UNBOUND ACOUSTICS. EMBRACING COMPLEXITY IN VIRTUAL SOUNDSCAPES

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This paper examines how sound structures and transforms the experiential conditions of video game worlds, foregrounding the dynamic relations that arise between auditory phenomena and the environments in which they unfold. Through an analysis of *Rain World* (Videocult, 2017) and *Silent Hill* (Konami, 1999), it argues that sound functions as an active agent linking player, avatar, and world. Departing from the objectifying tendencies of traditional soundscape theory, the paper draws on ecological and embodied perspectives to propose an analysis in which perception emerges through continuous interaction among sensory, cognitive, and material dimensions. In this view, sound is not merely representational but constitutive of the player's experience, shaping the agencies that define virtual worlds. Through concepts such as *embodiment, kynesonic syncresis*, and *transdiegesis*, the investigation reveals how game environments decentralize human subjectivity, situating the player within complex networks of interdependence. By engaging with the phenomenology of listening and the porous boundaries between diegetic and extradiegetic spaces, the paper argues for an understanding of virtual soundscapes as dynamic ecologies where meaning arises from complexity. Ultimately, it advances a holistic framework that situates sound as a central mode of world-making, one that reconfigures and problematizes the ontology of the *game-world* and invites a broader reflection on the entangled nature of perception, agency, and environment in digital media.

AN ECOLOGICAL EMBODIED INTERACTION

A couple of timid steps out of a filthy subterranean burrow and I am immediately overwhelmed by a resounding emptiness –punctuated solely by the incessant whistle of the wind - which serves as a stark warning of the desolation encircling my avatar. This avatar is a small, white creature half cat, half slug– aptly named 'slugcat.' Having entered a vast, unexplored area, I remain motionless while surveying my surroundings, pricking my ears in an attempt to discern any movement beyond the screen's confines. In the stillness characteristic of my slugcat, I inadvertently press the button assigned to the jump action, producing a slight noise reminiscent of a weight dropping to the ground; almost immediately, what I had assumed to be a static mass of dark-hued vines shifts toward me, seizes me with its tentacular limbs, and engulfs me. Game over. The sound output generated by my avatar's jump conveys a fundamental message: I am prey, and I must remain unheard.

Rain World (Videocult, 2017) is a game that compels the player to reposition their role within the virtual worlds we typically traverse during our video game experiences. In this hostile game environment, challenges arise not only from the demanding gameplay mechanics but, more importantly, from the opaque, hermetic structure underpinning the entire game (Caselli, 2024). As one navigates the labyrinthine burrows and the ruins of *Rain World*'s ecosystem, the gaming experience sharpens both the player's senses and those of the slugcat. This heightened sensory acuity serves to underline the true protagonist of the title: the environment. From the very onset, the architecture of this game world reveals itself as a network of innumerable passages –traversable via diverse modalities– that further accentuates the inherent inscrutability of the surrounding world.. Videocult's design deconstructs the traditional hierarchy in which the player is often cast as the dominant force, instead positioning us horizontally as one among many components within

an overwhelming network of agents (Latour, 2005). As philosopher and game designer Stefano Gualeni observes, a 'world' can be conceived as an assemblage of relations perceived through the specific sensibility of its inhabitants, a reminder that every environment is shaped by the modes through which it is perceived (Gualeni, 2024, pp. 36–37).

The growing prominence of game studies and design has brought renewed attention to the sensory dimensions of experience within digital environments. While research in visual perception has long dominated discussions of mediation and representation, recent developments have extended this focus to videogame sound design – commonly referred to as game audio– revealing its central role in shaping virtual worlds. Over the past five decades, game audio has evolved from a functional or ornamental accompaniment into an architectural and affective force that structures spatial, temporal, and emotional dimensions of gameplay. Early arcade and domestic gaming platforms –powered by rudimentary tone and noise generators and bounded by the severe memory limitations of the 1970s and toward the early 1980s– generated a markedly synthetic sonic palette, a condition that composers progressively transformed from a technological constraint into a deliberate aesthetic resource (Collins, 2008). Under these technological limitations, however, the player's perceptual experience remained peripheral: sound functioned less as an immersive medium than as a stylistic expression of the machine's material affordances. The advent of personal computing and digital sampling expanded both the timbral palette and the polyphonic complexity of sound, while innovations such as LucasArts' iMUSE system introduced conditionally sequenced and dynamically adaptive compositions responsive to player input (ibid., pp. 51-52). This marked a decisive shift toward adaptive audio, establishing a new grammar of interactivity and laying the foundation for contemporary middleware platforms –such as FMOD and Wwise– that simulate the materiality of sound in real time. These systems render

