

Examination of Rural vs. Urban Middle School Students 3D Spatial Visualization Skills

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Background

- “Visual-spatial ability is a multifaceted component of intelligence that has predictive validity for future achievement in science, technology, engineering, and mathematics (STEM) occupations.”¹
- Current research suggests that males have better visual-spatial skills compared to females.²
- Students from low socioeconomic status (SES) have been found to have lower 3D visualization skills than students from average or high SES.
- 3D spatial visualization is the ability to visualize real and imagined spatial relationships. This includes being able to mentally rotate, manipulate, organize, and reason spatial relationships.³
- Research has shown that different demographic attributes have differences in 3D spatial visualization skills, but there is little to no research on the difference between urban and rural people.

Purpose

The purpose of this research project is to determine if the development of 3D spatial visualization skills is impacted by the environment (rural/urban) students grow up in.

Methods

- More than 10,000 7th grade students were tested to measure their 3D spatial visualization skills at the beginning of the school year.
- Students tested were from seven states: Texas, Michigan, Georgia, Colorado, Ohio, Tennessee, and Alabama.
- These students were given two tests to measure their 3D spatial visualization skills:
 - The PSVTR test looks at student's ability to mentally rotate objects (Figure 1).
 - The DAT measures the ability to recognize objects that have been folded and unfolded (Figure 2).
- To determine which group (rural/urban) performed better on their 3D spatial visualization tests, an Independent sample T-test was used to determine the variation in their means.

Demographic Percentage of Students N = 9881	
White/Non-Hispanic	75.8%
Male	52.1%
Rural	57.4%

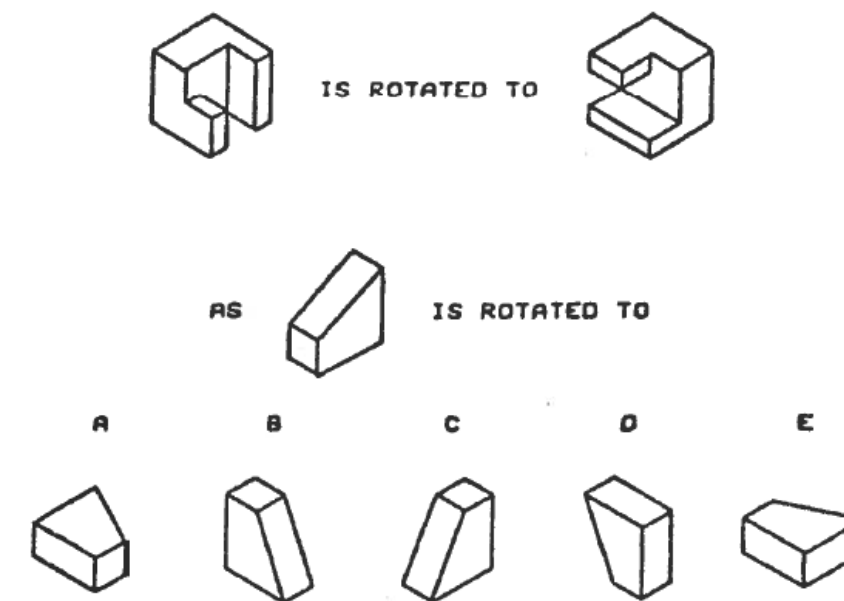


Figure 1. Example question from PSVTR Test

Students were asked to examine how the first two objects were rotated in relation to each other. They were then told to rotate the given shape and pick the answer that resembles the rotated shape.

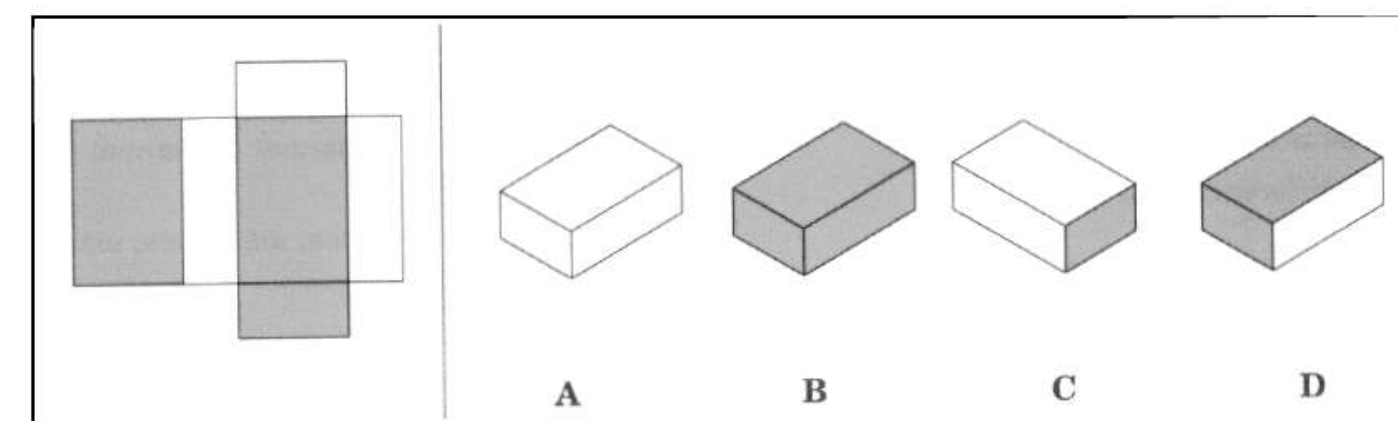


Figure 2. Example question from DAT Test

Students were asked to fold the shape on the left to form a 3D object mentally. Students were then told to pick the answer that resembled the shape they folded.

Results

Table 1. Examination of DAT and PSVTR test scores for rural and urban students¹

	Rural students	Urban students	Independent sample t-value	P-value	Effect size (r_{pb})
Sum of DAT and PSVTR Test Scores	6.44	5.26	14.58	<.001 **	.14

**correlation is significant at the .05 level (2-tailed)

¹ Means are on a 20-point scale with 0 being the lowest score and 20 being the highest score

Table 2. Examination of DAT and PSVTR test scores for male and female students¹

	Male students	Female Students	Independent sample t-value	P-value	Effect size (r_{pb})
Sum of DAT and PSVTR Test Scores	6.67	5.26	17.80	<.001 **	.17

**correlation is significant at the .05 level (2-tailed)

¹ Means are on a 20-point scale with 0 being the lowest score and 20 being the highest score

Conclusion

- Analyzing the T-test for the Urban vs. Rural students, it shows that the rural students performed better on the DAT and PSVTR tests than the urban students performed. This data aligns with the hypothesis for this project. It was hypothesized that rural students would perform better due to their environment. While the specific factors are unknown as to why rural students perform better on 3D spatial visualization tests, future work could include examination of what these factors could be.
- Male students performed better on the DAT and PSVTR tests than female students. This aligns with previous research performed in the field that male students usually perform better on 3D spatial visualization tests. This result indicates that the sample for this project is relatively consistent with other research.

Future Work

- An ANOVA test will be run to examine the differences in means between rural males, rural females, urban males, and urban females. This test will allow us to determine the students' environments have an equal impact on both males and females.

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