Embodied Reading: Structural Attribute Analysis and Functional Reconstruction of Metaverse Libraries

Authors: Wei Wenkai, Xie Haoying, Xie Haoying

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Abstract

The advent of the metaverse era has ushered in new opportunities for library development. This article begins by clarifying the logical commonalities between the metaverse and library development to validate the rationality of metaverse libraries' existence. It employs a structuralist paradigm to analyze multiple structural attributes of metaverse library architecture, including wholeness, relations, agency, self-regulation, and transformation. Focusing on embodied reading behaviors, the article examines the multiple relationships within metaverse libraries, such as traceability and cognition, connection and disconnection, immersion and disengagement, public and private domains, and representation and void. Furthermore, from an embodied cognition perspective, it conducts relevant analyses on the ritual, integrative, and social characteristics of reading and cognitive behaviors in metaverse libraries.

Full Text

Embodied Reading: Structural Attribute Analysis and Functional Reconstruction of Metaverse Libraries

Wei Wenkai, Xie Haoying
School of Literature / School of Journalism and Communication, Guangxi Normal University

Abstract: The advent of the metaverse era presents new opportunities for library development. Beginning by clarifying the common logical ground between the metaverse and library development, this article validates the rationality of the metaverse library's existence. Employing a structuralist paradigm, it analyzes the multiple structural attributes of the metaverse library—wholeness,

relationality, subjectivity, self-regulation, and transformation. Focusing on embodied reading behaviors, it dissects the multifaceted relationships within metaverse libraries: tracing and cognition, connection and disconnection, immersion and detachment, public and private, representation and vacuum. From the perspective of embodied cognition, the article conducts relevant analyses on the ritual, fusion, and social characteristics of reading-cognitive behaviors in metaverse libraries.

Keywords: Metaverse; Library; Embodied Communication; Structuralism

The advent of the metaverse era has ushered in new opportunities for library development. On May 22, 2022, the General Office of the Central Committee of the Communist Party of China and the General Office of the State Council issued the *Opinions on Promoting the Implementation of the National Cultural Digitalization Strategy*, emphasizing the need to "coordinate the construction of the national cultural big data system, the national smart library system, and the public cultural cloud, enhance the supply capacity of public digital cultural content, and elevate the digital level of public cultural services." This strategic integration of technological affordances with the "human-space-object" triad of libraries leverages technology to strengthen libraries' capacity for coordinating data resources, enhancing reading scenarios, and extending knowledge linkages. In recent years, academic and professional discussions on smart libraries have flourished. As a public knowledge service platform, libraries face urgent demands for digitizing massive collections and enabling personalized data storage and analysis, necessitating active intervention by novel technologies. Concurrently, libraries have become new testing grounds for technological applications. The fusion of technology and libraries transforms technology from "remote and unreachable" to "close at hand," responding to public needs in the public domain and obtaining direct feedback from the masses to test practical utility. Thus, from the web 1.0 era to the web 3.0 stage, the emergence of new technologies has consistently inspired innovation in library intelligence, achieving win-win outcomes through collaboration between technology and libraries.

The year 2021, hailed as the "metaverse 元年 (metaverse inaugural year)," witnessed landmark events: the listing of Roblox (the sandbox gaming platform) as the "first metaverse stock," the Seoul Metropolitan Government's announcement of the *Five-Year Plan for Metaverse Seoul* with an investment of 3.9 billion KRW to create a metaverse administrative service ecosystem, and Mark Zuckerberg's rebranding of Facebook as Meta. Since the metaverse concept sparked heated debate, academia has been constructing the notion of the "metaverse library," exploring conceptual clarification, future prospects, and rational critique from perspectives of technological evolution logic, scenario creation, and ethics. Most articles discussing metaverse libraries treat the library as a holistic entity, engaging in theoretical and practical discussions with the metaverse, reflecting high recognition from both academic and professional circles regarding their integration. However, in the early stages of metaverse development, when the combination of metaverse and libraries remains at the level of imagination

