

Designing for Emotional Granularity in VR Meditation: Understanding Emotional Flow in Immersive Experiences

Nian-Hao Chen, National Yunlin University of Science and Technology, Taiwan
Wen-Shan Chang, National Yunlin University of Science and Technology, Taiwan

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Abstract

This study aimed to design an immersive Virtual Reality (VR) meditation experience and explore its potential impact on emotional granularity. Emotional granularity refers to an individual's ability to identify and describe emotions with precision, which is closely linked to emotional regulation and psychological well-being. In this project, a multisensory VR meditation system was developed, incorporating visual, auditory, and guided components to create a calming and immersive environment. 8 participants were invited to engage with the experience. To assess changes in emotional granularity, participants completed an emotional granularity scale before and after the VR meditation session. The results showed that many participants demonstrated improved emotional awareness and finer distinctions in emotional expression after the experience. These preliminary findings suggest that immersive VR meditation may be an effective approach for enhancing emotional clarity and fostering self-awareness. Furthermore, the study contributes to a growing body of research exploring the role of emerging technologies in supporting emotional development. The outcomes offer early design insights for future applications of VR in the fields of mental wellness, relaxation, and interactive experience design, particularly in contexts where traditional meditation practices may be less accessible or more difficult to sustain. By combining immersive environments with mindful practices, this research provides a foundation for future interdisciplinary efforts aiming to support emotional health through technology-enhanced interventions.

Keywords: meditation, emotional granularity, virtual reality

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Research Background

This study explores the impact of immersive virtual reality meditation (VR Meditation) on emotional granularity and analyzes its potential for promoting mental health. In today's high-pressure environments, individuals face multiple sources of stress, leading to increasing difficulties in emotional regulation and heightened risks of anxiety and depression.

Emotional granularity refers to an individual's ability to identify and differentiate between emotional experiences, and it is closely linked to effective emotion regulation strategies. High emotional granularity helps reduce psychological distress and stress responses (Hoemann et al., 2022), whereas low emotional granularity often leads to emotional confusion and greater psychological burden (Wang et al., 2018).

Meditation has been widely applied in emotional regulation and stress reduction, but traditional meditation often requires specific time and environmental conditions. Virtual reality meditation, through immersive sensory stimulation and simulated environments, effectively enhances focus and the quality of relaxation (Navarro-Haro et al., 2017), and has demonstrated benefits for emotional stability and psychological resilience in various studies (Beverly et al., 2022; Kaplan-Rakowski et al., 2021).

This study aims to validate the effectiveness of VR meditation in enhancing emotional granularity and emotional regulation, and to propose its feasibility as a modern mental health intervention.

Research Objectives

Virtual Reality (VR) technology has been widely applied in the field of psychological healing, particularly showing positive effects in alleviating stress, anxiety, and depression. Integrating VR with meditation offers a novel immersive relaxation experience and is regarded as a promising psychological intervention approach. However, current research on VR meditation largely remains at the exploratory stage and lacks systematic evaluation.

This study aims to examine the effects of immersive VR meditation on emotional regulation, with a particular focus on changes in emotional recognition and psychophysiological responses. By integrating subjective questionnaires with objective instrument-based assessments, the study develops a novel evaluation process to address the limitations of existing research, which often relies on single-scale measurements.

At the emotional level, the study investigates whether VR meditation can facilitate positive emotional shifts and induce relaxation in terms of arousal. From an applied perspective, the findings aim to provide empirical support for the design of VR meditation experiences, helping to establish more effective and theoretically grounded operational guidelines, and further enhancing its application value in promoting mental health.

Literature Review

Emotional Granularity

Emotional granularity refers to an individual's ability to accurately identify, distinguish, and describe different emotional states (Lin et al., 2024; Wang et al., 2018). This ability is closely related to mental health—individuals with high emotional granularity are less likely to engage in maladaptive behaviors such as alcohol abuse or binge eating when facing stress, and they tend to experience lower levels of depression and anxiety (Li et al., 2024). Moreover, they are more effective at regulating emotions and exhibit greater psychological resilience and emotional insight (Cortiz et al., 2021; Demichelis et al., 2023).

The development of emotional granularity relies on diverse life experiences, cultural stimuli, and the accumulation of emotional vocabulary (Hoemann et al., 2022). Studies have shown that individuals with high granularity demonstrate greater emotional sensitivity and empathy in interpersonal interactions (Lindquist et al., 2014), and they are also able to make more accurate decisions during decision-making processes (Gendron & Barrett, 2019). The value of emotional granularity extends beyond the field of mental health—it has also been applied in artificial intelligence, affective computing, and emotion recognition technologies (Fong & Kumar, 2020).

