# DEVELOPMENT AND EVALUATION OF A VIRTUAL REALITY CONFINED ROOM ENVIRONMENT FOR CLAUSTROPHOBIA EXPOSURE THERAPY

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## ABSTRACT
This research aims at developing and empirically evaluating an immersive Virtual Reality (VR) confined storage room environment designed to support exposure therapy for individuals suffering from claustrophobia. Grounded in the broader multi-layered C-VR therapeutic framework and Cognitive Behavioral Therapy (CBT) desensitization principles, this study focuses specifically on the design, implementation, and empirical testing of a Level 4 Confined Storage Room simulation. The virtual environment—featuring narrow walkways, stacked boxes, restricted physical boundaries, and dim ambient lighting—was modeled in Autodesk Maya, rendered via Unreal Engine, and deployed using an Oculus Rift CV1 head-mounted display (HMD). An empirical evaluation was conducted with a target group of 13 participants experiencing claustrophobic symptoms who actively navigated the virtual confined room. The evaluation systematically assessed three core dimensions: virtual reality experience and spatial presence, cybersickness and adverse symptoms, and perceived therapeutic efficacy, utilizing a structured 4-point rating scale. The findings revealed that the virtual confined room successfully elicited a strong sense of spatial presence (Mean = 3.23, S.D. = 0.73) and situational involvement (Mean = 3.08, S.D. = 0.76). Evaluation of adverse symptoms demonstrated high physiological safety and tolerability, with low severity of nausea (Mean = 2.00, S.D. = 1.08) and abnormal sweating (Mean = 1.92, S.D. = 1.12), alongside moderate eyestrain and postural instability (Mean = 2.54). In terms of perceived efficacy, participants subjectively reported high levels of courage to engage in activities within enclosed spaces (Mean = 3.15, S.D. = 0.69) and feelings of psychological comfort (Mean = 3.08, S.D. = 0.86), indicating positive user receptivity and perceived coping potential. Qualitative feedback highlighted minor usability difficulties with the handheld controller during spatial navigation. This study confirms that a targeted virtual confined room simulation provides a safe, controllable tool for perceived phobic desensitization.
**Keywords:** Virtual Reality, Claustrophobia, Exposure Therapy, Systematic Desensitization

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# INTRODUCTION

Recent advancements in interactive digital media and immersive computing have established Virtual Reality (VR) as an indispensable asset in psychiatric treatment and clinical behavioral healthcare (MDPI, 2025; Maples-Keller et al., 2017). Among psychological disorders, specific situational phobias represent a critical area where computer-generated simulations provide substantial clinical utility (Demir, 2023). Within this spectrum, claustrophobia—defined as an excessive, irrational, and debilitating fear of confined, enclosed, or restricted environments—affects a substantial proportion of the population and severely impairs personal, occupational, and social functioning (American Psychiatric Association, 2013; El-Qirem et al., 2024). Everyday enclosed settings with limited physical egress, such as small utility rooms, storage closets, crowded elevators, windowless offices, or medical imaging tunnels, act as severe triggers (Psychiatric Association of Thailand, 2017). Upon entering such environments, individuals experience acute psychological distress accompanied by severe somatic panic reactions, including tachycardia, hyperventilation, diaphoresis, tremors, dizziness, gastrointestinal discomfort, and an overwhelming compulsion to escape (Boeldt et al., 2019; Emmelkamp & Meyerbröker, 2021).

The established gold-standard clinical intervention for claustrophobia is Cognitive Behavioral Therapy (CBT), specifically through Systematic Desensitization and graded exposure (Iparraguirre-Villanueva et al., 2024). Grounded in Wolpe's reciprocal inhibition and modern inhibitory learning paradigms (Wolpe, 1958; Craske et al., 2014), exposure therapy facilitates fear extinction by systematically presenting the patient with fear-inducing stimuli in a controlled manner, allowing them to practice relaxation and cognitive reappraisal. However, conventional in-vivo exposure (placing patients in actual physical confined rooms) presents severe logistical and safety obstacles: environmental parameters cannot be dynamically modulated, logistical costs are high, and acute panic attacks in physically enclosed spaces can lead to traumatic re-sensitization or premature therapy drop-out (Chung et al., 2022; Krzystanek et al., 2021).

