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# Democratizing Urban Well-being: Virtual Biophilic Interventions Mitigate Socioeconomic Disparities in Environmental Perception and Affect

**Cleiton Ferreira[1], Paula Latorre[2], Aurora Molina-Muñoz[2] and Francisco Nieto-Escamez[2] [3]**

[1] Federal Institute of Education, Science and Technology of Rio Grande do Sul, Rio Grande, 96201-460, Brazil

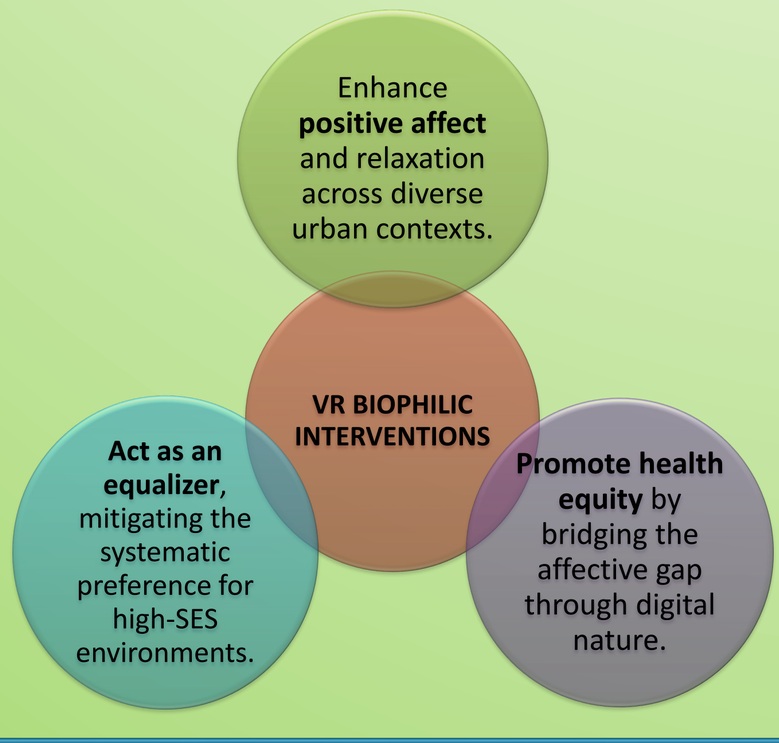
[2] Dep. Psychology, University of Almeria, Almeria, 04120, Spain

[3] CIBIS Research Center, University of Almeria, Almeria, 04120, Spain

## INTRODUCTION & AIM

Urban design is a critical determinant of mental health, yet access to restorative green spaces is often stratified by socioeconomic status (SES). This disparity creates an "affective gap" that penalizes psychological well-being in vulnerable neighborhoods.

Utilizing **Virtual Reality (VR)**, this study evaluates whether digital biophilic interventions can:




## METHOD

- Stimuli: 360° panoramic views of real urban areas (Almería, Spain) modified with digital vegetation (Unreal Engine/Photoshop).
- Apparatus: HTC Vive Pro Eye headset with integrated 120 Hz eye-tracking.
- Procedure: 2-minute immersion per scene followed by psychometric assessment.
- Measures: Psychological (PANAS, PSS, Liking) and Behavioral (Fixation count and coverage).
- Analysis: Repeated-Measures ANOVA + Bonferroni post-hoc tests.