In terms of assessment, in addition to traditional questionnaires such as PANAS, researchers have integrated semantic analysis, physiological data, and virtual reality simulations to improve the accuracy and ecological validity of measurements (Montana et al., 2020; Shamim & Muazzam, 2020). Virtual reality, in particular, offers an immersive training platform that helps users practice emotion recognition and regulation (Bertagni et al., 2023).

Stress

In modern society, stress has become a widespread factor critically impacting both mental and physical health. Surveys show that up to 22.2% of Taiwanese university students frequently feel depressed, and 13.2% exhibit significant depressive tendencies. Stress is essentially a physiological response to perceived threats. When left unmanaged over time, it may develop into chronic stress, leading to dysregulation across emotional, behavioral, immune, and cognitive systems. The convergence of the pandemic, work pressure, and social expectations has further intensified stress levels—especially in high-pressure professions such as nursing or research and development, which are prone to burnout and emotional exhaustion (Metreveli & Japaridze, 2022).

Chronic stress not only increases the risk of mental illness but also weakens immune function, contributes to cardiovascular problems, and raises healthcare costs. Emotional granularity and psychological resilience are recognized as effective stress-regulating factors, helping individuals more precisely identify stressors and adopt suitable coping strategies. Studies have also shown that non-pharmacological interventions such as meditation and mindfulness can significantly reduce stress responses, enhance resilience, and improve quality of life (Park, 2013).

Among adolescents and university students, common stressors include academic pressure, health-related anxiety, and family expectations. Their psychological resilience is often vulnerable and requires early intervention to prevent future mental health issues (Liu, 2012).

Stress not only affects short-term emotional states but also has long-term implications for career development and social adaptation.

Modern stressors are increasingly diverse and complex, including job insecurity, financial strain, and the intrusion of technology into personal life. Long working hours and low control are among the main risk factors. Research also highlights that social support is a critical protective factor that can effectively buffer the effects of stress. Conversely, the lack of emotional or material support exacerbates stress and contributes to anxiety and depression (Wang & Chen, 2014; Viertiö et al., 2021).

Additionally, sociocultural context and media narratives shape how stress is perceived and expressed. For example, the concept of “anxiety inheritance” in Western culture influences public understanding and responses to mental illness (Rebughini, 2021). In times of intense healthcare and education reform, public awareness of stress is further amplified (Kirby, 2022).

On the physiological level, stress can be quantified through biomarkers such as cortisol, while on the psychological level, it often manifests as symptoms of anxiety and depression. Moreover, women tend to experience higher levels of perceived stress due to social role expectations and unequal access to resources (Bolíbar et al., 2021; Viertiö et al., 2021).

Table 1

Summary Table of Stressors

Current Sources of Stress	Description	References
Job Demands and Control	High job demands combined with low control over work tasks are associated with mental health issues such as depression and anxiety, particularly affecting young adults.	Wang & Chen, 2014
Unstable Employment	Temporary contracts, lack of job security, and insufficient social welfare contribute to chronic stress and exacerbate health inequalities.	Bolíbar et al., 2021
Work-Family Conflict	Stress arises from balancing work and family responsibilities. Women experience higher stress levels when work interferes with family life.	Viertiö et al., 2021
Major Life Events and Daily Hassles	Major life events such as illness or financial hardship, along with minor daily hassles, interact with job stress and significantly influence overall stress perception.	Sørensen et al., 2021
Social Support	Lack of social support intensifies stress, while strong social networks can buffer its effects. Support also serves a moderating role, reducing the negative impact of work stress on mental and physical health.	Sørensen et al., 2021; Viertiö et al., 2021; Wang & Chen, 2014
Media-Related Stress	Media representations of stress can amplify perceived stress, especially in fields undergoing transformation such as healthcare and education.	Kirby, 2022
Psychological Distress	Stress is closely linked to symptoms of anxiety and depression, with women being more frequently affected, indicating gender differences.	Viertiö et al., 2021

Meditation

Meditation is a mental and spiritual practice rooted in diverse cultural and religious traditions, encompassing various forms such as mindfulness, compassion, insight (Vipassana), and yoga (Lin, 2017). Modern scientific research has shown that meditation can effectively reduce anxiety, depression, and stress, enhance positive emotions, and improve emotional regulation, making it a valuable tool for promoting mental health. Clinical evidence also indicates that meditation helps alleviate psychological stress responses in cardiovascular patients and supports emotional regulation in individuals with post-traumatic stress disorder (PTSD) and chronic illnesses (Malaktaris et al., 2022).