and preliminary experimentation, the broad perspective of a holistic approach weakens the analytical efficacy of specific research, failing to address concrete issues in metaverse libraries or guide their developmental path through forward-looking research. Based on this observation, this article adopts a micro-level approach to examine metaverse libraries, starting from library reading behaviors and employing the metaverse's characteristics of immersion, simulation, and spatiotemporality. Integrating paradigms from phenomenology of perception, cognitive communication, and structuralism, it focuses on the embodied transformation that the metaverse brings to library reading behaviors. Centering on the phenomenon of embodied reading in metaverse libraries, the article elaborates on the profound structural changes in reading behaviors resulting from metaverse technology intervention.

I. Conceptual Analysis of Metaverse Libraries and Metaverse Reading

(1) Conceptual Elaboration of Metaverse Libraries

After the National Science and Technology Terminology Committee's seminar discussion on the term "metaverse," the concept was standardized as: "a virtual world constructed by humans using digital technology, which maps onto or transcends the real world and can interact with it" [1]. Building upon this definition, this article discusses the concept of the metaverse library. Before defining the metaverse library, it is essential to first clarify the debate between "metaverse library" and "library metaverse." Zhang Xingwang et al. argue that the library metaverse constitutes an important component of the ideal metaverse form [2]. Li Mo suggests that the library metaverse can be understood as the application of metaverse in libraries [3]. Zhao Zhiyun et al. propose that the metaverse library refers to the metaverse empowering library construction through its concepts, technologies, thinking, and environments—in other words, libraries utilizing the metaverse for development [4]. The "library metaverse" emphasizes the metaverse's constructive role as an external technology intervening in library development, reinforcing the library's independent existence and selectively adopting metaverse technological features suitable for library applications. This represents a traditional additive approach. In contrast, the "metaverse library" transforms library development thinking through metaverse logic, treating the developmental thinking behind metaverse technology as an endogenous logic for future library development. By identifying common logical ground, it achieves dual efficiency gains from the co-development of metaverse and library, adjusting the development trajectory of smart libraries from a conceptual standpoint. This article adopts the concept of the metaverse library, which integrates the concepts, positioning, structures, and functions of both metaverse and library, delivering public knowledge co-creation centered on the core logic of virtual-real symbiosis, immersive experience, digital twinning, and public service. It aims to reveal the similar logics behind the empirical development of both metaverse and library and the iterative construction model

of mutual learning, pursuing a win-win goal through their fusion rather than simple addition.

(2) Common Development Logic Between Metaverse and Libraries

Libraries and the metaverse share a common technology-driven evolution process and exhibit high affinity [5]. Technologically, the metaverse's information technology infrastructure comprises brain-computer interfaces, artificial intelligence, cloud computing, blockchain, and other technologies. Library digitalization requires digital resource storage, analysis, and processing, as well as information resource organization and presentation, with increasing demand for sophisticated technologies like big data computing and cloud computing. Thus, both share numerous technological intersections. In terms of resource utilization, the metaverse's creation of virtual space is based on user information needs, while libraries, as public domains for knowledge service, are more direct channels for obtaining user information needs and habitual knowledge-acquisition venues. This aligns with the metaverse's natural capacity for content supply through front-end devices that migrate across scenarios, where scenario content portals can be various application contexts such as education, entertainment, tourism, and social interaction [6]. Regarding communication purposes, metaverse technology in its early development stage needs to build infrastructure through cultural dissemination, medical construction, and other content to concretely present application scenarios and attract audiences and investors. Libraries, as long-standing professional providers of knowledge services, bear the responsibility of meeting user information needs. However, uniform reading supply scenarios struggle to adapt to users' diverse needs in the new era. Effectively transforming reading behavior forms to adjust libraries' role positioning in the audience's mind represents an efficient pathway for library transformation. The developmental logics demonstrated by both through past evolutionary experiences coincide remarkably. From the metaverse library perspective, technology and knowledge service co-dominate, innovatively bridging social needs and leveraging unique advantages difficult to obtain through independent development.

