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The Application of Liminal Space Aesthetics in Building Space for Stress Alleviation among Young Adults

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The Application of Liminal Space Aesthetics in Building Space for Stress Alleviation among Young Adults

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ABSTRACT

Stress is a growing concern among young adults in the digital era, yet existing therapies often require professional guidance or long-term practice, making them less accessible for urban citizens with limited time. Therapeutically designed spaces, especially those inspired by liminal aesthetics, may provide a low-demand, immersive intervention for stress relief. This pilot study investigates whether liminal space aesthetics can reduce mild-to-moderate stress in young adults. 18 participants (aged 18–22) were randomly assigned to either a liminally designed room or a neutral control room. Stress levels were measured through physiological indicators as for heart rate variability (HRV) and blood oxygen saturation (SpO2), psychological assessments as for Stress Appraisal Measure (SAM) and Emotional-Stress Reaction Questionnaire (ESRQ). Preliminary analysis indicated that exposure to the liminal space significantly lowers stress markers, with participants reporting enhanced calmness and detachment compared to the control group. For example, average heart rate reduction was greater in the experimental group than in the control group. The foundational findings suggested that liminal aesthetics hold therapeutic potential as a passive, cost-effective, and scalable method for stress alleviation in educational and clinical environments, with future applications in schools, offices, and public spaces.

1. Introduction

Table 1. *Introduction Outline*.

Part	Content	Example phrase
Background	Stress in the Digital Era An increase in students experiencing stress [1]. High school student stress levels in Vietnam signaling an urgent need for intervention [2], [3]	"A global increase in psychological stress... multiple aspects of life."
Problem	Information Overload and Attention Fragmentation The Pressure of Constant Presence	"The continuous influx of information..."
Related work	Relaxation and meditation [4], [5], music therapy [6], and pharmacological approaches	"However, each presents limitations..."
Objective	Liminal Aesthetic as a Therapeutic Approach to Digital-Era Stress	"Liminal aesthetics may serve as a psychological counterbalance..."
Paper organization	Section 2 provides a comprehensive literature review exploring the psychological impacts of liminal spaces and sensory-rich environments. Section 3 outlines the research gap identified from previous studies, while Section 4 defines the core research questions and hypotheses. Section 5 and Section 6 present the	"The rest of this paper is organized as follows…"

statement of purpose and the value statement of this research, respectively.

1.1. *Background*

1.1.1. Stress in the Digital Era

Stress is defined as a challenged homeostatic state comprising three forms, among which distress represents adverse stress harmful to health [7]. Recent studies indicate a global increase in psychological stress [1], with most students experiencing it in multiple aspects of life [8]. In Vietnam, high student stress levels have been reported, signaling an urgent need for intervention [2], [3].

While traditional stressors - academic demands, family conflict, and social expectations - persist, the 21st century has introduced digital-era stress, characterized by its constant, diffuse, and uncontrollable nature [9]. Two mechanisms primarily drive this phenomenon:

Table 2. *Information Overload and the Pressure of Constant Presence*.

Theme	Mechanism/Cause	Consequence
Information overload and Attention fragmentation	Constant information influx exceeds working memory; multitasking impairs attentional control [10], [11]	Disorientation, stress, impaired emotional regulation [11]
Pressure of constant presence	"Always-on" culture erodes work-life boundaries [12]	Dependency, sleep loss, fatigue, reduced resilience, anxiety/depression risk [12], [13]

1.1.2. Current Therapies for Stress

Evidence-based interventions such as Cognitive Behavioral Therapy (CBT) [14], [15]; relaxation and meditation [4], [5]; music therapy [6], and pharmacological approaches have shown efficacy. However, each presents limitations: CBT and medication require trained professionals and financial resources [16]; music therapy can induce fatigue [17]; and meditation demands long-term adherence [4]. These barriers highlight the need for a low-cost, non-cognitive, passive, and time-efficient stress-reduction method.

1.1.3. Concepts of Liminal Space and Its Aesthetic

Table 3. *Liminal Space and Liminal Space Aesthetic*.

Concept	Definition/Origin	Key characteristics and relevance
Liminal space	Latin *limen* ("threshold"); transitional zones between defined spaces [18], [19]	Elicits unease/introspection [20]; therapeutic potential ("psychitecture")
Liminal Space Aesthetic	Internet-culture aesthetic of empty, surreal, uncanny-familiar spaces [21], [22]	Surrealism, nostalgia, soft ambiguity to induce calm/detachment

1.1.4. Theoretical Basis

Table 4. *The theoretical framework.*

Theory	Source	Core argument	Relevance to Liminal spaces
Embodied Cognition Theory	Lakoff & Johnson [23]; [24], [25]	Cognition arises through bodily engagement, not just the brain	Multisensory cues elicit embodied emotional regulation
Stress Reduction Theory (SRT)	Ulrich [26]; [27]	Nature elicits evolutionary restorative responses	Biophilic elements reinforce relaxation
Attention Restoration Theory (ART)	Kaplan [28]	"Being away," "extent," "soft fascination" restore attention	Blurred boundaries mirror restorative conditions, avoid overstimulation
Environmental Preference & Arousal Theories	Berlyne; Kaplan [29]	Preference for balance of novelty and familiarity	Nostalgic familiarity and mild ambiguity maintain optimal arousal
Liminal Aesthetic as Therapeutic Approach	Synthesis	Digital stress stems from overload and "always-on" state	Surrealism, nostalgia, biophilic cues support passive stress relief

1.2. Literature review

1.2.1. Influence of Liminal Space on Human Psychology

Current research has begun uncovering the psychological potential of liminal spaces - transitional zones mediating between functions and meanings [30], [31].

