



Embodied Interaction Research on Traditional Chinese Health-Preservation Exercises in Extended Reality

Haijie Kong 

College of Arts and Media, Tongji University, Shanghai, China

812169480@qq.com

Abstract. The inheritance and development of traditional Chinese health-preservation exercises, as a significant initiative to promote the national well-being, necessitate the mutual penetration of various academic disciplines, thereby presenting opportunities for research in health-preservation exercises empowered by extended reality technologies. To grasp the developmental pathways of embodied interaction research concerning traditional Chinese health-preservation exercises in extended reality, this paper first delineates the current research on traditional Chinese health-preservation exercises. Subsequently, from the perspective of embodied cognition, the paper discusses the interactive mechanisms between physical exercises and mental activities across three dimensions—cognition, emotion, and social interaction—drawing from the shared notion of embodiment inherent in traditional Chinese health-preservation culture. Furthermore, through analyzing the embodied characteristic of extended reality, embodied interactive experiences and applications, the paper elucidates, resonates with, and deepens the understanding of the concept and value of "the unity of body and mind." Finally, this paper summarizes the findings and future directions, aiming to foster advancement in this field.

Keywords: Traditional Chinese Culture, Health-Preservation Exercises, Embodied Cognition, Interaction Design, Extended Reality.

1 Introduction

Traditional Chinese health-preservation practices, crucial for national well-being, are gaining scholarly attention. Advancing this research requires integrating disciplines like medicine, sports science, psychology, and cognitive neuroscience, leading to a comprehensive theoretical framework. This framework aims to enhance our understanding of how these practices promote holistic physical and mental well-being and to explore new research avenues through extended reality technologies. (see Fig. 1).

This paper begins with a systematic review of literature on the integration of medicine and sports science, examining the origins of this concept and the cultural essence of traditional Chinese exercises, highlighting their benefits for physical and mental health. It then explores embodied cognition within this culture, focusing on the connections between physical exercise and cognitive activities across cognition, emotion, and

social interaction. By analyzing embodiment and interactive experiences in extended reality, the paper enriches the "unity of body and mind" philosophy and its cultural significance. Finally, the paper summarizes findings and future directions in the fields. Ultimately, the goal is to foster the innovative development of traditional Chinese health preservation, contributing to global health initiatives.

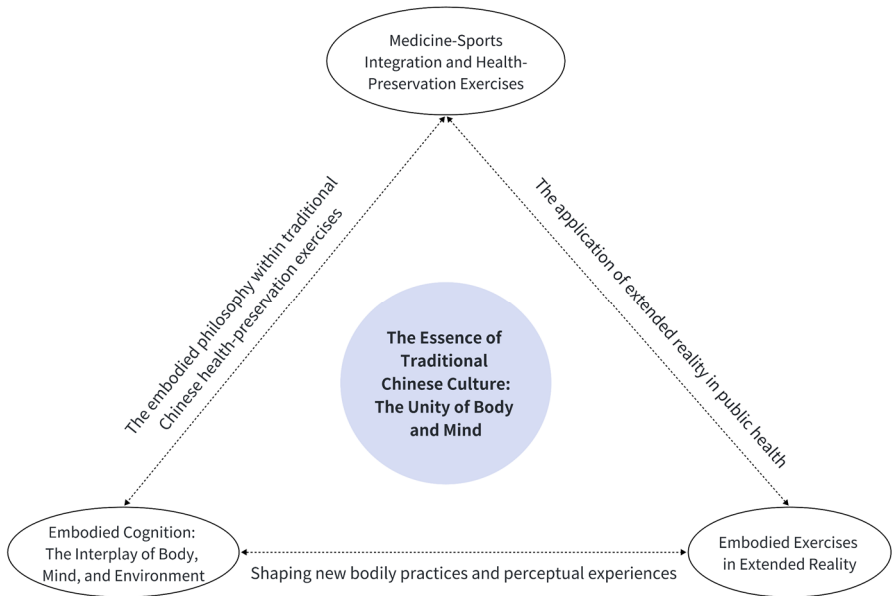


Fig. 1. Framework Diagram for Research

2 Traditional Chinese Health-Preservation Exercises in the Context of Integrating Medicine and Sports Science

The "integration of medicine and sports science" is a multidisciplinary approach that combines sports medicine, health sports, rehabilitation, health assessment, and exercise prescription, advocating for the mutual supplementation and enhancement of sports and medicine.[1] Recognizing exercises as essential for a healthy lifestyle has emerged as one of the primary objectives of this integration. This section will explore traditional Chinese wellness exercises, highlighting their role in merging medicine and physical activity, promoting cultural heritage, and enhancement of physical and mental wellness.

