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The Ubiquitous Body: Exploring Virtual Reality Art Through Embodied Cognition Theory

Jin Lei

Abstract

With the rapid iteration of virtual reality (VR) technology, new creative media and interaction methods have been activated. This paper delves deeply into the embodiment of VR art from the perspective of embodied cognition theory. The study reveals that the body plays a pivotal role in both enclosed artistic experiences facilitated by head-mounted VR devices and open digital media artworks involving physical interactions. Embodied cognition theory offers a novel perspective for research on VR art.

Key Words

Virtual reality art, embodied cognition, embodiment

Since the 1980s, the theory of embodiment has become a key concept in virtually all fields of cognitive science. In philosophy, psychology, neuroscience, robotics, education, cognitive anthropology, linguistics, and cognitive dynamics, researchers increasingly discuss the concept of embodiment.[1] As one of the most popular contemporary art forms, virtual reality (VR) art has brought bodily interaction to the forefront of cognitive science. Virtual reality art has pioneered a new phase of bodily participation in artistic interaction, expanding the cognitive space for both creators and participants, who derive immense physical and mental pleasure from it.

1. Coupling of Body, Technology, and Perceptual Subject

The theory of embodied cognition provides a unique analytical perspective for VR art, making body interaction an essential focus of discussion in these works. To understand the issues of embodiment in VR art, it is crucial first to comprehend the relationship between the body, technology, and perceptual subjects.

1.1 The Embodiment of Technology

Logocentrism, which regards consciousness as the absolute source of cognition, has long influenced research across various academic fields. For a long time, the body was relegated to a cognitive blind spot. It wasn't until the nineteenth century when Friederich Nietzsche proposed the ideas of "body as the standard" and "revaluation of all values," that humans began to truly consider the role of the body in cognition.[2] Following this, the emergence of phenomenology saw Edmund Husserl distinguish between the human body (the physical entity) and the body (the source of perception), bringing the concept of the body back into focus. Martin Heidegger, through his concept of the "ready-to-hand" tool, emphasized the coupling of the body with the environment and tools. Maurice Merleau-Ponty, building on his critique of René Descartes' mind-body dualism and the theories of Husserl and Heidegger, introduced the concept of embodiment. He argued that humans perceive the world through their bodies and that the body serves as an essential link between individuals and the external world. In his embodied cognition theory, Merleau-Ponty contended that human understanding of the world is neither a simple mirror reflection nor an illusion projected onto a cave wall, as in Plato's allegory. Consciousness does not dominate all cognitive activities; rather, it is through the body's structure and the interaction of sensory and motor systems that the world is ultimately shaped by a series of embodied experiences.

Marshall McLuhan viewed media as an extension of bodily organs, suggesting that media can amplify or extend human sensory perception and emphasize the inseparability of technology and the body. Whether it's

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Heidegger's hammer or Merleau-Ponty's cane, both are prime examples of technology's relationship with the body. Chris Shilling, through his study of the relationship between the body and society, argued that technological development cannot be separated from the body, as the body constantly influences and constrains the direction of technological progress. Don Ihde, by reflecting on the material body from a phenomenological perspective and considering Michel Foucault and Pierre Bourdieu's ideas on discipline and social bodies in different fields, developed a third concept of the body: the "technological body." From a phenomenological standpoint, this highlights the embedding and practical integration of technology and the bodily environment. The body, through technological media, amplifies and extends the scope of cognition, with technology embedding itself within the body, thus forming a complete bodily schema. Technology becomes part of the body and cannot exist without it. Similarly, our bodies cannot live purely without technology; the two are interdependent and in a coupled relationship. He illustrates this point well with the story of the fox and the grapes: the fox sees the grapes are too high and, with its body's jumping ability, cannot reach them, so it concludes that the grapes are sour. Initially, a human cannot reach the grapes either, but by picking up a stick and knocking them down, the human proves that there is no need to conclude that the grapes are sour. Both the fox and the human desire the grapes and perceive them as attainable, but it is the primitive technological situation created by the stick that allows the human to actually obtain the grapes and truly taste them. With the stick, the human's macroscopic perception gains both an object of perception and the ability to obtain it.[3]

