EAI Endorsed Transactions
on Pervasive Health and Technology
Research Article EAI.EU

From Passive Observation to Active "Deduction": A Study on the Therapeutic Effects of Directive Embodied Interaction

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Abstract

INTRODUCTION: Current art therapy practices struggle with disembodiment, characterized by "sensory deprivation" and "superficial interaction." A key challenge is the limited understanding of the mechanisms through which directive embodied interactions influence psychological states.
OBJECTIVES: This study aims to systematically investigate the therapeutic effects and underlying psychological mechanisms of "directive embodied interaction" art installations, exemplified by "do it," through the construction of a theoretical analytical model and the conduct of empirical experiments.
METHODS: This study constructed an "input-process-output" healing model using a mixed experimental design that combined between-group comparisons (experimental vs. control group) with within-group pre- and post-tests. Quantitative assessments were conducted on 110 participants using the Positive and Negative Affect Schedule (PANAS), Flow State Scale (FSS), and Perceived Stress Scale (PSS). A structural equation model was constructed based on questionnaire data to empirically test pathways within the healing mechanism analysis. Supplementary qualitative analysis was conducted through semi-structured interviews.
RESULTS: Research findings indicate: 1) Compared to passive viewing, directive embodied interaction significantly enhances positive emotions, reduces negative emotions, and induces higher levels of immersion and stress relief; 2) This emotional regulation effect exhibits specificity, primarily elevating high-arousal positive emotions (e.g., excitement) while alleviating high-arousal negative emotions (e.g., tension); 3) Its therapeutic mechanism stems from a synergistic pathway: instructions reduce cognitive load → action feedback triggers flow → action metaphors facilitate catharsis → group synchronization provides support.
CONCLUSION: This study empirically validates the effectiveness of "directive embodied interaction" as an efficient, low-threshold approach to art therapy, offering a novel pathway for promoting public mental health and well-being. The findings not only provide critical theoretical foundations and actionable strategies for designing therapeutic installations and spaces but also broaden the conceptual framework for digital art therapy. Furthermore, they deepen our understanding of the pivotal role digital media plays in influencing human perception, cognition, and behavior.

Keywords: Art therapy, directive embodied interaction, gamified interactive art, flow, micro-social connections.

Received on 22 November 2025, accepted on 06 January 2026, published on 19 January 2026

doi: 10.4108/eetpht.11.11060

1. Introduction

Art therapy seeks to help individuals expand their conscious boundaries, enhance self-awareness, and return to an ideal state of mind-body balance through the creative process of

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art. This process is inherently embodied, inevitably involving and mobilizing the coordinated participation of multiple human sensory systems. In recent years, the integration of digital technology and media has brought new development opportunities to art therapy, significantly enhancing its accessibility and popularity, and driving the formation of a digital art therapy paradigm.[1][2]

However, while current digital art therapy practices leverage technology to broaden their reach, they inevitably encounter disembodiment challenges such as “sensory deprivation” and “superficial interaction.” This hinders the establishment of deep emotional connections between therapists, participants, and the digital environment, often resulting in suboptimal therapeutic outcomes. Against this backdrop, the concept of embodied interaction—which emphasizes the body's central role in cognition and emotional expression—offers a critical pathway to overcoming these challenges. Among its approaches, directive embodied interaction provides a clear behavioral framework and immediate feedback, tightly coupling physical movements, psychological states, and virtual environments. This design direction holds immense potential for creating efficient, controllable therapeutic experiences.

As an emerging form of healing, immersive art therapy uses virtual reality and multisensory interaction technologies to induce integrated mind-body experiences through users' embodied engagement with virtual scenarios.[3][4] Despite its broad application prospects, this field faces challenges stemming from unclear core mechanisms: How exactly do directive interactive behaviors influence psychological states? Specifically, how can the “unity of mind-body-environment” emphasized by embodied cognition theory be translated into designable, actionable directive interaction strategies to effectively intervene in psychological states like anxiety?[5]

Addressing these questions, this study builds upon embodied cognition theory to systematically explore the dynamic mechanisms through which directive embodied interactions influence psychological states in immersive art therapy, while validating their efficacy. To address this, this study will construct a structural equation model. Through path analysis and mediation effect testing, it will quantitatively reveal the analytical pathway of “instruction clarity → flow experience → emotional catharsis → therapeutic effect.” This approach aims to provide an efficient, low-threshold, and evidence-based new pathway for art therapy to promote public mental health and well-being.

2. Literature Review

This study centers on the design mechanisms of directive embodied interaction within immersive art therapy settings, grounded in an integrated perspective that unites the psychological, physical, and environmental dimensions. However, such art therapy approaches emphasizing “directive embodied interaction” often rely on subjective descriptions of therapeutic effects, lacking objective data and theoretical elaboration. To systematically establish the theoretical foundation of this research, the following review unfolds along three progressive axes:

First, the evolution of art therapy mediums has shifted from static expression to interactive experiences.

Art therapy is a psychological treatment method grounded in psychological and art theory. Traditionally, it employs art forms such as painting, music, dance, and drama as mediums, guided by professional therapists to facilitate artistic creation and expression among clients.[6] This approach aids in addressing emotional issues, alleviating psychological stress, promoting psychological recovery, and fostering personal growth. With evolving practices, current research emphasizes distinguishing “healing” from “treatment.” Yin Yue et al. found healing's essence lies in participants' embodied interaction with physical media and environments. This implies interaction transcends purely mental processes, involving direct emotional release and cognitive restructuring through multisensory engagement—such as tactile, visual, and auditory input—during creation. At the individual experience level, Amic G. Ho's empirical research indicates that interactivity enhances emotional engagement by granting users autonomy.[7] When participants can independently control the experiential process within interactive art, their emotional investment deepens significantly, directly translating into perceptible healing benefits like relaxation and stress reduction. This reveals a key pathway through which interactivity delivers therapeutic effects. At the technological medium level, research by Hao Shimeng et al.[8] further operationalizes interactivity into specific behaviors, such as “autonomous perspective selection” and “motion interaction.” Their findings indicate that increased interactivity significantly enhances users' sense of presence in virtual environments, thereby elevating positive emotions like pleasure and relaxation while reducing anxiety and depression levels. At the societal level, highly interactive environments promote deeper psychosocial integration. Maria Àngels Miret Latas's evaluation study broadens the perspective to the social domain.[9] Using an “interaction analysis method” to assess art therapy workshops, it reveals that facilitators creating highly interactive environments effectively help participants establish a sense of self-control through artistic expression, ultimately promoting their emotional and social integration. This demonstrates that interactivity is not only about individual emotional regulation but also a powerful force for building supportive communities and promoting social healing.

Second, From Theory to Design: Design Research and Practice of Directive Embodied Interaction

The theory of embodied cognition reveals the unity of mind, body, and environment.[10] Translating this principle into actionable design practice, “directive guidance”—as a structured interactive framework—has been widely applied across multiple fields, from traditional therapies to modern human-computer interaction. In traditional art therapy, directives have long served as a core tool for guiding embodied expression. As early as 2005, Lisa B. Moschini noted in her research that art therapists often guide participants to transform internal emotions into external, perceptible bodily actions by issuing explicit instructions, such as "express your feelings through physical movements." These directives themselves constitute embodied interaction guidance, achieved through bodily movements, sensory experiences, and engagement with the medium. In the realm of public art, Zhang Tao et al.'s research on community interactive art demonstrates that providing audiences with explicit "instructional guidance" through installation narratives and interactive elements can directly exert positive regulatory effects on participants' cognition, emotions, and even social relationships.[11] This validates the potent therapeutic potential of directive guidance in non-clinical, public settings. However, instruction design must align with task complexity. Research by Ji Han et al. on human-computer interaction reveals a critical boundary: when handling complex tasks, purely directive interactions prove significantly less efficient than multimodal guidance.[12] This demonstrates that in scenarios involving psychological healing and emotional expression, clear and simple directives can reduce cognitive load and promote intuitive bodily responses.

Third, the healing mechanism of directive interaction: the synergistic effect of flow experiences and social connection.