Qualitative work has linked such spaces to self-reflection and stress relief in micro-liminal settings like stairwells [32], creativity and community in liminal workplaces enriched with greenery and sensory cues [33], and belonging and emotional autonomy in airports, where ambient qualities such as temperature and personal space fostered safety [18].

Collectively, these studies show that liminal settings, though often overlooked, can promote relaxation, identity reflection, and cognitive restoration.

1.2.2. Sensory-Rich Environments and Psychological Recovery

Hotz et al. [34] provided early empirical evidence that immersive, sensory-rich spaces enhance psychological recovery. Their quantitative research on Snoezelen therapy demonstrated significant cognitive and behavioral improvements in children with severe brain injuries. This supports the idea that multisensory stimulation - core to liminal environments - can facilitate emotional regulation and healing.

1.2.3. Evaluating Liminal Space Design Across Contexts

Recent work has moved from abstract theorization to evidence-based design analysis. Mixed-methods research on campus corridors and staircases revealed highly variable emotional responses - ranging from unease, consistent with alienation theory, to comfort born of habituation - highlighting how subjective interpretation mediates spatial stress effects [19]. Complementing this, quantitative studies on nursing home architecture found that curved and spiral geometries enhanced residents' emotional comfort and reduced stress [35], together suggesting that liminal geometry and sensory quality can measurably affect psychological well-being.

1.3. Research gap, question, hypothesis and statement of purpose

Table 5. *Research gap, Research question, and hypothesis.*

Element	Description
Research gap	Prior studies emphasize imagery, virtual simulation, or theory over real embodied exposure, leaving multisensory factors (sight, sound, touch, temperature) underexplored and physiological stress outcomes inconsistently measured [19]
Research question	Is there an efficacy of Liminal Space Aesthetics in treating mild to moderate stress?
Main Hypothesis	Exposure to a Liminal Space Aesthetic significantly reduces stress levels compared to neutral environment
Statement of Purpose	This study tests Liminal Space aesthetics as a passive, non-pharmacological stress-reduction intervention for young adults, aiming to (1) build a multisensory prototype evoking calm and (2) evaluate its efficacy via psychological and physiological indicators.

2. Materials and Methods

2.1. Study Design and Participants

Table 6. *Volunteers' demographic distribution and personal preferences*

Controlled				**Experimental**			
Gender	Male	Female		Gender	Male	Female	
	4	5			4	5	
Spatial Layout Preference	Ordered Layout	Chaotic Layout		Spatial Layout Preference	Ordered Layout	Chaotic Layout	
	8	1			7	2	
	Dislike	Neutral	Like		Dislike	Neutral	Like
Earthy smell	3	3	3	Earthy smell	2	3	4

Floral scent	0	5	4	Floral scent	0	3	6
Fruity scent	0	4	5	Fruity scent	0	3	6
Woody scent	2	1	6	Woody scent	0	4	5
Warm colors	2	5	2	Warm colors	4	1	4
Cool colors	1	1	7	Cool colors	0	2	7
Neutral colors	0	2	7	Neutral colors	0	1	8
Multi-colored (>3 colors)	1	8	0	Multi-colored (>3 colors)	1	4	4
Few colors (1–2 colors)	0	3	6	Few colors (1–2 colors)	0	3	6

The study utilized a quantitative, between-subjects, pre-post experimental design to compare stress reduction in a multisensory liminal space versus a standard office environment.

As this research serves as an initial pilot study to evaluate the foundational premise of the Liminal Space effect, a sample of 18 young adults (aged 18–22) experiencing mild to moderate psychological stress was recruited. Participants were screened using the PSS-10, PHQ-9, and GAD-7 questionnaires to establish baseline stress and exclude individuals with a history of psychiatric disorders or those currently taking mental health medication. Both groups were comparable in gender distribution and sensory preferences, ensuring that subjective factors such as personal taste were evenly balanced and unlikely to bias results

2.2. Experimental Environments

Both groups experienced controlled baseline conditions (temperature, humidity, and spatial interaction). The independent variable was the spatial design:

2.2.1. Experimental Group (Liminal Space)

Designed to create a calm, emotionally detached atmosphere using soft morning sunlight, ambient soundscapes, open spatial circulation, and tactile materials. Green elements were included to maintain a sense of familiarity.

2.2.2. Control Group

Designed as a standard, austere office setting with neatly organized objects. During the 20-minute exposure period, experimental participants were provided with optional, non-intrusive activities (free drawing and journaling) to promote introspection without performance pressure.

