

RADICAL IMMERSIONS

NAVIGATING BETWEEN VIRTUAL/PHYSICAL ENVIRONMENTS AND INFORMATION BUBBLES

DRHA 2019

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Abstract

Virtual reality is an embodied medium. It extends reality by altering the perception of the bodily senses. However, many virtual reality experiences ignore the body, attempting to leave it behind upon entering the virtual space. As virtual reality is experienced through the body, the conflict between mediated and unmediated senses splits the self between the virtual and actual spaces. We explore the process of embodying a virtual body through the lens of Lacan's mirror stage. Building on psychological research that has established the mirror's capacity to (partially) embody other bodies and artistic installations' capacity to alter and abstract the image of the body, we propose that mirrors can be used to embody abstract virtual bodies that go beyond simulating reality. To accomplish this, we introduce the concept of the mixed reality digital mirror, one which is co-located in both virtual reality and in actual space. The application of mixed reality mirrors is exemplified in the mixed reality installation *Transcending Perception*. From this we propose that mixed reality mirrors may be a promising way to connect the actual body and environment to their virtual counterparts to create a more holistic experience.

Keywords: Virtual Reality; The Mirror Stage; Embodiment

TRANSCENDING THE VIRTUAL MIRROR STAGE: EMBODYING THE VIRTUAL SELF THROUGH THE DIGITAL MIRROR

Introduction

Mirrors have long provided access to virtual space. Well established in everyday life and as artists' tools, the optics of these planar surfaces present an interface to interact with and understand ourselves through the virtual image. They simultaneously externalize and alienate the self from an objective body while situating it within and connecting it to a larger whole. The mirror reminds us of our likeness and difference to other human bodies and that which surrounds us (Lacan, 1949). Most importantly, it makes palpable the embodied mind's presence in reality.

The ongoing proliferation of immersive technologies enable a more intimate, embodied connection with an ever-expanding multiplicity of virtual spaces. These technologies blur the distinction between virtual and actual reality, allowing a physical exploration of cyberspace; however, in entering the virtual space, identity can become disconnected. In many current immersive experiences, the body disappears, represented instead by only hands or controllers. These distal and ethereal means of interacting with the virtual threaten our embodied selves with a translucent existence.

Providing a body in virtual reality (VR) acknowledges our embodied existence that persists when we enter virtual worlds (Hayles, 1991). It allows for a stronger sense of presence in a virtual environment and allows for the body itself to be altered (Slater 2009). It acknowledges the immersant's desire and need for virtual embodiment and creates an opportunity to mediate the body itself. Yet the body may remain estranged and even ignored due to its situation in the periphery of the immersant's restricted vision. In VR, we can make bodies more fluid, ethereal, and abstract than

the immersant is accustomed to, and as such, we need a mechanism to establish a connection between the self and its virtual embodiment.

Transcending Perception (Figure 1) is an immersive installation that uses body tracking combined with a VR headset and projections to allow immersants to use their bodies as musical instruments, producing abstract images and sound (Desnoyers-Stewart, 2018). The projections act as mirrors, presenting a real-time reflection of the virtual space, establishing its physicality and immersants' presence within it. Immersants are connected to co-located abstractions of their body through this mirror metaphor which persists in the virtual imagery of the VR headset.

We used mixed reality mirrors to create the immersant's digital identity by establishing a sense of ownership over the reflected virtual body in a familiar way. It situates their embodied self within the virtual environment presented in the mirror space, authenticated by the familiar connection between the virtual image and reality. Moreover, the two-dimensional nature of the mirror affords its existence both within the reality presented by a VR headset, and as a projected digital mirror outside of the headset. As an object with mixed realities, the virtual mirror projects the virtual space back outwards, allowing it to take on real, physical space.