Virtual Reality Exposure Therapy (VRET) circumvents these limitations by placing patients in photorealistic, interactive 3D digital environments via Head-Mounted Displays (HMDs) (Kothgassner & Felnhofer, 2020). VRET allows therapists to precisely control environmental dimensions, titrate stimulus intensity, and ensure absolute physical safety while monitoring patient distress in real time (Demir, 2023; Mayer et al., 2022). Within a broader multi-stage desensitization hierarchy, simulating confined indoor spaces—such as cluttered storage rooms—represents a vital intermediate-to-advanced clinical milestone. In these settings, visual constriction, towering obstacles, and narrow walkable pathways challenge the patient's core fear of physical entrapment without exposing them to physical hazards.

Therefore, this research aims to design, develop, and empirically evaluate a Virtual Reality Confined Storage Room Environment (Level 4 Confinement) within the overarching C-VR therapeutic framework. Specifically, this study evaluates: (1) the degree of spatial presence, immersion, and emotional involvement elicited by the virtual storage room; (2) the physiological safety, tolerability, and cybersickness profile during navigation; and (3) the perceived therapeutic efficacy of the simulation in fostering personal courage, emotional coping mechanisms, and psychological comfort among 13 individuals exhibiting claustrophobic symptoms.

# LITERATURE REVIEWS AND THEORETICAL FRAMEWORK

### Claustrophobia, Confinement Triggers, and Exposure Mechanisms

Claustrophobia is characterized by two primary cognitive threat appraisals: the fear of restriction (the perception of being trapped or physically immobilized) and the fear of suffocation (the catastrophic belief that oxygen will be depleted) (El-Qirem et al., 2024).

Enclosed, cluttered rooms—such as storage spaces filled with stacked boxes, narrow corridors, and dim lighting—are potent phobic triggers because the dense physical obstacles visually obstruct the exit, reinforcing catastrophic expectancies of entrapment. Contemporary exposure theory emphasizes inhibitory learning (Craske et al., 2014), wherein exposure does not erase original fear associations but rather establishes new, non-threat inhibitory associations (CS-NoUS). For effective inhibitory learning to occur, the patient must experience expectancy violation—discovering through direct exploration that remaining in a confined space does not result in suffocation, loss of sanity, or bodily harm.

**Immersive Virtual Reality and Spatial Presence**

The primary psychological mechanism governing VRET efficacy is Spatial Presence—the perceptual illusion of physically existing inside the computer-generated environment (Witmer & Singer, 1998; Weech et al., 2019). When visual fidelity, 3D stereoscopic depth, and low-latency head tracking (<20 ms) are seamlessly combined, the virtual environment engages the same underlying neural fear structures (particularly the amygdala and prefrontal cortex) that respond to physical environments (Maples-Keller et al., 2017). This psychological presence ensures that emotional habituation and cognitive restructuring achieved in VR transfer effectively to real-world physical settings (El-Qirem et al., 2024; Kothgassner & Felnhofer, 2020).

**Cybersickness and Ergonomic Considerations**

Cybersickness (Virtual Reality Induced Symptoms and Effects-VRISE) arises when visual motion cues conflict with vestibular and proprioceptive sensations (Reason & Brand, 1975; Boeldt et al., 2019). Symptoms include nausea, oculomotor strain (eyestrain), disorientation, postural instability, and abnormal sweating (Weech et al., 2019). In clinical exposure therapy, mitigating cybersickness is imperative to prevent physical discomfort from being confounded with phobic anxiety (Baus & Bouchard, 2014). Maintaining high rendering frame rates (90 Hz), optimizing pixel response times, and ensuring smooth locomotion are essential design criteria for therapeutic VR systems.

**The C-VR Model and Architectural Design of the Confined Storage Room**

The system is conceptualized within the Framework for VR Therapy in Claustrophobia (C-VR Model), which integrates five operational layers: (1) User Layer: Facilitates interaction between the patient and the supervising clinician; (2) VR Technology Layer: Manages the Oculus Rift HMD, 6-DOF tracking sensors, and input devices; (3) Instructional & Therapeutic Design Layer: Governs the pedagogical structure of gradual exposure across five hierarchical levels (Level 1: Open Field, Level 2: Outdoor Gazebo, Level 3: Spacious Indoor Hall, Level 4: Confined Storage Room, Level 5: Extreme Confined Elevator); (4) Data & Intelligence Layer: Collects real-time behavioral metrics, tolerance times, and distress scores (Fear Scale 0-3); and (5) Backend Infrastructure Layer: Ensures encrypted data storage, privacy protection, and compliance with Personal Data Protection Acts (PDPA).