2.3. Measurement Instruments

Stress levels were evaluated using complementary physiological and psychological tools:

2.3.1. Physiological Devices

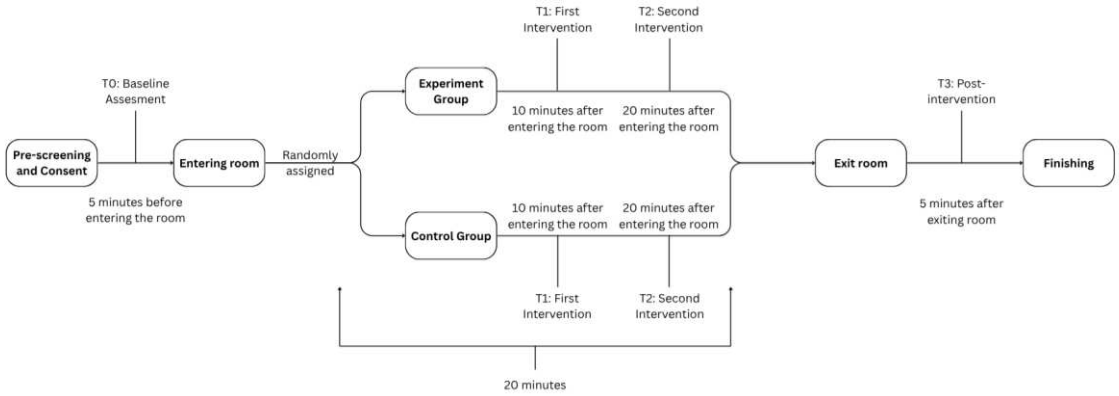
A WEB306 wrist monitor recorded systolic/diastolic blood pressure and heart rate. A finger pulse oximeter measured blood oxygen saturation (SpO2), perfusion index (%PI), and heart rate variability (HRV).

2.3.2. Psychological Scales

The Stress Appraisal Measures (SAM) evaluated affective states across valence, arousal, and dominance. The Emotional Stress Reaction Questionnaire (ESRQ) assessed self-regulation strategies.

2.4. Procedure

Figure 1. *Physiological data collect and self-assessment procedure*



Following informed consent and ethical briefing, the experiment followed a standardized timeline:

2.4.1. Baseline (T0)

Participants rested for 5–10 minutes before initial physiological data (blood pressure and heart rate) were recorded.

2.4.2. Intervention Phase

Participants entered their assigned environment for 20 minutes. Stress indicators were measured at the 10-minute mark (T1) and immediately upon completion (T2).

2.4.3. Recovery (T3)

Participants rested for a final 5–10 minutes outside the space before post-intervention physiological measurements were collected.

2.5. Data Analysis

Data were cleaned for outliers and missing values, then analyzed using SPSS-21. Descriptive statistics (mean, standard deviation, range) and independent t-tests were utilized to compare physiological and psychological stress indicators between the two groups.

3. Result and Discussion

3.1. Result

Table 7. *Heatmap illustrating the changes in percentages of participants' average physiological and psychological indices*

		Controlled				**Experimental**		
Timepoint/ Index	0	1	2	3	0	1	2	3
HR	88,42	-10,21%	-12,47%	-4,37%	95,66	-16,60%	-23,17%	-26,19%
BP_Dia	72,56	-3,98%	-7,51%	-0,39%	71,89	-15,15%	-20,10%	-22,72%
BP_Sys	109,89	0,61%	-5,16%	-2,73%	112,89	-12,80%	-19,59%	-23,43%
ESRQ_P	2,70	1,36%	-1,39%	9,62%	2,37	24,98%	45,32%	39,04%
ESRQ_C	2,00	4,17%	-8,34%	-15,28%	1,86	23,88%	37,32%	23,88%
ESRQ_T	1,53	-10,11%	-15,92%	-20,29%	1,58	-14,07%	-16,92%	-19,71%
ESRQ_I	1,56	-7,69%	7,05%	-21,79%	1,67	-6,59%	6,59%	0,00%
SAM_S	2,19	-5,06%	-5,06%	-11,39%	2,22	-1,25%	-11,25%	-17,50%
SAM_T	1,50	5,55%	-9,26%	-20,37%	1,72	-37,10%	-35,48%	-40,32%

SAM_C	3,17	-3,51%	-0,88%	5,26%	2,56	23,91%	33,69%	32,61%
SAM_Ce	1,94	0,00%	-7,14%	-11,43%	2,22	-18,75%	-31,25%	-47,50%
SAM_CoS	2,53	9,89%	14,29%	16,48%	2,56	25,00%	28,26%	26,08%
SAM_CoO	2,72	2,04%	11,23%	19,39%	3,19	5,22%	16,52%	19,13%
SAM_U	1,53	9,09%	-10,91%	-23,64%	1,67	-26,67%	-21,67%	-25,00%

Legend:



Values at Timepoint 0 (T0) represent absolute baseline measurements. Values at Timepoints 1, 2, and 3 represent the relative percentage change compared to the baseline (T0), calculated using the following equation:

$$\Delta\% = \frac{T_n - T_0}{T_n} \times 100\%$$

Positive values indicate an increase, whereas negative values denote a decrease from the baseline.

3.1.1 Physiological changes

The heatmaps revealed a distinct stress reduction in the experimental group, characterized by steadily falling heart rate and blood pressure. Conversely, the control group showed smaller, fluctuating drops, reflecting a less consistent decrease in stress.

3.1.2 Psychological changes

3.1.2.1. Emotional-Stress Reaction Questionnaire

The ESRQ heatmaps demonstrate two key effects in the experimental group:

- Enhanced adaptive coping: Increased Positive (ESRQ_P) and Challenge (ESRQ_C) indices, coupled with decreased Threat (ESRQ_T).
- Stronger psychological detachment: A stable Irrelevant (ESRQ_I) index (contrasting with the control group's decline), facilitating more effective emotional load reduction.

3.1.2.2 Stress Appraisal Measure

3.1.2.2.1 Stressfulness

Across the four time points (T0 - T3), both groups showed a decrease in the Stressfulness Index. However, the reduction was stronger and more consistent in the experimental group, indicating a greater overall improvement in perceived stress.

