Transcending Dimensions: Physical and Virtual Dancing Bodies

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Abstract

This chapter considers how the use of screens within dance performances and installations affects the ways in which audiences and participants experience bodies in space. Can bodies of physical flesh and virtual light transcend the dimensions ascribed to them traditionally by the material world and the projection screen? My discussion references mixed reality and the phenomenon that has become known as "ubiquitous computing", in recognition of how digital technologies are becoming increasingly embedded in our social and cultural experiences. Three dance or dance-related examples are examined in detail: Cunningham's Biped (1999), igloo's SwanQuake: House (2008) and Sermon's Telematic Dreaming (1992-present). These pieces use a range of approaches to the body and the screen that employ and sometimes challenge Euclidean and relational space and Newtonian physics. There tend to be two ways of designing for virtual reality—a realist perspective that aims to create an environment comparable to the physical world, and an alternative mode that highlights things that can only exist in the virtual world—yet both of these can easily create binaries that disrupt embodied experiences by prioritizing concept over sensation. This chapter concludes by suggesting that dance has much to offer in developing understandings of how the body and technology can manage and overcome binary tendencies within a mixed reality environment.

Key words

Screen, body, telematic, virtual, physical, space

Biography

Sita Popat is Professor of Performance and Technology at the University of Leeds, UK. She came into academia through dance, and her research focuses on the body and digital media. She is the author of Invisible Connections: Dance, Choreography and Internet Communities (Routledge 2006) and co-editor of Performance Perspectives: A Critical Introduction (Palgrave 2011). She is Associate Editor of the International Journal of Performance Arts and Digital Media. In her spare time, she enjoys playing World of Warcraft with her sons.

Introduction

This chapter is about dance with screens rather than dance on screens. It is about bodies of physical flesh and bodies of virtual light, transcending dimensions traditionally ascribed to them by the material world and the projection screen. I will discuss three dance or dance-influenced art works that blend physical and virtual elements within the performance environment, and I will argue that embodied experience lies at the heart of how these blended elements are experienced. Initially I will focus on the spatial arrangements of the work as seen by the audience member in the auditorium, and then I will explore what happens to the body when the audience member becomes a participant in the work. Since the analysis is focused on experience, I use my personal encounters with the works as a key source for the discussion and analysis. In each case I have seen the work at least once and discussed it with some or all of the artists involved in its creation.

Mixed reality environments are spaces that allow "physical and digital objects to cohabit and interact in real time"[1] thereby disrupting assumptions of difference or separation. Ubiquitous computing pervades our daily lives in Western society, defined by Mark Weiser as a "calm technology" that, dancer Susan Kozel explains, "moves easily from the periphery of our attention to the center and back."[2] I take my mobile phone from my bag to show my friend some pictures from a recent rehearsal. Then we switch to the Web browser to search YouTube for a family movie that she posted last week. Together we peer into the small screen and laugh at her son's excitement over his new Wii. The technology does not attract attention to itself particularly, and indeed Ekman suggests that such technology is "best seen when not seen"[3] or at least when not specifically noticed. Instead it enables my friend and I to communicate readily in the "visual vernacular"[4] of our society.

In this chapter I will review a selection of dances with screens from the past two decades to provide examples of how physical and virtual bodies relate to each other and the spaces around them. In each case, the virtual reality of screen space is not independent of the physical reality of the dancer or the spectator. Some involve the spectator as participant or performer, entering the work via the screen. All have elements of mixed reality implicit or

[1] Steve Benford and Gabriella Giannachi, Performing Mixed Reality (Mass.: MIT Press, 2011), 3.

[2] Susan Kozel, "Sinews of Ubiquity: A Corporeal Ethics for Ubiquitous Computing," in Throughout: Art and Culture Emerging with Ubiquitous Computing, ed. Ulrik Ekman (Mass.: MIT Press, 2013), 337.

[3] Ulrik Ekman, introduction to Throughout: Art and Culture Emerging with Ubiquitous Computing, ed. Ulrik Ekman (Mass.: MIT Press, 2013), 3.

[4] Anne Friedberg, The Virtual Window: From Alberti to Microsoft, Mass.: MIT Press, 2006), 3.

explicit in their performance environments. My question is not what is virtual and what is physical; rather, how do these combinations of light and flesh engage dancers and audience members in mixed reality experiences, and in what ways do they challenge traditional conceptions of spatial narratives and dimensions?

Theater director Thea Brejzek uses screens to combine physical and virtual spaces, and she describes the potential that this combination offers:

> Thus, the virtual space constitutes a space in which parallel to the actual action, to the actual set constellation and to the actual lighting set, inner psychological processes of one or more protagonists can be visualised explicitly. Such alternative processes or states may be dreams, moments of recollection and memory, wishes, anticipations or emotions, which are contrasted with the actual emotions on the stage.[5]

For Brejzek, the virtual space is a place of virtual or meta-narrative that exists outside of what she terms the "actual" space of the physical action, and indeed video and digital projection have been used effectively in this way in many other theater productions.[6] This chapter excludes reference to these specific narrative functions, however, and instead views the screen as enabling physical and virtual spaces to be experienced as coherent parts of a single aesthetic narrative in dance performances and installations. Cunningham's Biped (1999) presents a stage world in which physical and virtual dancers appear to co-exist in a single mixed reality space. The screen in this work is a scrim or gauze across the front of the

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[5] Thea Brejzek, "Physicality and Virtuality: Memory, Space and Actor on the Mediated Stage," in The Potentials of Spaces: The Theory and Practice of Scenography and Performance, ed. Alison Oddey and Christine White (Bristol: Intellect, 2006), 161-2.

