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Choreographic Encounters in XR: Reflections on Dancing in/Dancing with the Digital

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This article presents findings from first-person accounts of shifting choreographic practice into mixed-reality environments. *Dancing in/Dancing with the Digital*, is a transdisciplinary practice-based project exploring embodiment and movement in XR. In the research and design phases of the project, all authors kept reflective practice journals, which form the data for this auto-ethnographic and phenomenologically-driven reflexive practice analysis. We further support these perspectives by user-testing with professional dancers and the engineering students who developed the XR configurations. Through a kaleidoscope of perspectives, including dance, psychology, somatic practices, digital technologies, and design approaches, we explore embodied awareness and practice in existing and novel XR design. Themes discussed include elements of disorientation in digital environments and touch as a grounding point, the prospect of multimodal creative stimuli, complications of representation in digital spaces, and the digital-as-site for choreography.

Figure 1: Layering realities.

Introduction

the body forms and before it's fully seen

it's gone

reforming self in spaces

fragments of digestible shape

one body splits into multiple

as it re-emerges

in this space where feet never reach the floor

Dance has always been an embodied art form. However, in the last few years, there has been an explosion of activity in what could be called 'dance tech' (Bleeker, 2016).

Research has shown the impact of technologies in dance education (Risner & Anderson 2008, Tomczak 2011, Lepczyk 2009, Anonymous 2004, Anderson 2012); as stimulus in dance creation/choreography and performance (Anker 2008, McGregor 2002, Mullis 2013, Norman 2006, Roy 2001, Schiller 2002, Schiphorst 1992, Sicchio 2014, Valverde & Cochrane 2014); in scoring, archiving, documentation, and annotation (Blades 2015, Karreman 2013, Whatley & Varney 2009); among others (Bleeker 2016). Technology has even been used internationally as a tool for professional networking (Barrios Solano 2021).

…connected across inaccessible borders

The proliferation of internet-connected devices has radically altered how audiences consume creative content (Skybetter 2014: 83), a trend that has been heightened by the international shift to digital collaboration, creation, production, and promotion during the current Covid-19 pandemic and ensuing shut-downs of travel, border closing, social distancing, and lockdown measures.

How might we continue to build relationships and international collaboration in a time when travel, proximity, and touch are restricted?

As the COVID-19 pandemic has demonstrated, digital technologies are becoming ever more central, with XR (extended- or cross-reality, including augmented, virtual, and mixed-reality) offering unique opportunities for artists globally to come together and to disseminate their work. Though experimentation in VR (virtual reality) and performance began with VR's development in the 1980s (Smith 2018), connections between dance and XR technologies are limited, and more understanding of the ways in which digital technologies impact embodied practices is needed (deLahunta 2002b, Dixon 2006). As Cisneros et al. (2019: 27) assert, 'VR offers a different realm of possibility to create choreography and inform the body […] This space is what is now being exploited by choreographers to bring new ideas into the studio and to expand the making processes of performance.' Our current project offers an opportunity to identify and define some of these new ideas and processes of making and presenting performance, especially around aspects of movement, somatic sensation, and embodiment.

Dancing in/Dancing with the Digital is a collaborative project with partners from dance studies, cognitive psychology, design, engineering, music, and computer science. The project is designed to offer a transdisciplinary practice-based approach to researching

embodied cognition through creative choreographic practice within XR spaces. It began with a query: how might the shift from studio practice into the virtual realm impact dancers' sense of embodiment? How does the digital environment, which has become so central in dance practice, affect our creativity and sense of embodiment? And how might these altered senses impact an inherently physicalised creative process? As Brown (2006: 85) emphasises, 'In this [virtual reality] context, the "being in the body" of embodiment is radially reconfigured.'

Figure 2: Exploring Augmented Reality in an early workshop.

Theories articulating embodied cognition are relatively 'young' within cognitive science (Shapiro 2011), and little is yet understood about how virtual spaces impact our embodied cognitive patterning. Cognition is impacted by our environment, with research illustrating that digital environments impact both our cognition and the sense of our bodies. As Bailey, Bailenson and Casasanto (2016: 225) note, 'VR provides unique embodiment opportunities not found in other media and could

push the development of embodied cognition theory.' Even when abstracted, our sense of movement comes from an embodied awareness, with theories of embodied cognition demonstrating how this awareness impacts our thinking (Gibbs 2005). Embodiment, in this instance, is one's ability to sense and perceive the body, and is trained within dance practices (Weber 2018, Bläsing et al. 2012, Jola, Davis, & Haggard 2011). Dance is recognised as a unique environment in which to study embodied cognition (Weber 2018; Batson & Wilson 2014). This current project and subsequent article aim to extend understanding of embodied cognition in dance and digital environments.

...in this space where feet never reach the floor

Method

As this research investigates a choreographic sense of embodiment stemming directly through the unique cognitive (re)patterning that occurs in tandem with one's experiences in XR environments, it is only through the practice of being, doing, and creating within those digital (XR) environments that such creative, embodied, and embedded cognition can be examined. Stevens (2005) asserts that dance's embodied, choreographic cognition is a prime arena for studying cognitive psychology, and further that such study should be conducted in a naturalistic environment, or through the choreographic practice itself. The *Dancing in/Dancing with the Digital* project proposes multiple methods of investigation within this questioning, which may be understood within Smith and Dean's model of iterative creative and arts research processes, where the investigators cycle between practice-led research and research-led practice (2009).

