



Hello World: Liveness in Virtual Theatre for the Metaverse

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1 What Do Audiences Want?

1.1 Context

The live events industry, particularly theatre, sometimes has connotations of being low-tech and often only for the elite. Theatre may be one of the oldest industries in the world, but it has endured because it has remained technologically up to date. Today, it is a far less wealthy industry than it was in the nineteenth century, which means that a lot of technology is borrowed from other industries and reinvented to serve the purpose of entertaining audiences.

To take an early example, Wolfgang Mozart wrote the *Magic Flute* in response to a recent technological development: pyrotechnics. He chose to write into his story a trial by fire and a trial by water, which would use red and blue flares to create coloured light on stage. In a time when all

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light was produced by candles, this effect on stage would have seemed incredible and innovative to audiences of the time.

Today, the opera industry is amongst the most technically demanding workspaces in any industry as it manages to combine automation, digital video, sound, live filming, and digital manufacturing into its production practices. Theatre has a culture of engaging with new technologies to create spectacular experiences for audiences.

1.2 Virtual Theatre

The emergence of virtual theatre was gradual pre-pandemic, as innovations were led by funded venues. Meanwhile, the Audience of the Future programme, funded by Innovate UK, led to several new use cases being created, including the RSCs plans for a mixed reality, location-based experience of *Midsummer Nights Dream* by William Shakespeare. This was cancelled due to the pandemic and replaced with a remote experience viewed on a web browser as one of many solutions to pandemic theatre.

The pandemic certainly acted as a catalyst for virtual theatre as physical presentation had to be paused. An industry which runs a hand-to-mouth business model couldn't afford to risk producing works which may get cancelled in the future, and so they turned to virtual theatre models and digital streaming to keep audiences engaged with their brands.

Copper Candle has been proactive in developing use cases and working with theatres to find ways of meeting different audiences' expectations in each scenario. The problem facing the creation of virtual theatre is that it hasn't benefited from generations of development to discover what works and what doesn't. This emerging sector is in its infancy, as the cinema industry was in the early twentieth century. In that time, cinema created an experience that remediates the theatre industry with an auditoria set-up, theatrical onboarding, and in the very early days of cinema, a format of presentation which included a presenter standing in front of theatrical curtains.

Remediation is an important part of emerging entertainment industries, as we try to use what we already know to start a new industry. However, the virtual theatre sector is as much games as it is theatre, and

remediation of this new format using only theatrical knowledge is weakening our potential to develop this new sector. The RSC correctly brought in teams of experts from across games, film, immersive theatre, and Shakespearian theatre to develop *The Dream* to ensure it created a product that remediated content that was appropriate to the new format.

The inconvenient truth is that we don't yet know how to make this content because we don't yet know our audience as it is still emerging. We have game enthusiasts watching concerts in Fortnite, traditional theatre attendees watching digital live streams using cameras, and now audiences being introduced to virtual reality and the metaverse.

1.3 The Value of Liveness

This project was funded by Innovate UK under the Audience of the Future programme (Design Foundations Round 2). It posed the question, *what do audiences want?* And Copper Candle proposed to discover what audiences want from liveness in virtual theatre.

The reason this question is important for Copper Candle is because of its investment made in live streaming technologies which allow the sharing of motion capture, audio, and theatre lighting control data via cloud servers to reach remote users anywhere in the world. These investments are costly and are based on the assumption that live theatre in a virtual world *must* include live performance.

This assumption was brought into question when the producer of a prior project decided to create a screen recording of the real-time game view which was being broadcast as a screenshare to remote participants. This screen recording would be used as a backup in case the technology failed during a live performance and could be switched to the recording to ensure continuity for the audience which is a practice used regularly on live events and broadcasts where a particular effect is high risk and very noticeable. Key moments of the Olympics are pre-recorded for instance and held on standby during a live broadcast in case of a failure during the live display.

When the producer at Copper Candle proposed that an edited, high-quality capture was produced which went beyond the capabilities of the

standard live presentation, it undermined all of the work being done to create live streaming tools. The point was raised that the audience wouldn't notice the difference either way, because the end product looks the same.

From this emerged the research question: would an audience notice if we modified their experience to use high-quality, pre-recorded content to replace the live they are expecting? Will the audience engage with the experience more because it is live and how would they interact with each other? The assumption at the start was that audiences experience liveness because the moment is shared with others and that they wouldn't notice the difference between live content and recorded content in most situations.

