Reflexive-vr.com: Reconfiguring a physical VR exhibition into an online virtual exhibition due to the COVID-19 pandemic

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Abstract

This paper reviews a virtual exhibition titled *reflexive-vr.com*. Initially planned as a public exhibition featuring cinematic VR works by media artist/filmmaker Sojung Bahng, however, due to restrictions imposed by the COVID-19 pandemic, a different curatorial approach was needed in order to reconfigure the original installation plan into an interactive online viewing experience. This reflective analysis explores the design strategies involved in this case and how the viewing experiences associated with the artistic intent of three VR artworks (*Floating Walk*, *Anonymous* and *Sleeping Eyes*) was supported by the exhibition's translation from a gallery-based installation into an online virtual environment. We will address technical specifications, consider curatorial strategy and implications to narrative flow and phenomenological experience, and – while acknowledging present limitations – raise the potential for online exhibition formats to serve as a distinctive presentational mode in their own right for engaging viewers with VR works.

Keywords

Virtual Reality (VR), Viewing experience, Virtual exhibition, Curatorial Design, Mixed Reality, Scenography

Introduction

The coronavirus pandemic has had a significant impact on the cultural sector globally. One response to the disruption caused by COVID-19 to the "normal operations" of museums, galleries and contemporary arts venues has seen cultural organisations turn their attention towards digital channels and platforms in order to maintain their programming activity and engagement with audiences [1]. Since the beginning of 2020, countless exhibitions, including many public exhibitions of Virtual Reality (VR) works that require shared head mount displays (HMDs), were cancelled and some moved to remote online formats due to social distancing requirements [2, 3]. While prestigious film and media art festivals had already begun adopting virtual platforms to showcase VR films or artworks – a notable example being the Cannes Film Festival and its immersive multiplayer platform, the Museum of Other Realities (MOR) [4] – the forced closure of exhibition venues over the past two years along with restrictive measures introduced upon their reopening has instigated the need for further experimentation into how web-based virtual environments can be designed to support an accessible, inclusive and sustainable exhibition model, post-pandemic.

Definitions of 'virtual reality' vary markedly, including the broad concept of an imaginary or represented reality distinguished from the real world [5, 6, 7]. For the sake of clarity, in this paper, we define VR in direct reference to digital media whose highly personalised viewing experience requires an HMD in order to simulate visual realities. As such, exhibiting VR artworks in the public and social setting provided by galleries and festivals raises a set of challenges to exhibition design and more conventional modes of viewing, as well as curatorial protocols. As artists and curators working with the medium of VR, this situation has become even more compounded due to the implications of the pandemic on cultural engagement and urgent, prompting us to think about the roles that physical environments (e.g., galleries and exhibition venues), embodiment and performativity play in not only framing VR works curatorially, but underpinning the distinctive qualities of their viewing experience.

These observations lead us to ask: In what ways can virtual environments be designed to adequately support the aesthetic experience of VR? Can such digital spaces enhance or even supersede certain features associated with experiencing VR works in the context of physical exhibition? In this paper, we introduce the online VR exhibition, *reflexive-vr.com*, as a means of entertaining some of these associated questions.

reflexive-vr.com is an online exhibition that was initially developed to support the final presentation of cinematic VR artworks produced by Sojung Bahng (first author) as part of her *PhD* research thesis undertaken with SensiLab, an interdisciplinary research lab based at Monash University in Melbourne, Australia [1]. Bahng's practice-based research

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[1] This PhD project aligns with SensiLab's 'VR as Cultural Practice' research track, supervised by Jon McCormack and Vince Dziekan. This track recognizes that contemporary filmmakers and

visual artists alike are embracing the potential of immersive digital technology – such as Augmented and Virtual Reality – to tell stories in powerful, new and affective ways that mark a

programme was due to culminate with an examination conducted in the format of a public exhibition in June 2020. However, due to the outbreak of COVID-19 experienced in Melbourne at this time, plans for staging this examination exhibition were cancelled to comply with restrictions imposed by the Victorian State government and University, which included enforced "lockdown" and other precautionary hygienic and physical distancing measures. As a consequence, it was not possible to realise the original designs for presenting the works as part of a mixed-reality, gallery-based installation. This imposed a significant challenge to reconceptualise the curatorial strategy as a digital exhibition, and in response, a web-based 3D virtual environment was designed to meet the requirements of examination within a tight timeframe and a modest budget.