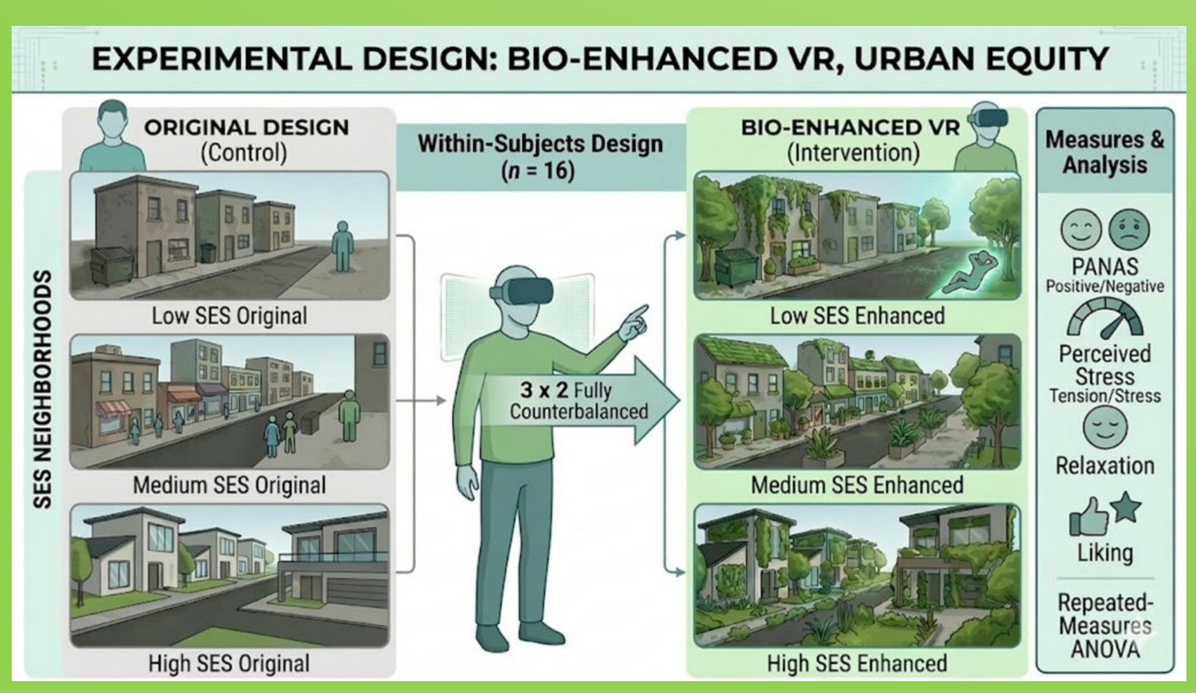



***Figure 1.*** **Experimental design.**

## RESULTS & DISCUSSION

- Bio-enhancement significantly increased **Positive Affect** (p=.006) and Relaxation (p=.004) across all conditions.
- A significant interaction for **Liking** (p<.001) showed that biophilic design neutralized the preference gap between Low and High-SES neighborhoods (figure 2).
- Perceived Stress remained driven by neighborhood SES (p=.021), as vegetation did not fully mitigate the impact of urban decay.
- **Bio-enhanced** Low-SES scenes attracted the **highest visual attention** (eye-tracking), indicating high engagement with nature in deprived areas.

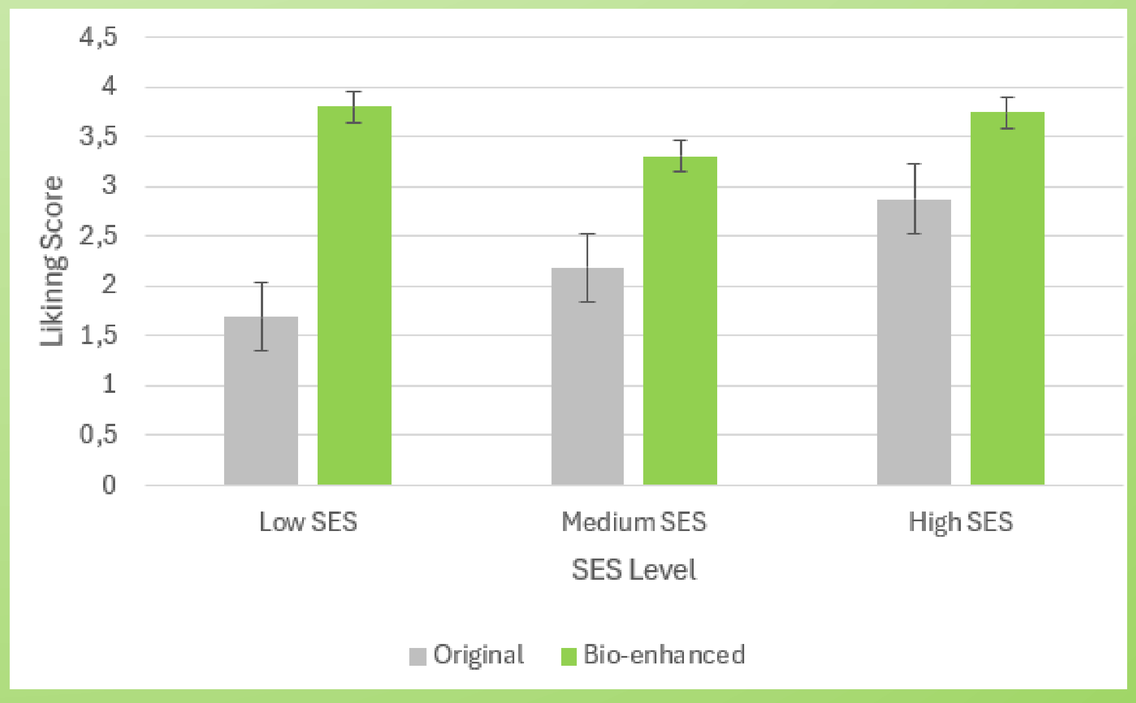



***Figure 2.*** **The Equalizer Effect.** Bio-enhancement neutralized the preference gap between SES levels (p < .001). While original Low-SES scenes were least preferred, their bio-enhanced versions reached scores comparable to High-SES areas.

## CONCLUSION

1. **Equalizer Effect:** Biophilic design neutralizes aesthetic and affective disparities across SES levels.
2. **Practical Tool:** VR nature offers a low-cost, high-impact solution for immediate psychological restoration.
3. **Structural Limits:** Greenery enhances affect but does not eliminate stress rooted in structural inequality.

## REFERENCES

- **White, M. P., et al. (2019).** Spending at least 120 minutes a week in nature is associated with good health and wellbeing. *Scientific Reports*, 9(1), 1-11.
- **Ferreira, C.P.; Latorre, P.; Nieto-Escámez, F.A. (2025)**. Impact of Nature and Architectural Design in Virtual Residential Spaces and Urban Settings on Human Mental Health and Well-Being: A Systematic Review. *J. Environ. Psychol. 108*, 102821.