2.1 The Cultural Connotations of Traditional Chinese Health-Preservation Exercises

The "Knowledge-Belief-Action" theory posits that changing health behaviors involves three key elements: knowledge, belief, and action, which are interrelated.[2] In health-

preservation culture, awareness and belief in health knowledge drive practices. To engage the public in traditional Chinese health exercises, it is essential for them to understand and believe in the cultural significance of these practices. This theory underpins the promotion and application of traditional Chinese health culture today, aiding in the transmission and innovation of health knowledge and behavior transformation.

Historically, the ancient Chinese sought to align with the universe's natural order through the philosophy of "the unity of man and nature," to enhance well-being and prevent illness. Traditional Chinese exercises, influenced by cultural tenets, draw from Daoist alchemy, seasonal principles, and theories like Tai Chi, the Five Elements and the Eight Trigrams.[3] These exercises integrate Daoism's calmness, Buddhism's mind-body balance, and Confucian social practices, highlighting inner and outer cultivation, unity of form and spirit, and the integration of movement and stillness. Tai Chi, for example, views the individual holistically, focusing on abdominal harmony through coordinated movements. It emphasizes "the unity of body and spirit", "harmony between man and nature", and the principles of guiding the mind with intention, directing the body with the mind, and moving the body with breath, striving to achieve a high degree of unity in mind, intention, strength, breath, and body. Through these exercises, individuals strengthen their bodies while nurturing their spirits. The culture of traditional sports extends beyond promoting physical and mental health, gaining international interest and appreciation and allowing traditional practices to gain global recognition and influence.

2.2 The Benefits of Traditional Chinese Health-Preservation Exercises

Traditional Chinese health-preservation exercises are widely acknowledged for their multifaceted benefits, including cognitive enhancement, emotional regulation, and physiological improvement.

Cognitive Enhancement. Traditional Chinese health-preservation exercises have been demonstrated to enhance the activation of the prefrontal cortex, mobilize a greater number of neurons and synchronize cognitive processing resources for heightened excitation to positively influence executive function, memory capabilities, visuospatial orientation and analogical reasoning, warranting their promotion in clinical settings. [4-6] Regarding the specific mechanisms, health-preservation exercises integrate the heart, mind, strength, energy, and body, requiring practitioners to continuously adjust their movements' direction, amplitude, intensity, and velocity. This ongoing calibration involves memory training and higher cognitive processes vital for postural stability, including perceptual visuospatial skills, attentional shifting, multitasking, and planning. [7] While basic aerobic activities like walking or cycling are beneficial, they often rely on monotonous, automated cognition that lacks focused attention. In contrast, traditional Chinese exercises like Tai Chi require full attention to movement details, enhancing related brain regions and stimulating neuronal excitability.

Emotional Regulation. Traditional health-preservation exercises emphasize the interconnectedness of body and spirit, rooted in ancient Chinese fitness and medicine. They focus on simultaneous maintenance of physical and mental health, utilizing tech-

niques like relaxation and meditation to promote harmony and alleviate symptoms. Research has shown these practices improve emotional regulation by enhancing cognitive functions.[8] For example, Tai Chi's movement memory training boosts working memory, aiding emotional control. [9] Additionally, group learning in these practices fosters social interaction, reduces stress, and further enhances cognitive abilities.

Physiological Improvement. Traditional Chinese health-preservation exercises improve physiological functions like fall prevention, balance, and cardiopulmonary health. These exercises focus on "preventive treatment" to maintain health by regulating vital energy and blood flow. Long-term practice enhances immunity, metabolism, and reduces illness risk. Both Tai Chi and Baduanjin improve connectivity in the frontal-parietal brain network, increase cortical thickness, and elevate plasma BDNF levels. [7] Their gentle movements are suitable for all ages, promoting circulatory health, flexibility, and agility, while also aiding in chronic condition management and symptom relief.

In conclusion, traditional health-preservation sports play a positive role in promoting physical and mental well-being. They are a valuable cultural heritage of the Chinese nation and an essential resource for global.

3 Traditional Chinese Health-Preservation Exercises Based on Embodied Cognition

Traditional Chinese exercises exert influence on an individual's physiological, psychological, social, and behavioral functions, demonstrating a comprehensive effect in health. From the perspective of embodied cognition, this experience can be perceived as an interactive process involving the body, cognition, and context. This section delves into the shared concept of embodiment within traditional Chinese health-preservation culture, exploring the interplay between physical movement and mental activities through the dimensions of cognition, emotion, and social interaction.

