GHOSTDANCE: ON THE MATERIALITY FEELING OF DANCING BODIES IN VIRTUAL REALITY

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https://doi.org/10.34632/jsta.2024.16041

Journal of Science and Technology of the Arts, vol. 16, n. 1 (2024): pp. 14-36

ABSTRACT

The *GhostDance* research project explores the changes in dancers' body perception when interacting with virtual bodies. Virtual reality's volatile and insubstantial nature, with its liquid architectures (Novak, 1992) and massless, weightless and fluid bodies, can be seen as inherently ghostly. The study aims to investigate how the presence and interaction with a body are influenced by the existence of a spectral dimension, be it our own body or that of another person or virtual entity. The research includes a live performance where two dancers contrast dance between physical and virtual reality partners, creating a phantasmagorical dialogue between human and virtual bodies. The study looks at changes in sensory-motor perception, kinesphere awareness, tactile experience, and the perception of weight and effort of dancers performing with virtual characters. It draws upon first-hand accounts from dancers to shed light on the complex interaction between physical and virtual elements in the dancers' experience. The study's findings pave the way for reflections on the implications of these interactions.

Keywords: Avatar; Embodiment; Performance; Dance and virtual reality.

ABOUT THE PERFORMANCE
ABOUT THE VIRTUAL ENVIRONMENT
ABOUT THE DANCER

A humanoid figure dances animatedly. It moves on a surface that appears to be concrete surrounded by water. The movements are choreographed. It doesn't react to stimuli. It's a shadow. It's a film character in a three-dimensional film. His body has shape, volume and expression. Like Sisyphus, he is condemned to repeat the same gestures until eternity. He repeats the movements of a previous time with precise execution. Movements that have been recorded — captured is the technical term — from a human dancer, and which he now repeats with no intentions. It "dances" his half of a choreographed duet. It waits for a flesh and blood partner who knows the choreography to complete it. "Through the virtual reality headset, I see it. I feel it. I move around it. It's another reality, and I'm in it." (De Lima et al., 2023)



Figure 1. The three dancers rehearsing *Ghostdance: Andamento* #1 © R.A.

INTRODUCTION
IMMERSION
INTERACTION

The lineage of the notion "embodied mind" traces its origins to thinkers such as William James, Edmund Husserl, and Maurice Merleau-Ponty. Over time, it has gained recognition in the field of neuroscience, aligning with notions like enactive cognition proposed by Francisco Varela and colleagues and embodied simulation introduced by Vittorio Gallese. This project is rooted in this epistemological lineage and the subsequent discussions that reached maturity on virtuality and telepresence within the context of performance, unfolding in the 1990s and 2000s (Kozel, 2007; Dyson, 2009). We look at what dance can teach us about the human perceptual nature, departing from the embodied experience of dancers

https://doi.org/10.34632/jsta.2024.16041
Journal of Science and Technology of the Arts, vol. 16, n. 1 (2024): pp. 14-36

when they dance with figurations of human persons in the ghostly context of virtual reality.

Virtual reality (VR) represents a *technical image* (following Flusser's understanding of the term), balancing the simplicity of the signs it presents to the user with the intricate, complex nature of its constituent elements and its value as a cultural object. Like photography, VR images have both "transparency" and "indexability". We tend to ignore their artifactuality while recognising their value as signs. The consensus is somehow the dualistic understanding that VR devices are illusion machines. However, as Chalmers argues, "VR devices are not illusions; they are reality machines" (Chalmers, 2022, p. 206). They consist of objects and events made of voltages, patterns of electronic voltages, bits, computational operations and processes. They are artefacts constructed to be perceived as representations ("reflection of a profound reality") or simulacrums ("with no relation to any reality whatsoever") — using the terms of Jean Baudrillard (Baudrillard, 1991). They put the user's sensory system into a "direct feedback loop with a computer" (Hayles, 1999, p.26); they have *causal power* over their users and affect them. As a technical format, VR devices refer to the historical apparatus of the magic lantern and phantasmagorias. Like cinema, VR is an art of shadows. We tend to equate the real with the mass, reverberation, and resonance. Nevertheless, virtual reality brings us into a world that preexists our embodied engagement, where objects, bodies, time, and space are manifestations of potential (in Pierre Lévy's conceptualisation of the virtual [Lévy, 1995] involving the rearrangement of the actual, prompting the emergence of novel inquiries), showing features and properties that may differ from the substantive physical reality that we live on.

When dancing within virtual reality, dancers interact with virtual entities and events while simultaneously dealing with the physical and substantive reality, literally grounded, i.e. with their feet on the ground. VR constitutes a dichotomy between the objective body and the phenomenal body, a place of spectrality, a place without time, with no direct tactility; it establishes itself as a principle and simultaneously a limit and boundary that allows passages. Chalmers calls this dual space the "physicality-virtuality continuum" (Chalmers, 2022, p. 236). Is this a disembodied interaction? If not, what is then left of the human in this experience?

Many artists and researchers have approached this issue from different perspectives (e.g. Kitsou Dubois's *Ghosts and Astronauts* [1997] dealing with the weightlessness, or Paul Sermon's *Telematic Dreaming* [1992] dealing with the absence of physical proximity and touch). Nevertheless, as this mode of relating becomes increasingly omnipresent, paradoxically, the "virtual" brings us closer to the lived experience of contemporary life (Ede, 2005, p.111); this is far from an exhausted subject. However, "we so sensuously inhabit our bodies that it is hard to see them as systems of knowledge" (Ede, 2005, p.133). As the rapid proliferation of new technologies has infiltrated and fundamentally transformed our lives in an accelerated timeframe, the issue is here to stay. That is why we have

https://doi.org/10.34632/jsta.2024.16041

found it relevant to develop further analytical and critical studies on this embodied consciousness.