From the perspective of behavioral intervention, the clear instructions and immediate action feedback in directive embodiment form a structured task that effectively captures cognitive resources, interrupts anxious rumination, and perfectly aligns with the "goal-feedback-skill balance" conditions described by flow theory.[13] This guides participants into a state of deep concentration and pleasurable immersion. Flow theory was systematically proposed by psychologist Mihaly Csikszentmihalyi in his 1990 book Flow: The Psychology of Optimal Experience.[14] Its core principle states that when an individual's skill level aligns with the challenge of an activity, they enter a state of total absorption where time and self are forgotten—the "flow" state. This theory is widely applied to enhance user immersion and engagement. In his research, Valtteri Yli-Olli demonstrates how game design can facilitate and sustain flow states by balancing difficulty with player skill, setting clear objectives with immediate feedback, and providing a strong sense of control. Within broader interaction design, DENG Ziyan et al. apply flow theory to optimize user journeys, ensuring experiences are neither overly simplistic to the point of boredom nor excessively challenging to the point of anxiety.[15] Simultaneously, flow states rely on clear verbal instructions to better guide user attention, reduce cognitive load, and enhance immersion.

When interactions synchronize within a group, they create a lightweight social ritual. Rhythmic synchrony within the collective has been shown to foster emotional resonance, generating a subtle sense of belonging and social connection. This fosters a supportive social environment for individual healing, synergistically forming an effective non-clinical psychological intervention pathway across cognitive, emotional, and social dimensions. Victor Chung et al. found that synchronized behavior often elevates positive emotions, such as generating pleasure through activating the brain's reward system and releasing endorphins.[16] This emotional state further promotes cooperation and a sense of belonging.

As evident, existing research primarily consists of fragmented theoretical interpretations and phenomenological descriptions, lacking an integrated theoretical model to systematically elucidate the intrinsic connections among the dimensions of "directive embodied interaction". Furthermore, there is a significant absence of controlled experiments to objectively quantify and validate the efficacy of this pathway. To address this research gap, this paper builds upon the aforementioned review to construct a healing model of "directive embodied interaction." This model is tested through experimental methods, yielding the theoretical framework illustrated in Figure 1.

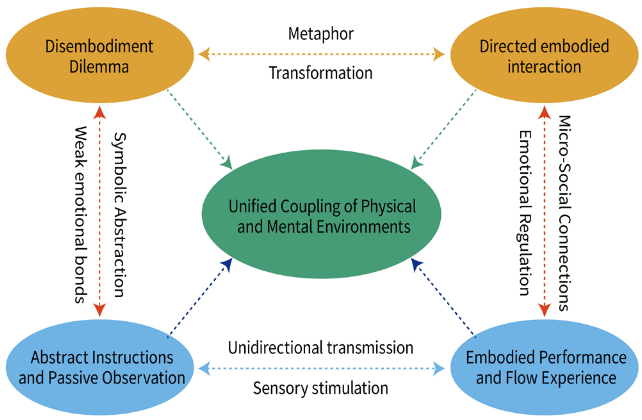

Figure 1. The Disembodiment Dilemma in Art Therapy and Embodied Interaction Pathways

3. Method

To systematically address the research questions raised in the introduction and validate the effectiveness of the constructed theoretical model, this study follows a path of "theoretical modeling—case verification—data analysis." The specific research path and methodological framework are illustrated in Figure 2. This chapter will provide a detailed elaboration of each component in sequence.

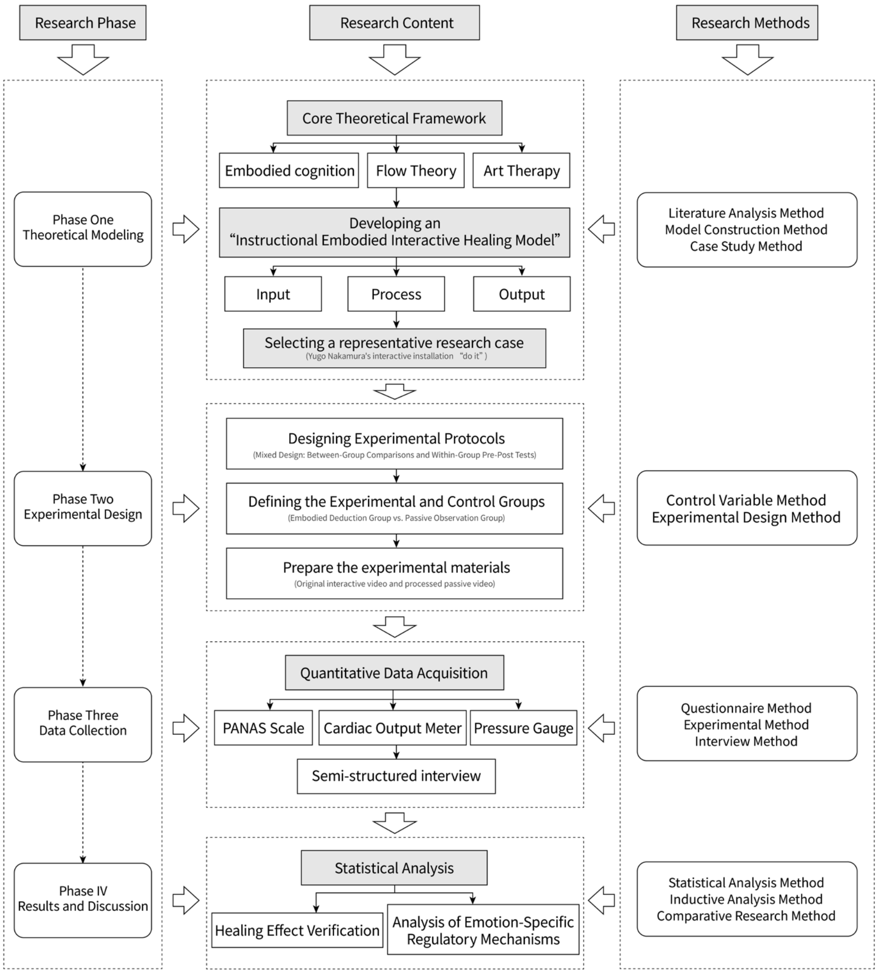

Figure 2. Research Pathways and Methods

3.1. Ethical Statement

All experimental procedures in this study adhered to the ethical guidelines outlined in China's "Ethical Review Measures for Life Science and Medical Research Involving Human Subjects" and the Declaration of Helsinki. Given that this study is a non-invasive, low-risk observational behavioral study, its content does not involve the collection of participants' privacy-sensitive information, nor does it involve deceptive or harmful physiological or psychological interventions. Furthermore, all data were processed and analyzed anonymously. The study design meets the criteria for exemption from full review by the Institutional Review Board (IRB). Additionally, this study strictly adheres to the following ethical standards: (1) All participants read and signed written informed consent forms prior to the experiment; (2) Participants were explicitly informed that they could withdraw from the experiment at any time without conditions; (3) All collected data is used solely for this study's analysis and is strictly confidential.

3.2. Development of a Directive Embodied Interaction Healing Model

Based on the aforementioned literature review, this study constructs a three-tiered design strategy model encompassing "input-process-output" to systematically analyze and evaluate the therapeutic effects of directive embodied interaction design, as detailed in Figure 3. Serving as an analytical framework, this model focuses on the complex "human-object-environment" relationships within digital art therapy scenarios. It translates abstract healing mechanisms into observable, testable dimensions of embodied interaction experiences. The aim is to provide a structured theoretical tool for interpreting why public art experiences centered on "directive embodied interaction" produce therapeutic effects. The input layer corresponds to the 'instruction clarity' variable in the experiment; the process layer includes two core mediating variables: 'flow experience' and 'emotional catharsis'; the output layer corresponds to two therapeutic effect indicators: 'emotional elevation' and 'stress relief'.

