Article

Employing a Dance-Somatic Methodological Approach to VR to Investigate the Sensorial Body across Physical-Virtual Terrains

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Abstract: This article takes a somatic dance standpoint to investigate bodily sensorial encounters with virtual reality technology (VR). Using somatic dance practices as sensory tuning methods, this article investigates the virtuality and corporeality of human and nonhuman bodies across virtual and physical environments and expanded sensory modes of seeing and feeling, using a multiperson interactive VR framework. Predicated on a dance-based sensibility and mode of engagement with VR, workshops crafted for groups of dancer and nondancer participants offer methods for the design and facilitation of VR encounters that expand ideas and expectations of both body and technology. Using autoethnographic writing and participant testimonies, alongside conceptual thinking around participation in VR, I present this methodological approach and demonstrate its potential to address new questions about VR experiences that are centred on the sensorial body.

Keywords: somatic; dance; movement; embodied; VR; sensory; multimodal; methodology; phenomenology

1. Introduction

This article follows the journey of my personal and physical explorations, as a dance practitioner and artist, with VR technology and how these explorations enabled a methodology for the design and facilitation of two sets of workshops. I draw from my extensive expertise as a dance practitioner to effectively bring a dance sensibility to the encounter between a human and the VR. In this article, I demonstrate through descriptions and discussions of the workshops and their findings how dancer research can contribute to questions and discussions about how VR systems are designed, developed, and participated in. My approach forefronts an experiential body-centred VR experience, unlike many other VR experiences, which decentre the bodily sensorial experience. A sensorial, embodied perspective, missing in research and design practices for VR and, more broadly, in discussions and debates which focus on human–technology relationships, is evidenced through the practice-as-research evidenced in this article.

As a dance practitioner who works extensively with somatic and improvisation practices, my experience of entering into a virtual environment (VE) using virtual reality technologies (VR) brings about the tension between my moving, sensing body and the visual pull of the virtual environment—a perception gap between seeing and feeling [1]. Over many years of undertaking the physical and somatic practices of dancer training, my body has undergone a sensorial shift which leads to an encounter with VR technology from an uncommon perceptual perspective. This dancerly perspective exposes and challenges the biased sensory participation and the underlying normative notions of the sensory body and modes of embodiment the technology affords. The questions and issues raised through my practice with the technology offer a perspective that is new and relevant in the fast-developing field of VR design and use.

The research questions that emerged through my encounters with VR, in an interrogation of the sensorial layers of presence and absence, human and nonhuman forms

and materialities across simultaneously occurring physical and virtual domains, were as follows:

1. What is the sensation I experience when I reach out to touch or sense something, with my eyes open to a visual world, which is not seen but is physically there;
2. What is the sensation I experience when I see something that, when I reach to touch it, is not physically there;
3. What is the experience in 1 and 2 when what is seen and felt contradict—simultaneous mappings of bodies or environments which do not align;
4. How might the way in which I experience these sensations be different to someone else, and why might this be.

These questions, which were drawn from the sensorial tensions and physical discomfort that I witnessed in my own body, offer a valuable perspective to others working in Human Computer Interaction (HCI) and associated fields with multimodal technologies, investigating body–technology relationships, the senses, and interaction. Research into VR design and use focuses on the effective affordances of the technology as a tool to mediate bodies and environments by replacing them visually, rather than bring to attention the discrepancies that spring up (if attended to) between the visual virtual environment within the VR headset and the physical, felt, and sensed space of and around the body (sensed by dancers). Furthering my investigation of these research questions from my body to other bodies, to gather more understanding of how different people experience the technology with a focus on the sensorial, bodily aspects of this engagement, I invited groups of dancers and nondancers to participate in the two sets of workshops detailed in this article. Somatic dance practices as sensory tuning methods were used to guide the workshop participants through the body–technology encounters using a multiperson VR framework.

This article will next address and discuss the ways in which dancers and technologists think and practice the senses differently, which therefore result in different perceptual and embodied frameworks. Using this as a backdrop, I argue that the processes through which dancers tune and train their senses bump up against the mode of sensing afforded by VR technology, creating a sensorial tension in the perceptual experience of VR for dancers such as myself. I will then describe the methodological processes undertaken across the two sets of workshops, and, using autoethnographic writing and workshop participant testimonies, alongside more conceptual thinking around participation in VR and the senses across dance and technology, I will discuss some of the key themes that emerged through the analysis of workshop data which centre on and describe the sensorial and bodily experiences of the participants: seen and unseen across virtual and physical environments, their expanded sensations of touch and tactility, the ways in which the technology left residual effects in their imaginations, and notions of participatory somatic agency in VR encounters.

The Visual Domain of VR Sensing

From the point of view of the creative technologist—VR researcher or experience creator—VR technology is an emerging and immersive technological medium "in which subjects use a head-mounted display (HMD) to create the feeling of being within a virtual environment" [2]. Immersion into a VE can lead to a sense of presence, of 'being there' [3] in that VE, a sensation created by the body's senses. Leading VR researcher Mel Slater writes, "[o]ur sensory organs take in data about external reality, which leads to perception, cognition and eventually to behaviour which converts this information into meaningful action through which we change external reality" [4]. The VE seen from within an HMD generates its simulated properties towards the participant's senses, the body receives this visual information, "the brain-body system automatically and rapidly reacts, while the cognitive system relatively slowly catches up" [5]. As Slater describes, the bodily "reactions have already occurred" [5], and the brain is "fooled into the illusion of being in an alternative world" [4]. Understood in this way, VR technology is "primarily centred around vision" [6]. The illusion of being there in the VE is achieved predominantly through the visual display, and, whilst a VR experience may have elements of sonic and haptic

feedback, it is considered in the field of VR research and development that "vision alone is often enough for numerous applications, since anyway for many people, it is perceptually dominant" [6]. Nonvisual sensory input aligns with and is driven by the visual world of the VE in order to be effective.