This article is situated on these lines of thought. It aims to deepen the challenges, uncertainties and perplexities generated throughout the work process of the exploratory research project — *GhostDance*. How does dance contribute to the reevaluation of our perceptions of the materiality of virtual bodies? In what ways does the spectrality of virtual bodies affect users? Concurrently, we investigate the new technical images produced by virtual reality to achieve a more profound understanding of the human experience. This perspective does not aim to constitute an absolute but rather an exercise in sharing and interpretation with many associated ontological and epistemological challenges.

GhostDance examines how dancers perceive their embodiment of movement — delving into aspects such as synesthesia and proprioception — particularly when engaging with the perceptual phantasy/sensation of being in the presence of an ethereal virtual body. While exploring dancers' experiences of embodiment within virtual reality, we uncovered many possibilities in the realm of bodily interaction. However, it becomes clear that the interaction with an evanescent virtual body lacks the tangible and dynamic qualities inherent in a physical, biological, carbon-based body. This points to a novel relational paradigm wherein our material bodies engage with intangible entities, aptly referred to as “ghosts”.

As such, the research poses essential questions about the dancer's sensory-motor perception when engaging with the corporeal-phantasmagorical virtual body. Specifically, it explores changes in the awareness of the dancer's kinesphere, tactile experience, perception of weight, and the effort exerted in each movement or interaction when their physical body intersects with an immaterial entity in motion, such as a 3D avatar animation of their dance partner. Furthermore, the research delves into the implications of this altered bodily perception on the dancer's relationship with the environment.

To address these questions, we investigate how the perception of the body, weight, personal space, touch, support, and materiality is altered when the dancers are involved in a kinesthetic interaction with a virtual body (i.e. a 3D avatar animation of their dance partner) comprising duets that were previously choreographed, rehearsed and performed live. In these duets, two dancers confront the disparities between dancing with a “real material partner” (a person) and dancing with a virtual reality partner (a 3D animated avatar of that person). The choreography serves as a laboratory for experimenting with VR animation exploring the concept of phantasmagoria. This dynamic creates a dialogue between human and virtual bodies, fostering interactions that complement, intertwine, and influence each other.

In the following sections, we will present the work in progress of this investigation, with a particular emphasis on the presentation that we did at Festival *Inshadow* on December 2, 2023, discussing the performance and its audiovisual components.

https://doi.org/10.34632/jsta.2024.16041

ANDAMENTO #1 [MOVEMENT #1]

Cecília de Lima created the performance *Ghostdance Andamento #1* in collaboration with three dancers: Daniel Pirata, Ester Gonçalves and Miguel Santos (De Lima, 2023). The research at the origin of the creation of this performance concerns the exploration of variances in the embodied perception of the dancers when dancing choreographed duets with "real flesh and blood partners" compared to dancing the same duets with a virtual partner[1].

1 See documental video at: https://ghostdance.ulusofona.pt/outcomes/videos.

The creative process was based on various movement studies, including *(i)* using support, *(ii)* the breath as the initiator of movement, and *(iii)* touch with and without manipulation. Six dance duets were created, and subsequently, the movements of each dancer were converted into a VR avatar (with a physiognomy somewhat reminiscent of the dancer and in relatively neutral clothing). We used an Awinda/XSens motion capture suit equipped with inertial sensors to capture the dancers' movements. This allowed us to record the space/time kinetic properties of the dance movement of the duet dancers. A Pico 4 VR headset device was used to access the VR environment, which was developed by José Siopa using the game engine Unity3D.

The performance of *Ghostdance Andamento #1* plays with the confrontation between the presentation of flesh-and-blood duets and virtual duets, where one of the dancers wears the VR headset and dances with a virtual partner. The audience sees the virtual world through a visual projection on the cyclorama. The different moments of the performance vary not only through the succession of different duets but particularly through how the virtual world is perceived.

In the opening act, Ester Gonçalves is alone on stage wearing a VR stereovision headset (with a resolution of 2160 x 2160 pixels per eye refreshed at 90 Hz) (Fig. 2). She dances the duet choreography created with her partner Miguel Santos, but now the presence of Santos is replaced by his avatar that replicates the pre-rehearsed movements. On the cyclorama projection, we, the audience, see Santos's avatar, but not as Gonçalves sees it through the headset. Instead, we see it through a spectator's eyes, observing from some distance. From this perspective, we can appreciate how Gonçalves coordinates her movements with the avatar. However, we are not immersed in the virtual world, so we still perceive two layers that relate through movement.

In the second moment, Santos and Gonçalves dance together on stage, revealing the initial duet to the audience (Fig. 3). The movement quality is mostly suspended and fluid, with their interrelation based on feeling each other's breath and support. The cyclorama displays a still image of the virtual environment ["a perspective from the earth, [...] on a platform with a concrete ground surrounded by water" (Santos, 2024a)].