sonic elements as spatially and temporally situated objects, endowed with kinetic and environmental qualities through extensive parametric control (ibid., p. 101).

Despite major technological advances, much of game audio scholarship still treats virtual *soundscapes* as fixed, representational fields rather than as relational and emergent processes. The emergence of ecological perspectives invites a different understanding: perception arises through the continual interplay of player, sound, and environment, in which emitter and receiver are no longer distinct but co-constitutive. As demonstrated by the initial sound design during the slugcat's jump, *Rain World* employs a peculiar auditory strategy that deepens the player's engagement with an ecological perspective. The game achieves a profound decentralization of human subjectivity by positioning the player as a non-human creature whose sensory and operational experiences define its interaction with the environment (Fig.1). This shift disrupts the anthropocentric worldview, urging the player to engage with the world not

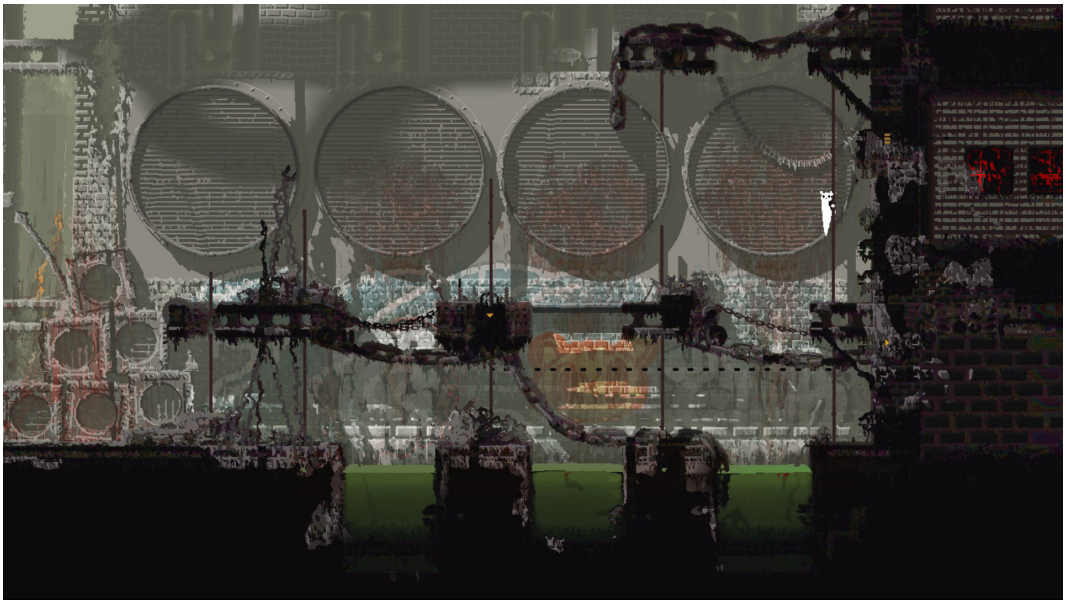

Fig. 1 Still from *Rain World*, 2017. Retrieved February 19, 2025 from https://thecakeisaliegaming.wordpress.com/2017/04/12/rain-world-review-discovery-and-wonder-tinged-with-frustration-n3dabl3/

from the vantage point of a human protagonist but through the embodied experience of another form.