This ocular-centric perspective of VR is leaned into by those who work with the technology across academia and industry. VR offers its visual world to the participant, and the brain rallies to fill in the gaps, suppressing any sensory input that does not align with the perceived 'virtual reality'. In actuality, the body located within a VE is receiving sensory data simultaneously from two different environments—from the VE and the physical world around. Something which, in my body-centred experience of the technology, is not backgrounded, as it commonly is in a less body, more tech-oriented experience. For most, drawing on the illusion of presence in a VE, which relies on the human participant's sensory system led by vision [7], the VE becomes foregrounded and the physical body and physical environment—both unseen within a VE—are reduced, suppressed, backgrounded. For example, "participants in a VR typically encounter a situation where their visual system places them on, say, a roller coaster, but all other sense perceptions are from the surrounding physical environment. Nevertheless, they may scream and react as if they are on the roller coaster even while talking to a friend in reality standing nearby" [6]. It is this notion of how VR can harness the power of the visual system as the driver of the senses able to change the participant's perception of reality in experiences in which "[e]verything about you and your world can change" [8], that underlies the aims and ambitions for technologists and researchers working in this technological medium (and in other immersive visual technological media).

In instances in which a participant's "presence in the virtual environment [is] be interrupted by sensory cues from the physical environment and imperfections in the interface" [7], the VR developer seeks to overcome them—often as quickly as possible for the smooth running of a VR experience. There can be moments in which the visual VE is disrupted, and the body's connection and relationship with the physical environment momentarily re-emerges. These moments can occur because of issues within the VE, e.g., around image quality or latency, and they can come from the physical world, e.g., if the participant accidentally bumps into something or someone, or there is a physical event such as a door opening or someone entering the room, a breeze, etc.—these are unseen phenomena, not mapped into the specified visually led experience of VR. These moments bring conscious awareness to the physical body and its located-ness in the physical environment, the presence of others within or the features of that environment, and the material presence of the technology. This physical and felt/sensed awareness of the body as relational to its surrounding environment is tuned up and tuned into through dance practices supporting dancers to engage with one another and with the space around them in ways that are 'more than visual'—a visuality which is infused with the tactile sensation (Little), and with senses that are 'synaesthetic' (Machon).

Within the VE, there are moments in which the visuality of the environment can bring about haptic sensations (the sense of touch to a virtual entity or environment with no physical counterpart and using no haptic device). This is a phenomenon and field of study described by a researcher of multimodal perception, Anatole Lécuyer, as pseudo-haptics. He writes, "[p]seudo-haptic feedback corresponds to the perception of a haptic property that differs from the physical environment, by combining visual and haptic information and proposing a new coherent representation of the environment" [9]. Lécuyer suggests that pseudo-haptic perception "is different from what the real haptic sensory supply would suggest by 'playing' with the multimodal—mainly the visual—feedback of a system" [10]. A sensation which, he writes, is achieved through "visually presented phenomenon" [10] which "should theoretically be capable of returning some kind of force" [10]. In matching this sensation of force to a defined action or movement results in the sensation of 'feeling' that object or force as a physical presence, he argues, "the user's central nervous system may adapt to the new, the artificial multisensory supply—and the illusion [of touch] occurs" [11].

As I have discussed, in a VR experience, there can occur mixed sensory messages—received by the body from both the physical and the virtual environment. In these moments, the "brain is confronted with ambiguous multisensory data" [10], and, more often than not, visual information takes precedence. Slater describes this as a cognitive process; "[I]t [the brain] attempts to resolve it [the ambiguous sensory data] by recalling related information from memory in order for the final percept to settle" [11]. Crucially, taking the viewpoint of a body that orients its senses around seeing, this 'memory' is typically dominated by vision. In his writing on 'Progressive Embodiment in Virtual Environments', Frank Biocca also takes an ocularcentric viewpoint, specifically considering how the body is sensed in a VE. He details the sensory processes through which the visual virtual body of a VE "can significantly distort the [physical] body" [7] due to the overriding mechanism of the visual and suppression of the nonvisual across the senses.

This article draws from my personal and physical dance-based experience of the technology to inform participatory workshops with VR, which uses sensory tuning methods to redress the notion of VR as a technology that reduces the senses toward the visual. VR technological pioneer Jaron Lanier considers this technology to be one of the "farthest-reaching apparatus for researching what a human being is in terms of cognition and perception" [8]. By combining sensory and embodied dance practices with VR, it is possible to explore the potential of Lanier's notion. To expose the reductive nature of these technologies on the senses and open up new possibilities for disrupting them. Sensory architect and scholar Juhani Pallasmaa argues that with the reduction and restriction of the sensory system to a visual process, "the isolation of the eye outside its natural interaction with other sense modalities" [12] contributes to the "elimination and suppression of other senses" [12]. With this process, he writes, there is the potential for "a sense of detachment and alienation" [12] between the body and the living, material world. With the extensive use of technologies such as VR, it is possible that the human sensory system would develop with a gradual reduction in the nuanced sensibilities of touch. Thus, the capacity to sense without vision or with reduced vision could diminish through a learned haptic dependence on visual input mediated by technology.

This article offers a response to Pallasmaa's notions—a practice with VR technology that challenges this visual reductionism, providing other sensory routes which can be attended to using VR. It is based on practices that bring dialogue into play between the dominant visuality of the VE and the feeling, sensing body situated in the physical world, and practices that expose the perceptual biases of the human sensory system and how these biases are becoming further entrenched with technology. Rather than overriding the physical body and environment with a simulated version of 'reality', this study points to their potential for VR as a tool; "[a]s VR progresses in the future, human perception will be nurtured by it and will learn to find ever more depth in physical reality" [8].