3.1.2.2.2. Other Indices

While both groups exhibited similar directional shifts in most appraisal indices (Ce, C, T, CoS) and stable social support (CoO), the experimental group's changes were notably greater and steadier, contrasting with the control group's fluctuations. Furthermore, perceived uncontrollability (U) steadily decreased only in the experimental setting, indicating that these participants ultimately viewed the stressor as significantly less threatening, less central, and more manageable.

3.2. Independent T-Tests

Table 8. *Statistically significant parameters identified by independent-samples t-tests between the control group (group 1) and the experimental group (group 2)*

	Levene's Test for Equality of Variances		**t-test for Equality of Means**			
	F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean Difference**

HR_finger_T3	Equal variances not assumed	9,008	0,008	3,157	11,71	0,009	15,889
HR_wrist_T3	Equal variances assumed	1,584	0,226	2,579	16	0,02	12
SpO2_T1	Equal variances assumed	1,271	0,276	-3,645	16	0,002	-0,007778
BP_dia_T1	Equal variances assumed	1,253	0,28	2,783	16	0,013	8,667
BP_dia_T2	Equal variances assumed	0,002	0,966	3,642	16	0,002	9,667
BP_dia_T3	Equal variances assumed	1,37	0,259	5,185	16	0	16,7222
BP_sys_T1	Equal variances assumed	0,01	0,923	2,77	16	0,014	12,111
BP_sys_T2	Equal variances assumed	0,011	0,916	2,519	16	0,023	13,444
BP_sys_T3	Equal variances assumed	1,677	0,214	3,042	16	0,008	20,444
ESRQ_Pos_T2	Equal variances assumed	0,166	0,689	-2,338	16	0,033	-0,78
ESRQ_ Challenge_T2	Equal variances assumed	0,132	0,721	-2,62	16	0,019	-0,72222
SAM_Primary_ Threat_T1	Equal variances not assumed	11,576	0,004	2,91	10,096	0,015	0,5

Although only a subset (10 out of 51) of indicators achieved statistical significance, their directional changes support the hypothesis. In our independent T-tests, the Mean Difference is calculated as Mean (Control) minus Mean (Experimental). Therefore:

- Positive Mean Differences in stress markers (HR, BP, and SAM_Threat) and perceived threat indicate that the control group retained significantly higher stress levels.
- Negative Mean Differences in beneficial metrics (ESRQ_Positive, ESRQ_Challenge) confirm that the experimental group achieved stronger positive coping responses.

3.3. Effect Size

Table 9. *Cohen's d effect sizes of the experimental metrics*

	HR_ Mean	BP_ Dia	BP_ Sys	ESR_ Q_P	ESR_ Q_C	ESR_ Q_T	ESR _Q_I	SAM _S	SAM _T	SAM _C	SAM _Ce	SAM _CoS	SAM _CoO	SAM _U
T0														
Cohen's d	3,62	0,34	1,50	0,17	0,07	0,02	0,06	0,01	0,11	0,31	0,14	0,01	0,24	0,07
Glass's delta	3,62	0,34	1,50	0,17	0,07	0,02	0,06	0,01	0,11	0,31	0,14	0,01	0,24	0,07
Hedges' g	3,62	0,34	1,50	0,17	0,07	0,02	0,06	0,01	0,11	0,31	0,14	0,01	0,24	0,07
T1														
Cohen's d	0,20	4,34	6,06	0,11	0,11	0,01	0,06	0,06	0,25	0,31	0,07	0,21	0,29	0,22
Glass's delta	0,20	4,34	6,06	0,11	0,11	0,01	0,06	0,06	0,25	0,31	0,07	0,21	0,29	0,22
Hedges' g	0,20	4,34	6,06	0,11	0,11	0,01	0,06	0,06	0,25	0,31	0,07	0,21	0,29	0,22
T2														
Cohen's d	1,95	4,84	6,72	0,39	0,36	0,01	0,06	0,06	0,13	0,14	0,14	0,19	0,35	0,03
Glass's delta	1,95	4,84	6,72	0,39	0,36	0,01	0,06	0,06	0,13	0,14	0,14	0,19	0,35	0,03
Hedges' g	1,95	4,84	6,72	0,39	0,36	0,01	0,06	0,06	0,13	0,14	0,14	0,19	0,35	0,03

T3

	HR_ Mean	BP_ Dia	BP_ Sys	ESR_ Q_P	ESR_ Q_C	ESR_ Q_T	ESR _Q_I	SAM _S	SAM _T	SAM _C	SAM _Ce	SAM _CoS	SAM _CoO	SAM _U
Cohen's d	6,97	8,36	10,23	0,17	0,31	0,02	0,23	0,06	0,08	0,03	0,28	0,14	0,28	0,04
Glass's delta	6,97	8,36	10,23	0,17	0,31	0,02	0,23	0,06	0,08	0,03	0,28	0,14	0,28	0,04
Hedges' g	6,97	8,36	10,23	0,17	0,31	0,02	0,23	0,06	0,08	0,03	0,28	0,14	0,28	0,04

The effect size analysis shows:

- Physiological indicators: Effect sizes are large (> 0.8), demonstrating substantial practical significance.
- Psychological indicators: Effect sizes range from small to medium (0.1 - 0.3). In a psychological context, while modest for a single experimental event, these effects indicate potential for meaningful long-term benefits in psychological contexts [42]

