1084 – 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.

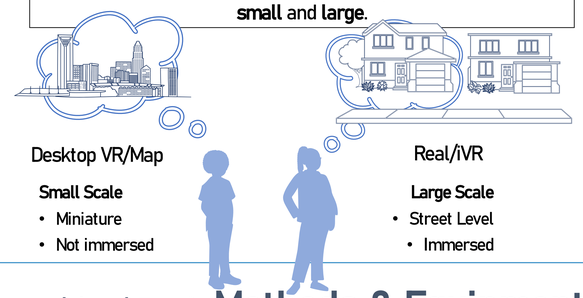
2. Environmental & Mental Representation Scale

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**.



Desktop VR/Map

Small Scale
- Miniature
- Not immersed

Real/iVR

Large Scale
- Street Level
- Immersed

3. Hypotheses

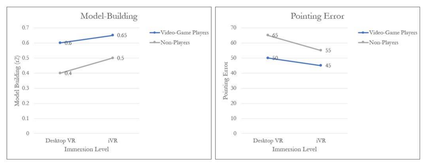
*preregistered

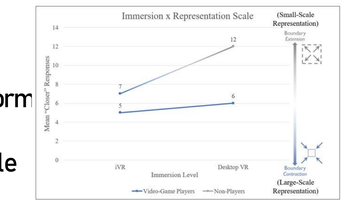
H1. Gaming experience is associated with better spatial learning.

H2. High-immersion level is associated with better spatial learning.

a. High-immersion level supports spatial learning for non-players.

H3. In low immersion, non-players form small-scale mental representations, whereas, in high, they form large-scale mental representations.

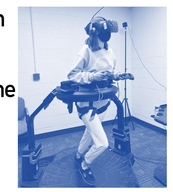




4. Methods & Equipment

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

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



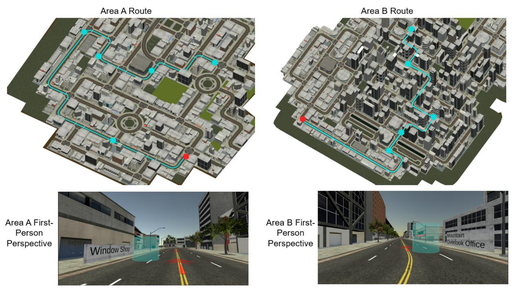
- Within-subjects quasi-experimental design
- VR: Low & High Immersion
- HTC Vive Head-Mounted Display w/ Virtuix Omni Treadmill