The third moment still explores the same duet. Now, Santos wears the headset and dances with the virtual avatar of Gonçalves (Fig. 4); however, the perspective of the virtual world projected on the cyclorama is different. Now, the audience sees what Santos sees through the headset,

https://doi.org/10.34632/jsta.2024.16041

i.e., the audience sees the viewpoint of Santos's dancing eyes. The movements of the eyes are fast: a close-up of the avatar's hand rapidly changes into a sweeping motion of the horizon. Then, it changes again into the moving vision of a cartwheel — for a second, the up-down visual reference gets disoriented — which might be unsettling.

The fourth moment transports us to the realm of pure virtualisation. The stage is devoid of physical presence, and the cyclorama exhibits two videos presented simultaneously side by side (Fig. 5). In each video, we see the image of the real dancer (wearing the headset) dancing with the avatar of their partner. In video 1, Daniel Pirata dances with the avatar of Ester Gonçalves, while in video 2, Gonçalves dances with the avatar of Miguel Santos[2]. Now, the audience sees the movement relation between the avatar and the dancer overlaid together in one visual layer, but it is not a live performance. (To create these videos, we captured both dancers individually using a blue-screen background and then overlapped and synchronised this recording with the same-angle recording of the avatar partner.)

2 See video at: https://youtu.be/1H7b84fpHeM

The following moments reintroduce physical and tangible presence on stage. One duet explores the agile yet dense quality of physical support between the bodies of Daniel Pirata and Miguel Santos (Fig. 6). Following this, another duet unfolds between Gonçalves and Santos. In contrast to the first duet, their bodies now navigate a relationship that delves into the empty spaces created between them, devoid of acts of support or manipulation, yet touch still occurs.

In the final moment, Pirata wears the headset to dance with Santos's avatar from the previous duet with Ester Gonçalves (Fig.7). Unfamiliar with this duet, Pirata improvises with Santos's dancing avatar. In the cyclorama, the audience observes the virtual world from Pirata's perspective. Acting as an embodied camera, Pirata selects what the audience sees through his gaze. As Pirata removes the headset, a blackout signals the end of the performance.



Figure 2. Dancer Ester Gonçalves wearing a headset, dancing with her partner's avatar. On the cyclorama the audience sees the avatar from perspective of an external observer. © R.A.

https://doi.org/10.34632/jsta.2024.16041



Figure 3. Dancers Ester Gonçalves and Miguel Santos perform together on stage. © Tomás Pereira.



Figure 4 Miguel Santos' viewpoint projected on the cyclorama. © R.A.



Figure 5. Overlaid images of avatars and dancers. © R.A.

https://doi.org/10.34632/jsta.2024.16041



Figure 6. Duet of Daniel Pirata and Miguel Santos. © Tomás Pereira.



Figure 7. A projection shares what the performer is seeing through the headset. © R.A

P FOR PERFORMANCE
P FOR PERCEPTION
P FOR PHENOMENOLOGY

To be a consciousness or rather to be an experience is to hold inner communication with the world, the body, and other people, to be with them instead of being beside them.
Merleau-Ponty, 2005, p.111

We seek a somatic form of materialism[3], emphasising an idea of embodiment and situated physicality within the context of technology and body movement in virtual performance. In the following sections, we revisit the performance Andamento #1 through the reflective memory of the dancers (Daniel Pirata, Ester Gonçalves and Miguel Santos) whom we have interviewed, and audio recorded[4]. We are interested in a "reflective capacity for exploration of liminal corporeal and perceptual states" (Doyle,

3 The term Somatic materialism is associated with a philosophical perspective that opposes the Cartesian mind-body split with an emphasis on the significance of the body (soma) and the way in which mental phenomena are rooted in the physiological and material processes of the body in order to understand consciousness, subjective experience and the mind-body relationship.

4 All interviews were in Portuguese and then translated to include in this article.

Journal of Science and Technology of the Arts, vol. 16, n. 1 (2024): pp. 14-36 https://doi.org/10.34632/jsta.2024.16041

2017, p.75) where “affect and somatics overlap and diverge” (Doyle, 2017, p.75). We have the dancers revisit their kinetic, visual, aural, haptic, gravitational, proxemic and tactile sensations while in the performance.

A BODY: MY OWN?

You believe your eyes, not your feet
Hsin-Chien, 2024

The dancers intensively practice the talent to believe their feet. They intensively practice the faculty to relate and apprehend their surroundings through their integral body – sensing weight and balance, expanding and contracting through space, and suspending and accelerating the rhythm of time. Dance training often incorporates exercises with closed eyes to heighten awareness of the body and its sensations, fostering a deeper immersion in the experience.

Immersed in a VR environment, dancers confront the physical world of their moving bodies with the virtual world of their sight. In *GhostDance*, we employed a VR setting where dancers cannot see their own bodies, so, despite actively using their vision, their bodies remain invisible to them.

Differently from their daily dance practices spanning many years, the uncanniness of not perceiving their own bodies visually seems disturbing in VR. “The simple fact that I also lack visual access to my own body in my visual field puts me in an even more alienated situation”, says Santos (2024b). They also mention a loss of clarity regarding the boundaries of their bodies. “Then I had no idea when I reached the ground, for example. It was super strange! – ‘Oh, the ground is already here!’ The landings and the attacks seemed more abrupt.” (Gonçalves, 2024)

In *Matter and Memory*, Henry Bergson articulated, “As my body moves in space, all the other images vary; that of my body, on the other hand, remains invariable. I must therefore make it a centre to which I will relate all the other images” (Bergson, 1929, p. 43). The permanence of one's own body “is absolute and is the ground for the relative permanence of disappearing objects, real objects”, adds Merleau-Ponty (2005, p.105). Both philosophers advocate for a figure-ground paradigm, wherein the central reference is the perceiver's body. As Bergson mentions, the body’s movement accentuates the impermanence of the world. Therefore, as dance practice emphasises, the body’s sensorimotor referential for relating with the surroundings must be intensified.