In this paper, we propose that the mixed reality mirror has the capacity to embody immersants within digital bodies, allowing them to enter virtual space, and enabling the virtual to permeate into physical space. Framed by *Transcending Perception*, and contextualized amongst other immersive digital artworks and technologies, we will



Figure 1. *Transcending Perception* at Nuit Blanche 2018. An immersant is seen interacting with the system as their virtual reflection is displayed in the co-located mirror behind them. The visuals projected onto their body are their virtual representation. Photo Munz Media © Nuit Blanche Regina, 2018.

support this theoretical discussion through the philosophy of Lacan and Foucault while grounding it in psychological research. Mirror space allows for navigation between digital and physical environments, by establishing a connected identity, and embodied virtual self.

The Virtual Mirror Stage

The image seen in the mirror is a familiar one. From a young age, around 2 years old, we learn to recognize our body as our self, distinct from its surroundings—an entity over which we have seemingly exclusive agency. However, it was not always so. This connection between image and identity, and the distinction

between the physical body bound by flesh from an external other, was acquired.

Lacan's mirror stage is the developmental phase in which the self is separated from the other. This formation of a self-other boundary occurs through an exploration of the agency over the physical body coupled with distinguishing between that which is similar and that which is different from the self. Lacan describes the child's discovery of the self in the mirror as: "[An] act [which]... immediately gives rise in a child to a series of gestures in which he playfully experiences the relationship between the movements made in the image and the reflected environment, and between this virtual complex and the reality it duplicates—namely, the child's own body, and the persons and even things around him." ([1949] 2006, p. 75)

The playful exploration of the virtual image in digital installation art and virtual reality parallels this process, and Lacan's concept of the mirror stage may help to understand how we can identify with a virtual avatar through an embodied process. Whether in VR or an interactive installation, as the immersant notices their agency over the image they move and play with it to understand the relationship. This event allows them to identify their existence in the virtual image or environment.

Embodiment through the Mirror

Lacan's mirror stage is foundational in understanding and critically analyzing the role of the mirror and image of oneself in embodying a virtual body. While Lacan uses the child's interaction with the mirror as exemplary of this stage, the mirror stage does not necessarily require a mirror per se. Instead, the mirror stage occurs through the recognition of the image of "self" as distinct from its surroundings. The image of others is also important to establishing the identity of the self.

Thus, the mirror phase involves not only the mechanism of the mirror but seeing other bodies which mirror or contrast with our own.

Nonetheless, the mirror, and the capacity to see one's self "over there" in the virtual image is an important tool which shapes one's identity. In many ways, the mirror, and Lacan's mirror stage, present potential tools and metaphors to better understand how we might embody the virtual self.

Bolter and Gromala state that, "looking into a silvered mirror is an experience of looking at and looking through. A mirror seems to be transparent and to reveal a world parallel to our own..." (2003, p. 34) In contrast however, virtual reality interfaces often seek to be transparent, to disappear completely. Virtual reality psychologist and researcher, Mel Slater, defines presence in VR as "the extent to which people respond realistically within a virtual environment." (2009, p. 3555) Arguably, this focus on "realistic behaviour" originates in his use of VR to conduct psychological studies of "real world" phenomena rather than as an exploration of the possibilities of virtual realities.

To produce "realistic behaviour" requires the medium to disappear and be fully transparent—to be a window, not a mirror. Taken to an extreme, the ultimate form of presence defined in this way would arise in the dissolution of the actual body. In reality, the body's presence always reminds the user of their actual existence and embodied memories along with the virtual reality experience's artificiality.

The Physicality of Virtual Space

Yet, virtual reality is an embodied experience—to remove the body is as futile as it is terrifying. As Katherine Hayles states, "Our bodies are no less actively involved in the construction of virtuality than in the construction of real life." she states that "we can see, hear, feel, and interact with virtual worlds only because

we are embodied." (1996, p.1) As a result, virtual reality needs to reflect our physical and embodied existence rather than ask it to disappear. Mirrors allow the virtual body to exist in virtual space, they create a sense of physicality within the ethereal.