3.4. Discussion

3.4.1 Comparison with other studies

Table 10. *Present study compared with other studies*

Criteria	Present study	Study by Li et al. (2022)	Study by Naja et al. (2024)
Sample characteristics	Individuals experiencing acute stress	Healthy participants	University students
Stress level	Mild - moderate (PSS-10)	Induced acute stress (TSST)	Not specified
Control group outcome	Fluctuating stress indices	Slight reduction	General reports of both comfort and unease (uncanny valley)
Liminal space outcome	Greater stress reduction compared to the control group	Reduction observed	Reported mixed feelings of comfort and unease (uncanny valley)
Evidence supporting the stress-reducing effect of liminal spaces/designs	Demonstrated a more pronounced direct effect	Suggested possible stress reduction, but inconclusive	Unclear effect; primarily reported uncanny valley responses

Unlike previous studies showing general stress recovery across virtual environments, our acutely stressed control group maintained or heightened arousal in conventional settings. This highlights liminal aesthetics as uniquely effective for elevated stress. Furthermore, while naturally occurring liminal spaces can evoke mixed feelings of unease [19], our findings demonstrate that intentionally designed, multisensorial liminality consistently transforms ambiguity from unsettling to therapeutic.

3.4.2 Limitations

This study's key limitations include a small sample size, which restricts generalizability; high data variability, which affects statistical significance; and a single-trial design, which leaves potential habituation effects unexamined.

4. Conclusions

This pilot study demonstrates the empirical efficacy of liminal spatial aesthetics as a passive, non-pharmacological intervention for alleviating mild-to-moderate stress in young adults. By integrating surrealism, nostalgic elements, and biophilic design within a physical prototype, this approach successfully elicited both psychophysiological relaxation and cognitive-emotional recovery.

Key Outcomes:

- Physiological Recovery: Exposure to the designed liminal space led to statistically significant reductions in cardiovascular stress indicators (systolic/diastolic blood pressure and heart rate) along with progressive improvements in peripheral microcirculation (perfusion index) compared to the control group.
- Psychological Restoration: Self-reported scales (ESRQ and SAM) confirmed that participants achieved greater adaptive coping, elevated benign-positive emotional states, and a significant reduction in perceived threat and uncontrollability.

Future Orientations:

- Methodological Scaling: Future investigations should expand the sample size, include diverse cohorts, and evaluate longitudinal impacts to determine if habituation or tolerance occurs over repeated exposures.
- Design Parameter Optimization: Subsequent research should isolate specific sensory modalities (such as acoustics, lighting variables, or visual boundaries) to identify the precise drivers of restorative liminality.

Practical Application: These findings establish a baseline of design principles that can be translated into stress-relief micro-spaces within high-stress settings, including high schools, universities, offices, and clinical waiting environments.

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Conflict of Interest

The authors declare no conflict of interest.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the authors used ChatGPT, Gemini, and Grammarly solely for English-language editing and stylistic refinement. After using this service, the authors thoroughly reviewed, verified, and edited the content as necessary, and they assume full responsibility for the accuracy and integrity of the final publication.

Data Availability Statement

The raw physiological datasets and psychological questionnaire scores supporting the findings of this study are available in a public Google Sheets repository or can be provided by the corresponding author upon reasonable request.

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Appendix

Appendix A. Participant Documentation

Figure A1. Research Information Sheet

PHIẾU CUNG CẤP THÔNG TIN NGHIÊN CỨU

Nếu các Anh/Chị tham gia vào nghiên cứu này đọc thông tin mà chưa hiểu rõ nội dung thì vui lòng liên hệ với người thực hiện nghiên cứu hoặc người phụ trách công tác khảo sát, phỏng vấn.

Tên đề tài: Ứng dụng Liminal Space trong hỗ trợ điều trị stress ở sinh viên và thanh niên

Họ và tên SV/HVCH/NCS: Phạm Phương Nghi

Cơ quan công tác: Trường Phổ thông Năng khiếu, ĐHQG-HCM

Số điện thoại: 0399882861

E-mail: nghiphamphuong21@gmail.com

Mục tiêu nghiên cứu:

Nghiên cứu này nhằm tìm hiểu khả năng của không gian liminal – được thiết kế với đặc tính đa giác quan và tính mơ hồ về không gian – như một phương pháp can thiệp phi dược lý giúp giảm căng thẳng. Nhóm nghiên cứu sẽ đánh giá cả phản ứng sinh lý và cảm xúc của người tham gia trong không gian này so với không gian trung tính.

Lý do vì sao cần có sự tham gia của khách thể nghiên cứu:

Sự tham gia của anh/chị rất quan trọng để nhóm nghiên cứu hiểu rõ hơn tác động của môi trường vật lý lên trạng thái tâm lý và sức khỏe tinh thần. Việc anh/chị tình nguyện tham gia sẽ đóng góp vào cơ sở khoa học cho việc ứng dụng thiết kế không gian trị liệu trong đời sống.

Mô tả cách tham gia cho các khách thể nghiên cứu:

Nếu đồng ý tham gia, anh/chị tham gia tổng cộng 3 buổi thực nghiệm với quy trình:

- Tham gia trải nghiệm không gian nghiên cứu
- Các chỉ số sinh lý (nhịp tim, huyết áp, %SpO2, %PI) sẽ được đo ở 4 thời điểm
- Điền bảng câu hỏi phản hồi cảm xúc (SAM, ESRQ) ở 4 thời điểm

Tổng thời gian tham gia dự kiến: khoảng 20-30 phút chưa tính thời gian điền bảng câu hỏi phản hồi và đo sinh lý.