According to Paul Dourish (2004), embodiment does not simply denote the physical presence of the body but the condition through which our actions acquire meaning within a shared world. Interaction, then, is embodied insofar as it is situated in our practical, perceptual engagement with both technological and social environments (ibid.). Within *Rain World*, this dynamic becomes central: the player's bodily responses –tension, stillness, or hesitation– mediate perception and determine survival. In this sense, the game exemplifies what Peter Bayliss (2007) terms *embodied gameplay*, where play arises through the sensory negotiation between player and system. The body thus functions not as a mere interface but as the locus through which meaning, perception, and action converge.

The complex interconnection of components within a virtual world –mediated by embodied interaction– calls for a reconsideration of how perception operates in digital environments. Anthropologist Tim Ingold invites us to conceive perception not as the passive reception of sensory data but as a movement of the body within the world, a continuous scanning that ties sensory awareness to physical presence (2000, p. 244). Even in stillness, the perceiving body remains active, tracing fluctuations in its surroundings and responding to them through subtle adjustments of attention and orientation. His research further revisits established concepts such as the *soundscape*, showing how interactions with the environment shape our very capacity to gather and interpret auditory information (Ingold, 2011). Perception thus unfolds as an ecological process, a dynamic circuit that joins brain, body, and environment in a single flow of engagement.

Transposed into the virtual domain, this theory helps to explain how auditory experience in games like *Rain World* emerges from the player's situated negotiation with the environment. Listening becomes a form of orientation: each sonic cue invites the player to recalibrate distance, anticipate

movement, and act within a precarious ecology. The game's sonic design thus transforms perception into a mode of navigation, dissolving the separation between listener and world and grounding play in a shared field of sensitivity (Roddy, 2018). This active reconfiguration of auditory perception proves particularly valuable in addressing key issues related to sound and its interaction within game design.

CRITICAL APPROACHES TO *SOUNDSCAPE*

In his text UDO (2023), Matteo Lupetti proposes an understanding of the video game medium as an object capable of establishing a relationship between the human and the non-human, also describing it as the quintessential medium of the Anthropocene. In his analysis, the video game –referred to here as 'UDO' (Unidentified Digital Object)– is presented as a complex, not fully knowable object, formed by a series of elements, systems, and sections that cannot be encapsulated under a single concept. According to Lupetti, the individual components of a game cannot be reduced or cataloged into specific research areas; instead, the game as a medium necessitates a theoretical exploration that begins with the very vastness that defines it, echoing Donna Haraway's (2016) call for the acceptance of complexity and the unknown.

The analysis of a video game environment reveals the inherent limitation of reducing its entirety to the simple dichotomy of sound and images, a framework that once sufficed for traditional media like cinema. What fundamentally distinguishes a video game as a medium is its ergodic nature, grounded in the action and interaction of the player, whose experience is inherently unpredictable and predominantly subjective (Bilchi, 2022). Just as within game worlds, it is impossible to separate the various realms of our sensory perception without considering the interactive act,

the same problem arises when we perceive an environment in the 'material' world. Here, our sensory experience is also interconnected and dynamic.

The perception of a given *soundscape*, therefore, cannot be isolated from other sensory dimensions and from an active reading of the environment itself. Historically, the term *soundscape* was coined by Canadian composer Raymond Murray Schafer to designate an acoustic version of landscape, which is similarly experienced by the individual (listener) immersed in it (Schafer, 1977). However, the concept of the *soundscape* has historically been associated with objectifying approaches to the *scape*: despite Schafer's study being one of the early foundations of acoustic ecology and sound studies, the listener finds themselves contemplating sounds, seeing them as objects rather than phenomena, and cataloged with the same kind of definition (ibid.). At the same time, the broader field of soundscape studies has long accommodated perspectives that complicate this objectifying tendency. Already in early acoustic ecology, Barry Truax's relational model (1984) reframed the *soundscape* as a system of communicational exchanges in which meaning arises through ongoing feedback between listener and environment rather than through the cataloguing of discrete sonic objects. Moreover, ethnographically oriented approaches –most notably Steven Feld's acoustemology (1996)– further emphasized the experiential and affective conditions through which sonic environments come into being, foregrounding listening as a mode of dwelling and environmental attunement. These trajectories already indicate that the *soundscape* is less a stable acoustic tableau than a shifting configuration shaped by the ways listeners move through and attune to their surroundings.