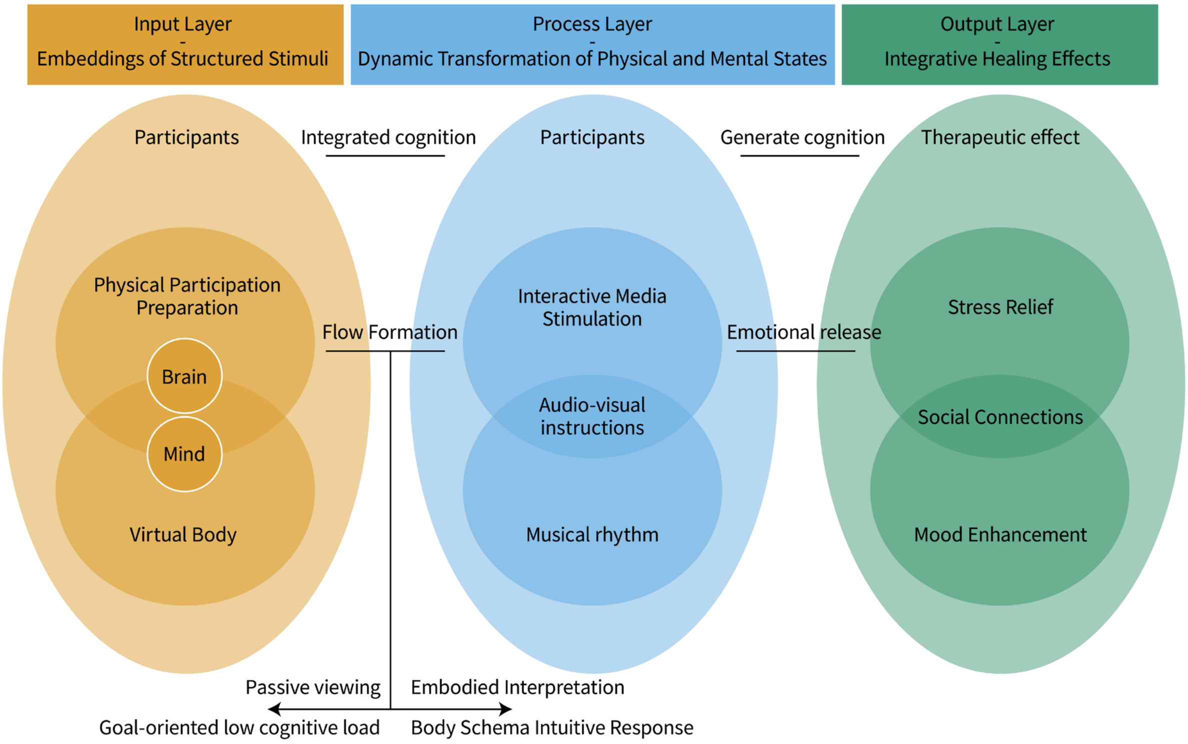

Figure 3. A Three-Tiered Directive Embodied Interaction Healing Method Model

3.2.1 Input Layer: Design and Embedding of Structured Stimuli

The input layer constitutes the starting point and external conditions for the healing experience. Its core lies in creating a scenario with low cognitive barriers and high appeal for users' embodied participation through carefully designed, controllable external stimuli. Clear audiovisual instructions serve as a structured interactive framework. By providing explicit action goals requiring no decision-making, they effectively reduce users' cognitive load, guiding their consciousness away from deliberation and rapidly immersing them in physical action. Simultaneously, the cultivation of group atmosphere through synchronized music, chants, and shared space builds a lightweight sense of collective ritual. This atmosphere, functioning as positive environmental pressure, not only reduces participants' individual social apprehensions but also initiates the awakening of their shared willingness and behavioral motivation to participate.

3.2.2 Process Layer: Dynamic Transformation Mechanisms of Physical and Mental States

The process layer is the core of this model, revealing how stimuli from the input layer trigger positive shifts in users' cognitive and emotional states through their bodily mediation. This process comprises two synergistic sub-processes that collectively form a dynamic coupling system among mind, body, and environment. Within this system, the formation of the flow loop focuses on activating the cognitive-emotional pathway: participants execute instinctive bodily movements according to instructions, achieving a transformation from mental cognition to physical action—a direct manifestation of embodied cognition. Subsequently, the user's actions immediately trigger synchronized changes in the audiovisual environment, forming an instantaneous "action-feedback" causal loop. This loop perfectly aligns with and powerfully induces the highly focused, self-forgetful state of immersion described by flow theory, thereby efficiently interrupting the individual's anxiety and rumination. Parallel to this is the process of symbolic reconstruction of intrinsic meaning, which emphasizes cognitive-metaphorical transformation.[17] The everyday actions guided by commands inherently carry subconscious metaphors. When extracted and amplified within an extraordinary artistic context, their functional aspects diminish while their symbolic significance intensifies. This transformation converts them into symbols for emotional expression, enabling participants to unconsciously project inner pressures and pent-up emotions onto their movements, achieving symbolic catharsis and release.

3.2.3 Output Layer: Multi-dimensional Integrative Healing Effects

The process layer crystallizes into perceptible, measurable integrative healing effects at both the individual and group levels. The elevation of positive emotions primarily stems from the intrinsic pleasure and satisfaction generated by the flow state itself; stress relief arises through multiple pathways, including the interruption of rumination, metaphorical emotional release, and physiological regulation via physical movement. Furthermore, when multiple individuals synchronize their actions under shared instructions and rhythms, it fosters a transient sense of collective connection. This experience of “playing together while each engages individually” constructs a wordless sense of belonging from a social dimension, thereby consolidating and enriching the overall therapeutic effect.

The “input-process-output” pathway described by this model, particularly the dynamic transformation relationships among multiple variables at the process level, will be quantitatively validated through structural equation modeling to confirm the rationality and validity of its underlying logic.

3.3. Case Selection and Rationale

This study selects Japanese designer Yugo Nakamura's interactive installation “do it” as the core empirical case. This selection is based on the installation's perfect alignment with the “Instructional Embodied Interaction Healing Model” constructed in this paper. The installation requires participants to follow clear audiovisual instructions to perform a series of physical actions, receiving immediate visual feedback from the device. Its core operational mechanism aligns closely with the “input-process-output” pathway described in this model. Consequently, the “do it” installation is regarded as a quintessential example of directive embodied interaction design, providing an ideal and representative context for this study to validate the theoretical model's effectiveness.

3.4. Experimental Design

3.4.1 Definition of Experimental Group and Control Group

To evaluate the therapeutic effects of directive embodied interactive art installations, this study employs a mixed-methods design combining between-group comparisons with within-group pre- and post-tests. The core objective of this study is to examine the therapeutic efficacy difference between “directive embodied interaction” and traditional “passive reception” art experiences. Therefore, we established a classic experimental group and control group. The experimental group (embodied performance group) represents a complete interactive form integrating directives, physicality, and feedback; while the control group (passive observation group) simulates the disembodied, viewing-centric experience commonly found in contemporary digital art therapy.

The independent variable is “experience type,” operationally defined as two categories:

Experimental group (embodied deduction group): Participants were instructed to actively imitate the movements demonstrated in the interactive video with their whole body throughout the session.

Control group (passive observation group): Participants were instructed to sit still and only watch the processed observation video attentively, without performing any body movements or imitating the actions shown on the screen.

The dependent variable is the therapeutic effect post-intervention, quantified through the following standardized psychological scales:

- Emotional state: Measured using pre- and post-test changes on the PANAS scale.
- Stress baseline control: All participants completed a standardized stress-inducing task (timed mental arithmetic) prior to intervention to ensure comparability of initial stress levels across groups.
- Flow experience: Measured using the Flow State Inventory (post-test).
- Stress levels: Measured using the Self-Rating Stress Scale (post-test).

Additionally, the post-experiment questionnaire included measurements of process variables such as “instruction clarity,” “emotional release,” and “group synchrony.” These data will collectively serve as observed variables for constructing structural equation models to examine the underlying psychological pathways of the therapeutic effects.

3.4.2 Experimental participants

This study aims to explore a low-threshold, accessible art therapy pathway for the general public. Consequently, 110 volunteers were recruited through open recruitment to serve as participants. All participants belonged to the young and middle-aged demographic with daily experience using digital media. Participants ranged in age from 18 to 35 years old, comprising 48 males (43.6%) and 62 females (56.4%). All participants possessed higher education qualifications. To minimize pre-existing differences' impact on experimental outcomes and ensure intergroup homogeneity, a fully randomized grouping design was employed. The specific procedure was as follows: After each participant completed the pretest and signed the informed consent form, an experimenter not involved in data collection assigned them to either the experimental group (embodied deduction group, n=55) or the control group (passive observation group, n=55) using a computer-generated random number sequence. This assignment occurred immediately after the completion of the stress-inducing task and before the commencement of the experimental intervention.

3.4.3 Experimental Materials and Equipment

The core materials used in the experiment were two sets of video stimuli, with details of the video processing procedures provided in Figure 4.

- “do it” Original Interactive Video: This video originates from publicly released materials by Japanese designer Yugo Nakamura, containing the complete audiovisual instruction sequence guiding participants through embodied interaction.

