A Qualitative Study of Spatial Strategies in Blind and Low Vision Individuals

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Introduction

Spatial ability is the cognitive ability to construct, re-orient, transform, and reconstruct mental images. Past studies have confirmed that spatial ability is tied to academic and professional success in STEM fields (Newcombe, 2010). It has also been shown that spatial ability can be learned and maintained (Sorby & Baartmans, 2000). One population that has been widely overlooked is blind and low vision (BLV) individuals. Little is known about strategies employed by BLV individuals to solve spatial problems.

This study aims to identify spatial strategies in four BLV high school aged individuals with the intent to gain an understanding of non-visual components of spatial ability.

References

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Newcombe, N. S. (2010). Picture This: Increasing Math and Science Learning by Improving Spatial Thinking. American Educator, 34(2), 29.

Sorby, S. A., & Baartmans, B. J. (2000). The Development and Assessment of a Course for Enhancing the 3-D Spatial Visualization Skills of First Year Engineering Students. Journal of Engineering Education, 89(3), 301–307. https://doi.org/10.1002/j.2168-9830.2000.tb00529.x

Methods

The T-MCT is a tactile spatial ability test adapted from the MCT (Ashby et al., 2018). In this study two high spatial performers and two low performers were selected based off their T-MCT scores. Each student participated in a talk aloud interview while solving a T-MCT problem, which was recorded, transcribed, and qualitatively coded to identify spatial strategies. The results of the qualitative analysis were then categorized and compared with each student's T-MCT score to evaluate effective and ineffective strategies.

Table 1- Average T-MCT score and sum of qualitative codes identified by the research team in the transcribed interviews, per strategical category.

Strategy	# of Codes	Average T-MCT
Geometric Strategies	30	71.9%
Analytical Strategies	22	62.2%
Mixed Strategies	16	68.3%

Table 2- Participant demographics.

Participant ID	Gender	Grade Level	T-MCT Score
207	Male	10	92%
225	Female	10	83%
208	Female	11	25%
209	Female	11	25%

Results

The geometric strategy category of codes was the most correlated with higher T-MCT scores, with an average score of 72% followed by a mix of geometric and analytical strategies with an average score of 68%. Pure analytical strategies had the lowest score of 62%.

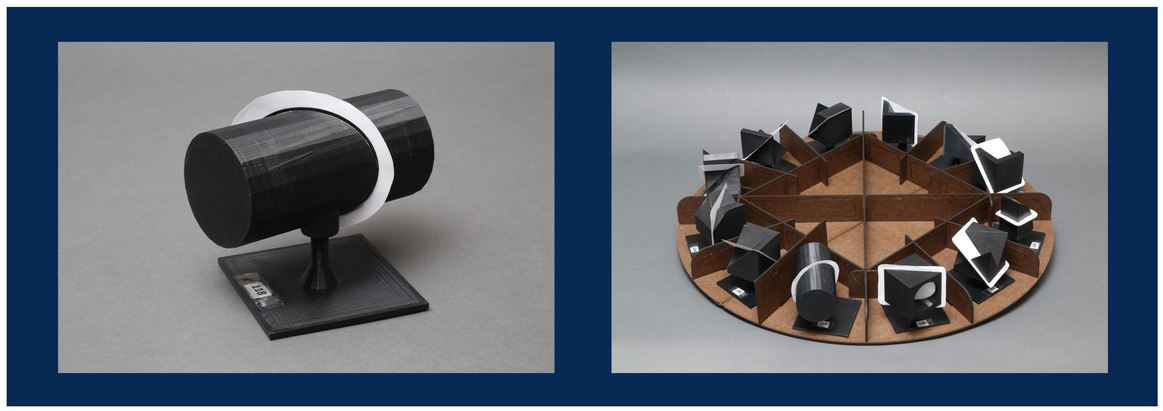

Figure 1- Sample problems from the T-MCT.

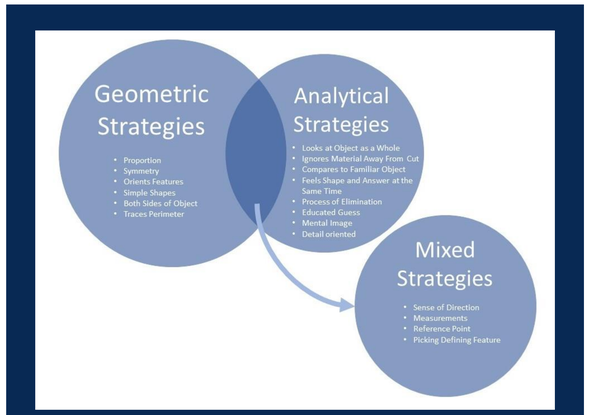

Figure 2 – Strategies identified and their corresponding qualitative codes. Circles are scaled to the respective frequencies of codes.

Conclusions

Participants who demonstrated high spatial ability on the T-MCT were found to rely more on geometric strategies than analytical. This suggests that increasing BLV students' exposure to geometric relations and graphical problem-solving methods will positively affect spatial ability.

Certain strategies may be more effective than others depending on the student's vision level, learning style, and adherence to one or more strategy.

Future Work

Future work in this study will include a larger number of participants in order to build on and solidify conclusions from the case study. It is anticipated that a deeper understanding of non-visual components of spatial ability will aid creating more effective interventions for BLV populations as well as sighted populations.

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