Using Virtual Reality Environments to Assess Within and Across Context Segmentation and Spatial Memory Performance

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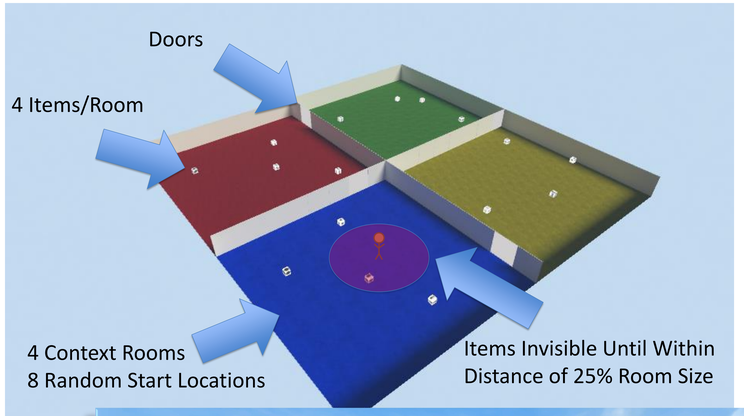
Introduction

- Virtual Reality (VR) provides increased control and measurement capabilities over other methods with improved ecological validity. [1, 2]
- Previous work on sequential memory has shown context boundaries result in episodic segmenting effects, wherein within-context associations are remembered as being closer together than across-context associations, even when equidistant. [3]
- However, no study has investigated the interaction between context changes (context boundary effects) and real-time spatial navigation and memory.

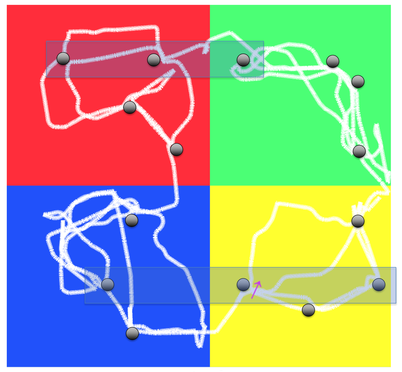
Goal of the Study:
To evaluate the effects of contextual boundaries on spatial memory performance after real-time navigation in a VR environment