- "do it" Processed Observation Video: This version was created through post-production processing of the original video. Processing involved: Removing all visual, audio, and textual instructions prompting participants to perform actions, while ensuring visual continuity and background audio coherence, maintaining the original video's total duration.

Experiments will be conducted in a quiet, isolated laboratory setting. Primary equipment includes a high-definition display for presenting stimulus videos and a computerized questionnaire system for collecting participant rating data.

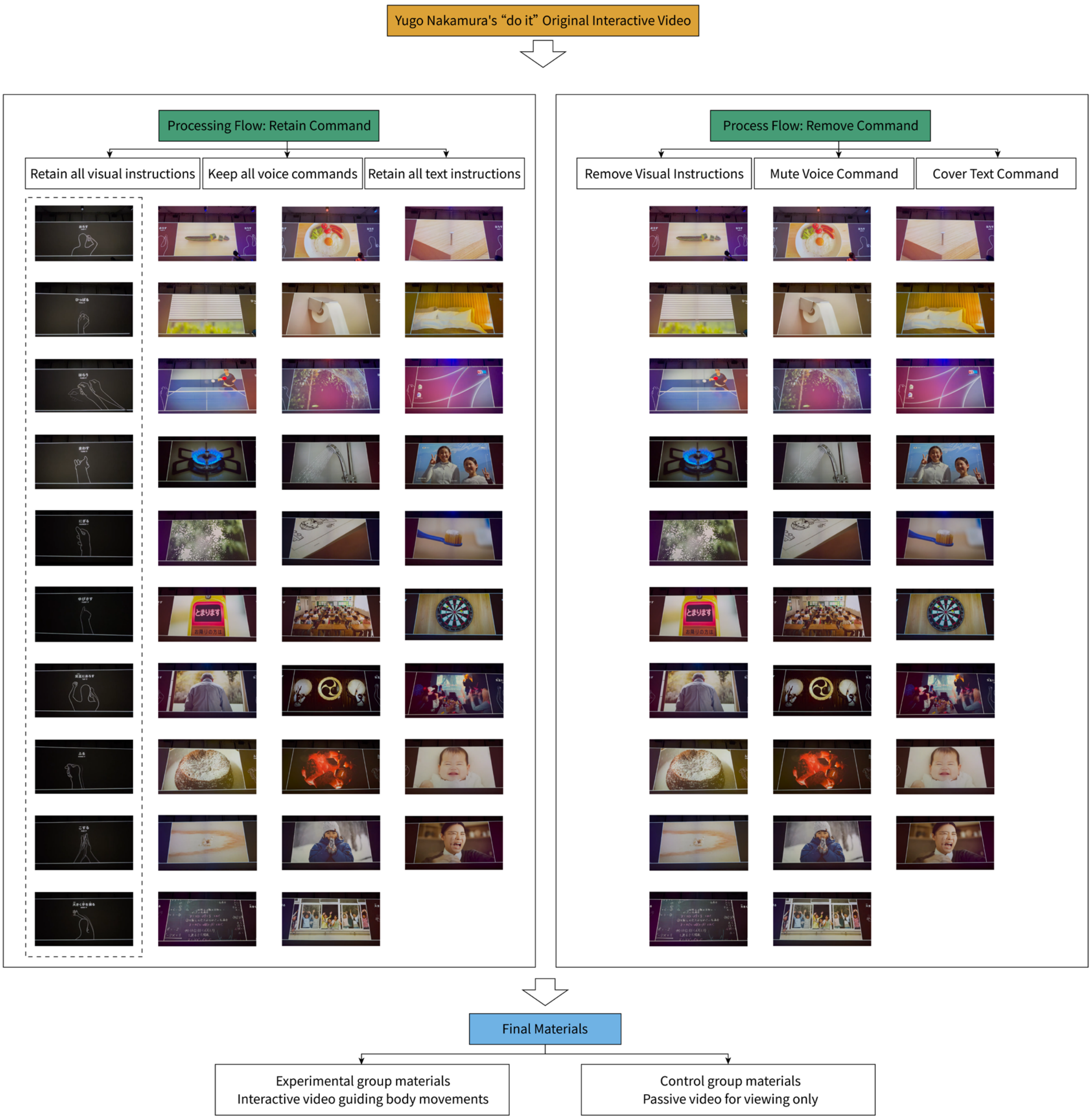

Figure 4. "do it" Two Versions of Interactive Video Stimulation

3.5. Experimental Procedure

To systematically evaluate the therapeutic effects of directive embodied interactive experiences, this experiment followed a standardized protocol. Each participant's session was conducted sequentially in an isolated laboratory setting, with a total duration of approximately three and a half minutes. The specific procedure is as follows:

3.5.1 Arrival at the laboratory and signing of the informed consent form

Upon arrival, the experimenter will briefly introduce the study overview and then ask participants to read and sign the informed consent form.

3.5.2 Pre-test

Prior to the commencement of the experimental intervention, participants will complete the PANAS questionnaire on a computer. This instrument is used to precisely measure participants' initial emotional state before undergoing any experimental treatment, serving as baseline data for assessing subsequent emotional changes.

3.5.3 Pressure Baseline Control

To establish a comparable elevated stress baseline for all participants prior to the experimental intervention, this study employed a laboratory stress induction method widely validated in psychophysiological research: the “timed mental arithmetic task.” Research by Yang Mingxing et al. indicates that similar timed mental arithmetic tasks reliably induce acute stress states in participants. The task required participants to perform consecutive mental subtraction calculations as quickly and accurately as possible within 3 minutes, ensuring both the experimental and control groups reached a comparable, uniform initial psychophysiological baseline prior to intervention.

3.5.4 Experimental Intervention

Based on the pre-randomized assignment, participants in the experimental group and the control group received different task instructions. For the experimental group, the experimenter said: “In a moment, please follow the movements demonstrated in the video with your body as accurately as you can, and keep moving together with the video until the end.” For the control group, the experimenter said: “In a moment, please sit still and watch the video attentively. Do not imitate any of the movements; just observe what happens on the screen.”

Apart from these task instructions and the version of the video presented, all other experimental conditions (laboratory environment, screen size, sound volume, seating arrangement, duration, and experimenter–participant interaction) were kept strictly identical between the two groups in order to minimize experimenter expectancy effects.

3.5.5 Post-test

Following the conclusion of the intervention phase, participants immediately underwent a post-test assessment. They were required to complete the Positive and Negative Affect Schedule (PANAS) once more, along with the Flow State Scale (FSS) and the Self-Rating Stress Scale (PSS). Additionally, they filled out a process variables questionnaire designed to measure instruction clarity, emotional catharsis, and group synchrony, thereby establishing the data foundation for subsequent structural equation modeling analysis.

3.5.6 Semi-structured interview

After completing quantitative data collection, this study will select a portion of participants from each group for brief semi-structured interviews. These interviews aim to gain deeper insights into participants' subjective perceptions of core experiential dimensions, focusing on their understanding and reactions to “instructions,” their experiences and interpretations of “physical movements,” the sense of collective connection emerging within the group setting, and other significant experiential dimensions that surface during interactions. This qualitative data will provide rich contextual depth and interpretive layers to complement the quantitative findings.

3.6. Structural Equation Modeling of the Healing Mechanism

To empirically test the proposed healing mechanism of “directive embodied interaction,” this study constructs a Structural Equation Model (SEM) based on quantitative and qualitative data. The aim is to quantitatively reveal the causal mechanisms among psychological variables through path analysis and mediation effect testing. Through operational definitions, directive clarity was established as the input variable, with flow experience, emotional catharsis, and group synchrony serving as mediating variables, and therapeutic effects as the output variable, forming a structured research hypothesis system.