2. Methodological Movements

2.1. Tuning Practices towards a Tactile Sensibility in Dance

Somatic principles and improvisation techniques from my dance training enable me to bring attentional skills and sensory sensibilities to an engagement with VR technology that offers a particular state of presence: an ability to be tuned into and communicate through a field of sensations, of "metastable configurations between the microcellular, the multicellular, and the inter-corporeal" [13] within and beyond the skin boundaries of my body. I move and am moved by the human and nonhuman bodies and environments that circulate around, and within me, their liveness and liveliness experienced through the dance-based tuning processes that are foundational to my practice. These tuning processes increase "felt and perceptual experiences of our own bodies" [14], the ability to sense the moving body as a dynamic force and fluid materiality, "a corporeal-kinetic intentionality, as bodily-kinetic experience" [14]—a felt engagement with the body and with the environment around the body.

Sensory processes, a touchstone in the dance practices that I engage in, activate and retune the senses toward an integrated and synaesthetic play in perceiving the body and its relations toward other bodies and the surrounding environment. Decentring the visual sense, in its dominant position in the sensory system and as the driver of the senses, is a method used by dancers to support a synaesthetic modality for sensing. This is achieved through processes of visual deprivation, such as moving with the eyes closed, with a blindfold on or in dark environments. These processes pivot the senses away from a visual reliance, re-enlivening the nonvisual senses and generating their more active participation in perception. After a time, this sensory shift can be retained with the eyes open, reintegrating this synaesthetic sensibility with incoming visual information. Nita Little is a dance scholar who practices and teaches dancers a mode of sensing that she refers to as "tactile attention" [15]. "When we enhance our visual sense with its synesthetic potentials, sight combines with the tactile properties of our felt embodiment" [16]. Working in this way, as I do in my own practice, there can be a restoring of the "flow between the haptic and the optical that our culture is currently lacking" [17].

When I reach out to touch you, I extend the space I have created between you and me. This extension carries my sense perception (my almost touch) and can therefore also be considered a prosthetic to my 'organic' matter form. [13]

The dancing body extends beyond its skin boundaries to meet the 'other' in the spaces between bodies, between surfaces. "With space between them, individuals may extend a field of awareness that weaves them into tactile configuration, a volatile form of togetherness" [16], and this "dynamic weaving of our tactile presence" forms "an important relational aspect of a dancer's presence" [16].

Dance improvisation practices or "training structures" [18]—such as Nina Martin's Ensemble Thinking and Lisa Nelson's Tuning Scores—support dancers to "learn something of the nature of seeing" [18] as more than a visual process through ensemble and relational tuning practices. Nelson developed her tuning work to explore "movement as a response to environmental influences—both the external and the internal" [18] and the "co-dependence between the senses and the moving body" [18], shifting the patterning of the senses "from a visual to a kinaesthetic perception" [19]. Dancers move in response to the felt materiality of the body, to sensations of weight, depth, flow, tension, force, etc., that occur both within the body and within the spaces and bodies that they move with. In attending to this felt sensing, "[t]here is an uncovering of a physical dimension of seeing" [18], the eyes can "function like organs of touch" [17]. The increased flexibility and communication between the senses that dancers practice goes some way to what Marks describes as "restoring a flow between the haptic and the optical that our culture is currently lacking" [19].

2.2. An Autoethnographic Approach

During the time that I have been entering into VEs of varying kinds (a journey into simulated worlds seen within VR headsets that began in 2016), I have drawn on these experiences by taking an autoethnographic approach. These accounts have drawn on specific moments holding an emotional or affective resonance for me, for example, writing in response to physical events, studio practice, and literature. This research is predicated on my encounter with VR, and the autoethnographic writing brings my experience and my body onto the page.

Sociologist, practitioner and researcher of occupational therapy Sally Denshire writes about the role of autoethnography in her work and field, foregrounding "the social relationships and responsibilities that may have implications for everyone identified" [20]. She discusses "the social implications of telling a story from more than one point of view" [20], specifically the "scope" [20] of this storytelling from "previously silenced authors" [20]. She writes of the importance of "writing body-selves back into autoethnographic accounts" [20], though she describes this as being "difficult to accomplish when lived bodies have been strangely absent" [20] from her field of "healthcare research" [20]. My writing comes from the body, drawing on my dance practice as a means to understand and communicate

experiences. These are processes that dance scholar Jane Bacon explores and articulates in her own research. Using "somatic practices as methodological imperative or praxis for arts research" [21], there "comes a bodily knowing—a felt sense, a feeling tone—that is like no other and is the point from which many practice-led researchers in movement-based realms find the voice of her body" [21]. I also write on the experiences of others, using critical ethnography as a ground from which to articulate participant testimonies. This approach, as critical ethnographer D. Soyini Maddison writes, "begins with an ethical responsibility" [22]. "The critical ethnographer [also] takes us beneath surface appearances, disrupts the *status quo*, and unsettles both neutrality and taken-for-granted assumptions" [22].

I consider and experience my body as a malleable, porous, and relational entity, and my practice enables me to connect to the materiality of the human and nonhuman world around and within me as a tactile field of attention. The experience of my own body in the VE is, much of the time, in tension or at odds with the visual environment seen through the HMD. There are moments of feeling connected to the VE in which I can drop away, to some extent, from the physical world around me. At other times, I feel completely disconnected from both physical and virtual realms. Dropping into the visuality of the VE can take me into expanded sensory domains and into 'felt' sensing of the virtual of the VE. A disconnect between the VE and my awareness of the physical, sensory environment—in which I am still present—arises in these moments of tuning into the touch and tactility of the virtual world. The shifting relations between my body and the environment mediated through my senses and the technology are apparent. In the moments of 'full immersion', a giving over of my body to the technology—in the way that the technology has been designed for, arises a deep sense of 'trouble' within me. My body simultaneously moves into its extension within the VE and pulls away from it [23].

