An Examination of Three Assessment Models of the PVST:R

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Abstract

The Purdue Spatial Visualization Test: Rotations (PSVT:R) has been a staple assessment in engineering graphics education for several decades and its use does not appear to be decreasing. This study shows no difference between the original test, a pictorial version, and a game version. Analysis of students taking all three assessments revealed no significant differences in the mean scores and highlights the ceiling effect potential present in the PSVT:R among engineering graphics students.

Since the development of the Purdue Spatial Visualization Test and subsequent extended versions in 1976, the test has remained largely unchanged with only a few revisions to the figures used in the assessment. In particular, the Purdue Spatial Visualization Test: Rotations (PSVT:R) has taken several different forms since the original release by Guay (1976). A pictorial test has been used as an alternative to the original assessment (Ernst, Lane, & Clark, 2014) as well as a game version of the PSVT:R (Blue, 2013). These alternative forms offer different methods of assessing mental rotation but use either familiar media or objects as we move progress into a new millennium. As the (PSVT:R) continues to be used as an assessment in engineering graphics educational settings, evaluating and comparing these differing methods is an important consideration as we determine the use of the PSVT:R and its efficacy as an assessment in our field.

With these considerations in mind, this study examines the PSVT:R using three different testing models in an engineering graphics course. Models examined include the original PSVT:R

developed by Guay (1976), the pictorial version, which approximated the original assessment using real items in the same order and relative positions of the 1976 PSVT:R (Ernst, Lane, & Clark, 2014), and the spatial visualization gaming instrument (SVGI) which is the game version of the original PSVT:R figures (Blue, 2013). These three models can be seen in Figure 1.

Understanding whether the assessment model or mode of delivery has an impact on students' score may offer insight into the validity or reliability of these modes or models when determining acceptable scores on these tests. Recent questions with respect to the validity of the PSVT:R itself (Author), may be related to the mode or model of assessment and may be addressed with further study of the results from these alternative versions of the PSVT:R.

This study involved students in an upper-level engineering graphics course at a large land-grant university. Seventeen students participated in the study with demographics displayed in Table 1. All students, with one exception, had prior exposure to the PSVT:R with a mean prior exposure of 2.18 times.

Table 1.
Participant Demographics

		Number	Percentage
Gender			
	Male	16	94.12%
	Female	1	5.88%
Ethnicity			
	African-American	1	5.88%
	Asian	1	5.88%
	Caucasian	11	64.71%
	Caucasian/Asian	1	5.88%
	Hispanic	1	5.88%
	Native American	1	5.88%
	Other	1	5.88%
Class Level			
	Senior	13	76.47%
	Junior	4	23.53%
Major			
	Engineering	7	41.18%
	TDE	4	23.53%
	TDE & GC	6	35.29%

Note. GC = Graphics Communications, TDE = Technology, Engineering, and Design Education.