In this article, we present one strand of that investigation, namely a phenomenological and auto-ethnographic reflective practice, from the dancers' first-person perspective. The authors are both professional dancers working in the research team, and as such have been involved in the exploration and development of a digital (XR) demo/prototype artefact, with the aim of creating a full dance work within the next year of the project.

Though the *Dancing in/Dancing with* project is ongoing, several key findings have already begun to emerge through the experiences of moving our embodied choreographic practices into XR spaces. We present our auto-phenomenological perspectives through the unfolding of our creative process, excerpts from field notes and journals, as well as reflections from first-person experiences generated within workshops co-designed

in collaboration with professional-level dancers, and software and bioengineers. Below, we share some of the themes developed thus far. In line with Kozel, Gibson, and Martelli's approach (2018: 2), these reflections 'act as affective counterpoints to the theoretical discussion' and are lightly edited reflections 'where the perspective of the "I," the "she," or the "we"' may be one or a combination of authors' or dancer-participants' perspectives drawn from our workshops.' These perspectives, we feel, represent the spirit of 'bothness' articulated by Kozel, Gibson, and Martelli (2018: 2)—one in which the embodied and experiential passages that describe our experimentation reflect shared and communal sensations of the practice of working in virtual realities from a dance artist's point of view.

...one body splits into multiple
as it re-emerges

Disorientation

Disconnection between perceptual input from the 'real world' and my own body, versus representations within virtual reality, was the strongest and most recurrent theme that arose in our experiments. Even the initial setting up of an Oculus Quest 2 VR headset produced immediate awareness of the lack of proprioceptive synchronicity with virtual representations.

> *My virtual hands not matching my real hands is bizarre. I am executing different movement (gripping my middle finger, clicking with an index finger) in order to make a gesture (e.g. pointing my index finger) in the virtual space, creating disconnect between what I feel and what I create.* (Journal entry, 13 Feb 2021)

The tutorial featured a dance sequence, bringing awareness to the disconnect within a full body schema:

> *The dance interaction is hands-only, as I move through these handheld controllers. I feel very limited by the lack of other limbs, like my legs, and yet still engaged in a full-bodied way. A 'get down' sequence where a VR robot mimicked my movement exacerbated this frustration—while the system attempts to determine body positioning from my head and hands, it feels like a real shortcoming. Dance is multimodal, yes, but also <u>polycentric</u>. I miss 'having legs.'* (Journal entry, 13 Feb 2021)

Using the controllers to delineate a playing boundary by tracing the edges of open space in my room and touching the floor to calibrate, the disconnect between the sense of

my feet on the ground, the impact of gravity on my body in the real world, and the affordances of the virtual world came to the fore:

> *The only awareness the VR space has of my actual space is what I dictate—the VR floor, even recalibrated, feels floating above the floor my feet are touching. The sound through the speakers drowns out noise in my room. Sound is an important multisensory element in making this experience truly immersive. And yet, sweat and steam on the screen takes me away from the experience.* (Journal entry, 13 Feb 2021).

In initial VR experiences, while identifying affordances (the lack of gravity, for instance) was enjoyable and creatively stimulating, a tension between the virtual and my real-world sensory input (proprioceptive, kinaesthetic, and the 'messy' reminders such as sweat in the headset) arose.

This sensory disconnect theme continued throughout our explorations. For example, one workshop featured dancers working within a 360-degree 3D point cloud rendering with cameras mounted in the centre of the ceiling, the room we were in replicated in virtual reality via a live feed. Within the VR headset, we could see the space we were in, the people in the space, and our own body from an external perspective. At first, within VR, there was a mismatch between what could be seen and the real world: there was an approximate 180-degree miscorrelation between where people were seen in VR and where their voices were in the actual room. Echoing this disconnect, Thomas and Glowacki (2018: 2) mention that when transported into a virtual reality, 'the physical environment has not gone away; rather it serves as a sort of background to a more dominant visual virtual experience which "takes over" the sensory domain.' I recall,

> *I put the VR headset on and was instantly destabilized by the disconnect between what I was seeing and what I could hear in the room around me. I could see a 3D rendering of the room, but the people did not match the location the voices were coming from. I could see myself not like in a mirror (something that may have been grounding because of my dance training), but more like a God's eye view, looking down on myself from above.* (Journal entry, 5 July, 2021)

My own body could be seen within this space but was reshaped depending on where in the room I was standing. If I stood right under the central cameras, parts of my body would disappear or stretch to abnormal sizes. If I stepped out from the centre of the room, I could see the back of my body standing in front of me. 'It

takes me out of my body...it feels like I am standing above and looking down on you all, but also on myself. There's a weird disconnect to my body, because I'm back to back with myself,' I noted. Thomas and Glowacki (2018: 7) comment on a similar set of sensations, arguing that though the body can sense the mismatch there is an 'intrinsic sensorial re-wiring' that occurs where the VR participant is not simply shifted into a new space, rather the way that they understand, interact and respond within this space shifts. They articulate this as 'a sort of disruption,' one that 'mediates continuous dialogue between the real (body) and the virtual (environment)' (2018: 2).