[6] See reference in Note 5 for further examples.

proscenium stage. In igloo's SwanQuake: House (2008), the visitor[7] is invited to explore virtual and physical environments that intersect and overlap through computer screens and printed paper. In Sermon's 1994 version of Telematic Dreaming, performer Susan Kozel extends her body in virtual form to dance with spectators via a projection onto a bed within a gallery space. These three works cover a continuum of mixed reality dance performance using screens, from the illusion of mixed reality viewed from the outside in Biped; through the meeting of virtual and physical realities that overlap and intersect in SwanQuake: House; to the participation in cohabiting realities in Telematic Dreaming. In each case, I will examine how realities are mixed for the audience member, spectator or visitor, and consider the spatial expectations and limitations that are reflected in the work.

Euclidean Space and Relational Space

In 1435, Leon Battista Alberti published his famous treatise on painting and perspective, De pictura, describing how three-dimensional Euclidean space could be transformed into two-dimensional representation on the canvas.[8] Three dimensional space and its two dimensional representation dominated the visual art forms including dance for centuries. In the early part of the twentieth century, Rudolf Laban visualized the physical space of the dancer's body using six primary directions relating to Euclidean coordinates—up, down, left, right, forward, backward—interspersed by equidistant secondary and tertiary directions pointing to the corners of an icosahedron. He used this directional mapping as the basis of Labanotation, his system for recording choreography in written form. In 1959, Doris

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[7] "Visitor" is the igloo artists' preferred term for audience members or participants in their installation.

[8] Friedberg, The Virtual Window: From Alberti to Microsoft. Euclidean space can be expressed as a set of points, mapped using coordinates relating to three dimensions.

Humphrey's posthumous publication, The Art of Making Dances, proposed a Euclidean-style interpretation of stage space that attributed particular forces, concepts, or sensations to specific areas of the stage.[9]

Whilst Laban, Humphrey and some of their contemporaries were working primarily with Euclidean forms, others chose to take alternative approaches to space. Choreographer and dancer Merce Cunningham (1919-2009) became fascinated by relativity, and Einstein's remark that there are no fixed points in space inspired him to create one of his most renowned works, Points in Space (1986). No part of the stage was prioritized over any other in his choreography, and Cunningham used chance to disrupt any natural inclination towards meaning-driven usage of space and movement. The principles of relational space underpinned his choreography, in which space is composed of and defined by the relationships between bodies or matter within that space. The observer is a key element of relational space, as he/she is also a body in space and perceives the spatial relationships between him/herself and other bodies or matter from his/her particular perspective. Hence relational space acknowledges the viewpoint of each observer as being equally valid to that of any other observer.

When Cunningham began to work with a movie camera, he found another outlet for his interest in relational space, as he could capture the same movement from multiple angles and explore the subtle differences of multiple perspectives. The movie camera captures the dancer's three-dimensional movement and presents it back in two dimensions, framed by the screen. The perspective of the camera as the recording apparatus is therefore fundamentally Euclidean, providing a single perspective upon the action (even though Cunningham saw it as a way to represent relational space through multiple camera shots showing the perspectives of multiple observers). Dance film director Bob Lockyer describes this single perspective as a

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[9] Doris Humphrey, The Art of Making Dances (London: Dance Books, 1997 [1959]).

"receding pyramid of space, which as a ground plan, appears as a triangle."[10] Lockyer's description of what the camera can "see" is not dissimilar to what Alberti might have said about representing a three-dimensional scene in a two-dimensional painting:

> You have an enclosed area of space. It is an area that extends into infinity— […] but it is limited to the right and the left, top and bottom, by the frame. […] In addition, from a certain key point, the closer to the camera that the dancer comes, the smaller amount of the dancer we see.[11]

Movie editing has drawn increasingly on non-Euclidean techniques over the years, and the proliferation of screen-based technologies in contemporary Western society has provided "a new space of mediated vision" that is "post-Cartesian, postperspectival, postcinematic, and posttelevisual"[12]. It was this type of approach that attracted Cunningham to the camera, offering multiple perspectives through which to mediate a single movement. But still the filming process begins with the camera delivering a Euclidean-style image that relies on Albertian principles to read it as three-dimensional, and Friedberg notes that this new mediated vision space "remains within the delimited bounds of a frame and seen on a screen."[13] This inherent battle between relational space and the Euclidean image can be examined most readily within Cunningham's work in his 1999 production, Biped.

Cunningham's Biped and Euclid

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[10] Bob Lockyer, "Stage Dance on Television," in Parallel Lines: Media Representations of Dance, ed. Stephanie Jordan and Dave Allen (London: John Libbey & Company, 1993), 129.

[11] Ibid.

[12] Friedberg, The Virtual Window: From Alberti to Microsoft, 6-7.

[13] Ibid., 7.

Merce Cunningham collaborated with digital artists Paul Kaiser and Shelley Eshkar to create Biped, performed by dancers in both physical and virtual forms. It is distinctive in its blending of bodies of flesh and light, as both appear to occupy the same stage space from the perspective of every audience member in a large auditorium. This is unusual because in many other works that contain projected images of dancers, there is clear separation between the space of the physical bodies and that of the projected images (e.g. William Forsythe's Kammer/Kammer 2000). Alternatively, the illusion of co-existence is created by placing dancer and projection in very close proximity in order to avoid perspectival slippage, so the dancers must perform standing right up against the gauze or screen (e.g. Darshan Singh Buller's Eng-er-land 2005). In Biped, however, the physical and virtual dancers appear to perform throughout the dimensions of the stage space, maintaining a mixed reality for the audience where the screen is invisible, and even perhaps aesthetically irrelevant, but nevertheless deeply significant in its impact on the spatial narrative. (See Fig. 1.)

