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Data Article

# Dataset: Spatial visualization ability assessment among undergraduate students at Jiaying University

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ABSTRACT

This dataset, collected through a comprehensive online survey and testing process, evaluates spatial visualization ability among undergraduate students at Jiaying University. Utilizing the Revised Purdue Spatial Visualization Test: Rotations (Revised PSVT: R), the dataset encompasses demographic information and responses to Likert-scale questions. With applications in experimental and cognitive psychology, the dataset offers valuable insights into spatial cognition and its implications for educational contexts. Researchers can utilize this dataset as a benchmark for comparative studies, explore correlations with demographic factors, and develop educational interventions to enhance spatial ability. The dataset, accessible on the repository, can be retrieved through the following citation [1].



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Specifications Table

| | |
|---|---|
| Subject | Experimental and Cognitive Psychology |
| Specific subject area | Spatial visualization is a subfield within cognitive psychology that investigates how individuals perceive, process, and manipulate spatial information in their minds. |
| Type of data | Excel, PDF |
| Data collection | We conducted a comprehensive online survey in Chinese using the 'WenJuanXing' platform. The survey covered demographic information like gender, academic major, and class ranking, alongside specific questionnaires [2]. After the initial survey, participants proceeded to the Revised PSVT: R [3] to assess spatial visualization ability—a vital skill for understanding geometric concepts and solving visual-spatial problems. The survey platform automatically recorded essential data, including each participant's test completion time. |
| Data source location | Jiaying University, Meizhou City, Guangdong Province, China<br>Latitude: 24.2890° N Longitude: 116.1161° E<br>GPS coordinates: @24.325387,116.1261517 |
| Data accessibility | Repository name: Spatial visualization ability evaluation data set based on PSVT: R<br>Data identification number: DOI: 10.17632/688wrx2927.2<br>Direct URL to data: https://data.mendeley.com/datasets/688wrx2927/2<br>Instructions for accessing these data: Click on the links and access the nested data, which is available for download. |

## 1. Value of the Data

- **Insight into Spatial Visualization Ability:** The dataset provides a valuable resource for studying spatial visualization ability among undergraduate students, contributing to the broader understanding of cognitive skills in educational contexts.
- **Benchmark for Comparative Studies:** Researchers can use these data as a benchmark for comparative studies on spatial abilities within diverse student populations or across different educational settings, fostering a nuanced exploration of factors influencing spatial cognition.
- **Educational Intervention Strategies:** The dataset offers insights into potential interventions to enhance spatial ability, serving as a foundation for researchers and educators to develop targeted strategies and optimize training methods.
- **Demographic Correlations:** Researchers can explore correlations between spatial ability and demographic factors, such as gender, major, or class ranking, shedding light on potential patterns and informing tailored educational approaches.
- **Cross-disciplinary Insights:** The dataset's inclusion of students from various disciplines allows for cross-disciplinary analyses, offering valuable insights into the intersection of spatial ability and academic pursuits.

## 2. Background

We compiled this dataset with a keen interest in understanding variations in spatial ability among individuals, considering diverse cultural contexts and specific situations like age-related differences. Acknowledging the multifaceted nature of spatial ability disparities influenced by various factors, our dataset serves as a comprehensive exploration of spatial cognition.

Built upon the foundational work of Linn and Petersen [4], our data analysis delves into nuanced dimensions contributing to spatial ability differences. Our goal is to offer a more precise understanding of individuals' spatial proficiency by exploring the factors and manifestations of these differences. This, in turn, opens avenues for potential interventions and strategies to enhance spatial ability, including optimizing training and education methods.

For a deeper analysis, readers can refer to the original article, "Spatial Visualization Ability Assessment for Analyzing Differences and Exploring Influencing Factors: Literature Review with Bibliometrics and Experiment" by Yang et al. [5]. This dataset stands as an independent resource complementing the insights in the associated research article.

## 3. Data Description

This dataset primarily presents the spatial visualization abilities of college students under different background conditions. Specifically, the data includes basic demographic information such as gender, major, and academic performance, as well as survey data on students' spatial experiences and test results for spatial visualization abilities. The assessment of spatial visualization ability utilized the Revised PSVT: R, a widely recognized tool for evaluating individual spatial visualization capabilities, especially in mental rotation. The dataset comprises the following 4 files: data.xlsx_: The main file, where the resulting data is stored.

Demographic Survey and Revised PSVTR.pdf_: Used to display questionnaire and test items and content.

Online test system display.pdf_: Used to show the composition and part of the online test system

README.txt_: It is used to show the correlation and specific details of the entire data set to help users understand and apply the data set.

The table below systematically describes the meaning of each label in the data and the significance of the numerical values. The values corresponding to serial numbers 4–10 represent Likert scores. In this study, the Likert scale responses were transformed into consecutive experience scores. This transformation involved assigning a numerical value to each Likert item, ranging from 1 to 5, where 1 indicates "Never" and 5 indicates "Always." Subsequently, the scores for each Likert item were aggregated for each respondent to derive their overall expe-