Figure 3: God's-eye perspective.

Our computer scientists shifted the VR perspective from God's eye to person-height, though the 'person' viewing was my VR avatar, viewing the room from the camera's perspective, so I could still see my own body as though it was an external person in the room with the 'me' that was doing the seeing, including the mis-match between the VR perspective and my real-world sensorial perception. As I moved, my perspective did not shift—the camera's view and height is stationary, so my VR perspective remains stable though my physical relationship to other bodies and spaces in the room changes. There was a slight delay from executing a movement to seeing it in VR. I noted that the camera height differed from the height I always see the world from, challenging the

senses I use to orientate. There was no sense of depth, no judgement of where the floor was.

I miss having legs
...in this space where feet never reach the floor

Madary and Metzinger (2016: 4) mention in a set of recommendations for VR development that the mind is 'capable of being continuously shaped and reshaped' and does so in response to different environments. Indeed, it did not take long for me to begin to understand the 'rules' of this virtual reality, to understand that what I was seeing was not real and how to adjust my body in order to move and negotiate both the real and the virtual. The audio-visual mismatch continued. Though they suggested trying to align the voices and image, there was a pleasant creative challenge that arose from the disconnect, a negotiation and removal from the real world, and so I requested the mismatch remain.

continuously unlearning
recalibrating self in space

It took less time to adjust to the updated parameters of the space, but the new rules bought a different set of realisations. Within this space, my body was not my body: it was a projected body, one that I could fully control. However, I could sense reservations within myself as I began to dance. I couldn't see where my feet touched the floor, so I felt resistant to moving dynamically, beginning with very small movements that travelled and only momentarily jumping off the floor. 'The safety of knowing that the floor is there to catch you isn't present,' I observed.

Touch

As I began to understand the mismatch, another dancer stepped into the space and began to move. It took a while to understand where she was in my vision/where I could hear and feel her. How could I move around this 'real' body that I could see in VR, but mismatched? After a few moments of trying to negotiate around each other within the space, she paused and reached out a hand. I found her hand with my own, the VR me reaching backward, as I reached out at a 35-degree angle. As my hand found hers, I felt an instant sense of grounding--a heightened sense of safety and (re)understanding of the virtual world. In this space where my feet don't reach the floor, her hand was the grounding point through which I could further orient myself and grow an embodied sense of confidence. (Journal entry, May 24 2021)

Figure 4: Touch as a grounding point in VR.

That moment of grounding grew my confidence within the VR space. I was no longer navigating alone, negotiating the seen and heard; the introduction of touch enabled a jump start of my sensorial re-wiring. Due to the miscorrelation between sight and sound, it made attuning to my own body and my ability to engage with somatic awareness elusive. A separation between the visual in the goggles and what I was feeling through my senses came into acute awareness. I noted that I was using an external visual of myself to find touch, not allowing my body to follow touch instinctually.

In this space where I was navigating, negotiating and (mis)trusting my senses, how are you able to relax, tune in and allow your body to lead?

As I became accustomed to the 'intrinsic sensorial re-wiring' that Thomas and Glowacki (2018: 2) noted, I was able to shift between visual and sensory input as primary. The visual could become an effect, secondary to the sensation of touch in directing my movement. As Popat (2015: 173) notes, in XR, 'the more we engage in finding our way through the environment, the more we are able to orientate ourselves in that environment.' I wonder if more time spent within this space would allow me to become fully attuned to the 'rules' of that virtual world and therefore generate intrinsic response systems that would allow me to more easily tune back into my own embodiment, fully trusting my body, fully trusting my knowing of this new world.

