

AUTONOMY AND MINDFULNESS IN VR SANDBOX

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Introduction

Research shows VR can enhance mindfulness training and meditation, particularly in nature-based environments (Ma 2022). VR's visual and auditory elements help users focus on the **present moment** (Seabrook 2020), while mindfulness itself improves **well-being**, emotional regulation (King 2011), and reduces stress and anxiety (Bartlett 2021).

However, research hasn't examined how VR design **elements**, especially user control, affect mindfulness. This pilot study will investigate whether VR sandbox environments can facilitate mindfulness practices, measuring outcomes through **presence and anxiety levels**, with particular focus on how **user control** impacts the experience.

Hypothesis

Question: "How does the degree of control on the VR ambient environment affect participants' mindfulness?"

Hypothesis

H0 or Null Hypothesis: The degree of control in VR ambient environment has no effect on mindfulness and presence (immersion).

HA or Alternative Hypothesis: The degree of control in VR ambient environment has an effect on mindfulness and presence (immersion).

Methodology

Independent Variable: Control vs. No Control

- Control: Users select environment settings and move freely
- No Control: Random environment assignment with fixed position

Dependent Variables:

- Presence
 - Measured via Presence Questionnaire (Witmer & Singer 1994)
- Anxiety
 - Measured via State Trait Anxiety Inventory (Spielberger et al. 1964)
 - Assessed pre/post both conditions

Between-subject design was used to prevent carryover effects.

Ethical Protocols

- Informed consent with voluntary participation
- Pre-screening for VR sickness risk
- Confidential data handling
- Clear and standardized VR usage instructions
- Post-experiment debriefing

Materials

- This pilot study used the Meta Quest 2 VR headset and controllers to immerse the participants in the virtual environment.
- The Presence Questionnaire (Witmer & Singer 1994) and the State Trait Anxiety Inventory (Spielberger et al. 1964) were used as data collection tools.

Procedure

Sample: Ten participants divided into control and no-control conditions, with two females and three males per condition.

Pre-VR Protocol: Prior to VR experience, participants completed the State Trait Anxiety Inventory for baseline measurement.

VR Experience:

- "Has control" group selected from four environments (daytime forest, sunset forest, sunset mountains, or nighttime mountains). They were able to move freely within their chosen scene.
- "No control" group was placed in a randomly selected environment without movement abilities.
- All participants listened to identical guided meditation audio with breathing exercises.

Post-VR Protocol: Participants completed both the State Trait Anxiety Inventory and Presence Questionnaire following the VR experience. Sessions conclude with debriefing discussions.

Results

Mindfulness

- Participants with autonomy showed significantly higher mindfulness, which correlates to greater anxiety alleviation (Mean = 8.60) compared to those without autonomy (Mean = 3.00)
- The autonomy group demonstrated more consistent responses with a lower standard deviation (SD = 4.41) than the no-autonomy group (SD = 6.81)
- The median scores show an even more pronounced difference: 10.00 for autonomy vs 2.00 for no-autonomy
- A moderate positive correlation exists between autonomy and mindfulness ($r = 0.44$)

Immersion (Presence)

- Immersion levels were relatively similar between groups (Autonomy: Mean = 65.00, No Autonomy: Mean = 67.00)
- The autonomy group showed higher variability (SD = 13.78) compared to the no-autonomy group (SD = 12.12)
- Median scores suggest a different pattern, with autonomy group showing higher presence (72.00 vs 61.00)
- No correlation exists between autonomy and immersion ($r = -0.08$)

Discussions

- The results suggest that having autonomy over the VR environment **significantly enhances** mindfulness experiences. This aligns with fundamental mindfulness principles where personal agency and conscious choice play crucial roles in maintaining present-moment awareness.
- However, the relationship between autonomy and immersion appears more complex, with **zero to minimally negative correlation**, suggesting that autonomy might slightly decrease presence in the virtual environment. The higher variability in immersion scores for the autonomy group might indicate that different participants utilize autonomy features differently, or they could spot the "incongruencies" in the VR environment easier.
- The discrepancy between mean and median scores in the immersion data suggests that **individual differences** play a substantial role in how autonomy affects presence. Meanwhile, we received positive feedback on the guided meditation, which could have constituted an inalienable part to the conducted mindfulness practice.

preliminary statistics

	Values	Autonomy (Controllability)		Total
		No	Yes	
Mindfulness	Mean	3.00	8.60	5.80
	Median	2.00	10.00	7.50
	SD	6.81	4.41	6.38
Immersion (Presence)	Mean	67.00	65.00	66.00
	Median	61.00	72.00	67.50
	SD	12.12	13.78	13.02

Limitations and Future Implications

Limitations

- Small sample size (n=10) limits statistical power and generalizability
- Between-subjects design may not capture individual differences in VR experience
- Scenes offered may not represent full range of possible VR experiences

Future Directions

- Conduct larger-scale studies with more diverse participant pools
- Investigate long-term effects through longitudinal studies
- Explore different types of environmental autonomy beyond movement and scene selection
- Examine the role of guided meditation content in relation to environmental autonomy
- Investigate the optimal balance between user autonomy and guided experience

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