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Representation vs. Representability: The New Taboos of Contemporary Discourse

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THE UNIMODAL AND MULTIMODAL WORLD: A DEFINING CHARACTERISTIC OF MIXED REALITY?

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ABSTRACT

This article offers an epistemological and performative reflection on mixed reality (MR) as an emergent language uniting art, technology, and cognition. Expanding on David Nelson's notion of MR as a site of shared agency and ethical co-presence, it contrasts "unimodal" and "transmodal" universes through examples from cinema, immersive theater, and human-computer interaction. Drawing on research from the USC Institute for Creative Technologies, the study situates MR as a dramaturgic environment enabling empathic adaptation. Ultimately, it proposes MR as a new expressive grammar–an evolving "language-system" redefining narrative, perception, and presence at the intersection of aesthetics and ethics in the digital age.

BIO

Ligia Ciornei is an interdisciplinary artist, screenwriter, director, and producer, known for integrating mixed reality into storytelling. She studied Film Directing and Production at I. L. Caragiale National University of Theatre and Film in Bucharest, where she is now completing a PhD on immersive cinema distribution and technology. Her films–including *Clouds of Chernobyl*, *Do You Believe in God*?, and the VR short *Dr. TEX*–have screened internationally and are available on HBO Max, Tubi, and Amazon Prime. Beyond film, she creates performative installations like *Citadela* and directs theater works such as *Grounded*. She is a film selector at Simfest, an artistic consultant for the Noetic Ark, and has completed research residencies at the University of Southern California and the Birmingham Institute of Robotics. She is currently producing *Gone Guy*, a feature documentary, as well as two feature films: *Three Sisters*, *My Robot* and *Grounded Between Borders*.

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Introduction

In order to arrive at a syntax, a language, or what might ultimately be recognized as a new artistic form, as Professor David Nelson suggests, it is necessary to conceptualize the world of Mixed Reality (MR) and its established applications as they have evolved by 2025. Over the past twenty-five years–since the influential introduction of the "reality–virtuality continuum" by Paul Milgram and Fumio Kishino–the landscape of published research and practical implementations has profoundly reshaped how individuals perceive and engage with digitally constructed environments.

Emergent forms of infinite, speculative, and simulated realities are increasingly framing the social and ethical architecture of the near future. Within this context, MR is no longer a matter of technical augmentation but becomes, in Nelson's words, a domain governed by "the absolute right of ethical consciousness,"[1] wherein the deed–its phenomenological figure in mixed reality–must coincide with that which is known. In other words, MR begins to demand a redefinition of experience in which presence, agency, and perception are co-constituted within shared digital space.

Professor Nelson emphasized that what we refer to as "mixed reality" is not merely a simulated environment, but rather a domain of co-presence–of *shared agency*–in which the ethics of decision-making becomes inherently performative. Within research projects developed at the USC Institute for Creative Technologies, such as SARC-VR and SimCoach, MR is not simply a technological interface; it emerges as an affective space of intervention. As Nelson articulates, "We're designing for real-time perception and emotional response–not for fiction, but for transformation."[2]

Despite these conceptual advances, recent research and innovation in interaction design methods remain insufficiently systematized, resulting in significant ambiguity. For instance, when taste, smell, and haptic modalities are subsumed under sensor-based input, a system utilizing all of these might paradoxically be classified as *unimodal*. This is rooted in the mathematical definition of unimodality–referring to a distribution or process centered on a single peak or mode of data processing. In the context of human-machine interaction, the term "unimodal" denotes systems that rely primarily on a single sensory channel. As such, this conceptual imprecision invites reconsideration of how modality itself is defined in multimodal and transmodal interactive environments.

In the research hypothesis prompted by Professor David Nelson, the term *unimodal* is employed not in its strict sensory sense (i.e., visual, auditory, etc.), but as an epistemological metaphor: a narrative world governed by a single ontological layer and a singular logic of representation–namely, one that is physical, linear, and internally coherent. This "unimodal world" is, by its very nature, constrained within a closed paradigm of perception. As Professor Nelson pointed out during our discussion, "It still feels like a cinematic experience... interesting, but not yet a new language." In this regard, mixed reality does not merely propose a sensory expansion, but rather a cognitive reconfiguration–a domain of multiplicity in which narrative is not merely represented, but enacted, negotiated, and co-created.