Mindfulness meditation, which emphasizes present-moment awareness, promotes emotional stability and activates brain regions associated with positive affect, and is widely applied in stress reduction and emotion-focused therapies. Loving-kindness meditation cultivates goodwill and empathy, fostering inner calm and enhancing interpersonal understanding. Insight meditation focuses on observing change and impermanence, helping individuals let go of emotional attachments. Yoga meditation, which integrates physical movement and breath control, has demonstrated significant benefits for anxiety, insomnia, and emotional resilience (Tellhed et al., 2019).

With technological advancements, online guided meditation has become increasingly accessible through apps and virtual courses, also showing benefits in reducing anxiety and depression. Although meditation is generally effective for most individuals, it may have adverse effects for those with severe emotional distress and should be approached with caution. Meditation, which combines emotional regulation, cognitive training, and stress management, offers an evidence-based emotional healing method for modern individuals and has been shown to positively influence long-term mental health outcomes (Koh et al., 2022).

Virtual Reality (VR) Technology

Virtual Reality (VR) technology has shown remarkable potential in the field of emotional and mental healing. Its highly immersive nature effectively isolates users from external distractions, creating a personalized and safe psychological space that facilitates relaxation and self-awareness. Studies have shown that VR interventions can improve stress and reduce negative symptoms in 65% of individuals with mental health conditions. By incorporating natural environments and sensory stimuli, VR experiences can enhance emotional stability and positive affect (Seabrook et al., 2020).

In the context of meditation support, VR helps guide users into deeper states of mindfulness. Through visual, auditory, and voice-guided elements, it enhances the quality of meditation and improves concentration. Many of these systems also integrate breath-based biofeedback technologies to assist with emotional regulation and stress relief (Rockstroh et al., 2021).

The key advantage of VR lies in its ability to offer highly personalized healing environments—from forests and water scenes to soft ambient lighting—tailored to individual needs, thereby increasing the appeal of meditation and its therapeutic effectiveness (Seabrook et al., 2020). Further research has also shown that immersive VR experiences can enhance self-awareness, reduce anxiety and emotional distress, and contribute to long-term improvements in psychological well-being (Matamala-Gomez et al., 2021).

Literature Summary

In the context of increasing stress in modern society, effective emotional healing has become a crucial issue in mental health. Emotional granularity, as the ability to identify and regulate emotions, enables individuals to maintain greater stability and resilience under stress, thereby reducing the risk of negative emotions and maladaptive behaviors. When stress remains unaddressed over time, it can lead to physical and psychological distress, disrupting emotional balance and lowering quality of life.

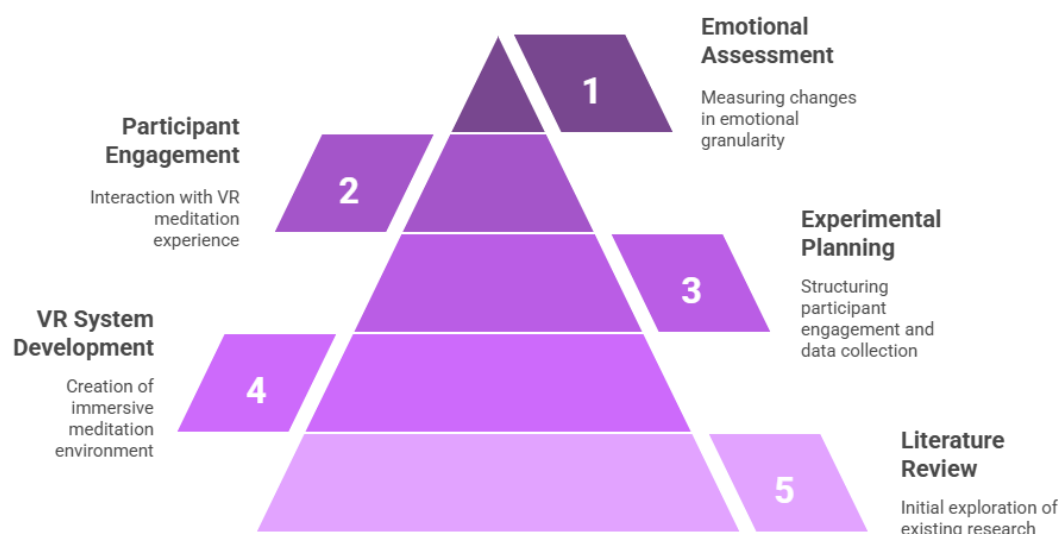
Meditation is widely regarded as an effective self-regulation tool. Through breath awareness and inward focus, it helps stabilize emotions, alleviate stress, and enhance positive psychological experiences. When combined with virtual reality (VR) technology, meditation's healing potential is further expanded. The immersive visuals and sensory stimulation provided by VR allow users to enter a more relaxed state more easily, promoting emotional stability and self-awareness.