My practice has deeply explored these moments of oscillation, and this practice has informed the ways in which I have considered and crafted the workshops. Rather than overriding or suppressing the moments in which the physical body and space momentarily come to the fore, disrupting or distorting their experience of the VE, I wanted to focus on these moments, to explore the movement or oscillation of attention and thus the presence between the virtual and the physical. This approach contrasts those taken by other VR-makers and technologists, who typically uphold "an effort to fully embody the user in the virtual environment" [7] through the "sensory suppression of the immediate environment" [7]. Their aims are to immerse the participant in the VE using "the capacity of those senses engaged by the system" [7] vision and to saturate the user in such (virtual) visual information, which "suppresses stimuli from the physical environment" [7].

In designing and facilitating the workshops, I drew from these experiences—of my dance-somatic sensibilities in seeing and touching the spaces of VR technology and the ruptures and oscillations in my sensory and embodied attention. I also drew from practices and tools used in dance to support the ways in which the participants were guided and supported, cared for, and able to care for each other through the workshop sessions.

2.3. Ways of Seeing and the Felt Sense Workshops

The participatory workshops investigated the senses of sight and touch across shared and interactive physical, virtual, and imagined environments. In conceptualising and planning the workshops, I split up the senses of seeing and feeling, each assuming the focus of one set of workshops. I explored seeing–sight in the Ways of Seeing (WOS) workshops and feeling–touch in The Felt Sense (TFS) workshops. Whilst this split is a superficial distinction—as the senses of sight and touch are much more complex and interconnected within the larger sensing framework of the human sensory system, and the physical and the virtual are not binary worlds adhering to one sense only but more complex environments which draw on the complexities of the senses—it supported a process of breaking down and problematising the complex issues around the sensory body in VR.

In both sets of workshops, the commercial HTC Vive Pro VR technology was used. A multiperson framework, in which multiple participants are copresent across both physical

and virtual environments and are able to see each other, move, and interact within a shared VE, was developed for specific science-based applications at the University of Bristol [24]. In each workshop, up to four participants were able to enter into and share the VE at one time. The VR headsets were tethered with thick wires to large laptops situated on a table at one end of the workshop space, each with approximately 3 m of reach. The two lighthouse cameras were positioned diagonally opposite one another in corners of the space to track the movements and position of the embedded sensors in the VR headsets. Participants held a VR controller in each hand which they were able to use to interact with the molecular forms in the VE.

The workshop journeys were crafted using somatic and improvisation practices in dance, designing sequences of activity that invite shifts in sensory attention, perception, and embodiment. Through both sets of workshops, I wanted to consider the VE as one aspect of a wider experiential and somatic-based journey, not as the sole element of the experience. These practices challenge normative visually dominant modes of perception and, therefore, the expectation or notion of VR providing a space to 'escape' to, devoid of connection to the physical world. I wanted to explore how the layers of perceptual information that are simultaneously received from physical and virtual environments are attended to by different people and how this was similar to or differed from my own experiences.

I led the first set of two workshops (WOS) as part of the Bodily Undoing symposium at Bath Spa University (September 2017), with participants who were practitioners, artists, and scholars working with somatic practices within the field of dance (see Figures 1 and 2). Developed from a series of 'dancer labs' at the Arnolfini in Bristol (March 2017), these workshops explored the expanded sensibilities of seeing as an embodied and tactile sense across six movement-based activities [1]. The workshop layered experiences of sensing body and environment across physical and virtual, seen and unseen realms. A blindfolded practice was used to tune up the felt sensibilities of the body and explore the use of touch to connect to the physical environment and the other bodies within the physical space. Once in VR in the virtual environment, the participants drew from this tuning process to explore the relationship between this dance-based felt mode of sensing and the visuality/visual pull of the VE. The participants were invited to explore their experiences of gaps and crossings between the physical and the virtual. This was performed through talking, moving, and sensing together as partners—guides and witnesses for each other—one body housed within the VE, the other outside of the technology, located in the physical space. After this practical session, there was a group discussion in which participants were invited to respond to a series of questions, based on the sensorial body, about their experience.

Figure 1. WOS workshops, Bodily Undoing Symposium, Bath Spa University, 2017 (the first workshop).

Figure 2. WOS workshops, Bodily Undoing Symposium, Bath Spa University, 2017 (the second workshop).

The second set of six workshops was hosted at Knowle West Media Centre in Bristol (2018), engaging with the centre's staff and the local community as participants. The practices, format, and sequencing design for *TFS* workshops were tested with Bath Spa University dance students (March 2018) and at Coventry University's Digital Echoes symposium with a range of dance practitioners, artists and academics (April 2018). The Felt Sense (TFS) workshops explored the haptic realm of VR technology and sensations of touch as a tactile or felt sense experienced beyond the body and with virtual phenomena. The sensorial practice in these workshops was less focused on the relations between bodies (which had been the emphasis in the WOS workshops) and more centred on the sensing of physical, virtual, and imagined objects (balls).

Different states of presence and materiality were journeyed through by participants in *TFS* workshops across a sequence of tasks. The participants sensed and moved ball-like objects/entities as physical, virtual, and imagined 'states' across six 'sensing stages': (1) physical; (2) imagined; (3) sounded–virtual; (4) visual–virtual; (5) visual and sounded virtual; and (6) (re-)imagined (see Figures 3–6).
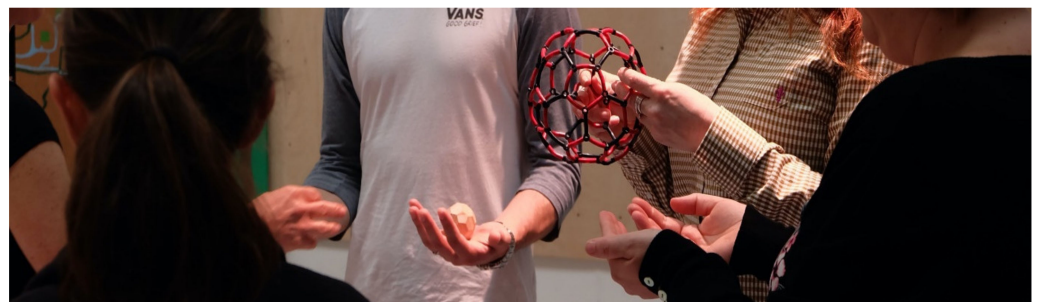

Figure 3. TFS workshops, task 1—Knowle West Media Centre, 2018.