**Table 1**
Label description.

| No. | Label | value | Description |
|---|---|---|---|
| 1 | ID | 1–75 | One ID represents one student (assessment participant), for a total of 75 participants. |
| 2 | Major | STEM=1; non-STEM=2 | Represents the student's major category |
| 3 | Gender | Male=0; Female=1 | Representing the gender of the student |
| 4 | Ranking | 5 choices: A\B\C\D\E, Corresponding to 1\2\3\4\5 | Ranking in the comprehensive test of the class last semester (academic year) |
| 5 | Leader | | During your university years, did you often serve as a student cadre? |
| 6 | Sport | | How often have you played sports? |
| 7 | Drawing | | How often have you engaged in drafting, design and design sketching, engineering graphics, or other manual (by hand) technical drawing activities? |
| 8 | E-game | | How often have you played electronic games? |
| 9 | Art | | How often have you engaged in creating artwork (drawing, graphic design, painting, 3D art, photography, etc.)? |
| 10 | Handwork | | How often have you fixed things, such as working on a car, home improvements, construction, carpentry, electronics, or other similar activities? |
| 11 | Pretest | 0–30 | pre-test score (get one point for a correct answer, for a total of 30 questions) |
| 12 | Pre-time | Unit: minute | The time taken to complete the pre-test |
| 13 | Posttest | 0–30 | post-test score (get one point for a correct answer, for a total of 30 questions) |
| 14 | Post-time | Unit: minute | The time taken to complete the post-test |

rience score. Through this method, the ordinal Likert data was converted into continuous experience scores, facilitating statistical analysis and modeling. Notably, question 4 pertains to the participant's rank in the class on the comprehensive test, with 1 denoting the "Last 20 %" and 5 denoting the "Top 20 %."

## 4. Experimental Design, Materials and Methods

### *4.1. Instrument*

The PSVT: R, as conceptualized by Guay [6], has played a pivotal role in educational research, particularly within STEM disciplines, and has become a fundamental tool in engineering education. Widely acknowledged for its effectiveness in evaluating students' spatial visualization ability, particularly in mental rotation [7,8], the test is specifically tailored for engineering contexts. The uniqueness of the PSVT: R lies in its incorporation of 3-D objects with inclined, oblique, and curved surfaces, posing a more intricate visualization challenge compared to other spatial tests [9].

Recognizing concerns related to inconsistent usage and identified bugs in the original PSVT: R, Yoon and collaborators took steps to address these issues, resulting in the development of the Revised PSVT: R. In the context of this study, spatial visualization ability was appraised using this refined instrument, encompassing 30 test items. The test adheres to item response theory (IRT) principles and features figures with diverse truncated slots. Participants are required to identify the rotation of a figure that matches a given pair of examples from a set of five choices, providing a comprehensive evaluation of their mental rotation skills [3].

### *4.2. Population and sample*

The study encompasses students enrolled at Jiaying University, an established institution in Guangdong Province with a century-long tradition of providing comprehensive education across disciplines such as literature, science, engineering, law, and medicine. Jiaying University, as a distinguished public undergraduate institution, currently enrolls nearly 30,000 full-time students..

Utilizing the G*Power sample quantity calculation formula: $\alpha = 0.01$, Power = 0.9, Effect Size = 0.3, the initially calculated sample size was 169.

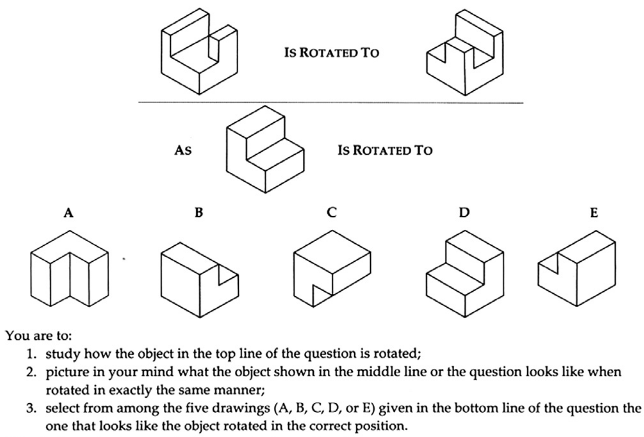


**Fig. 1.** A sample item from the Revised PSVT: R [3].

A total of 181 undergraduate students from Jiaying University participated in the study, all of whom were enrolled in the elective course "3D Modelling and Printing. "This course, spanning a single semester with a duration of 24 h, attracted students from diverse academic backgrounds. Data collected from these 181 students during the Spring of 2023 met inclusion criteria following the exclusion of invalid tests and the resolution of missing demographic information.

Among the 181 participants, 111 were male students, and 70 were female students. STEM majors comprised 127 students, while non-STEM majors accounted for 54 students.

### *4.3. Procedures*

Data collection utilized the ’WenJuanXing’ online survey (Chinese Version) for demographic information and additional queries on leadership, sports, drafting, e-gaming, art involvement, and handwork. Likert scales quantified responses into continuous Experience scores. Participants then completed the Revised PSVT: R, testing their mental rotation abilities. They were informed of unlimited time for the test, and the system automatically recorded individual completion times post-test. Participants completed questionnaires and tests in class and in a single session.

## Limitations

This study’s results may be constrained by the convenience sampling method and the relatively small sample size, limiting the generalizability to diverse populations in various educational settings. Conducted in an online, non-time-restricted format, the reliance on participant self-reports for grouping variables and demographic information introduces the potential for response bias, impacting the study’s outcomes. These limitations underscore the need for cautious interpretation and suggest avenues for future research to address these constraints and enhance the robustness of findings across broader contexts.

## Ethics Statement

This study received ethical approval from the Mahasarakham University Ethics Committee (Reference: 364–411-/2023). All participants provided informed consent, and the ethical review process documented the comprehensive details of this consent. Participants were well-informed about the study’s objectives, procedures, risks, and benefits. Voluntary participation was emphasized, with participants aware of their right to withdraw at any point without facing consequences.

## Data Availability

Spatial visualization ability evaluation data set based on PSVT: R (Original data) (Mendeley Data).

## CRediT Author Statement

**WeiZhi Yang:** Data curation, Writing – original draft; **Jiraporn Chano:** Conceptualization, Methodology, Visualization, Investigation; **Chowwalit Chookhampaeng:** Supervision, Writing – review & editing.

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## Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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