However, when moving in VR and attempting to coordinate one's movement with an avatar, the perception of the body as the reference point for our relationship with the world became distrusted. “I doubt to what extent what appears to be the ground to me is truly the ground”, says Daniel (Pirata, 2024a). One sees the ground, but the ground one sees is not the same ground that supports the body; it is not the same ground where one surrenders his weight when rolling, jumping, turning or falling. One sees textures, shapes and spatial limits, yet they cannot be touched or grabbed. One can feel their own body, but it cannot be seen.

https://doi.org/10.34632/jsta.2024.16041

The usual harmony between visual perception and sensorimotor perception becomes disrupted. When such fundamental referential relations of the body with the environment fail, the sense of reality becomes deconstructed and questioned. Pirata expressed a sense of unease: “I felt this need to know that, in that virtual reality, I could find a sensation that was truly real” (Pirata, 2024a). Drawing on his expertise as a dancer, Pirata delved deeper into a somatic and proprioceptive mode of connecting with the environment. His awareness of weight gave him a sense of what was “truly real”: “My touch on the ground was always much stronger and even made more noise than without the headset because there was a real need for me to feel that there was something there”.

A BODY: THE "OTHER"

It is through my body that I understand the other,
just as it is through my body that I perceive “things”.
Merleau-Ponty, 2005, p.216

The ghostly nature of VR is accentuated by the lack of mass and the absence of reactive actions by their virtual dancing partners. This changes the nature of the dancers’ self-awareness. They describe the virtual partner’s presence as cold: “I felt the avatar was very cold, I felt it was cold” – says Gonçalves (2024). “A bittersweet and somewhat strange sensation because I do not feel a response from the Avatar” – adds Santos (2024b).

Again Merleau-Ponty would say:

> The communication or comprehension of gestures comes about through the reciprocity of my intentions and the gestures of others, of my gestures and intentions discernible in the conduct of other people. It is as if the other person’s intention inhabited my body and mine his. (Merleau-Ponty, 2005, p.215)

The spectrality brought by this lack of response, of these “intentions” from the avatar that seems to be unable to “inhabit his body”, was also emphasised by Pirata. He commented on a physical monologue of the virtual dancer, turning him into a spectator of the spectral figure:

> It seems like there is a break in the middle where I am dancing, and I know I have this avatar with me who is also dancing. I do not have to give him signals. He doesn't need me. He doesn't need me. It immediately makes me think that I do not need him either... there is no communication, no relationship between my body and the Avatar. (Pirata, 2024a)

Pirata continues, reflecting that he was dancing an improvised duet with a spectral counterpart; thus, he was the one who had to conform and follow:

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> In reality, I needed him. I had to have this communication with him. But I do not have a response, only communicating with him. And he did not communicate with me. When I passed through him and tried to stay in his body, he would move and go elsewhere. I had to follow him. (Pirata, 2024a)

He then continues: "The Avatar fled. What do I do now? – I almost had to respond immediately. I really had to do it within this improvisation." (Pirata, 2024a). Pirata recalls the necessity of being attentive and following the visual hints provided by the avatar. Ester Gonçalves also stresses these rhythms almost martially imposed since this was a duet:

> My head has to follow the Avatar. And then there is another thing, he does not follow my pace. I must follow the rhythm that is always set... If I fall, he will not adjust. (Gonçalves, 2024)

This asymmetric relation breaks the rules of engagement in a partnered relationship such as a duet, and given the unresponsiveness of their virtual dancing partner, the dancers resorted to focusing on themselves. "There is a real distance: he is truly an Avatar... This makes me much more introspective. I think much more about what I am doing." (Pirata, 2024a). Like Pirata, Merleau-Ponty seems to look for a reverberation in his own body of the intentions the other is communicating: "There is mutual confirmation between myself and others" (Merleau-Ponty, 2005, p.215). But, in this unidirectional communication, Pirata finds himself in solitude, numbing some of his perceptive channels and turning into himself.

WEIGHT I TOUCH I SUPPORT

Our perception of weight is a reflection of our connection with gravity and the Earth, as highlighted by Steve Paxton: "[Gravity] is the deep background of the stories we focus on, which in turn describe our relation to it" (2018, p. 5).

According to the neuroscientist António Damásio (2003; 2010), the perception of weight, associated with our proprioception, makes us aware of our fundamental structural relationship with the world. It is central to the edifice of the consciousness of the self.

From our perception of weight, we gain access to various aspects, including (i) A sense of balance and imbalance associated with notions of falling, support and stability; (ii) A feeling of effort linked to movement and muscular tension, which, as Daniel Stern (2010) underlines, are foundational to self-perception; (iii) The perception of spatial constructions, such as levels, directions, depth, and trajectories, which are based on our reference to the earth's surface and on our vertical orientation. (iv) The conception of physical structure associated with bodily movement and its spatial constructs, according to Lakoff

https://doi.org/10.34632/jsta.2024.16041

& Johnson (1999), is central to the conception of the concepts of organisation and analysis.

