The Influence of Spatial Ability on Anatomy Examinatio Questions in an Integrated Medical Curriculum

Jennifer Xiong[1], Anna C. Edmondson, Ph.D.[2], & Charys M. Martin, Ph.D.[3]
[1]Class of 2018, Medical College of Georgia at Augusta University, Augusta, GA
[2]Cellular Biology and Anatomy, Medical College of Georgia at Augusta University, Augusta, GA
[3]Department of Anatomy and Cell Biology, Schulich School of Medicine and Dentistry at Western University, London, ON

Introduction

Visualization spatial ability (VSA), the ability to mentally manipulate two and three-dimensional visuospatial representations, is a valuable skill necessary for the comprehension of anatomy and beneficial in all medical professions.

- Previous studies have found that spatially competent students (with high VSA) outperform spatially limited students (with low VSA) in anatomy courses [1,2].
- To the authors' knowledge, no prior studies in the field of anatomical education have evaluated the influence of VSA on anatomy performance based specifically on question difficulty.

Study Aims:

1. To evaluate the influence of VSA of first year medical students on anatomy examination questions of varying difficulty levels categorized by discrimination index (DI)
2. To evaluate the influence of VSA of first year medical students on varying levels of anatomy examination questions categorized by Bloom's taxonomy.
3. To confirm whether there is a correlation between VSA and performance in anatomy written examination, lab examination, and performance overall in anatomy.

Hypotheses:

4. We expect to observe a positive correlation between VSA and questions categorized by DI.
5. We expect to observe a positive correlation between VSA and questions categorized by Bloom's taxonomy.
6. We expect to observe a positive correlation between VSA and anatomy written exam grade, lab exam grade, and overall anatomy grade.