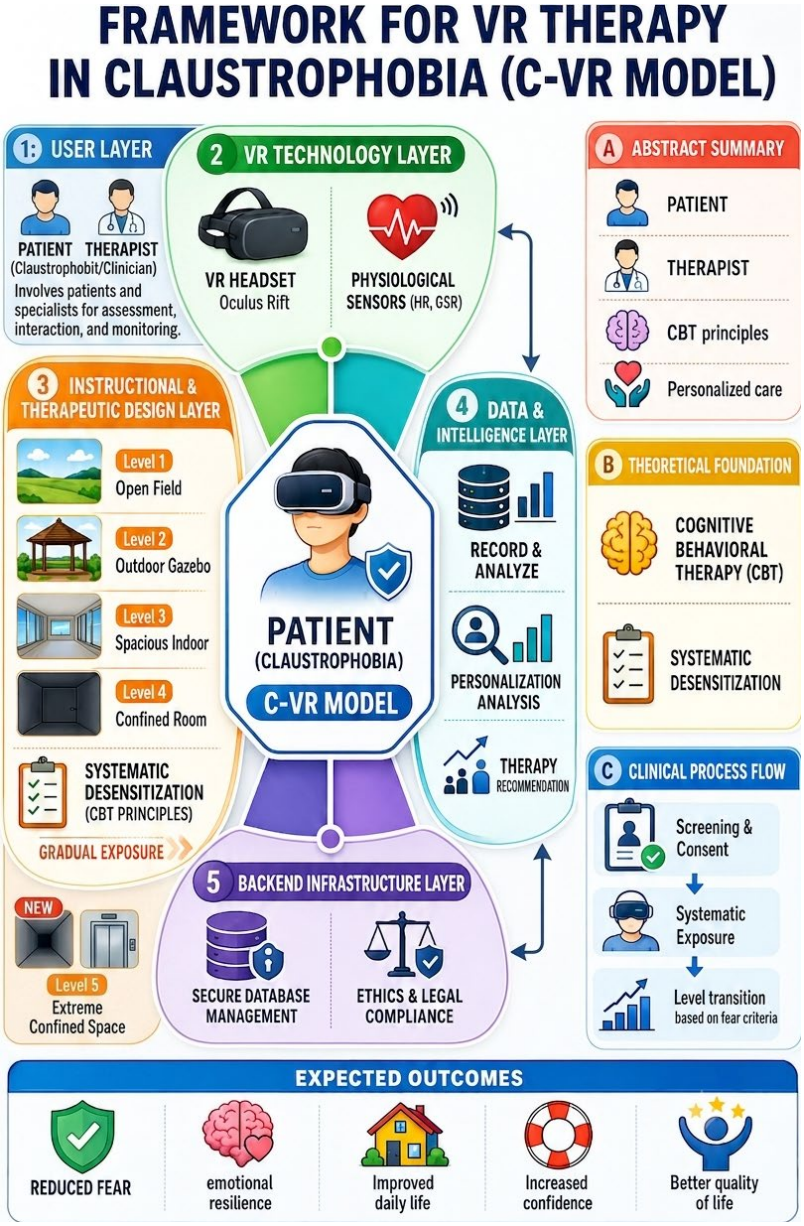
This empirical study specifically focuses on the Level 4 Confined Storage Room, which is architecturally designed with the following parameters

Spatial Geometry: A compact rectangular interior space (approx. 3.0m × 2.5m) with low ceiling height (2.2m) to create immediate overhead and lateral boundary awareness.

Environmental Obstacles: High-density stacks of textured cardboard cargo boxes, tall metal shelving units, and storage containers arranged to form narrow, labyrinthine corridors (width < 0.8m) that visually restrict the field of view.

Lighting and Atmosphere: Dim, localized point-light sources that cast deep ambient shadows, amplifying the psychological sensation of enclosure while maintaining clear visual contrast for task navigation.

Interactive Task Mechanics: A goal-directed interaction mechanic requiring the patient to navigate through narrow aisles, locate hidden items (e.g., books/keys), and unlock the exit door, thereby fostering active cognitive engagement and purposeful movement under spatial stress.