Dancing as Normal

We tried removing the VR goggles to see if the removal of the immediate feedback loop would allow a reattuning to the body. We quickly realised that without the goggles and therefore no virtual space, there didn't appear to be any difference between moving in this room wearing a motion capture suit and moving in the studio. We were easily able to return to 'tuning in' to somatic sensation to direct our movement. This comfortability with somatically-directed movement supports earlier research that dancers' exhibit stronger proprioception than non-dancers and rely on proprioception even when physical and visual information are present (Jola, Davis, & Haggard 2011), so it seems the virtual environment does indeed affect dancers' perception and override our preferred sensory input systems differently than 'live' environments which also include visual and other sensory stimuli, such as viewing oneself in a mirror. For the purpose of the research, it seemed pertinent that the dancer continued to wear the headset and be immersed in the virtual space.
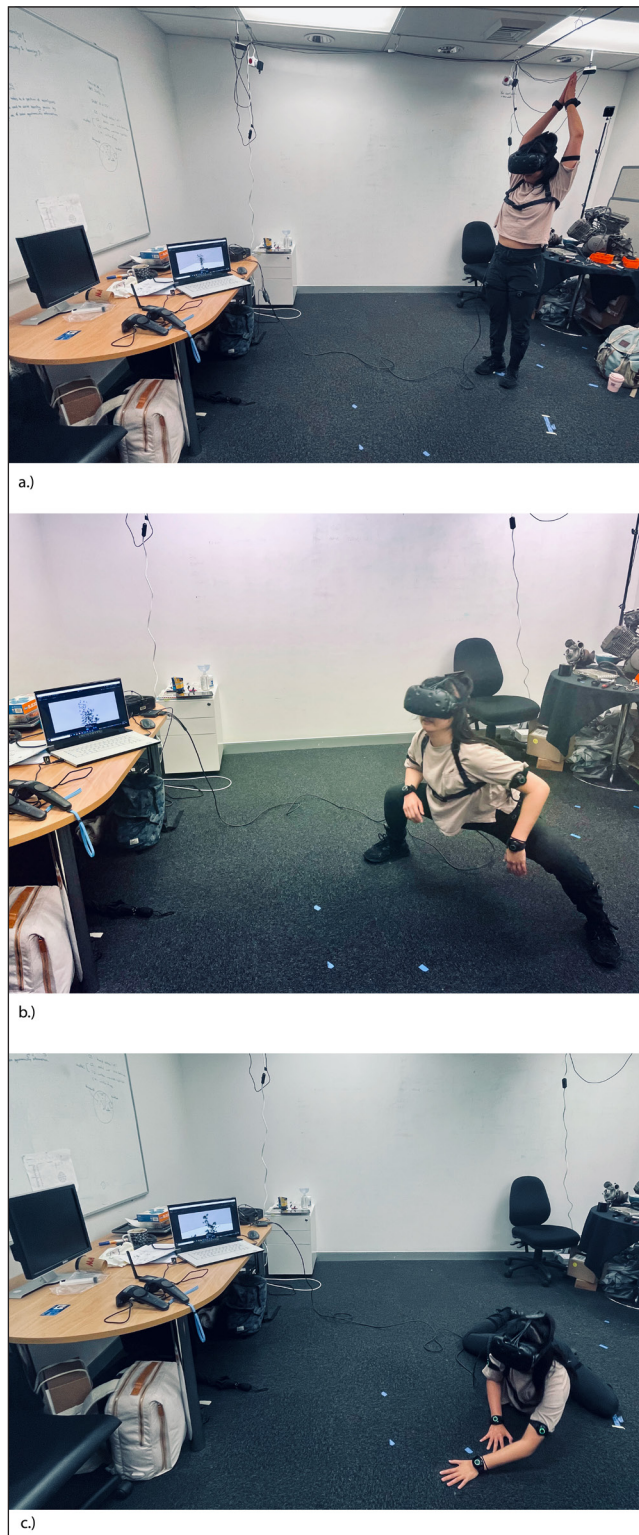
a.)

b.)

c.)

Figure 5 (a,b,c): Dancing as normal in Virtual Reality.

Seeing the Self

Returning to wearing VR headsets meant engaging again in explorations where the dancer's bodies were accurately represented through a live stream 360 3D point cloud video capture and later in 360 2D video rendering. In these, realities of self and body came to the fore in the immersive VR environment. Seeing oneself from an objective, external perspective invited a highly-trained, self-critical eye, and obfuscated attempts to stay connected to an inner, first-person somatic sensation. 'I wasn't interested in myself in VR, but in what you could do,' noted my dancing partner, reflecting both of our preferences to avoid looking at ourselves from this awkward, external perspective. This negative self-judgement may occur, in part, because of our focus on professional-level dancers as research participants.

While research relating to dance and body image is mixed, there is a correlation between the positive impacts of dance on body image that occurs with novices (Burgess, Grogan, & Burwitz, 2006; Erfer & Ziv, 2006), while negative impacts occur with experienced dancers (Anshel, 2004; Ravaldi et al, 2006) and those with higher dancer identity (Langdon & Petracca, 2010). One element which may contribute to higher levels of negative body image is viewing the self through mirrors (Radell, Adame, & Cole, 2002), and dancers' higher tendency toward self-objectification (Tiggerman & Slater, 2001). In earlier research, recording dancers was shown to change their locus of awareness to an external, objectified perspective, and seeing recordings of themselves in specialised annotation tools created for rehearsals initially exacerbated self-judgement; continued use refocused attention on annotations by reinforcing objectification of self in a more neutral way (Carroll et al. 2012). Regarding the external perspective offered by live-stream video in VR, I recall,

> *Years of dance training in front of mirrors has conditioned my critical eye. This coupled with self-judgment that grows from societal beauty standards and my own conditioning collides in me and produces a heightened self-critical bodily awareness. Stepping into the VR space, the close alignment to my body within the 3D video render of myself within which I can see from many angles, flares the critical, but as the direct replication of the body starts to shift my critical self-judgment begins to ease (Journal entry, May 24 2021).*