[INSERT FIGURE 1 HERE]

In the making of Biped, Cunningham's dancers performed movement phrases from the choreography in a motion-capture studio.[14] The movement was captured digitally and used to animate pale-colored, line-drawn dancers, performing alone or in pairs, sometimes amongst floating pale blue bubbles or forests of vertical white bars. The animation is front-projected onto a large, transparent gauze or scrim filling the proscenium arch, locating the two-dimensional image between the audience and the stage. However, the animated world is designed using three-dimensional perspective, which means that the virtual dancers appear to be able to move backwards and slightly up into the screen, thereby giving the illusion that they co-habit the slight rise of the three-dimensional raked stage alongside the physical

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[14] Marc Downie, Shelley Eshkar and Paul Kaiser, "Biped," OpenEndedGroup, last accessed November 1 2013, http://openendedgroup.com/artworks/biped.html.

dancers. The virtual dancers are much larger than the physical dancers and they move within the visual frame of the proscenium as if viewed through a camera lens. Sometimes they fill the entire height of the proscenium arch, but then they dwindle to a smaller size as they move into the virtual distance upstage in an exaggerated perspective that is still readily translatable to the reference point of the stage floor.

The whole piece lasts for approximately 50 minutes, but the animated figures are only on stage for around half of that time. Paul Kaiser explained that the piece was successful for him if the audience's perception of it was affected by the projected images even when the images were not there.[15] Viewing this piece in the Lowry Theater, Salford, UK in 2004, my eye was drawn to the height of the proscenium arch in comparison to the physical dancers' bodies. That cavernous arc was filled with virtual elements from time to time but the sense of space, empty or filled, remained in my consciousness throughout the performance. The vulnerability and physical effort of those tiny dancers was highlighted by the calm, ethereal presence of the virtual dancers, simultaneously inhabiting the stage but only lightly touched by the force of gravity.

The theme of framing is common to both the screen and the stage, in the literal as well as the theoretical sense. Friedberg, in her thesis on The Virtual Window, explains that "the frame of the moving-image screen marks a separation—an "ontological cut"—between the material surface of the wall and the view contained within its aperture."[16] The "ontological cut" acknowledges the separation of the framed content from the world around it, where meaning within the frame can exist in a symbolic order independent of that without.

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[15] Paul Kaiser speaking on Merce Cunningham: A Lifetime of Dance, documentary, directed by Charles Atlas (1999; New York: Thirteen/WNET, 2001.), Video.

[16] Friedberg, The Virtual Window: From Alberti to Microsoft, 5.

Performance theorist Maikke Bleeker argues that in drama, it is not actually the physical span of the proscenium arch that acts as the frame for what is seen. Rather, it is the dramatic logic of the work—its aesthetic and choreography—that functions as the frame, "inviting the spectator to see what is presented before his or her eyes as a symbol of a unitary and complete world, even if what is presented is highly abstracted or consists of fragments only."[17] The ontological cut in Biped is applied both by the dramatic logic of the dance and by the edges of the screen/gauze stretched across proscenium arch. The dramatic logic of the choreography is echoed across both physical and virtual performers. This maintains the logical connection between the two, even though the animated virtual performers were created entirely separately from the rehearsal of the physical performers (as was often the case in Cunningham-led creative collaborations). The stage space is enclosed by full-length black curtains, through which the physical dancers enter and leave with an immediacy that reflects the appearance and disappearance of the virtual figures. The lighting design produces squares of pale blue on the floor similar to the pale blue and white light of the projected images. The aesthetic choices make plain the coherence of the symbolic stage world, to allow the audience to see the physical and virtual dancers as co-existing in a single "unitary and complete" world. This sense of "world" stretches not only from side to side of the proscenium arch, but also from bottom to top. Hence the full import of the ontological cut is revealed not simply as the virtual and physical dancers performing within a world with a unified ontology of being, but also as the combined physical and virtual spaces of the whole world contained within the proscenium/gauze frame. I notice the dancers, but the space around the dancers is also highlighted in my consciousness as meaningful through the device of the double frame of theater and screen.

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[17] Maaike Bleeker, Visuality in Theatre: The Locus of Looking (Basingstoke: Palgrave, 2011), 42.

What is perhaps most interesting about Biped, though, is that it relies on a disruption of Cunningham's own theories of space in order to achieve its coherence. Cunningham's interest in relational space acknowledges the individual perspective of every member of the audience. Indeed, part of the beauty of Biped, and the reason why it works so effectively as an illusion, is that the visual impact is equally effective from any point in the auditorium. This is possible precisely because of the fragmented logic of Cunningham's choreography, which denies meaning-driven relationships between dancers, space, and time. The virtual dancers and the physical dancers can be seen in any relationship to each other, so perspective slippage is not a problem and each audience member's personal perspective is equally as valid as that of any other. However, this effect is not without its limitations. The dance must be viewed from the auditorium in order for the two-dimensional projection to map directly onto the three-dimensional stage space. Yet even in the auditorium, if the projection is seen from the extreme side angle then the back of the stage and the virtual image may be misaligned at times, with the projection spilling onto the black drapes at the side rather than corresponding to the stage floor.[18] From another perspective again, the dancers on the stage see their virtual counterparts performing in the raked auditorium among the seated audience members. The mixing of virtual and physical realities in Biped is an illusion that only works for a single perspective (albeit a wide one) and it relies on the spectators understanding the conventions of mapping two dimensions to three dimensions in the manner of Alberti or the camera lens. Cunningham's use of relational space in Biped remains fundamentally grounded in Euclidean cultural expectations of both stage and screen that enable the audience to perceive virtual and physical spaces as a mixed reality. Against Cunningham's own principles of space, the Euclidean reading remains the most prominent feature of spatial organization in the piece.

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[18] This misalignment is partially overcome by the lack of a visible floor in the projected image, which allows the stage to be seen as the floor more readily.

igloo's SwanQuake: House and Newton

The discussion of Biped above has focused on the audience member's visual perception of the stage as a spatial environment related to but separate from his/her own body. As the perspective of each observer is inherent in the definition of relational space, so the sensory experiences of the perceiver's body also play an important role in the construction of space. This section will consider perceptions of space where the perceiver is placed within the spatial parameters of the performance environment. This brings into play the body of the observer as a component of the performance and highlights a broader range of senses beyond the visual.