[Figure 1: see original paper] Logic 梳理 (Logic Mapping) of Metaverse Libraries

(3) Embodied Reading in Metaverse Library Spaces

As a primary domain for knowledge dissemination, optimizing knowledge communication structure and effect has become libraries' natural mission. Reading behavior, as a crucial method of knowledge transmission, becomes the primary innovation target in every library transformation. From traditional reading behaviors in Library 1.0 to Library 2.0 born in 2004, which leveraged digital service platforms like Wikipedia and SNS, libraries called for the evolution of physical reading behaviors into dynamic communicative reading alongside technological waves, realizing the concept and practice of personalized and diversified services. Initially, digital libraries emphasized disembodied reliance on technology. As intelligent technology continuously intervened in knowledge communication, li-

brary reading behaviors began an information society turn. Building upon the long-standing paradigm focusing on spiritual communication in reading and communication, the perspective of media technology made originally virtual and disembodied reading and communication behaviors attend to the body's mapping. Among these, library spaces employing XR (VR/AR/MR) technology innovated reading behaviors, calling for bodily 感知 (perceptual) reading, experiential reading, and a return to reading. As Merleau-Ponty stated, for the perceived world, "my body is the common structure of all objects," "the general instrument of my 'understanding' " [7]. The body serves as a crucial perceptual hub for reading-cognitive behaviors, representing a return to original perceptual experience attributable to phenomenology. Relying on bodily perception, embodied reading experiences form alongside consciousness based on neuronal reflex activities. In other words, the mind depends on the body's physiological and neural structures and activity patterns; embodiment is experientiality [8]. Metaverse technology invites the body to participate in perception and communication, and this bodily call is centrally manifested in library domains through reading scenario creation. The application of somatosensory interaction, eye-tracking, and other technologies in metaverse libraries tends to demonstrate the developmental trend of embodied reading. Analyzing the creative thinking and functional evolution of metaverse libraries regarding embodied reading behaviors holds significant importance.

II. Structural Deconstruction of Embodied Reading in Metaverse Libraries

(1) Wholeness: Interactive Integration Attributes Driving Scenario Service Value Externalization

From a structuralist perspective, wholeness is the pathway to seeking the essence of events. Under wholeness guidance, components within a structure can closely revolve around this essence. As a whole, the metaverse library aims to achieve integration for maximized effect. Compared to traditional paper reading, digital and electronic reading creates spatiotemporally generalized scenarios of anytime, anywhere access, yet has not leveraged the body's subjective advantages. Under embodied reading scenario demands, the interactive attributes of metaverse and libraries constitute their common ground. Merleau-Ponty believed that grasping the depth of things and their development is closely related to the depth possessed by the subject itself. The metaverse's re-presentation of the technologized body through virtual reality, augmented reality, and three-dimensional space immerses digital avatars in knowledge interaction. Virtual and interactive spaces deepen users' conscious cognition of information acquisition, reaching deeper cognitive layers through the body. Integrating the interactive attributes of metaverse and libraries to further contact cognition represents a method for unifying the knowledge and cognitive service values of both. Interactivity is the primary connection and functional channel for embodied reading. For metaverse libraries, interactive characteristics are the externalized features of

the overall structure, using interactive representation to promote the fusion of metaverse technology in library reading content presentation and reading behavior guidance. With interactive form iteration as the means and creating embodied reading with good interactive experience as the goal, it becomes a forcing mechanism for metaverse and libraries to integrate from independent entities into a whole.