Paul Preston supports Ihde's view on the embodied nature of technology and further distinguishes two types of technological bodies: technological extension and technological embedding. He argues that, due to the different paradigms and characteristics of technology, not all technologies seamlessly integrate into and construct bodily schemas. Technologies that cannot, or can only partially, alter the bodily schema serve only to extend perception and motor abilities; these fall under the category of technological extension. In contrast, technologies that can fully integrate into and reconstruct the bodily schema are categorized as technological embedding. After the efforts of researchers to restore its rightful recognition, the status of the body has finally received the attention and elevation it deserves. Meanwhile, the coupling relationship between technology and the body has become increasingly clear. The body participates in the construction of cognition, technology extends and integrates into the body, and the body and technology are inseparable.

According to Ihde, the embodiment of technology requires three characteristics: 1) it can integrate into the bodily schema; 2) it has a proprietary nature; 3) it possesses transparency or near transparency.

In Heidegger's example of the hammer, we can see how the hammer, as a ready-to-hand tool, extends the subject's ability to perceive and transform the environment, merging with the body and becoming an extension of the body's senses. The hammer becomes a new hand for the subject, disappearing into the subject's bodily schema. In the process of perceiving the world, the subject uses technology to extend the body's senses, while technology also integrates into the bodily schema, creating an embodied relationship between the person and the technology.[4]

From a phenomenological perspective, ownership emphasizes the subjective sense of ownership over one's body, perception, and experience. Specifically, this means that we perceive our body as an integral part of ourselves and interact with the world through it. Our identification with the body is the condition that distinguishes us from others and the external world. In short, the perception that the subject gains is first-person perception; it is not a mere reflection in the water, but something genuinely perceived by the subject. All the sensory feedback provided by technology belongs to the self.

The transparent characteristic of media is what Heidegger refers to as withdrawal, where, as the glasses help you see things clearly, you gradually forget their existence. This demonstrates that the glasses have become transparent to the subject. In the story of Zhuangzi's "Cutting up an Ox," the butcher's knife skillfully moves through the ox's body structure, becoming an extension of his body. For the butcher, the knife is also transparent. The transparency of a technological object is that, while it extends the body's sensory capabilities, it causes the subject to become unaware of its presence, as if it disappears from the subject's perception. The body forgets the existence of the technology, and the technology fully integrates into the body.

1.2 Embodiment of the Perceptual Subject

In the study of embodiment, Merleau-Ponty's *Phenomenology of Perception* establishes a phenomenological system centered around the body. He argues that the body's existence provides us with a new mode of experience, where we communicate with the world in real time through the bodily schema. This creates an organic interaction between the consciousness-body-world,

Figure 1. Back Light Studio. *Blanca Li: Le bal de Paris*. Virtual reality, 2021 (https://npac-ntch.org/programs/14174).

where cognition is obtained through the body's real-time interaction with the world. According to Merleau-Ponty, the body is a crucial element in the construction of the perceptual subject. Cognition is the result of the body's continuous interaction with the environment. Whether the self or the other, both are merely phenomena, primary experiences that emerge in the body's field of vision. Merleau-Ponty reveals not a me and the other within the perspective of me, but a perceptual subject (the body), which, as the foundation of all individuals, experiences self and other within its field of perceptual experience.[5] The viewpoint of phenomenology of perception rejects the "consciousness as king" dualism of mind and body, positioning the body at a prominent place in the cognitive process of the perceptual subject.

Merleau-Ponty opposes the view advocated by George Lakoff and Mark Johnson that "cognitive processes do not need to be shaped by the body, and important cognition does not require the body's participation." He disagrees with Norbert Wiener's definition of the interaction between the body and machines in his cybernetics theory, which includes concepts like "reflexivity, dynamic balance, and self-organizing systems." He also strongly resists the so-called posthuman cyborg body proposed by Donna Haraway, Katherine Hayles, and Friedrich Kittler. In his view, these perspectives all divide human perceptual subjectivity into isolated physiological parts and mental structures, thereby severing the channel of perception. For Merleau-Ponty, human existence is neither a detached mental activity nor the operation of complex machines. The acquisition of subjectivity lies in the engagement with the environment through the unique physiological features of the human body.[6] He emphasizes the body's significant role not to completely negate mental consciousness but to reconstruct subjectivity under the perceptual body. He denies the idea that human cognition of the objective world is a mirror image in the mind, arguing instead that cognition is acquired through the real-time interaction of the mind and body. Our concepts and thinking abilities are shaped through the interaction of the mind, body, and environment. There is no purely mental cognition separated from the body, nor is there a body isolated from the brain.[7] Thus, perceptual embodiment unifies the four dimensions of cognitive experience: self-awareness, awareness of the objective world, awareness of others, and the attribution of meaning, and offers

an in-depth exploration of the relationship between consciousness, the body, and the world.

