, etc. Some participants stated that their way of performing is limited to their cameras' angle, and the reproduction of their performance was manipulated by the live stream software settings. The distant context requires a performer to treat the camera as a proxy for the audience. In other words, the performer must immediately interact with the camera in order for audiences to believe that the artist is performing for them. Performing body image is digitized, the three-dimensional body movement is transformed into two-dimension, and the performers are physically isolated from their environment. This finding offers insights that while online context reduces much of the sense of presence, it also provides opportunities for technology to intervene and play a role in influencing the watching experience and outcome.

6.1.2 The Audience

What Connected Gaze reinforces is the audiences' participation in an online performance, which is aimed at providing both engaging online watching experience and concerned performing experience. In a traditional live performance, remote audiences are limited in their experience of the performance largely to observation [30]. This system involves audiences' intervention in the performance with the control over light. While the image of the performers are mediated by the capturing devices, audiences' images are also mediated by the embodied technology. Using Connected Gaze or not to watch performance online, the audiences are inevitably represented by the online stream platform. While they are transformed into a two-dimensional moving image of their faces in traditional cases, Connected Gaze embodies and digitalizes audiences into stage lights, allowing them to evolve from bystanders to co-creators.

6.2 Performer-audience relationship

6.2.1 The performers

Connected Gaze enhances performers' interaction and engagement with the audiences by reacting to improvising based on the lighting system controlled by the audiences online. It liberates performers from the dominance of the performance and the independence of the art creation [13]. What the liberation leads to is the redefinition of performers' role in performance. We argue the alternative role of performers to be the 'dialogue initiator' in a cultural transmission process, who open the discussion with their arts of performance but leave the following conversation open for audience engagement. By inviting participation of audiences in online performance, we hope to redefine the performers' role in engaging with co-creating audiences.

6.2.2 The audiences

The enhanced feeling of attention and concern of distraction are rare situations in traditional performing arts, revealing the transformation of audiences' power and role in a performance [13]. Performing online paradoxically enriches the way audiences can participate. In comparison to physically sitting in the auditorium, the online format empowers one to directly participate in the creation of performance, which in our case is the control of the key element of lighting. The limitation in turn opens up possibilities for audiences' more engaging, embodied approach of co-creating a performance. Adjustable camera angles allow audiences to watch the performance from different perspectives, potentially enhancing the perceived engagement they receive from the performer. The audiences evolve from observers to co-creators, who can physically participate in the performing arts and have conversation through the embodiment enabled by technology.

6.3 The Cosubjects in Community Construction

Connected Gaze reinforces the reconceptualization of the relationship between performers and audiences and blur the boundaries between them in a tele-present context. The system, by embodying audiences through lighting systems, picks up Schechner's question of "what about audience participation?". He advocates a dissolve of performer-audience separation through the metacommunication of performances. Newton [16] proposed the term 'Metacommunicative Performative Competence' (MPC) that views performance as a meaning-making system. Our findings resonate with Newton's statement in dissolving the performer-audience separation. The interviews led us to the understanding of the challenges and limitations that performing artists are confronting. Unlike previous studies that focus on dissolving the boundary between the two in a live performance context [1,15,31], our design attempts to intervene the relation in a distant format. The entangled relation of performer-audience in a virtual performing art is the core of our effort to derive a new ontology of performance as a result of the findings. The 'dialogue' happening between the performer and audience blurs the boundaries, so that they are both contributing to the end product.

Connected Gaze incorporates dialogues between the behaviors of audiences and body language improvisation of performers, transforming a performance into an 'event' rather than a work of art. The reversal of roles from both sides make "*all participants experience a metamorphosis*" [6], and the subject and object integrate into one. The dance adventure is the joint outcome of the dissolved dualities. The result reframes the form of performing art to be impromptu, generative, experimental and unique. By prototyping the system, we see potential in building an arts community and co-creating a platform in an online context. Both the performer and the audience move beyond meaning-sharing to reframe their roles. They incentivise one another's perceptions as an approach to reach the performative state of co-experience in the here and now.