(2) Relationality: Virtual-Native Behavior Space Shaping Independent Reading Consciousness

The metaverse library appears to be merely a relational connection between intelligent technology and library physical space. In reality, within the metaverse library's relational network, the creation of presence scenarios for embodied reading is built upon multiple associations among brain, body, and material objects generated by native behaviors and virtual behaviors. Because embodied mental activities include interactive relationships between brain, body, and world [9]. Through technological intervention, metaverse libraries associate traditional library reading behaviors with the body, evolving from Descartes' "cogito, ergo sum" dictum that metaphorically implies a dualistic ontology of body and mind to Merleau-Ponty's "phenomenal body," where reading occurs through the body, perceiving the perceptual responses and knowledge consciousness brought by reading behaviors. Breaking through reliance on technological thinking and escaping the univariate logic of change triggered by technology, we can dissect how technology serves as a clue behind metaverse libraries, triggering the body's evolution as a mediating role. Through bodily perceptual experience, it becomes the hub connecting reading behaviors and reading consciousness. Under metaverse virtual-native creation, virtual characters and reader avatars generate multiple digital doppelgängers, creating interactions between virtual humans and readers, producing synesthetic experiences of touch and smell. Reading experiences and direct conscious reactions triggered by reading are recorded in data storage form, mobilizing bodily senses to participate in reading and reflecting reading through bodily responses. The metaverse library structure's reshaping of the relationship between body and reading, through structural internal subject element evolution thinking governing partial elements, shapes the reading need for bodily return and creates new developmental space for reading scenarios.

[Figure 2: see original paper] Structure of Metaverse Libraries

(3) Subjectivity: Blending of Virtual and Real Dissolves Field Boundaries to Construct New Visions

The metaverse library is a direct case of integrated thinking running through it, presenting the result of the fusion of both logical relationships. The consistent integrated logic reflected in specific library scenarios is the metaverse's virtual-real blending phenomenon, enabling users to achieve cross-spatiotemporal interactive communication between virtual and real through constructing a dual-

role relationship of "physical + virtual," ultimately achieving immersive experience effects [10]. In metaverse library structures, subject elements continuously achieve diverse transformations, with attention to single subjects gradually evolving into generalized subject roles. Traditional reading behaviors' call for bodily senses focused on direct reactions produced by the body in physical space, with concrete spatiotemporality as field boundaries, possessing clear spatiotemporal boundedness. Embodied reading behaviors in metaverse libraries dissolve subjects' clear positioning in traditional spaces, breaking through the shackles of individual physical flesh and making possible the co-phase interaction and common progress of virtual humans and physical humans. Embodied research approaches do not focus on studying direct reactions of human physical flesh; from a structural perspective, the research 重心 (focus) is the sum of various relationships among subjects associated with the human body. This reflects that when metaverse libraries pursue structural balance, the subject associations generated between users' re-interpretation of reading behaviors from consciousness to body follow the value evolution of integrated thinking.

(4) Self-Regulation: Ternary Life Maintenance System Enabling Bodily Spatiotemporal Jump

Any structure possesses a certain degree of self-regulation capability. As a highly compatible independent system, the metaverse library has the capacity to create independent spaces, primarily for reading behavior exchanges between virtual humans and physical humans. Along with the application and proliferation of virtual worlds in library spaces, new reading spatiotemporalities integrating multi-sensory interaction, spatiotemporal jumping, and data interconnection incorporate natural life, virtual life, and machine life that will soon enter the metaverse library field as a trinity system internal structure. Humans enter digital spaces 率先 (first) through certain bodily components, becoming "digital components" of split individuals [11], with senses split into various parts of the body to play direct associative roles with perceptual consciousness. From a structural perspective, the metaverse library system achieves self-regulation through "maintenance" and "shutdown" functions. "Maintenance" refers to preserving the harmonious symbiotic relationship among the three, while "shutdown" means retaining corresponding functions based on reading experience principles when contradictions arise among the three parties. Therefore, for embodied reading, the metaverse library is a self-regulating system based on bodily reading experience blueprints and perceptual consciousness as the core, representing the interactive result of intelligent applications and bodily perception.