Overall, VR meditation demonstrates promising and evidence-based therapeutic value in fostering emotional granularity and relieving stress, offering a feasible and innovative approach to emotional healing in today's demanding environment.

Research Design

This study aims to explore the impact of immersive Virtual Reality (VR) meditation experiences on emotional granularity and to describe the overall research design and implementation process. The study followed a multi-phase structure, including a preliminary literature review, development of the VR meditation system, and experimental planning. The system integrates visual, auditory, and guided voice elements to create an immersive meditation environment that supports relaxation and emotional awareness. A total of 8 participants were invited to engage with the experience. Emotional granularity was assessed before and after the meditation using a designated scale to observe changes in emotional identification and expression. The overall design emphasizes the integration of immersive experience and emotional perception, providing a practical foundation for future studies and related applications.

Figure 1
VR Meditation Research Process



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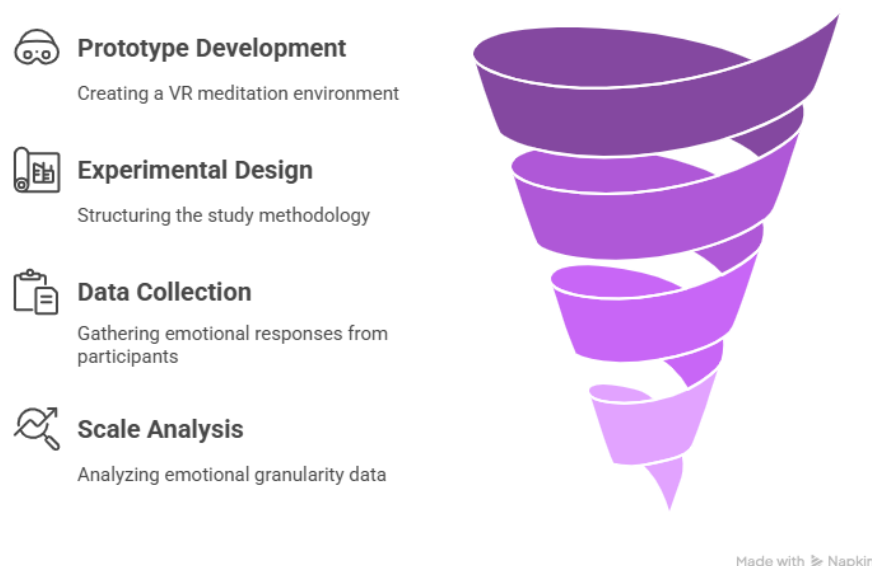
Research Procedure

This study aims to explore the impact of immersive virtual reality (VR) meditation experiences on emotional granularity by constructing a comprehensive experimental framework through a multi-stage process and interdisciplinary methods. The research involved a sequence of literature review, prototype development, and experimental design, integrating psychological theories with VR technology to create a highly immersive meditation environment.

Throughout the process, the Emotional Granularity Scale was employed to systematically collect participants' emotional responses before and after the meditation experience. The study examined the potential benefits of VR meditation in enhancing emotional awareness and improving emotional granularity through scale analysis of pre- and post-test assessments.

The findings not only demonstrate the therapeutic value of immersive meditation but also provide an empirical foundation for future research design and technological development in related fields.