The 'shift' from direct replication of the body came with the introduction of 'particles,' a bespoke VR effect created in Unity with real-time motion capture through an Axis Perception Neuron suit and experienced through an HTC Vive headset. This was the first experimental demo that encouraged a lot of movement from participants, as the technology we had previously explored in workshops was centred around novel perspectives.
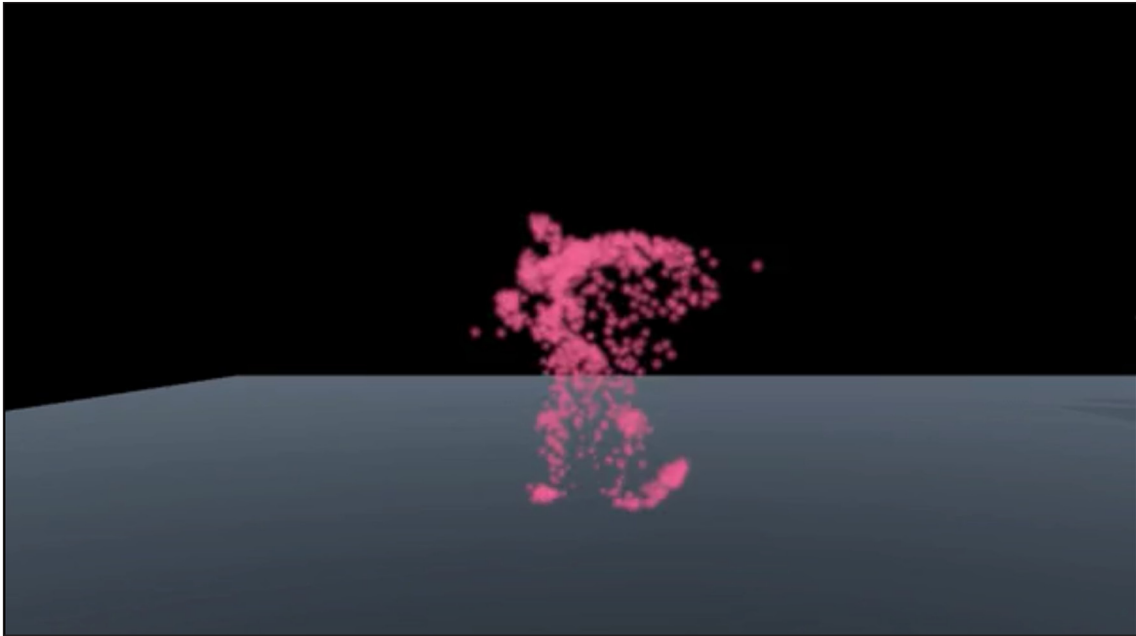
Figure 6: Abstracted particle representation.

The dancers shook their limbs and jumped around to achieve dramatic effects, as various parameters of their movement created the dot-particles and shaped how they were emitted in the VR space. I found the abstracted particle body less jarring than seeing the 'real' me, stating, 'I can focus on the movement rather than what I look like.'

traces of movement

energy

fragments of self   in space

One dancer tried to roll a motion from the top of their body to the bottom to create a wave of activity. They also experimented with holding their bodies completely still to stop particle emission and become essentially invisible, playing between movement and stillness to create desired effects in the particle response. An issue raised was that visibility of the human form could become clouded when lots of movement was happening around the centre of the body. This desire to 'see' the body was at odds with the dis-ease felt when the body was presented in a higher-fidelity, more 'realistic' representation through the 360 experiments. We felt the introduction of particles, rather than an avatar, brought new levels of embodied and creative freedom. I could step away from a desire to curate my body in a way that might be aesthetically pleasing for an audience, and instead turn my attention to the reaction of the particles.

Within this project the abstraction of the body (into particles) mitigated the intense sense of judgment. I felt more freedom to explore without the instant curation of trying to produce something that makes my body look aesthetically pleasing to the viewer's eye. The particles allowed me to shape and reshape my body and, depending on the parameters, abstract the body almost entirely, allowing me to explore and approach movement in new ways. (Journal entry, July 5 2021).

Reciprocal Feedback Loops: Stimuli/Embodiment

In the particle scene, I'm not thinking about what I'm doing. I'm thinking about what the particles are doing. It's not doing what I imagine it will do, so there's a lot of filling in the gaps, which created a lot of excess movement in my body. It is very visually-driven. I am moving to create a virtual self, and to orientate my perception. (Field notes 5 July 2021)

This project is researching somatic embodiment within XR, but as a dancer adjusting to VR, I initially forgot my body was meant to lead and instead focused on making (visual) things happen. Initially the movement generated within the particle scene was directly related to a particle response. If the movement was dynamic, more particles would be released in quick succession, whereas if the movement was slower and more fluid, the particles would release more slowly. Changing parameters in the code, we explored how different aspects of the particles impacted movement—their lifetime, relationship to gravity, response to acceleration or deceleration, and other physical properties. I noticed my movement came from external stimuli rather than embodied somatic awareness. Not being able to absolutely discern which parameters of my movement affected which effects, I found my movement creation sparked and discovered novel qualities in my improvisation. I realised even though the movement was mine, I was seeing my abstracted avatar as another dancer, not as myself. I wonder, with time and the wearing off of the initial novelty, if I might be able to tune back into a different, more somatically-driven motivation for movement.