(5) Transformation: Digital Twins Following Dynamic Principles Awakening Subject Consciousness

The metaverse represents the next-generation internet social formation, and the metaverse library is a joint product of network technology and social production

needs. The principles of system structure transformation follow the dynamics of change between parts and parts, and parts and whole. The current digital twin stage represents a further deepening of digital libraries, with reading logic shifting from digitalized electronic linear reading logic to a replication logic in virtual space where everything can be copied and everything can be virtualized. The transformation principle is not a static objective existence but is constantly in the process of being structured and structuring. This means that the manifestation of embodied nature is also a dynamic link, with perceptual cognition developing into continuous enhancement of environment, body, and mind, ultimately forming a balanced driving mechanism of "mind-body-environment" [12]. The digital twin stage emphasizes bodily participation, while the virtual-real blending stage emphasizes the contribution of embodied reading. The degree of maintenance of symbiotic states and adaptation to dynamic changes directly affects the structural change logic of the metaverse library system. The current metaverse library structure's mobilization of bodily senses is the starting point, with transforming embodied reading into a common component of the environment as the future development direction. From the metaverse's awakening of bodily perception subjects in reading behaviors to the body becoming a routine element of reading, the metaverse library undoubtedly becomes the driving force and activation button.

III. Dialectical Thinking in Embodied Reading Within Metaverse Libraries

(1) Tracing and Cognition: External Turn of Internal Perceptual Meaning Processing

Reading behavior, based on knowledge input, achieves self-cognition reshaping through text meaning processing. Embodied reading, through reading behaviors performed by the body, produces cognitive behaviors that represent recognition of self-cognition. Because Merleau-Ponty emphasized that the world humans inhabit is nothing but a "world of meaning" [13], where subjects' cognition of the world is formed in pre-perception. The metaverse's virtual avatar images conduct knowledge input through bodily media, representing a reproduction of self-perception. Reading behavior is also a repeated cognitive act based on pre-cognition, representing the self-examination logic of embodied reading. However, the public and knowledge-sharing characteristics of library spaces externalize the meaning processing of knowledge objects. For example, personalized needs and decorations for digital doppelgänger self-images represent the result of multiple cognitions of one's own body, transforming originally internal meaning processing behaviors of paper reading into external transformation. Reading perception behaviors through the body achieve concrete presentation through text analysis and spiritual analysis. The tracing blueprint shifts from the body to multiple superpositions of body and virtual images, plus concrete virtual imaging effects, making embodied reading's utilization of the body increasingly dependent on external tools. For instance, when expressing ancient

poetry, virtualized books release heart-refreshing fragrances. If using embodied reading's internal processing, the fragrance would remain in the brain, but the metaverse library's imaging function externalizes this presentation, making cognition more explicit. This reflects a dialectical logic where part of embodied reading's original dependence on physical bodily senses migrates to digital technology.

(2) Connection and Disconnection: Holographic Situation Presence Generalizing Bodily Perception

The operational foundation of smart libraries is the rational utilization and automated operation of data resources. The metaverse library represents an advanced model of smart libraries. Data constitutes the basic element enabling metaverse library operation and the foundation for interconnecting body and virtuality. In the Library 2.0 era, data powered the efficient operation of mobile library service systems. In the metaverse environment, mobile library information resource data, user personal information data, and user-mobile library interaction data will grow exponentially [14]. If controlling data poses risks of excessive connection, the holographic environment's comprehensive use of the body in metaverse reading scenarios represents even more obvious total data manipulation, recording eye dwell time, pupil dilation conditions, hand gestures, and facial muscle

[Figure 3: see original paper] Operational Rules of Embodied Reading in Metaverse Libraries

analysis during reading to achieve mastery of individual reading preferences through bodily attributes. Holographic situation settings associate perceptual-cognitive behaviors of bodily consciousness. Multiple bodily data connections represent rational resource utilization while emphasizing bodily presence phenomena. The subconscious language expressed by the body becomes deep value that metaverse libraries can mine, with subconscious reading needs better capturing users' reading interest points. The metaverse library's repeated collection, utilization, and processing of bodily perception can construct complete user knowledge-cognition maps. However, before technological convenience, the involved ubiquitous information collection rights may become taken for granted.