Newtonian physics is a deeply embedded canon for dancers, whose bodies are trained to recognize mass and gravity in movement (whether accepting or defying such forces). In recent decades, somatic movement practices have become particularly influential in Western contemporary dance spheres.[19] These practices were developed over the course of the twentieth century against a backdrop of growing interest in somatics more broadly. The philosophical developments of existentialism and phenomenology, coupled with the transmigration of people and movement practices from the Far East (e.g. yoga, Chi Kung), fueled to the desire to find new ways to experience the body and to seek ways of moving that

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[19] Sarah Whatley, "The Poetics of Motion Capture and Visualisation Techniques: The Differences between Watching Real and Virtual Dancing Bodies," in Kinaesthetic Empathy in Creative and Cultural Practices, ed. Dee Reynolds and Matthew Reason (Bristol: Intellect, 2012), 273.

were natural, pain-free and grounded in specific body.[20] Somatic movement practices are characterized by the cultivation of "awareness of self within the world, in relationship to the environment."[21] They are based on "the capacity to make decisions based on sensory discriminations that accentuate the singularity of one's body,"[22] and thus they are often described as "authentic" movement practices. The nature of these kinds of practices is that they are performable for bodies of all types, ages and movement capacities, since they take a phenomenological, environmental perspective on the body through the focus on the individual self and its experiences in the world. Yet they are intensely Newtonian since they are fundamentally concerned with notions of weight, resistance, mass, and momentum in the movement of the dancer's body. Given Newton's highly empirical approach to the process of discovering his laws of physics, it is hardly surprising that somatic dance practices share his principles. However, the virtual elements of a mixed reality environment do not need to obey the laws of physics, since they are not subject to the rules of the physical world as our bodies understand them. How might the Newtonian-embedded dancer inhabit this kind of space?

A company that explores mixed reality performance in many of their works is the London-based igloo (Ruth Gibson and Bruno Martelli). Gibson is a somatic dance practitioner and a certified teacher of Skinner Releasing technique. She comments on how she and computer programmer Martelli work to translate the moving body and the physical environment into virtual worlds:

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[20] Martha Eddy, "A Brief History of Somatic Practices and Dance: Historical Development of the Field of Somatic Education and its Relationship to Dance," *Journal of Dance and Somatic Practices* 1, no.1 (2009): 5-27.

[21] Whatley, "The Poetics of Motion Capture and Visualisation Techniques: The Differences between Watching Real and Virtual Dancing Bodies," 273.

[22] Fortin 2009 cited, ibid.

In one sense we're looking to translate live-ness into the virtual world, that is individual qualities, authenticity of capture, weight and gravity. We also try to do this in the way we construct the landscapes, building with great textures, shadows, light, reflection, water, grass which blows in the wind. In virtual worlds there is also the opportunity to create totally new places, new bodies and new performance material, which is impossible in the real world.[23]

Gibson's first two sentences refer to the desire to reflect Newtonian physics and representational realism in the design of the virtual world, but her last sentence counters this with the suggestion of as yet unexplored alternatives. Yet is she implying in those first two sentences that such alternatives would not feel "live"—that the experience of live-ness is equivalent to or reliant upon experience of Newton's laws? Given somatic dance practices' concerns with Newtonian laws as the pragmatic realism of embodied movement in the world, such implications would be hardly surprising, and perhaps might be seen to characterize a dancerly perspective on the physical/virtual connection. Dance artist Susan Kozel, for example, who works extensively with a range of new media technologies, denies equations of the "real" with "mass" and the "virtual" with "abstraction," instead citing the abstract qualities of the real body and the sensuousness of the virtual creation.[24] However, she also explains that both her "intuitive conviction" and her experiences of working with body and

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[23] Ruth Gibson cited in Janis Jefferies, "Blurring the Boundaries: Performance, Technology and the Artificial Sublime: An Interview with Ruth Gibson and Bruno Martelli," in Interfaces of Performance, ed. Maria Chatzichristodoulou, Janis Jefferies and Rachel Zerihan (Farnham: Ashgate, 2009), 53.

[24] Susan Kozel, Closer: Performance, Technologies, Phenomenology (Mass.: MIT Press, 2007), 236.

technology lead her to feel that the "virtual body is entwined with the fleshly body."[25] Whilst

one might not equate the real with mass at all times, it seems that the connection between the

dancer's physical body and the virtual environment carries the mass of the body with it as an

experiential element. Given that the dancer's embodied experience of the environment is

deeply grounded in Newtonian laws, it is inevitable that those laws will be part of at least the

baseline for the virtual world experience. In 1979, ecological psychologist J.J. Gibson

proposed that "the information picked up by an agent in the context of practical activity

specifies what are called the 'affordances' of objects and events in the environment".[26] The

agent (in this case the dancer) experiences what can be done with an object or an event and

thus applies in future that set of possibilities or affordances to objects or events that are

similar. Such affordances are usually deeply internalized and drawn upon instinctively, so that

two dancers who have performed contact improvisation together many times will have

embodied knowledge of the affordances of their own and each other's bodies and behaviors,

and will be able to respond to each other with extreme speed. Digital performance theorist

Gabriella Giannachi talks about the "hypersurface" between physical and virtual realities,

which is often represented by a screen.[27] She describes crossings between physical and virtual

realms, in which she says that there is often some contamination in the passage between

realms. Affordances from the physical realm are inevitably applied in the virtual realm, where

virtual objects are recognizable representations of their physical counterparts. This applies

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[25] Op. Cit., 99.

[26] James J. Gibson cited in Tim Ingold, The Perception of the Environment: Essays on

Livelihood, Dwelling and Skill (London and New York: Routledge, 2000), 166.