Figure 4. TFS workshops, task 2—Knowle West Media Centre, 2018.

Figure 5. TFS workshops, tasks 3, 4 and 5—Knowle West Media Centre, 2018.

Figure 6. TFS workshops, task 6—Knowle West Media Centre, 2018.

Biocca asserts that, at any one point in time, a participant in a VE "can be said to feel as if they are physically present in only one of three places: the physical environment, the virtual environment, or the imaginal environment" [7] and that "[p]resence oscillates among these three poles" [7]. A significant aspect of the study design involved the specific ordering of these tasks, which enabled the participant's experience to build through the workshop journey, and which tooled a more nuanced experiential understanding of touch prior to engagement with the VR technology. The sequenced design of the workshops provided a framework that guided the participants toward somatic and tactile modes of sensing prior to entering into the VE, supporting an opening to these sensibilities whilst using the technology. The physical balls grounded the experience in physical and material touch, from which the notion of a ball could come into being virtually in the participant's

imaginations. The participants were then introduced to the virtual balls in the VE, first through sound only, interacting with the sonification of the virtual balls using the VR controllers to move and interact with them, then interacting with the visual virtual balls within the HMD, and then with both visual and sound elements combined. After each task, there was time for participants to write/draw/mark their immediate responses (TFS mark-making data), and at the end of the workshop session, there was a group discussion in which participants were invited to respond to a series of questions about their experience.

2.4. Ethical Considerations

Numerous ethical issues and concerns have emerged through my investigations with VR and have become a key aspect of my thinking and practice in developing participatory experiences with the technology. Rigorous ethics procedures, using University of Bristol protocols, were followed for this research project. A full ethics review was undertaken for the workshops, which focused on how the research is conducted by bringing people together in immersive settings, ensuring that safety is a prime concern with the apparatus of the technology and consideration. It is important to note that all participation was voluntary; participants were informed that they could withdraw at any time without needing to give a reason. Alongside the consent form, an information sheet was made available, which detailed the research activity, and I was available to respond to any questions the participants had on reading and signing these forms. Participants were also able to select, via an additional media consent form, different levels of permission for the (audio, video, and photographic) documentation, and the use of their data and right to remain anonymous was made explicit. In my research practice, I have explored and responded to my own ethical concerns through dance-somatic and improvisation tools. Drawing on practitioners such as Nita Little, Nancy Stark Smith, and others who locate themselves in the field of Contact Improvisation—a practice that offers highly nuanced relational practices of partnering, movement improvisation, and touch. I have also drawn from the VR/technology industry and the use of immersive technology such as VR for immersive artistic/gaming 'installations' or 'interactive demos', taking into account the specific affordances of VR, its participatory conventions, and current ethical concerns and approaches to these concerns (e.g., Madary and Metzinger, Cortese and Zeller).

2.5. Analysis

The group discussions in both sets of workshops (eight workshop sessions in total: two for *WOS* and six for *TFS*) were audio-recorded, and the practical sessions were video-recorded. In *TFS* workshops, video footage was recorded in both the physical environment and from within the VE (internal VE footage was recorded using software called OBS Studio by University of Bristol researcher Helen Deeks). The process of analysing the group discussions in each of the workshop sessions and my own observations and field notes was to take a thematic analysis (TA) approach, outlined by Braun and Clarke [25]. Braun and Clark's approach is a "widely used qualitative analytic method within psychology" [25] for "identifying, analysing and reporting on patterns (or themes) within data" [25]. The authors state that the process of TA "provides accessible and systematic procedures for generating codes and themes from qualitative data" [26]. Following this process, I coded all of the participant's comments, a process of fragmenting and abstracting the data into the "building blocks for themes (larger) patterns of meaning, underpinned by a central organising concept; a shared core idea" [26]. Alongside following Braun and Clarke's approach, I took a phenomenological lens to, more intuitively, pull out and attend to the participant experiences and testimonies (from the data and from my own observations and experiences of the workshops as a facilitator), which centred the body and 'feeling' senses. This was carried out using my own dancer sensibilities, the depth of my own sensorial and bodily engagement with the technology, which helped me unpack and thematically organise the experiences of the workshop participants detailed in this article.

3. Generative Themes

In this section, I briefly introduce four themes developed through the methodology outlined above. These themes pertain to the participants' experience of: (i) their body as seen and unseen in physical and virtual environments; (ii) sensations of touch and tactility in VR; (iii) the residual effects of VR technology on exiting the headsets; and (iv) somatic activation and agency in VR. These themes, which have emerged through these workshop practices, show the power of a dance-somatic standpoint in engagements with VR to engage with expanded sensory modes of seeing and feeling and to address new questions of VR experiences centred on the body.

3.1. Seeing: Bodies Seen and Unseen in the VE

As somatic dance practitioners, operating and moving within a blindfold or with eyes closed was common practice for the *WOS* participants—moving with the body 'unseen', 'seen', or sensed nonvisually. The workshop activity of removing their blindfolds from behind the HMDs and entering into the visuality of the VE—yet with a body still 'unseen' in the virtual visual space—exposed differences in the ways in which these participants tuned into and moved their bodies, revealing their somatic sensing processes [1]. One participant spoke about the freedom she felt as she would move with her eyes closed or with a blindfold on, able to sense and move her body as unseen in the VE. For another participant, this process was more difficult and left her feeling disorientated and ungrounded, "seeking other beings, location, something, to ground me" [27]. "I think when my eyes are closed, I have a really strong sense of where my hands are, but it's when they're open, and it's so stimulated visually that the visual sense takes over and then it's almost like my proprioception goes into low volume, my vision is high volume" [27]. Choreographer and scholar Einav Katan-Schmid writes about the rehearsals for her performance Playing in VR (2017), bringing up similar issues of contrasting sensibilities for dancers engaging with VR technology.