(3) Immersion and Detachment: Dual Overlay of Holistic Intention and Implicit Cognition

Embodied learning theory originates from reading's embodied simulation mechanism. Cognitive scientists propose the Conceptual Metaphor Theory (CMT), which states that through conceptual metaphor mechanisms, subjects can experientially represent and process abstract concepts using perceptual-motor experience [15]. Immersive scenarios represent metaverse libraries' transformation of traditional library reading scenes, shifting from textual metaphor to perceptual-motor metaphor. Elements presented in metaverse scenes—concepts, words,

images, sounds—form memory cognition, with brain surfaces conducting conditioned reflex behaviors through memory via bodily mediation. As Merleau-Ponty stated: "Whether concerning a perceived thing or a historical event that has occurred, when we choose to 'understand,' it is to re-grasp the holistic intention" [16]. Reading's premise is also "understanding." In immersion, the primary object obtained through reading is the holistic intention of things in metaverse scenes. However, reading possesses strong differentiation, with interpretation and presentation of holistic intention composed of bodily conditions, current perception, consciousness constitution, and other aspects. In library spaces, while the metaverse externalizes the body, it simultaneously constructs the "deep thinking" hidden behind the body through virtual images. The externalization of implicit cognition crowns reading behavior with new meaning.

(4) Public and Private: Ideological Enhancement Across Full Domain Spatiotemporal Evolution

The metaverse library platform functional framework consists of four layers: user layer, algorithm layer, data network layer, and physical layer [17], with ascending layers expressing evolution from individual to public space. Traditional libraries, based on the publicity of the overall environment, emphasize creating uniqueness in personal space. From embodied reading's acquisition tendency, when individuals acquire knowledge in metaverse libraries, public immersion brings holistic intention, while personalized processing of intentional meanings combined with bodily sensory transformations aligns with individual roles' implicit cognitive patterns. During the public extension process in metaverse libraries, immersion's cultivation of user thinking transfers to other public domains, with personalized special experiences achieving a privatization turn of publicness. Ideologism—the privatization of public domains implanted in thinking—represents metaverse libraries' value assignment to reading behavior. The openness, publicity, and public welfare of library domains grant ideologism stronger extension effects from formation to development. Metaverse libraries elevate the personalization threshold for original library spaces, plus the mobility of metaverse spaces, effecting another spatiotemporal transformation of library spaces. Reading spaces presented with scenarios undergo privatization conversion through the body, relying on common elements in the body to achieve library spatiotemporal transformation through metaverse scene recognition and reconstruction technology.

(5) Representation and Vacuum: Bidirectional Parallelism of Suspending Experience and Simulacra Objectivity

Through mirror twinning technology, metaverse libraries can achieve virtual broadcasting explanations of books and interactive displays of virtual bookshelves. Heterospace regeneration technology can record reader footprints, reading bills, and activity logs. This represents a comprehensive representation of library reading behaviors. People's free activity spaces in the metaverse

achieve life representation through virtual technology. However, unlike daily behaviors in ordinary life, reading behaviors—especially in library domains—possess strong scenario-dependent attributes. Reading memory associates with spatiotemporal memory, with reading phenomena representing side memory selection of comprehensive events. Although only seeing one side of an object, one can still recognize it as a complete object. As Husserl stated: "I first perceive through others' gestures that this is a physical body. I also know that within my body there is a soul. Therefore, although I do not see others' souls, my 'appresentation' ability ensures that I recognize this physical body is simultaneously also a lived body" [18]. Fragmented memory pieces in library scenes are jointly added to the understanding memory of read texts, such as lighting brightness in the library during reading, seat positions, current crowd numbers, and location in the library, jointly constituting reading behavior memory images. However, metaverse libraries' re-virtualized scenarios, where digital doppelgängers experience historical events in mirror twins, may fall into the digital Narcissus effect due to excessive focus on the doppelgänger, unable to distinguish between digital illusion and real society [19]. This represents both multiple representations of simulacra and objective reality, and a phenomenological vacuum.

