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Embodied Calligraphy: Collective Agency, and Co-Creation in AI-Mediated Performance

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Abstract

Embodied Calligraphy integrates guided and improvised movement, Chinese calligraphic animation, sonification, and AI-mediated interaction through computer vision-based motion tracking and real-time audiovisual feedback. The project explores co-creation among three interconnected agencies: the artist-designer, participants, and interactive technologies. Drawing on intersemiotic translation, multimodal social semiotics, and somaesthetics, the research shows how calligraphic strokes are transformed into bodily gestures and audiovisual expressions, while meaning is distributed through collective interaction. Reciprocal exchanges among dancers, participants, and interactive technologies encourage imitation, improvisation, shared authorship, bodily awareness, and self-fashioning. Based on a participatory workshop at the University of California, Riverside, the study explores how programmed interactions and dancers' guidance influence participants' creative choices and collective engagement. Rather than treating technology solely as a facilitating instrument, *Embodied Calligraphy* considers its active role in shaping artistic outcomes, proposing an interdisciplinary approach connecting performance, computational creativity, and embodied meaning-making.

Keywords: Interactivity; Digital Performance; Human-Computer Interaction; Embodiment; Creativity

1. Introduction

This research extends my doctoral dissertation, *Chinese Calligraphic Dance (CCD) and Generative Arts: Phantom of Utopia* (Cheng, 2024). The *Phantom of Utopia* series draws inspiration from *Peach Blossom Spring*, a literary work by Tao Qian (Tao Yuanming), a renowned poet of China's Eastern Jin dynasty. The work imagines an idealized alternative to reality, portraying a utopian world that reconsiders human relationships, existence, and social structures under political instability and unrest (Tao, 1965).

While the *Phantom of Utopia* series consists of dance performances that establish relationships between audiences and dancers through an immersive interactive system, inviting experiences of peace and solace, *Embodied Calligraphy* seeks to extend this ideology through a more intimate and participatory approach by breaking down the boundaries between the audience and the stage. It invites audiences to become participants, not merely to observe the world we create, but to inhabit a world they actively co-create. Through collective participation, they contribute to the shared authorship of this emerging world.

Ultimately, *Embodied Calligraphy* aims to cultivate a meditative immersive experience that manifests this utopian imagination through three interconnected agencies: the artist-designer, participants, and interactive technologies.

2. Theoretical Framework

This research adopts three interconnected theoretical frameworks: intersemiotic translation (Jakobson, 1959), multimodal social semiotics (Kress & van Leeuwen, 2001), and somaesthetics (Shusterman, 2008).

2.1. Intersemiotic Translation: Reimagining *Cangjie* through Embodiment

Embodied Calligraphy was inspired by the ideology of Chinese mythological figure *Cangjie* (倉頡) (Demattè, 2022). He is the legendary inventor of Chinese writing, who is believed to have observed patterns in nature, including animal forms and natural scenery such as mountains, water, moon, and sun, and transformed these three-dimensional visual observations into two-dimensional written symbols. This research references the process of encoding the perceived three-dimensional world into two-dimensional visual representations. What if this process could be reversed, allowing us to reimagine what *Cangjie* might have seen by reinterpreting written symbols through bodily movement? Through this reversal, human participants become active interpreters, showing their own understanding, imagination, and artistic expression into the movements they create. Rather than reconstructing the original images or meanings, this process creates opportunities for alternative interpretations through participants' embodied experiences.

Roman Jakobson (1959) introduced *intersemiotic translation* as the interpretation of verbal signs through nonverbal sign systems. Building upon this concept, *Embodied Calligraphy* demonstrates how the forms, directions, rhythms, and dynamics of Chinese calligraphic strokes can be translated into animation, bodily gestures, and generative audiovisual expressions. Instead of focusing on reproducing the original linguistic meanings or precise shapes of Chinese characters, the project explores their visual, temporal, and kinesthetic qualities as sources of reinterpretation.