The dancer Lisanne Goodhue could not relate the virtual representations and her dance at the same time. Goodhue described her experience in VR as fragmented—she could either draw or dance. She could not bridge the two experiences immediately and intuitively into one comprehensive practice. In contrast, the dancer Nitsan Margaliot tended to integrate the score immediately into his dance, to be carried away by it and to identify it, as he reported, with his own imagination. [28]

Phenomenologist Drew Leder writes about the paradoxical nature of the experience of the body as both absent and present, "[w]hile in one sense, the body is the most abiding and inescapable presence in our lives, it is also essentially characterised by absence" [29]. He writes that "one's own body is rarely the thematic object of experience" [29]. In this research, though, the body is placed centrally. Whilst exposing differences in habituated sensing processes, the WOS participants all drew emphasis to their bodies in their visual absence in the VE: their bodies were sensed as part of the experience, rather than being passively lost or left behind. Katan-Schmid writes, "[a]t the outset, moving in VR technology interrupts the dancers' somatic awareness" as "the VR setting converts the experience of how dancers normally lead their dance" [28]. The experience of VR, for Katan-Schmid's dancers Goodhue and Margaliot, opened up a conscious 'perceptual gap' [1], "the dancers became aware to the distance between the environments—the virtual and the actual" [28]; rather than it disjointing the experience, the technology provided them with the ability to "develop reflective awareness to the processes of leading visions and movements" [28]. The WOS participants reflected on their own somatic processes and the fact that these processes were different for each of them, and this was enabled by their own experiences of VR.

3.2. Feeling: Touch and Tactile Connections

Both sets of workshops offered somatic dance and invited the participants to explore practices that retuned their senses, albeit temporarily, away from the visual world and toward a felt sensing of their body, other bodies and the environment. These modes of

sensing were then employed by them whilst in an engagement with VR—a technology that demands the visuality of its environment as the driver of sensation. This brought up expanded sensations of touch beyond skin-to-skin or surface-to-surface physical contact.

In a VE created by VR technologies, there can occur a tangible sensation of the presence of the environment and of the virtual objects within that environment, despite there being nothing physically there—a pseudo-haptic sensation drawn from the moving visuality of the VE. The WOS participants commented on the 'air' in the VE feeling "thicker" [27] than the air in the physical world. This synaesthetic sensation caused a kinaesthetic response, an inward movement and contraction, "It must do something to the Kinesphere [Laban, 1966], that [it] kind of shrinks in response to that virtual world" [27]. TFS participants experienced a similar reaction to the approach of the virtual ball towards their bodies, "[I had to] move away from it, duck" [30], "[in VR] my body naturally reacted to the virtual ball's actions when it came too close or was falling to the ground. I felt my body responding to the virtual ball like an instinct" [31]. Other participants experienced the sensations of "merging and melting" [30] with the virtual balls.

The body draws on its haptic memory ascertained in the physical world and applies this information to the visuality of the VE. "Seeing emerges as a sense which is inherently tactile in this responsive, visual environment—due to the relationship between seeing and feeling or tactility, and also due to the movement/responsivity of the visual environment" [1]. Drawing from philosopher George Berkeley, Pallasmaa writes that the "visual apprehension of materiality, distance and spatial depth would not be possible at all without the cooperation of the haptic memory" [12]. Pseudo-haptic sensations derived from the moving visuality of the VE are drawn from an accumulation of sensory learning and the forming of habituated links between the senses. Pallasmaa writes about these linkages, that "vision needs the help of touch" [12], as "sight detached from touch could not have any idea of distance, outness of profundity, nor consequently of space or body" [12].

3.3. After VR—The Residual Effects of the Technology on Participants' Imaginations

One of the key takeaways from TFS workshops was the shift that the participants made between the first imagination task (task two) and the second imagination task (task six). Reflecting on the first imagination task, participants commented, "I've not got a very good imagination" [31], and "I struggle to imagine things" [31]. In this first imaginative task, they tended to imagine familiar and recognizable balls, "a tennis ball" [31] and "my son's red ball" [31], commenting, "I don't have the kind of imagination to create something new" [31]. In the second imagination task, which took place once the participants had experienced the VE through both sound and vision (tasks four and five), the participants noted, "I was imagining a much more interesting ball, rather than a boring ball" [31]. The newly imagined balls were entities that did not or could not exist in the physical world, "my concept of a ball was changed" [31]. There was a sense of expansion in their imaginative capacity, "I had more imagination by the end of it" [31], shifting from the realm of the 'possible' to that of the 'potential'. Marcyrose Chvasta, Assistant Professor in performance, cultural, and media studies, writes, "we have a tendency to concretize the possible" [32], and this process "[s]trips away at potentiality—the essence perhaps, of life" [32]. In the second imagination task, the participants explored ideas that had been previously unknown to them, "an embrace of alterity" [32] rather than a "reification, a reduction to the thing" [32].

TFS participants explained that their experience of the VE had "made it far more interesting for how I would imagine the ball again" [33]. The second imagined balls came with "effervescent and changing" [33] qualities. "I felt like I could instantly form a connection with the ball. It was larger and incorporated my movement into its shape more easily" [30]. The participants moved more with these balls and moved with them as part of their bodies, "I could feel it inside of me, and it was like not just a ball" [33]. These balls were influenced by the VE, "the visual impact and its properties of the VR ball were very strong in my head" [30]. The experience with the technology had activated and expanded

their imaginations, "I found it easier to imagine the ball once you had seen and heard the ball. You could kind of see how it worked, in terms of how it moved in the VR bit, and then you can kind of do it, imagine it really" [33].

Once participants had exited the VE, taking off their headsets and putting down their controllers, there was a sense of a continuing presence of the VE in the physical environment through this reimagining in the final task. The VE had entered into the imaginations of the participants as a residue of the virtual forms seen and sounded in the VE. Madary and Metzinger write about the psychological effects "that last after leaving the virtual environment" [2]. This aspect of the technology is both considered a positive tool for change and a cause for ethical concern.