Lakoff & Johnson (1999) further illustrate that such physical experiences of orientation, balance, body structure, and effort are fundamental "Emergent or Primary Concepts" at the foundation of our metaphorical cognitive processes. Therefore, our sense of weight and relationship to gravity do not manifest merely physically but are also a fundamental pillar within the construct of our cognitive paradigm.

The relationship to gravity and to the body's weight is embedded in the dancer's daily practice: mastering how to use the body's weight, how to use the momentum, how to transfer weight between different parts of the body and how to transfer weight between different bodies requires a specific technique and a thorough practice. Following Damásio's and Lakoff & Johnson's studies, when the dancer shares his weight with the partner, it is not merely a vulnerable physical act but also an act of sharing his sense of self and engagement with the world.

Describing this deep connection with his dance partner, Ester Gonçalves, Santos expresses:

> Ester is constantly in contact with me and offering me this resistance, this weight, so I know exactly where I am with her. There is a fit. If I do not know where Ester is, and if Ester does not know where I am, the fit becomes strange and compromises the following moment... We have a unique timing that obviously undergoes constant weight adjustments. There are adjustments... there is an almost visceral connection of sharing a centre that transports me to a certain state (demonstrates with his hands while talking). (Santos, 2024b)

Support is part of our daily lives. We feel the support of gravity and find our dynamic balance to be able to walk, jump, skip, slide, etc. Babies feel support in their mum's lap as she cradles them. We rely on the support of the chair we are sitting on. Grounded on this supporting relation, we generate actions and thoughts. When immersed in a dance with a virtual entity, the fundamental law of interactive movement (the counter-force of resistance) and its relationship to a sense of support become challenged. The virtual partner does not have weight, so it does not offer resistance. It cannot offer support and cannot be supported.

Unlike a material body, a virtual avatar does not experience a relationship to gravity. It is unbearably light. Santos comments on such lightness and later observes that such lightness produces severe difficulty in "really connecting" to the avatar. "Despite having a virtual ground and despite the Avatar being on the virtual ground, everything is very light, everything the Avatar does is very light" (Santos, 2024b). When reflecting on Kistou Dubois' work, *Ghosts and Astronauts*, Susan Kozel (2007) discusses the relation of weight with an emotional relationship. For Dubois, our rapport with reality is mediated through weight; for her, when there is no weight, there is no emotion.

https://doi.org/10.34632/jsta.2024.16041

Gonçalves describes an unexpected, absurd moment when she is supposed to be supported by her partner. However, when dancing with the avatar, she falls inside it, ending up beneath it: “There is a moment [in the choreography] when I go to his back and fall on top of him. And, at that moment, I am underneath him [the Avatar]” (Gonçalves, 2024). She continues describing another situation when she should be doing a lift — a movement during which she has both feet off the floor with the assistance or support of her partner: “[The Lift] is weird because I want to get up, and I will not leave the ground... It is almost like dancing solo, basically” (Gonçalves, 2024).

“Where can I lean on and rely upon? How can I share my weight and feel the other?” — These fundamental questions permeated every aspect of the creative process of the performance, both on a physical and affective level. Faced with the absence of support from the avatar, the dancers felt compelled to seek alternative solutions.

Gonçalves mentions the need to adjust her posture to convey a sense of weight and touch, seeking to give texture to the movement: “Movement had to be changed to gain texture... I tried my best to feel the weight that did not exist. I had to use more internal force on my own” (Gonçalves, 2024).

Santos revealed a different approach. He highlights the sensory impact of breathing and describes the air as having a density that affects his ribcage as well as his state of balance and alignment:

> I had to resort to breathing as a form of weight. The air created space and created weight. It had a density; it created a different density in my ribcage. In other words when I breathed in, it could put me in my centre, on my axis. (Santos, 2024b)

Additionally, Santos emphasises the connection between sensory experience and the emotional or mental state that occurs in the physical/real world. He contrasts this with virtual reality, implying that the same level of sensory and emotional engagement was not achieved in a virtual setting:

> The sensation of her pressure and the descent of her touch, the glide of it immediately put me in the state of mind for the quality of movement for the duet... which did not happen with virtual reality… (Santos, 2024a)

Our relationship with gravity and our felt sense of weight are fundamental experiential constructs shaping our living experience, self-awareness, and even our mode of making sense of the world. In these experiences described by Gonçalves and Santos, the avatar appears to be a hollow entity that disdains the necessity for support. How can we engage and connect deeply with an entity devoid of matter, one that has no relation to the gravitational pull of “Mother Earth”?

https://doi.org/10.34632/jsta.2024.16041

PERSONAL SPACE I INCORPORATING IMMATERIALITY – A VIRTUAL ACT OF STRANGE INTIMACY

As demonstrated above, the dancer visualises the avatar's moving body in a three-dimensional space, observing it from all angles and distances and moving around it. However, his sight does not correspond to the tactile sense. There is no possibility of holding it or being supported by it. The absence of palpable matter in the virtual body causes an incongruence between different sensorial perceptions, inducing an unsettling experience, often mentioned as “strange”. Adding to such incongruence, we observed another somatic disruption: the possibility of trespassing and being trespassed by the virtual “body".

