

INTRODUCTION

- Mathematics and deductive (top down) reasoning have been intertwined for centuries in the form of geometric proofs.
- Current empirical associations between geometric proofs, non-geometric math areas, and deductive reasoning are limited.
- In this study, the hypotheses being tested is that there is a significant overlap in the reasoning skills involved within geometric proof solving, and other areas of math, including but not limited to deductive reasoning.
- Individual performance on the geometric proof will predict differences in accuracy on the probabilistic reasoning (logic-based word problem) task..

Given:
 $\triangle ABC$ is a triangle with $\overline{AB} \cong \overline{AC}$,
 and $\triangle DBC$ is a triangle with $\overline{DB} \cong \overline{DC}$.

Prove:
 \overline{AD} bisects $\angle BAC$.

Choose the correct justification for each step in the proof below.

$\overline{AB} \cong \overline{AC}$	Given
$\overline{DB} \cong \overline{DC}$	Given
$\overline{AD} \cong \overline{AD}$	Things are congruent to themselves
$\triangle ABD \cong \triangle ACD$	Side-Side-Side
$\angle BAD \cong \angle CAD$	Definition of congruent triangles
\overline{AD} bisects $\angle BAC$	Definition of bisecting an angle

Figure 1. Geometric proof from study with answers filled in

HYPOTHESES

Hypothesis 1

- Individual differences in performance on the geometric proof task are positively related to individual differences in probabilistic reasoning.

Hypothesis 2

- Individual differences in geometric proof task performance are positively related to the following to observed differences in the below processes assessed while performing a geometric proof task
 - (a) "Making connections", (b) "Logical reasoning", and (c)
 - "Planning/verifying"

Hypothesis 3

- Individual differences in probabilistic reasoning are positively related to differences in the previously listed a,b, and c processes assessed while performing a probabilistic reasoning task.

METHODS

Planned Sample Size

- At least 107 participant; 51 have completed thus far

Testing Reasoning and Math Proficiency

Probabilistic Reasoning Task (PRT)

Geometry Proof Task (GPT)

- **Logical reasoning skills**
 - Participant uses explicit logical reasoning language, such as "if..." or "because..."
- **Making connections**
 - Participant refers to problem statement (PRT and GPT) and/or other step of the proof (GPT)
- **Planning/verifying**
 - When participant demonstrates overt evidence of metacognitive processes
- Accuracy
 - Proportion of correct responses per task

Figure 2. Quotes from high-performing participants (95% accuracy or higher) in line with hypothesis (H) predictions. Red: H1, Purple: H2, Green: H3

PLANNED ANALYSIS

- **Hypothesis 1:** Will be tested via correlation analysis between Geometric Proof Task accuracy and Probabilistic Reasoning Task accuracy.
- **Hypothesis 2:** Will be tested with correlational analysis, like H1, except using data from the Probabilistic Reasoning Task instead of from the Geometric Proof Task.
- **Hypothesis 3:** Will be tested via correlation analysis between the Geometric Proof Task accuracy, and:
 - (a) "Making connections", (b) "Logical reasoning", and (c) "Planning/verifying" on the Geometric Proof Task.

REFERENCES

- William David Braithwaite, "Processes in Adults' Geometry Proof and Math Reasoning (Registration Metadata, Florida State University, 2022), 1-6.
- William David Braithwaite, "Learning and Individual Differences Relations Between Geometric Proof and Mathematical Reasoning" (Manuscript draft, Florida State University, 2021), 1-39.

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DISCUSSIONS AND PROJECTIONS

- While results are preliminary, the present study builds off past research to more deeply understand correlations between geometric proof and deductive reasoning.
- The investigation into deductive reasoning and math ability may yield enhanced methods for teaching math reasoning in school curriculums.
 - Reasoning skills are often a fundamental interdisciplinary skill
- Understanding the link between reasoning and geometric proofs may contribute to human advancement by potentially bettering educational curriculum.