Both virtual reality and the image in the mirror create what Morie calls the "bifurcated self." (2007) Agreeing with Hayles, she claims the physical body cannot be left behind to enter virtual space. The body is simultaneously in two spaces at once, virtual and actual, as shown in Figure 2. Diverging sensory inputs split the body in two. In the mirror we see the self "over there" but our other senses tell us we're still "here." In VR, vision suggests we inhabit another body in another world, but the kinesthetic senses, and the memory of our actual body counter this experience; recalling the body's simultaneous presence in actuality. Understanding that presence is situated in the body and becomes split through the divergence between the mediated and unmediated senses will help to advance our use of virtual reality in new ways. It will allow us to move past the obsession with leaving the body behind and focusing on bringing it with us into cyberspace.

This bifurcation of the self spills out of the experience as the immersant removes their headset. Not only is the body split, but reality is too—the virtual space takes on physicality retained through the memories of the embodied experience. Just as the immersant remembers their actual body and environment in virtual reality, they remember their virtual body and environment when they return to actuality. Foucault states that the mirror is simultaneously both a utopia and heterotopia, a place with no reality and yet one that is completely real (1986). The same applies to the space of virtual reality—it is perceived as occupying physical space and yet is a site with no actual place. Through the digital mirror this heterotopian/utopian space flows out into reality, taking on physical form through the metaphor of the mirror.

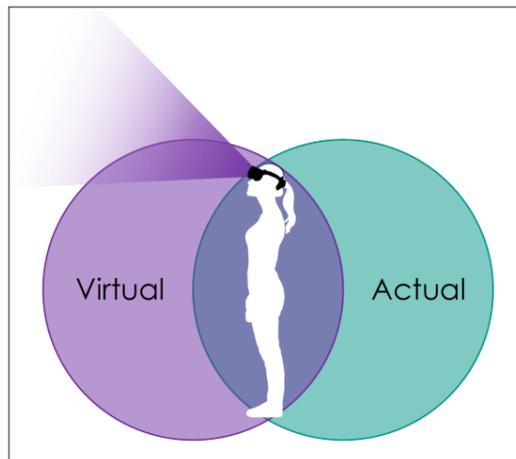


Figure 2. The bifurcated self, split between virtual and actual environments. Revised from Morie (2007) using graphics from © dimensions.com, 2020.

Digital Mirrors

In Psychological Research

Virtual mirrors have been used extensively in psychological studies to create an illusion of body ownership in VR to test the effects of embodying another body on one's behaviour. González-Franco et al. (2010) demonstrated that the synchrony between the mirror image and the body directly affects body ownership. Subsequently, Slater et al. (2010) demonstrated that the use of this co-location and mirror technique was sufficient to induce body ownership without the need for visuotactile synchrony, in contrast to Slater et al.'s previous findings (2009). This realization opened up the possibility of many body illusion experiments. In each of the following examples the participants wore a motion capture suit and could see their virtual avatar from the first person co-located with their body and reflected in a virtual mirror. Kilteni, Bergstrom, and Slater used this technique to show that embodying a casually dressed dark-skinned avatar promoted better performance

in a drumming task over a formal light-skinned avatar (2013). Banakou, Hanumanthu, and Slater showed that embodying a black avatar as shown in Figure 3 (i) could reduce implicit bias (2016). Further Banakou, Groten, and Slater showed that this mechanism could induce behavioural change and alter implicit biases by placing the immersant in the body of a child (2013).

Gonzalez-Franco and Lanier (2017) suggest that these behaviours are the result of stereotypes and preconceived notions of the immersant about the other body that they are occupying. One study by Osmio et al. (2015) shown in Figure 3 (ii), seems to play into the stereotypes of participants explicitly as it begins by having them explain a personal problem to a virtual Sigmund Freud, and then subsequently embody Freud to counsel themselves about that problem. The researchers demonstrated that embodying Freud had a significant effect on the improvement in mood and happiness. Once again, a mirror is used to reinforce the sense of embodiment, but in this case to also reinforce embodiment within another body while one's own body is in plain view.