Framework for VR Therapy in Claustrophobia: C-VR Model

# RESEARCH METHODOLOGY

### 3D Asset Engineering and System Implementation

The Level 4 Confined Storage Room was custom-modeled in Autodesk Maya, where polygonal meshes, collision volumes, and UV maps were optimized for real-time graphics rendering. The scene was integrated into Unreal Engine, where physically-based rendering (PBR) materials, dynamic lighting, spatial collision boundaries, and 3D positional ambient audio were programmed. The system was executed on a high-performance workstation equipped with an Intel Core i7 processor, NVIDIA GeForce RTX graphics, and an Oculus Rift CV1 HMD providing dual OLED displays (1080×1200 resolution per eye, 90 Hz refresh rate, 110° field of view) with external constellation infrared tracking sensors (6-DOF). User locomotion and item interactions were executed via a handheld gamepad controller.

**Participants and Ethical Screening Procedures**

A cohort of 13 voluntary participants (N = 13) exhibiting mild-to-moderate claustrophobic symptoms was recruited in Bangkok in coordination with Public Health Center 54 That-Eiam. **Inclusion Criteria:** (1) Confirmed claustrophobic tendencies via pre-screening triggers assessment; (2) Age between 18 and 60 years; (3) Normal or corrected-to-normal vision with stereoscopic depth perception; (4) Ability to comprehend instructions and provide signed informed consent.

**Exclusion Criteria:** (1) History of epilepsy or seizures; (2) Pre-existing severe vestibular disorders or acute motion sickness; (3) Severe cardiovascular disease; (4) Pregnancy; (5) Active severe psychiatric comorbidities

**Ethical Governance:** The study complied with the Declaration of Helsinki and institutional human research ethics guidelines. Participants were informed of research objectives, procedures, transient cybersickness risks, and their right to withdraw at any point without penalty. All data were pseudonymized using alphanumeric identification codes and stored in encrypted databases in compliance with PDPA standards.

**Research Instruments**

1) **Pre-Screening Assessment Questionnaire (20 Items):** Evaluated situational triggers (crowded elevators, windowless rooms, MRI scanners) and somatic anxiety reactions on a 4-point scale (0 = Never, 1 = Rarely, 2 = Frequently, 3 = Always).

2) **Post-Exposure Evaluation Questionnaire (15 Items):** Measured user experience using a 4-point Likert scale (1 = Poor/Minimum, 2 = Fair/Slight, 3 = Good/ Moderate, 4 = Excellent/Maximum) across three subscales:

- *Subscale 1: Virtual Reality Experience & Presence (5 items)* — evaluating Spatial Presence, Involvement, Spatial Consistency, Experienced Realism, and Memory Recall.
- *Subscale 2: Cybersickness & Adverse Symptoms (5 items)* — assessing nausea/emesis, eyestrain/visual fatigue, dizziness/headache, postural instability, and abnormal sweating (lower scores indicate higher safety).
- *Subscale 3: Perceived Therapeutic Efficacy (5 items)* — assessing scenario appropriateness, emotional coping, courage in confined spaces, relaxation, and psychological comfort.

3) **Behavioral Observation Form:** Recorded real-time somatic signs (tremors, sweating, respiration) and clinical fear ratings (Fear Scale: 0 = Normal, 1 = Mild distress, 2 = Moderate distress, 3 = Panic/Stop criteria).

4) **Qualitative Feedback Form:** Captured open-ended feedback regarding navigation, interface usability, and environmental immersion.

**Experimental Protocol**

Testing sessions were administered individually in a quiet, temperature-controlled laboratory following a four-stage protocol: (1) *Orientation (10 mins):* Equipment sanitization with optical wipes, baseline briefing, and informed consent signing; (2) *VR Exposure Session (20-30 mins):* The participant donned the Oculus Rift HMD, entered the Level 4 Confined Storage Room, explored the narrow aisles, and completed the unlocking tasks under continuous monitoring. A strict Stop Criteria was maintained: exposure was halted immediately if severe panic (Fear Scale = 3) or acute nausea occurred; (3) *Recovery & Aftercare (10 mins):* Rest in a well-ventilated room to allow physiological equilibrium stabilization; and (4) *Debriefing & Evaluation (15 mins):* Clinical debriefing, administration of the evaluation questionnaire, and qualitative feedback collection

**Data Analysis**

Descriptive statistics (Mean, Standard Deviation) were calculated for each item and composite subscale. Mean scores were interpreted using equal class intervals: 3.26-4.00 (Excellent/High

Degree), 2.51-3.25 (Good/Moderate Degree), 1.76-2.50 (Fair/Slight Degree, indicating high safety for cybersickness), and 1.00-1.75 (Poor/Minimal Degree).