Building on these considerations, Schafer's conception of the *soundscape* calls for a reframing that relocates the subject within a field of active perceptual engagement rather than passive observation, a shift that becomes particularly necessary when the notion of *soundscape* is transposed into

the interactive and processual conditions of game audio. One of the fundamental points of Ingold's counter thesis focuses precisely on the traditional conception of sound as an 'object', a tendency often stemming from representation theories, which view our eyes and ears as technological instruments capable of recording data, whereas they are actually apparatuses capable of perceiving phenomena (Ingold, 2011, p. 137). Just as the eyes are capable of seeing thanks to the phenomenon of light, which makes sight possible, the ears are capable of hearing thanks to the phenomenon of sound, which travels through matter (ibid.). Talking about a *soundscape*, whether virtual or not, thus becomes problematic when conceived through a presumed materiality, or in other words, it is "a phenomenon of experience, that is, of our immersion in, and commingling with, the world in which we find ourselves" (ibid.).

In this exploration, understanding sound phenomenologically allows for a closer adherence to the interactive conceptions of the videogame *soundscape* and its various modes of reproduction and listening. Garner and Grimshaw offer their definition of sound as "an emergent perception arising primarily in the auditory cortex and that is formed through spatio-temporal processes in an embodied system (2014, p.1)." This definition of sound –specifically theorized by the authors in relation to a research area concerning virtual environments– emphasizes a focus on immersion within an environment, termed as the embodied system here. As previously mentioned, Ingold's starting point highlights the essential embodied action of 'scanning'; it is not an action carried out only through the activation of the eyes or ears, but an action that materializes through the entire body, in a process where one is 'immersed' in the environment itself (Ingold, 2000). Listening, therefore, means performing an action, even more accentuated when traversing a virtual world through the body of an avatar. Theorist Alexander R. Galloway proposes a theory that is based on action rather than interaction in the video game

field; this conception does not exclude the interactivity inherent in the medium but emphasizes the physicality of the experience itself within a virtual environment, through which tangible material changes can occur (Galloway, 2022, p. 23-24).

To underscore this connection between sound and embodied action, Karen Collins highlights the semantic distinction between traditional listening to sound, and its interaction within a game world, or "interacting with sound" (2013, p. 3). The passive conception of traditional listening echoes Schafer's *soundscape* theory, indirectly focusing attention on Ingold's conception of listening and the importance he attributes to listening as action, making it a theoretical model particularly suited for the study of virtual *soundscapes*.

In light of the foregoing, immersion becomes a pivotal nexus in Ingold's study, wherein our engagement with an environment is defined through an embodied perceptual act. This sense of attunement with the environment we traverse causes our subjectivity –comprising both material-world subjectivity and virtual subjectivity (Gualeni, Vella, 2020)– to become increasingly porous.

The complexity stemming from the very structure of virtual worlds and from our perceptual activities necessitates a re-examination of the definitions that accompany sound analyses in traditional media. Terms associated with sound in linear audiovisual media, such as *diegetic* –part of the internal narrative of a fictional world, what the characters can hear– and *extradiegetic* –external to the narrative, such as the soundtrack (Chion, 1994)– become problematic within the game context. This is precisely because the immersive nature of the medium and the resulting interactivity render porous the distinction between the real and the virtual, between what the player perceives as the avatar within the game experience and what is heard outside the screen, thereby shaping a *soundscape* with exceedingly ambiguous boundaries.

TRANSDIEGETIC SOUNDS AND VIRTUAL ACOUSTIC ECOLOGY

In his seminal text Audio-Vision (1994), Michel Chion theorizes what he terms syncresis, the automatic association that occurs in our minds between a sound and its corresponding image. This process reflects the ability to spontaneously link a given sound, detached from its source, with a visual stimulus reminiscent of its characteristics. For example, in a science-fiction film such as John Carpenter's *The Thing* (1982), the inhuman roars and screams of the alien parasite are sonically appropriate to the creature, despite it being a fictional entity with no direct counterpart in the material world. This is an extreme example intended to demonstrate a simpler concept, such as associating the classic sound of footsteps with a walking sequence, two elements that are technically separate in cinema.