Figure 2
Enhancing Emotional Granularity Through VR Meditation



VR Interface Presentation

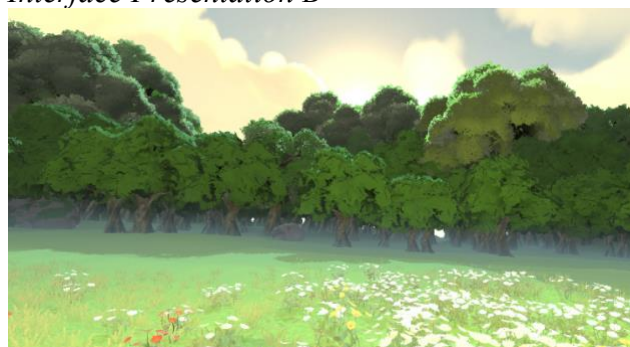
This system integrates visual design and interaction design to establish its core value and user appeal. The visual design adopts a minimalist and nature-inspired style, using soft color tones and delicate lighting to create an immersive meditation atmosphere. Elements such as clouds, trees, and flowing water are rendered with realistic dynamic effects, offering users a lifelike natural experience. Previous research has shown that virtual natural environments contribute to stress relief and emotional restoration, effectively compensating for the lack of nature in modern urban life.

The interaction design emphasizes a natural and intuitive user experience by incorporating touch and gesture recognition, along with real-time visual and voice feedback. The system also considers users of different ages and cultural backgrounds to enhance overall usability. Within the meditation scenes, changeable visual elements are embedded to help guide users into deeper meditative states.

The following images illustrate the final visual presentation of the system.

Figure 3
Interface Presentation A



Figure 4*Interface Presentation B***Figure 5***Interface Presentation C*

Research Methods - Emotional Granularity Scale

The Emotional Granularity Scale (EGS) is a tool used to assess the degree to which individuals differentiate their emotional experiences. The level of emotional granularity is closely associated with one's ability in emotional regulation and psychological well-being. In this study, the EGS is used to analyze users' subtle emotional changes during interaction with the system. By collecting data through this scale, researchers can gain deeper insights into the emotional nuances experienced by users. Participants with high emotional granularity are better able to describe their emotional experiences in detail, providing concrete references for future system optimization. Additionally, emotional granularity data can support the design of more targeted and context-sensitive feedback mechanisms, thereby enhancing user experience and improving system effectiveness.

The scale consists of 12 items, among which Items 1, 5, 9, and 11 are reverse-scored. These items must be recoded during scoring to ensure the accuracy and consistency of the overall evaluation. This design helps verify the internal consistency of participant responses and reduces potential response bias caused by habitual answering patterns, thereby improving the reliability and interpretability of the scale.

Table 2*Emotional Granularity Scale*

No.	Statement	Not at all true → Strongly true				
		1	2	3	4	5
1	In daily life, I do not experience many different kinds of feelings. (R)	1	2	3	4	5
2	I can notice subtle or fine distinctions within a particular emotional state.	1	2	3	4	5
3	Throughout my life, I have experienced many different kinds of feelings.	1	2	3	4	5
4	Each emotion has a clear and distinct meaning to me.	1	2	3	4	5
5	The emotions I frequently experience are limited. (R)	1	2	3	4	5
6	I tend to make clear distinctions between similar feelings.	1	2	3	4	5
7	I experience a rich and diverse range of emotions.	1	2	3	4	5
8	I am aware that each emotion has a completely different meaning.	1	2	3	4	5
9	In everyday life, I don't feel a wide variety of emotions. (R)	1	2	3	4	5
10	If emotions were described as colors, I would be able to notice subtle differences within each color.	1	2	3	4	5
11	Expressions like "feel good" or "feel bad" are enough to describe most of how I feel in daily life. (R)	1	2	3	4	5
12	Among all emotional experiences, I can sense the fine differences between them.	1	2	3	4	5
13	I want to experience a wide and diverse range of feelings.	1	2	3	4	5
14	I am very good at distinguishing subtle differences between nuanced emotional terms.	1	2	3	4	5

Note. Adapted from "Individual Differences in Emotional Complexity: Their Psychological Implications," by S.-M. Kang and P. Shaver, 2004, *Journal of Personality*, 72(4), pp. 687–726.

Research Analysis

To investigate the impact of immersive Virtual Reality (VR) meditation experiences on participants' emotional awareness and expression abilities, this study employed the Emotional Granularity Scale administered before and after the meditation session. Emotional granularity refers to an individual's ability to describe and categorize emotional experiences in a nuanced, precise, and differentiated manner. Research has shown that individuals with high emotional granularity tend to perform better in emotional regulation, psychological well-being, and stress management, and are more capable of engaging in emotional self-reflection and social interaction.