Echoing the lure of the visual in VR, Carol Brown (2006) argues that vision holds primacy in virtual spaces. She claims that instead of tuning into the somatic experience of the body, dancers find their sense of grounding from external sources. Brown (2006: 94) adds that relying on external reference points can feel,

alienating and, at times, disembodying because it refuses the customary focused attention of the dancer, diffusing her agency through multiple layers of performance […] Relearning embodiment through the experience of interactive dance in this way may be experienced as fragmenting, unsettling, and destabilizing.

Likewise Slater et al. (2010) assert that when in VR, within our perceptual systems, vision overrides other sensory input, emphasizing virtual layers over an embodied sensation of reality. Here, again, our theme of tension between multimodal inputs in both real and virtual worlds arises. However, rather than the earlier theme of discomforting dis-embodiment, we propose that we might be able to comfortably shift and intentionally direct attention between those 'real' and virtual sensory layers. This balance of attention might instead offer creative choreographic affordances—playing with an 'attentional score' (Barnard 2016, 2019; Barnard & deLahunta 2018; Weber 2018) between multimodal sensory input systems, originating from real and virtual spaces, could be a creative impetus for dance creation.

In this process, we noticed that with more time spent in the virtual environment, we became able to direct our attention and move away from the desire to create a visual artefact and (re)engage with our sensory perception. In this way, we propose a new creative method—a choreographic sense of digital embodiment—that is found through multisensory subjective engagement and enables us to create digital choreographic artefacts. As such, we are currently exploring the possibilities of working with an improvisational, somatic attentional score and a purposeful approach from a felt-bodily perspective. Could this allow the focus to shift back to the body, allowing the creative work to be driven by a choreographic approach to digital dance creation?

Zhou et al. (2021: 6) note that 'within current interactive performances, a significant subset was about supporting improvisation in dance using interactive agents.' Technological support for improvisation faces the challenge of finding the right amount of freedom of expression as well as the training and planning needed to set the stage for it. Our perspective is no different, but takes a unique bottom-up approach as we create works derived from the interfacing of embodied sensory perception and the digital affordances of XR. This might enable us to elicit embodied awareness and innovative, creative movement generation as we cultivate an artistic artefact that exists in both the 'real' and virtual word(s). This approach also contributes to understandings of embodied cognition while pushing the boundaries of technological representations and approaches to human movement with real-time interaction between movers—extending artistic approaches to dance practice within the digital realm.

Digital as Site

The advancing of digital technologies raises exciting possibilities for extending the impact of dance while maintaining the situational awareness inherent in site dance. Site dance is a broad term for site-specific, site-responsive, site-determined, and other forms of site-based dance practices. These are practices which examine and

redefine the art-site relationship. They emerged in the 1960s and were 'initially based in a phenomenological or experiential understanding of a site' based on its physical attributes (Kwon 2002: 3). Barbour and Hitchmough (2014) assert that site-specific dance practices relate site, performers, and audiences, combining embodied, emotional, and perceptual experiences with the myriad features and sociocultural histories of a site. Site dance does not take the site as a passive background but as an active collaborator in the process of its own reproduction through the dance.

In the process of moving our practice into virtual reality, the idea of treating this digital immersive space as its own location for site dance emerged. The unique affordances and challenges of the VR site are markedly different from both a proscenium stage and a physical location, spaces in the real world that have historically been the ground for dance creation. As Mikon Kwon (2002: 3) illustrates, site dance has grown to include both the literal and non-physical, or 'virtual, like a theoretical concept.' Here, Kwon's use of 'virtual' is distinct from the *virtual* in VR, though she also asserts that—in line with James Meyer's (1997: 95) approach to a 'functional site'—a site in digital cyberspaces is structured to be experienced sequentially, one after the other, rather than simultaneously as in a live site. However, digital sites have changed considerably since Kwon discussed the internet as a site, and the increase in immersive XR spaces may indeed offer a simultaneous experience akin to a live site. Cognitive scientist Mel Slater describes a phenomenon in virtual reality called 'place illusion,' where there is 'a strong illusion of being in a place in spite of the sure knowledge that you are not there' (2009: 3551). She argues that bodily and perceptual responses to the virtual environment within the headset override our cognitive understanding that it is not a 'real' world (Slater et al, 2010)—something which the dancer's heightened perceptual awareness and disconnect between the virtual representation and embodied kinaesthetic and proprioceptive feedback identified above might contest. Regardless, if a virtual world is able to present such a high-fidelity rendering of either a real or imagined space, the unique affordances (e.g. subverting gravity and/or physical qualities of weight, presence, etc.) may need to be limited in order to create a stronger place illusion, raising the question: why not just make dance in the real world? In discussions with the team, a theme that repeatedly arose was this 'so what' aspect of making dance in the virtual. In my journaling, I articulate:

> *In the VR space, I am not interested in simply replicating 'real life'—otherwise, what is the point when I could just make a work in person? VR offers unique affordances, including a suspension of the usual physical rules of real life—gravity, weight, a multiplicity of/lack of fixed perspective, even the solidity and ever-presence of our physical form. What can these affordances offer me as a mover, a maker, for the audience?* (Journal entry, 21 June 2021)