3.6.1 Variable Definition and Measurement

The model defines five core latent variables, whose operational definitions and measurements strictly adhere to this study's design and procedures:

- Instruction Clarity: Refers to the explicitness and ease of execution of guidance information during interactions, serving as an input variable to initiate the healing pathway. This variable is measured by three items in the post-experiment questionnaire: ZL1 (Clear Instructional Goals), ZL2 (Easily Understandable Action Requirements), and ZL3 (I can follow the instructions without difficulty).
- Flow Experience: Refers to the state of deep concentration and self-forgetful immersion participants enter during interactions, serving as the core mediating variable in the healing process. This variable directly utilizes the total score from the Flow State Scale (FSS) obtained in the post-test. Its nine items were grouped into three observed indicators (FL1, FL2, FL3) based on balanced factor loadings and incorporated into the model.
- Emotional Catharsis: Refers to the unconscious release and expression of emotions achieved through embodied movement, serving as a transformative mediating variable in the healing process. This variable is measured by three items in the post-test questionnaire: XS1 (I felt my emotions were released), XS2 (My movements helped me express my inner feelings), and XS3 (I felt a sense of relief after the activity).
- Exercise Engagement: Refers to participants' subjective perception of the amplitude and intensity of their

physical movements during interactions. This variable serves as a control variable in exploratory analyses, measured by two items in the post-test questionnaire: TR1 (“My movements were very large”) and TR2 (“I was fully engaged in the physical activity”). This variable is not included in the core structural equation model but is used in subsequent exploratory analyses to preliminarily control for the potential influence of physical activity levels on outcomes.

- Group Synchronization: Refers to micro-social connections formed through shared instructions and rhythms, serving as a social support mediating variable in healing. This variable is measured by three post-test questionnaire items: TB1 (I felt synchronized with others' actions), TB2 (I sensed the collective rhythm), and TB3 (Synchronized actions gave me a sense of belonging).
- Healing Effect: Refers to the integrated outcome of enhanced positive emotions and reduced stress following the intervention, serving as the model's output variable. This variable functions as a second-order latent variable composed of two first-order latent variables: Positive Emotion (measured by the positive emotion total score on the post-test PANAS scale) and Stress Reduction (measured by the reverse-scored total score on the post-test PSS scale).

3.6.2 Research Hypotheses and Theoretical Models

Based on the “input-process-output” theoretical model and the aforementioned literature support, this study proposes the following research hypotheses. The corresponding hypotheses are presented in Table 1, while the theoretical model is illustrated in Figure 5.

Additionally, to explore the influence of the possibility that the directive effect may stem solely from physical movement, this study will conduct a supplementary exploratory analysis after completing the core hypothesis testing. This analysis will utilize only experimental group data, employing correlation and partial correlation analyses based on total variable scores or means. Its purpose is to preliminarily examine whether, after statistically controlling for exercise engagement, instruction clarity still exhibits a significant association with healing effect indicators. This will assess the contribution of the “instruction” factor to the experiment independently of physical movement.

Table 1. Research Hypothesis

Suppose	Research Hypothesis
	Variable content
H1	The clarity of instructions has a significant positive impact on the flow experience.
H2	Flow experiences have a significant positive impact on emotional release.
H3	Flow experiences exert a significant positive influence on therapeutic effects.
H4	Emotional expression has a significant positive impact on therapeutic effects.
H5	Group synchrony significantly positively influences therapeutic effects.

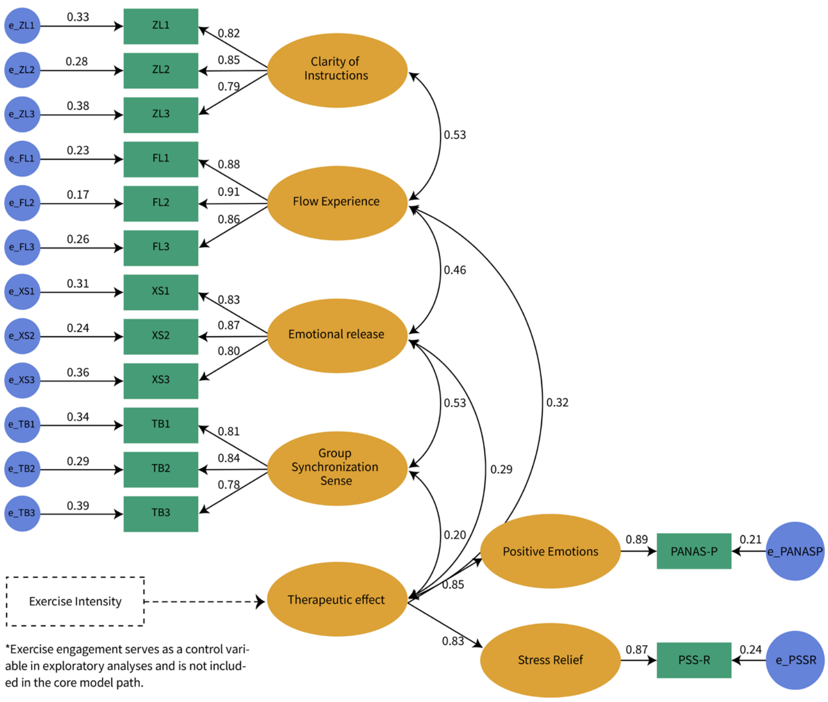

Figure 5. Prescriptive Embodied Interaction Healing Mechanism Hypothesis Model

4. Result

This study aimed to examine the therapeutic effects of directive embodied interaction experiences. Data from 110 participants (55 in the experimental group and 55 in the control group) were included in the analysis. First, to verify the effectiveness of random assignment and assess baseline homogeneity between groups prior to intervention, independent samples t-tests were conducted on pretest PANAS scores. Results indicated no significant differences between groups in positive emotions ($t(108) = 0.37$, $p = .71$) or negative emotions ($t(108) = -0.22$, $p = .83$). These findings indicate that the random assignment procedure successfully balanced baseline data across groups, establishing comparability in core affective measures and providing a reliable foundation for subsequent analysis of intervention effects.

4.1. Changes in Emotional State (PANAS Scale)

To examine changes in emotional states before and after the intervention, I conducted a repeated measures analysis of variance on PANAS scores. Descriptive statistics are detailed in Table 2 and Figure 6.

Table 2. Positive and Negative Emotion Scores for the Two Groups of Participants

Group	Before and after the intervention		
	Measurement Time	Positive Emotions	Negative Emotions
Experimental Group(n=55)	Pre-test	24.35±6.12	17.82±5.89
	Post-Test	29.47±5.83	14.26±4.95
Control Group(n=55)	Pre-test	24.02±5.87	17.65±6.14
	Post-Test	25.18±6.45	17.01±5.72

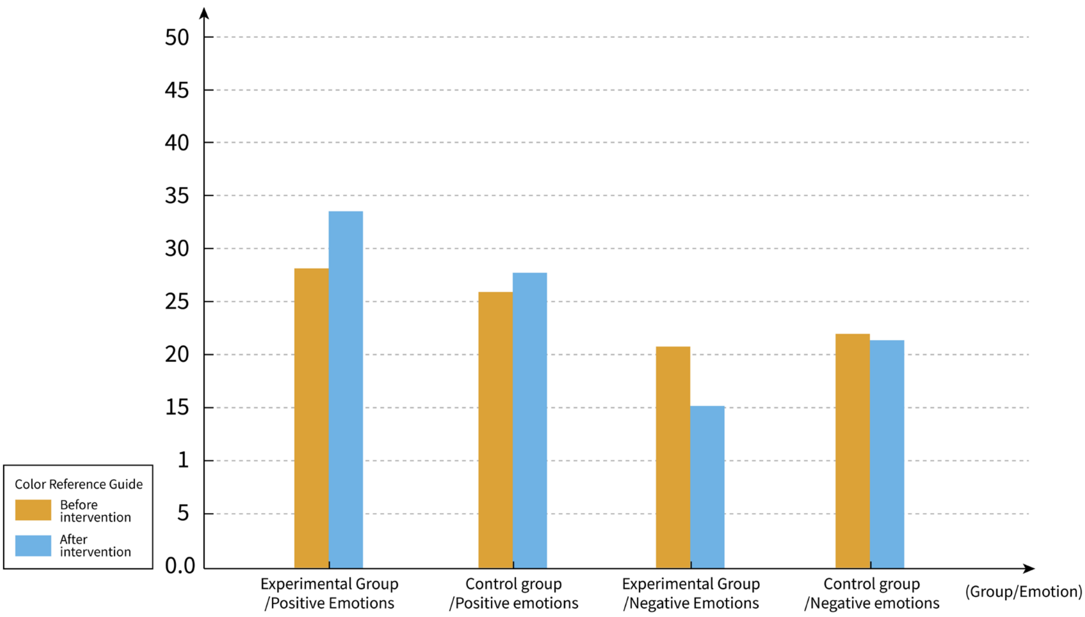

Figure 6. Bar chart showing changes in intervention group scores before and after the intervention

The analysis results indicate:

For positive emotions, the interaction between measurement time and group was significant ($F(1, 108) = 15.78$, $p < .001$, partial $\eta^2 = 0.127$). Simple effects analysis revealed that the experimental group's post-test positive emotion scores were significantly higher than their pre-test scores ($p < .001$) and significantly higher than the control group's post-test scores ($p < .001$). The control group showed no significant change between pre- and post-test scores ($p = .085$).

