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Article

Research on Memory Transmission of Virtual Human and Human Cognitive Reconstruction in Post-human Context

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Abstract: This paper focuses on the memory transmission phenomenon of virtual humans in a post-human context and its profound influence on human cognition. As digital entities become increasingly integrated into daily life, the boundaries between biological memory and artificial data storage are blurring. Through the comprehensive application of literature research and case analysis, this paper systematically explains the relevant theories of post-humanism, virtual humans, memory communication, and human cognition. Additionally, this paper presents a comprehensive analysis of the memory construction, storage, and communication mechanisms of virtual humans, detailing how artificial intelligence algorithms facilitate the emulation of human-like recall and experiential sharing. It discusses the reconstruction effects these mechanisms cause in cognitive, self-cognition, and social cognition modes, particularly how individuals perceive their own identities and interact within digital ecosystems. Furthermore, it analyzes the ethical dilemmas and social and cultural challenges arising from this technological shift, proposing corresponding strategies to ensure responsible innovation and harmonious societal adaptation. The research indicates that the memory communication of virtual humans is fundamentally reshaping the cognitive system of human beings. Consequently, this necessitates proactive coordination among technology developers, educational institutions, and policy makers to achieve a sustainable balance between rapid technological development and the healthy, ethical development of human cognition.

Keywords: post-humanism; virtual humans; memory transmission; human cognition; technology ethics

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1. Introduction

With the continuous breakthroughs and deep integration of advanced technologies such as artificial intelligence, big data, and virtual reality, human society is undergoing transformative changes and gradually entering a new era characterized by the profound interconnection between technology and humanity. Technology has evolved beyond being merely a tool for humans to modify their environment; it now plays a pivotal role in redefining human existence, cognitive frameworks, and societal structures. Brain-computer interface technology facilitates direct interaction between human thought and machines, while advancements in gene editing challenge traditional notions of life itself [1, 2]. The rapid development of virtual humans has introduced innovative possibilities in the realm of information exchange and interaction, marking a significant milestone in technological evolution.

Virtual humans have progressed from basic two-dimensional animated images to sophisticated three-dimensional entities with highly anthropomorphic appearances and intelligent interaction capabilities. Their applications have expanded beyond virtual idol performances in entertainment to encompass diverse fields such as education, healthcare,

public services, and finance. In education, virtual teachers can tailor personalized teaching content and programs based on students' learning progress and individual characteristics, thereby enhancing the dissemination of knowledge and improving retention. In healthcare, virtual digital entities can simulate patient cases, assist in surgical rehearsals, and facilitate medical training, contributing to the advancement and innovation of medical expertise. In public services, virtual digital assistants provide round-the-clock online consultation services, ensuring efficient communication of policies and information. These virtual entities, with their unique technological advantages, have emerged as novel mediums for information exchange, continuously enhancing the speed, scope, and depth of communication [3, 4].

The transmission of information by virtual humans is not merely a straightforward process of copying and sharing data; it involves intricate technical mechanisms and carries significant social and cultural implications. Unlike human communication, which is rooted in biological memory and experiential learning, the memory construction of virtual humans relies on extensive data collection and algorithmic training. Their communication processes exhibit characteristics such as immediacy, temporal flexibility, and high controllability [5]. As these technologically generated memory contents increasingly permeate human cognitive domains, they are poised to influence existing cognitive frameworks, self-perception, and societal understanding. From a cognitive perspective, the fragmented and multifaceted presentation of information by virtual humans may challenge traditional linear thinking patterns. On an individual level, the idealized images and distinct personalities crafted for virtual entities may prompt humans to reassess their own identities. At the societal level, the values and cultural narratives conveyed by virtual humans are subtly reshaping public discourse and influencing patterns of cultural exchange.