7 Conclusion

This paper reflects on the two-stages interview with a proposed participatory interactive online performance system in between. The participants were nine dancers with a background in dance performance both offline and online. The system, by letting audiences change the pointing directions of lights and experience the performance from the perspectives of the lights, aims to intervene the performers-audiences engagement in the distant performance situation. We identify the behavior and performing strategies change during the isolation in the findings of the first interview. We then introduce the design process of the proposed system Connected Gaze, with the following findings articulating how interactive technology mediates their performing strategies as well as their perceived online performing experience. The discussion of the findings allowed us to demonstrate the mediating role of technology in online context, and the potential for interactive technology to facilitate performer-audience cosubject and post-pandemic online arts community.

REFERENCES

1. Sarah Fdili Alaoui and Jean-Marc Matos. 2021. RCO: Investigating Social and Technological Constraints through Interactive Dance. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–13. Retrieved July 6, 2021 from https://doi.org/10.1145/3411764.3445513
2. Aili Bresnahan. 2014. Improvisational Artistry in Live Dance Performance as Embodied and Extended Agency. *Dance Research Journal* 46, 1: 85–94. https://doi.org/10.1017/S0149767714000035
3. Teresa Cerratto-Pargman, Chiara Rossitto, and Louise Barkhuus. 2014. Understanding audience participation in an interactive theater performance. In *Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational* (NordiCHI '14), 608–617. https://doi.org/10.1145/2639189.2641213
4. Steven Dow, Manish Mehta, Ellie Harmon, Blair MacIntyre, and Michael Mateas. 2007. Presence and engagement in an interactive drama. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1475–1484. Retrieved September 7, 2021 from https://doi.org/10.1145/1240624.1240847
5. Sarah Fdili Alaoui, Jules Françoise, Thecla Schiphorst, Karen Studd, and Frederic Bevilacqua. 2017. Seeing, Sensing and Recognizing Laban Movement Qualities. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems* (CHI '17), 4009–4020. https://doi.org/10.1145/3025453.3025530
6. Erika Fischer-Lichte, Minou Arjomand, and Ramona Mosse. 2014. *The Routledge Introduction to Theatre and Performance Studies*.