Lợi ích và quyền hạn của việc tham gia vào nghiên cứu:

- Anh/chị có quyền từ chối hoặc rút lui khỏi nghiên cứu bất kỳ lúc nào mà không cần đưa ra lý do và không chịu bất kỳ ảnh hưởng bất lợi nào.
- Anh/chị sẽ được cung cấp thông tin về kết quả chung của nghiên cứu khi nghiên cứu hoàn thành.
- Sau 3 buổi thực nghiệm, anh/chị sẽ được nhận giấy chứng nhận điện tử có mộc đỏ từ công ty bảo trợ pháp lý cho dự án và được chọn 1 mẫu phone charm theo sở thích làm quà lưu niệm
- Được hỗ trợ về mặt tâm lý và thể chất xuyên suốt quá trình thực nghiệm, có hỗ trợ đồ ăn nhẹ và trà chiều.

Rủi ro khi tham gia vào nghiên cứu:

Rủi ro có thể bao gồm:

- Cảm giác mệt mỏi nhẹ trong quá trình đo chỉ số sinh lý.
- Một số cảm giác khó chịu tạm thời (nếu có) khi ở trong không gian liminal.

Mọi rủi ro đều đã được cân nhắc và có biện pháp giảm thiểu thích hợp.

Phương pháp ngăn ngừa rủi ro:

- Nhóm nghiên cứu bố trí nhân sự túc trực để hỗ trợ kịp thời trong trường hợp người tham gia thấy khó chịu.

- Các thiết bị đo sinh lý đều là thiết bị tiêu chuẩn y tế, an toàn cho người sử dụng.
- Người tham gia sẽ được giải thích rõ quy trình trước khi thực hiện và có thể dừng lại ngay khi cảm thấy không thoải mái.
- Thời lượng thí nghiệm được giới hạn ở mức an toàn (tổng thời gian phơi nhiễm chưa tính thời gian đo và thực hiện bảng hỏi không vượt quá 30 phút)
- Phòng thực nghiệm có chuẩn bị nước uống và khu vực nghỉ ngơi.

Cách thức bảo mật thông tin cá nhân cho khách thể nghiên cứu:

Tất cả dữ liệu gốc, bao gồm video ghi hình, điểm bảng hỏi cá nhân, câu trả lời và các chỉ số sinh lý, sẽ được lưu trữ và quản lý trong các tệp Google Sheet bảo mật. Chỉ có tối đa 7 cá nhân có quyền truy cập vào các tệp này, bao gồm:

- Thành viên nhóm nghiên cứu: Ngô Bảo Khoa, Phạm Phương Nghi, Bùi Quỳnh Anh, Đỗ Dương Nhựt Quang, Trần Nguyễn Đức Anh.
- Giáo viên hướng dẫn: Ks. Phạm Thị Quỳnh Anh, PGS.TS. Bùi Văn Hồng.

Trong quá trình phân tích và báo cáo, toàn bộ dữ liệu sẽ được mã hóa và ẩn danh. Trường hợp cần trích dẫn hoặc làm minh chứng, nhóm nghiên cứu sẽ chỉ sử dụng mã số tình nguyện viên thay vì thông tin cá nhân.

Dữ liệu sẽ chỉ được sử dụng cho mục đích nghiên cứu và không chia sẻ cho bên thứ ba ngoài phạm vi đã được nêu.

Xử lý hậu quả

Nhóm nghiên cứu đảm bảo các quy tắc an toàn, đặt sức khỏe tinh thần và thể chất của tình nguyện viên lên hàng đầu, song nhóm nghiên cứu vẫn nhận thức các hậu quả có thể xảy ra và sẽ xử lí theo nguyên tắc ưu tiên an toàn cho người tham gia. Cụ thể:

- Nếu người tham gia có phản ứng tâm lý mạnh (ví dụ: lo âu, hoảng sợ), thí nghiệm sẽ được dừng ngay lập tức và sẽ được hỗ trợ tâm lý sơ bộ.
- Nếu phát sinh tình trạng sức khỏe bất thường (như tụt huyết áp, khó thở), nhóm sẽ liên hệ khẩn cấp với cơ sở y tế gần nhất để được hỗ trợ kịp thời.
- Người tham gia sẽ được theo dõi trong khoảng thời gian cần thiết sau khi kết thúc thí nghiệm để đảm bảo ổn định.
- Tất cả các sự cố sẽ được ghi nhận, báo cáo và điều chỉnh quy trình nhằm tránh lặp lại trong các phiên sau.

Ngoài ra, tình nguyện viên cũng có thể góp ý với nhóm nghiên cứu thông qua form ẩn danh sẽ được gửi qua mail sau mỗi buổi thực nghiệm.