In further dialogue, we examined how traditional cinematic works tend to be inherently unimodal–"a camera perspective with no agency," as Nelson defines it–while theatre, despite offering symbolic mobility, still lacks perceptual autonomy. By contrast, his current projects at the USC Institute for Creative Technologies incorporate eye-tracking, natural language processing sensors, and real-time emotional analytics to construct what he describes as "a dramaturgy of adaptive narrative space."[3]

Films frequently depict what can be understood as a *unimodal world*–a reality constrained to a single ontological framework. This dominant framework is often rooted in the physical, where characters engage with each other and their environment in a linear, cause-and-effect sequence. Rarely do cinematic narratives allow characters to interact meaningfully with virtual elements or alternate dimensions, and when they do, such interactions are

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typically justified solely through diegetic or directorial choices. In doing so, cinema reinforces the presumption that physical reality is both the sole and authoritative mode of human experience. Nevertheless, contemporary cinematic art has increasingly ventured into more interconnected narrative terrains, where hybrid realities become legitimate sites for exploring the simultaneity of the real and the virtual.

By contrast, theatrical performance often employs symbolic and metaphorical strategies to engage with unimodal and transmodal paradigms. A play might, for example, stage a character grappling with multiple coexisting realities, thereby representing the cognitive and emotional dissonance of navigating a world in which the physical and the virtual are intertwined. Alternatively, tangible props–such as a virtual reality headset or a live-streamed projection accessed through a tablet–can serve as theatrical proxies for intangible, digital experiences. These metaphoric devices are crucial for illustrating how unimodal reality is perceived and negotiated by those situated within it.

Moreover, contemporary theatre increasingly addresses themes central to mixed reality, such as the dissolution of boundaries between physical and virtual space, or the ethical ambivalence of technological mediation. Through such dramaturgical techniques, theatrical productions provide audiences with an experiential and reflective lens through which to examine the complexities of life in an era defined by hybrid ontologies.

In the performative arts, theatre occupies a privileged position in articulating the phenomenological depth of Mixed Reality (MR). Unlike cinema's fixed temporality, the stage sustains an open and recursive dialogue between real and virtual presences. In certain contemporary productions, digital avatars coexist with human actors, forming a dramaturgy of negotiation rather than representation. This hybrid format recalls what Hegel described as the reconciliation between essence and appearance, wherein spirit externalizes itself through form only to rediscover its own truth in the act of performance[4]. Recent experiments by the USC Institute for Creative Technologies have extended this notion of "living dramaturgy" through adaptive avatars that respond to audience emotion, gesture, and language in real time, transforming the spectator into a participant within the dramaturgic fabric[5]. Such performances dissolve the boundary between author and observer, proposing theatre as a site of ontological co-creation–an evolving interface where affect, cognition, and technology converge to redefine what it means to act, perceive, and exist in shared virtual space.

The Evolution of the Unimodal World in Cinema and the Emergence of Cognitive Layering in Mixed Reality

The development of a unimodal world in cinema refers to the structured process by which a narrative is adapted to function within a single, coherent modality. This involves several distinct stages: the creation of an original narrative or the adaptation of an existing one to fit cinematic conventions; the development of characters and the narrative world; the visual design that constructs a cohesive universe; the integration of animation or visual effects to support action and enhance immersion; and the orchestration of sound and music to generate a multisensory experience. Finally, editing consolidates the elements into a seamless narrative flow. Each stage contributes to producing a self-contained world in which all expressive vectors converge to reinforce a singular perception of reality.

In contrast, mixed reality (MR) introduces a scenographic multiplicity–a performative space where several types of reality coexist within the same interactive frame. As Professor David Nelson emphasized in our discussions, MR does not simply add a digital overlay to the physical world but constructs a cognitive presence in which perception, attention, and interaction are dynamically co-regulated in real time: *"Mixed reality is not only visual layering–it's cognitive layering. It's dramaturgy in motion."*

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This "dramaturgy in motion"[6] (USC ICT Research Group, 2014) entails a form of algorithmic scenography wherein space is not merely decorative but intelligent (responsive, adaptive, and user-aware). Nelson's work on the SimSensei project at the USC Institute for Creative Technologies illustrates this principle by developing empathetic avatars that read users' nonverbal cues and adjust narrative tempo and conversational flow accordingly. Initially conceived for post-traumatic therapeutic interventions, this system reveals significant potential for immersive theatre, where the performer becomes a responsive system, and the audience a narrative catalyst.

