Navigating the Metaverse: The Relation Between Scale and Expertise in Spatial Knowledge of Immersive and Desktop Virtual Reality

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1. Introduction

- **Throughout evolutionary history, people navigated in real three-dimensional environments.**
- Recently, desktop virtual reality (VR) and immersive VR (iVR) are becoming accessible.
- **Playing video games** is associated with increased visuospatial abilities, and spatial navigation skills[1,2].
- **First-person shooters** or **navigationally active games** result in better navigation and attention tasks after training[1].
- However, gamers' cognitive processes underlying improved spatial navigation are not defined.

Variations in the **mental representation scale** of environments may account for the navigation performance differences between video game players and non-players.

2. Hypotheses

*preregistered

1. Gaming experience supports spatial learning.
2. High-immersion level supports spatial learning.
   a. High-immersion level supports spatial learning for non-players.
3. In desktop VR, non-players form small-scale mental representations, whereas, in iVR, they form large-scale mental representations.

3. Groups

Video game players = action video games >4 h/week

Non-players = no play for the last 3+ years[1]

4. Methods & Equipment

- Within-subjects quasi-experimental design
- Two immersion levels: Desktop & Immersive VR
- HTC Vive Head-Mounted Display
- Virtuix Omni Treadmill

Still recruiting (n = 75)

- *RSRT*	Player	Non-Player	Total
Female	13 -*3*	13 -*1*	26
Male	12 -*1*	0	12
Total	25	13	38

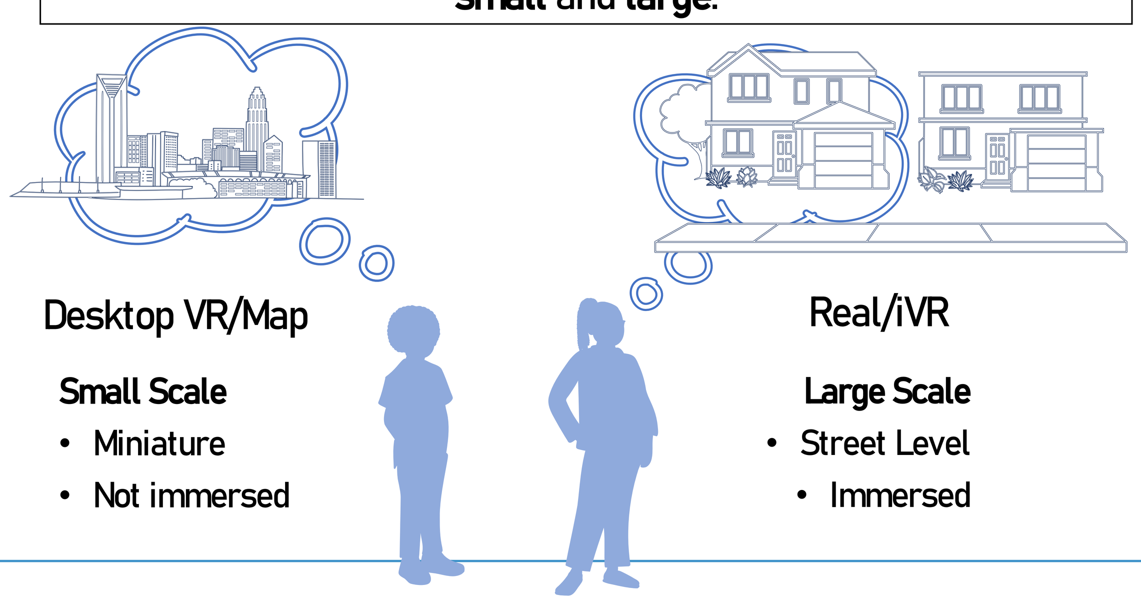
5. Environmental & Mental Representation Scale

Ittelson (1973) suggested two different scales for environments: **small** and **large**.