The embodied perceptual subject advocated by Merleau-Ponty is neither a monism of consciousness and body nor a dualistic opposition. To be precise, he emphasizes the real-time interactive concept of consciousness-body-world, where the body serves as an important bridge connecting consciousness and the world. "My body is indeed the pivot of the world: I know an object has several sides because I can walk around it. In this sense, I become aware of the world through my body."[8] The body holds significant ontological and methodological importance. From this perspective, Merleau-Ponty does not completely dismiss the value of the mind in cognition. While affirming the role of the material body in constructing cognition, he shifts the focus of research toward the interaction of the perceptual body. In his concept of embodiment, consciousness acts more like the body's good companion, always involved in the interactive activities between consciousness, body, and the world.

2. The Presence and Absence of the Body

2.1 Presence? Absence?

Given that the focus of this study concerns the issue of embodiment in VR technology, the presence or absence of the body when facing technology becomes a key aspect of embodiment research.Traditional metaphysical theories judge the states of presence and absence based on whether the physical body (the physiological body) is spatially manifested, which has been the theoretical foundation for analyzing the embodiment of traditional technological media. The era of traditional media technologies, dominated by Cartesian dualism, placed consciousness far above the body, with the notion of eliminating the body deeply ingrained. The concept of "mechanical embodiment" caused traditional technologies to focus on the transmission of information while neglecting the use of interactive media. Therefore, in traditional media technologies such as newspapers, television, and radio, the body exists in an absent technological state. Communication studies at one point even regarded the body as an obstacle to be excluded, advocating for the removal of the body's presence to break through the constraints of distance and time and transmit information to more people. Mainstream communication theory was built on a rational, conscious subject, viewing the body as an irrelevant factor to subjectivity. Communication is understood as the understanding and response to discursive information on the level of rational consciousness. The media, in this view, is a medium that connects the subject and object or constitutes intersubjectivity. The media is external to the subject, and of course, external to the body. Under the domination of the rational conscious subject, communica-

Figure 2. Ex Nihilo, ARTE France, Archer's Mark. *Notes on Blindness: Into Darkness*. Virtual reality, 2016 (https://miro.medium.com/max/1400/1*s1-kNH48wRlJHyZZBQc41Q.png).

tion technology exhibited the following characteristics: focusing on the content of information while neglecting the medium; stripping communication from embodied relational contexts; praising reason while rejecting the irrational; obscuring space and geographical elements; dismembering the body into separate organs and connecting them to various forms of media.[9] The absence of the body's presence means that consciousness can be separated from the body and communicated independently, and this perspective is the root of the absence of the body in traditional technology.

With the advent of digital technology, scholars have begun to engage in a new discussion on the traditional concept of the body's presence. There is no doubt that under the theory of rational consciousness, digital technology is absent. But can we still rely on ancient metaphysical concepts to determine the body's absence? In other words, under new technologies, is the body's disembodiment truly the separation of bodily perception? Can complete information be obtained by relying solely on consciousness, without the body's involvement?