Nevertheless, several pressing issues must be addressed in the development and application of virtual human technology, particularly concerning its impact on human cognition. Concerns related to data privacy, the potential for misinformation through the spread of inaccurate memories, and the challenges posed by differing cognitive interpretations among various groups require careful consideration. Addressing these issues is essential not only for advancing academic inquiry but also for enriching the theoretical frameworks of post-human studies, memory communication, and cognitive science. Such exploration enables a deeper understanding of the mechanisms underlying virtual human memory transmission and its influence on human cognitive evolution, while also informing strategies to mitigate associated risks. Furthermore, these efforts hold practical significance by guiding the responsible development of virtual human technologies, fostering positive advancements in human cognition, and promoting a balanced and harmonious integration of technology with human life.

2. The Core Concepts and Theoretical Basis

2.1. Posthuman and Virtual Human

Posthuman is a multifaceted concept that integrates technology, philosophy, and social culture. It refers to a transformative state in which human existence undergoes profound changes due to the pervasive influence of technology. In this scenario, the distinction between humans and technology becomes increasingly indistinct, challenging traditional human-centered perspectives [6]. For instance, advancements in brain-computer interface technology enable direct connections between human brain signals and computer systems, making the concept of "man-machine integration" a tangible reality rather than a speculative idea. Similarly, gene editing technologies empower humanity to modify the genetic code of life, redefining the essence and boundaries of biological existence. The convergence of technology and humanity has led to the emergence of novel social structures, cultural paradigms, and value systems. These developments underscore the transformative potential of technology in reshaping human identity and societal norms.

A virtual human, as a representative creation within the posthuman framework, is a digital entity constructed using computer graphics, artificial intelligence algorithms, speech synthesis, and related technologies. Based on their functions and applications, virtual humans can be categorized into entertainment, service, and functional digital entities. Entertainment-focused virtual humans, such as virtual idols, engage audiences through performances, offering unique cultural and interactive experiences. Service-oriented virtual humans, like intelligent customer service agents in banking, assist users by providing consultation and transaction support. Functional virtual humans are utilized in fields such as film production and educational training, where they perform specialized tasks. With advancements in technologies like deep learning and Generative Adversarial Networks, the realism and personification of virtual humans have significantly improved. These entities can now engage in intelligent interactions through natural language processing, gradually evolving into autonomous participants in digital communication and interaction.

2.2. Memory Transmission and Human Cognitive Theory

Memory transmission plays a vital role in the preservation of cultural heritage and the exchange of knowledge within human society. It involves the process by which individuals or groups convey memory content to others through various means such as language, symbols, media, and other tools. Traditional theories emphasize that memory is not merely an individual activity but is shaped and constructed through interactions within social groups. With advancements in digital technology, the characteristics of memory communication have undergone significant changes. Digital storage technologies now allow memory to be preserved for extended periods and accessed with remarkable speed, while social media platforms have removed traditional barriers of time and space in memory sharing. Furthermore, technologies such as algorithmic recommendations and big data analysis have enabled the precise alignment of memory content with user preferences, facilitating personalized sharing. For instance, algorithms analyze user activity on digital platforms and suggest content aligned with their interests, which can lead to a narrowing of exposure to diverse perspectives. This phenomenon underscores the importance of understanding how digital tools influence the dynamics of memory transmission in contemporary society.

The development of human cognition is a multifaceted psychological process, and cognitive psychology provides a valuable framework for understanding this complexity. The information processing theory likens human cognition to the functioning of a computer system, suggesting that individuals acquire external information through sensory perception and process it through stages such as attention, encoding, storage, and retrieval to form an understanding of the world. In the digital era, the vast influx of information, particularly from virtual sources, has significantly influenced the way humans process and manage information [7]. Virtual digital entities, with their engaging visual representations and interactive capabilities, can effectively capture human attention. However, this heightened engagement may contribute to information overload, potentially impacting the depth and accuracy of cognitive processing. Additionally, social and cultural factors play a crucial role in shaping cognitive development. The values and cultural narratives embedded within digital interactions subtly influence the cognitive structures and social identities of emerging generations. Figure 1 provides a visual representation of human cognition within a dual-process framework, illustrating the interplay between these factors.