Virtual Reality Environment

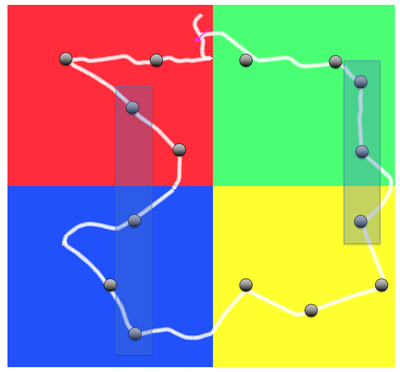


Wired X-Box Controller for Control and Oculus DK2 for VR

Study and Exploration Results

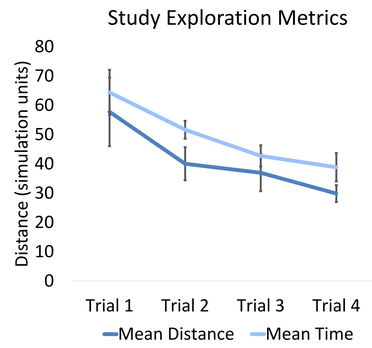


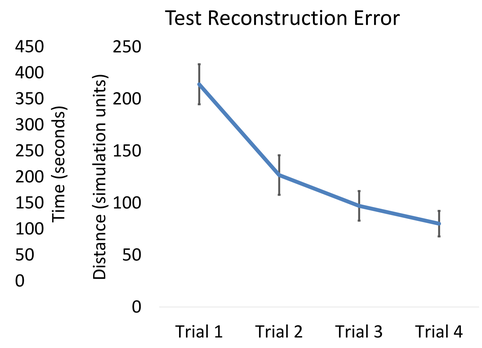
Trial 1



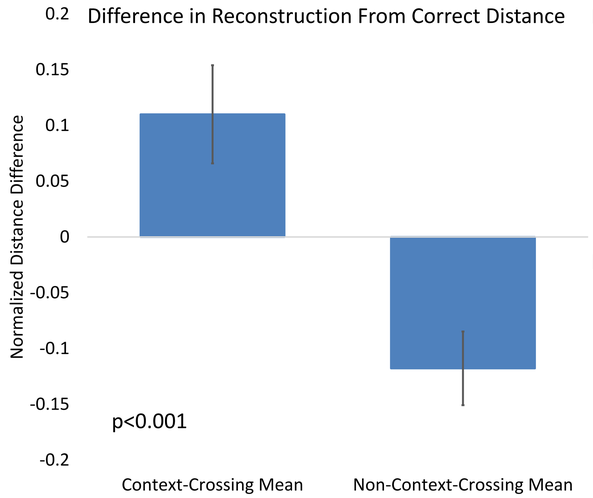
Trial 4

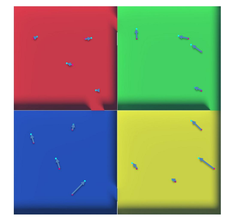
A subset of the items are equally spaced triples used to determine distance judgments.



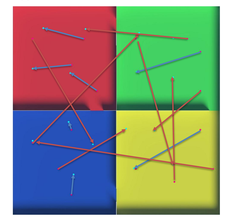


Context Segmentation Effect Results





Low Error Reconstruction



High Error Reconstruction

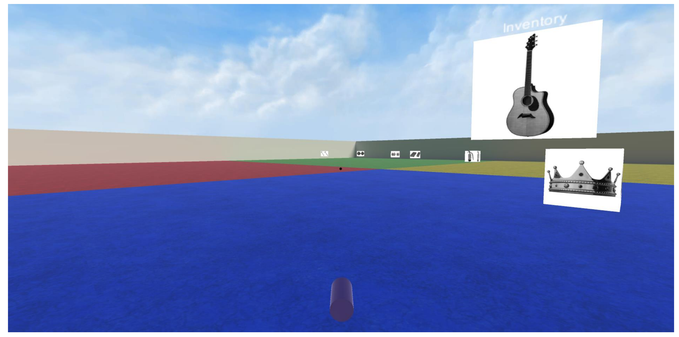
Reconstructions on a 2D map (right) show no obvious global systemic bias.

Discussion

- Similarly to sequential memory studies [3], context boundaries result in context segmentation effects in spatial memory.
- Context segmentation effects were present even after repeated study-test sessions, suggesting that these effects are robust and not simply due to poor memory accuracy.
- Results demonstrate that virtual reality can be used successfully to investigate spatial memory and context boundary effects.
- VR provides potential new measures of both study and test behavior with increased spatiotemporal resolution for future analyses.

Future Directions

- Inclusion of additional metrics of exploration, looking behavior, and path complexity (including fractal and entropy measures) will allow for a richer analysis of segmentation effects.
- A VR version of the test phase (below) with an inventory for placing any item when desired will help explore how patterns of movement at test may match patterns of movement during study.



- Video game or virtual reality expertise will be evaluated via self reported survey and may influence different types of errors.
- Future version of this task using “events” in space-time instead of “objects” in space will allow a more detailed view of how time could influence representation errors.

References

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2. Kuliga, S. F., Thrash, T., Dalton, R. C., & Hölscher, C. (2015). Virtual reality as an empirical research tool — Exploring user experience in a real building and a corresponding virtual model. *Computers, Environment and Urban Systems*, *54*, 363–375. http://doi.org/10.1016/j.compenvurbsys.2015.09.006s, 27(4), 186–193. doi:10.1016/j.tins.2004.02.007
3. DuBrow, S., & Davachi, L. (2013). The influence of context boundaries on memory for the sequential order of events. *Journal of Experimental Psychology. General*, *142*(4), 1277–86. http://doi.org/10.1037/a0034024

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