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The Effect of Spatial Ability on Learning from Text and Graphics

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Introduction

Previous research has shown that participants' comprehension of spatial information described in text improves when either graphics or animation accompanies the text (Morrison & Tversky, 2001). This relationship was found to be true in all cases for low spatial ability participants; however, it was only true under the most difficult conditions for high spatial ability participants. When given enough time to do so, high spatial participants were able to mentally imagine what was described in the text, and therefore did not need externally provided graphics.

The high and low spatial ability distinctions described above were based on a median split of scores on the Vandenberg and Kuse (1978) Mental Rotation Test. The study was conducted with undergraduate students from Stanford University, raising concerns about the accuracy of the categorization and the generalizability of the results. The study presented here replicates the original with a more typical college population.

The Learning Study

Method

Fifty-nine Bryant College undergraduates participated in the study. Although specific GPA data was not available for the participants, the average high-school GPA of an entering student is 2.95 at Bryant and 3.90 at Stanford (Undergraduate Guide, 2003). After completing a test of spatial ability, the Vandenberg and Kuse (1978) Mental Rotation Test, participants began the learning phase of the experiment. They read through a learning interface with 7 novel rules four times, studying for as long as they wished. The interface included text, text plus static graphics, or text plus animated graphics. Following the learning phase of the experiment, participants completed three timed performance tests requiring applications of the rules. The scores on these tests have been combined into a composite Problem-Solving Score, which can range from 0-100.

Results

As with previous analyses, due to a lack of difference between the static and animated graphics conditions, these conditions were combined into a text plus graphics condition. The problem-solving data was analyzed with a one-way (text vs. text plus graphics) ANOVA with spatial ability as the covariate. Participants performed better in the graphics condition than in the text condition, $F(1,56)=21.1$, $p<.01$. High spatial ability participants performed better than their low spatial counterparts, $F(1,56)=16.0$, $p<.01$.

Participants were separated into low and high spatial ability groups according to a median split of spatial ability scores. Figure 1 displays the Problem-Solving Score earned by the low and high spatial ability groups across the text and text plus graphics conditions.

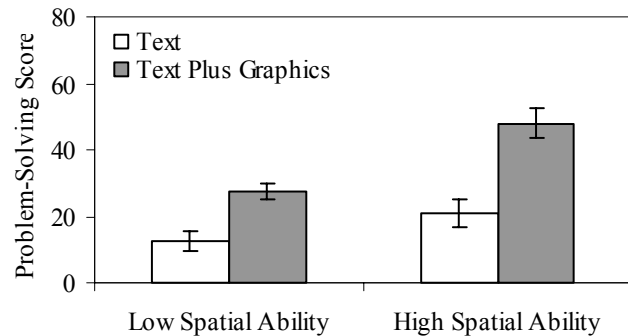


Figure 1: The relationship between spatial ability and interface type for Bryant students.

Discussion

Participants with high spatial ability and those who studied static or animated graphics were better able to learn the spatial rules described in the interface. These results replicated the previous research, in part. In the Stanford version of this study, the low spatial text participants performed more poorly than the three other groups, which did not differ, showing that graphics have benefits, but only for low spatial participants (Morrison & Tversky, 2001). However, the pattern of data seen above is identical to the performance of Stanford participants when limited to studying the interface a single time and with instructions to do so quickly. This suggests that when spatial ability decreases (MRT Score: Bryant $M=7.53$, $SD=3.4$; Stanford $M=9.17$, $SD=4.2$) and/or when the task becomes more difficult, the benefits of graphics become more pronounced. Although the participants in both studies were college students who may have higher aptitude than the general population, it is clear that there is a learning advantage when spatial material is presented with accompanying graphics.

References

- Morrison, J.B. & Tversky, B. (2001). The (in)effectiveness of animation in instruction. *Extended Abstracts of the ACM Conference on Human Factors in Computing Systems* (pp. 377-378). Seattle: ACM.
- Undergraduate Guide to Four Year Colleges 2004* (34th ed.). (2003). Stamford, CT: Peterson's.
- Vandenberg, S.G. & Kuse, A.R. (1978). Mental rotations, a group test of three-dimensional spatial visualization. *Perceptual and Motor Skills*, 47, 599-604.