IV. Functional Reconstruction of Embodied Reading in Metaverse Libraries

(1) Reading Cognitive View: Multi-dimensional Construction Orientations of Consciousness Viewpoints

From a cognitive perspective, the meaning of reading behavior must be reconceptualized with metaverse technology intervention. The metaverse library is an information aggregation space collecting users' multiple reading behaviors. Whether from the metaverse's technological viewpoint or the library's information integration perspective, the formation process of embodied reading cognition is significantly impacted. Based on brain imaging research, Gallese proposed a theoretical framework combining the mirror neuron system with phenomenology—"Embodied Simulation" [20]. Body manipulation and imagined manipulation belong to the same control system in traditional reading behavior. However, after concrete expression of reading materials, body and emotion are no longer subject to single manipulation but imitate the emotions simulated in metaverse scenes. At this point, reading intention reference possesses stronger specificity, and individual processing principles of reading behavior become more explicit. In metaverse libraries, by seeing actions of subjects within reading materials and perceiving their emotions, 联动 (linkage) is generated with self-body representations, with stronger emotional mobilization effects. Deep-level content of reading becomes relatively 浅显化 (simplified) by imaging technology. Cognition of reading behavior and re-cognition of self-image through reading behavior are affected by simplified metaverse reading, weakening boundaries that previously distinguished readers by book types, with minimal differences between past imagined cognition and real cognition. Although technology does

not directly integrate into reading behavior, the metaverse possesses stronger explanatory power over reading behavior occurrence and development in text interpretation.

(2) Reading Fusion: Multi-dimensional Presentation Methods of Ubiquitous Spiritual Realm

If traditional reading represents a method of exploring the spiritual world through material action, embodied reading under metaverse libraries can be termed knowledge interpretation behavior exploring the virtual symbiotic world through the spiritualization of material presentation. In embodied reading, mirror neuron analysis plays a significant role and provides reliable scientific evidence for the relationship between thinking and embodiment. Thinking is constituted by simulations of internal representations of real-world events, bodily states, and actions. Embodied simulation through mirror neuron mechanisms combines perception and action, understanding, judgment, and other cognitive processes with the bodily sensorimotor system [21]. Reading erects a meta-space in the virtual world, presenting reading content through simulation. Data at every spatiotemporal point brings density enhancement, extending infinitely from physical to virtual space. This presents new challenges and opportunities for metaverse library professionals. Traditional library professionals undertake knowledge service and resource management, while metaverse library professionals need to participate in the creation and performance processes of metaverse reading materials, standardizing and managing the intelligent spatiotemporality of library spaces. Based on fundamental interpretation of reading materials, they must integrate concrete presentation with 立体音效 (stereophonic sound), visual changes, and other effects.

(3) Reading Sociality: Multiple Social Attributes Feeding Back to Physical Entities

As metaverse libraries incorporate multiple attributes of library subjects, reading behavior in traditional libraries is not only an individual behavior but also a collective behavior highly dependent on context. Especially in embodied reading, reading behavior possesses strong relevance to bodily cognition. According to cognitive flexibility theory, individuals with cognitive flexibility can construct learning knowledge from multiple angles in digital existence, select appropriate learning solutions based on context, flexibly adapt to environments, and possess high self-efficacy regarding change [22]. Rational utilization of metaverse technology to select metaverse reading scenarios with high 适配度 (compatibility) in libraries will be a key factor determining reading efficiency. For physical bodies, whether reading behaviors in metaverse libraries can 发挥 (exert) sociality like traditional libraries significantly impacts users' self-cognition. If examining reading based on multiple interactions among diverse individuals, technologies like RFID can precisely identify readers' facial expressions, dynamic footprints, and wireless frequency-based movement patterns, saving readers' dynamic foot-

prints and facial dynamic information to functional databases. In virtual bionic technology, utilizing collected reader facial information and body language 挖掘 (excavates) the social attributes of reading behavior, generating bionic interactions between physical bodies and virtual humans, and 挖掘 (excavating) the social attributes of metaverse library reading behaviors.