Over the rest of this paper, we will review the process of translating the physical exhibition, which was initially conceived to provide the necessary viewing conditions to experience three VR projects (*Floating Walk*, *Anonymous* and *Sleeping Eyes*), into an online 3D virtual environment. We will address key considerations involved as part of the process of reconfiguring the exhibition, its inventory and spatial design or scenography. We will discuss the outcome and reflect upon curatorial considerations, audience engagement and the potential – and limitations – realised from developing the virtual exhibition itself.

VR Exhibition in VR

In the following section, we will briefly introduce two relevant precedents that help contextualise the creative response guiding the development of *reflexive-vr.com.*

Alluded to earlier, the Museum of Other Realities (MOR) is an online, multiplayer interactive VR exhibition platform that prestigious international festivals, including Cannes XR and Tribeca, have used to exhibit VR projects affected by the COVID-19 pandemic [4]. The MOR is run by SteamVR [2]. Audiences can access media using personal headsets, such as the HTC VIVE or Oculus Rift(S), which are enabled to run Steam; however, it is currently not possible to use the MOR with mobile headsets such as Gear VR or Google Cardboard. Upon entering the MOR, audience members can customise their avatars and communicate with others using gestures or sending messages. VR projects are exhibited in a virtual space that resembles a "white cube" gallery. MOR provides a navigable interactive experience whereby the visitor is able to move through galleries and select the VR work they wish to view by clicking upon the installation artworks or sculptures. While providing a format to experience virtual artworks using HMDs, the design tropes that the MOR calls upon mimic a real-world event and venue.

In comparison, the Festival of International Virtual & Augmented Reality (FIVARS) built its own multiplayer VR exhibition platform to work on the Web [8]. While supporting a fuller range of headsets, all VR projects are rendered in 360° video. Upon entering the FIVARS online exhibition, audience members can choose avatars and interact socially with others via voice or text chat. The festival is composed of a mixture of imaginary spaces and a typical exhibition venue with spherical images standing in for each project. This inventory of videos can be watched on a personal computer or headset. If wearing a headset, audience members can access media content by navigating the spaces using controllers or through gaze interaction. In contrast, the Web version only enables the environment to be navigated by using a keyboard and mouse.

To summarise: Achieving the fullest visual and interactive experience of VR requires a demanding technical set-up. Nonetheless, it is still possible to provide audiences with a cinematic viewing experience by curating online festivals or virtual galleries that serve up readily accessible 360° rendered videos distributed via the Web or mobile headsets. While the MOR offers a navigable-interactive VR experience, it only works with high-performance virtual headsets; whereas, the FIVARS's platform works with the Web and all kinds of headsets but does not support interactive experiences. These comparisons – and the dilemmas they reveal – speak to the current possibilities and limitations of experiencing VR in a domestic setting.

The curated experience provided by MOR and FIVARS translates features immediately associated with physical exhibition (galleries; conference venue) into a virtual facsimile of those spaces. While effective and efficient for the most part, are there other possibilities for reaching audiences online that are more affective, satisfying and speak to the fuller spatial, embodied and performative experience that VR artworks can conjure?

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transformational moment in the evolution in the craft of "immersive storytelling". By adopting practice-based methodologies that embrace studio research, practitioner-researchers (media artists, creative technologists, content producers) are challenged to engage deeply and experimentally with immersive image technologies to conceive, develop and undertake projects resulting in creative outcomes (artworks, film screenings, installations) that seek to define the language of these media forms and introduce new

understandings of the narrative and experiential parameters of the medium beyond the cinematic frame to cinematographic space.