[27] Gabriella Giannachi, Virtual Theatres: An Introduction (London and New York: Routledge,

2004), 99.

also to the affordances that one senses in relation to the representation of one's own body. Perhaps Newtonian physics will inevitably contaminate virtual reality for the dancer.

Ruth Gibson's list of features designed to translate live-ness into the virtual world explain the kind of realism that she and Martelli seek, which is the same kind of realism sought by many designers of virtual gaming environments. Indeed, Martelli worked with computer game engine technology in designing some of his recent virtual environments. This desire for representational realism draws on Euclidean notions of space in that virtual gaming environments are seen from a single perspective—the "eyes" of the avatar. Tradition dictates that this perspective reflects a camera-style viewpoint, a cultural reference point that corresponds to Alberti's representation of three-dimensional space in painting and allows the observer to read the screen-based virtual world as existing in three dimensions (in the same way that Cunningham mapped the virtual dancers' environment onto the stage space in Biped). This representation style gives the user a set of culturally defined and engrained expectations about the Newtonian-style affordances for his/her avatar's movement in that Euclidean environment. These expectations might be re-learnt through experiences within the virtual world, but they are necessarily the baseline from which such experiences start. Yet what other spatial characteristics and experiences might be offered by those new (virtual) places and bodies that Gibson mentions? There are examples of multimedia installations that explore the manipulation of space in different ways (immersive, deconstructed, abstracted, etc.),[28] but for the purposes of this discussion I will focus on igloo's mixed reality installation titled SwanQuake: House and its particular combination and juxtaposition of physical and virtual spaces. This installation might not be immediately recognizable as a dance work. However it focuses on experiences of the body, and the visitor to the installation encounters Gibson's

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[28] For discussion of a wide range of multimedia installations, see Nick Kaye, Multi-Media: Video, Installation, Performance (London and New York: Routledge, 2007).

dancing avatars within it, so it is useful to consider for the purposes of this chapter. I will be referring to my personal experiences of and responses to this work, combined with my discussions with the artists about their creative process and their intentions in relation to space and the embodied experience of the visitor.

In 2008 I went to the V22 Gallery in London to see SwanQuake: House. I entered the installation alone, walking down a small flight of stone steps into a basement consisting of four small rooms. The paint was peeling and bare brickwork was exposed on all of the walls. There was a damp musty smell and the air felt cold and clammy. In the middle of the first room was a bare dressing table with a wide screen instead of a mirror and a trackball and two buttons set into the tabletop (see Fig. 2). I sat down in the chair and saw a virtual world in the screen, through which I could travel using the tabletop controls. I explored an abandoned London underground station with a burning train on the line, a lava filled valley, and an old house with small dark rooms and peeling paint. I could not see my avatar's body as the perspective was "first person," but I was aware at times that my avatar was casting a shadow as I moved it through the virtual environment. In the game I saw a number of avatars designed to look like Gibson, dancing alone or in widely spread groups (see Fig. 3). The avatars ignored me, and if I approached them too closely then they disappeared, reappearing as I moved away. Their dance movement was designed using movement data captured from Gibson and three other dancers in a motion-capture suite.[29] Sometimes it looked realistically human, but at other times the movement glitched or jumped between phrases, seeming oddly broken on the human body design of the avatars. Back in the virtual underground station, I stepped into a second tunnel and found myself falling for an impossibly long time before the screen went white as my avatar "died." Martelli told me that this tunnel is the same as the first

[29] Sita Popat, "Technology," in Performance Perspectives: A Critical Introduction, ed. Jonathan Pitches and Sita Popat (Basingstoke: Palgrave, 2011), 130.

tunnel, but the vertical and horizontal planes are switched, literally twisting the representation through ninety degrees. I stood up from the dressing table and walked through the other three rooms of the installation. At the end of the short corridor I saw an old-fashioned oval mirror on the wall. As I approached it, I realized that the mirror was a screen and in it I could see part of a room in the virtual environment in which one of the Gibson avatars was dancing. In another room the walls seemed oddly out of focus, even though the room was well lit. Martelli revealed that he had taken low-resolution photographs of the walls in that room and printed them out full-size. He had then placed the images back over the original walls, creating a strange effect that often left visitors to the installation feeling confused or unnerved.[30]

[INSERT FIGURE 2 HERE]

[INSERT FIGURE 3 HERE]

In SwanQuake: House, Gibson and Martelli created a mixed reality environment that includes both physical and virtual elements in multiple relations to each other. They attempted elements of both the realism and the new visions described by Gibson in the quotation at the beginning of this section. The virtual environments have gravity that affects both the visitor's avatar and the dancing Gibson avatars. Indeed, in the lava filled valley I gave in to the temptation to jump my avatar off the cliff path and fall into the fiery river below, and I experienced the sensation of falling in my stomach even though my physical body had not moved at all. The Gibson avatars are animated using motion-capture data from human dancers, so their movement follows the Newtonian physics of human bodies. The visual realism of the dark damp rooms in the virtual house chimed sufficiently with the dark damp physical basement to make me shiver at the close correlation between physical and

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[30] Ibid., 128.

virtual experiences, which used Euclidean spatial representation to place my bodiless single perspective in the virtual room whilst my fleshy body was in the physical room.[31]

Alongside this representational realism were elements that felt "new" in Gibson's terms. The glitching movement of the dancing avatars placed their bodies temporarily in impossible contortions or switched them between positions without transitions, so that they did not necessarily succumb to gravity for a moment. Similarly the low-resolution printed walls were disconcerting in their resemblance to the physical walls beneath—almost close enough to fool the eye, but just different enough to be perceived as fundamentally not "real." The greatest shift from physical reality was the second tunnel in the virtual underground station, where the architecture switches between horizontal and vertical planes as the visitor's avatar steps into it, so that the avatar plunges down the corridor instead of moving along it. Yet gravity remains the largest factor in the experience, even though it is now functioning sideways instead of vertically. Here, Newtonian physics wins again.

