School of Psychology and Clinical Language Sciences

University of Reading

Do we navigate through a 3D model or across a surface of images?

Maria Elena Stefanou | Alexander Muryy | Andrew Glennerster

Introduction

When an individual navigates to return to a previously-visited location, 'home', they could either do so by building a 3D representation of the space or by matching the views from that location (Gootjes-Dreesbach et al., 2017). The present study aimed to investigate this this question when an imaging matching strategy is impossible.

Methods

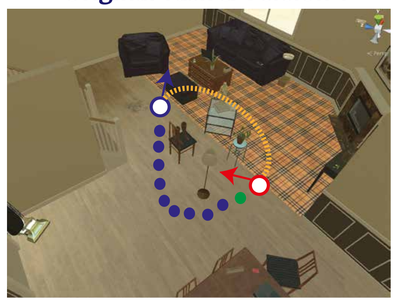
Apparatus:

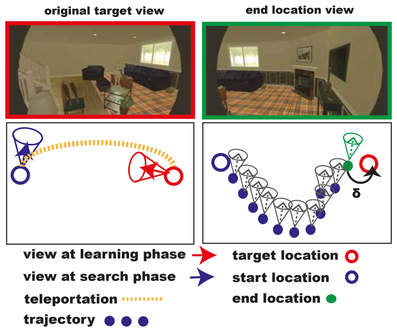
- 19 participants completed the task in 3 different rich scenes. They were allowed to freely walk in the physical room which was 5x3 metres.
- The scenes were delivered via an nVisor SX111 head-mounted display and were tracked with the use of Vicon tracking equipment.

Original Task:

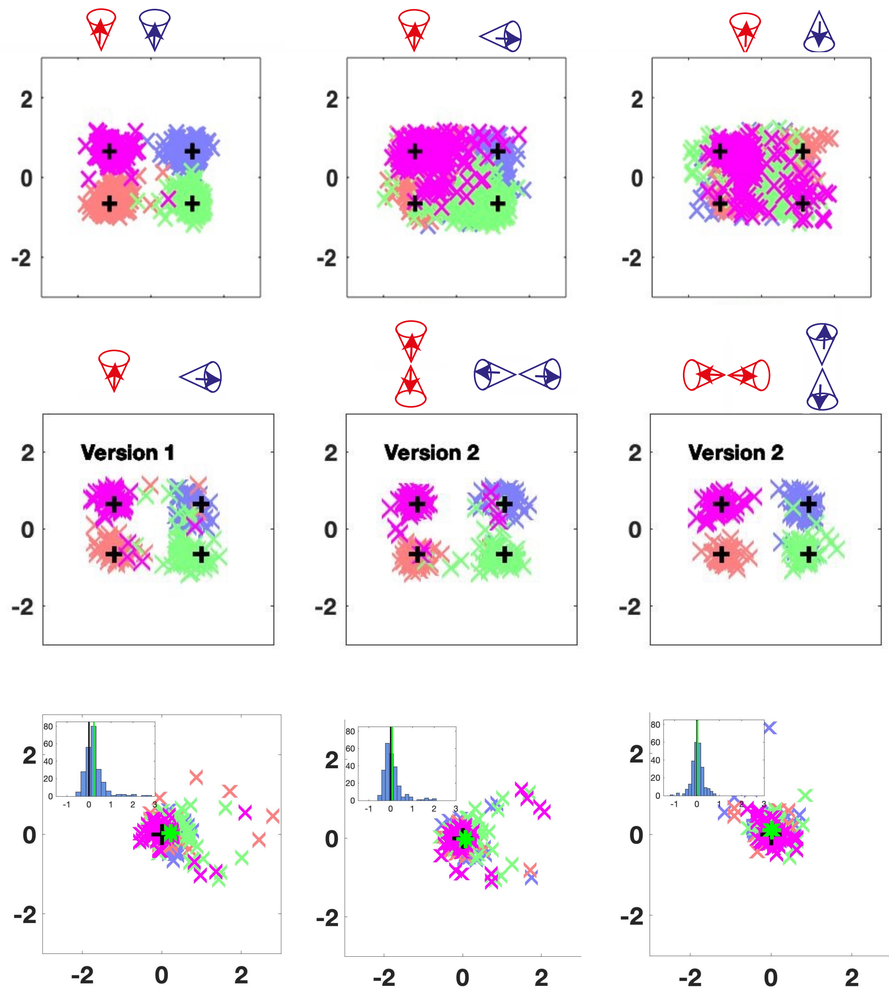
- The task included 2 intervals. During the first interval, the learning phase, participants started at one out of 4 possible locations and memorized their location, 'home'. During this interval, their movements was restricted to ±0.5 metres.
- They were then teleported to another location, 'search phase', and had to go back to 'home'.

Original Task & Version 1

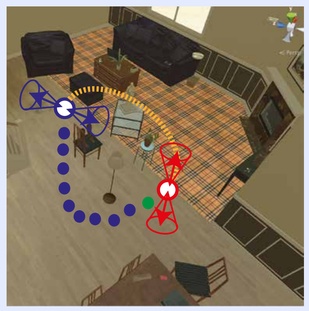




- To exclude an image matching strategy participants' view was restricted to a 90° FOV by a cone-shaped occluder in both intervals.
- Based on the results, two versions of the task were created:
- **Version 1:** During the search phase, the cone's orientation was rotated by 90° relative to the view of the learning phase.
- **Version 2:** The cone-shaped occluder allowed participants to have two view orientations, e.g. north and south. This was again rotated by 90° relative to the view of the learning phase.
- Version 1 and 2 of the task has been completed so far by two participants.



Version 2



Results

Original task:

- There were consistent errors when the view in the second interval was rotated by 90° or 180° compared to the view of the first interval.
- The reported locations were systematically shifted based on the viewing orientation of the second interval. These reported end locations, when projected to the C-T line for all 19 participants resulted in a mean response of 0.55m towards the centre of the room.

T-tests:

- All reported end locations are significantly different from Ground Truth in the original coordinate frame (all $p < 6.5301e\text{-}39$).
- In version 1 and version 2 (where the view during the search phase is 90° rotated away from the centre of the room), we replicated the above finding, i.e., there was a bias towards the centre of the room (smaller than before but significant, (C-T line; $p < 0.0001$ and $p = 0.0077$ respectively).
- However, in version 2, when the view during the search phase was towards the centre of the room, end points did not differ significantly from the target location when data are projected on the C-T line ($p = 0.15$).

Conclusion

- **Eliminating the possibility of image matching introduces large biases in a homing task.**
- **The bias cannot be entirely due to the asymmetry of the viewing window (one cone, in Version 1) as it remains when participants can look in both directions (double cone, Version 2).**
- **We will continue to investigate the source of these biases.**

References

1. Gootjes-Dreesbach, L., Lyndsey, C., P. , Fitzgibbon, A. W., & Glennerster, A. (2017). Comparison of view-based and reconstruction-based models of human navigational strategy. *Journal of Vision, 17*(9), 23–25. https://doi.org/10.1167/17.9.11

Acknowledgements

- **Funded by EPSRC/Dstl EP/N019423/1**

Contact information

- School of Psychology and Clinical Language Sciences, University of Reading, Whiteknights, RG6 6AH
- Email: **m.e.stefanou@reading.ac.uk**
- **www.reading.ac.uk/ PsychologyHome/pcls-home.aspx**