John Durham Peters once stated: "The minds of individuals can never truly touch each other, but this does not mean that our bodies cannot touch each other... If we consider communication as the union of true thoughts, we are underestimating the sacredness of the body… Being physically present is perhaps the closest guarantee we have to bridging the gap between people."[10] Digital technology aims to enhance and expand the authenticity and richness of human information acquisition and perception, and naturally, its primary task is to ensure the presence of the body. Under digital technology, the body has experienced both separation and integration by technology; it is neither the absence seen in traditional technology nor the presence in face-to-face interactions. The subjectivity of the body is manifested in the stitching and combining of fragmented senses, creating various forms of bodily presence and resulting in a diversified presence of the body. Due to the limitations of digital technology, the body's presence exhibits contradictory phenomena. On one hand, the sensory separation created by digital technology forces the once-integrated bodily perception to be split. The mechanism of the body as a whole subject is disrupted, and human experiences of the body are broken down into sensory combinations made up of individual organs. The continuity of the original body senses is lost. On the other hand the participation of certain, or multiple, body senses greatly enhances the subject's cognitive experience and the depth of information acquisition. The inclusion of hearing, for example, allows the recorded voice of a deceased friend to transcend the eternal effect of cinematic photography: the body is not a ghostly replica in a black-and-white imagined realm, but exists in the form of a real voice.[11] The fragmented connection between the senses and the body can be seen as the body's presence in new technology. Even if it is not complete, the body has never been expelled, and its presence exists in diverse new forms.

2.2 The Activated Virtual Body

Through the previous discussion, we have established that the body in digital technology is a multifaceted and unique form of presence. It should be noted that the presence of the body in digital technology often refers to the objective participation of the physical entity (the physical body), even though the body schema does not fully integrate the senses. In other words, the feedback received by the senses still originates from the real, objective world. So, how should we view the body in VR technology? (It is important to emphasize that the virtual body here specifically refers to the body within the scope of this study on VR art, namely the digital three-dimensional body generated in immersive VR headsets, augmented reality (AR) headsets, and the abstract body in flat spaces created by open digital technologies). What is the relationship between this virtual body in the virtual world and the physical body in the real world? Is the virtual body present or absent in the physical body? Does it have the embodied functions of technological media?

Since Haraway's concept of cyberspace entered our field of view, discussions about the virtual body have never ceased. Based on traditional metaphysical theories, early scholars considered the virtual body a quintessential disembodied entity. This also raised concerns about the development of technological media, with VR technology being seen as depriving the human body of its role as the subject of cognitive interaction, thereby weakening the body's interaction with the objective world. Digital virtual technology leads to the loss of the body's status, bringing cognitive acquisition and bodily perception into a dilemma. But is this the case? Is there truly no presence of the body in the virtual world? Does the conclusion that VR is disembodied apply to the body concept in this study? To objectively and rigorously address this issue, it is necessary to categorize and analyze the virtual world. Specifically, it can be divided into two categories: two-dimensional virtual worlds (flat spaces) and three-dimensional virtual worlds (immersive spaces).

The two-dimensional virtual world generally refers to artistic forms such as websites, films, animations, and

games. When viewers experience such artwork, the boundary between the body and the artwork is relatively clear, and we can distinctly feel the distance between the virtual space and the real space. In this case, the virtual body cannot integrate with or effectively reconstruct the body schema of the real physical body. Viewers find it difficult to establish a natural connection between the virtual body and their real bodily actions. As a result, most scholars consider this type of VR art to be disembodied or non-embodied. They argue that the virtual body in a flat virtual space does not conform to the perceptual habits of the real-world body. This can be explained in two aspects.

First, the body perspective in virtual space does not align with the first-person bodily experience. Idhe uses the example of skydiving to illustrate the difference between bodily presence (embodiment) and bodily absence (disembodiment). When we skydive, we feel nervous, our heart rate increases, and we experience the rapidly moving air. This process of integrating bodily perception into experience is the embodiment, where the body is from the first-person perspective. However, when we imagine observing ourselves skydiving from a third-person perspective, we cannot feel the physiological activity during the experience. This process of viewing the body from an objective perspective is disembodied behavior, where the body is viewed in the third person.[12] According to Idhe's theory, the disembodied body corresponds to the corporeal body in the phenomenological sense, while the embodied body corresponds to the body; he stated "The virtual body in VR is thin and will never achieve the thickness of the real physical body."[13] David Chalmers refers to this type of VR as "weak virtual reality." He believes that the body in such VR is a representation of the digital art form simulated through computer technology, with a clear boundary from the physical body in reality. The body is an objective image body, possessing all characteristics beyond the direct experience.[14]

Second, these virtual realities of human-machine interaction devices do not effectively replicate human bodily behavior patterns. For example, in video games, we often use controllers, keyboards, mice, and other devices to interact and control the movements of characters in the virtual world. The jumping and running of characters in the game are translated into the pressing of directional keys and the A and B buttons on the controller, with the real physical hand movements mapped to the virtual body's actions. This is different from the bodily perception we are more familiar with. It is undeniable that such interactive behaviors are simple and easy to learn in real life, but they are not natural or realistic movements inherent to the human body.[15]