[2] Steam is a video game digital distribution service by Valve. SteamVR, operated by Steam, is the tool for experiencing VR content using HTC VIVE, Oculus Rift or Window Mixed Reality headset.

Reflexive-VR.com

Inventory of the exhibition

As part of the examination requirements associated with Sojung Bahng's practice-based *PhD* thesis, *Cinematic VR as a reflective tool beyond empathy*, it was expected that the creative outcomes of her studio research be presented in the form of a final exhibition. Ostensibly, the purpose of the exhibition and its adherence to the examination policies outlined by Monash University is predicated upon providing two appointed external examiners with the opportunity to view the body of creative work first-hand. This viewing experience enables them to engage in a first-hand phenomenological way with each VR project – which might be construed as the "primary source" artefacts – along with accompanying archival materials and other supporting documentation.

The inventory of the examination exhibition was comprised of three VR projects produced by Bahng between 2016-2020: *Floating Walk* (360° video), *Anonymous* (interactive mobile VR) and *Sleeping Eyes* (interactive navigable VR). Each project was conceived as a means of exploring the communicative potential of cinematic VR in response to themes of personal and societal alienation, disconnection and isolation. The socio-cultural issues focused upon in these creative works prompt the audience to engage in critical self-reflection and to reconsider how they connect empathetically with others. More specifically, the subject of these projects engaged with immigrant identity (*Floating Walk*), no-relationship society (*Anonymous*), narcolepsy and social ignorance (*Sleeping Eyes*). Brief synopses of each work follow.

Figure 1. – A still from *Floating Walk*

Floating Walk – Gangnam Kangaroo is a 360° autobiographical documentary of a Korean woman living in Australia. She goes on a journey of self-confrontation to the root of her unclear but painful emotion and discovers that historical traumas have affected her identity. A spatial collage of 360° video images represents the artist's journey in Australia and Korea.

Figure 2. – A still from *Anonymous*

Anonymous is an interactive 3D real-time rendered cinematic VR applying gaze interaction. The story concerns the life of an old man living alone and remembering his life. The main character and his environment are abstracted by using cardboard textures. The viewer is able to access the perspective of objects that fill this domestic setting, ultimately finding themselves assuming the role of the man's dead wife, where from the vantage of her portrait hung on the wall, they observe the rituals of his solitary daily life.

Figure 3. – A still from *Sleeping Eyes*

Sleeping Eyes is an interactive cinematic VR piece that tells the story of Sungeun Lee, a South Korean media artist suffering from narcolepsy. The work invites viewers to experience the symptoms and experience of someone with narcolepsy, including uncontrollable sleepiness and physical violence rooted in social ignorance. Non-linear narrative and gamification techniques were applied to make the viewers actively explore a series of surrealistic episodes. Additionally, the viewer makes them aware of their own feelings by utilising a heart-rate sensor to visualise their own stress states while experiencing the artwork.

Initial exhibition plan

As an integral part of Bahng's research programme, each of these works was presented previously in a variety of public exhibition settings and contexts. These occasions provided the opportunity to understand how viewing conditions influence the interpretation of the work by audiences. Insights gained from reflecting on the successes (and otherwise) were drawn upon to inform installation plans for the final examination exhibition.

Floating Walk was exhibited at several venues[3]. Installation components were limited to a set of rotating chairs with mobile headsets, such as Gear VR or Google Daydream, and stereo headphones. As this project relates the artist's personal stories to historical and collective memories, it was crucial that viewers be encouraged to draw connections between historical events and the artist's family history through the archival information provided. Furthermore, as the work contains a high degree of spatiotemporal information, including various spaces, times, people and audio sources, it was observed that many people struggled to focus simultaneously on the visuals and audio, and thus missing important information about significant parts of the story. Informed by this observation, it was decided that it would be beneficial to display background historical documents, such as family photos, news articles and related books, along with the VR film as part of any future exhibition of *Floating Walk*.

