Effects of Interactivity and Spatial Ability on the Comprehension of Spatial Relations in a 3D Computer Visualization

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Introduction and Method

This experiment was designed to investigate the roles of interactivity and spatial visualization ability in the comprehension of 3D computer visualizations.

Undergraduates were presented with a fictitious anatomy-like structure in the form of both printed 2D images and a 3D computer visualization that could be rotated in *x*, *y* and *z* dimensions. A superimposed vertical or horizontal line on the printed images indicated where they should imagine the structure had been sliced. The task was to draw the cross-section at that point. The drawings were assessed for spatial understanding using a standardized scoring scheme.

Sixty participants were randomly allocated to one of two conditions. The *active* group was allowed to rotate the computer visualization at will via keyboard controls during the drawing task. The *passive* group had no control over the movements. Using a yoked pairs design, the manipulations performed by the active participants were recorded and later played back to the passive participants, so that both members of each pair received the same visual information.

Spatial ability was measured via the Mental Rotation Test (Vandenberg & Kuse, 1978) and a modified version of Guay's Visualization of Views test (Eliot & Smith, 1983).

Results

There was no main effect of condition, indicating no significant difference between the active and passive control conditions. However, a main effect of spatial ability was found (median split; F=9.38, p<.005; Figure 1). Although the interaction between these two factors did not reach significance, pairwise comparisons revealed that high- and low-spatial participants differed significantly in the passive condition (t=2.80, p<.01), but not in the active condition (t=1.47, p>.1; Figure 1). In line with this finding, the correlation between spatial ability and performance was relatively attenuated under active control (r=.29, p>.1), compared to passive viewing (r=.51, p<.005; Figure 2).

Discussion

The data indicate that having active control of the computer visualization did not benefit overall performance. A more important predictor of success was individual differences in spatial ability. However, the contribution of this factor was stronger in the passive condition than in the active condition, i.e. when participants were allowed to manipulate the 3D model, the performance means of high and low spatial individuals were brought closer together. While low-spatial participants were helped by interactivity, this benefit did not extend to high-spatial individuals. We are currently undertaking a replication study with a more intuitive control mechanism, to establish whether these findings arose from the nature of the interface or from interactivity *per se*.

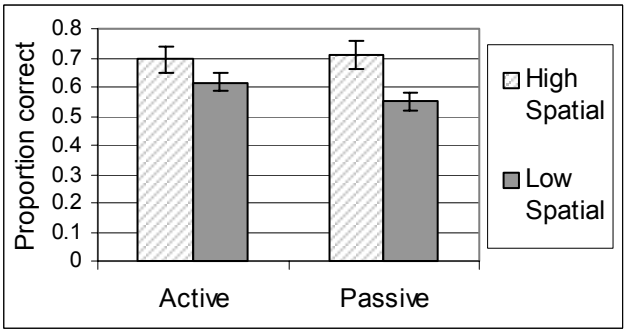

Figure 1: Performance on the cross-section drawing task by interactivity condition, as a function of spatial ability.

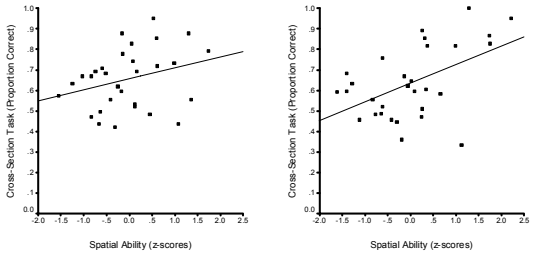

Figure 2: Correlation between spatial ability and performance, by interactivity condition.

Acknowledgments

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References

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