The three-dimensional virtual world generally

Figure 3. Hsin-Chien Huang. *Samsara*. Virtual reality, 2020 (https://d3d9mb8xdsbq52.cloudfront.net/s3/220622/092856rfn.jpg).

includes immersive virtual experiences created by devices such as AR, VR, and mixed reality (MR), primarily using head-mounted displays. Unlike the aforementioned two-dimensional VR, immersive virtual technologies create a three-dimensional environmental space, where real bodily movements are mapped into the virtual space through intermediary devices and can interact with it behaviorally. Changes in the virtual environment can influence bodily perception, which further controls the body's responses, and real-world actions can reflect into the virtual space to navigate the virtual environment. This forms a seamless feedback loop between real and virtual bodily perception, which is considered an embodied existence.

Therefore, the real agency of the body becomes particularly important. F. A. Hanson introduced the concept of the "extended agent," suggesting that action depends on the relationship between humans, technology, and the extended agent, viewing the subject as the one who performs actions. Real bodily actions are indispensable in measuring the existence of subjectivity. Immersive three-dimensional VR technology breaks the flat bodily representation of non-immersive two-dimensional virtual technologies and reshapes human perceptual subjectivity. At the same time, technology is no longer limited to one-dimensional control of the body; humans themselves also become a medium acting on technology, making technology an experiential presence that adapts to human needs, illustrating the mutual construction and integration of body and technology, and sensation and environment.[16]

3. The Embodiment of Virtual Reality under Ihde's Theory

In light of the discussion on the two types of VR technologies, Ihde's three necessary conditions for the embodiment of technology provide another theoretical perspective for analysis. He argues that for a technology to be considered embodied, it must meet three necessary conditions: 1) the technology can be integrated into the body schema; 2) the technology has the quality of ownership; 3) the technology possesses transparency or near-transparency.

First, what kind of technology can be integrated into the body schema? Paul Preston further divides the relationship between the body and technology into technological extension and technological incorporation. She believes that the former expands the body's sensory abilities but does not integrate into the body schema or reconstruct it, and therefore does not belong to embodied technology. The latter, however, incorporates technology into the body schema and reorganizes the body's perception, thus qualifying as embodied technology. Ihde agrees, suggesting that certain technologies may be integrated into the body without altering the body's ownership, thus becoming embodied technology.[17] At the same time, according to Prestridge's view, the body schema cannot be extended; it can only be incorporated and reconstructed. The body schema is a complete organism and cannot be extended by technology, but it can undergo internal reconstruction.[18] So, can VR technology be incorporated into the body schema and reconstruct it? We view the physical body in reality as A, and the body created by virtual technology as B. A, through immersive virtual technology, projects natural movements and perceptions onto B, and B fully inherits and maps A's sensory and behavioral characteristics, thereby forming an abstract body experience of A and B's coupling, which we call C. A and C are different body schemas, but they exist simultaneously in A. In other words, the body schema created by the coupling of the real body and the virtual body in the virtual space merges with the actual body schema, and the body schemas of A and B are perfectly embedded into the former's body schema and are reconstructed. At that moment, A experiences the presence of C and temporarily forgets about A and B. In this case, we regard it as possessing embodiment.

The flat virtual space to some extent restores the real environment, simulates a virtual body, and allows interaction with the real body. However, the experiencer can always feel the clear boundary between the real and virtual bodies, and the mapping of virtual body movements does not completely align with the movements and sensory habits of the real body. Interaction requires the rational transformation of the mind to be realized, and the experiential process cannot achieve a unified body schema. From this perspective, this type of VR technology does not possess the characteristics of embodiment.

Three-dimensional VR art creates a completely new immersive virtual environment, where the human bodily experience connects with the virtual scene. The body schema is reconstructed and enhanced, forming a continuous perceptual experience interaction between virtual technology and the body. The coupling of the real and virtual bodies allows the experiencer to receive perceptions and behavioral sensations that align with the real body schema, blurring or even eliminating the boundary between technology and the body. This human-machine dialogue relationship, with the body as a medium, truly places the experiencer into a virtual world initiated by their actions. In this enclosed and

continuous virtual space, the experiencer is constantly giving commands with the body, receiving feedback from the replicated real world information with the body and experiencing a comprehensive physiological and psychological response through the body.[19] Therefore, this type of VR is considered embodied.

