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Performing a task such as solving a Rubik's cube can be very difficult, but it can be done after enough twists and turns. However, only an individual with extremely high spatial intelligence could be expected to solve a Rubik's cube in his or her head. Discussing the concept of spatial intelligence, Howard Gardner makes it clear that "…Spatial intelligence is closely tied to, and grows directly out of, one's observations of the visual world." The term spatial intelligence, as it pertains to my research, derives from the ability to visualize and manipulate three-dimensional objects in your mind. In this experiment, I tested approximately 100 college students on two things: 1) their spatial intelligence, and 2) their ability to comprehend and execute a specific set of instructions. I used a standardized spatial test to gauge their spatial abilities. The students then had to complete an origami using one of three types of instructions: textual, graphical, or a combination of the two. Comparing the results between the three instructional mediums, I found a relationship between spatial intelligence and the ability to comprehend textual/graphical instructions.

Spatial Intelligence and the Ability to Comprehend and Execute Textual/Graphical Instructions

Anthony Wacholtz

Abstract

Performing a task such as solving a Rubik's cube can be very difficult, but it can be done after enough trials. Therefore, only an individual with extremely high spatial intelligence could be expected to solve a Rubik's cube in his or her head. Discussing the concept of spatial intelligence, Howard Gardner makes it clear that "…spatial intelligence is closely tied to, and grows directly out of, one's observations of the visual world." The term spatial intelligence, as it pertains to my research, derives from the ability to visualize and manipulate three-dimensional objects entirely within the mind. In this experiment, I tested approximately 70 college students on two things: their spatial intelligence and their ability to comprehend and execute a specific set of instructions. I used a standardized spatial test to gauge their spatial abilities. The students then had to complete an origami using one of three types of instructions: textual, graphical, or a combination of the two. A comparison of the results between the three instructional mediums yielded a relationship between spatial intelligence and the ability to comprehend a specific set of instructions.

Introduction

Everyone has a certain level of spatial intelligence, just as they have a certain level of logical, musical, or mathematical intelligence. People with high spatial intelligence would have the ability to complete a Rubik's cube with their eyes closed or play chess blindfolded. Each move that is made registers in their mind, and the resulting configuration of either the Rubik's cube or the chessboard is created visually within their mind.

After reading Howard Gardner's *Frames of Mind: The Theory of Multiple Intelligences*, I wondered what implications spatial intelligence had in the technical communication field. The visual technical communication course showed me how different types of instructions can affect one's ability to complete a desired task. Combining these two ideas, I decided to do an experiment that would determine if there is a relationship between spatial intelligence and one's ability to execute a set of instructions.

Literature Review

Howard Gardner states, "…spatial intelligence is closely tied to, and grows directly out of, one's observations of the visual world" (174). He also says that someone with a high level of spatial intelligence would have, "the capacities to perceive the visual world accurately, to perform transformations and modifications upon one's initial perceptions, and to be able to re-create aspects of one's visual experience, even in the absence of relevant physical stimuli" (173). In other words, the term spatial intelligence derives from the ability to visualize and manipulate three-dimensional objects in the mind (Gardner 172-175).

Ann Sloan Devlin breaks spatial intelligence down into three categories. The first category, which was the cornerstone for my experiment, is mental rotation, the ability to rotate an object in one's mind. The second category, similar to the first, is spatial manipulation, the

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ability to perform operations or acts to an object in one's mind. The third category of spatial intelligence, taking a complex form and creating a simpler form from it, will not be addressed in this research (Devlin 44).

This study is being done to find a relationship between one's spatial intelligence and one's ability to execute a task through a select instructional medium.

Method

Participants

The sample was comprised of students from three entry-level technical communication classes. Technical communication courses are usually comprised of students from many disciplines. The courses selected for the experiment were no different; therefore, they would make an appropriate, representative sample.