Nếu trong quá trình tham gia vào nghiên cứu, các Anh/Chị phát hiện ra những điều không đúng với các thông tin nêu trên, vui lòng liên hệ với Trường Đại học Sư phạm Kỹ thuật TP.HCM, địa chỉ: Số 01 Võ Văn Ngân, Phường Linh Chiểu, Thành phố Thủ Đức, TP.HCM; SĐT: (+84 - 028) 38968641 - (+84 -028) 38961333 - (+84 -028) 37221223. Email: ptchc@hcmute.edu.vn

Thành phố Hồ Chí Minh, ngày … tháng … năm …

Chủ nhiệm đề tài nghiên cứu

(Ký và ghi rõ họ tên)

Figure A2. Consent Form

GIẤY ĐỒNG Ý THAM GIA VÀO NGHIÊN CỨU

Tôi tên là:

Tôi đồng ý tham gia đề tài nghiên cứu khoa học mang tên: "Ứng dụng Liminal Space trong hỗ trợ điều trị stress ở sinh viên và thanh niên"

Tôi đã được thông báo về nguồn gốc và mục đích của đề tài nghiên cứu; cách thức tổ chức thực hiện nghiên cứu; lợi ích dự kiến của nó và rủi ro có thể xảy ra đối với các đối tượng tham gia, bao gồm các phương pháp ngăn ngừa và xử lý hậu quả.

Tôi đã đọc kỹ Phiếu cung cấp thông tin nghiên cứu. Nhà nghiên cứu cũng đã giải thích và trả lời các câu hỏi của tôi. Do đó, tôi đồng ý tham gia trong đề tài khoa học này.

Tôi nhận thức được quyền của mình là được cung cấp thêm thông tin liên quan đến lợi ích và rủi ro từ việc tham gia vào đề tài nghiên cứu và quyền rút hoặc từ chối tham gia bất kỳ lúc nào mà không có bất kỳ hậu quả nào trong tương lai.

Tôi đồng ý cho các nhà nghiên cứu sử dụng thông tin cá nhân của tôi nhưng không đồng ý cho bất kỳ cá nhân nào tiết lộ thông tin cá nhân của tôi. Thông tin phải được trình bày như một phần của toàn bộ kết quả nghiên cứu.

Nếu tôi có bất kỳ câu hỏi nào về quy trình nghiên cứu, hoặc về những điều kiện không mong muốn từ nghiên cứu này, tôi có thể liên hệ với chủ nhiệm đề tài: Phạm Phương Nghi. SĐT: 0399882861. Email: nghiphamphuong21@gmail.com.

Nếu tôi cảm thấy mình không được đối xử theo đúng nội dung đã nêu trong Phiếu thông tin nghiên cứu, tôi có thể liên hệ với Trường Đại học Sư phạm Kỹ thuật TP.HCM, địa chỉ: Số 01 Võ Văn Ngân, Phường Linh Chiểu, Thành phố Thủ Đức, TP.HCM; SĐT: (+84 - 028) 38968641 - (+84 -028) 38961333 - (+84 -028) 37221223. Email: ptchc@hcmute.edu.vn

Tôi đã tìm hiểu kỹ các tuyên bố trong Phiếu thông tin nghiên cứu và đồng ý ký tên tham gia.

Thành phố Hồ Chí Minh, ngày … tháng … năm …

Người tham gia vào nghiên cứu

(Ký và ghi rõ họ tên)

Trong trường hợp người tham gia không biết chữ (hoặc dưới 17 tuổi), người đọc thông tin hỗ trợ cho người tham gia, tên là _____, sẽ ký tên của mình với tư cách là nhân chứng (hoặc người giám hộ).

Thành phố Hồ Chí Minh, ngày … tháng … năm …

Nhân chứng (hoặc Người giám hộ)

(Ký và ghi rõ họ tên)

Figure A3. SAM and ESRQ Questionnaire

Note. The questionnaire was translated to Vietnamese from *Stress Appraisal Measure (SAM)*, by Edward J. Peacock & Paul T. P. Wong, 1989 (http://www.drpaulwong.com/wp-content/uploads/2018/03/Stress-Appraisal-Measure-SAM-Peacock-Wong-1990-Scale.pdf) and *SHIFT-BASED EMOTIONAL STRESS REACTIONS IN EMERGENCY NURSES AFTER*