For negative emotions, the interaction between measurement time and group was significant ($F(1, 108) = 9.54$, $p < .01$, partial $\eta^2 = 0.081$). Simple effects analysis revealed that the experimental group's post-test negative emotion scores were significantly lower than their pre-test scores ($p < .001$) and significantly lower than the control group's post-test scores ($p < .01$). The control group showed no significant change between pre- and post-tests ($p = .256$).

4.2. Intergroup Comparison of Flow Experience (FSS) and Stress Levels (PSS)

To examine the immediate effects of the intervention, we conducted an independent samples t-test to compare post-test flow experiences and stress levels between groups. The results are presented in Table 3.

Analysis results indicate:

The experimental group scored significantly higher on flow experience than the control group ($t(108) = 4.62$, $p < .001$, Cohen's $d = 0.88$).

The experimental group scored significantly lower on stress levels than the control group ($t(108) = -3.66$, $p < .001$, Cohen's $d = -0.70$).

In summary, the quantitative data consistently indicate that, compared to passive viewing, engaging in directive embodied interaction significantly enhances participants' positive emotions, reduces negative emotions, induces higher levels of flow experience, and more effectively alleviates stress. These findings provide robust empirical support for the therapeutic effects of directive embodied interaction.

Table 3. Intergroup comparison of post-test flow experiences and stress levels between the two groups of participants

Dependent variable	Intergroup comparison			
	Experimental group (n=55)	Control group (n=55)	t-value	p-value
Flow Experience	4.32±0.71	3.65±0.82	4.62	<.001
Stress Levels	2.89±0.95	3.58±1.04	-3.66	<.001

4.3. Subdivided Dimensions of Emotional State Analysis

To further investigate the specific effects of directive embodied interaction on emotional states, this study conducted an additional analysis of the subdimensions of the PANAS scale. Drawing on Watson & Clark (1994)'s theoretical framework, we categorized positive emotions into high-arousal positive emotions (e.g., interested, excited, enthusiastic, inspired) and low-arousal positive emotions (e.g., focused, determined); Negative emotions were categorized into high-arousal negative emotions (e.g., annoyed, afraid, tense) and low-arousal negative emotions (e.g., depressed, tired).

Repeated measures ANOVA (2 × 2: pretest vs. posttest × experimental vs. control group) was conducted for each emotional sub-dimension. Descriptive statistics are presented in Table 4.

Table 4. Descriptive Statistics and Interaction Analysis of Emotional Subdimension Scores

Emotional Subdimension	Emotional Sub-Dimension Statistics				
	Group	Pre-test	Post-Test	F(Time × Group)	P-value
High arousal positive emotions	Experimental group	12.45±3.05	16.82±2.91	14.236	<.001
	Control group	12.18 ± 3.21	13.15±3.18		
Low-wakefulness positive emotions	Experimental group	11.90±2.87	12.65±2.74	3.125	.080
	Control group	11.84±2.92	12.03±2.89		
High arousal of negative emotions	Experimental group	9.52±2.75	6.21±2.35	10.874	<.01
	Control group	9.41±2.98	8.95±2.87		
Low arousal negative emotions	Experimental group	8.30±2.64	8.05±2.41	1.457	.230
	Control group	8.24±2.73	8.06±2.68		

The analysis revealed:

Regarding positive emotions, the interaction between measurement time and group was significant for high-arousal positive emotions ($F(1, 108) = 14.24$, $p < .001$, partial $\eta^2 = 0.116$). Simple effects analysis revealed that the experimental group's post-test scores were significantly higher than their pre-test scores (*p* < .001) and significantly higher than the control group's post-test scores (*p* < .001). However, for low-arousal positive emotion, the interaction did not reach significance ($F(1, 108) = 3.13$, $p = .080$, partial $\eta^2 = 0.028$).

For negative emotions, the interaction between measurement time and group was significant for high-arousal negative emotions ($F(1, 108) = 10.87$, $p < .01$, partial $\eta^2 = 0.091$). Simple effects analysis revealed that the experimental group's post-test scores were significantly lower than their pre-test scores (*p < .001) and significantly lower than the control group's post-test scores (*p < .01). For low-arousal negative emotions, the interaction was not significant ($F(1, 108) = 1.46$, $p = .230$, partial $\eta^2 = 0.013$).

These findings indicate that the emotional benefits of directive embodied interaction exhibit clear directionality:

it significantly enhances high-arousal positive emotions associated with excitement and enthusiasm while specifically alleviating high-arousal negative emotions linked to tension and anxiety.

4.4. Testing of the Healing Mechanism Model and Path Analysis

To validate the causal relationships among variables in the theoretical model, this study conducted goodness-of-fit tests and path analysis on the structural equation model. First, confirmatory factor analysis was conducted on the measurement model. Results indicated that composite reliability (CR) for latent variables ranged from 0.862 to 0.918, while average variance extracted (AVE) ranged from 0.602 to 0.735, demonstrating ideal reliability and convergent validity for the measurement model.

Subsequently, model fit was assessed for the structural model. The fit indices were as follows: $\chi^2/df = 2.841$, RMSEA = 0.077, CFI = 0.934, TLI = 0.919. All indices met acceptable standards, indicating good fit between the theoretical model and observed data, enabling path hypothesis testing.

Model path coefficients are presented in Table 5, and hypothesis testing results are shown in Table 6. All standardized path coefficients were statistically significant ($p < 0.05$), and research hypotheses H1 through H5 were supported by the data.

The model validation results confirm the efficacy of the "directive embodied interaction" therapeutic mechanism. Data indicate that clear directives exert their effects by triggering the core psychological process of flow state (H1). Flow state not only directly delivers therapeutic benefits (H3) but also generates additional indirect benefits by facilitating emotional catharsis (H2, H4). Furthermore, group synchrony, as an independent auxiliary pathway, reinforces the ultimate therapeutic effect (H5).

This finding translates theoretical inferences into statistically robust empirical conclusions, fully revealing the dynamic, multi-pathway mechanism that transforms external directive input into internal psychological state changes, ultimately achieving emotional elevation and stress relief.

Table 5. Model Path Coefficient

Path relationship	Model Path Coefficient			
	Estimate	S.E.	C.R.	
ZL1<-- Instruction clarity	0.825	0.052	15.865	***
ZL2<-- Instruction clarity	0.811	0.051	15.902	***
ZL3<-- Instruction clarity	0.798	0.053	15.057	***
FL1<- Flow Experience	0.856	0.048	17.833	***
FL2<- Flow Experience	0.832	0.049	16.980	***
FL3<- Flow Experience	0.819	0.050	16.380	***
XS1<- Emotions should be vented	0.801	0.055	14.564	***
XS2<- Emotions should be vented	0.788	0.056	14.071	***
XS3<- Emotions should be vented	0.763	0.057	13.386	***
TB1<- Group Synchronization Sense	0.792	0.058	13.655	***
TB2<- Group Synchronization Sense	0.781	0.059	13.237	***
TB3<- Group Synchronization Sense	0.755	0.060	12.583	***
Flow Experience <- Instruction Clarity	0.531	0.071	7.215	***
Emotional Release <- Flow Experience	0.463	0.069	6.362	***
Therapeutic Effects ← Flow Experience	0.324	0.082	4.451	***
Therapeutic Effect <-- Emotional Release	0.287	0.075	3.987	***
Therapeutic Effect <- Group Synchronization	0.198	0.068	2.834	0.005

Table 6. Hypothesis Test Results

Suppose	Hypothesis Test Results	
	Variable content	Subheading
H1	The clarity of instructions has a significant positive impact on the flow experience.	Pass
H2	Flow experiences have a significant positive impact on emotional release.	Pass
H3	Flow experiences exert a significant positive influence on therapeutic effects.	Pass
H4	Emotional expression has a significant positive impact on therapeutic effects.	Pass
H5	Group synchrony significantly positively influences therapeutic effects.	Pass

4.5. Exploratory Analysis: Distinguishing Command Effects from Movement Effects

To preliminarily explore whether the "directive" factor functions independently of physical exercise levels, this study conducted an exploratory analysis of the experimental group data (n=55). In this analysis, variables were simplified as follows:

- Directive Clarity: Calculated as the mean score of its three measurement items (ZL1, ZL2, ZL3).
- Exercise Engagement: Calculated as the mean score of its two measurement items (TR1, TR2).
- Flow Experience: Total score from the Flow State Scale (FSS).
- Positive Emotion: Total positive emotion score from the post-test PANAS scale.
- Stress Relief: Reverse-scored total score from the post-test PSS scale (higher scores indicate greater stress relief).
- Descriptive statistics and correlation matrices for each variable are presented in Table 7.