However, when navigating a virtual environment, syncresis becomes a far more structured concept. Whereas in linear media sound is paired with images in a continuous reverberation of meanings dictated by our perception, in the video game medium the sonic phenomenon is intimately linked to action. Collins defines this concept as *kinesonic syncresis* –the juxtaposition of sound and action within a virtual world (2013, p. 32). Notably, the action in question is not the exclusive domain of the player; while a player may execute actions via a controller such as running, throwing objects, or speaking– that generate various sounds, *kinesonic syncresis* is continuously realized within the game environment itself, independent of complete player control. In *Rain World*, for example, the creatures inhabiting the ecosystem autonomously emit an array of sounds. One can often hear the hissing emitted by vividly colored lizards engaging in noisy territorial disputes, driven by the procedural intelligence of these entities. According to Galloway, however, the distinction between the player's actions and those of the environment –or the 'machine' (i.e.,

the hardware)– is purely theoretical, as both are integral to the overall game experience in a "cybernetic relationship aimed at realizing the various actions of the video game in its totality" (2022, p. 25).

Action thus emerges as a pivotal element in critically redefining sound within the complex ecosystem of the game, continuously questioning the player's position relative to phenomena and the environment itself. As previously noted, whereas cinema traditionally distinguishes between *diegetic* and *extradiegetic* sound, in the video game medium this binary is undermined by the interactive component and the consequent redefinition of the player's environment. According to Kristine Jørgensen (2017), a subject's agency in relation to a virtual environment is fundamentally different from that of a cinematic audience; the *soundscape* in a game is action-oriented, much like how we engage with the material world around us. Our 'perspective' is based on the perception of the environment and the subsequent bodily actions we perform (Uexküll, 1934). In experiencing a video game, we thereby challenge the boundaries between what exists 'inside' (*diegesis*) the narrative and what exists 'outside' (extradiegesis), since our environment becomes a fusion of material and virtual realities. This inability to apply a strict *diegetic/extradiegetic* binary to the video game medium has led to the conception of the term *transdiegetic*, which denotes a particular action-oriented sonic typology that functions according to the player's environment. As Jørgensen explains:

> Such sounds will be defined as *transdiegetic* sounds, and what is characteristic for these is that they cannot be posited as clearly *diegetic* or *extradiegetic*. Instead, they seem in some respect to place themselves somewhere between the two, either by being virtually *extradiegetic* sounds that communicate to entities internal to the diegesis (typically the avatar, for example *extradiegetic* music that alerts about upcoming dangers), or they are *diegetic* sounds that directly address entities external to the diegesis (typically the player, for example when a

> strategy game unit says 'all right' when the player gives it an order). These sounds are central for the comprehension of the positioning of sound in computer game spaces, and work as a bridge between the game world and the player's world (Jørgensen, 2007, p. 3).

Jørgensen intentionally keeps the notion of the *transdiegetic* open-ended, reflecting the inherent fluidity of sonic elements that emerge through interaction rather than belonging to a fixed spatial category. Since computer games constitute a hybrid of user-system and fictional world, this mixed condition generates the need for sounds that operate across, rather than within, established boundaries (ibid. p.13). According to Jørgensen, these sounds are defined not by their location but by their directionality: they are either *diegetic* elements that address the player beyond the diegesis, or *extradiegetic* cues that communicate inward to entities within the game world. Crucially, the *transdiegetic* is not a third autonomous space; it is a functional property of *diegetic* and *extradiegetic* sound alike, one that foregrounds how sonic meaning in games is continually reconfigured through context rather than fixed by spatial origin (ibid. p. 14).