3.1 The Concepts and Development of Embodied Cognition and Embodied Interaction

Embodied cognition theory stresses the impact of bodily experiences on cognition and emotion, advocating for holistic well-being methods. In the age of artificial intelligence, applying this theory to enhance bodily experiences highlights the interconnectedness of mind, body, and environment, especially within extended reality.

The concept of embodiment is interpreted in various ways, but scholars generally agree that the body's structure and its sensory, motor, and neural systems significantly influence cognitive processes and shape its essential content.[10-11] Thus, cognition, body, and environment form a dynamic unity. Embodied interaction fosters the creation and sharing of meaningful information through engagement, enhancing users' ability to acquire and perceive information via bodily actions and sensory experiences, with the core principle of integrating bodily actions and sensory experiences into design. Research on embodied interaction examines how physical engagement influences perception and cognition in human-computer interaction (HCI). Recent advancements have

focused on: designing embodied interactions through full-body engagement, applying phenomenological theories to HCI, improving technology for embodied interaction, and understanding how bodily actions facilitate meaning-making.[12-13]

Consequently, we may regard embodied interaction-based health-preservation as a method through which individuals utilize their bodies as a conduit for cognitive processes, aiding in the regulation of both mind and body. This cognitive approach, along with experiential modes, can be developed through physical engagement in events and activities. It highlights how bodily interactions with the environment significantly influence emotional and cognitive states. Particularly, by encouraging participants to tap into their intrinsic experiences and sensations, we can activate their responses to spatial cues and foster interactive activities, enhancing self-adjustment and the effectiveness of physical wellness practices.

3.2 The Embodied Philosophy within Traditional Chinese Health-Preservation Exercises

Embodiment highlights the body's presence in an interactive world, merging body and mind, emotion and matter, and reason and sensibility. This idea is deeply rooted in traditional culture, evident in concepts like "the unity of nature and man," "the unity of body and mind," and "the unity of knowledge and action," all of which illustrate the interplay between the body, emotions, and intellect within their environment.

Chinese health-preservation exercises are deeply rooted in traditional philosophies like Confucianism, Taoism, and Buddhism.[14] Taoism promotes gentleness and mindfulness, highlighting harmony between humans and nature. Buddhism emphasizes the unity of mind and body, focusing on enlightenment and self-discovery. Confucianism combines social practice with personal growth, all of which inform wellness practices. Tai Chi exemplifies these philosophies, treating the body as an interconnected whole, with the abdomen as the core, promoting coordinated movement. The balance of movement and stillness, openness and closure, and offense and defense in these exercises reflects a holistic wellness perspective and dialectical philosophy.

3.3 The Significance of the Body: The Interplay of Sports with Cognition, Emotion, and Social Interaction

Embodied cognition in sports has roots in early sports culture and therapies that emphasize the mind-body connection, drawing from philosophy, kinesiology, psychology, and cognitive neuroscience. This perspective highlights the links between physical movement, cognition, and emotions, fostering diverse forms of physical expression. Recent research has explored how sports influence cognition, emotions, and social interactions. In terms of cognition, through the sensory, motor, and emotional experiences in sports, individuals gradually establish an integration and unity of body and cognition.[15] This helps improve visuospatial functions, manage multi-channel information, enhance balance and coordination, and influence memory valence, leading to significant cognitive improvements in both the general population and patients. Studies show that practices like Tai Chi can alleviate stress and boost confidence.[16] Additionally,

social activities, such as group yoga, strengthen interpersonal connections and enhance emotional stability, promoting overall psychological health.[17]

In conclusion, as a form of exercises that combines physical movement with cognitive abilities, sports aim to promote both physical and psychological well-being. Whether through the influence of cognition on emotions, as well as the role of the environment in cognitive processes during social interactions, the emphasis is on gradually building an integrated experience of the environment, the body, cognition, and emotions. This helps individuals better understand their relationship with themselves and their environment, enhancing self-awareness and self-regulation, ultimately achieving comprehensive personal development and health.

4 Embodied Exercises Supported by Extended Reality Technology

4.1 The Embodiment of Extended Reality

Extended Reality (XR) combines real and virtual environments, utilizing technologies such as Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR) to create immersive experiences. The discovery of mirror neurons sheds light on how humans understand and imitate actions and emotions, suggesting that XR is an embodied experience. This explains the strong sense of "presence" users feel in XR, even when aware of its simulation. Users' brains may activate mirror neurons, simulating actions and eliciting emotional and physical responses without actual movement. Unlike traditional activities, XR promotes creative engagement and movement freedom, enhancing immersion through sensory alignment. High-quality XR systems further intensify this effect with realistic audiovisual stimuli.