Materials and Methods

- 61 first year medical students participated in the study, completing the Mental Rotation Test (MRT) and a demographic survey prior to the start of their anatomy course.
- The **Mental Rotation Test (MRT)** [3] is a standardized test that determines a participant's VSA by requiring participants to conceptually manipulate three-dimensional block figures.
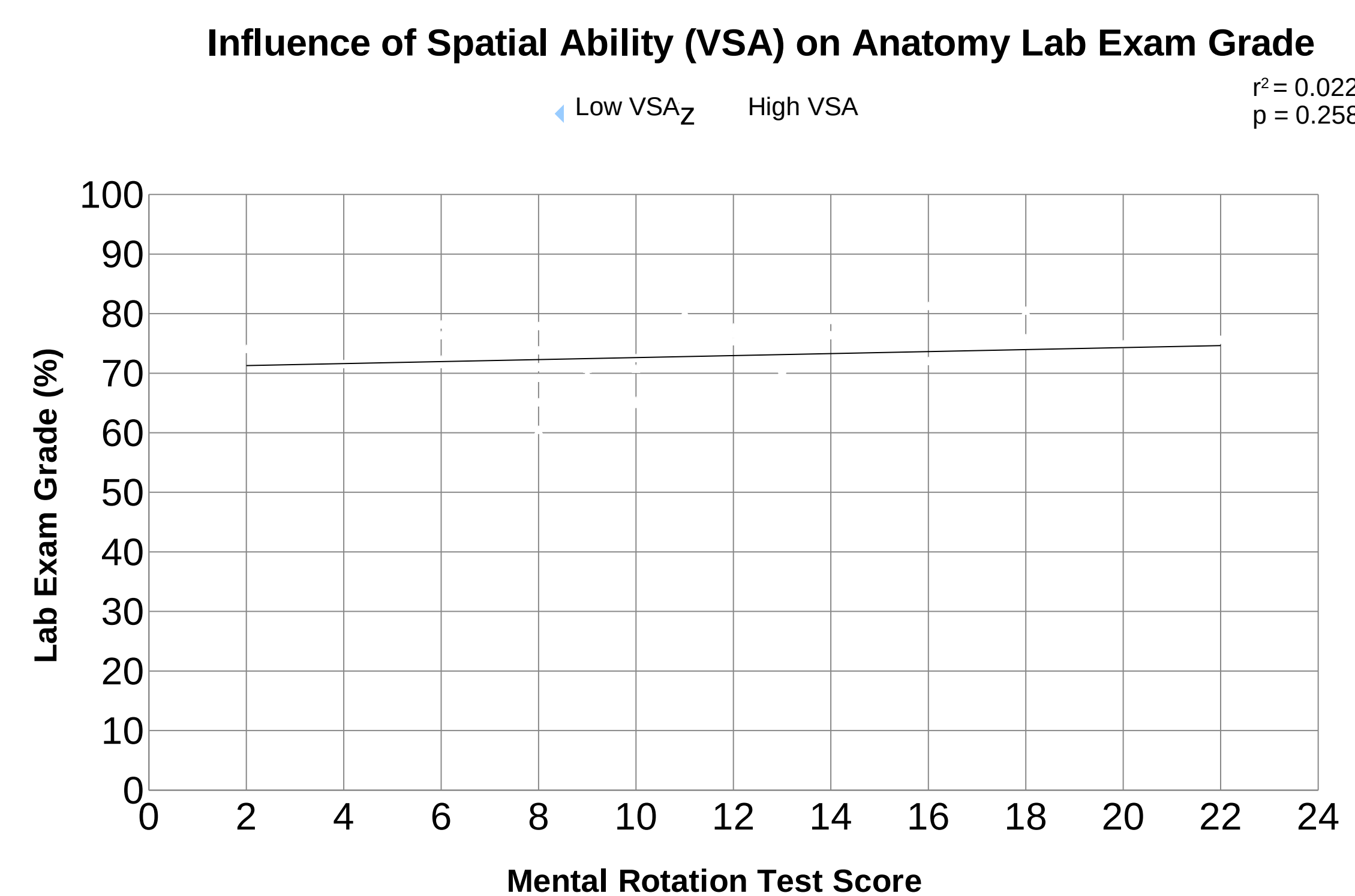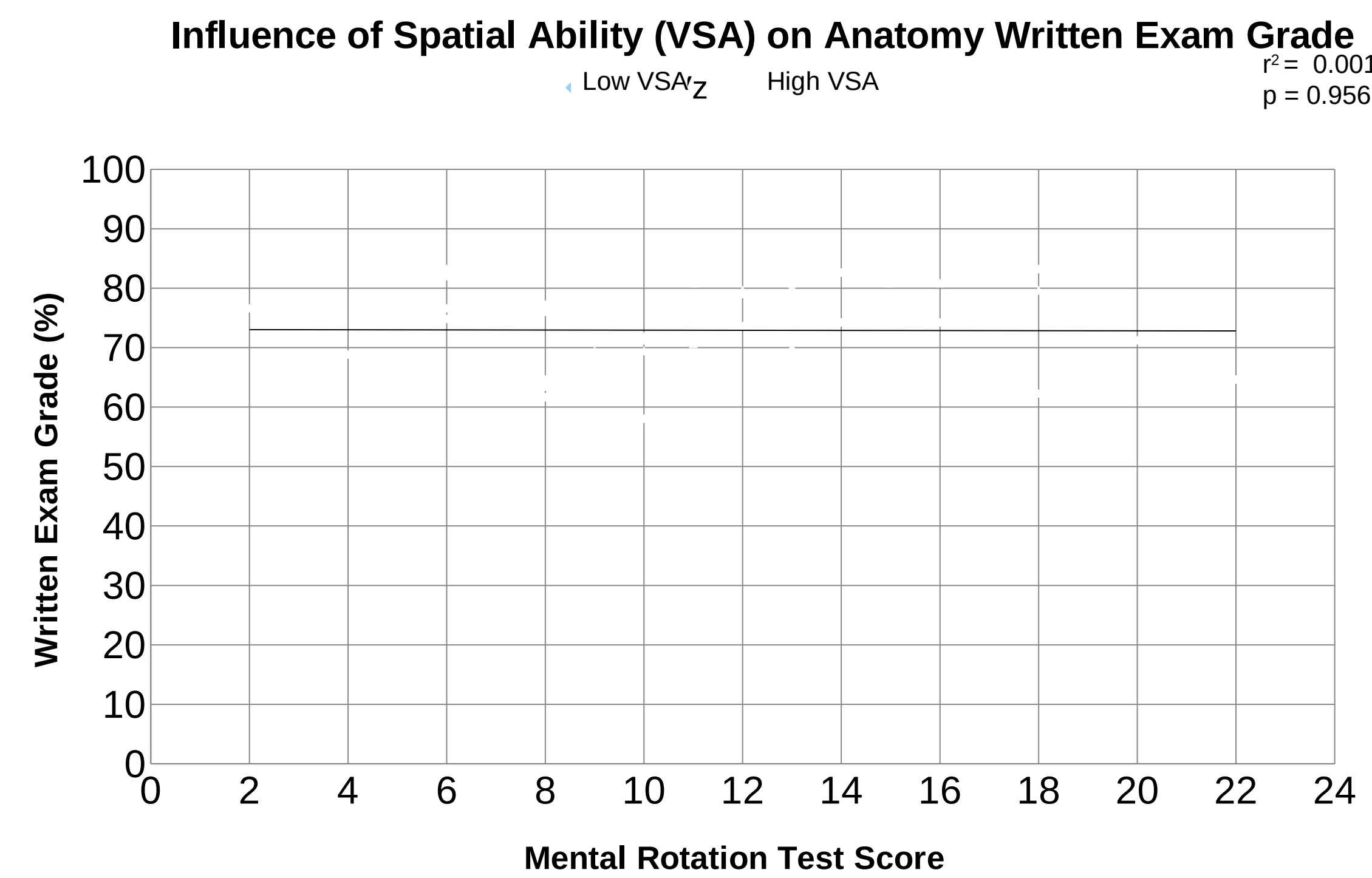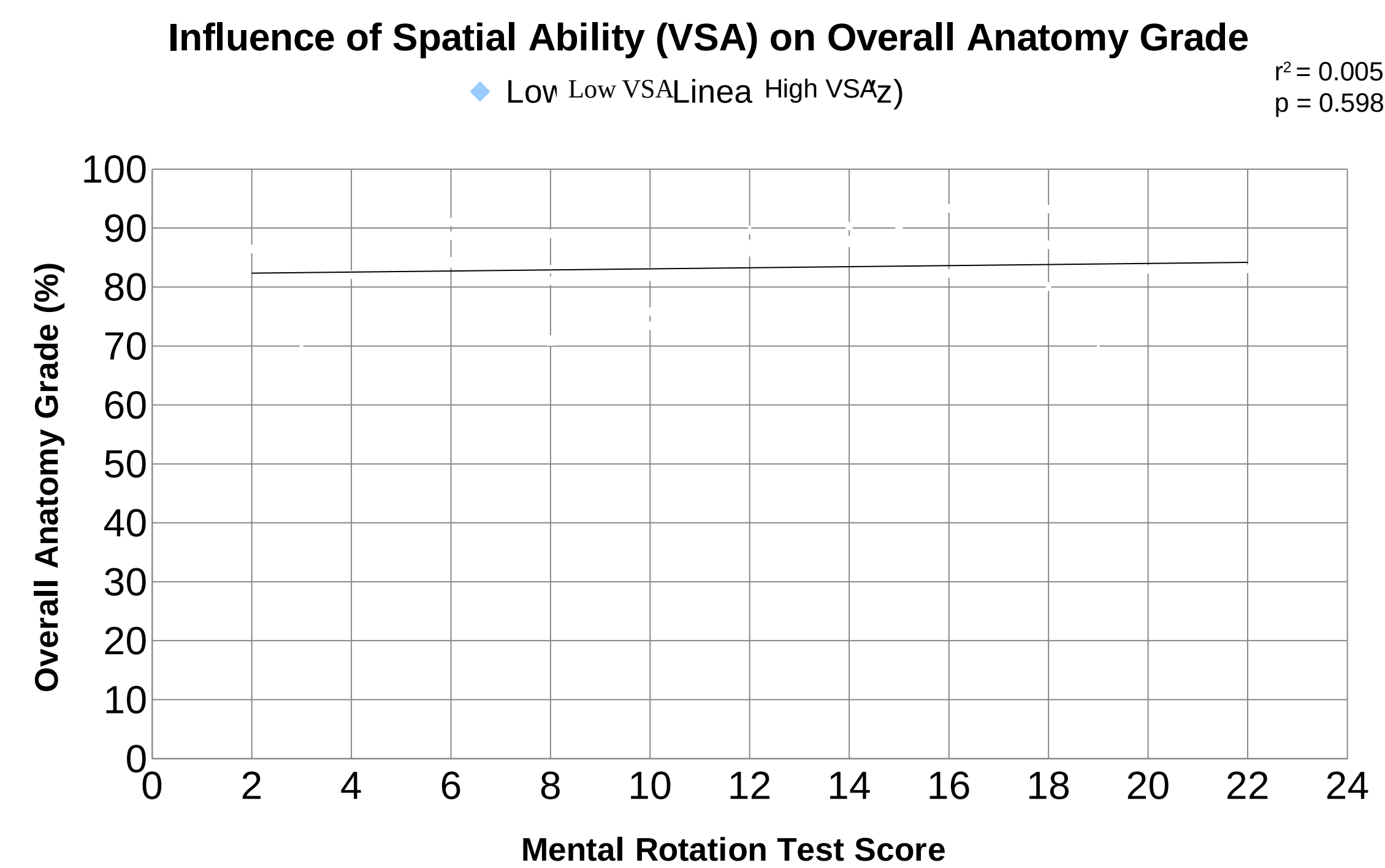