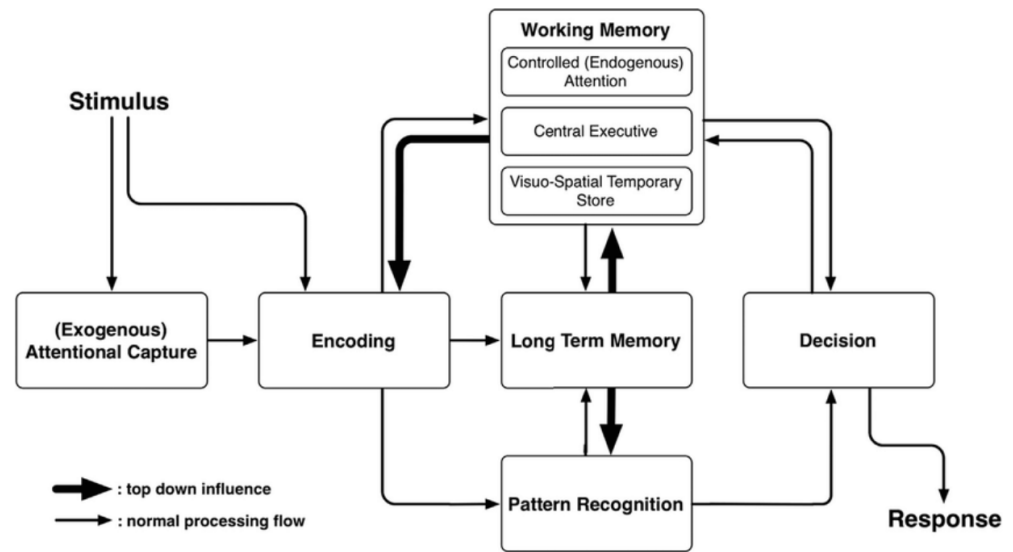


Figure 1. Human Cognition Based on a Dual-Process Framework

3. The Memory Transmission Mechanism of Virtual Human

3.1. Memory Construction and Storage

The construction of memory in virtual humans involves a multifaceted process that integrates data collection, cleaning, and algorithmic training. During the data collection phase, virtual digital entities gather information from diverse sources, such as publicly available texts, multimedia content, and user interaction data. For instance, intelligent virtual customer service systems derive their data from industry-specific knowledge bases, historical user consultation records, and updates to operational guidelines, which serve as foundational materials for memory development. In the subsequent data cleaning and preprocessing stage, algorithms are employed to filter out irrelevant information, consolidate redundant data, and convert raw data into structured formats suitable for further processing. This ensures that the memory construction process is both efficient and accurate.

Machine learning algorithms are pivotal in the development of virtual human memory systems. Natural language processing (NLP) technologies enable the analysis of textual semantics and the comprehension of logical relationships within information. Knowledge mapping techniques further enhance this process by organizing fragmented data into coherent knowledge systems, creating networks of interconnected entities and relationships. For example, a virtual education assistant may utilize knowledge mapping to link mathematical formulas and physical laws with practical examples and application scenarios, thereby constructing a systematic and functional memory structure. Additionally, deep neural networks (DNNs) simulate human learning processes by training multi-layered neural models, continuously refining the precision and adaptability of the memory content to meet diverse operational requirements [8].

Memory storage in virtual humans combines distributed storage systems with cloud computing technologies to ensure data security, accessibility, and operational efficiency. Distributed storage disperses memory data across multiple server nodes, mitigating risks associated with single-point failures and enhancing data reliability [9]. Cloud computing provides robust computational resources and supports virtual environments, enabling rapid access to memory content across various scenarios. For instance, a virtual idol operation platform requires a storage system capable of managing diverse data types, including image files, musical compositions, and personalized memory content generated during fan interactions. By employing an optimized storage architecture, these systems achieve millisecond-level data retrieval and synchronization across multiple devices, ensuring seamless user experiences and operational continuity.