2 The Projects Methodology

2.1 Research Mechanics

The mechanisms in place to discover this covered two methods. First was a survey for participants after the experience which looked at their emotional responses. Second was a system built into the application itself that measured a subliminal response from the audience, turning the game application itself into a data collection tool which measured button clicks and interactions. There were 100 participants in this experiment over 27 performances, ranging from 15 in some shows to only 1 in others. A total of 57 participants responded to the survey. The survey participants were from a mixed demographic of ages, locations across the UK (some international), and an equal gender split as well as an equal number of regular game and theatre participants.

2.1.1 Survey

The survey needed to create a baseline set of answers which asked the audience to identify their connectedness to the performer, the other audience, and the story. It focused on key parts of the story which asked

questions such as how important it was for the moment to be experienced live? The moments in the show it identifies, such as the dance or a particular section of dialogue, were in reality a mixture of live and pre-recorded content, sometimes with one performer switching to pre-recorded content whilst the other continued to be live. At this point, the participant isn't aware that the performance contains any pre-recording at all; they assume it is all live because it has a scheduled start time and the performers use direct address to them at the start, so the answers are supposed to test whether the pre-recorded responses are different to the live sections' responses.

Later in the survey, it is revealed that sections of the experience are pre-recorded and the baseline responses are then compared to the new answers. This allowed the responses to reveal if an awareness of liveness is important by knowing if the audience who were unaware that their experience was “fake” and if they were in any way removed from the experience emotionally compared to those who did realise.

The survey also allowed more technical questions to be asked to understand their enjoyment of voting systems in the experience, their connection to the audience, and what mechanisms in the experience made that work (Fig. 1).



Fig. 1 Hello World application including admin log windows

2.1.2 Data Tracking in Game

Surveys can sometimes reveal an intentional response and not the instinctual choice. To measure the real-life situation, the game application, built in Unreal Engine, was able to track each button interaction and print it to a log file held on an admin server accessible only to the principal investigator. This print log contains a record of special interactions listed below.

2.1.2.1 *Directors View/Interaction Mode*

The audience had the ability to switch between a mode which creates a pawn actor and allows them to navigate the scene as they would in a computer game, and to a camera output which is controlled live via the live streamed lighting desk data. Each time the buttons were clicked it printed to the log which user and at what time they decided to switch views.

2.1.2.2 *Chat Window*

A chat window allowed the audience to talk to each other and the performers, where they could respond directly to the performers' direct address to them, to vote or make suggestions on the narrative, or to talk with each other during the plot. Every response was recorded in the print log too.

2.1.2.3 *Emoji Buttons*

A key research mechanism was the use of buttons to create responses from the audience to the game application. This included applause, laughter, and a set of fruit which could be pressed to send responses to votes. When pressed, the audience would see an instant reaction on their screen of the emoji spinning in their window and disappearing into the scene, creating a visceral interaction.

These buttons were deliberately not connected to the rest of the experience, creating no interaction at all with the rest of the audience, the story,

or the performers. The test was to see whether the audience would use these buttons for their own gratification and if they would notice that it had no impact on the storyline. The button clicks were also printed to the log file, so there was a record of the audience's intention to use the buttons. The ability to view voting responses became part of the production as a way to test audience's engagement with real voting instead of votes that created a pre-determined response.

2.2 Equipment and Processes

The production was presented as a 15-min, two-hander performance (two actors on stage together) which incorporated live interaction with the audience as well as dance and special visual effects. Every part of the production had the ability to run live and the only reason not to run some of it live was because of the choices to build in research mechanisms to test different audience responses to live and pre-recorded content.

Key to this system is a plugin for Unreal Engine which has been developed by Copper Candle to allow parametric control of game applications using a theatrical lighting control system. These control interfaces are designed to allow operators fast and efficient manipulation of thousands of parameters of data via nested pallets of pre-configured positions and looks. A good lighting operator can control a live music events lighting in a very similar way to a musician playing a keyboard. This plugin allows for this powerful interface to be integrated into Unreal Engine to provide the same parametric control of anything from lights, audio, objects, positions, and game mechanics within Unreal's visual scripting system, blueprints.

Copper Candle's other products, *Copper Stream* and *Bone Stream*, allow for low-latency communication between the source data (lighting desks and motion capture, respectively) to the game application via a remote cloud server on AWS. Using these combined methods, it is possible to iteratively control live content on the published application whilst working with a theatrical design process familiar to existing practitioners. This meant that the director and performers didn't need to adapt their process to create content, they could observe their established language

and communication tools and had familiarity with the performance protocols used by stage managers and operators of live performance. They do, however, still need to consider the design for the medium, to ensure that they are providing an experience that works for audiences of virtual theatre instead of traditional theatre audiences.