In this experiment, a total of 8 participants completed both pre- and post-test measurements. By comparing changes in total scores, this study conducted an initial evaluation of the potential effectiveness of immersive meditation experiences in enhancing emotional granularity. The summarized results are shown in the table above, indicating that most

participants exhibited notable positive changes after the experience. The following section provides a detailed analysis of the data, exploring individual differences, potential influencing factors, and possible interpretations, as well as suggestions for future research.

Table 3

Emotional Granularity Scale Results

Participant	Pre-test	Posttest	Change
B 林 O 凱	18	24	+6
D 陳 O 吟	36	36	+0
F 丁 O 珊	27	33	+6
G 徐 O 謐	1	23	+22
I 陳 O 綺	16	23	+7
J 劉 O 毅	24	23	-1
L 林 O 柔	29	31	+2
M 李 O 霆	17	32	+15

Research Findings

A total of 8 participants were invited to complete pre- and post-assessments using the Emotional Granularity Scale, in order to compare total score differences before and after the meditation experience and evaluate changes in emotional granularity.

Overall most participants showed improvement in emotional granularity after the immersive virtual reality meditation, indicating enhanced ability to identify and differentiate emotional nuances. The most significant change was observed in G 徐 O 謐, whose score increased dramatically from 1 (pre-test) to 23 (post-test), a 22-point gain demonstrating substantial positive growth. M 李 O 霆 also showed a remarkable improvement of 15 points, suggesting a clear enhancement in emotional awareness and expression.

Other participants, such as B 林 O 凱 (+ 6), F 丁 O 珊 (+ 6), I 陳 O 綺 (+ 7), also demonstrated steady progress, reflecting the general effectiveness of the meditation experience in enhancing emotional granularity.

A few exceptions were also observed. For instance, J 劉 O 毅 (- 1) had slightly lower post-test scores compared to pre-test. D 陳 O 吟 showed no change between pre- and post-tests. These cases may be associated with individual baseline emotional stability, psychological state during measurement, or limitations in the scale's sensitivity to certain emotional shifts. Future studies could explore these factors further through qualitative data and expert interviews.

The pre- and post-test results of the Emotional Granularity Scale support the hypothesis that immersive virtual reality meditation may enhance individuals' emotional awareness and fine-grained differentiation ability, showing promising potential as an emotional healing intervention.

Research Conclusion

This study examined the impact of immersive virtual reality (VR) meditation on emotional granularity by analyzing pre- and post-assessment data from 8 participants using the Emotional Granularity Scale. The results showed that most participants experienced an increase in total scores after the VR meditation session, indicating improved emotional recognition and finer differentiation. Among them, participants such as G 徐 O 謐 and M 李 O 霆 demonstrated particularly significant progress, reflecting highly positive changes. Additionally, several other participants showed steady improvement, suggesting a general emotional enhancement effect provided by the VR meditation experience.

Although a few participants exhibited either decreased scores or no change, this may be preliminarily attributed to factors such as individual emotional baselines, momentary psychological states, or the sensitivity of the measurement tool. Further qualitative investigation is needed to better understand these outcomes. Nevertheless, the overall quantitative findings support the research hypothesis: immersive VR meditation can enhance individuals' emotional awareness and their ability to make fine-grained distinctions between emotional states. These results demonstrate its empirical potential and practical value as an emotional healing intervention.

Research Recommendations

Based on the findings and research process of this study, the following three recommendations are proposed for future research and practical applications:

1. *Expand Sample Size and Diversify Participant Backgrounds*

This study involved a limited sample size, primarily composed of younger individuals with a certain level of technological proficiency. Future research is encouraged to expand the sample size to include participants of varying ages, genders, and cultural backgrounds, in order to examine the applicability and impact of immersive virtual reality meditation across different populations and enhance the external validity of the findings.

2. *Integrate Qualitative Data and Longitudinal Follow-Up*

This study focused on short-term pre- and post-assessments, which provide only a preliminary view of changes in emotional granularity. To better understand the long-term effects of VR meditation, future research could incorporate qualitative methods such as in-depth interviews, participant observation, or self-recorded journals, along with longitudinal follow-up, to capture the deeper and lasting influences of the meditation experience on emotional development.

3. *Optimize System Design and Interactive Interface*

Participants responded positively to the immersive quality and interactive feedback of the meditation environment, suggesting strong potential for real-world application. Future improvements could include personalized adjustment mechanisms based on user needs, as well as the integration of AI-guided adaptation, emotion recognition modules, and real-time feedback from physiological data, in order to enhance the precision and therapeutic effectiveness of the meditation experience.

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Contact email: nianhao0906@gmail.com