3.2. Ways and Characteristics of Memory Transmission

Social media platforms have become pivotal in enabling virtual human memory communication. Virtual digital personas engage with users frequently by sharing diverse content formats, such as images, text, videos, and live broadcasts. For instance, virtual idols host online concerts on interactive platforms, gathering feedback from fans through real-time interactions and incorporating their emotional experiences into future content creation. Virtual anchors disseminate trending information on short video platforms, leveraging algorithm-driven recommendations to amplify the spread of memory-related content. This approach transcends the limitations of traditional media's one-way communication model. Users are transformed from passive recipients into active participants in memory exchange through commenting, sharing, and creative reinterpretation, thereby fostering a decentralized communication network that enhances the dynamism of memory transmission.

Virtual Reality (VR) and Augmented Reality (AR) technologies offer immersive environments that significantly enhance the communication of virtual human memories. In educational VR scenarios, students experience historical events as though they are physically present, with virtual narrators recounting these events from a first-person perspective, thereby deepening engagement and comprehension. Similarly, AR applications in marketing allow consumers to scan product QR codes with their mobile devices, activating virtual guides that provide detailed information about product features and usage contexts. This integration of virtual and real elements, coupled with multisensory stimulation, improves the effectiveness of memory communication by fostering a more profound understanding and retention of shared content. Such advancements highlight the transformative potential of these technologies in bridging the gap between virtual experiences and real-world applications.

The communication of memories by virtual humans exhibits several distinctive characteristics. Instantaneity is demonstrated through their ability to respond promptly to user inquiries, such as virtual customer service retrieving relevant information from memory databases in real time. Interaction is achieved through intelligent dialogues and emotion recognition, enabling virtual companion robots to adapt their memory-sharing strategies based on users' emotional states. Additionally, the cross-temporal nature of virtual humans allows them to overcome geographical and temporal barriers, enabling simultaneous sharing of cultural and historical content with global audiences. For example, virtual museum narrators can present cultural relics to users worldwide, with the content accessible for replay at any time. These attributes collectively enhance the efficiency and scope of memory communication, positioning virtual humans as innovative contributors to the evolving landscape of post-human interaction.

4. The Impact and Challenges on Human Cognitive Reconstruction

4.1. Cognitive Model and Self-Cognitive Remodeling

The communication of virtual human memory facilitates a significant transformation in human cognitive models, shifting from a predominantly linear approach to a more dynamic and nonlinear framework. Traditionally, the process of acquiring and understanding information has adhered to a sequential, step-by-step logic. However, the advent of virtual humans introduces a paradigm where information can be processed in a more adaptable and interactive manner. Through diverse content presentation and interactive methods, virtual humans enable users to engage with information in ways that transcend the constraints of traditional linear learning [10–12]. For instance, in knowledge dissemination scenarios involving virtual entities, users are empowered to explore topics of interest by selecting interactive elements such as links and buttons, thereby personalizing their learning experience and fostering a more holistic understanding. Furthermore, the emergence of virtual humans has profound implications for self-awareness and identity. Their presence encourages individuals to reflect on their own sense of self, as seen in the case of virtual idol enthusiasts who often integrate their

admiration for these entities into their social identity and personal values. Additionally, the superhuman attributes of virtual humans prompt deeper contemplation about the interplay between physical embodiment and consciousness, inspiring discussions on the potential evolution of human existence through technological augmentation.