However, even if cinematic productions are bound to unimodal coherence, they achieve significant complexity through high-level worldbuilding. James Cameron's *Avatar* is a paradigmatic example of a film that, while unimodal, leverages advanced technology to simulate an immersive fictional universe. Through sophisticated visual effects, sound design, and musical composition, *Avatar* creates a multisensory continuum that fully absorbs the viewer into the diegetic world. The unimodal consistency lies in its adherence to a single experiential reality–one that, though fictional, remains ontologically self-contained.

Similarly, the Wachowskis' *The Matrix* (1999) explores speculative ontology but does so within a controlled, singular narrative structure. By deploying innovations like "bullet time" cinematography, the film enables viewers to experience the same event from multiple spatial and temporal vantage points, reinforcing the illusion of total immersion. Yet, the film remains structurally unimodal: its experiential logic unfolds within a defined, internally coherent system–the Matrix.

Christopher Nolan's *Inception* (2010) furthers this paradigm by interweaving dreamscapes and physical reality into a nested narrative logic. The "folding city" visual motif exemplifies how spatial manipulation can reflect psychological distortion, without abandoning the film's central ontological frame. While these examples stretch the formal limits of traditional cinema, they do so without crossing into the polymodal interactivity that defines MR environments.

Thus, unimodal films–despite their technological and narrative advancements–ultimately offer immersive experiences bounded by authorial intent and linear perception. As Nelson suggests, this does not negate their artistry, but it highlights a structural limit: "*Every film with an author presents, by definition, a unimodal world.*"

Mixed reality challenges this premise by replacing the singular authorial gaze with a system of negotiated presence–an emergent, interactive dramaturgy where narrative is co-authored in real time by both system and user.

Multimodality, Transmodality, and the Epistemic Threshold of Mixed Reality

American researchers in human-computer interaction, Harry Bunt and Francis Quek, have argued in separate foundational studies that human interaction with technology is inherently multimodal–rooted in the simultaneity and complementarity of sensory channels such as sight, sound, and touch. Their frameworks challenge the monolithic conceptualization of interaction design, positing instead that effective communication emerges through the integration of multiple perceptual modes. As such, re-evaluating augmented reality (AR) and mixed reality (MR) in light of this perceptual multiplicity may not only enhance interactional design but also serve as a catalyst for creative and narrative thinking in emerging experiential media[7]. (Bunt and Black, 2000)

This distinction raises a pivotal question: is mixed reality best described as a multimodal space, or does it constitute a transmodal synthesis–an emergent artistic language in its own right? In the lexicon of human-computer interaction, a "modal representation" typically refers to the dominance of a single communicative channel (visual, auditory, textual, spatial) within a given interface.

MR, by contrast, embodies transmodality: it orchestrates a space in which perception, action, and meaning are not merely parallel, but co-regulated in real time.

The devices through which MR is accessed–whether VR headsets, AR glasses, smartphones, or desktops–are not merely portals but cognitive interfaces. They modulate attention and user engagement in relation to degrees of immersion. While traditional taxonomies of MR applications are concentrated in technical fields such as medicine, architecture, and tourism, such classifications have yet to be fully extrapolated into the performative arts, where the implications for dramaturgy, authorship, and audience participation are profound and largely under-explored[8].

Contemporary multimodal films exemplify a hybrid form of narrative expression that blends live-action, high-fidelity CGI, and immersive soundscapes. Titles such as *The Jungle Book* (2016), *The Lion King* (2019), and *Avengers: Endgame* (2019) are emblematic in this regard, offering coherent fusions of digital characters, human actors, and spatialized sound. While viewers are not agents in the narrative, the cinematic experience approaches a passive form of MR wherein the sensory strata deepen immersion without enabling participatory modulation of the diegesis.

Films like *Inception* (2010) and *The Matrix* (1999) push the ontological boundaries of the real and the simulated. However, they do so within a unimodal structure that positions the viewer as contemplator rather than co-creator. In contrast, the MR systems developed by Professor David Nelson at the USC Institute for Creative Technologies, particularly *SimSensei*, propose adaptive narrative architectures. Empathetic avatars within these systems respond in real time to users' emotional cues, speech, and spatial orientation, generating a dramaturgy that is not linear but reactive[9].