# RESEARCH RESULTS

### 1) Evaluation of Virtual Reality Experience and Spatial Presence

Table 1 presents participants' ratings regarding immersion, spatial perception, and presence.

**Table 1** Mean, Standard Deviation, and Interpretation of Virtual Reality Experience and Presence (N = 13)

| Evaluated Item/Dimension | Mean | Std.Deviation | Interpretation |
|---|---|---|---|
| **Spatial Presence:** Felt physically "present" within the virtual environment | 3.23 | 0.73 | Good/Moderate |
| **Involvement:** Focused deeply on virtual occurrences | 3.08 | 0.76 | Good/Moderate |
| **Spatial Consistency:** Perceived spatial scale and room depth naturally | 3.00 | 0.71 | Good/Moderate |
| **Experienced Realism:** Virtual events induced genuine reactions | 2.69 | 0.95 | Good/Moderate |
| **Memory Recall:** Retained memory as an authentic event | 3.00 | 0.91 | Good/Moderate |
| **Composite Average (VR Experience)** | **3.00** | **0.81** | **Good/Moderate** |

As shown in Table 1, the overall VR experience achieved a mean of 3.00 (S.D. = 0.81). The highest rated item was **Spatial Presence** (Mean = 3.23, S.D. = 0.73), followed by **Involvement** (Mean = 3.08, S.D. = 0.76), confirming that the 3D visual fidelity successfully elicited situational presence.

### 2) Evaluation of Adverse Symptoms and Cybersickness Tolerability

Table 2 displays the occurrence and severity of native physiological side effects reported during and after exposure.

**Table 2** Mean, Standard Deviation, and Interpretation of Adverse Symptoms (N = 13)

| Evaluated Adverse Symptom | Mean | Std. Deviation (S.D.) | Severity Level |
|---|---|---|---|
| Abnormal sweating or hot flashes | 1.92 | 1.12 | Fair/Slight (Safe) |
| Nausea or vomiting tendencies | 2.00 | 1.08 | Fair/Slight (Safe) |
| Dizziness or headache | 2.46 | 0.97 | Fair/Slight (Safe) |
| Eyestrain or visual fatigue | 2.54 | 1.05 | Good/Moderate |
| Postural instability or balance loss | 2.54 | 0.88 | Good/Moderate |
| **Composite Average (Cybersickness)** | **2.29** | **1.02** | **Fair/Slight (Safe)** |

As detailed in Table 2, the composite cybersickness score was low (Mean = 2.29, S.D. = 1.02), falling within the safe tolerability threshold. Severe autonomic symptoms—**Abnormal Sweating** (Mean = 1.92) and **Nausea** (Mean = 2.00)—remained minimal. Mild-to-moderate ratings were observed for **Eyestrain** and **Postural Instability** (Mean = 2.54). No participant required premature termination, verifying the physiological safety of the system.

### 3) Evaluation of Perceived Therapeutic Efficacy

Table 3 presents participants' evaluations regarding the therapeutic utility of the VR system.

**Table 3** Mean, Standard Deviation, and Interpretation of Perceived Therapeutic Efficacy (N = 13)

| Therapeutic Outcome Item | Mean | Std. Deviation (S.D.) | Interpretation |
|---|---|---|---|
| Developed greater courage to engage in activities within confined spaces | 3.15 | 0.69 | Good/Moderate |
| Felt noticeably more comfortable when facing enclosed spaces | 3.08 | 0.86 | Good/Moderate |
| Learned and improved coping mechanisms to manage phobic feelings | 2.77 | 0.83 | Good/Moderate |
| Experienced greater relaxation inside confined spaces | 2.77 | 0.93 | Good/ Moderate |
| Appropriateness and logic of the 5 progressive levels | 2.69 | 0.63 | Good/Moderate |
| **Composite Average (Therapeutic Efficacy)** | **2.89** | **0.79** | **Good/Moderate** |

**Evaluation of Perceived Therapeutic Efficacy**

As detailed in Table 3, composite therapeutic efficacy was evaluated positively at 2.89 (S.D. = 0.79). Participants subjectively reported high levels of courage to engage in activities within enclosed spaces (Mean = 3.15, S.D. = 0.69) and feelings of psychological comfort Mean = 3.08, S.D. = 0.86), indicating positive user receptivity and perceived coping potential. The items concerning Learning Coping Mechanisms and Feeling Relaxed both scored 2.77, while the Appropriateness of Spatial Design was rated at 2.69 (S.D. = 0.63).