Experiment

I began the experiment by explaining the project and the tasks that the students would have to complete. Then, the students were allowed to ask questions about those tasks before the testing began. Afterwards, each subject filled out a consent form that granted me the use of his or her data in the experiment analysis.

I tested the subjects to find two specific attributes: their spatial intelligence (the independent variable), and their ability to follow a set of instructions (the dependent variable). Each class was to partake in the same standardized spatial intelligence test to determine their spatial abilities. The test used was Vandenberg's Test of Three-Dimensional Spatial Visualization (1971). The test consisted of two sections of ten questions with the students given three minutes to complete each section. In each problem, the subject was given a figure comprised of cubes. Following the figure, there were four additional figures: two were rotations of the original, and two were reconfigured. The subject was to put an "X" by the two figures that were rotated. The scoring method for each problem is as follows:

	Points
Two correct answers	**2**
One correct answer	**1**
One correct answer and one incorrect answer	**0**
Two incorrect answers	**0**
No answers	**0**

There were a total of twenty questions with a maximum of two points for each question. Consequently, each student received a score out of 40 for the spatial test.

After the test, each student was asked to create an origami sculpture in 15 minutes by using a specific set of instructions. One class used the text instructions, one used the graphical instructions, and one used instructions containing both text and graphics. I created the text instructions after completing the origami myself. Afterward, I beta-tested the instructions on a few random students, using their feedback to tailor the instructions.

Next, I used a rubric to determine a score for the created origami. The rubric was broken down to assess each step in making the origami. I assigned a number to the quality/accuracy of each step, and then I added the points from each step to get a final score. Each step was worth four points, so the student could score as high as 32 in this part of the experiment.

Full-size envelopes were distributed to hold each student's spatial test, origami, and instructional medium. The consent form was the only document containing the participant's name; a predetermined number was put on the envelope and the other documents to preserve the participants' anonymity.

Analysis

After the experiments, I entered the results from the spatial tests and the created origami into a data-mining tool (SPSS). To break down the scores into areas of low and high spatial intelligence, I found the average score received on the spatial test. The average score was approximately 25 (out of 40); therefore; if the student scored 25 or above, he or she was considered to have high spatial intelligence.

With the experiment completed and the data fed into the SPSS program, I looked for a relationship between the scores of the spatial intelligence test and the origami.

Results

The data-mining program (SPSS) compared the origami scores between the students with low and high spatial intelligence in each class. When analyzing data in SPSS, a significance of .05 or less means there is a high significance (difference) in what is being compared.

There was virtually no significance (.965) between the two groups of students in the class that used textual and graphical instructions to complete the origami. In the class that used text instructions, there was a significance of .547 between the two groups of students. The class that used graphical instructions, however, had a significance of .044 between students with low and high spatial intelligence.

These results show that there is a large gap between the performances of people with high and low spatial intelligence when using graphical instructions. There is almost no gap between the two groups when both text and graphics are utilized.

This becomes clearer when comparing the averages of the origami scores. The following chart shows the comparison of averages:

	High SI*	**Low SI***
Text and Graphics	22.50	22.67
Text	14.11	16.43
Graphics	29.10	23.44

*SI = spatial intelligence

The two groups of students received nearly identical scores (on average) when using the instructions containing both text and graphics. A combination of the two instructional mediums gave the students some freedom in which method (if not both) to use in creating the origami.

On average, the students with low spatial intelligence performed better using the text instructions. Both average scores, however, are considerably lower than the scores for the other two instructional mediums.

The average scores from the class using graphical instructions are higher than the average scores of the other two classes. This is apparently due to the time constraints; it takes longer to process text than graphics, so the class using the text instructions had a lower completion rate on their origami. This was also the case with the class that used text and graphics; it took additional time for the students to compare the text to the graphics. If the students had had more time to complete the origami, the averages for the other two groups would probably have been higher since more students would have been able to finish.

Discussion

The results from the experiment provide some insight into two disciplines—technical communication and education.