As Nelson emphasized in our personal interview: *"Mixed reality is not only visual layering–it's cognitive layering. It's dramaturgy in motion."*

Thus, rather than extending a single sensory dimension, MR platforms articulate an emergent transmodal language–one where sensory, affective, and narrative vectors interweave into a dynamic ecology of co-presence and interaction.

Examples of films considered multimodal include those that combine elements of animation, virtual reality, and live-action, as well as productions employing multiple technologies–such as surround sound, special effects, and motion capture–to create an immersive and interactive experience for audiences. Notable examples of multimodal films include *The Jungle Book* (2016), *The Lion King* (2019), *Captain Marvel* (2019), and *Avengers: Endgame* (2019), all of which seamlessly integrate animated sequences, live actors, and high-fidelity visual effects to construct compelling visual worlds. The narrative design of these films reflects the directors' multimodal approach, offering viewers a richer and more immersive experience. Directors make use of multiple modalities–music, sound design, production design, special effects, and performance–to construct complex and coherent cinematic universes. For example, in the *Star Wars* saga, directors have crafted a detailed world that blends elements of science fiction, fantasy, and mythology through the use of special effects, production design, and musical composition. This allows audiences to feel as though they are part of the *Star Wars* universe, deepening the immersive experience and enhancing narrative engagement.

The umbrella terms *unimodal, multimodal, tangible, collaborative*, and *MR (Mixed Reality)*–without clearly focusing on modality or the interaction context–represent overlapping literacies that evolve from one another and aim to simulate reality endlessly. Consequently, inaccurate representations of the available interaction methods may hinder creative thinking in future researchers and prove counterproductive to the development of MR as a discipline. Previous attempts to enumerate or classify the components of augmented and mixed reality have revealed that a clear and comprehensive taxonomy of interactions is either lacking

or insufficiently disseminated in scientific communities. Starting from the hypothesis that the mix of realities is driven by the convergence and evolution of the arts (painting, sculpture, architecture, music, dance, literature, and cinema), the most effective mode of communication between human and device is one that aligns with language systems already internalized over time. This mirrors the historical trajectory of cinematographic art in the 19th century, which eventually emerged as an autonomous art form.

Mixed Reality (MR)

Mixed Reality (MR) possesses all the prerequisites to become a new form of art. This article attempts to demonstrate that potential by analyzing the historical evolution of the human-computer interaction language and the corresponding technological frameworks.

Mixed Reality (MR) is an ever-evolving field whose recent innovations are beginning to delineate new models of human-computer interaction. Among the most advanced institutions in both theoretical and applied research is Meta Lab, which has adopted a shared thesis: to bring possible worlds into a unified temporal and spatial framework, both real and virtual. Through the integration of smart glasses powered by AI and AR, immersive 360-degree sound systems, and haptic feedback devices, Meta Lab aims to embed users within truly hybrid experiences.

A key challenge today concerns the development of a language adequate to this new perceptual regime, one that is simultaneously visual, tactile, sonic, and computational. This challenge is reminiscent of the emergence of cinematic language in the late 19th century, which similarly required decades of formal, technological, and narrative refinement. The arts–cinema, performance, architecture, music–are not peripheral to this transformation but central: MR, as an expressive system, evolves alongside the aesthetic and symbolic grammars of these disciplines.

Human-computer interaction (HCI) has undergone considerable refinement, nearing what some theorists call a form of cognitive symbiosis. And yet, skepticism or cautious curiosity still surrounds the public reception of augmented and mixed realities. As Gustave Le Bon argued in *The Crowd: A Study of the Popular Mind*, humans are deeply conditioned by the emotional resonance of images and the shifting meanings of words over time. Concepts such as *democracy* or *freedom* have held radically different connotations across cultural and historical contexts, shaped by the collective imaginaries they evoke.

In contemporary performance practice, the stage has become a laboratory for testing the porous boundaries between real and simulated experience. Directors and performers increasingly employ digital projection, motion capture, and reactive scenography to explore how perception itself can be staged. In such environments, the actor no longer interprets a fixed role but coexists with algorithmic entities that learn, mirror, or respond to human expression. The result is a dramaturgy of presence in which action is both embodied and extended, simultaneously material and virtual. Theatre, in this expanded sense, becomes a cognitive experiment–an art of adaptation–where technology amplifies rather than replaces human agency, and where performance itself becomes a dialogue between code and consciousness.