Anonymous was previously exhibited for both a single viewer in an enclosed room, as well as for a larger audience in a public venue[4]. From these experiences, it was gleaned that some viewers tended to reflect more upon the work and their own feelings when in the private set-up than when in the public venue surrounded by people. Thus, for the final examination exhibition, it was determined that creating a staged, ritualistic private set-up in an enclosed room containing cardboard made ceremonial objects related to the work would be most affective to elicit the viewer's curiosity about the work and provide a ceremonial experience for *Anonymous* related to death and loneliness. For example, we planned to create cardboard portraits of the widower and his wife. In front of the portraits, we wanted to put different foods such as fruits, chocolates, nuts and tea on cardboard made plates, as is often used in a small ritual for commemorating dead people in Korea.

Lastly, with regards to *Sleeping Eyes*, VR was used as a medium to represent the symptoms of narcolepsy and provoke fundamental reflections on the boundary between dreams and reality. The story itself is set between locations representing a high school and a military training ground. Considering the important role that these psychologically charged environments play in the work, we aimed to fabricate a physical structure resembling an army watchtower in the exhibition space. In addition to symbolising an in-between liminal space that resonates with the project's theme, this structure would be treated as the main presentation platform where viewers would be fitted with the headset and heart-rate monitor to interact with the piece.

However, with the onset of COVID-19, it became immediately clear that it would no longer be feasible to convene the examination exhibition as per "normal", let alone realise the curatorial design of the installation as envisaged. Thus, with little other recourse, the strategy for the examination had to be reconsidered, and the staging of the exhibition reconfigured in response to presenting the works exclusively through an online exhibition platform.

Redevelopment of the exhibition

The main objective of the virtual exhibition was to substitute for the physical exhibition as the part of PhD examination process. We designed a Web-based 3D virtual environment working with a tight timeframe of six weeks and a modest budget of $4000. Technically, the virtual exhibition was implemented using Three.js, a JavaScript library used to create and display animated 3D graphics in a web browser using WebGL. Presently, the current version of the exhibition can be only viewed on a standard computer screen; for instance, the viewer can play a 360° video in the virtual gallery by clicking and dragging with a mouse. As with the FIVARS implementation, the ultimate goal is to turn the exhibition into a fully immersive experience by using VR HMDs to showcase the works within the virtual environment (i.e., VR in VR).

Our aim was not to recreate the planned physical exhibition in a virtual format, but rather to create an explorative, phenomenological and spatial experience that would support and contextualise the set of cinematic VR works being exhibited. In this respect, our chosen approach aligns with the concept of 'time-based scenography' [9]. While originally drawn from a theatrical context, in more contemporary terms, scenography is recognised as a transformative model for curating and designing exhibition-based experiences that cross-pollinate theory and practice. Instead of considering objects and media as discrete from each other, or viewing visual, auditory or other sensory modes separately, time-based scenography seeks to take account of all elements that comprise an exhibition more holistically. As part of our

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[3] *Floating Walk* was presented at the Melbourne Fringe Festival 2017 and was selected as one of the finalists for the Social Impact Media Awards (SIMA) 2018 in Los Angeles.

