Spatial Memory of Children and Teens in Virtual Environments

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ABSTRACT

Children have begun to use virtual reality with increasing frequency; however, it is uncertain how immersive virtual environments affect a child's understanding of three dimensional space. We present preliminary work evaluating the spatial memory of children across real and virtual worlds.

Our results include the assessment of 10 children (aged 9-12) and 9 teenagers (aged 16-18) in a spatial orientation task akin to that used in Rieser et al. [1994]. Participants learned the locations of five posters on the walls of a room either in the real world or a virtual, equivalent world rendered by an HTC Vive. The spatial orientation of all participants was then evaluated in a dark virtual environment–an effective blindfold.

The only visible cues in the blindfolded environment were two small markers on opposite sides of the space, each marker represented a distinct reset point for the two conditions used to evaluate participants: a locomotion condition and an imagination condition. Reset points were used to avoid drifting orientation in the dark. Although evaluations occurred without vision, participants were allowed to refresh their memory of either the real or virtual room between conditions.

In the locomotion condition, participants were asked to physically turn to face one of the posters and then they were asked to point with an HTC Vive controller to a second poster. After each trial, users reset their orientation by facing the designated reset point. In the imagination condition, participants were first asked to turn 180° away, thereby facing the second reset point. Then, without turning, participants were asked to pretend (or imagine) that they were facing one of the posters. They then pointed with the controller to the position of a second poster, as if they were facing the imagined poster.

For both conditions, pointing accuracy (turning error) and time to complete pointing (latency) were recorded. A repeated measures ANOVA on the turning error, with recall condition (locomotion vs. imagination) as the repeated measure, and age, gender, order of blocks, and learning environment as between-group variables, showed only a main effect of condition, $F(1,11) = 61.63$, $p < .0001$. A similar ANOVA on latency also showed only a main effect of condition, $F(1,11) = 16.58$, $p < .001$. All participants were slower and made more errors in the imagination condition. These results are consistent with those of Rieser et al. [1994]. Our current experiment reveals no age-related differences in spatial learning between real and virtual environments. This outcome echos the results of our prior work with adults evaluating spatial representations [Williams et al. 2007]. Our next steps are to evaluate younger children and implement additional methods of evaluation for spatial learning.

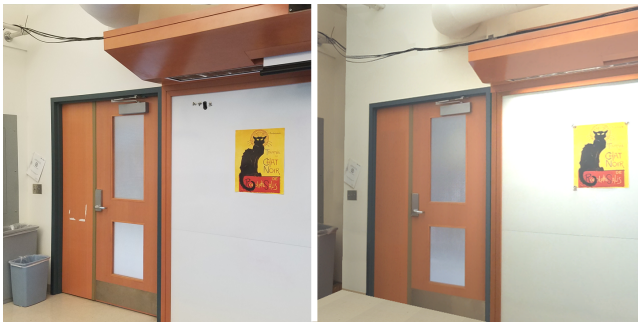

Figure 1: Images of the real (left) and virtual (right) environments.

CCS CONCEPTS

• **Human-centered computing** → **Virtual reality**; **Empirical studies in HCI**; • **Applied computing** → *Psychology*;

KEYWORDS

virtual environments, spatial memory, perception, children

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