The translation process involves several stages. First, Chinese calligraphic strokes are transformed into animations that visualize the direction, rhythm, continuity, and dynamics of writing. The animations incorporate variations in burst intensity, ink depth, speed, and expressive strength within individual strokes to simulate the dynamic qualities of Chinese calligraphy. Burst intensity, in particular, conveys the ebb and flow of calligraphic writing through variations in visual energy, direction, and articulation. These animated strokes serve as movement prompts for dancers and participants, who interpret them through imitation, improvisation, and personal expression.

Their bodily movements are subsequently captured through computer vision-based motion tracking and translated into generative sound and visual responses. These responses may influence participants' gestures, creating a recursive process of interpretation of intersemiotic translation and reinterpretation. In this sense, *Embodied Calligraphy* does not seek a fixed correspondence between calligraphic signs and bodily movement. Instead, meaning continuously emerges and transforms through interactions among the agencies of artist-designer, participants, and interactive technologies.

2.2. Multimodal Meaning-Making: Collective Agency and Co-Creation

While intersemiotic translation explains how Chinese calligraphic signs are decoded and encoded into bodily movement and audiovisual expressions, multimodal social semiotics

examines how meaning is constructed with different modes of communication. Kress and van Leeuwen (2001) said that meaning-making extends beyond verbal language, involving visual imagery, gestures, sound, and spatial arrangements. In *Embodied Calligraphy*, these modes are interconnected through three agencies: the artist-designer, participants, and interactive technologies.

The artist-designer builds the interactive system through calligraphic animations, movement prompts, and audiovisual mappings and sequencing. Participants exercise creativity through imitation, improvisation, and personal expression, while the system transforms their movements into generative audiovisual feedback. In *Embodied Calligraphy*, dancers guide participants through a series of warm-up gestures inspired by the cyclical nature of life, resonating with the Daoist concept of *自然 (ziran)*, or natural spontaneity, and the continuous transformation of nature (Moeller, 2015). Through embodied interpretation, participants explore the life cycle of a tree: a seed sprouts, grows into a tree, develops leaves and blossoms, and eventually bears fruit. As the fruit ripens and falls to the ground, its seeds give rise to new life, completing a continuous cycle of growth, transformation, and renewal. These gestures invite participants to embody natural processes through imitation and improvisation, cultivating shared expression and collective meaning-making. These responses may subsequently influence participants' movement choices, creating continuous exchanges in which artistic meaning emerges through human-computer interaction rather than being predetermined by the designer.

Multimodal meaning-making also involves reciprocal and multidirectional interactions among dancers and participants. Gestures are imitated, modified, and reinterpreted through collective improvisation, while audiovisual feedback introduces additional cues for creative expression. Norris (2004) emphasizes how gestures, posture, eye contact, and spatial relationships contribute to multimodal communication. These interconnected interactions allow individual expressions to influence collective participation.

Through this process, *Embodied Calligraphy* transforms audiences from passive observers into active interpreters and co-creators. Artistic meaning emerges not from a single agency but through the relationships among human expression, technological mediation, and shared embodied experiences, fostering opportunities for collective authorship, interpersonal connection, and community engagement.

2.3. Somaesthetics: Bodily Perception, Self-Fashioning, and Lived Experience

Intersemiotic translation examines the transformation of Chinese calligraphy into generative audiovisual art by the translation into animated gesture and embodiment, and multimodal social semiotics explores collective meaning-making; whereas somaesthetics provides a framework for comprehending how these meanings are perceived, experienced, and cultivated through the living body from the first-person perspectives of human agents: dancers and participants. Shusterman (2008) conceptualizes somaesthetics as the cultivation of the body as a site of sensory perception, aesthetic appreciation, and self-fashioning. Human agents engage in reciprocal and multidirectional interactions that emphasize bodily consciousness and the interconnectedness of body and mind in shaping embodied expression and personal identity.

In *Embodied Calligraphy*, participants engage in guided and improvised gestures inspired by Chinese calligraphic forms and natural processes. Through movement, they explore bodily sensations, spatial awareness, rhythm, and expressive qualities while responding to real-time audiovisual feedback. Participants may choose to interact with the camera-based system,

which uses AI-assisted motion tracking to transform captured movement data into live sound through sonification, while observing visual feedback on the screen that reflects their bodily gestures. The interactive environment invites participants to observe how their movements influence sound and imagery, while these audiovisual responses may subsequently reshape their bodily expressions. This reciprocal relationship creates opportunities for somatic awareness and aesthetic manifestation, allowing participants to experience the body as both an instrument of artistic expression and a subject of perception.