Second, before discussing whether VR technology possesses ownership (or selfhood), it is essential to clarify two crucial concepts: "agency" and "ownership" perception. Only when the body possesses these two sensations can it be said to have ownership. Sean Gallagher and Dan Zahavi, through their research, pointed out that agency is the pre-reflective experience and feeling of "I am the initiator of action" (such as the experience of being able to control one's actions). Ownership perception is the feeling of "I am the subject of movement" (such as the kinesthetic experience of movement).[20] In other words, the interaction between the body's perceptual subject and the environment aligns with the body's habitual and experiential patterns, and the body itself is experienced as the originator of the actions. Only when both of these conditions are met can the body be said to possess ownership.

According to Gallagher and Zahavi's theory, two-dimensional VR technologies provide the body with a sense of agency. For example, in video games, the participant can control the virtual body in the virtual world with a controller, performing actions such as walking, running, jumping, or punching. Throughout this process, the participant can experience the feeling of "I am the initiator of the action." However, in this kind of interaction, it is difficult for the perception of the real body to be integrated into the virtual body's interaction, and the participant does not experience the sense of "I am the subject of movement." In such an interaction experience, the virtual body is more like a puppet controlled by strings, while the real perceiving subject is the performer controlling the puppet. The subject and the virtual body are in a fragmented and opposed state, with a clear gap between the real and the virtual, thus lacking a sense of ownership. One could say that this virtual experience is like a reflection in the water—the subject can control its actions, but it cannot regard it as the body itself; it is merely a reference and representation of the objective body.

In immersive virtual technologies, the bodily behaviors and habits in the virtual world closely resemble those of the real body. Participants use immersive headsets to gain a realistic sense of virtual space through their vision, and they control the virtual body and interact with the environment using controllers. The body's behavioral experiences are well-mapped in the virtual space. For example, in increasingly popular VR games, three-dimensional virtual headsets immerse players in a fantastical game world, which realistically exists around the player's body. When you turn your head to the left, the virtual environment presents the visual experience corresponding to your left side; when you pick up a bottle and smash it onto the ground, the sound of glass shattering follows, and you might instinctively move your feet to avoid injury. In the virtual space, your actions interact with and transform the objects and environment, even offering sensory experiences that feel real. Not only does this provide a sense of agency, but it also gives a sense of ownership. Therefore, from this perspective, three-dimensional VR technology possesses ownership.

Third, Ihde argues that real or material technologies always have a certain level of transparency or semi-transparency, which is the cost of the amplification effect brought by technology.[21] For technology to achieve embodied transparency, it must be constructible. In other words, it must be learnable by the user, and the better the technology, the higher its transparency. Ihde uses the example of automobiles to illustrate this point. Compared to the outdated, bulky, and large cars of the 1950s, a well-performing race car allows for a more precise perception of the road surface and the pressure on it. When the embodiment is well-established, people can feel the road surface without needing to see it, meaning the car, as a bodily technology, becomes transparent. Virtual reality technology, through immersive headsets, creates a virtual experience of real space for the user. By using binocular disparity, it creates a realistic three-dimensional effect. When a person puts on a headset, it withdraws from their body, becoming transparent, much like Heidegger's hammer. Ihde also acknowledges the telephone as an embodied relationship of hearing, noting that as long as the telephone's quality is good, it stands before you, though your eyes are closed. He also emphasizes that the telephone is an embodied technology for a single sense, without the multi-dimensional presence that happens in face-to-face interaction. It must rely on your tone of voice to imagine these dimensions.[22]

Virtual reality technology, due to technical limitations, makes it difficult to fully achieve the multi-dimensional presence of face-to-face interactions. In other words, it is unrealistic to fully replicate everyday bodily senses. Ihde has also expressed skepticism about this: "In a negative sense, the desire for pure transparency is to escape the limitations of materialized technology. This hope is full of contradictions: the user wants to gain the technology, but does not want to experience it as technology."[23] Currently, VR technology can only achieve a form of