3.4. Exposing the Perceptual Gap: Activating Somatic Agency in the Visual Grip of a VE (250)

Taking the WOS participants through an experience of the technology as a material, weighted object prior to seeing the VE created an attentional shift. The HMD was placed over the blindfold so that the participants could take some time to touch the headset and sense and feel the weight of it on their heads, and to move to experience the physical sensation of this in their bodies before the blindfold was removed.

Sensing the equipment with touch, reading it, and trying to understand its form with touch, the touch and felt sensing of the hardness of the headset contrasting [with] the soft textile fabric of the blindfold—this equipment felt like it was the bridge between the reality and the virtual reality [27].

This activity brought the participant's attention to the physical relationship between their bodies and the technology in its material form and exposed the materiality of the technology and the effects of this physicality on the physical body—something that is not typically attended to (usually hidden) in a VR experience. This attentional practice, rooted in a somatic sensibility, offered the participants the possibility to become aware of their own participatory agency. In the pull of a visual VE with a visually dominant sensory system, this practice offered experiential options in their play with VR. The 'exposed' materiality of the VR headset did shift once the blindfolds were removed and the physical relationship between the headset and their bodies became more, in Idhe's post-phenomenological terms 'transparent' [34], bringing to attentional fore the visual simulation, "I was so much more conscious of having this thing on my head when we put it on with the blindfolds on, as soon as the blindfolds got removed, I wasn't even thinking of the weight of my head or anything like that" [27].

In the design and facilitation of the workshops, the ruptures or gaps between the physical body, the materiality of the technology and physical environment, and the simulated bodies and materiality of the VE were attended to—opened up, not covered over. These moments provided openings into experiences and sensations which challenged normative expectations of the technology and expanded sensory perceptions of bodies and environments. Some participants found it hard to navigate these moments—as one WOS participant's comment highlights, drawing on an experience with his partner which he struggled to reconcile: "I think I touched [her] hair at one point while we had our VR sets on, and I was like, I can't really feel that. Where I think if I didn't have the VR, because we were dancing earlier on, I was much more aware of that contact, but because of all the visual stimulation, it was almost like it hardly existed, like it was quite hard to find it" [27].

He added, "It's confusing for the brain, isn't it? That it's touching something and seeing something else, and it can't reconcile those two things" [27]. By combining somatic-dance practices and VR technology, this research investigates these perceptually confusing moments between two coexisting environments, seen and felt, and the ways in which these environments weave together in our experience as different realities.

4. Discussion

The methodological framework for the workshops described and discussed here, drawn from my personal and physical engagement with VR, provided participants with

an entry into and experience of the technology which foregrounded their sensory bodies. This research framework offers a model for VR design of value to the field of multimodal technologies and interaction, which incorporates participatory agency and supports notions of difference—of non-normative sensing bodies using the technology. The ways in which the workshops were crafted used dance-based sensory practices, which, combined with the technology, exposed experiences of perceptual gaps between seeing and feeling and enabled the participants to explore these moments of sensory confusion and tension through movement and dialogue together. In the workshops, moments of disconnect—the gaps or ruptures between physical and virtual bodies and environments—were leaned into, not covered over, and provided the participants with experiential insight into their own sensory, embodied attention and agential capacity in their VR encounters. Activating and enlivening their somatic awareness alongside the visual domain of VR enabled the workshop participants to access and flex their sensory standpoint toward an interoceptive and embodied sensing alongside the visual grip on the senses that the technology affords. This enabled the participants to directly experience how the technology forces and shocks the senses, rupturing this felt connection to body and world. The participants were guided and cared for in all of the workshop sessions and supported by the dance-based practices; they were given the tools to guide and care for one another. The workshops enabled the communication of the different ways in which the participants encountered the technology and the connection between these encounters and the sensory processes through which the participants perceived and understood their bodies, each other and the environment around them. The participants sought to find connections and make contact with one another within and across the different sensory realms and the ways in which the VR technology left residual imprints in their imaginings, exposing different sensory, perceptual and embodied patterning across and within the different participant groups.

5. Conclusions

In bringing a dance sensibility to the encounter between the human and the VR machine, through a process of exploring and understanding the technology from my standpoint as a dancer and taking this insight into the design and facilitation of participatory workshops to investigate the experiences of others, enables/gives rise to issues that are not commonly addressed by technologists or by the VR industry. This methodological process, originating from my own dancer's response to the technology, raises key issues of sensory bias, flexibility and agency, bodily difference and inclusivity, and the lasting effects of VR. VR experiences are typically designed to encourage a 'user' further into the visual realm of the VE. The over-reliance on the visual, as the activator of the sensory system, reduces or suppresses other modes of sensing body and environment. Modes which are the backbone of a dancer's ability to tap into their own and another's 'felt-sensed' body and space around. Whilst ethical implications for bodies in VR are being investigated (e.g., in the work of Madary and Metzinger, Cortese and Zeller), as Loke and Schiphorst point out, there is a need for a fuller understanding of the sensorial body to create "technologies and interfaces that can take account of the somatic dimension, with its ethic of care" [35].