Notably, amongst the authors in all these examples is influential VR psychologist, Mel Slater. According to Slater et al., "One of the advantages of a virtual reality representation is that it is possible to easily go beyond what is feasible in the physical world." (2009, p. 217) Yet many of these psychological studies center around reproducing "realistic" behaviour through "realistic" representations. The uncanny representation of the simulated "realistic" human seen in these examples points to its artificiality without acknowledging it. Nonetheless, these psychological studies demonstrate the plasticity of body ownership which allows humans the capacity to enter another bodily representation. Gonzalez-Franco and Lanier point to several studies which suggest that this plasticity could allow body ownership to be bent beyond conventional human forms (2017).

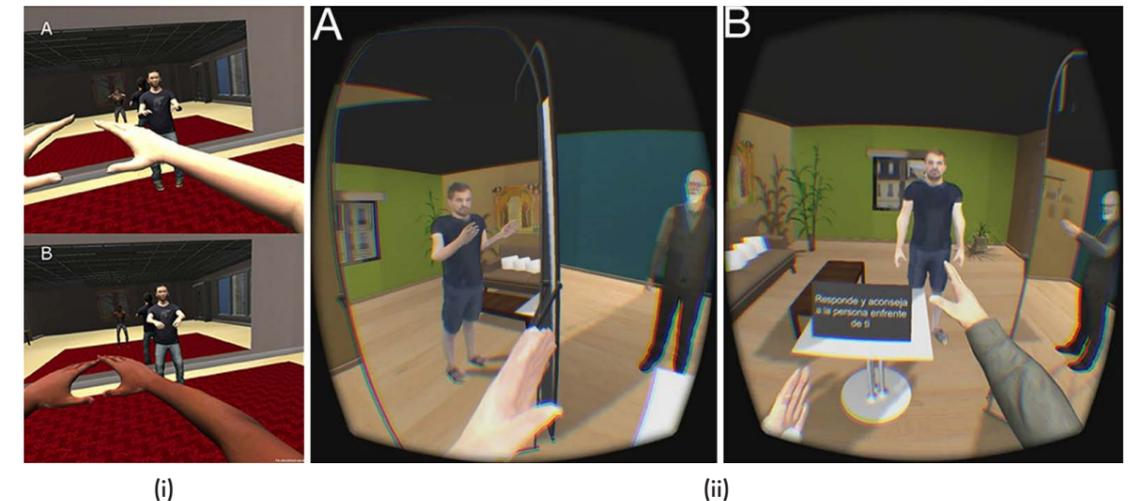


Figure 3. Examples of mirrors used to induce body ownership in Mel Slater's experiments. (i) Two conditions from Banakou et al. (2016) where the participant does Tai Chi while in a White or Black body. © Banakou, Hanumanthu and Slater, 2016, CC-BY. (ii) In Osmio et al. (2015) participants first embody a virtual version of themselves (left) while explaining a personal problem and then embody a virtual Freud to counsel themselves on how to resolve the problem © Osmio et al., 2015, CC-BY.

In Installation Art

Through the focus on reproducing reality, these examples fail to imagine the potential of virtual reality to expand reality. If "realistic" representations lead to "realistic" behaviour, then could abstract and ethereal representations alter that behaviour? Could this proven mirror metaphor continue to hold when the body loses connection to its familiar form?

There are many examples of abstract digital mirrors in interactive art. Perhaps the most famous are the mechanical mirrors of Daniel Rozin. His mirror installations manipulate tiles of materials to form a reflection in an array of physical pixels, reminding the viewer of the physicality of the digital interface and how it mediates their identity.