Sita Popat (2015) presents a blend of physical site and digital immateriality as an example of site dance work when discussing Kozel, Gibson, and Martelli's (2018) entwined Augmented Reality and tangible art installation *Vermillion Lake*. There, Popat argues that it is 'the presence of the visitor's sensing, moving body in the artwork' that is the critical factor in its site-specificity—in other words, the interaction of an embodied experience with the artefact that creates a site in which the work exists, and on which its existence relies (2015: 168). Popat argues that 'mixed and virtual realities are no less able to function as sites' than physical realities (2015: 167). She notes, 'the physical engagement of the body is central to the experience of mixed reality environments in site-specific performance' (2015: 174) where the physical and virtual share the same space. What of the virtual where there is no physical, other than our sense of embodiment, which may be altered or skewed by the sensory input of virtual reality phenomena? When working with the affordances of an XR space, Popat claims that the more closely coupled virtual elements and physical realities are, the more 'acceptable' the embodied experience. She notes, too, the tendency to conflate the term *physical* with *real* in the discourse, and Mapas (2009: 174) likewise urges us to divorce the term *virtual* from *digital.* Both theorists seem to agree that the physical is also present in virtual spaces, and that if real-ness is constructed through embodied experience, then virtual-ness is a subset of what is *real.* Which is to say, even in virtual reality environments, we gather sensory information and have an authentic physical experience, even if it is not in our usual non-virtual reality environments.

> In VR, I am having a real experience—but it is not the same as my normal reality. I am able to slow down or speed up time, to alter my relationship to gravity, to escape the physical confines of my body in certain ways. Am I representing the human body, or emphasizing movement? It forces me to consider which aspects of the practice are most important to capture, and what it means to miss out on other facets. How do we accurately translate the moving body to this virtual environment? And do we even want accuracy?
>
> Like in screen dance, I have the power to position an audience's perspective or offer multiple perspectives. I can allow the audience—or choreographer—to live within the dance, not just to watch it from the outside. I am able to work in real time with a collaborator or leave traces, snippets as cues or clues to reconstruct the movement and give it a new form or new life. I am creating both in the now, in the real world with my physical body, and am making in the virtual—which can be in the now, or recorded and transmitted or translated into other forms and times. (Journal entry 5 Oct 2021)

Popat (2015: 173) notes, this virtual place is 'a space, the site of a particular set of phenomenological qualia,' which must be considered in a digital site-specific

approach. As noted above, there is in digital site work, just as in non-digital site work, the need to become intimately familiar with the layers of meaning and possibilities that a site carries. De Certeau (1988, as cited in Popat, 2015) posits that a space involves one's subjective experience of being in and moving through it, which is necessarily an embodied experience. Popat (2015: 173) argues that 'one orients oneself to a site through the practice of being in that place.' Here, we again return to earlier questions of how one's engagement and sensory awareness may develop over time, once the novelty of the initial encounter with the digital site wears off. De Certeau and Popat's perspectives reiterate the necessity of familiarisation with a site, even if it is digital. We return to the question of balancing 'real' embodied sensation with virtual sensory layers: how might one create a real experience through embodied awareness without losing the affordances offered in a virtual environment? Are there effects that capitalise on VR's possibilities, while at the same time fostering an environment which allows us to tune in to our first-person, full-bodied sensory perception? And, if so, how might these experiences facilitate an exchange of embodied experience? Barbour, Hunter, and Kloetzel (2019: 22) note that site-dance is an artistic field which can integrate 'local and localized bodies into globalized processes and exchanges;' if live site dance is capable of bringing localised bodies into global exchange, what does it mean for bodies across the world to inhabit the same digital site, and what opportunities for embodied exchange exist?

International Connections

Within our experiences of *Dancing in/Dancing with the Digital*, a myriad of possibilities have emerged as we work in new, digital immersive environments even though, as earlier researchers have noted, the interface of the virtual space is unfamiliar and not intuitive to performance artists (Caputo et al. 2016, Whatley and Varney 2009). As discussed above, there are also the added challenges of staying connected to one's sense of embodiment, the judgement raised by physical representations of the self, and conundrum of navigating both a present, felt subjective-self simultaneously with a delayed representational object-self (notwithstanding the other bodies in space and time). As we navigate and explore all of these factors, we recognise the potentialities of the virtual space in creating new, unique opportunities for dance artists to collaborate across time and space, in digital immersive environments.

Heyang and Martin (2020) report that one of the repercussions of the currently-ongoing global COVID-19 pandemic is the inability to move internationally and the impact this has on our ability to conduct dance activities such as making or performing. They recommend consideration of 'how we might work together internationally, with

less emphasis on economic or status imperatives' (Heyang and Martin 2020: 6). With this impetus we recognise that working within the digital, mixed reality spaces presents opportunities for new ways of working and collaborating internationally. With the work being held online, there is also a possibility for the work to reach a wider scope of audience, in ways that are often limited in traditional, in-person approaches to making and sharing dance works. Brown (2006: 91) articulates that when 'dancing within digital environments our kinaesthetic and proprioceptive senses shift from the axis of a gravitational force field to the matrices of inter-connectivity.' As such, a shift to digital practices may mitigate some of the social or economic 'gate-keeping' and create more opportunities for collaboration and professional connection for artists who, for whatever reason, have previously been unable to meet the high cost of 'corporeal mobility' that was required for artistic achievement on a global scale (Heyang and Martin 2020, Storme et al. 2017). Suddenly, the networks an artist has access to, and what audiences a work may reach, expand through digital technologies.