(4) Reading Ritual View: Multi-directional Value Pursuit of Virtual-Real Evolution

The infinite extension of metaverse virtual space represents the current stage's re-utilization of space. Through virtual-to-real transformation, metaverse libraries unfold life curves developing toward reality based on initial virtual space continuation. Virtual-real symbiosis and harmony are common pursuit goals. However, when users obtain satisfaction and experience with digital identity in the virtual-real integrated meta-space, they will crave obtaining digital identity feelings when returning to real life. Psychologically, users hope to achieve effects identical to real space, generating psychological dependence on digital identity 认同 (identification) in virtual reality spaces [23]. In virtual-real evolution, reading behavior's dependence on virtual scenarios and bodily experiences returns to actual life scenarios, unfolding a pursuit of reading rituals. For instance, metaverse libraries highly 还原 (restore) real ancient books and historical artifacts to create cultural spaces. Through operating handles, bodies can genuinely feel and touch cultural relics. Metaverse technology's virtual bionic technology makes reading behaviors for special books 仿佛 (as if) creating presence rituals. Extending embodied reading thinking to the value regeneration of cultural products represents a pursuit of rituals and "virtual objectivity."

(5) Reading Industry Chain: Multi-lateral Economic Value Addition Through System Extension

Chen Wei, Chairman of Shenzhen Taikuli Computer System Co., Ltd., believes the metaverse is a complete, self-consistent economic system—a full chain of pure digital product production and consumption. The advancement of metaverse libraries also follows the developmental logic of a complete industry chain. Jon Radoff proposes that the metaverse consists of seven layers: experience, discovery, creator economy, spatial computing, decentralization, human-computer interaction, and infrastructure [24]. Users can obtain direct creative inspiration from embodied reading behaviors, transforming from subconscious to conscious, with created digital products undergoing 竞价排行 (bidding ranking) in virtual space and converting into NFT products, achieving 全民化 (universal) content production from reading to creation. Of course, obtaining benefits from the metaverse world through reading must fully utilize the public attributes of library spaces. For example, public welfare allows metaverse libraries to use digital fiat currency, maintaining only application-layer decentralization while still accepting central bank regulation. This achieves the goal of constructing digital assets, introducing virtual digital economy, while remaining associated

with real economic systems and social governance structures, maintaining consistency between virtual and real worlds in economic logic and social behavior [25]. From a reading perspective, creating metaverse products centered on reading and feeding back into metaverse world knowledge communication behaviors assists the high integration of metaverse and real life, achieving virtual-real symbiosis across the full metaverse library industry chain.

In this era of rapid metaverse technology development, metaverse technology intervention has clearly become the mainstream trend for knowledge communication. The full application of metaverse technology in library domains helps cultivate readers' matching reading thinking within intelligent technology. The changes and challenges that metaverse brings to traditional reading behaviors can be initially attempted, addressed, and cultivated in the public domain of libraries—a risk-controllable and feasible method. Metaverse libraries remain in theoretical construction and preliminary exploration stages. Seeking common ground behind both developmental logics rather than using metaverse technology as a single tool for developing smart libraries represents a necessary thinking approach for metaverse libraries. Based on the full integration of development needs and existing technologies, cultivating embodied reading also presents significant challenges. Transforming traditional reading methods and escaping disembodied reading thinking represents a call for bodily return and a 呼唤 (call) for reading behaviors to produce dual physiological and psychological effects. Metaverse libraries represent the future development direction of the library industry, but the premise is enabling metaverse and libraries to 融合 (fuse) rather than simply add together. Discussing developmental paths based on developmental logic is a necessary path for research.

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Note: Figure translations are in progress. See original paper for figures.