When these moments occurred, the three dancers responded with subtle twitchy movements and, at times, vocalisations expressing a sensation of vertigo. They all remarked on the strangeness and discomfort of feeling trespassed through without actually feeling tangible materiality – as if they were incorporating a ghostly entity.

In the testimony of her experience with a virtual avatar, Cecília de Lima states that being invaded by virtual bodies that move within her body caused an intense impact and a sensation of bodily transformation:

> I felt a momentary fainting of strength, as if the muscle had become numb, a momentary feeling of disintegration of the body. For a few seconds, I felt as if my very core was being invaded, touched from the inside. However, after a while, there was the feeling that the materiality and weight of my body were gradually disappearing as if my body was becoming transparent, empty, and without contours. (De Lima, 2023)

Interoceptive perception (the ability to perceive internal sensations of the body such as hunger, thirst, sexual needs, sensations of pain and pleasure, fatigue, etc.) provides us with a fundamental recognition of the body that, according to António Damásio (2010), is core to the consciousness of the self. Therefore, being trespassed or penetrated by another entity provokes an invasive sensation, not only at the level of the organic body but also at the level of bodily intimacy associated with self-awareness. Following this line of thought, being trespassed by a virtual body is an invasion of the space where we recognise ourselves – the internal space where our survival process functions. It is a virtual act of intimacy.

After the initial moment of vertigo of the sensation of being invaded, the dancers’ bodies open in an act of vulnerability, incorporating the sensation of lightness, buoyancy, and transparency as if their corporal materiality was disaggregating into immateriality.

However, this virtual act of intimacy rapidly gets confronted with its paradoxical nature.

https://doi.org/10.34632/jsta.2024.16041

> This sensation of immateriality became even more disturbing when it turned into an ambiguous awareness: my body feels buoyant, almost immaterial, but, at the same time, I also feel a strong desire to grasp the virtual entity, to hold it and be held by it. (De Lima, 2023)

On the one hand, the dancers share their internal corporeal space with the virtual entity; on the other hand, this intimate sharing becomes frustrated by an unfulfilled desire for touch and support that never materialises. Within the impossibility of touching, supporting or holding, the experience of virtual intimacy accentuates an insurmountable distance, not a spatial distance but a dimensional distance. Virtual intimacy becomes a paradoxical, disconcerting experience.

AN UNSETTLING IDEO-MOTOR RELATION

Pirata also shares a sense of discrepancy or mismatch: He describes a disconcerting and unsettling experience,

> There is always some tension in that virtual reality, everything is different from our reality. For instance, the feeling of this contact with the ground and even the density of the air does not seem to correspond to that [virtual] reality... It brings me not fear but rather apprehension, a disquiet, for it feels like reality while being within something distinct. (…) I felt this need to know that I could find an authentic sensation in that virtual reality. (Pirata, 2024a)

Naturally, Pirata brings his previous embodied experiences into the virtual experience. However, in this other reality, his habitual sensorimotor sensations feel misappropriate. He feels the need to confirm that he could experience a sensation that felt genuinely authentic and comparable to real-life feelings within the virtual reality environment. His embodied motor memory from the real world conflates with the present experience in the virtual world.

Henri Bergson helps to understand what Pirata is feeling. He sustained that memory plays a crucial role in perception and shapes our understanding of the present, emphasising the dynamic interplay between the material world, perception, and action (Bergson, 2011). For Bergson, perception emerges within the context of memory and the material world, and the present moment involves a connection between perception and motor action: “Consciousness means virtual action” (Bergson, 1929, p.48). Bergson elaborates further on what constitutes the material world,

> (…) objects, or, if you prefer it, of dissociate images, of which all the parts act and react upon each other by movements. And that which constitutes our pure perception is our dawning action, in so far as it is prefigured in those images. The actuality of our perception thus

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> lies in its activity, in the movements which prolong it… the present is ideo-motor. (Bergson, 1929, p.74)

Pirata's perceptive memory feels threatened when his ideo-motor framework gets troubled so that his previous experiences of the world do not bring him any security in this unfamiliar environment. This unsettled ideo-motor relation to a new environment and the uncanniness of not knowing what the possible "emerging actions are" induces him some anxiety.

VISUAL_FOCUS@POV I ARTIFACTUAL MATERIALITY

> *Instead of an embodied consciousness looking through the window at a scene, consciousness moves through the screen to become the pov… In cyberspace, point of view does not emanate from the character; rather, the pov literally is the character*
> Hayles, 1999, p.38

Santos describes Gonçalves' gaze while focused dancing, in flow. A specificity, almost emanating, seems to be on the look when Gonçalves is entirely engaged in a dance. "I look at Ester [Gonçalves], concentrated, and it seems that there is some extra sparkle there" (Santos, 2024a). Perceptual learning calls this type of attention "chunking", when "all the disparate parts of a cognitive activity become one" (Bailenson, 2018, p.36), and this is achieved with practice and experience, allowing the dancer to "create and call upon extremely refined 'mental representations' of what is happening around them" (Bailenson, 2018, p.36). Is this type of attention happening entirely in the VR experience of *GhostDance*'s dancers?

Visual perception calls upon a two-tiered operative focus:

> Focal awareness is the ordinary kind of fully conscious awareness we have in focusing attention on a specifiable object. Subsidiary awareness, in contrast, refers to the peripheral noticing of features of an object that are not attended to in themselves but are seen as pointers or clues to the object of focal attention. (Scott, 1971, p. 23)

Santos reveals that despite rehearsing his duet with the avatar innumerable times he was intentionally focused on it: "So, my concerns today and now, for this performance, for this exercise, are to constantly look at [the avatar of] Ester [Gonçalves]." (Santos, 2024a). Why did he do so instead of trusting on his sense of chunking?