The performers wore perception neuron (PN3) suits made by Noitom. These use inertial sensors to detect movement and create a relatively accurate skeleton rig which was reliable enough for a research activity. For live performance, an optical motion capture system would have been more accurate and reliable, but the PN3 suits provided the advantage of flexibility so that more work could be undertaken without requiring access to an expensive studio during several weeks of R&D and design iterations.

2.3 Story

The general story is set in the metaverse, with an AI represented as a robot discovering themselves and their relationship to human beings. The protagonist is a Scottish woman who has joined the metaverse for the first time and has personified herself as a robot. There is light humour as the combination of Scottish and American accents get confused with the language. We relate to the humans' frustration with their AI, just as many do in real life, but with the added twist that the AI is now personified as a performed avatar, and we can tell from the body language that these mistakes are often intentional and motivated by their own amusement.

3 Discoveries

The two research mechanisms used, the survey and the data tracking, created related and complementary findings that supported each other. More than 60% of the audience were not aware that they were watching pre-recorded content at any point in the show and the majority were not aware that their voting choices were often ignored.

Most audience members were content with finding out their experience wasn't genuine once they recognised that pre-recorded content

resulted in higher quality content. The fact that motion capture data might not be coming from a live performer was not a requirement, but it enhanced the audience interaction when the responses were live.

The audience felt that they connected better to the performer in this virtual theatre experience than they would in a traditional theatre experience, mainly because they were able to communicate and interact with the performer which most traditional theatre experiences don't allow. They felt even more connected to the other audience members than they did to the performers which was seen as a good thing.

The voting options were a very popular component of the experience with audiences enjoying the ability to choose the narrative and influence the show. Even when they found out that some of their voting choices were ignored, they didn't mind because it was more interesting for them to see what other audience members were saying in the chat as it increased a sense of togetherness for them.

The print log of interactions showed that audience members would try to reinforce their vote by clicking multiple times. Most users pressed the button more than once which they might have done because of how this might look at the receiving side of the voting system, and how it might inspire or motivate the performer, unaware that the performer didn't see any voting responses.

The applause and laughter buttons were also clicked on regularly but only at points of interaction with the audience. If something funny happened in the show, the audience were less likely to click an emoji icon than if they were called out by name or as a conclusion to a voting sequence. This suggests that the audience adopts a passive viewing experience when they are not being engaged with by the performer. Their interaction with the application and user interface only happens when an activity demands pro-activity.

The takeaway for better work in the future is to ensure that all development work happens in the medium and not in the physical world. This means engaging with motion capture early, building early versions of the set design in the virtual world and performing within it. Regular testing with audiences is also essential to judge their interaction and purpose within the narrative. Not doing these things results in a product that isn't created for the medium that it will eventually be presented in.

4 Conclusions

This project has allowed Copper Candle to shape the development of its live, virtual performance platform, *Copper House*. Understanding the role of the audience is essential to predicting the type of market that might want to purchase tickets and feel part of a community of live virtual theatre audiences.

As was established early in this chapter, it is still unknown what the market is for this industry as different models emerge, and artists attempt to create work that remediates their existing methods and creative styles. The findings of this research project have demonstrated that liveness isn't *necessary*, but it is *useful*. Knowing that there are times when you can prioritise quality is helpful to artists who know that because a section is repeatable and passive that it could be pre-recorded and mixed with live content which would help reduce production costs.

Having said that, the flexibility to perform live supports the iterative nature of theatre design and production development, allowing artists to continue to refine and develop a piece of work right up until it eventually needs to be performed.

Because audiences enjoyed the live interaction with the performer, it justifies the need for live performance. Seeing as the medium being used is a game application, even if it is running on a PC or a web browser, it could be argued that live interaction is necessary for the medium to be viable. If this is the case, it supports the idea that *all* virtual theatre should use live performance because a static, passive experience isn't what audiences want from a game application.

The most important conclusion drawn from this project is that the assumption that audiences value shared experiences was proven to be true. The interaction with the other audience members and the resulting feeling of connectedness was considered highest as a benefit for viewing live entertainment in this format. The feeling of liveness was more to do with this than the performers themselves by using scheduled and shared experiences to encourage a feeling of togetherness for audiences.

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