[4] *Anonymous* was shown at Bucheon International Animation Festival (BIAF2019) in Korea, Tbilisi International Animation

Festival (TIAF2019) in Georgia, Torino Short Film Market (TSFM2019) in Italy, and Montreal International Animation Film Festival (ANIMAZE2020) in Canada.

curatorial strategy, we intended to provide an immersive experience along with supplementary documentation related to each VR project. This redevelopment supported main requirements of the exhibition; namely, establishing spatial context, embodied experience and performative viewing.
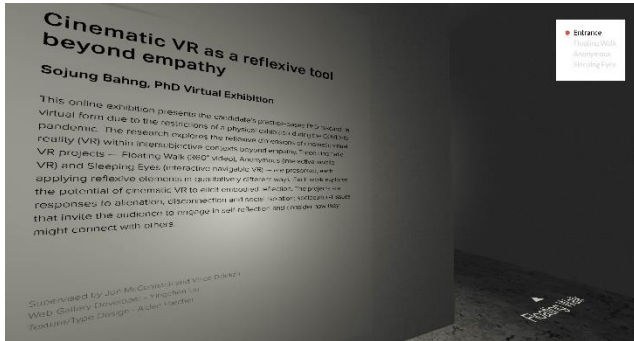

Figure 4. – First-person views of the online gallery: the gallery entrance. A simple menu (top right in each image) allows quick navigation to rooms in the exhibition already explored.

Design of the virtual environment

In order to support these requirements, we developed a curatorial design approach [10] that treated the virtual exhibition as an opportunity to reconfigure the spatial, embodied and performative aspects associated with the distinctive viewing experiences of each of the three principal VR projects.

In the resulting web-based 3D environment, the exhibition space is divided into four sections. The visitor's journey through these "galleries" is predetermined and follows a linear path. The presentation of each VR work follows a chronological order. The viewer is directed from one gallery space to the next in successive order, and only upon reaching the final room are they able to retrace their steps and re-visit works at their own discretion.

Upon first entering the exhibition, the viewer finds themselves in an anteroom where they are provided with an introductory explanation about the exhibition and its inventory of artworks in the form of a didactic panel. Each artwork is installed in a dedicated gallery, providing the viewer with access to renditions of the VR films (either 360° video or play-through) along with representative images, digital objects and textual descriptions related to the individual project.

Figure 5. – The room of *Floating Walk* with the headset visible on the table.

The 360° VR film, *Floating Walk,* is located in the first gallery. A timeline runs along the side wall of this small cubic space, juxtaposing modern and contemporary South Korean history with the personal history of the artist and her family. Facing opposite, a full wall of passports is displayed from all over the world symbolising a story of immigration. These collected artefacts (photographs, newspaper clippings, passports) can be inspected more closely by the viewer and at their own discretion. These documentary materials provide the viewer with a wealth of historical and personal detail that help contextualise the auto-ethnographic aspects of *Floating Walk*.

In order to view the VR film itself, the viewer activates the 360° video by clicking on a virtual depiction of HMD found amongst assorted items placed on a desk in the centre of the room. Next to the HMD is a pair of headphones, which plays a short, spoken explanation of the work by the artist in a manner similar to a traditional gallery audio guide. By drawing upon familiar and established museological conventions (i.e., the interpretive function of displays of archival resources or audio guides), the viewer is comfortably enabled to navigate the virtual environment in a manner not unlike how they might experience the exhibition in a physical gallery setting.

After watching the video, the visitor will notice that the gallery environment has undergone a subtle change: a cardboard door has appeared in the corner of the room, which reveals a connecting passageway leading onwards to the next gallery in which the second artwork, *Anonymous,* is featured.

Figure 6. – The gallery room for *Anonymous*

This second space is treated in a far less literal than the first. Our design intention was to defamiliarise the viewer by transitioning from a space that resembles a conventional art gallery to a small room made from cardboard. Finding themselves in this enclosure breaks the viewer's expectations. By evoking spatial estrangement [11], we hoped to instill a sense of curiosity that encourages them to explore the virtual space more actively and imaginatively. For starters, the lining of the walls, floor and ceiling appear to be made from a cardboard box. A small shrine is placed in the middle of the room.