Through improvisation and self-fashioning, participants are encouraged to develop their own interpretations rather than reproduce predetermined movements, allowing the artistic outcomes to remain flexible and indeterminate, often producing unexpected results across different iterations of the experience. Each individual perceives and interprets the world differently, and this diversity becomes a source of artistic expression. Participants introduce gestures that reflect their own characteristics and identities, while their bodily expressions are continually shaped through interacting with others, producing different interpersonal dynamics and creative possibilities in each session. Through self-fashioning, participants engage in an ongoing process of interaction, sometimes involving consensual physical human touch through which they may perceive and exchange bodily energy and sensations. Their perceptions of their own bodies and those of others may consequently evolve throughout the experience. Their phenomenological lived experiences, physical capacities, and creative decisions contribute to the evolving artistic environment. In this sense, *Embodied Calligraphy* approaches somaesthetics as a participatory practice in which bodily awareness, sensory perception, and artistic expression are cultivated through human–computer and interpersonal interactions, potentially encouraging meditative attention with the system design.

3. System Design: Meditative Sound, Embodied Interaction, and Narrative

Embodied Calligraphy integrates AI-mediated motion tracking, sonification, meditative music, guided verbal narration, and immersive audiovisual environments to facilitate embodied interaction and collective co-creation.

3.1. Meditative Sound Design : Binaural Beats and Guided Breathing

The auditory environment incorporates meditative music, binaural beats, and guided narration to encourage relaxation, focused attention, and bodily perception. A JavaScript-based sound synthesis system generates evolving binaural beats through slightly different frequencies delivered separately to the left and right audio channels. The meditation preset begins with an 8 Hz frequency difference, gradually moves to 4.5 Hz, and returns toward 7 Hz, creating a changing auditory experience conceptually associated with the alpha and theta frequency ranges. Rather than maintaining a fixed frequency, the system incorporates organic frequency shift and smooth transitions to create a continuously evolving soundscape. The musical composition further incorporates smooth harmonic progressions, slowly evolving textures and soundscapes, and field recordings of natural environments to create a sense of tranquility and immersion.

The sound synthesis further integrates sustained drones, soft harmonics, filtered noise, and subtle spatial modulation to create an imaginative and immersive soundscape that reference *Peach Blossom Spring*. The system offers customizable musical parameters, including carrier frequencies, binaural-beat patterns, harmonic intensity, and atmospheric textures. Its JavaScript implementation generates different modes of beat patterns in 48 kHz, 24-bit stereo

audio, allowing the artist-designer to produce different musical environments for meditation, calm focus, emotional comfort, and breathing exercises.

A breathing envelope guided by verbal narration modulates the sound amplitude through gradual expansion and contraction, offering selectable breathing patterns such as four-second inhalation and six-second exhalation, five-second inhalation and exhalation, or six-second inhalation and exhalation. This rhythmic modulation accentuates the calming patterns of breathing and provides an auditory reference for bodily awareness. The guided narration additionally introduces the 4-7-8 breathing exercise, inviting participants to inhale for four counts, hold for seven, and exhale for eight while imagining natural scenery like rivers, wind, bamboo, and peach blossoms. Although the programmed breathing envelope and narrated exercise operate with different rhythmic patterns, both contribute to the meditative structure of the experience. Together, meditative music and spoken instructions encourage participants to attend to their breathing, bodily sensations, and imagined surroundings.

3.2. Immersive Visual System

The visual environment alternates between prerecorded videos introducing the world of *Peach Blossom Spring* and live camera feeds transforming through generative visual effects with smooth crossfading transition. Prerecorded sequences portray the imagined landscape through evolving imagery guided by long following shots and slow camera movement, while live feeds incorporate participants' bodily presence into the audiovisual environment. The transitions between these two visual modes encourage participants to move between observing the imagined world and becoming part of it.