Figure 4. Jin Lei. *Space Art Gallery*. Virtual reality, 2024. The image is from Jin Lei's Screenshot of Virtual Reality Interactive Artwork.

semi-transparency, which restores certain aspects of bodily sensory experiences to some extent. To determine whether a technology is transparent or not, beyond the constraints of technological capability, the user's proficiency in operating the technology is another important factor affecting its transparency. For example, when a person first learns to ride a bicycle, they focus their attention on gripping the handlebars and pedaling, as the bicycle itself presents a technical challenge. However, once they have mastered the skill, their attention shifts from the bicycle to the road, and the technology disappears, becoming part of the body's movement. Similarly, VR technology—whether in the form of flat, open virtual worlds or immersive, three-dimensional environments—has a certain level of transparency and semi-transparency. The user engages in bodily interaction through virtual technology, restoring a degree of sensory perception and actionability. Due to differences in how users familiarize themselves with virtual devices, the level of perceived transparency of the technology may vary from person to person.

In conclusion, the study of embodiment in VR technology must be approached from two perspectives. For immersive art forms like VR and AR, where virtual interaction is facilitated through immersive devices, the virtual body's mapping of the natural actions of the perceiving subject leads to a reconstruction of the body schema. This reconstructed body schema possesses the belongingness of the real body. Moreover, when engaging with VR technology, the virtual device provides highly similar real-life behavioral experiences, to the extent that the user forgets its existence. These types of VR art satisfy the three key components of the technological embodiment described by Ihde and thus can be classified as embodied art. On the other hand, flat, open VR art typically employs two-dimensional digital displays, where devices like controllers enable physical interaction with the virtual world. However, the operation of these devices diverges from the perceptual habits of the real body, and the visual representation of the virtual space lacks immersion. On one hand, the subject can control the virtual character's interaction with the space via the device, and the subjective body receives some sensory feedback. On the other hand,

the virtual body schema cannot fully merge with and reconstruct the real body, and the subject remains separated from the virtual world by a screen. Based on the above analysis, most scholars in VR art research consider immersive VR and AR art to be embodied art forms, while virtual interactive installations based on open digital interaction are considered to belong to the semi-embodied category.

4. Conclusion

Virtual reality technology is an advanced digital technology, and its relationship with the body naturally remains within the scope of technological embodiment. The interaction between the body and the virtual world is not a tactile, material-based cognition. How the body perceives this interaction, and how the relationship between the body, intermediary devices, and the virtual world is established, requires a perceiving body. Traditional cognitive theories have often focused on information while neglecting the role of the medium, leading to the view that the body in VR is in an absent state. However, through the lens of embodied cognition theory, it has been demonstrated that VR can link bodily movement with the brain's imagination, providing a perceptual experience that aligns with the real body.

Whether it's the highly immersive 3D virtual experience or the 2D VR art that requires the body to actively adjust, both activate the interactive function of body behavior within the embodied system. Andrew Feinberg publicly refutes Ihde's strict requirement that the "material body must be present," arguing that although VR art lacks physical body contact, it can still provide genuine experiences from the virtual world. He emphasizes that bodily movement is a necessary condition for acquiring virtual perception. Therefore, it is clear that bodily behavior creates a unique characteristic of VR art and embodiment is always present in, and essential to, VR art.

College of Film and Animation
Sichuan Academy of Fine Arts

JIN LEI is a lecturer at the Film and Television Animation College of Sichuan Fine Arts Institute and holds a PhD from the Central Academy of Fine Arts. His works involve new media art, digital prints, and virtual reality interactive art.

Editor: Yao Xiao

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無處不在的身體——具身認知理論探究下的虛擬現實藝術

金磊

摘　要：伴隨著虛擬現實技術的快速迭代，全新創作媒介和交互方式被激活。本文從具身理論角度出發，對虛擬現實藝術的身體性進行深入討論。研究發現，無論是基於頭戴式虛擬現實設備之下的封閉藝術體驗，還是具有身體交互的開放型數字媒體藝術之中，身體始終扮演著關鍵性角色。具身認知理論為虛擬現實藝術的研究提供了又一個全新視角。

關鍵詞：虛擬現實藝術；具身認知；具身性