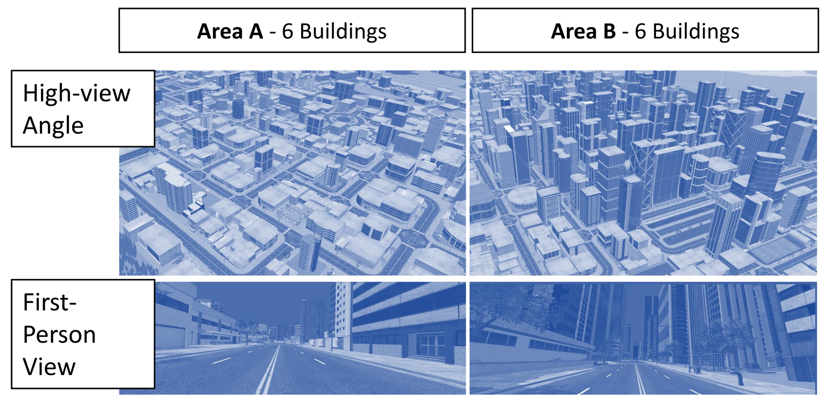
Small-scale: visible via a static visual field (a table-top model or a map).

Large-scale: require movement, entail spatial processing and temporal summation.

Two different scales for **mental representations**: **small** and **large**.