This discrete installation serves an important ritualistic purpose, and reprises a performative strategy whereby a constructed model (or "prop") was included in previous public exhibitions of the work. On a small, unassuming table, portraits of the film's main characters (the widower and his wife) are lovingly placed, along with a candle and some food such as fruits, chocolates, nuts and tea. Crucially, this tableau was originally fabricated entirely from cardboard, thereby creating a portal between the physical environment of the exhibition space and the virtual world the viewer discovers themselves performing the ritual as soon as they don a headset and enter the imaginary scene.

Once again, digital renditions of an HMD and headphones resting unobtrusively on a cardboard box cue the protocol established with the viewer with the first work, whereby upon clicking the HMD, the 360° video of *Anonymous* is played. At the conclusion of the video, the visitor is drawn towards a doorway in the corner of the room, which serves as a gateway into the final section of the exhibition.

Unlike the previous transitions between the gallery spaces, this time, the viewer is immediately immersed in a different, alien environment that resembles a meandering, cave-like tunnel. Atmospherically, a sense of unease is reinforced by a surreal soundscape interspersed with distorted voices. The cave symbolises a bridge from the conscious world to the unconscious dream world. After their descent, the viewer emerges into a surprisingly vast, cavernous space where only a single watchtower stands, imposing and silent.

The design of the virtual environment was inspired by the original intention to fabricate a physical platform in which

to situate the viewer as part of the gallery-based exhibition. This construction would have introduced a theatrical dimension to the viewing experience, and transformed the otherwise limited "visual" engagement with the VR film into a fuller multisensory, mixed-reality encounter with the work.

This exhibition-making approach is not uncommon amongst contemporary artists working with VR who incorporate installation-based or spatial design considerations into their practices. Illustratively, artists Jess Johnson and Simon Ward introduced a themed series of spatial elements to create a multi-dimensional setting for their five-part, virtual reality experience, *Terminus* (2017-18). Each "station" plays an important role in what might be considered as a world-building exercise that establishes a relationship between these interior spaces and the virtual world experienced via VR. A similar convergence, this time between real objects and represented spaces, was achieved in a survey exhibition of New Zealand jeweler, Lisa Walker at the Museum of New Zealand Te Papa Tongarewa. The exhibition design featured a range of constructions and objects as well as tools and materials from her workshop displayed along with a 360° video tour of the artist's studio; which serves to contextualise the other is left open to interpretation. For his part, Christian Thompson successfully transported the viewer of *'Bayi Gardiya' (Singing Desert)* – his VR commission for the Australian Centre for the Moving Image – into the landscape of his childhood by staging the performative viewing of the work within a simple ring of sand. This simple physical feature complemented the highly immersive, visual and sonic experience by literally and imaginatively connecting the viewer to a creek bed known as The Sixth Mile in Barcaldine, Western Queensland, where the artist grew up.

Returning to *Sleeping Eyes*: When the viewer approaches the watchtower in its reconstructed digital form in the virtual exhibition, they are invited to ascend a ladder. Upon reaching the top, they alight onto a small, restrictive platform containing a classroom desk where a set of drawings created by the film's protagonist (the artist, Sungeun Lee) are scattered across its surface, along with an HMD that invites activation of a 2D play-through video of the VR film.

Figure 7. – The view from up in the watchtower *for Sleeping Eyes*; The HMD and headphones can be seen on Sungeun's desk.

Reflection and Discussion

The need to shift from preexisting plans for physical installation to online exhibition demanded an agile curatorial response. The subsequent manifestation of the virtual environment sought to reconfigure certain presentational as well as more phenomenological considerations related to the experiential qualities associated with each of the three VR artworks.

In the first instance, it proved unfeasible to provide viewers with a full VR experience of the works due to the technical and budgetary constraints of the current version of the online exhibition. Head-mounted displays are synonymous with VR, and the physical encumbrance of wearing one is certainly an embodied aspect of the viewing experience. However, in the current version of the digital exhibition, the three VR films can only be viewed in a web browser as rendered videos (360° and 2D play-through videos). Because there is currently no uniformly adopted platform for sharing VR media, for practical purposes, we found that exported 360°, or 2D play-through video proved to be the safest way to both archive and share content remotely through an online presentation.