3.3. Narrative Design : Guided Embodiment, Improvisation, and Collective Participation

The narrative structure guides participants through meditative preparation, embodied improvisation, and collective co-creation. In the verbal narration, the dancer assumes the role of the fisherman from Tao Qian's *Peach Blossom Spring* (Tao, 1965), leading participants from an unsettled outside world into an imagined utopian village. Through poetic descriptions of mountains, rivers, peach blossoms, and natural landscapes, the narration encourages sensory awareness, imaginative immersion, and bodily relaxation. Guided breathing and meditative music further prepare participants for embodied exploration in the space.

As the narrative progresses, participants transition from observing the dancer to engaging in movement. Inspired by calligraphic animation and natural imagery, they imitate, reinterpret, and improvise gestures, transforming their body into imaginary forms that evolve over time. For example, the narration guides participants to turn their hands into flowers, and limbs into branches to match with the linguistic reinterpretation of *Peach Blossom Spring*. The dancer subsequently invites participants to introduce their own movements, which are exchanged, transformed, and developed into collective improvisation. Eye contact, movement exchanges, and consensual physical touch further encourage interpersonal connection and shared bodily awareness.

Participants are invited to hold hands, and return to guided breathing. The narration gradually brings them from the imagined landscape back to their physical surroundings, encouraging them to carry the experience of *Peach Blossom Spring* beyond the performance. Through this progression, *Embodied Calligraphy* transforms the utopian imagination into a participatory

experience shaped by embodied expression, communal engagement, and collective authorship.

4. Limitations and Future Directions

The current implementation of *Embodied Calligraphy* relies on a single projector directed toward a wall, which limits the spatial immersion and participants' interaction with the audiovisual environment. Future development could incorporate multiple projections across surrounding walls and an additional projection onto the floor, allowing participants to experience calligraphic imagery and generative visuals within a more immersive environment. This expansion could be achieved through additional projectors, synchronized video outputs, and projection-mapping software that calibrates the imagery according to the dimensions and perspectives of different surfaces. Floor projections could further encourage participants to explore spatial relationships through walking, turning, and bodily gestures, transforming the surrounding environment into an interactive artistic space.

Another limitation concerns the interactivity of the current motion-tracking system, which primarily relies on computer vision-based gesture recognition. Future revision could incorporate ultrasonic proximity sensors, such as PING sensors, or depth-sensing cameras to detect participants' spatial positions, distances, and interactions with their surroundings. These measurements could be mapped to musical parameters while influencing generative visual responses. Integrating multiple sensors could support more complex interactions among participants, dancers, and technology, allowing the system to respond not only to individual gestures but also to interpersonal distances and collective movement patterns.

These developments could also establish a foundation for interdisciplinary research in movement, accessibility, and well-being. Some scientific research has demonstrated how synchronized camera networks, movement recognition, and responsive technologies can facilitate movement exploration within socially enriched environments (Kokkoni et al., 2020). Building upon these methodological approaches, *Embodied Calligraphy* could explore opportunities for interdisciplinary collaboration with researchers in engineering, movement science, neuroscience, and rehabilitation. While the project is primarily an artistic system rather than a clinical intervention, its integration of creative movement, sonification, and immersive audiovisual feedback offers potential for examination on how interactive technologies can support embodied perception, movement engagement, and accessibility of diverse movement capabilities. Future collaborations could incorporate specialized sensing, kinematic measurement, and assistive technologies, subject to the availability of research resources and expertise, to investigate how the system accommodates participants with diverse physical capacities. Such interdisciplinary approaches could gradually extend *Embodied Calligraphy* beyond artistic and aesthetic expression toward scientifically informed research on inclusive movement experiences and their potential contributions to physical and psychological well-being.

5. Video Documentation

The accompanying video, *Embodied Calligraphy: The Body Jam Lab*, documents the project's integration of Chinese calligraphic animation, bodily movement, sonification, and interactive audiovisual environments. It illustrates the theoretical and technical concepts discussed in this paper, highlighting how the artist-designer, participants, and responsive technologies interact

to facilitate collective co-creation and shared experiences. Link to Video: https://youtu.be/bB1Aq3r4wBc?si=x7r6lNYX7RBOPCE2

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