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References

1. Thomas, L.M.; Glowacki, D.R. Seeing and Feeling in VR: Bodily perception in the gaps between layered realities. *Int. J. Perform. Art Digit. Media* **2018**, *14*, 145–168. [CrossRef]
2. Madary, M.; Metzinger, T.K. Real Virtuality: A Code of Ethical Conduct. Recommendations for Good Scientific Practice and the Consumers of VR-Technology. *Front. Robot. AI* **2016**. Available online: https://doi.org/10.3389/frobt.2016.00003 (accessed on 8 December 2021).
3. Slater, M.; Perez-Marcos, D.; Ehrsson, H.; Sanchez-Vives, M.V. Inducing Illusory Ownership of a Virtual Body. *Frontiers in Neuroscience* 2009. Available online: https://doi.org/10.3389/neuro.01.029.2009 (accessed on 8 December 2021).
4. Slater, M.; Usoh, M. Body Centred Interaction in Immersive Virtual Environments. *Artif. Life Virtual Real.* **1994**, *1*, 125–148.
5. Slater, M. Immersion and the illusion of presence in virtual reality. *Br. J. Psychol.* **2018**, *109*, 431–433. [CrossRef]
6. Slater, M.; Sanchez-Vives, M.V. Enhancing Our Lives with Immersive Virtual Reality. *Front. Robot. AI* **2016**, *3*, 74. [CrossRef]
7. Biocca, F. The Cyborg's Dilemma: Progressive Embodiment in Virtual Environments. *J. Comput. Mediat. Commun.* **1997**, *3*, JCMC324. [CrossRef]
8. Lanier, J. *Dawn of the New Everything: Encounters with Reality and Virtual Reality*; The Bodley Head, Penguin Books: London, UK, 2017.
9. Lécuyer, A. Simulating Haptic Feedback Using Vision: A Survey of Research and Applications of "Pseudo-Haptic Feedback". *Presence* **2009**, *18*, 39–53. [CrossRef]
10. Pusch, A.; Lecuyer, A. Pseudo-Haptics: From the Theoretical Foundations to Practical System Design Guidelines. In Proceedings of the ICMI 11: Proceedings of the 13th International Conference on Multimodal Interfaces, Alicante, Spain, 14–18 November 2011.
11. Pusch, A. Visuo-Proprioceptive Conflicts of the Hand for 3D User Interaction in Augmented Reality. Human-Computer Interaction [cs.HC]; Institut National Polytechnique de Grenoble—INPG, 2008.
12. Pallasmaa, J. *The Eyes of The Skin*; John Wiley & Sons Ltd.: Chichester, UK, 2012.
13. Manning, E. *Politics of Touch: Sense, Movement, Sovereignty*; University of Minnesota Press: Minneapolis, MN, USA, 2007.
14. Sheets-Johnston, M. *The Corporeal Turn: An Interdisciplinary Reader*; Imprint Academic: Exeter, UK, 2009.
15. Little, N.; Dumit, J. Articulating Presence: Attention is Tactile. In *Thinking Touch in Partnering and Contact Improvisation: Philosophy, Pedagogy, Practice*; Sarco-Thomas, M., Ed.; Cambridge Scholars Publishing: Newcastle upon Tyne, UK, 2020.
16. Little, N. *Enminded Performance: Dancing with a Horse*; Lexington Books: Washington, DC, USA, 2016.
17. Marks, L.U. *Touch: Sensuous Theory and Multisensory Media*; University of Minnesota Press: Minneapolis, MN, USA; London, UK, 2002.
18. Buckwater, M. *Composing While Dancing: An Improvisers Companion*; The University of Wisconsin Press: Madison, WI, USA, 2010.
19. Marks, L.U. *The Skin of the Film*; Duke University Press: Durham, CA, USA, 2000.
20. Denshire, S. On Auto-Ethnography. *Curr. Sociol. Rev.* **2014**, *62*, 831–850. [CrossRef]
21. Bacon, J. The voice of her body: Somatic practices as the basis for creative research methodology. *J. Danc. Somat. Pract.* **2010**, *2*, 63–74. [CrossRef]
22. Madison, S. *Critical Ethnography: Method, Ethics, and Performance*; California: Sage Publications, Inc.: California, CA, USA, 2005.
23. Thomas, L.M. *Auto-Ethnographic Writing*; University of Bristol: Bristol, UK, 2018.
24. Connor, M.O.; Deeks, H.M.; Dawn, E.; Metatla, O.; Roudaut, A.; Glowacki, B.R.; Sage, R.; Tew, P.; Wonnacott, M.; Bates, P.; et al. Sampling molecular conformations and dynamics in a multi-user virtual reality framework. *arXiv* **2018**, arXiv:1801.02884v1.
25. Braun, V.; Clarke, V. Using Thematic Analysis in Psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [CrossRef]
26. Clarke, V.C.; Braun, V. Thematic Analysis. *J. Posit. Psychol.* **2015**. Available online: https://doi.org/10.1080/17439760.2016.126261 3 (accessed on 8 December 2021).
27. Thomas, L.M. Ways of Seeing workshops—Participant group discussions. In *Bodily Undoing Symposium*; Bath Spa University: Bath, UK, 2017.

28.   Katan-Schmid, E. Playing with Virtual Realities: Navigating Immersion within Diverse Environments (Artist-Led Perspective). *Body Space Technol.* **2020**, *19*, 224–238. [CrossRef]

29.   Leder, D. *The Absent Body*; University of Chicago Press: Chicago, IL, USA, 1990.

30.   Thomas, L.M. *The Felt Sense Workshops—Mark-Making Activity Undertaken by Participants*; Knowle West Media Centre: Bristol, UK, 2018.

31.   Digital Echoes Participant Email Correspondence to Thomas, L.M. 2018. Available online: https://www.digitalmeetsculture.net/article/c-dare-call-for-proposals-digital-echoes-2018/ (accessed on 8 December 2021).

32.   Chvasta, M. Remembering Praxis: Performance in the digital age. *Text Perform. Q.* **2005**, *25*, 156–170. [CrossRef]

33.   Thomas, L.M. *The Felt Sense Workshops—Participant Group Discussions*; Knowle West Media Centre: Bristol, UK, 2018.

34.   Ihde, D. *Technology and the Lifeworld: From Garden to Earth*; Indiana University Press: Bloomington/Indianapolis, Indiana, 1990.

35.   Loke, L.; Schiphorst, T. The Somatic Turn in Human-Computer Interaction. *Interactions* **2018**, *25*, 54–5863. Available online: https://doi.org/10.1145/3236675 (accessed on 8 December 2021).