Lokka, I.E., Çöltekin, A. (2017). Remembering what we see: Designing virtual environments to improve visuo-spatial recall for navigation tasks.
In Proceedings of the 28th International Cartographic Conference (ICC2017), July 1-8th, Washington DC, USA.

Remembering what we see: Designing virtual environments to improve visuo-spatial recall for navigation tasks

Ismini E. Lokka, Arzu Çöltekin

Department of Geography, University of Zurich, Switzerland; ismini-eleni.lokka@geo.uzh.ch, arzu.coltekin@geo.uzh.ch

Even though humans navigate every day, it does not mean they are particularly good at it. Many people struggle with determining where they are, deciding their next turn, or remembering relevant visual details on a path in unfamiliar environments. As a result, when studying a destination, people might seek additional visual realism to support the information found on maps, such as landmark representations, street level imagery, or virtual walk-throughs (Çöltekin et al., 2015). Combining visual and spatial tools might support memory, however, it is not currently understood which design elements in a virtual scene contribute to remembering, and how much. We propose a preliminary design framework for designing virtual environments (VEs) as devices of memory training.

To create memorable visualizations, the following three components are of key importance (Lokka & Çöltekin, 2016): (i) information presented in the visualizations, (ii) type of the recall task, and (iii) individual and group differences among users. We break down the first (information in the visualization) further into key design elements. Our review of spatial cognition and visualization literature suggests that a VE should include 'just the *necessary* amount' of *identifiable* information, in the most *prominent* locations for users to successfully recall the relevant information. In other words, the most relevant criteria for designing memorable 3D visualizations are:

- amount of visual detail/realism
- semantic qualities of the highlighted elements
- location of the highlighted elements

While the amount of visual detail can vary from fully photo-textured models to selectively textured and abstract renderings, the semantics of the design elements refer to how easy it is for people to name what they see (e.g., Borkin et al., 2013). We categorize these elements into easy-to-identify (e.g., nameable colors/labels/human faces), moderate (not namable but e.g., high contrast colors/objects/shapes), and difficult (non-nameable and low contrast colors/generic textures). The location of the highlighted visual elements can be based on landmark theories, i.e., important visual elements should be placed on intersections, specifically, towards the direction of turn (Röser et al., 2012). Thus, we hypothesize that by placing easy-to-identify visual elements selectively on critical locations on a route, visuospatial recall should be improved compared to moderate- or difficult-to-identify objects. On the other hand, factors such as spatial abilities, memory capacity and age may strongly influence recall rates in such a navigation task (Höffler, 2010; Huk, 2006). To validate our theoretical design framework, we tested various VEs in a controlled experiment. Initial findings from the study support our position in terms of which design considerations are important for successful recall of relevant information.

Keywords: 3D geovisualizations, visuo-spatial recall, memory, navigation, landmark saliency

References

Borkin, M. A., Vo, A. A., Bylinskii, Z., Isola, P., Sunkavalli, S., Oliva, A., & Pfister, H. (2013). What makes a visualization memorable. *IEEE Transactions on Visualization and Computer Graphics*, *19*, 2306–2315. http://doi.org/10.1109/TVCG.2013.234

Çöltekin, A., Lokka, I.-E., Boer, A., Coltekin, A., Lokka, I.-E., & Boer, A. (2015). The utilization of publicly available map types by non-experts

A full-paper developed from this abstract is published here:

Lokka, I-E., Çöltekin, A. (2017). Towards optimizing the design of virtual environments for route learning: An empirical study of memorability with changing levels of realism. International Journal of Digital Earth. (DOI: http://dx.doi.org/10.1080/17538947.2017.1349842)

-- A choice experiment. *Proceedings of the 27th International Cartographic Conference (ICC2015)*.

Höffler, T. N. (2010). Spatial ability: Its influence on learning with visualizations-a meta-analytic review. *Educational Psychology Review*, *22*(3), 245–269. http://doi.org/10.1007/s10648-010-9126-7

Huk, T. (2006). Who benefits from learning with 3D models? the case of spatial ability. *Journal of Computer Assisted Learning*, *22*(6), 392–404. http://doi.org/10.1111/j.1365-2729.2006.00180.x

Lokka, I., & Çöltekin, A. (2016). Simulating navigation with virtual 3d geovisualizations - A focus on memory related factors. In *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives* (Vol. 41, pp. 671–673). http://doi.org/10.5194/isprsarchives-XLI-B2-671-2016

Röser, F., Hamburger, K., Krumnack, A., & Knauff, M. (2012). The structural salience of landmarks: results from an on-line study and a virtual environment experiment. *Journal of Spatial Science*, *57*(1), 37–50. http://doi.org/10.1080/14498596.2012.686362

A full-paper developed from this abstract is published here:

Lokka, I-E., Çöltekin, A. (2017). Towards optimizing the design of virtual environments for route learning: An empirical study of memorability with changing levels of realism. International Journal of Digital Earth. (DOI: http://dx.doi.org/10.1080/17538947.2017.1349842)