Because *Floating Walk* was originally created in 360° video, it is readily viewable online. For its part, *Anonymous* was exported as a 360° video. Original production considerations for this work took into account a seated viewing position and simple gaze interaction; however, the active engagement derived from looking at and interacting with objects was omitted from the 360° version. Additionally, it was determined that producing a 360° video version of *Sleeping Eyes* was not an applicable way to represent the work.

The viewer's interactive engagement within the film is integral to the narrative experience; these interactions include grabbing objects to trigger sounds, gamification elements that require viewers to perform movements such as avoiding lasers and a biofeedback sensor that connects the viewer's heart rate to values that affect audiovisual aesthetics. Complex interactive elements like these cannot be translated into 360° video. Instead, it was determined that a 2D play-through video that provides a first-person simulation experienced by the typical viewer would be more appropriate. The video represents the audiovisual and narrative aspects of the project and demonstrates how these interactions were intended to work. However, this format cannot deliver the actual phenomenological engagement provided by interactive navigable VR with HMDs and controllers.

Despite these technical limitations, the design of online exhibition online forced us to rethink some underlying presentational conventions. In the first instance, as demonstrated by the curatorial design strategy applied to *Floating Walk*, familiar gallery conventions were called upon to make the viewer comfortable with the virtual environment. This strategy supported the viewer's ability to access supplementary materials related to each of the works and actively explore this content (informative and poetic artefacts, images, and texts). These materials enriched contextual understanding of the works, their genesis and framing stories.

The curatorial design framing the presentation of both *Anonymous* and *Sleeping Eyes* embraced the potential of the virtual exhibition more adventurously. In each of these cases, the VR films are contextualised in ways that would otherwise not be possible in a "real" gallery by creating unrealistic and exaggerated settings for these works to be experienced within. In a sense, instead of incorporating digital media "into" the exhibition, it is the visitor who finds themselves brought "inside" the narrative. These design interventions indicate the potential to interleave different spatial tropes in order to produce a more experiential scenography.

Conclusion

This paper has presented a timely opportunity to take account of the significant implications that the COVID-19 pandemic had upon the way in which we approached the staging of an exhibition of cinematic VR works. This unexpected situation forced us to reflect more directly upon the role of the exhibition, notably the ways that physical environments and embodied performativity contribute to the viewing experience of VR. Ultimately, we found these deliberations to be especially prescient, given that the subject of social isolation found itself represented both in the central themes found in this body of creative work and amplified by presentational issues facing their exhibition and viewing experience.

Finding ourselves in a situation wherein we needed to find a practicable way to present this series of VR projects, we discovered that we were faced with a larger intellectual challenge. This entailed reconceiving the very idea of what constitutes VR exhibition-making. In this regard, time-based scenography inspired us to rise to the challenge – not only those encountered with respect to issues surrounding the staging of the aforementioned examination exhibition – but to seize the curatorial opportunity for treating the exhibition as a means to reimagine the nature of viewing experiences involving 'a multisensory body, moving through multi-channel space and an elapsed time' [9].

Having negotiated this reconfiguration from a physical to virtual means of exhibiting VR works, we inevitably found ourselves reflecting upon what enduring impact the global pandemic might have on the ecosystem of the VR industry in coming years. Faced with the post-pandemic "reopening" of museums, galleries and arts festivals, it is to be expected that it will become increasingly difficult for shared headsets to be used if presenting VR artworks in public settings. In contrast, it is reasonable to anticipate that VR experiences will become more directed towards private consumption at home using personal devices than at present.

These implications raise a host of new opportunities to develop imaginative modes of VR exhibition-making that support rich, situated mixed reality experiences to connect people with place and counteract isolation and disconnected social circumstances.

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