GhostDance's dancers have a perceptual limitation inscribed in their experience by the headset's design. Their vision is restricted to a primarily frontal angle (104º horizontal and 103º vertical of the visible field of view [FoV][5]); it was not possible to use peripheral vision, compromising the dancer's subsidiary awareness, the ability to see things at the edges of the field of view got slightly weakened, when looking at the edges, the

5 The headset allows movements in six degrees of freedom: Motion produced by translation in the three perpendicular axes—forward/backwards (surge), up/down (heave), left/right (sway)—is coupled with alterations in orientation achieved through rotation about three perpendicular axes, commonly referred to as yaw (normal axis), pitch (transverse axis), and roll (longitudinal axis).

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blurriness of defocusing became more pronounced. A personal concern that Pirata also shared: “Sometimes it blurs, for example, it does not have peripheral vision, and for me, that is the worst. So, when you look at the edges, it is more blurred.” (Pirata 2024b). Pirata’s concerns about his subsidiary awareness brought him to occasional deliberate pauses to enhance focus and a sense of security. In the words of Pirata, referring to his improvisation act with the avatar: “I would even stop the movement to observe the Avatar… also because it was necessary, but somehow that also brought me a sense of security” (Pirata, 2024a).

On top of this, the headset (it weights 586 grams) as an object (or prosthesis) also introduced a barrier creating physical limitations and a sense of slight discomfort in the shared experience. Wearing a headset placed on the area of the head where the vestibular system is located can also disturb the balance a bit. The prosthesis exerts pressure and has a weight not compensated for by the gaze:

> That also puts weight on the face... it is a limitation too... for example, things on the ground... I could not even lower my head to the ground... the neck... the headset would come off and hurt... so there was always that discomfort of adaptation.... The headset would sometimes disconnect... in that kind of thing, even on the ground, with impact. (Gonçalves, 2024)

That barrier affected the dancer's awareness. For instance, restricted on their immersiveness and flow has made them more alert and cautious: “At that moment in the choreography, there is a switch... There is a synapse, there is some kind of switch that says... ‘be careful with the headset’(...).” (Santos, 2024b)

TO CONCLUDE

> *The collaboration between dance and VR technology is an emerging art form, or at least a hybrid made by uniting different ways of spacemaking. If dance is able to play a role in the future development of VR technology, we could end up with radical new directions for materiality within virtuality, as well as the basis for a poetics of virtuality that centres on the dancing body.*
> Kozel, 2007 p.103

“I am my body”, tells us Merleau-Ponty (Merleau-Ponty, 2005, p.231). What body is this in VR? Can we say that “the virtual is the new materiality”? (Kozel, 2007, p.92).

Much has been said about the aesthetics introduced by new media (Manovitch; Grau; Baurriaud). Virtual spaces are increasingly an integral part of contemporary performative imagery (Collins & Nisbet, 2010) and dancing in virtual reality fits in a specific historical context informed by these discussions of a new sort of historical subjects no longer consumers of images but in a participant coexistence and interaction

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with multiple signs and sensations in order to be able to experience the new image. What we call reality is rooted in matter, but the life of this emerging subject is permeated by spectral technologies, from immaterial digitised information to relations. This subject is now asked to envision the possibility of living with new entities, beings, and potentials independent from the physical experience. Now intimately connected with the image, in a continuum, it breaks away from the representation regime established by Leon Battista Alberti's squared frame[6]. This comes with a price, as the mediation appears to become synonymous with spectralization. The new subject is now invited to coexist with ghosts – images, non-reactive figurations, inscriptions with which he dances. Or, as Katherine Hayles puts it, in *How We Became Posthuman*, becoming part of a "cybernetic circuit" where the dancer "learns, kinaesthetically and proprioceptively, that the relevant boundaries for interaction are defined less by the skin than by the feedback loops connecting body and simulation in a technobio-integrated circuit" (Hayles, 1999, p.27).

Looking back at groundbreaking performances addressing virtuality from two decades ago, like *Telematic Dreaming* (Sermon, 1992), *Ghosts and Astronauts* (Dubois, 1997), what can we add to these discussions on "cybernetic circuits" characterised by co-location and co-presence? What can we bring anew? In what ways is dancing around a massless body in a virtual world different from interacting with a character in a flat-screen-based performance?

We presented a performance, *Ghostdance Andamento #1*, as a case study to look at how dancers engage with the virtual environment, specifically when they engage with spectral bodies. We believe that there is a striking ontological contrast between these three-dimensional entities we are addressing in this paper and the flatness of screens earlier discussed in the domain of Telematics. VR proposes an illusion of transparent mediation. The contrast between the representational simulacrum-bodies and human ones is a persistent outline.

Ghostdance invites us to look into a sense of kinaesthetic presence and somatic corporeality, it problematises thinking of the body as a given and self-evident physicality. Inevitably, it delves into the contrast between these representational simulacrum-bodies and human ones. The *Ghostdance* dancers never attributed a human existence to their dancing avatar-partner; instead, they consistently maintained a troubled bodily resonance with their counterpart[7].