Table 7. Descriptive Statistics for Key Variables in the Experimental Group (n=55)

Variable	Descriptive Statistics for Key Variables in the Experimental Group						
	M	SD	1	2	3	4	5
Instruction Clarity	5.82	1.05	-				
Engagement Level	5.41	1.21	.28*	-			
Flow Experience	4.75	0.89	.42**	.31*	-		
Positive Emotions	3.21	0.76	.38**	.29*	.51***	-	
Stress Relief	3.05	0.81	.31*	.23	.45***	.39**	-

*p < .05, **p < .01, ***p < .001

As shown in Table 7, instruction clarity exhibited significant positive correlations with all three core healing indicators. Concurrently, exercise engagement demonstrated positive correlations with instruction clarity and certain healing indicators.

To further discern these relationships, we calculated partial correlation coefficients between instruction clarity and healing indicators while controlling for exercise engagement. Results revealed:

- The partial correlation coefficient between instruction clarity and flow experience remained significant ($r = .36, p < .01$).
- The partial correlation coefficient between instruction clarity and positive emotion also remained significant ($r = .32, p < .05$).
- The partial correlation coefficient between instruction clarity and stress reduction dropped to near-significance ($r = .25, p = .07$).

This indicates that after statistically controlling for individual differences in physical exertion levels, the association between "instruction clarity" and positive outcomes (particularly flow and positive emotion) persists. This finding validates the theoretical model's positioning of "instruction clarity" as an independent variable, whose effects are not entirely mediated through physical exertion.

5. Discussion

This study systematically examined the therapeutic effects of "directive embodied interaction" represented by the "do it" device through a controlled experiment, while also delving into its underlying mechanisms. The following section will synthesize the findings by integrating quantitative data, qualitative feedback, and the previously constructed theoretical model, ultimately distilling design implications.

5.1. Comprehensive Discussion: The Therapeutic Efficacy and Mechanisms of Directive Embodied Interaction

This study primarily investigated whether "directive embodied interaction" can effectively alleviate stress and enhance positive emotions. The results strongly support its efficacy.

First, quantitative data provide compelling evidence for the existence of therapeutic effects. Repeated measures ANOVA revealed that compared to passive observation, active participation in directive embodied interactions (experimental group) significantly enhanced participants' positive emotions while markedly reducing negative emotions (see Table 1). A more granular analysis of emotional dimensions further reveals that this emotional benefit exhibits clear directionality: it primarily manifests as a surge in high-arousal positive emotions (e.g., excitement, enthusiasm) and a sharp decrease in high-arousal negative emotions (e.g., tension, anxiety) (see Table 3). This directly corroborates the "excitement" and "stress-reducing effects" derived from the interactive experience. Simultaneously, the experimental group reported significantly higher levels of flow experience and significantly lower stress levels in the post-test (see Table 2), fully outlining a therapeutic pathway from positive engagement to deep immersion, culminating in stress relief. The regulatory effect of directive embodied interaction on low-arousal emotions did not reach statistical significance. This specific outcome aligns precisely with the matching effect in emotion regulation—where the characteristics of the regulatory strategy must match those of the regulated emotion to be effective. This experiment induced acute anxiety through a high-arousal stress task. The intervention provided immediate action feedback and dynamic audiovisual stimuli, constituting a high-arousal, action-oriented positive experience. According to the two-dimensional model of affect-arousal, this experience effectively displaced the original high-arousal negative emotion. Conversely, regulating low-arousal emotions (e.g., frustration, fatigue) often involves deeper cognitive restructuring or resource restoration, which poorly matches the embodied, high-arousal attentional allocation strategy employed in this study. Thus, the results not only do not diminish the intervention's value but precisely delineate its psychological boundaries for efficacy: rapidly resetting and transforming high-arousal emotions. Thus, the lack of effect on low-arousal emotions does not indicate intervention failure. Instead, it confirms the precise positioning of directive embodied interaction as a rapid mood-altering strategy: it excels at swiftly counteracting high-arousal negative emotions induced by stressful tasks through high-arousal, embodied positive experiences, replacing them with equally high-arousal positive emotional states.

Second, these quantitative findings align closely with theoretical models and qualitative feedback, collectively revealing the synergistic mechanisms underlying the therapeutic effects. The argument is as follows:

5.1.1 Following instructions reduces cognitive load and directs attention

Following instructions reduces cognitive load and directs attention: Clear audiovisual instructions create a structured task requiring no decision-making. As the literature review indicates, this effectively reduces participants' decision fatigue and initial cognitive load, freeing their consciousness from scattered thoughts and creating the preconditions for immersive mind-body interaction. One participant remarked during an interview: “I didn't have to think about what to do—just follow along. My mind went blank instantly.”

5.1.2 “Body coordination” and “instant feedback” trigger the flow experience

“Body coordination” and “instant feedback” trigger the flow experience: Participants instinctively execute physical movements according to instructions, which are instantly transformed into vibrant visual feedback on the screen, forming a tight “action-feedback” loop. One participant later remarked: " When I saw my movements directly affecting the objects on the screen, I was completely absorbed and lost track of time." This loop perfectly aligns with the core conditions of flow theory—clear goals and immediate feedback—powerfully inducing a state of deep concentration and self-forgetfulness. This is the fundamental reason for the significantly higher flow scores in the experimental group. Moreover, the intrinsic pleasure derived from the flow state itself directly contributed to heightened positive emotions.

5.1.3 “Action metaphors” achieve the symbolic release of emotions

“Action metaphors” achieve symbolic catharsis of emotions: The “process layer” of the theoretical model indicates that everyday actions acquire symbolic meaning within an artistic context. Simple gestures like waving or jumping cease to be functional behaviors during interaction, instead becoming metaphorical symbols of release, connection, and celebration. Participants in interviews stated: “After performing the pushing motion, I instinctively exhaled deeply, as if I had truly pushed away something that was blocking me.” Through the body—the most direct medium—participants unconsciously projected internal pressure and emotions outward, achieving a metaphorical emotional release. This explains why highly arousing negative emotions (tension, anxiety) experienced specific relief.

5.1.4 Group synchronization provides lightweight social support

“Group Synchronization” offers lightweight social support: Although participants operate independently, their actions align temporally and spatially under shared instructions and rhythms. This synchrony creates a subtle collective ritual or communal experience, providing individuals with a sense of micro-social connection—a feeling of “being together.” Feedback from interviews—such as “Even though I'm doing the movements alone, I feel in step with others. It's a comfortable sensation of belonging without scrutiny, generating an inexplicable sense of reassurance”—validates how this subtle social support positively reinforces therapeutic outcomes.

Although the primary conclusion of this study lies in confirming the overall superiority of the integrated intervention known as “Instructional Embodied Interaction,” our exploratory analysis of experimental group data provides valuable validation for the unique role of “instructions.” The analysis revealed that, after controlling for motor engagement, instruction clarity remained significantly correlated with enhanced flow experiences and positive emotions. This implies that among participants with similar self-perceived physical fitness levels, those receiving clearer instructions experienced greater immersion and emotional enhancement. This finding resonates with flow theory's emphasis on “clear goals,” suggesting that the cognitive framework and immediate feedback loop established by clear instructions may yield psychological benefits that transcend the physiological arousal from physical activity alone. It provides preliminary justification for future studies to rigorously isolate these two effects through controlled experimental designs.