There is the potential not only for remote collaboration through digital technology (Weber, Mizanty, and Allen, 2017), but also for remote audiences to be present in the same virtual 'space' and time as the performers. Caputo et al. call this 'pure Virtual Theatre' (2016: 2). Technological immersion in theatre, as opposed to physical immersion, has been argued to 'foreground the sensuous matter of the human body,' an aspect particularly salient to dance works, and may heighten audiences' embodied sensual experience (Machon 2013: 36). Wilson (2020: 116) noted that virtual reality in particular allows for new modes of audience engagement, including feeling and being, which can create intimacy between a viewer and the art work and 'shift perceptual modes away from the audio-visual and onto embodied perception and subtly encourage changes in behaviour from the viewer/experiencer.' Likewise, Kozel, Gibson, and Martelli (2018: 16) note that VR offers unique technological affordances, including 'the principle of action (affording kinaesthesia and proprioception)' and interactivity for viewers. Each of these raises the possibility of facilitating an embodied awareness, not only in dancers and choreographers, but also in audience members through the use of XR technologies.

Conclusion

As we have discussed in this article, a number of themes have arisen within the first stages of the *Dancing in/Dancing with the Digital* project. The project was initially intended to investigate the alternative sense of embodiment produced by real-time, immersive technologies in XR through choreographic practice. We offer dancers' first-person reflections on shifting an in-person choreographic practice into digital

XR spaces, and how these technologies impact a dancer's sense of embodiment and sensory perception. Of primary significance was the ways in which digital technologies created a sense of disorientation and perceptual mismatch. Simultaneous perception of 'real world' dynamics (e.g. proprioceptive sense, awareness of aural stimuli in the environment) and virtual representations that do not match the 'real world' sensory inputs creates a form of sensory chaos or confusion. Echoing earlier researchers' findings that visual stimuli override other sensory input (Brown 2006, Slater et al. 2010), dancers reported not being able to 'trust' the information from their bodies as the visual VR scene took primacy. However, when touching another dancer in the room, dancers found the haptic feedback grounding, offering a tool for navigating our awareness of the conjoint physical and virtual environments (Thomas and Glowacki 2018), and a potential avenue for (re)organizing and orienting our perceptual systems within virtual reality. Being confronted with a high-fidelity, 'realistic' representation of the self body (such as in live 360 video rendering) was challenging, both because of the unfamiliarity of viewing one's body from an external perspective and because of the inherent judgement that arose. This may be due to the participants all being professional level dancers, who exhibit higher occurrences of negative body image and tendency towards self-objectification (Anshel 2004, Ravaldi et al. 2006, Langdon & Petracca 2010, Radell, Adame & Cole 2002, Tiggerman & Slater 2001). One solution which mitigated this default judgement was an abstraction of the body's representation through introduction of a bespoke 'particle' scene, where particles were generated by the bodily movement. Initially, the shift into particle representations allowed us to reconnect to somatic sensation as the primary impetus for movement generation. Both linking the particle generation to different movement parameters and altering the particles' physical effects generated novel creative movement, but raised the question of whether movement was being generated from internal sensation or a desire to create a visual effect in the VR environment. The challenge of balancing attention between 'real' and virtual sensory input again arose, this time introducing the possibility of using the affordance of layered stimuli as a choreographic tool. Shifting the catalyst for movement through an attentional score, embracing the reciprocal feedback loop between movement as physical sensation and its virtual representation is one way of embracing the unique affordances of the VR site, and offers a new creative practice method for choreographers.

We propose that digital XR offers a new 'site' for site dance creation and performance. Opportunities abound for choreographers and dancers to 'meet' in virtual realities, connecting beyond physical borders and boundaries of time, space, and socioeconomic limitations. It also offers new avenues for audiences to be immersed in performance,

viewing it from 'the inside out,' and potentially creating a new sense of embodiment not only for dancers but viewer/participants as well. As Madary and Metzinger note, 'VR technology will eventually change not only our general image of humanity but also our understanding of deeply entrenched notions such as "conscious experience," "selfhood," "authenticity," or "realness"' (2016: 1–2). Though we have but scratched the surface in the early stages of *Dancing in/Dancing with,* we are already encountering opportunities for new ways to engage self, collaborators, and audiences with an increased understanding of virtual environments' impact on embodied perception—both the challenges and benefits this new, virtual terrain offers.

the space between us
       folding   *unfolding*
   particles tracing energy lines
         parts of you never fully form   *they fall away*
seeing my body separate from itself

      new knowing in this space
           fingertips are not extensions of arms
body abstracted in space
      in this space where particles

         never feet reach the floor

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