6. Virtual Environment & Tasks



1. Onsite Pointing;

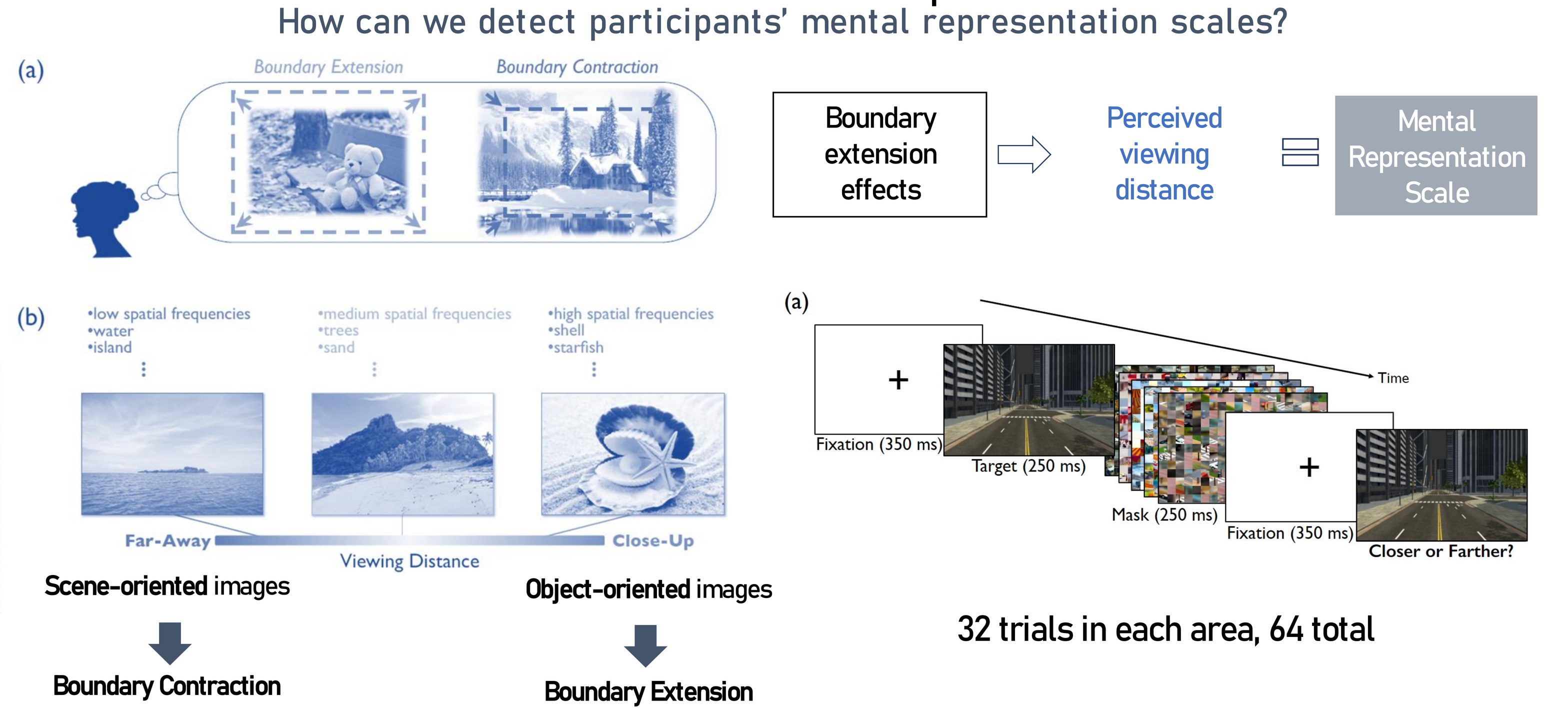
with controller or joystick

DV = Pointing error angle

2. Rapid Scene Recognition Task (RSRT);

DV = Number of Closer Responses

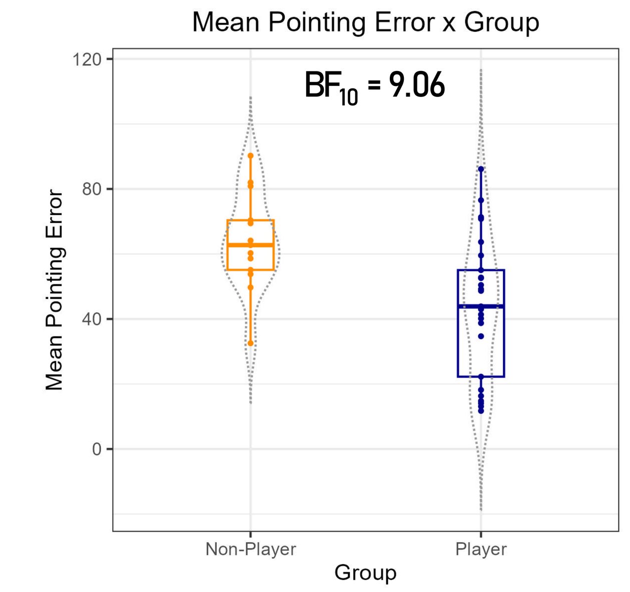
How can we detect participants' mental representation scales?