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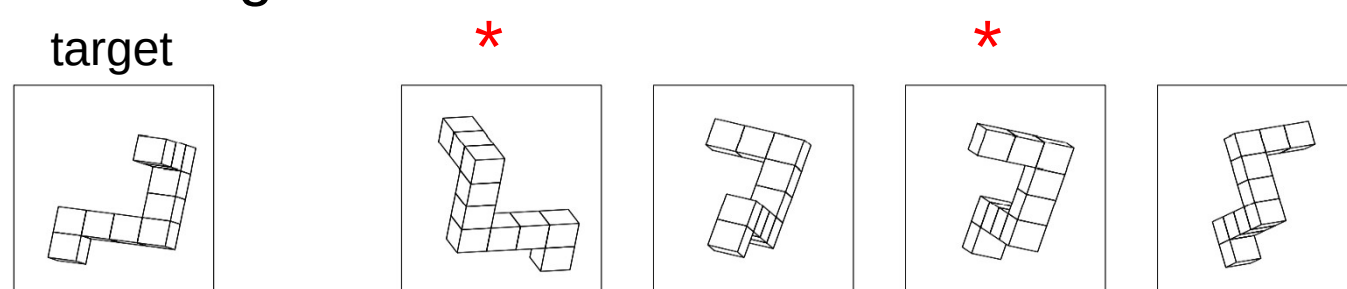
- The **Demographic Survey** gathers information from the students regarding sex, age, previous anatomy experience, and prior experience playing video/computer games.
- Written examination questions were categorized into three tiers by **Discrimination Index (DI)**, which measures how an assessment differentiates between high and low scorers
- Questions were also categorized by **Bloom's taxonomy**, which categorizes questions into increasing tiers of difficulty (identification, comprehension
- Students' anatomy performance data were evaluated by a **multiple regression analysis** to assess how students of different VSA perform on exam questions of varying levels of DI as well as Bloom's taxonomy.
- Students' anatomy performance data were also assessed via **ANOVA** to confirm whether there was a significant correlation between VSA and performance in anatomy written examination, lab examination, and performance overall in anatomy.