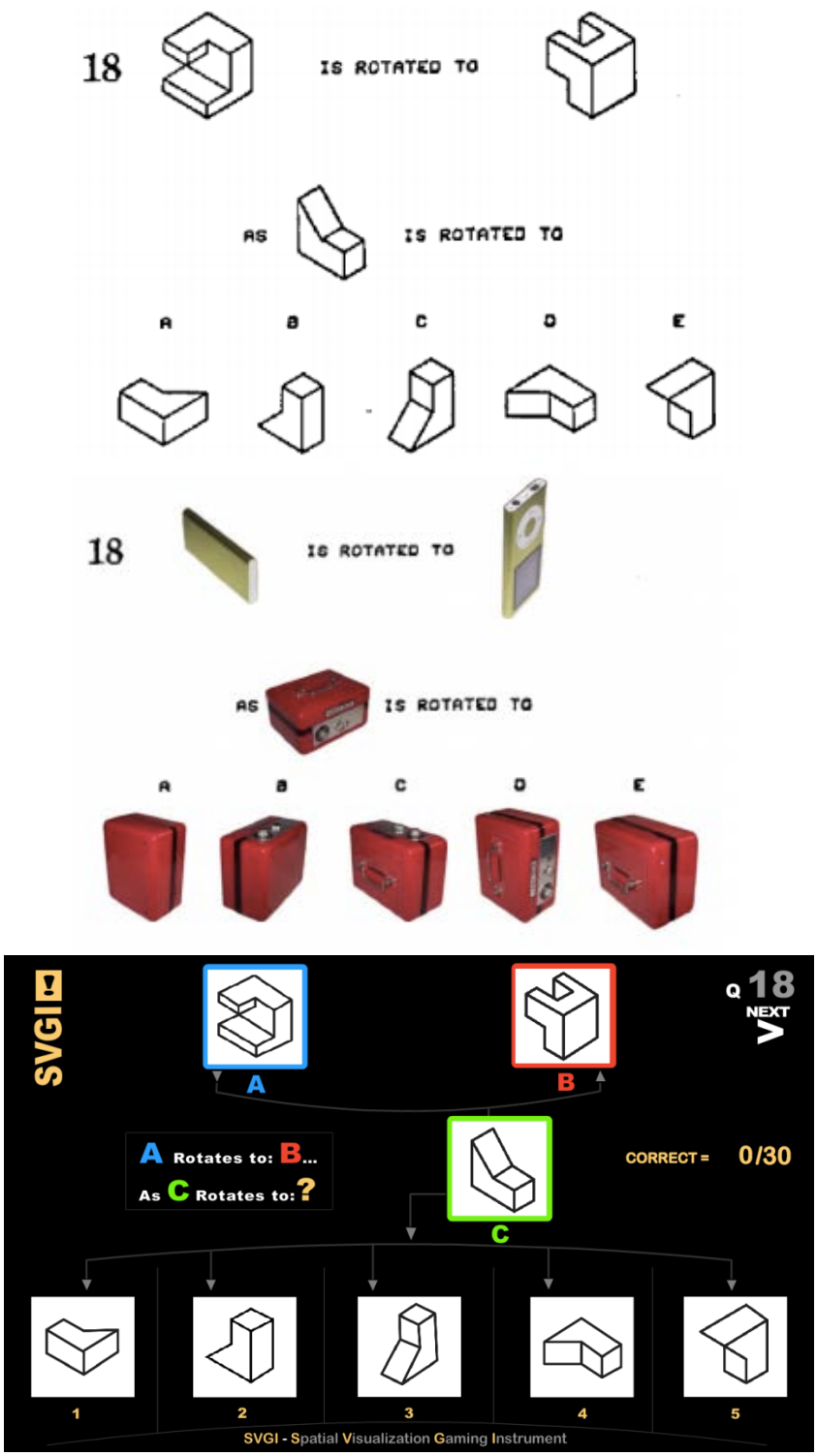

Figure 1. **Three Versions of Question 18 of the PSVT:R Used In This Study. From Top To Bottom: Guay (1976), Ernst, Lane, & Clark (2014), and Blue (2013).**

Students participating in this study took the three versions of the PSVT:R in class. The means and standard deviations of their scores on each PSVT:R assessment model is presented in Table 2. Also listed in Table 2 is the students reported testing model preference.

Table 2.

Means, Standard Deviations, and Preference for Testing Models

	n	M	SD	Preference
Test Model				
Original	17	25.35	3.76	11.76%
Photo	17	24.53	5.06	52.94%
Game	17	25.59	3.12	35.29%

In order to compare the mean scores of these three models of the PSVT:R an ANOVA was performed. No statistically significant differences between groups were found in this analysis, $F(3,16) = 3.19$, $p = 0.18$. Mean scores of the three assessment methods of the PSVT:R compared in this study (original, pictorial, and game) showed no appreciable differences among participants of this study. The authors acknowledge that a test-retest threat to internal validity may exist given the methods used in this study, however, believe this threat is mitigated in this case due to the prior exposure to the PSVT:R by the participants as addressed previously.

Students in this study overwhelmingly preferred the pictorial model with 53% choosing it over the original PSVT:R with 12% reporting they preferred that version. The familiarity and relatability of the real-world objects pictured in the pictorial version of the PSVT:R was the primary stated reason for this preference. Even though the students participating in this study largely preferred the pictorial version, the lack of significantly different results may suggest that object familiarity may not play a vital role in students abilities to mentally rotate objects. The ceiling effect evident in the PSVT:R may also play a role in the similarity of means as true parametric analysis is difficult to perform due to the non-normal distribution inherent in these assessments.

This study offers a preliminary comparison of three assessment models of the PSVT:R. The results of this study indicate no statistically significant differences exist between these models. Given the nearly identical mean scores with a maximum variance of only 1.06 points, no practical significance between models exists as a result of this study. Although this study has some discernible limitations it offers a comparison of different assessment models and modes for a commonly used assessment in engineering graphics education. Further study into the reliability of

these models is warranted and essential if the alternative models are to be used as replacements for the original PSVT:R. Further experimental study utilizing randomized groups with limited prior exposure to the PSVT:R would provide a clearer picture of the differences or similarities resulting from differing testing models. Also telling would be an examination of differences in computer and paper based versions of the test as more and more assessments are being delivered electronically.

References

Blue, C. N. (2013). Developing an Interactive Spatial Visualization Gaming Instrument (SVGI) for Exploring Assessment Retention and Scoring Improvements Utilizing the Purdue Spatial Visualization Test of Rotations.

Ernst, J. V., Lane, D., & Clark, A. C. (2015). Pictorial Visual Rotation Ability of Engineering Design Graphics Students. *Engineering Design Graphics Journal*, *79*(1), 1-13.

Guay, R. (1976). *Purdue Spatial Visualization Test*. Educational testing service.