Routledge, London. https://doi.org/10.4324/9780203068731
7. Louise C Hawkley and John T Cacioppo. 2003. Loneliness and pathways to disease. *Brain, Behavior, and Immunity* 17, 1, Supplement: 98–105. https://doi.org/10.1016/S0889-1591(02)00073-9
8. Stacy Hsueh, Sarah Fdili Alaoui, and Wendy E. Mackay. 2019. Understanding Kinaesthetic Creativity in Dance. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–12. Retrieved June 28, 2021 from https://doi.org/10.1145/3290605.3300741
9. Tzung-Jeng Hwang, Kiran Rabheru, Carmelle Peisah, William Reichman, and Manabu Ikeda. 2020. Loneliness and social isolation during the COVID-19 pandemic. *International Psychogeriatrics* 32, 10: 1217–1220. https://doi.org/10.1017/S1041610220000988
10. Jodi James, Todd Ingalls, Gang Qian, Loren Olsen, Daniel Whiteley, Siew Wong, and Thanassis Rikakis. 2006. Movement-based interactive dance performance. In *Proceedings of the 14th ACM international conference on Multimedia* (MM '06), 470–480. https://doi.org/10.1145/1180639.1180733
11. Celine Latulipe, David Wilson, Sybil Huskey, Berto Gonzalez, and Melissa Word. 2011. Temporal integration of interactive technology in dance: creative process impacts. In *Proceedings of the 8th ACM conference on Creativity and cognition* (C&C '11), 107–116. https://doi.org/10.1145/2069618.2069639
12. RAY LC, Aaliyah Alcibar, Alejandro Baez, and Stefanie Torossian. 2020. Machine Gaze: Self-Identification Through Play With a computer Vision-Based Projection and Robotics System. *Frontiers in Robotics and AI* 7. https://doi.org/10.3389/frobt.2020.580835
13. Christie Logan. 2005. The Space Between: Phenomenologies of Audience, Performer, and Place for Three Performances of Menopause and Desire. *Text and Performance Quarterly* 25, 3: 282–289. https://doi.org/10.1080/10462930500210057
14. Ethan Sacks Ethan Sacks writes for NBCNews.com. COVID-19 strikes discordant note for the music industry. *NBC News*. Retrieved September 3, 2021 from https://www.nbcnews.com/pop-culture/music/covid-19-strikes-discordant-note-music-industry-artists-find-way-n1202571
15. Matti Nelimarkka, Kai Kuikkaniemi, Antti Salovaara, and Giulio Jacucci. 2016. Live Participation: Augmenting Events with Audience-Performer Interaction Systems. In *Proceedings of the 2016 ACM Conference on Designing Interactive Systems* (DIS '16), 509–520. https://doi.org/10.1145/2901790.2901862
16. Deborah Newton. 2014. Performativity and the Performer-Audience Relationship Shifting Perspectives and Collapsing Binaries. 7.
17. Katerina El Raheb, George Tsampounaris, Akrivi Katifori, and Yannis Ioannidis. 2018. Choreomorphy: a whole-body interaction experience for dance improvisation and visual experimentation. In *Proceedings of the 2018 International Conference on Advanced Visual Interfaces* (AVI '18), 1–9. https://doi.org/10.1145/3206505.3206507
18. Susanne Ravn. 2020. Investigating Dance Improvisation: From Spontaneity to Agency. *Dance Research Journal* 52, 2: 75–87. https://doi.org/10.1017/S0149767720000182
19. Tina M. Schwender, Sarah Spengler, Christina Oedl, and Filip Mess. 2018. Effects of Dance Interventions on Aspects of the Participants' Self: A Systematic Review. *Frontiers in Psychology* 9: 1130. https://doi.org/10.3389/fpsyg.2018.01130
20. Afrizal Yudha Setiawan, Indra Bulan, and Dwiyana Habsary. 2020. Social Media as a Platform of Performing Arts Education During Covid-19 Pandemic. 6.
21. Kent De Spain. 2012. Improvisation and intimate technologies. *Choreographic Practices* 2, 1: 25–42. https://doi.org/10.1386/chor.2.25_1
22. Anselm Strauss and Juliet Corbin. 1998. *Basics of qualitative research: Techniques and procedures for developing grounded theory, 2nd ed.* Sage Publications, Inc, Thousand Oaks, CA, US.
23. Anselm Strauss and Juliet M. Corbin. 1997. *Grounded Theory in Practice*. SAGE.
24. Ben Walmsley. 2021. Engagement: The new paradigm for audience research. 18, 1: 18.
25. Sarah Webber, Mitchell Harrop, John Downs, Travis Cox, Niels Wouters, and Andrew Vande Moere. 2015. Everybody Dance Now: Tensions between Participation and Performance in Interactive Public Installations. In *Proceedings of the Annual Meeting of the Australian Special Interest Group for Computer Human Interaction* (OzCHI '15), 284–288. https://doi.org/10.1145/2838739.2838801
26. Wu Zhen and Lian Luan. 2021. Physical World to Virtual Reality – Motion Capture Technology in Dance Creation. *Journal of Physics: Conference Series* 1828, 1: 012097. https://doi.org/10.1088/1742-6596/1828/1/012097
27. 2020. COVID-19's Pandemic's Impact on The Arts: Research Update August 31, 2021. *Americans for the Arts*. Retrieved September 4, 2021 from https://www.americansforthearts.org/node/103614
28. How do experts observe movement? | Proceedings of the 2nd International Workshop on Movement and Computing. Retrieved September 7, 2021 from https://dl.acm.org/doi/10.1145/2790994.2791000
29. "Participation" by Claire Bishop. Retrieved September 8, 2021 from https://academicworks.cuny.edu/gc_pubs/97/
30. The Performer-audience Relationship During Live and Remote Musical Performances - ProQuest. Retrieved September 3, 2021 from https://www.proquest.com/openview/ab475d5b1d8d7fa5c47f24c6d78f4f93/1?pq-origsite=gscholar&cbl=18750&diss=y
31. Boiling Mind: Amplifying the Audience-Performer Connection through Sonification and Visualization of Heart and Electrodermal Activities | Proceedings of the Fifteenth International Conference on Tangible, Embedded, and Embodied Interaction. Retrieved August 15, 2021 from https://dl.acm.org/doi/10.1145/3430524.3440653