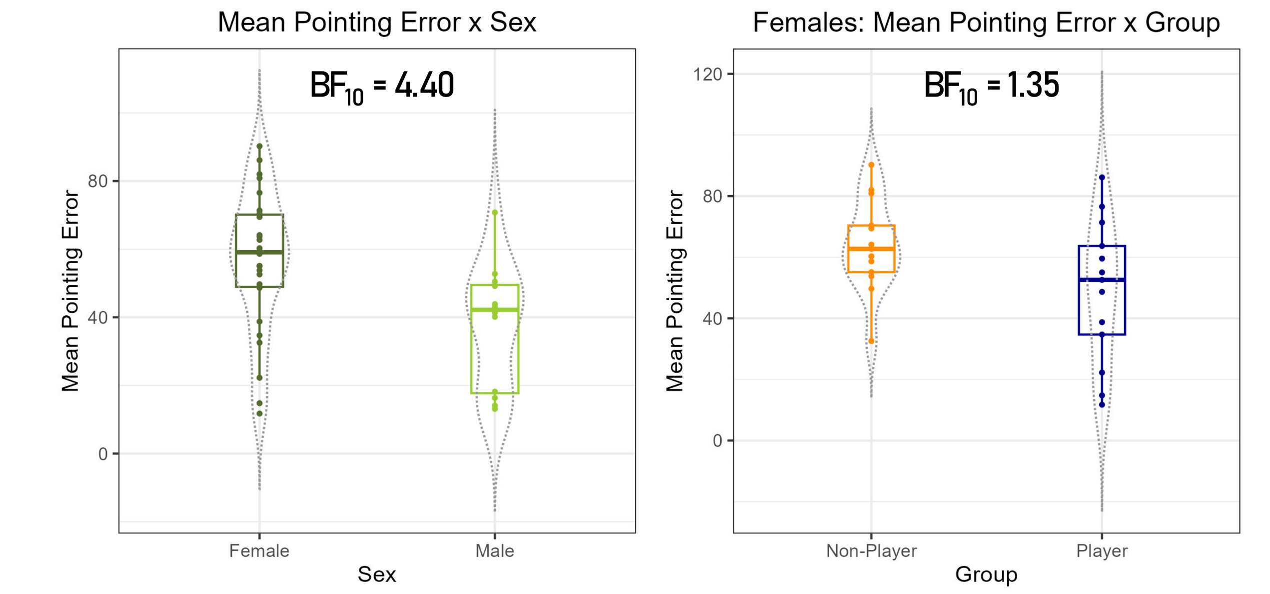
32 trials in each area, 64 total

7. Results Pointing Task

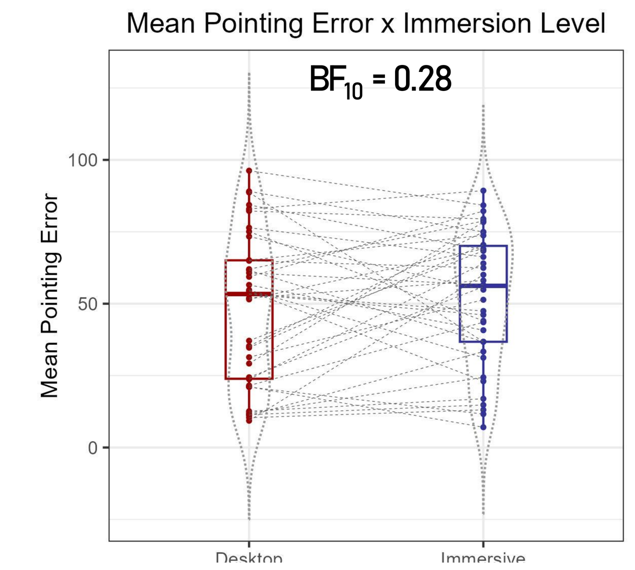
1. Is gaming experience associated with pointing task performance?



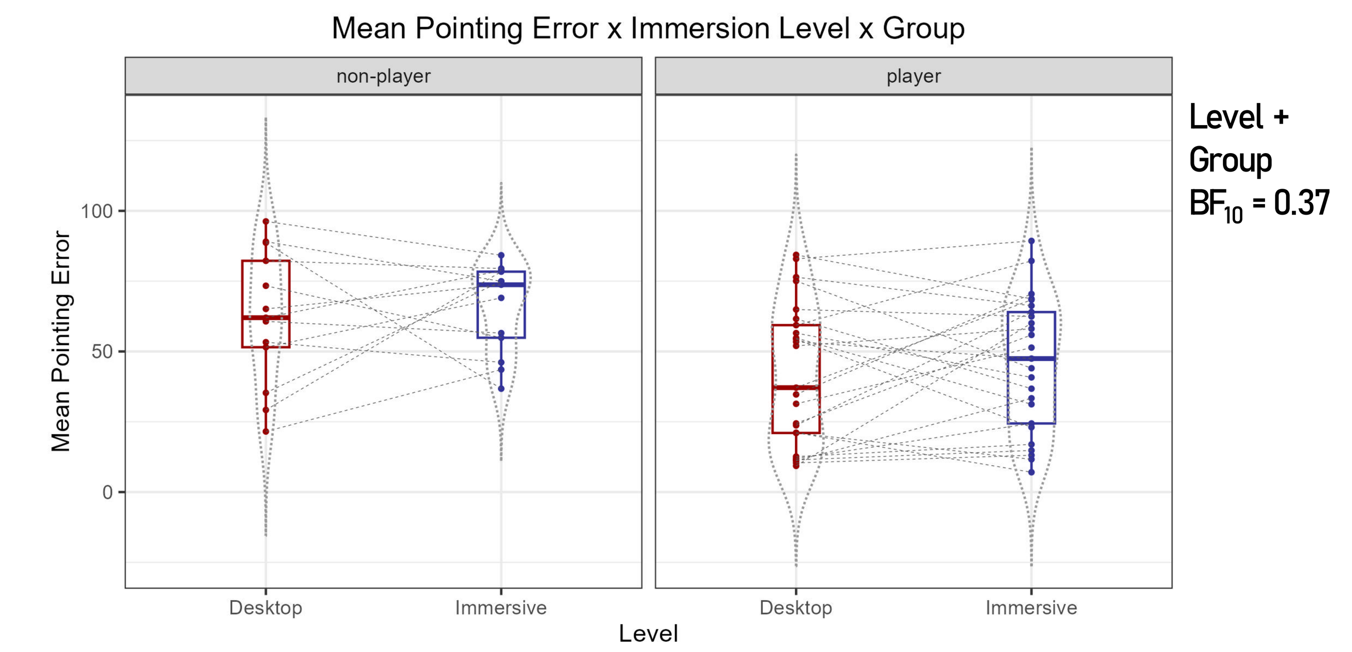
+ Is sex associated with pointing task performance?