The nature of Gibson and Martelli's installation space is relative and relational. The visitor to the space is free to roam around the space and to create his or her own experience of the work by choosing where to go, what to observe or do, and how long to remain in any location or position. The emphasis, one might argue, is on both space and movement through space. The virtual environment in the SwanQuake: House installation's dressing table screen is also relational in that one can move within it and choose where to stand and how long to be there. Yet in order to move freely within the space of the virtual environment, one must give up relational experience with the physical environment since one must remain seated at the dressing table looking at a fixed point—the screen. There is a conflict between relational and

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[31] For a more detailed analysis of SwanQuake: House, see Sita Popat, "Keeping It Real: Encountering Mixed Reality in igloo's SwanQuake: House," Convergence: The International Journal of Research into New Media Technologies 18, no.1 (2012): 11-26.

Euclidean spatial experiences, in other words, as the representation on the screen relies on Euclidean principles similar to the camera. (Indeed the most annoying factor for me in any screen-based virtual world is the lack of peripheral vision!) So I entered the physical damp, musty room and then remained stationary, sitting in the physical world whilst I explored the virtual underground station, lava filled valley and house, until I came into the virtual damp, musty room. The similarity of the virtual room to the physical room brought about a sudden conflation of the two spatial experiences, both Euclidean and relational since one was the fixed point from which I viewed the other.

In 1970, robotics professor Masahiro Mori suggested that as robots and prosthetic limbs became increasingly similar to humans, they were at first acceptable, but when they became very close to humans but still different, they dropped into what he calls "the uncanny valley." Mori calls this "a kind of horror," and indeed it has been proposed that zombies and cyborgs are situated within this valley.[32] Mori's writing is about humanoid objects (e.g. robots, puppets) but the same concept can be applied to spaces. The virtual room was eerie in its familiarity, setting up a strong binary between physical and virtual and causing a shiver to run down my spine. Similarly the experience of the room with its low-resolution printed walls resulted in discomfort as the walls looked "real" from some positions (presumably related to the Euclidean single perspective of the camera position from where the image was taken) but visual perception of them was distorted when I moved around in the space. My responses to the installation were echoed in Gibson's recollection of the "horror genre responses" that they received from other visitors.[33]

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[32] Masahiro Mori, "The Uncanny Valley," Energy 7 no.4 (1970): 33-35. A very similar concept is discussed in Sigmund Freud's 1919 essay titled The Uncanny (Das Unheimliche).

[33] Ruth Gibson cited in Popat, "Technology," in Performance Perspectives: A Critical Introduction, 132.

This analysis of responses to the visual similarity of the spaces in SwanQuake: House suggest that representational similarity between physical and virtual elements is not necessarily the key in creating an effective mixed reality environment experience. Visual mapping of virtual and physical spaces using Euclidean coordinates was sufficient to create the illusion for the seated spectator in Biped, but the installation visitor's movement through relational space demands a more complex approach to mixed reality environments. Is it possible, then, to cohabit virtual and physical spaces with the calmness of human experience that was suggested in the introduction to this chapter?

Sermon's Telematic Dreaming and Third Space

Paul Sermon has been developing telematic[34] performances since 1992, and Telematic Dreaming was his first work in this genre. It has existed in various forms ever since, either independently or as an element in the larger installation titled *There's No Simulation Like* Home (1999). Sermon explains that the longevity of Telematic Dreaming is due to the work being based on a concept rather than a piece of technical kit.[35] The technology improves with each new version, but the underlying theme remains consistent and is equally relevant today as it was twenty years ago. The version that I will discuss here was shown in 1994 in Finland and included dance artist Susan Kozel as performer. Kozel's detailed phenomenological

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[34] The term "telematics" is a conflation of telecommunications and informatics. In relation to live performance it usually refers to real-time linking of performers working in remote locations, often via the Internet or telecommunication systems. For more information see Steve Dixon, *Digital Performance: A History of New Media in Theater, Dance, Performance Art, and Installation* (Mass.: MIT, 2007), 419-436.

[35] Paul Sermon, inaugural speech as Professor of Creative Technology at University of Salford, 2009.

analysis of her experiences forms an important text in this analysis,[36] together with my own

experiences of participation as a visitor in a more recent version in the United Kingdom.[37]

In the 1994 installation, two beds (A and B) were located in physically remote spaces.

Bed A was covered with a blue-screen sheet on which Kozel was situated. This bed was

filmed from directly overhead by a single camera, and there were three monitors arranged

around its sides. Bed B was in a public gallery. Kozel's image was relayed from the camera

above Bed A to a projector above Bed B, and her image was projected onto the sheet on Bed

B so that gallery visitors could see her on the bed. There were three cameras around Bed B.

These relayed images back to the monitors around Bed A, so Kozel could see and respond

when visitors approached the bed and interacted with her projected image. (See Fig. 4 below.)

There were no instructions or expectations for visitors. Some people passed through the

gallery, whilst others stopped to sit, lie or interact with Kozel. There was no audio connection,

so communication relied on non-verbal modes that encouraged physical engagement. Kozel

spent four weeks performing in this installation for several hours each day. She describes how

some visitors to the gallery "froze or fled" from the bed when they realized what was

happening in the installation. But at other times,

> when the movement worked well [it] felt very much like good contact
>
> improvisation; a hypnotic feeling of not knowing what is coming next but
>
> letting the strong flow of movement carry you onward. When the movement

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[36] Kozel, Closer: Performance, Technologies, Phenomenology, 92-103.