In this light, the phrase "mixed reality" may one day constitute not merely a descriptor but a foundational term in a new cognitive and symbolic language. Scholarly studies on virtuality and augmented presence point to MR as a synthesis of lived perception and technological mediation. Yet this synthesis demands temporal adaptation. As Donald Norman notes in *The Design of Everyday Things*, humans navigate systems more effectively when design aligns with intuitive perceptual schemas. The success of MR depends on cultivating such intuitive literacy across visual, auditory, and spatial channels.

Theorists like Umberto Eco and Jaakko Hintikka have framed "possible worlds" as conceptual tools for exploring narrative and logic. In MR, these worlds are no longer mere metaphors but operational environments, navigable through interaction and immersion. Dolezel and Pavel have extended this to narrative semiotics, suggesting that fictional objects and structures are cumulative models with real cognitive and emotional impacts. As users become more adept at these models, their expectations for interactivity, immersion, and coherence will increase.

However, perceptual overload remains a barrier. Unlike linear media, MR presents multidimensional data streams that must be cognitively parsed and emotionally assimilated. Here, the concept of perceptual reality—as shaped by memory, sensory input, and context—becomes central. MR systems, by blending physical and digital elements, offer enhanced perceptions that may transcend biological limitations. In cinema, such effects are anticipated in films like *Citizen Kane* and *Vertigo*, where perception and subjectivity are central themes.

In *Citizen Kane* (1941), Orson Welles constructs a fragmented portrait of the protagonist through multiple viewpoints and non-linear flashbacks. The film illustrates how narrative framing alters spectator interpretation, aligning with constructivist theories of reality. Similarly, Alfred Hitchcock's *Vertigo* (1958) uses disorienting cinematographic techniques to immerse the viewer in the protagonist's psychological turmoil. These works anticipate the perceptual complexity of VR and MR, where users are not passive viewers but active agents within adaptive environments.

In VR, the spectator may undergo real-time transformations as if they were their own; AR introduces mediated layers of meaning atop the real; and MR—distinct in its bidirectional interaction—allows for a dynamic hybridization of memory, illusion, and agency. The result is not just a new medium, but potentially a new epistemology: a way of knowing that is embodied, co-constructed, and performative.

In live performance, the human body remains the most advanced interface ever conceived. It negotiates presence with precision and vulnerability, functioning as both transmitter and receiver of meaning. When integrated into a mixed reality environment, the performer becomes a living sensor—an instrument through which virtual and physical planes intersect. Movement acquires informational density; silence becomes a threshold for perception. The stage, once a delimited frame, transforms into a dynamic network of signals, light, and feedback. What emerges is a performative ecology where gesture, environment, and audience share the same perceptual loop. In this setting, theatre ceases to be an imitation of life and becomes its augmented continuation, a rehearsal for future forms of coexistence between human consciousness and intelligent space.

Thus, understanding MR today requires an integrated framework—drawing from philosophy, media studies, cognitive science, and aesthetic theory—to grasp its implications not only for storytelling or technology but for how we define presence, identity, and knowledge in the 21st century.

Other popular applications of Mixed Reality (MR) include simulation-based games designed to train users for various careers or to enhance their professional skills. One of the most significant artistic productions in the realm of MR-based computer games is *Second Life*. Developed by Linden Lab in 2003, this virtual environment allows users to interact within a 3D space, where they can create avatars—digital representations of themselves—and engage in a wide range of activities. In *Second Life*, users can explore, build, and even purchase virtual land. They may also participate in events, shopping experiences, or gameplay scenarios. As such, *Second Life* exemplifies the principles of mixed reality, blending real-world sensibilities with virtual autonomy. The platform empowers individuals to shape their own environments and interact in ways unattainable in the physical world. For instance, users can engage with digital objects that have no

physical counterpart—such as manipulating 3D renderings of artifacts or configuring immersive landscapes beyond physical possibility. Additionally, interactions with virtual entities, including AI-driven avatars or scripted digital characters, offer nuanced social and cognitive experiences. These interactions enhance user engagement, allowing them to explore emotional, relational, and psychological dimensions within a secure and dynamic environment. In this context, *Second Life* not only redefined virtual socialization but also laid the groundwork for deeper exploration into the nature of identity, agency, and perception in digitally constructed environments.