2. Does iVR support spatial learning?

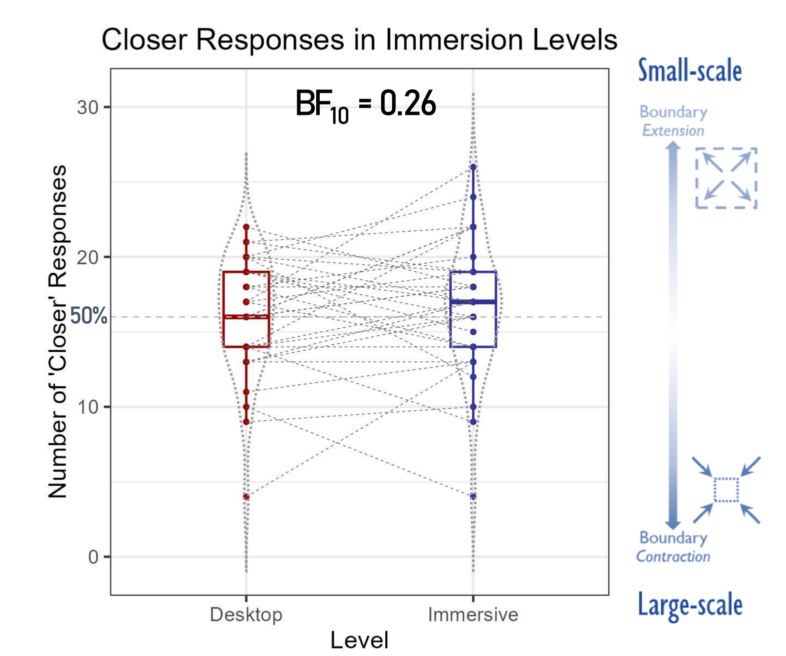


2.a. Does iVR affect non-players differently in spatial learning?