[37] I attended Telematic Dreaming at the National Media Museum, Bradford, UK in 2000 and

2003. There was no performer at this installation version. The two beds were located in

adjacent rooms and visitors had full access to both rooms.

moved through us in this way, based on openness and trust, the distinction

between which bodies were real and which were virtual became irrelevant.[38]

[INSERT FIGURE 4 HERE]

Kozel's analysis of her experiences focuses closely upon her embodied engagement,

as has my own analysis of this work has in other places,[39] but this chapter is concerned with

the spatial aspects of the work. The directness of co-existence that seems to be inherent in

Telematic Dreaming, with its virtual and physical participants together on the gallery bed,

could at first be seen as a more extreme version of the Biped illusion. In all of his telematic

pieces, Sermon stresses the need for the scale of the projected body to be as close as possible

to that of the physical body, in order to "generate a common telepresent space that enables

situational co-operation, such as two or more people in separate locations sharing a mutual

picnic."[40] In Biped, the physical and virtual bodies were vastly different sizes, so the sense of

co-habitation came from the illusion of a shared stage environment. The lack of direct

scalability between physical and virtual dancers allowed some leeway in the scalability

between virtual and physical stages whilst maintaining believable co-existence. However, for

his telematic works, Sermon explains that direct correlation between the projected size and

the physical size of the bodies involved is essential in establishing a "third space" where the

participants experience co-presence in more concrete terms. Sermon's third space can be seen

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[38] Kozel, Closer: Performance, Technologies, Phenomenology, 94.

[39] Sita Popat and Kelly Preece, "Pluralistic Presence: Practising Embodiment with my Avatar,"
in Identity, Performance and Technology: Practices of Empowerment, Embodiment and
Technicity, ed. Susan Broadhurst and Josephine Machon (Basingstoke: Palgrave, 2012).

[40] Paul Sermon, "Dance on Telematic Stages," in Dance and Technology: Moving Towards
Media Productions, ed. Soke Dinkla and Martina Leeker (Berlin: Alexander Verlag, 2002),
256. (Original italics.)

in the monitors around the beds, where participants in both locations can see their images inhabiting a shared space. Importantly, this common telepresent space is not a representation of a real space.[41] The participants' bodies are projected as video images rather than mirror images, which is disorientating for participants given that the usual way of seeing one's image is in a mirrored reflection. Consequently participants often look at themselves in the monitor and are surprised when they move their right hand and the image also moves its right hand (rather than its left one). Kozel explains how she overcame this disorientation:

> … by drawing my attention back to the pattern of my body in physical space. Instead of moving my arm according to the logic of images in the monitor, I would look at my body and move the hand on the side of the bent knee, or I would move my arm up toward my head.[42]

Rather than drawing on internal kinesthetic awareness to orientate her body, she used external visual cues to direct her movements spatially in relation to the image of her body and other reference points in the space. Extending this disorientation of reversed left and right, the three-dimensional spaces in which each participant moves are experienced as flattened into a single two-dimensional shared space on the monitors. Participants feel physical contact with three-dimensional objects around them whilst observing their actions in two dimensions on the monitors, creating an experience of space that is neither two-dimensional nor three-dimensional.[43] Far from creating the Biped-like illusion of Euclidean co-existence, then,

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[41] Leeker cited in ibid., 254.

[42] Kozel, Closer: Performance, Technologies, Phenomenology, 100.

[43] Sermon, "Dance on Telematic Stages," in Dance and Technology: Moving Towards Media Productions, 254.

Telematic Dreaming emphasizes relationality and "otherness"[44] in virtual/physical spatial co-presence.

Yet earlier I quoted Kozel's account of her extended habitation of telematic space, in which she describes the "flow of movement" and the irrelevance of distinctions between real (physical) and virtual bodies. Of the three works discussed in this chapter, my own experiences and those described by other writers, artists, and colleagues indicate that Telematic Dreaming is the work where the experience of inhabiting mixed reality can become most pronounced. Why might this be the case, when there is a distinct lack of the culturally recognizable spatial realism that worked so effectively in Biped and SwanQuake: House? Telematic Dreaming takes time to learn to inhabit, as shown in the description of how Kozel trained herself to respond to the visual cues. Biped and SwanQuake: House can both be experienced with minimal disruption to bodily engagement due to their reliance on realism and established cultural readings of space and the body. Nevertheless, the learning of the affordances of Telematic Dreaming seems to lead to a more embodied experience over time.

Reference to a "third space" is not unique to Sermon, although his application to telematic installations is quite specific. Cultural geographer and critical theorist Edward Soja employs the same term, presented in the form of the single word "thirdspace", as a key term in his theorization of postmodern spatiality as "lived social space."[45] Soja builds on Lefebvre's theories on The Production of Space, which lists a trialectic of spaces: "spatial practice," "representations of space," and "spaces of representation." The first is concerned with space as it is perceived in objective terms. The second addresses conceptualized spaces such as utopian vision, memory and imagination. (These two spaces might remind the reader

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[44] Leeker cited in ibid., 254.

[45] Edward Soja, Thirdspace: Journeys to Los Angeles and Other Real-And-Imagined Places (Oxford: Blackwell, 1996), 58.

of the use of screens in Brejzek and other directors' theater productions as described in the introduction to this chapter, where the screen often represents memory, imaginings, and emotional spaces that sit alongside the representation of physical action on the stage.) The third in the trialectic is "spaces of representation," which Soja explains "contain[s] all other real and imagined spaces simultaneously."[46] This theorization chimes closely with Sermon's explanation of the "third space," which was born out of his practical experiences of telematics.[47] The space of representation in Telematic Dreaming is the space that the participant experiences via the monitor screen, with its blend of two and three dimensions and its lived social connection between virtual and physical participants. Soja explains that this process of "thirding" (seeking a third option to the spatial binary) "does not derive simply from an additive combination of its binary antecedents but rather from a disordering, deconstruction and tentative reconstitution of their presumed totalization producing an open alternative that is both similar and strikingly different."[48] It is this lack of clear distinction between binaries that avoids the perilous drop into Mori's uncanny valley, where familiarity and unfamiliarity clash jarringly. In SwanQuake: House the shiver down my spine was caused by such a binary between the physical and virtual damp dark rooms, but in Telematic Dreaming Kozel comments on the irrelevance of physical and virtual distinctions as the participants work to negotiate their spatial experience—both as individuals moving in virtual space, and as partners engaging in movement interactions within that space. The negotiation process of living (in) that space develops both a practice and a conceptualization of it simultaneously as one learns to accommodate one's own existence and starts to establish the

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[46] Ibid., 69.