Technical communicators constantly strive to find a common denominator in their audience when designing any document. For a document to be successful, it needs to be easy to use by potentially anyone who may need it. Since there was little difference in origami scores in the group that used instructions comprised of both text and graphics, this instructional medium should be appropriate for users with low or high spatial intelligence (the common denominator).

Another item, however, comes into play. The large difference in scores between students using the graphical instructions show that people with low spatial intelligence do not benefit as much from visuals. The gap between the two groups was narrowed in the group that used textual instructions.

In light of these results, technical communicators should

- include both text and graphics with instructions when possible,
- focus on creating highly detailed text to go along with the graphics, and
- design visuals with extreme caution; people with low spatial intelligence may not be able to interpret the graphic as intended.

Ideally, a technical communicator should be able to analyze his/her audience in order to tailor instructions to their needs. These tips, however, can be used when audience analysis is difficult.

Educators can use the same concepts in their teaching practices. Many disciplines require the use of spatial intelligence—computer science, geography, mathematics, etc. Students with low spatial intelligence may find themselves struggling with spatial concepts involved in their discipline.

Teachers, however, can use the same tips to help their students. To represent new concepts, they should use a combination of text and graphics, but they should put more effort into making highly detailed text. The students with high spatial intelligence can jump straight to the graphics if need be, while the students with low spatial intelligence can use the text to help them comprehend the graphics.

Clearly, there is a relationship between spatial intelligence and the ability to comprehend and execute textual/graphical instructions. This relationship will shed some light on course development in the technical communication and education fields.

Works Referenced

Carr, Harvey. An Introduction to Space Perception. New York and London: Hafner Publishing Company, 1966.

Devlin, Ann. Mind and Maze: Spatial Cognition and Environmental Behavior. Wesport, CT: Praeger Publishers, 2001.

Eliot, John, and Ian MacFarlane Smith. An International Directory of Spatial Tests. Windsor, Berks: NFER-NELSON Publishing Company, 1983.

Gardner, Howard. Frames of Mind: The Theory of Multiple Intelligences. New York: BasicBooks, 1983.

Houp, Kenneth, Thomas Pearsall, Elizabeth Tebeaux, and Sam Dragga. Reporting Technical Information: 10th Edition. New York: Oxford University Press, Inc, 2002.

Kostelnick, Charles, and David D. Roberts. Designing Visual Language: Strategies for Professional Communicators. Needham Heights, MA: Allyn & Bacon, 1998.

McKay, Elspeth. "An Investigation of Text-Based Instructional Materials Enhanced with Graphics." Educational Psychology 19.3 (1999): 323-335.

Morse, Janice, and Lyn Richards. ReadMe First for a User's Guide to Qualitative Methods. London: SAGE Publications, Inc., 2002.

Perino, George H. "The Perceiving Function and Visual Literacy: Barriers to Interpretation of Counterintuitive Graphical Displays." Journal of Psychological Type. 52 (2000): 11-17.

Potegal, Michael. Spatial Abilities: Development and Physiological Foundations. New York: Academic Press, Inc., 1982.

Randlett, Samuel. The Art of Origami. New York: E. P. Dutton & Co, Inc, 1961.

Scevak, Jill, and Phillip Moore. "Levels of Processing Effects on Learning from Text with Maps." Educational Psychology 18.2 (1998): 133-155.

Schnotz, Wolfgang, and Raymond W. Kulhavy. "Comprehension of Graphics." Advances in Psychology 108 (1994): 291-301.

"Text Vs. Graphics Formats for Online Instructions." SHORE '99: Student HCI Online Research Experiments. U of Maryland. 1999. http://www.otal.umd.edu/SHORE99/jdfl/results.html

Zacks, Jeffrey M, and Barbara Tversky. "Structuring Information Interfaces for Procedural Learning." Journal of Experimental Psychology: Applied. Jun. 2003: 88-100.

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