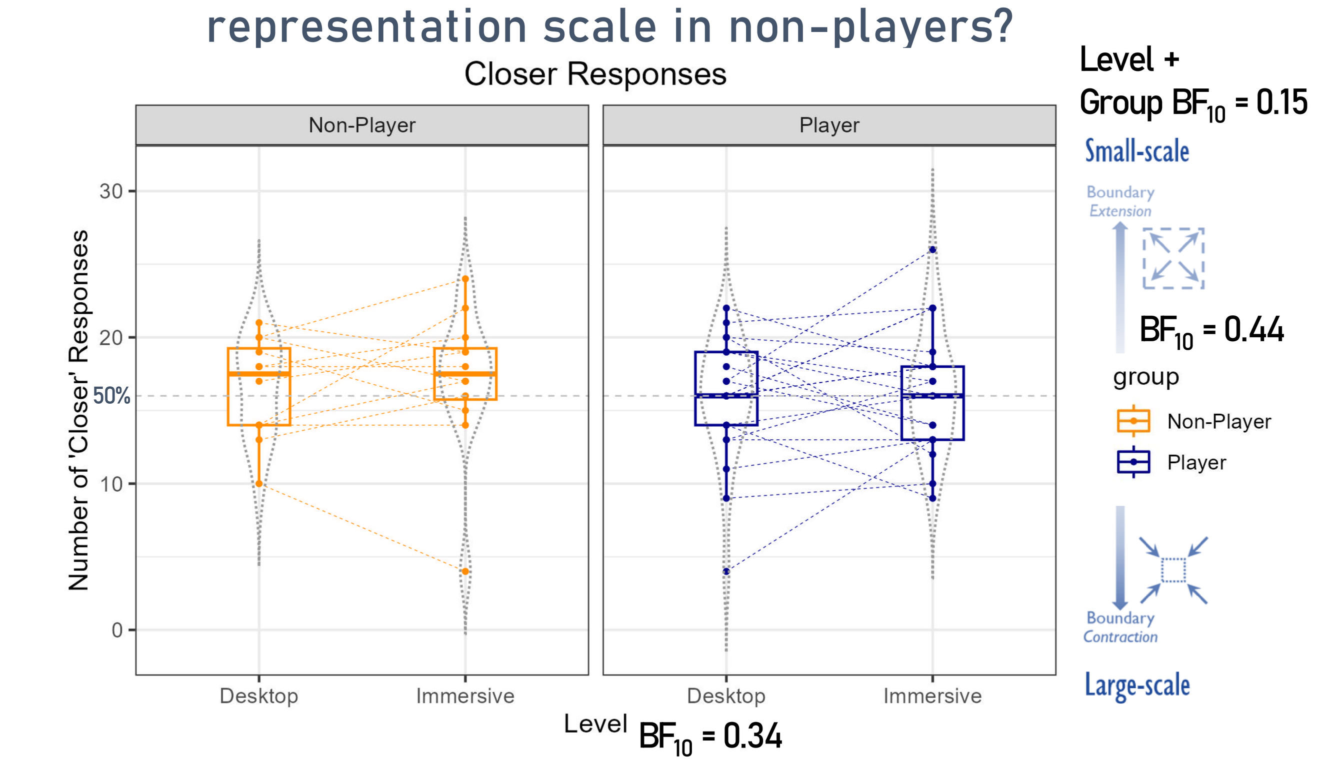


RSRT

3. Does level of immersion affect mental representation scale?



3.a. Do level of immersion affect mental representation scale in non-players?



8. Conclusions & Future Directions

+ We replicated the first hypothesis that video game experience supported spatial learning.

- We did not observe any advantages for iVR in the pointing task. We also did not find an interaction between immersion level and gaming experience.

- We did not find evidence in favor of H3; people did not differ in mental representation scale in different immersion levels.

- However, we are still recruiting subjects. Improved sample size may reveal more information about the relation between scale and expertise in spatial knowledge.

[1] Feng, J., Spence, I., & Pratt, J. (2007). Playing an Action Video Game Reduces Gender Differences in Spatial Cognition. Psychological Science, 18(10), 850–855.

[2] Ventura, M., Shute, V., Wright, T., & Zhao, W. (2013). An investigation of the validity of the virtual spatial navigation assessment. Frontiers in Psychology, 4.

[3] Ittelson, W. (1973). Environment Perception and Contemporary Perceptual Theory. In W. H. Ittelson (Ed.), *Environment and Cognition* (pp. 141-154). New York: Seminar.

[4] Hafri, A., Wadhwa, S., & Bonner, M. F. (2022b). Perceived Distance Alters Memory for Scene Boundaries. *Psychological Science*, 19.

Scan(n) for more lab work!

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