BẢNG KIỂM THÍ NGHIỆM								
Họ và tên								
Câu hỏi		Khoanh tròn vào lựa chọn đầu tiên xuất hiện trong đầu bạn mô tả đúng nhất cảm xúc của bạn NGAY LÚC NÀY.						
		Không phản ánh	Phần nào phản ánh	Khá phản ánh	Hoàn toàn phản ánh			Ghi chú
ESRQ	Thờ ơ	☐	☐	☐	☐			
	Thư giãn	☐	☐	☐	☐			
	Hài lòng	☐	☐	☐	☐			
	Vui vẻ	☐	☐	☐	☐			
	Cảnh giác	☐	☐	☐	☐			
	Tập trung	☐	☐	☐	☐			
	Chú tâm	☐	☐	☐	☐			
	Tràn đầy năng lượng	☐	☐	☐	☐			
	Lo lắng	☐	☐	☐	☐			
	Kích động	☐	☐	☐	☐			
	Cáu gắt	☐	☐	☐	☐			
	Tức giận	☐	☐	☐	☐			
	Không chắc chắn	☐	☐	☐	☐			
	Thất vọng	☐	☐	☐	☐			
	Điểm tổng							Nhóm nghiên cứu thực hiện
SAM	**Câu hỏi**	Vui lòng trả lời dựa trên cảm nhận của bạn về tình huống này NGAY LÚC NÀY.						
		Hoàn toàn không	Hơi hơi	Ở mức trung bình	Khá nhiều	Rất nhiều		Ghi chú
	Đây có phải là một tình huống hoàn toàn vô vọng không?	☐	☐	☐	☐	☐		
	Tình huống này có khiến tôi cảm thấy căng thẳng không?	☐	☐	☐	☐	☐		
	Kết quả của tình huống này có nằm ngoài tầm kiểm soát của bất kỳ ai không?	☐	☐	☐	☐	☐		
	Tôi có thể tìm được người hoặc tổ chức nào đó để nhờ giúp đỡ nếu cần không?	☐	☐	☐	☐	☐		
	Tình huống này có làm tôi cảm thấy lo âu không?	☐	☐	☐	☐	☐		
	Tình huống này có mang lại hậu quả quan trọng đối với tôi không?	☐	☐	☐	☐	☐		
	Liệu điều này có tạo ra tác động tích cực cho tôi không?	☐	☐	☐	☐	☐		
	Tôi có cảm thấy sẵn sàng để giải quyết vấn đề này không?	☐	☐	☐	☐	☐		
	Tôi sẽ bị ảnh hưởng như thế nào bởi kết quả của tình huống này?	☐	☐	☐	☐	☐		
	Tôi có thể trở nên mạnh mẽ hơn nhờ đối mặt với vấn đề này không?	☐	☐	☐	☐	☐		
	Kết quả của tình huống này có tiêu cực không?	☐	☐	☐	☐	☐		
	Tôi có đủ khả năng để xử lý tốt tình huống này không?	☐	☐	☐	☐	☐		
	Tình huống này có ý nghĩa nghiêm trọng đối với tôi không?	☐	☐	☐	☐	☐		
	Tôi có đủ năng lực để làm tốt trong tình huống này không?	☐	☐	☐	☐	☐		
	Tôi có được sự hỗ trợ cần thiết để đối phó với vấn đề này không?	☐	☐	☐	☐	☐		
	Tình huống này có vượt quá khả năng đối phó của tôi không?	☐	☐	☐	☐	☐		
	Tôi có đủ nguồn lực cần thiết để ứng phó với tình huống này không?	☐	☐	☐	☐	☐		
	Không ai có thể làm gì để thay đổi tình huống này phải không?	☐	☐	☐	☐	☐		
	Tôi có cảm thấy hào hứng khi nghĩ đến kết quả của tình huống này không?	☐	☐	☐	☐	☐		
	Mức độ đe dọa của tình huống này đối với tôi như thế nào?	☐	☐	☐	☐	☐		
	Vấn đề này có hoàn toàn không thể giải quyết được không?	☐	☐	☐	☐	☐		
	Tôi có thể vượt qua được vấn đề này không?	☐	☐	☐	☐	☐		
	Có ai có thể giúp tôi xử lý tình huống này không?	☐	☐	☐	☐	☐		
	Tôi cảm nhận tình huống này căng thẳng đến mức nào?	☐	☐	☐	☐	☐		
	Tôi có đủ kỹ năng cần thiết để đạt được kết quả tích cực trong tình huống này không?	☐	☐	☐	☐	☐		
	Sự kiện này đòi hỏi tôi phải nỗ lực đối phó đến mức nào?	☐	☐	☐	☐	☐		
	Tình huống này có thể gây ra hậu quả dài hạn cho tôi không?	☐	☐	☐	☐	☐		
	Liệu điều này có ảnh hưởng tiêu cực đến tôi không?	☐	☐	☐	☐	☐		
	Điểm tổng							Nhóm nghiên cứu thực hiện

TRAUMATIZING EVENTS, by Wilson et al. (2019), Journal of Emergency Nursing, 45(6), 634–643. https://doi.org/10.1016/j.jen.2019.08.002

Appendix B. Experimental and Controlled designs

Figure B1. Experimental Room's design



Figure B2. Controlled Room's design



Appendix C. Data Analysis

Figure C1. Raw Data

Full table was uploaded in:
https://docs.google.com/spreadsheets/d/1b0q1mhq2Ey11vVatAjCyPfLkzOwVklBp/edit?usp=drive_link&ouid=113609977545718661611&rtpof=true&sd=true

Note. Invalid dataset (including missing responses and duplicate selections) had been sorted

Independent Samples T-test

Full table was uploaded in:

https://docs.google.com/spreadsheets/d/17ySTRS7WoL-I1x6w_5J3KhbWIIGGDCMUffRn00GD6Qs/edit?gid=486619728#gid=486619728

https://drive.google.com/file/d/103-J06nry0YevazIPXbvd1FQYPQyhtYm/view?usp=drive_link

Calculation C2. Confidence Intervals (95%) calculation

$CI_{95\%}$_lower = Mean - 1.96 * (SD / SQRT(N))

$CI_{95\%}$_upper = Mean + 1.96 * (SD / SQRT(N))

Note. Confidence Intervals (95%) range from A to B means 95% of the true population parameter tend to fall within the range

Appendix D. Table of Abbreviations

Abbreviations	Full term
HR	Heart Rate
BP_Dia	Diastolic Blood Pressure
BP_Sys	Systolic Blood Pressure
ESRQ_P	Positive Emotion Index in ESRQ
ESRQ_C	Challenge Index in ESRQ
ESRQ_T	Threat Index in ESRQ
ESRQ_I	Irrelevant Index in ESRQ
SAM_S	Stressfulness Index in SAM
SAM_T	Threat Index in SAM
SAM_C	Challenge Index in SAM
SAM_Ce	Centrality Index in SAM
SAM_CoS	Controllable-by-Self Index in SAM
SAM_CoO	Controllable-by-Other Index in SAM
SAM_U	Uncontrollable Index in SAM