We focused on the perceptual perplexity when dancers are in a VR environment negotiating liminalities. They were confronting their own body and the body of the "other" (he-she-it/human-digital figure). A space where the dancer-participant-observer is situated in an ambiguous state with sensorial feedback bringing conflict between his awareness and his vision. This experience highlights the intricate interplay among sensory perceptions, virtual realities, and the human desire to produce bodily resonance and tangible, grounded connections within the immersive VR space. Collectively, these insights underscore the relational and affective significance of altered perceptions in immersive VR experiences

6 The pictorial rectangle served as a device in a transition that instituted a gaze regime positioning the observer outside the landscape, observing what he knows to be a representation of it: "So far, we have talked about the power of vision and about interception. But as the painter must not only know what an interception is but also how to make one, we will deal with that now. (...) when I'm going to paint, I draw a right-angled quadrangle, the size I prefer, which I consider to be an open window through which I can observe what's going to be painted there, and then I decide on the size I like for the men in the painting... so that everyone knows that no painted thing can ever be similar to real things if you don't keep a certain distance to see it" (Alberti in *Da Pintura*, 1435, as cited in Pinto, 2021, p. 61).

7 In the second chapter of ***How We Became Post-Humans***, N. Katherine Hayles describes flickering signifiers as the cascade of signs and significations produced by the multilayered architecture of computer instantiations, where symbols and signs trade and exchange signifiers (Hayles, 1999). The recognition and identification of a data figuration as flesh opens up signifying possibilities that may induce a sense of presence and materialism.

https://doi.org/10.34632/jsta.2024.16041

— where the materiality of the body is absent. We advocate for a focus on embodied interaction as a means of being present within affective relationships and simultaneously, we call attention for the potential of virtual reality environments as platforms for expanding our habitual perceptual constructs.

Considering the experiences of the dancers involved in the study, it becomes evident that the subjective nature of personal perceptions significantly shapes their understanding of the virtual environment, their presence and the presence of others in that environment. Their sensations, such as the touch on the ground and the density of the air, do not correspond to the virtual reality they are immersed in. This haptic ambiguity led to a form of incorporeal touch. This disjunction made them question and validate the authenticity of sensory experiences within the virtual realm, emphasising the need to find genuinely real experiences in that context. They also reflected on the necessity to make substantial alterations to their movement. This adjustment requires them to rely more on their internal energy, highlighting a sense of personal adaptation and self-driven effort to adjust to the virtual experience.

In their considerations, the dancers also shared their evolving understanding of duet relationships and communication — "I began to understand and think about relationships and communication between duets in a different way" (Pirata, 2024b). For instance, one dancer, Pirata, contemplated the significance of focusing on gaze, weight, and various aspects of the Avatar's movements, exploring how these elements influence his movements — "what does the focus on the gaze bring me, what does the focus on the weight bring me, the different focuses on that avatar on my part, what do they bring me to the movement?"(Pirata, 2024b).

This experience underscores the complex interplay between sensory perceptions, virtual realities, and the human desire to produce bodily resonance in tangible, grounded connections within the immersive space. These insights underscore the relational and affective impact of altered perceptions and limitations in sensory input. The dancers' reflections touch upon feelings of doubt, alienation, and uncertainty within the immersive world of virtual reality, providing valuable contributions to ongoing discussions about the nature of performance, perception, and communication in digital spaces. Although it is still a beginning, we see a glimpse of the value of this research when imagining a future disconcerting "extra-reality" where the immersion of Virtual Reality interacts with Artificial Intelligence.

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ACKNOWLEDGMENTS

We would like to thank the dancers Daniel Pirata, Ester Gonçalves, Miguel Santos, and the software engineer José Siopa for their involvement in the performance. Also, we would like to show our appreciation to Teatro do Bairro for hosting the performance and AND_LAB, Dança do Vento and Escola Superior de Dança for providing their studios for rehearsals.
The Ghostdance project integrates researchers from INET-md and Laboratório de Biomecânica da Faculdade de Motricidade Humana, Universidade de Lisboa; ICNOVA—FCSH, Universidade Nova de Lisboa; IHA—FCSH, Universidade Nova de Lisboa; Lasige—Faculdade de Ciências, Universidade de Lisboa; CICANT—Universidade Lusófona; and Escola Superior de Dança—Instituto Politécnico de Lisboa.
This article was written within the framework of the exploratory project GhostDance: A methodology for analysing movement in virtual reality FCT:EXPL/ART—PER/1238/2021(https://doi.org/10.54499/EXPL/ART-PER/1238/202) which sponsored the research and which was also partially supported by the Centre for Research in Applied Communication, Culture and New Technologies with reference UIDB/05260/2020 (https://doi. org/10.54499/UIDB/05260/2020) and FilmEU—European Universities Alliance for Film and Media Arts, FILMEU_RIT—Research | Innovation | Transformation project, European Union GRANT_NUMBER: H2020-IBA-SwafS Support-2-2020, Ref: 101035820, of the FilmEU—The European University for Film and Media Arts project, European Union GRANT_ NUMBER: 101004047, EPP-EUR-UNIV-2020.
The text was proofread using AI language model tools like Grammarly, DeepL and ChatGPT-3.

Article received on 11/02/2024 and accepted on 15/04/2024.

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https://doi.org/10.34632/jsta.2024.16041

Journal of Science and Technology of the Arts, vol. 16, n. 1 (2024): pp. 14-36