Evaluation
Synthesis
Analysis
Application
Comprehension
Knowledge
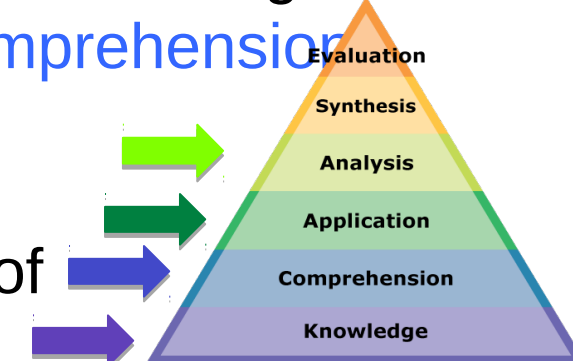
Results

1. Influence of Spatial Ability (VSA) on Anatomy Course Grades

Influence of Spatial Ability (VSA) on Overall Anatomy Grade

Low VSA   Linear (High VSA)
$r^2 = 0.005$
$p = 0.598$

(y-axis: Overall Anatomy Grade (%), x-axis: Mental Rotation Test Score)

Influence of Spatial Ability (VSA) on Anatomy Written Exam Grade

Low VSA   High VSA
$r^2 = 0.001$
$p = 0.956$

(y-axis: Written Exam Grade (%), x-axis: Mental Rotation Test Score)