Golan Levin uses a mirror metaphor in his large-scale interactive projection, Ghost Pole Propagator, shown in Figure 4. Here, bodies are abstracted using an algorithm commonly used in Optical Character Recognition (OCR) to simplify

them to petroglyph-like stick figures. This mirror reflects a glyph which focuses the participant on their posture and gesture, allowing them to form new symbols with their bodies.

Chris Milk uses the abstract form of the shadow and a mirror metaphor to transform the participant's body in his Kinect-based interactive installation, The Treachery of Sanctuary. In this triptych, the user goes on a journey through phases of birth, death, and transformation, represented by birds being emitted from the body, birds attacking the body, and finally ending with the participant's shadow spreading wings and flying away.

Transcending the Virtual Mirror Stage

What is unclear in these artistic examples is whether the mirror image on its own is sufficient to create the illusion of body ownership over the reflected image. The participant sees another image in the mirror but when they look down they still have their own body. In this case, perhaps the mirror actually reinforces



Figure 4. People interacting with Golan Levin's Ghost Pole Propagator II. Their bodies control the appearance of the glyph-like figures seen in the large laser projection © Golan Levin, 2016 CC-BY.

a boundary, creating a more externalized sense of control over the marionette behind the mirror. How can we transcend this virtual mirror stage and embody these abstract bodies?

Transcending Perception

In the virtual reality installation, *Transcending Perception*¹, (Figure 5) co-located digital mirrors are used to project the virtual space outwards with the aim of combining the actual and virtual and combating the bifurcation of the self and space. In its third public exhibition at the 2019 Richmond World Festival, Digital Carnival we transformed the inside of a shipping container into a stage surrounded on three sides by virtual mirrors. It was used by an estimated 1000 participants over two days and served as the site for several experimental VR dance performances, where participants could watch dancers through the VR headset or the virtual mirrors (Figure 6).

In *Transcending Perception*, bodies are tracked by a Kinect in 3D space and transformed into ethereal particle system bodies. These



Figure 5. Several people interacting with *Transcending Perception* at Nuit Blanche Regina 2018. The projections behind them act as mirrors of what can be seen in the VR headset. Photo © Yujie Gao, 2018.

bodies translate movement into instruments of light and sound. Up to 6 participants can simultaneously interact with the projections. One participant can put on the VR headset and enter the virtual space completely as the people who surround them are abstracted into the forms seen in the projections in 3D space.

The Mixed Reality Digital Mirror

Missing from previous examples was the co-location of the virtual and physical mirrors. In the examples of VR psychology research, the mirror exists only within the virtual environment. Meanwhile, in the examples of artworks using digital mirrors, the space within those mirrors is as impenetrable as the physical mirrors that they are inspired by.

In *Transcending Perception*, the mirror metaphor was used to create a sense of three-dimensional space that would form an initial stage of immersion and allow for interaction without the VR headset. To accomplish this a "mirror cave" was used, consisting of virtual mirrors projected onto three walls that surrounded the user while leaving an open entrance for progression between observation and interaction. In the image shown in Figure 7 you can see the immersant looking at the very same reflection that we see in the projection—we see what she sees through the mirror.

These mixed reality digital mirrors are created by co-locating projections of the reflected virtual space with mirrors in the virtual environment. The body tracking alters the projection to align with the user's head, matching the perspective of a real mirror—an effect so natural that it becomes transparent to the tracked immersant while simultaneously being made evident to others as the perspectives of onlookers are warped to conform to the tracked immersant's point of view.



Figure 6. An audience member watches a performance by Annabelle Wong through a VR headset, those waiting for their turn to watch in the headset see the same imagery in the projections. Photos © Ash Tamasiychuk, 2019.

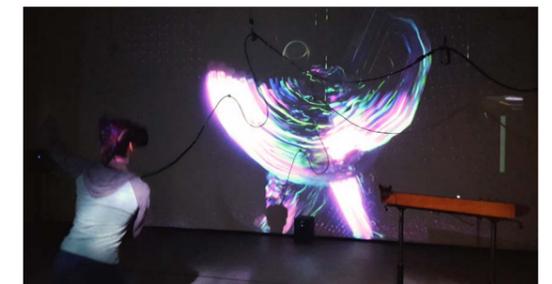


Figure 7. An immersant playing with their abstract reflection in the mirror demonstrating the parallel between the mirrors seen in the headset and projections. Photo © John Desnoyers-Stewart, 2018 .