[47] Sermon, "Dance on Telematic Stages," in Dance and Technology: Moving Towards Media Productions, 252.

[48] Soja, Thirdspace: Journeys to Los Angeles and Other Real-And-Imagined Places, 61.

social norms of the interaction with other participants. The absence of language, the bed as a cultural object, and the framing within a public art gallery confuse assumed social practices and encourage playfulness and experimentation, all of which help to disrupt everyday behaviors and expectations. It is notable that telematic participants often try to touch their remote partners at some stage early on in the experience, particularly if there is no verbal communication facility. Kozel describes the "excessive importance" of hand contact when gallery visitors first joined her projected figure on the bed.[49] The social implications of this tentative attempt to make contact between virtual fingers are coupled with the practical process of making sense of the lived experience of sharing a space that is neither two- nor three-dimensional with other co-present participants. The images of the performers or participants may seem more "real" than in Biped and SwanQuake: House, since they are direct visual representations of those people through real-time camera feeds, but spatially the experience of third space is disordered and deconstructed equally for all participants when they experience themselves as engaging together in space, physically, conceptually and socially.

Spatial Narratives in Mixed Reality

Earlier in the chapter I quoted dance artist Ruth Gibson discussing two options for virtual reality. The first was the translation of "live-ness" into the virtual world through representations of physical behaviours and qualities (e.g. weight, gravity, grass blowing in the wind). The second was "to create totally new places, new bodies and new performance material, which is impossible in the real world." The dramatic logic in Biped was constructed around a concept of spatial realism, placing the dancers and their projected counterparts simultaneously on the stage via cultural understandings of Euclidean space and its

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[49] Kozel, Closer: Performance, Technologies, Phenomenology, 93.

representation in two dimensions and thus enabling audiences to read the illusion of co-existence in the stage space. SwanQuake: House drew on realism as a fundamental measure of success, with the artists constructing some imagined spaces but also building their own house within the virtual environment, comparing it to their physical house as they worked.[50] It also exploited glitches and inconsistencies in the physical and virtual spatial designs, as well as the movement of the dancing avatars, in order to begin to reveal other possibilities. Yet this work was the one in which I experienced Mori's uncanny valley most vividly, when physical and virtual became too close and the relationship between the familiar and the unfamiliar became uncomfortable. Telematic Dreaming provided the strongest match between physical participant and virtual representation by using a direct camera feed, but it seemed to offer an alternative way of conceiving and experiencing space that combines virtual and physical, two and three dimensions, without creating a divisive binary, but crucially with the requirement for a process of negotiation and learning of how to inhabit that space.

The avoidance of the binaries seems to be the source of the calmness that Weiss claims for ubiquitous computing, not so much to denying their presence as such but by downgrading their centrality in the experience of the event. Indeed, it is difficult to avoid some type of binary when introducing screens into three-dimensional environments, and this is why Brejzek and others are able to use screens so effectively to represent alternative times, spaces, or emotions to the action on stage. In Biped the screen appears absent via a clever illusion, but it is denied rather than decentralized. In SwanQuake: House the dressing table screen forms a kind of Euclidean-style portal between relational spaces that highlights binaries, to the extent that Mori's uncanny valley was evoked and the virtual/physical division was foregrounded in my embodied experience. In Telematic Dreaming, the screen becomes the place of action, the third space existing as a meeting point of two- and three-dimensional

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[50] Popat, "Technology," in Performance Perspectives: A Critical Introduction, 127.

spaces. The binary is decentralized through the focus on the third space as the point of contact

between the participants. This third space retains its readability as a shared space by

highlighting the bodies of all participants as the mode of access to and the primary reference

points within it. Indeed Kozel argues vehemently that the body is at the heart of virtual

experiences.[51]

There is a great deal of dance on screens and dance with screens that fragment and

deconstruct performance and installation spaces. However, there is as yet little dance that

would fall readily within the term "mixed reality" in the manner of ubiquitous computing as

described in the introduction to this chapter. The examples discussed above suggest that

emphasizing embodied experience can assist in challenging notions of realism as the norm in

virtual and mixed realities, since placing the body at the heart of mixed reality supports the

exploration of a unified ontology of being. The calmness of ubiquitous computing takes a

little time to establish in Telematic Dreaming, as the participant must work to learn the

affordances and practices of that shared space. Perhaps taking that time is an essential part of

the process of mixing realities for embodied interactions, since one must learn the affordances

encapsulated in the particular combination of physical and virtual elements. But if there is no

willingness on the part of the participant (or user) to take the time to learn new affordances

then the designers of mixed reality environments are inevitably limited in what they can offer,

since the environment must present recognizable affordances for the sake of quick and easy

participant/user acclimatization. Dance offers both practices and theories of embodied

experience that might be brought profitably to bear in the design and analysis of mixed reality

environment, offering a balance between Ruth Gibson's options of familiar "live-ness" and

new possibilities. New computing interfaces may offer new ways of engaging physically with

mixed reality in the future, but I conclude this chapter by encouraging dancers and

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[51] Kozel, Closer: Performance, Technologies, Phenomenology, 97.

choreographers to play their part in the development of the embodied experience of ubiquitous computing and to consider what alternatives for the body in mixed reality might be discovered through dance.[52]

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