4.2. Social Cognitive Changes and Ethical Dilemmas

The evolution of virtual human social cognition is evident in various aspects of interpersonal relationships, social culture, and broader social interactions [13, 14]. Within the realm of interpersonal relationships, virtual entities have emerged as new social participants, influencing how individuals perceive and engage in communication. For instance, users who become accustomed to the immediate and accommodating interactions provided by virtual entities may find it challenging to navigate the nuanced and multifaceted nature of real-world social exchanges. From a cultural perspective, the values and content disseminated by virtual entities are reshaping traditional cultural frameworks. The rise of trend-driven and network-based subcultures promoted by virtual entities has garnered significant attention from younger demographics, thereby altering patterns of cultural dissemination and audience preferences. However, this transformative process introduces several ethical considerations. Issues related to privacy and data security are particularly pressing, as personal information collected during interactions with virtual entities is susceptible to unauthorized access or misuse. Additionally, the propagation of inaccurate or fabricated memories through virtual interactions has the potential to misinform public understanding and compromise the impartiality of collective opinion. Furthermore, variations in the perception of virtual entities across different age groups and cultural contexts may result in generational and cultural divergences, necessitating careful consideration to foster mutual understanding and cohesion in an increasingly digital society.

4.3. Coping Strategies

To address the challenges associated with the memory communication of virtual entities, a multidimensional approach encompassing technology, education, and governance is essential. From a technological perspective, advancing the development of robust data protection mechanisms and privacy-preserving technologies is critical [15, 16]. This includes implementing stringent systems to audit and manage virtual memory data, thereby minimizing the risk of disseminating inaccurate or misleading information. In the educational domain, integrating digital literacy programs into formal curricula is recommended to enhance the public's ability to critically evaluate and differentiate between virtual and real memory content. Such initiatives can foster critical thinking and informed decision-making. Regarding governance, it is imperative to establish comprehensive frameworks for managing virtual entities. These frameworks should clearly define the responsibilities and obligations of operators, regulate memory-related activities, safeguard user rights, and ensure the sustainable and ethical growth of the virtual entity industry. Collectively, these strategies aim to promote a balanced and secure integration of virtual technologies into society.

5. Conclusion

This study systematically examines the mechanism of memory transmission by virtual humans in a post-human context and its implications for the reconstruction of human cognition. The analysis indicates that virtual humans can build and disseminate highly efficient memory systems through the coordinated use of data acquisition, machine learning, cloud computing, and related digital infrastructures. Owing to their immediacy, interactivity, persistence, and cross-temporal reach, these systems are substantially reshaping how information is received, stored, interpreted, and circulated. At the cognitive level, virtual humans facilitate a shift from predominantly linear reasoning toward more nonlinear, associative, and discontinuous modes of thought, thereby prompting renewed reflection on the relationships among self-identity, embodiment, memory, and consciousness. At the social level, they are also reconfiguring patterns of

interpersonal cognition, symbolic exchange, and cultural communication across diverse media environments. At the same time, the advancement of these technologies introduces significant challenges that require careful evaluation. Privacy and security vulnerabilities may result in the exposure of personal information, while false memories amplified by algorithmic bias may distort public understanding and weaken trust in digital content. In addition, intergenerational and cultural differences may intensify divergence in social perceptions, communicative expectations, and value interpretation, thereby increasing the complexity of social coordination in digitally mediated environments.

Although this study proposes response strategies involving technological optimization, educational guidance, and policy supervision through a multidimensional analytical framework, virtual human technology is developing rapidly, and many aspects of the relationship between its memory and communication capacities and human cognition remain insufficiently understood. Future developments, especially with the deeper integration of generative artificial intelligence, may enable virtual humans to display more advanced emotional interaction, adaptive feedback, contextual understanding, and autonomous learning capabilities. As a result, their memory transmission functions may extend beyond conscious information processing and exert a more profound influence on implicit cognition, affective response, and long-term interpretive habits. Subsequent research may therefore focus on how emerging technologies reshape the ethical boundaries of virtual human memory communication, how new models of human-computer collaborative cognition can be established, and how individuals can preserve cognitive subjectivity, reflective judgment, and psychological autonomy amid accelerating technological change. Interdisciplinary inquiry will be especially important for clarifying the long-term cultural, philosophical, and communicative consequences of virtual human systems. Through sustained theoretical refinement and practical exploration, it may become possible to promote a more balanced relationship between technological innovation and the human spiritual world, thereby supporting a form of development in which digital advancement and human-centered values remain mutually compatible and constructively aligned.

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