Assessing Virtual Environments as Measures of Spatial Ability

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BACKGROUND

Spatial navigation, which involves learning the layout of an environment and applying the knowledge to go from one location to another, is one of the most important, everyday aspects of human behavior. Technological advancements have led to the emergence of virtual reality as a viable way of conducting large-scale navigation studies that model navigation in the real world while maintaining a high level of experimental control.

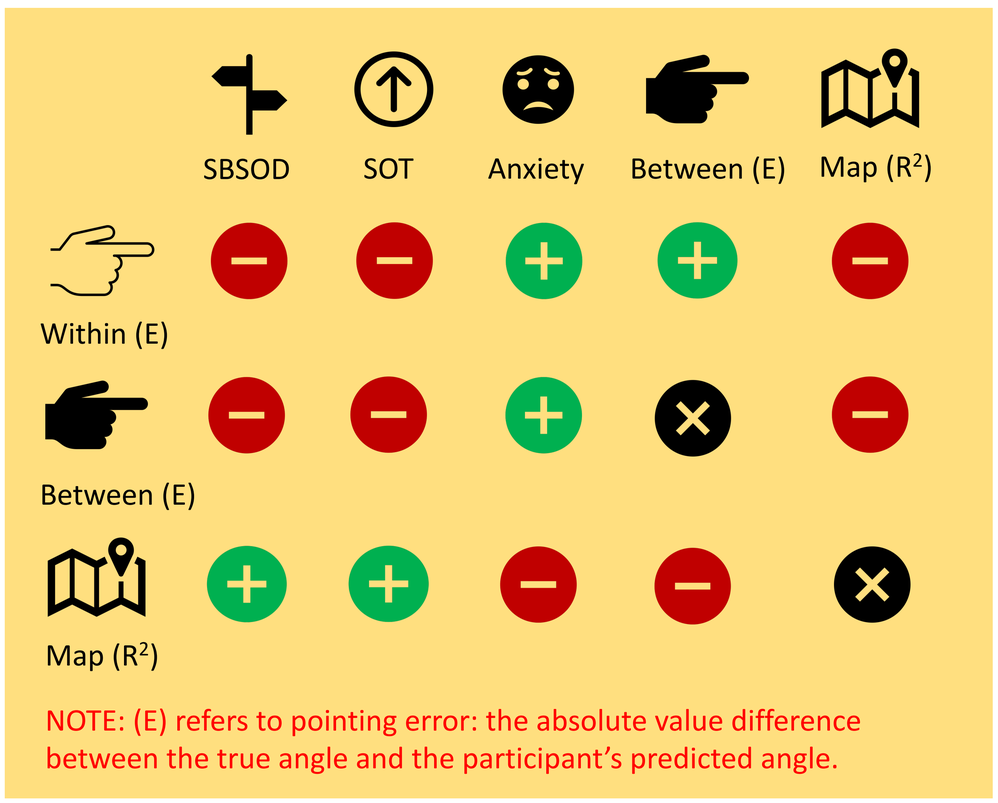
Virtual SILCton is a Virtual Environment (VE) where participants learn how buildings on different paths in an environment relate to each other and perform pointing and map arrangement tasks that test their knowledge (Weisberg et al., 2014).

In this project, we aim to understand how SILCton relates to other measures of spatial ability by testing it against psychometric measures.

ANALYSIS & RESULTS (EXPECTED)

Previous Results:

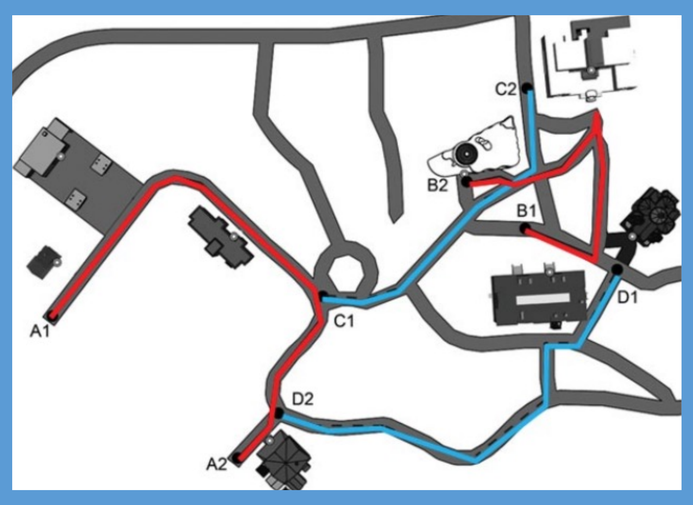
- Pointing error is greater for between-route trials than within-route trials (Weisberg & Newcombe, 2014)
- There are large individual differences in a college student population



We hypothesized that SILCton would be positively correlated with perspective taking ability and self reported sense of direction, but negatively correlated with spatial anxiety.

We have also made progress in developing a new version of SILCton that will be eventually tested against the original to validate the task.

How well does Virtual SILCton relate to other measures of spatial ability?

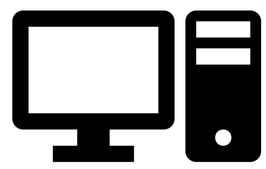


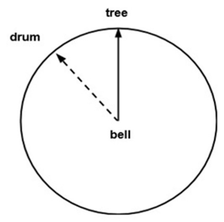
METHOD

Participants:

40 students from the University of California, Santa Barbara, will participate in this pilot study.

Materials:





- **Virtual SILCton*** (Weisberg et al., 2014).
- **Spatial Orientation Test** (SOT), a measure of small-scale perspective taking ability (Kozhevnikov & Hegarty, 2001)
- **Spatial Anxiety Scale** (He & Hegarty, 2020) + **Santa Barbara Sense of Direction Scale** (SBSOD), a self report measure of sense of direction, (Hegarty et al., 2002)

Composed of the following tasks:

- Walking through four paths and learning buildings
- Pointing task
- Map reconstruction task

Preliminary SILCton data (N=19)

- Range in average within-route pointing error*: 85.46° (min. 6.13°, max. 91.59°)
- Range in average between-route pointing error*: 76.21° (min. 13.42°, max. 89.63°)
- Map reconstruction scores using a bidimensional regression analysis**: range in R^2 = 0.93 (min. 0.02, max. 0.96).

*An error of 90° is considered chance performance, while an error of 30° or less indicates very good performance.

** Scores range from 0 to 1, where scores close to 1 are very good, and scores below 0.3 indicate poor performance.

CONCLUSION

Some participants had near-perfect accuracy on the pointing and map reconstruction tasks, while others had chance or near-chance performance. The high range in performance on SILCton despite the similar educational backgrounds of the participants highlights the **large differences in navigation ability**, as well as the **sensitivity of SILCton in measuring these differences**.

These are only **preliminary** conclusions. We intend to complete the development of the new version of SILCton and test it against the original to verify the reliability of the task. We will also test different VEs against each other to see how they relate.

The insights from this project may aid further research in how VEs can be used in spatial cognition studies.

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