When discussing these categorizations within a virtual environment, a series of discourses emerge regarding the relationships between the player, sound, and the environment itself, especially in anxiety-related contexts or first-person shooter games (Grimshaw, 2007). This acoustic ecology is rooted in the central role that fear has historically played in ecosystems, as it is intrinsically linked to taking action and responding to the environment, thereby influencing decision-making and reinforcing societal standards, with different cultures upholding distinct rules regarding fear (Bergström, 2007). Ecological phenomena such as emotions, physiology, memory, ability, and environmental factors can all influence our sensation of fear in response to sound. In the survival horror game *Silent Hill* (Konami, 1999), various types of sounds challenge the very concept of 'environment' in relation to their *transdiegetic* nature. The game casts the player in the

role of Harry Mason, who searches for his adoptive daughter Cheryl in the eerie town of Silent Hill. The uniqueness of the game's environment lies in the transition between two realities through which the avatar moves: one version of the town shrouded in constant fog and inhabited by nightmare creatures, and an even more terrifying variant immersed in a horrific decay marked by blood and metal, called the Otherworld (Fig.2). The game's soundtrack, composed by Akira Yamaoka, has over time become an exemplar for subsequent survival horror models; its compositions range from trip-hop ballads to nerve-wracking industrial loops designed to create a sense of defamiliarization and anxiety. These tracks, resembling elements of ambient sound design more than a traditional film score, emerge at the moment when *Silent Hill* shifts from a fog-enshrouded town to its nightmarish variant, where building facades rot and the entire environment exudes death (Perron, 2012). As the game progresses, Harry Mason learns that *Silent Hill* itself represents the resentment and frustration of a young girl, Alessa, sacrificed by a pagan cult and now merged with the town's subterranean world, trapped in an endless cycle of

Fig. 2 Still from the gameplay session by Youtube channel Avenger-senpai, depicting the Otherworld from Silent Hill, 1998, Retrieved February 19, 2025 from https://www.youtube.com/watch?v=uCXEBaT-rs4&ab_channel=Avenger-senpai

suffering. Alessa's influence becomes perceptible within the game world, both to the player and the avatar, rendering her pain «palpable in its world's gruesome sights and sounds» (Cheng, 2014, p. 95). Through this narrative information, the game communicates that its sound design operates on multiple levels simultaneously. On one hand, the affective component of sound –perceived extradiegetically as part of the soundtrack– is designed to evoke specific emotional states in the player, often employing low-frequency sounds to induce anxiety and fear (Goodman, 2012, p. 121-127). On the other hand, the narrative conveys environmental influence exerted by Alessa, reconfiguring the music in the nightmare sequences as a projection of the girl's own pain, effectively rendering it a *diegetic* element within the game world.

The haunting soundtrack is not the only example in *Silent Hill* that provides parameters for an acoustic ecology of virtual environments. One of the game's most iconic features is the small radio that the protagonist discovers early on. This radio functions as a crucial tool for detecting hostile creatures, often located off-screen, by emitting a static signal that intensifies as enemies approach. This gameplay mechanic enables players to locate threats outside their immediate visual field, frequently obscured by fog or limited lighting. Interestingly, the radio's sound is not merely a gameplay tool but also an integral part of the in-game environment, meaning that the protagonist too can hear it, rendering it a *transdiegetic* element. However, the crucial point is not solely which event emits the sound, but what generates it.

As Kristine Jørgensen (2007) notes, the sound generator is distinct from the sound source; the source is the object producing the sound, while the generator is the event that causes the sound to occur. In this way, the radio's static becomes more than a simple signal for the player, it reflects the game state and provides feedback on the player's actions (Roux-Girard, 2010).

These examples demonstrate how the environment in which the player's action unfolds is extremely complex to

define using classical theoretical tools. According to Michiel Kamp, the acoustic ecology of a game world should be understood as a mutual process in which both the subjects inhabiting or perceiving it and the environment itself shape one another through their interactions, giving rise to a process of 'reciprocal attunement' (2013). In this perspective, the network of interactions established between the player and the game world contributes to the construction of a personal 'perspective' that is both individual and entangled with the environment (Bridle, 2020). Drawing on James Gibson's cognitive theories of interaction (1979), Kamp's study proposes an approach to the *soundscape* that is largely based on the affordances that sound provides in a virtual environment:

> (Affordance) are possibilities for (inter)action –specific patterns or relationships– between organism and features of the environment. The kinds of actions that an object in the environment affords are dependent on the morphology of the perceiving organism, their goals and the environment (Kamp, 2013, p. 237).