	F	M	Total
Player	18	18	36
Non-player	18	8	26
Total	36	26	62

5. Virtual Environment & Tasks

Virtual Environment

2 separate routes;
6 buildings in each route

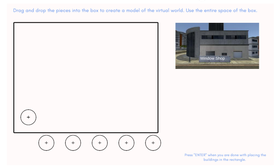


1. Pointing Task

DV = Pointing error angle

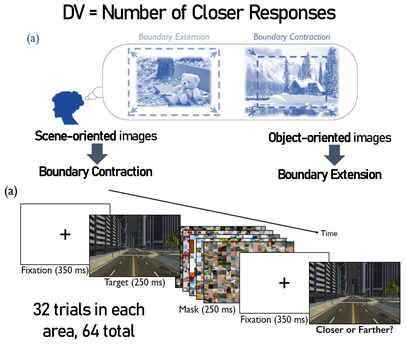
2. Map-Making Task

DV = Bidimensional Regression



3. Rapid Scene Recognition Task (RSRT);

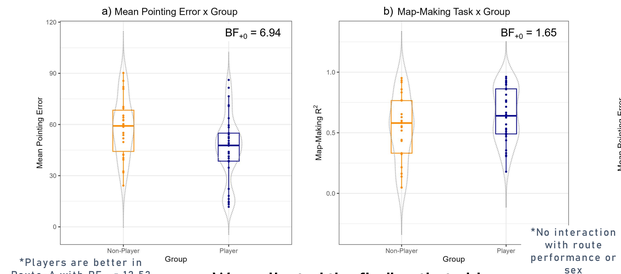
DV = Number of Closer Responses



32 trials in each area, 64 total

6. Confirmatory Results

1. Is video gaming experience associated with enhanced navigation performance?

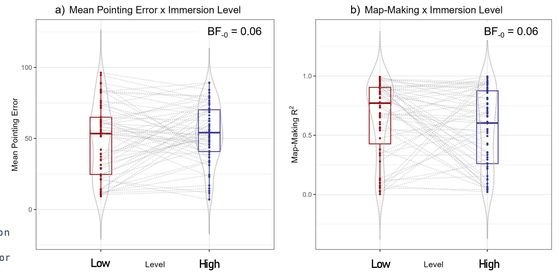


*Players are better in Route-A with BF_{10} = 12.53
*No main effect of video game in males

*No interaction with route performance or sex

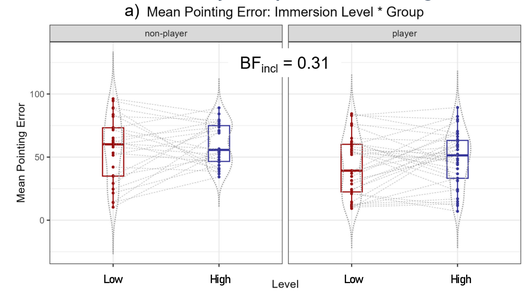
+ We replicated the finding that video game experience is associated with better spatial learning.

2. Is high immersion associated with higher spatial memory compared to desktop VR?

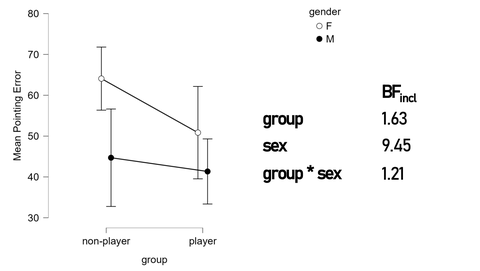


- We did not observe any advantages for high immersion in spatial tasks.

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



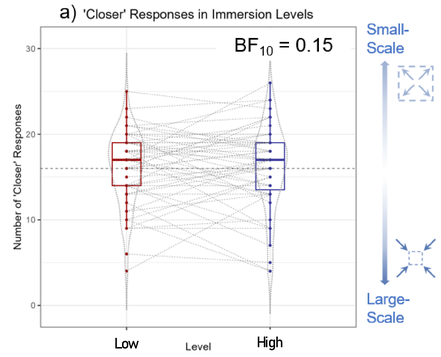
Exploratory: Is there an interaction between video game group and sex?



	BF_{incl}
group	1.63
sex	9.45
group * sex	1.21

- We did not find an interaction between immersion level and gaming experience.

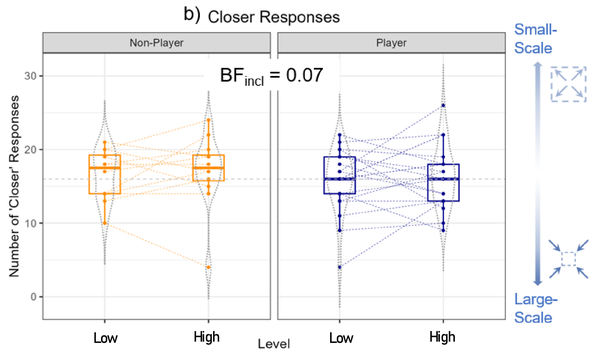
3. Does level of immersion affect mental representation scale?



Small-Scale

Large-Scale

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



Small-Scale

Large-Scale

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

7. Conclusions & Future Directions

- High immersion did not help participants to learn the environment better. Omnidirectional treadmill, unnatural walking?
- RSRT might not be the task for determining mental representation scale?
- Further research might examine other possible moderators in video game play experience and spatial learning.

[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 work!

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