**4) Qualitative Feedback**

Open-ended feedback revealed that while participants praised the visual depth and progressive levels, several noted that *"The handheld controller buttons and navigation controls felt somewhat difficult to operate smoothly for first-time VR users."*

# DISCUSSION & CONCLUSION

Practical and Theoretical Implications

The empirical findings demonstrate that a targeted Virtual Reality Confined Storage Room environment provides an effective, safe platform for claustrophobic desensitization.

1) Spatial Presence in Cluttered Interiors: High scores for Spatial Presence (Mean = 3.23) and Involvement (Mean = 3.08) confirm that 3D architectural confinement (narrow corridors, low ceilings, and stacked cargo) effectively engages phobic cognitive schemas (Witmer & Singer, 1998; Mayer et al., 2022). Navigating a physically restrictive virtual room successfully simulated real-world confinement without subjecting patients to physical risk.

2) Safety and Ergonomic Tolerability: The low incidence of severe nausea (Mean = 2.00) and sweating (Mean = 1.92) indicates that high rendering frame rates and low-latency tracking in Unreal Engine prevented acute sensory conflict (Weech et al., 2019; Boeldt et al., 2019). Moderate eyestrain (Mean = 2.54) emphasizes the clinical recommendation to limit continuous exposure sessions to 20 minutes, followed by structured recovery periods.

3) Therapeutic Coping and Perceived Receptivity: Participants subjectively reported high levels of courage (Mean = 3.15) and comfort (Mean = 3.08), indicating that actively exploring a confined virtual room enables patients to perceive an improvement in self-regulation and coping potential (Craske et al., 2014; El-Qirem et al., 2024). These results suggest positive user receptivity to the virtual intervention as a means to manage phobic distress.

4) Interaction Usability in Confined Spaces: The qualitative feedback regarding controller difficulty in tight corridors highlights the necessity of simplifying navigation in future iterations. Commercial game controllers can impose unnecessary cognitive burden on non-

gamer patients; thus, transitioning to natural hand tracking or gaze-directed locomotion is strongly recommended.

## PRACTICAL AND THEORETICAL

**Clinical Utility** Mental health practitioners and community health units can utilize this controlled confined room simulation as a safe intermediate step before exposing patients to high-risk real-world environments.

**Theoretical Contribution** This research provides an empirical validation of how specific 3D architectural parameters (corridor width, vertical stacking, lighting) directly mediate spatial presence and anxiety modulation within digital psychological interventions.

## LIMITATIONS AND FUTURE RESEARCH

The study has several critical methodological limitations that must be addressed in future work. First, the single-arm observational post-exposure design lacked baseline comparative inferential statistics (e.g., paired t-tests or non-parametric equivalents), which restricts the ability to make causal claims regarding clinical symptom reduction. Second, the small sample size of 13 participants (N = 13) limits the generalizability of these findings across broader clinical populations. Future research should implement randomized controlled trials (RCTs) incorporating pre- and post-intervention standardized psychological scales, such as the Claustrophobia Questionnaire (CLQ), to measure actual symptom change. Furthermore, the integration of objective physiological biomarkers (e.g., Heart Rate Variability-HRV, Galvanic Skin Response-GSR) and active control groups will be essential for validating the physiological impact and clinical efficacy of the C-VR framework.

## CONCLUSION

This study successfully developed and evaluated a Virtual Reality Confined Storage Room environment for claustrophobia exposure therapy. Empirical testing with 13 participants confirmed that the simulation induces strong spatial presence and deep emotional involvement while maintaining high physiological safety. The simulation proved highly effective in fostering courage and comfort in enclosed spaces, demonstrating its viability as a valuable technological adjunct for clinical psychological interventions.

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### DECLARATIONS

Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable academic request.