Thus, affordances are variables that can offer the individual a range of interactive possibilities subject to situational modifications. Although Gibson's analysis primarily focuses on visual elements, its framework of affordances is equally applicable to sound, extending across a wide range of situations and sensory phenomena. Consider again the case of the radio in Silent Hill. This device enables the player to receive information about the game environment through fluctuations in its emitted signal. While its primary function is to alert the player to the presence of hostile entities within the game world, in certain situations this function may yield different outcomes. Some enemies, for instance, are capable of evading the radio's detection, activating it only when they move or not activating it at all, as in the case of a particular Slurper enemy encountered in the Brookhaven Hospital in *Silent Hill* 3 (Konami, 2003). This scenario allows the radio's sonic affordances to disrupt the player's established interaction with the game ecosystem, prompting

a shift in the way the player perceives and responds to the environment. As Kamp argues, the set of actions offered by the *Silent Hill* radio is continuously reconfigured by both the game's environment and the player's immediate objectives, thereby shaping the experience in real time (Kamp, 2013). In this sense, ecological-embodied listening does not merely supplement gameplay; it constitutes the very conditions of world formation in digital environments, where perception and action are inseparable from sonic processes.

CONCLUSION (?)

This exploration of the virtual environment and its embedded sounds demonstrates how challenging it is to define the video game medium, while simultaneously encouraging an openness to its intrinsic complexity and form. In reference to the inseparability of 'scapes' as described by Ingold (2000) –understood by the anthropologist as the totality of the environment perceptible to a subject– the video game medium reveals itself as an amalgam of theoretical and practical domains, sustained by the player's own experience and the affordances that develop throughout that process.

As the example of the *Silent Hill* radio illustrates, sound becomes a tool for rendering the boundaries between the player –as avatar– and the surrounding environment porous. In this regard, William Cheng observes that the industrial sounds in *Silent Hill* have the capacity to transcend the virtuality of the town, penetrating directly into the player's material world; this is made possible precisely by the *transdiegetic* ambiguity inherent in the game (2014). Consequently, the player's acoustic space during gameplay is not simply shaped by the *diegetic* narrative, but instead constitutes an environment shaped by the perception of the entire surrounding world. If one attempts to partition this experience into discrete compartments or relegate it to narrowly defined disciplinary territories, the so-called

gameworld becomes an extremely problematic field of inquiry. Various scholars have attempted to define this term: it may be considered an environment founded on the rules of the game (Jørgensen, 2017) or alternatively defined through a phenomenology of the avatar as an 'organism', both a *diegetic* organism within the game world and a construct shaped by the player's perceptions (Kamp, 2013). This perspective invites a broader reflection on the ontology of the *gameworld* as a distributed ecology, in which the boundaries between the human, the machinic, and the environmental are continuously renegotiated. To understand sound as constitutive rather than supplementary is to recognize its role in shaping the temporal, spatial, and affective conditions of play. Listening becomes an act of ecological participation, where perception and world are co-produced through exchanges of attention, movement, and resonance.

In examining the layered structure of video games, it becomes evident that these games exist both within and beyond the boundaries of the simulated worlds they construct. The experiences afforded by these games are not about a simple escape from the materiality of our existence; rather, they involve engaging with the complexities and contingencies that shape our lived experience. Sound, in conjunction with embodied interaction, plays a significant role in how we phenomenologically perceive and navigate these virtual spaces. Audiovisual interactive media extend far beyond the confines of the screen, unfolding simultaneously in the auditory and peripersonal spaces surrounding us and thereby influencing our interaction with and understanding of the environment.

There is one final example that further highlights the complexity of this field of research and underscores the necessity of accepting that complexity as such. In *Bloodborne* (FromSoftware, 2015), one particular sonic element has the capacity to challenge the very notion of the *gameworld*. The title is renowned among players for its hermetic and indirect narrative, communicated through object descriptions and

hidden information dictated by the environment itself. During an introductory sequence for a boss battle, the entity known as the Orphan of Kos emits a cry while gazing at a decaying sun on the horizon (Fig. 3), sparking a series of theories among the most active online communities. Some data miners within these communities, delving into the game's system files, discovered that the audio file for that cry is identical to one produced by another character in the game, a character who, as the title's narrative subtly implies, is both the cause of the Orphan's suffering and its progenitor. This action, although external to the canonical gameplay of *Bloodborne*, successfully provided a *diegetic* piece of information about the ambient sound through a noncanonical process. In this instance, one must ask: what constitutes the *gameworld* of *Bloodborne*? What is its *soundscape* when its virtual acoustic ecology is considered within the entirety of the video game medium, not only the internal narrative space but also the player's interactions with it and with the hardware itself, the 'machine'?