Influence of Spatial Ability (VSA) on Anatomy Lab Exam Grade

Low VSA   High VSA
$r^2 = 0.022$
$p = 0.258$

(y-axis: Lab Exam Grade (%), x-axis: Mental Rotation Test Score)
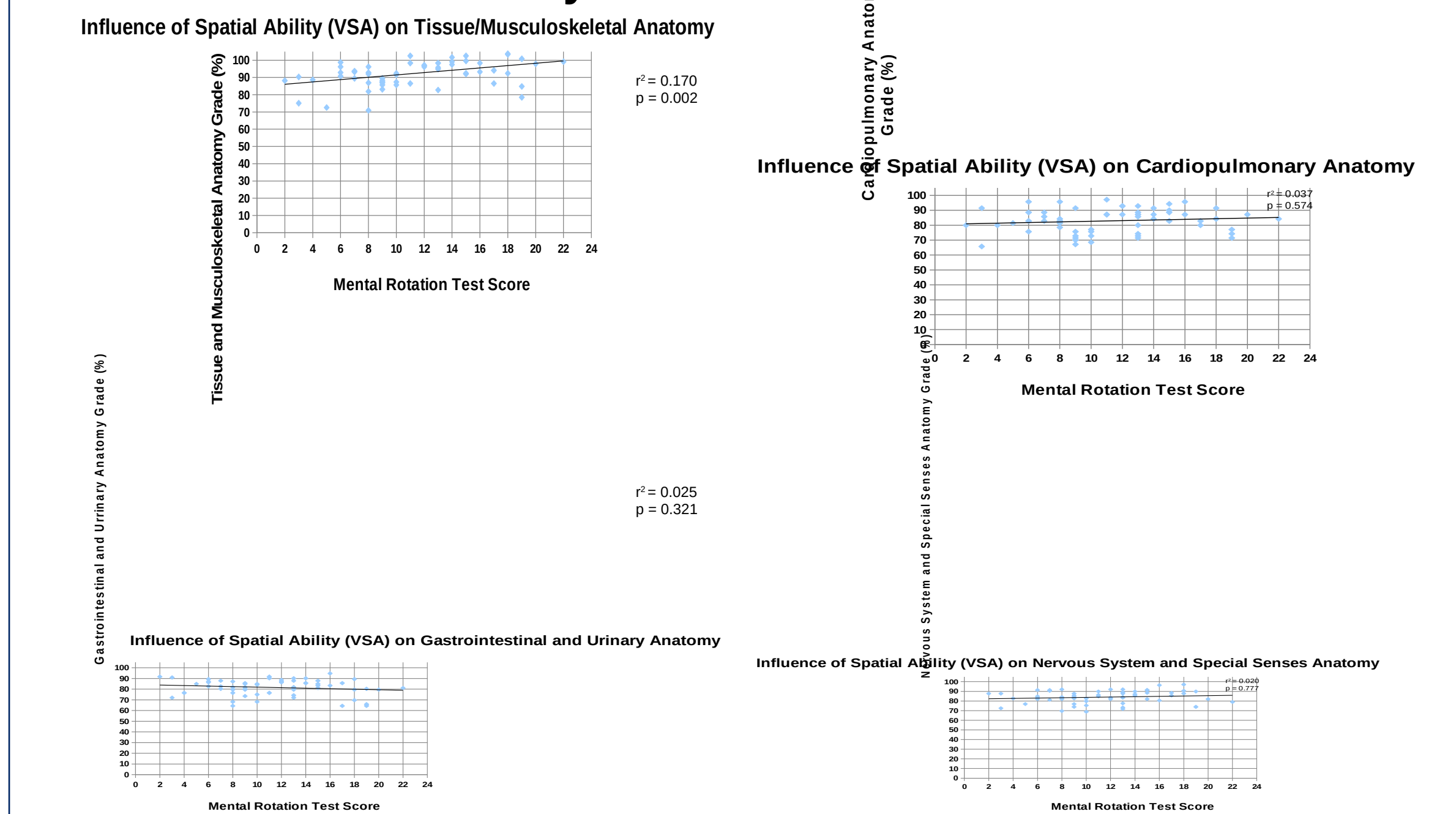
Results (continued)

2. ANCOVA of entrance VSA and DI of questions showed no significant correlation while ANCOVA of entrance VSA and questions categorized by Bloom's taxonomy also showed no significant correlation

- A significant relationship was found between questions of level 3 DI and level 4 Bloom's.

3. Influence of Spatial Ability (VSA) on Systems Based Module Performance in Anatomy

Influence of Spatial Ability (VSA) on Tissue/Musculoskeletal Anatomy
$r^2 = 0.170$
$p = 0.002$

Influence of Spatial Ability (VSA) on Cardiopulmonary Anatomy
$r^2 = 0.007$
$p = 0.517$

Influence of Spatial Ability (VSA) on Gastrointestinal and Urinary Anatomy
$r^2 = 0.025$
$p = 0.321$

Influence of Spatial Ability (VSA) on Nervous System and Special Senses Anatomy

- No significant interaction was observed between VSA and questions categorized by DI or Bloom's taxonomy within the first systems-based module (p>0.05)

Conclusions

- VSA taken prior to anatomy course appears to play an insignificant role in medical student anatomy lab exam performance, written exam performance, and overall performance in the anatomy course, rejecting our hypotheses that there is a positive correlation between entrance VSA and questions categorized by DI or Bloom's taxonomy.
- However, when VSA was compared to anatomy performance subdivided into system based modules, results showed a significant correlation between performance in the earliest anatomy module and entrance VSA, and there was no significant correlation between entrance VSA and any subsequent modules.
- **These results suggest that VSA influences anatomy performance early on, but students with low VSA find ways to cope and catch up throughout the course**.
- Limitations: many variables may contribute to student performance that cannot be controlled.
- As such, further research needs to be performed to explore the potential for VSA growth as well as academic coping and their possible interaction with performance in anatomy throughout the school year.

References

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