Particularly, the embodiment in VR elevates the experience from psychological projection to physical perception[18], enhancing the user's sense of presence and making them feel truly immersed in the virtual environment. Furthermore, VR can recreate real scenes or invent new scenarios, activating mirror neurons and shaping new perceptual and cognitive experiences, beneficial for training, education, entertainment, and psychotherapy. Thus, mirror neurons are crucial for understanding and utilizing XR technology, highlighting how it can enrich our bodily and cognitive experiences.

4.2 Embodied Interactive Experiences in Extended Reality

In HCI, the significance of embodied experience is increasingly prominent, particularly in XR, influencing design methodologies and user engagement. The following discussion delves into the influencing factors, design methodologies, frameworks of embodied experience and the pros and cons of various XR technologies.

Regarding the influencing factors, Lv, J. et al. (2023) examined how virtual reality design influences users' embodied cognition, highlighting connections between interface and ontological factors across three interaction design levels: cognition, behavior, and emotional experience.[19] As for embodied design methodologies, Professor Dor

Abrahamson distinguishes between perception-based and action-based design, advocating for designs that engage bodily experiences and support the perception-action cycle.[20] Effective embodied design in XR should incorporate kinesthesia, proprioception, interoception, exteroception, haptics, and haptic feedback, as these elements influence cognitive processes. Although haptic feedback can enhance immersion and emotional connection, its application is underexplored. Human touch involves specialized nerves that convey emotional signals, particularly during gentle tactile interactions, offering interface design opportunities to evoke emotional touch.[21] Therefore, considering that eliciting emotional pleasure in HCI design holds great promise for enhancing user's experience in XR, especially emotional touch, aiming to evoke a sense of embodiment, pleasure, and continuity through affective tactile experiences.

In the realm of the pros and cons of various XR technologies in embodied practices, VR enhance motor recovery and cognitive function through techniques like motor imagery and action observation but have limitations in visuospatial skills and cognitive load. [22] In contrast, AR offers a better user experience, particularly for the elderly, with exercise games that lower fall risk and enhance cognitive function.[23], though it may lack the immersive intensity of VR. Overall, VR is superior for immersive rehabilitation, while AR excels in user experience and practical applications like fall prevention. Additionally, gamified experiences serve as a vital means to promote and preserve traditional exercises.[24-25]

Embodied practices in XR exhibit vast potential for clinical and gamified experiences, ranging from cognitive-motor interventions to socio-psychological rehabilitation. XR technologies offer users novel experiences and avenues for improvement. These technologies not only foster the preservation of traditional culture but also provide innovative methods for modern rehabilitation and education. Research will further validate their effects and applications across various domains.

5 Conclusion

Based on a comprehensive analysis of the research on the traditional Chinese health-preservation exercises in the context of medicine-sports integration, and an interpretation of embodied cognition connotation within it, this study explores the interaction mechanisms between physical movements and mental activities from cognitive, emotional, and social dimensions. It becomes evident that there is the mutual resonance of intrinsic coherence between embodied cognition and traditional Chinese Culture—that is the unity of body and mind. We can find that traditional Chinese health-preservation exercises combine physical activity with cognitive skills to influence emotions and cognitive processes during social interactions, fostering a holistic experience of the environment, body, cognition, and emotions. This integration enhances self-awareness and self-regulation, leading to comprehensive personal development and health.

Furthermore, based on analyzing the embodiment characteristic, embodied interactive experiences, and practical applications of XR technologies, the study finds that through shaping new bodily practices and perceptual experiences, embodied exercises

in XR deepen the understanding of the "mind-body unity" essence and aid in cultural inheritance and integration development.

Looking ahead, future research directions may focus on the following areas. Firstly, with the development of technologies, applying XR technologies in the teaching and practice of traditional exercises can provide people with more embodied and personalized wellness experiences. Future research will explore how to enhance the attractiveness and effectiveness of wellness exercises through multi-sensory features while addressing limitations such as cognitive load, especially in terms of tactile feedback. Additionally, gamified experiences are crucial for promoting the inheritance and preservation of traditional health-preservation exercises. Secondly, investigating how to incorporate traditional health-preservation exercises into public health strategies involves promoting these exercises in communities, schools, and workplaces, and developing policies to support public participation in these activities. Last but not least, it is essential to explore the similarities and differences between traditional Chinese health-preservation exercises and similar practices in other cultures, and how to integrate health-preservation wellness philosophy with global health trends.

Through in-depth exploration of the aforementioned research directions, future studies can not only promote the development of ethnic health-preservation exercises but also provide scientific evidence and practical guidelines for improving national health levels. This will drive the inheritance and innovative development of traditional Chinese health-preservation exercises, allowing them to play a greater role in the global health field.

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