Revisiting Lupetti's thesis on accepting the indefinability of this medium, this final example does not seek to provide yet another answer to these questions. As previously noted, the

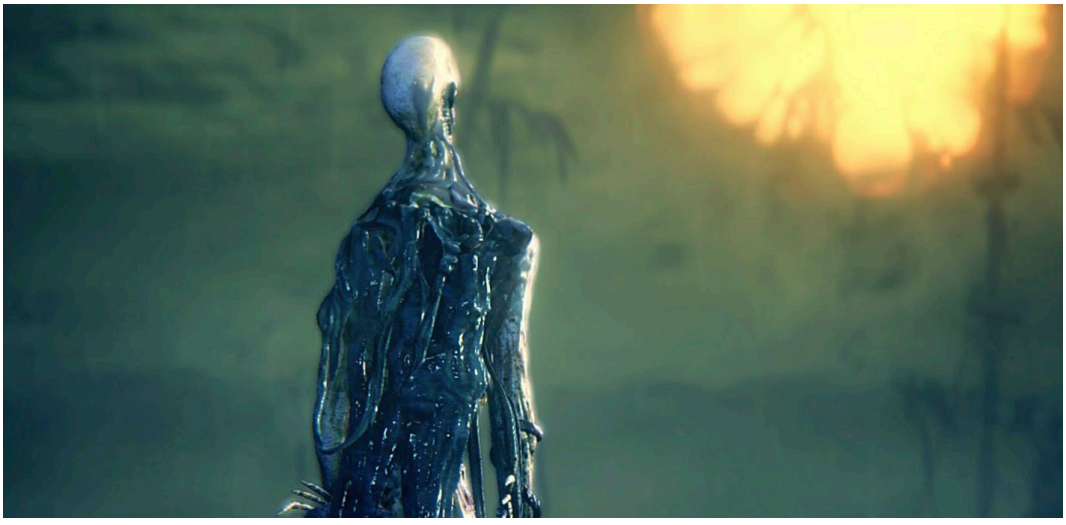

Fig. 3 Still from the gameplay session by Youtube SHiNWiN, depicting the Orphan of Kos facing the horizon in *Bloodborne*, 2015, Retrieved February 19, 2025 from https://www.youtube.com/watch?v=79JSktm-alA&ab_channel=SHiNWiN

objective of this paper is not to establish a definitive or stable definition of how sound operates within virtual environments, but to demonstrate that the field of game studies –and, more specifically, sound studies in relation to games– constitutes a complex and evolving research terrain. The theoretical perspectives discussed here participate in an ongoing process that shifts attention toward the player's interaction with the environment itself, which lies at the core of this contribution. In doing so, this exploration of virtual soundscapes invites a reconsideration of the very nature of interaction, pushing the boundaries of traditional media studies.

At the same time, the continuous evolution of game audio technologies opens new trajectories for both design and research. Procedural and AI-driven sound generation already points toward the emergence of autonomous sonic ecologies, capable of adapting dynamically to the player's state or the system's material conditions. Future developments may further extend this ecological-embodied paradigm toward adaptive listening environments in which human and non-human agencies co-compose the auditory field. Beyond entertainment, such approaches could inform experimental design practices and critical sound art, fostering new forms of situated listening that reflect the interdependence of digital and planetary ecologies. In this sense, to study sound in games is not merely to enrich our understanding of interactive media, but to engage with a broader model for perceiving and inhabiting complexity, one in which virtual worlds are not pre-given spaces awaiting exploration, but dynamic processes of sonic becoming: worlds that listen back.

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