Conclusion

Philosophers have long debated the concept of immortality, with some arguing that it is fundamentally unattainable due to the finite nature of human existence. Others contend that immortality may be achieved through the preservation of memory and ideas, passed across generations. A further view proposes spiritual or metaphysical means—such as reincarnation or an afterlife—as potential pathways to immortality. Ultimately, there is no consensus on the matter, as philosophical positions vary widely.

Within the framework of mixed reality (MR), however, the notion of immortality takes on a new, technologically mediated dimension: the possibility of continuing to "exist" within a virtual environment after physical death. This vision assumes that some essence of consciousness—be it emotional imprint, cognitive pattern, or behavioral model—might be digitally preserved, allowing the individual to interact with others in an augmented or holographic form. This form of post-biological continuity could be achieved via artificial intelligence, which would enable a digital avatar to respond, adapt, and communicate as though still alive.

In fact, this was one of the underlying conceptual intentions behind the creation of *Second Life*—a virtual world launched by Linden Lab in 2003. The platform allowed users to craft digital avatars, establish alternate identities, and inhabit a persistent virtual ecosystem. These avatars could, in theory, persist indefinitely, thereby granting users a sense of symbolic immortality. Even after users disengaged from the platform, their avatars could remain active, leaving behind digital traces of thought, personality, and interaction.

This perceived continuity appealed to many participants, as it enabled the exploration of selfhood and interpersonal dynamics in a safe and unregulated space. *Second Life* was revolutionary in offering a virtual sanctuary for identity experimentation, emotional rehearsal, and social simulation. Nonetheless, its popularity has waned in recent years due to the emergence of more advanced virtual reality technologies. These newer systems, equipped with real-time presence, memory storage, and AI-assisted interaction, have surpassed *Second Life* in their ability to deliver immersive and emotionally resonant experiences. As virtual and augmented reality technologies become more accessible and user-friendly, they are increasingly likely to attract broader demographics. The fusion of digital memory, behavioral learning, and holographic projection suggests a future where identity itself may be archived and reanimated—challenging the very boundaries of mortality and presence.

The diminishing appeal of *Second Life* can be attributed to its outdated graphics and lack of engaging functionalities. Technical issues such as latency further eroded its usability and, consequently, its user base. Today, *Second Life* no longer occupies the cultural and technological relevance it once did. However, its conceptual legacy finds new life in the emergence of the Metaverse—a shared, immersive virtual space that exists independently of physical reality. This interconnected digital universe enables real-time interaction between users and serves as a platform for socialization, gaming, commerce, and cultural events. From exploring virtual cities to attending concerts and conferences, the Metaverse presents a hybrid space where physical and digital realities converge.

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Its potential lies not merely in technological innovation but in the way it redefines human experience and presence. The Metaverse stands as a more advanced and compelling prototype of what *Second Life* once aimed to be. Fundamentally, the trajectory of these developments underscores a deep-seated human desire for continuity–perhaps even for a form of digital immortality. As research progresses, we may soon encounter a proliferation of disembodied avatars–conscious agents suspended in fully digital realms–inhabiting a persistent virtuality characterized by infinite narrative threads. In this speculative horizon, the user ceases to be a passive observer and becomes an active participant in a digitally extended selfhood.

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1.　G. W. Friedrich Hegel, *The Phenomenology of Spirit*, trans. Terry Pinkard (Cambridge University Press, 2018), 253.

2.　David Nelson, *Immersive Ethics: Participatory Presence in Mixed Reality* (research paper, University of Southern California, Institute for Creative Technologies, 2021), 4.

3.　*Virtual Human Toolkit, University of Southern California, Institute for Creative Technologies, accessed 2024, https://ict.usc.edu.*

4.　Hegel, *The Phenomenology of Spirit,* 416.

5.　Nelson, *Immersive Ethics*, 4.

6.　David DeVault et al., *"*SimSensei: A Virtual Human Interviewer for Health Assessment*," in Proceedings of the 13th International Conference on Autonomous Agents and Multiagent Systems,* 2014, 3–5.

7.　Harry C. Bunt and William Black, *Multimodal Human-Computer Communication: From Theory to Practice* (Springer, 2000), 14–16.

8.　Francis Quek et al., *Multimodal Human Discourse: Gesture and Speech* (Cambridge University Press, 2002), 92–93.

9.　David Nelson, interview by the author, University of Southern California, Institute for Creative Technologies, 2025.

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