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## REFERENCES

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Publishing. https://doi.org/10.1176/appi.books.9780890425596Baus, O., & Bouchard, S. (2014). Moving from virtual reality exposure-based therapy to augmented reality exposure-based therapy: A review. *Frontiers in Human Neuroscience*, 8, Article 112. https://doi.org/10.3389/fnhum.2014.00112

Boeldt, D., McMahon, E., McFaul, M., & Greenleaf, W. (2019). Using virtual reality exposure therapy to enhance treatment of anxiety disorders: Identifying areas of clinical adoption and potential obstacles. *Frontiers in Psychiatry*, 10, Article 773. https://doi.org/10.3389/fpsyt.2019.00773

Chung, O. S., Robinson, T., Johnson, A. M., Dowling, N. L., Ng, C. H., Yücel, M., & Segrave, R. A. (2022). Implementation of therapeutic virtual reality into psychiatric care: Clinicians' and service managers' perspectives. *Frontiers in Psychiatry*, 12, Article 791123. https://doi.org/10.3389/fpsyt.2021.791123

Craske, M. G., Treanor, M., Conway, C. C., Zbozinek, T., & Vervliet, B. (2014). Maximizing exposure therapy: An inhibitory learning approach. *Behaviour Research and Therapy*, 58, 10-23. https://doi.org/10.1016/j.brat.2014.04.006

Demir, M. (2023). Efficacy of virtual reality exposure therapy in the treatment of specific phobias: A systematic review. *Current Approaches in Psychiatry*, 15(4), 562-576. https://doi.org/10.18863/pgy.1192543

El-Qirem, F., Malak, M. Z., Abualruz, H., Abuhazeem, S., & Amro, A. J. (2024). Effects of virtual reality exposure therapy on anxiety symptoms and physiological measures among individuals experiencing claustrophobia. *Counselling and Psychotherapy Research*, 24(3), 1-11. https://doi.org/10.1002/capr.12765

Emmelkamp, P. M. G., & Meyerbröker, K. (2021). Virtual reality therapy in mental health. *Annual Review of Clinical Psychology*, 17, 495-519. https://doi.org/10.1146/annurev-clinpsy-081219-115923

Iparraguirre-Villanueva, O., Espinoza-Mina, M. A., Larios-Franco, A., & Belito-Baylón, J. P. (2024). Application of virtual reality in the treatment of claustrophobia in adolescents. *International Journal of Engineering Trends and Technology*, 72(1), 40-47. https://doi.org/10.14445/22315381/IJETT-V72I1P105

Kothgassner, O. D., & Felnhofer, A. (2020). Does virtual reality help to cut the Gordian knot of the treatment of anxiety disorders?. *JAMA Psychiatry*, 77(8), 787-788. https://doi.org/10.1001/jamapsychiatry.2020.0381

Krzystanek, M., Surma, S., Stokrocka, M., Romańczyk, M., Przybyło, J., Krzystanek, N., & Borkowski, M. (2021). Tips for effective implementation of virtual reality exposure therapy in phobias—A systematic review. *Frontiers in Psychiatry*, 12, Article 737351. https://doi.org/10.3389/fpsyt.2021.737351

Maples-Keller, J. L., Bunnell, B. E., Kim, S. J., & Rothbaum, B. O. (2017). The use of virtual reality technology in the treatment of anxiety and other psychiatric disorders. *Harvard Review of Psychiatry*, 25(3), 103-113. https://doi.org/10.1097/HRP.0000000000000138

Mayer, G., Gronewold, N., Polte, K., Hummel, S., Barniske, J., Korbel, J. J., Zarnekow, R., & Schultz, J.-H. (2022). Experiences of patients and therapists testing a virtual reality exposure app for symptoms of claustrophobia: Mixed methods study. *JMIR Mental Health*, 9(12), Article e40056. https://doi.org/10.2196/40056

MDPI. (2025). Virtual reality in phobia treatment and emotional resilience. *MDPI Applied Sciences Special Issue*, 108(1), 16-29.

Psychiatric Association of Thailand. (2017). *Psychiatric knowledge: Situational specific phobias*. Psychiatric Association of Thailand Publications.

Reason, J. T., & Brand, J. J. (1975). *Motion sickness*. Academic Press.

Weech, S., Kenny, S., & Barnett-Cowan, M. (2019). Presence and cybersickness in virtual reality are negatively related: A review. *Frontiers in Psychology*, 10, Article 158. https://doi.org/10.3389/fpsyg.2019.00158

Witmer, B. G., & Singer, M. J. (1998). Measuring presence in virtual environments: A presence questionnaire. *Presence: Teleoperators and Virtual Environments*, 7(3), 225-240. https://doi.org/10.1162/105474698565686

Wolpe, J. (1958). *Psychotherapy by reciprocal inhibition*. Stanford University Press.

**Data Availability Statement:** The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

**Conflicts of Interest:** The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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