Figure 8. Participants interacting with *Transcending Perception* in a variety of different ways. At the top an immersant interacts while looking in the co-located mirror; in the centre, an immersant looks at the virtual representation of another's body; and at the bottom an immersant actively plays with the visuals presented in the VR headset. Photos © Ash Tamasiychuk, 2019.

Extending Reality through the Mirror

The physically co-present, mixed reality digital mirrors help to unite the actual and virtual body, to counter the bifurcation of the self and transform virtuality into an extension of actuality. The immersant is still aware of their actual body, but their senses no longer disagree with their virtual body. This allows immersants to embody very abstract and ethereal forms.

Figure 8 shows several examples of immersants interacting with *Transcending Perception*. In the first image you can see an immersant beginning to interact with the system, looking in the virtual mirror to see their virtual body for the first time. In the second image the immersant looks at the virtual representation of another. Their familiar appearance is transformed into a magical display of light and sound that responds to their excited movement. In the third image, an older adult is seen playing with the lights and sounds, inspired by the body's extended potential to move expressively in front of a crowd of onlookers. These images also demonstrate a common progression seen as immersants go through this virtual mirror stage, from first noticing the reflection, to timid exploration, to expressive movement and playful interaction.

The immersant retains their virtual body both in the VR headset and outside of it—taking their actual body in with them and bringing a virtual one back out. Their virtual body is not somewhere else, but here—continually co-present as long as they remain in the active space. More than this, the VR experience becomes a virtual mirror world, with the actuality of human bodies injected into the virtual experience and their virtual representation projected back out into reality through the VR headset and mirror projections. In *Transcending Perception*, the virtual mirror projects the virtual space back outwards, allowing it to take on real, physical space. The virtual space becomes a simulacrum of reality, and reality a copy of the virtual—each a copy

of one another without original. The actual and virtual are blurred together into a hyperreality. This hyperreal space takes on the utopian and heterotopian qualities of the mirror itself, simultaneously actualized and virtualized.

Implications/Applications

So far, this work has shown that the embodiment of radically abstract bodies is possible through the use of a mixed reality mirror, and that mixing reality through the mirror expands reality and connects the virtual and actual selves, allowing a more complete and united embodiment than would otherwise be possible.

Lacan suggests that this division between self and other is a misrecognition, a false dichotomy that is far less strongly defined by the boundary of our bodies than would appear. Is it possible for mirrors to enable a dissipation of the very self/other boundary formed through the mirror stage? We are extending the tools used in *Transcending Perception* to explore this question in our ongoing research (Desnoyers-Stewart et al. 2020)—sharing and mixing between bodies and seeing how far beyond the body embodiment can take us.

Conclusion

Lacan's mirror stage provides a theoretical foundation for understanding the process of self-identification and the role of the mirror mechanism in establishing that identity. The virtual mirror stage is the process of discovering our agency over a virtual body and identifying the self with that body. This playful exploration forms an essential step in embodiment within virtual bodies.

By mirroring reality into the virtual experience and vice-versa, *Transcending Perception* allows immersants to identify with their virtual body while establishing the physicality of the virtual space. Using co-located digital mirrors, *Transcending Perception* connects the

virtual to the actual, mixing those realities to expand reality. As we enter the virtual space of the installation, it spills out into physical space. These tools and metaphors can allow us to transcend the virtual mirror stage, embodying our virtual selves through the identity established in the digital mirror.

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Footnote

1 A video of *Transcending Perception* at the Richmond World Festival 2019 <https://youtu.be/XLH6DyXihRI>

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