In summary, compared to passive viewing, following instructions for embodied interaction yields more pronounced therapeutic effects. Crucially, this effect cannot be attributed solely to physical movement. According to this study's theoretical model, the mechanism is rooted in the tasks elicited by instructions: clear directives reduce cognitive load and channel attention; the closed-loop of instructions and feedback triggers flow states; and the everyday actions guided by instructions gain metaphorical meaning within an artistic context, thereby facilitating emotional release. This entire synergistic psychological pathway is initiated and sustained by the core feature of "directiveness," effectively boosting positive emotions and alleviating stress.

This study rigorously empirically tested the aforementioned theoretical mechanisms using structural equation modeling. The quantitative results triangulated with the theoretical model and qualitative feedback. The model paths revealed that instruction clarity exerts a highly significant direct driving effect on flow experiences ($\beta = 0.531$, $p < 0.001$), confirming that "following instructions reduces cognitive load and directs attention" constitutes the critical first step in the entire healing process. Flow experience serves as a central hub: it not only directly contributes to healing effects ($\beta = 0.324$, $p < 0.001$) but also significantly positively influences emotional catharsis ($\beta = 0.463$, $p < 0.001$). Structural equation modeling quantitatively demonstrated that instructions serve not merely to initiate interaction, but to create and sustain a highly immersive "action-feedback" flow loop, thereby ensuring sustained emotional catharsis. Furthermore, group synchrony was confirmed to make an independent direct contribution to the therapeutic effect ($\beta = 0.198$, $p = 0.005$). This aligns with the therapeutic value of micro-social connection experiences mentioned in interviews, such as the "unexplained sense of reassurance."

5.2. Practical Insights: Design Approaches for Public Art Therapy

The findings of this study provide clear theoretical foundations and practical guidelines for designing low-barrier, high-impact art therapy experiences in public spaces.

First, this study clearly reveals the core therapeutic mechanisms of the "directive embodied interaction" design paradigm, which translates abstract healing principles into manipulable design elements: "following instructions" serves as the starting point for guiding attention, "physical collaboration" acts as the vehicle for embodied cognition, "immediate feedback" is key to sustaining flow, while "action metaphors" and "group synchronization" function as catalysts for deepening emotional and social effects.

Based on this, we offer the following specific recommendations for designers seeking to create healing public art experiences:

5.2.1 Instruction design must be clear, concise, and intuitive

Avoid complex decisions, allowing participants to engage in action without deliberation, thereby minimizing cognitive load.

5.2.2 Interaction mechanisms must rely on physical participation and provide immediate feedback

Design should focus on eliciting substantial physical movements, ensuring each action receives an immediate and clear visual, auditory, or tactile response to establish a robust flow loop.

5.2.3 Uncovering the metaphorical potential of everyday actions

When designing interactive flows, consciously select and employ everyday actions that inherently carry emotional symbolism—such as "push away," "embrace," or "leap up"—to facilitate metaphorical expression and release of emotions.

5.2.4 Can incorporate lightweight group synchronization elements

By synchronizing rhythmic commands, shared audiovisual experiences, or synchronized feedback effects, we cultivate a sense of collective presence without forcing direct social interaction. This fosters micro-social connections and enhances the collective dimension of healing.[18]

5.3. Experimental Design and Methodological Limitations

This study demonstrated through a controlled experiment that directive embodied interaction, as an integrated intervention, yields significant benefits in emotion regulation, flow experience, and stress reduction. Exploratory analyses within the experimental group further revealed that, after controlling for motor engagement levels, directive clarity remained a robust predictor of positive outcomes. However, constrained by the current experimental framework comparing active participation versus passive observation and relying on self-reported data, the study could not further isolate the precise contribution of "instructions" versus 'movement' at the group level. Future research could introduce a "free movement" control group and employ more objective behavioral measures to precisely quantify the incremental validity of the "instruction" component, thereby enabling a more accurate assessment of core elements in interactive healing design.

Second, regarding ecological validity, this study was conducted in a quiet, controlled laboratory setting—ideal for validating core psychological mechanisms but markedly different from real public art environments. This discrepancy implies that extrapolating findings to open, complex public spaces faces practical challenges stemming from environmental heterogeneity, crowd dynamics, and social psychology. To systematically examine the robustness and inclusivity of this interaction model in practical applications and provide more concrete guidance for future spatial transformations, the following sections will analyze these potential challenges.

5.4. Real-world Challenges in Public Space Applications

Although this study validated the therapeutic mechanisms of directive embodied interaction, its implementation in open, uncontrolled public spaces will encounter a series of complex challenges not addressed in laboratory settings. This process is not merely a technical transfer but a profound redesign requiring deep adaptation to social, environmental, and behavioral psychological contexts.

5.4.1 The complexity of crowd dynamics and uneven engagement levels

Participants in public spaces exhibit significant variations in motivation, age, cultural background, and physical abilities, which may lead to uneven levels of engagement. Some audience members may actively participate, while others merely observe, creating an implicit disturbance between performers and spectators that undermines the emergence of collective synchrony. Designing multi-entry, multi-tiered interactive pathways that facilitate a smooth transition from passive observation to deep engagement is crucial for ensuring inclusive experiences across diverse groups.

5.4.2 Environmental Disturbances and Spatial Mobility

Distractions in public spaces—such as noise, fluctuating light levels, and passing crowds—can disrupt the integrity of the closed-loop process from instruction to feedback, hindering the maintenance of flow states. Additionally, participants entering or leaving at any time fragments the experience, making it difficult to ensure the sustained immersion required for healing. Design must prioritize environmental adaptability, such as employing strong audiovisual cues to counteract distractions or establishing clear session durations and structured checkpoints.

5.4.3 Social Psychology and Behavioral Constraints

Performing physical actions in public settings may trigger heightened self-awareness, social awkwardness, or behavioral hesitation, particularly when engaging in high-arousal movements such as jumping or shouting. Unlike the relatively private and secure laboratory environment, such settings may inhibit the full expression of emotional release. Design solutions must balance the visibility of actions with social acceptability, potentially employing techniques like concealment or anonymization to reduce social pressure.

5.4.4 Reliability and Scalability of Technology Implementation

Public installations must endure prolonged exposure to fluctuating climates and intensive use, presenting challenges in equipment stability, maintenance costs, and the immediacy of interactive feedback. Simultaneously, these installations must support simultaneous or asynchronous participation by multiple users, placing heightened demands on system concurrency processing and spatial audio-visual planning.

Despite the limitations of the experimental methods and future application scenarios mentioned above, this study, as a foundational investigation rigorously verifying core mechanisms under controlled conditions, holds value in that it experimentally establishes for the first time the efficacy of the “directive embodied interaction” pathway and reveals its underlying operational model. This lays the necessary theoretical groundwork for subsequent in-depth research and design translation.

6. Conclusion

This study aims to systematically investigate how “directive embodied interaction” art installations produce therapeutic effects. By constructing an “input-process-output” theoretical model and empirically testing it using Yugo Nakamura's “do it” installation as a case study, Experimental data confirms the significant therapeutic value of this interactive model. Compared to passive observation, embodied participation significantly enhances participants' positive emotions and flow experiences while effectively reducing negative emotions and stress levels. In-depth dimensional analysis further reveals that its effects are specific, primarily manifested in activating high-arousal positive emotions and alleviating high-arousal negative emotions. Second, this study validated its underlying mechanism. The therapeutic effect stems from a coherent psychophysiological process: clear instructions guide attention and reduce cognitive load; bodily actions and immediate feedback form a closed loop, inducing deep flow; while movement metaphors and group synchronization facilitate symbolic emotional release and micro-social connection, respectively. In summary, this study not only confirms directive embodied interaction as an effective public art healing pathway but also, as an initial mechanistic exploration of this pathway, demonstrates its therapeutic efficacy in non-clinical, low-threshold, gamified settings. Furthermore, by revealing its underlying mechanisms, it translates the embodied cognitive principle of “mind-body-environment unity” into designable, actionable strategies. These can be widely applied in museums, public squares, community centers, and even online virtual spaces. This provides a solid theoretical foundation and practical guidance for constructing public art environments with enhanced mental health promotion capabilities, laying crucial groundwork for future applications and evaluations in more complex real-world settings.

Acknowledgements.

Jiangsu Provincial Higher Education Teaching Reform Research Project - Priority Project: Innovation in Art and Design Talent Cultivation Models from a Moral Education Perspective (2025JGZZ03); Jiangsu Provincial Brand Major Construction Project Phase III - Product Design (4243042404).

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