

# Thinking outside the box: children's understanding of geometrical rules is not rooted in shapes

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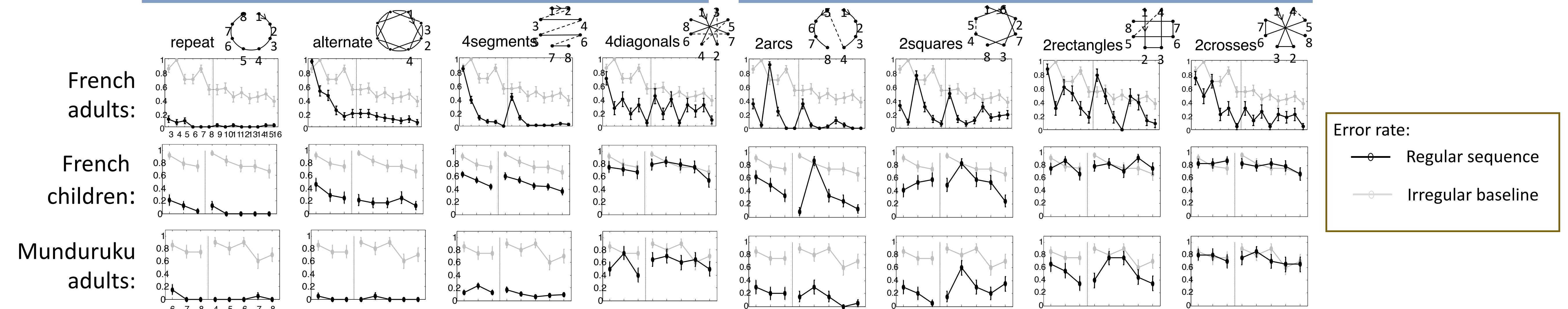


## Introduction

While geometry seems to be part of the human core knowledge, still little is known on how the human brain learns geometrical concepts. A previous study assessing adults' and preschoolers' comprehension of geometrical spatial sequences built on an octagon, exhibited a putative "language of thought" for geometry. This "language" made of primitive and combinatorial rules seemed to develop with age and education. Rotational symmetry and 3-level embeddings were particularly challenging for preschoolers and uneducated adults. In the present study, we tested whether training on the recognition and labeling of static shapes would mitigate preschoolers' potential limitation to perceive regularities in sequences using 3-level embedding.

### Knowledge of geometrical primitive rules

### Learning of embedded rules

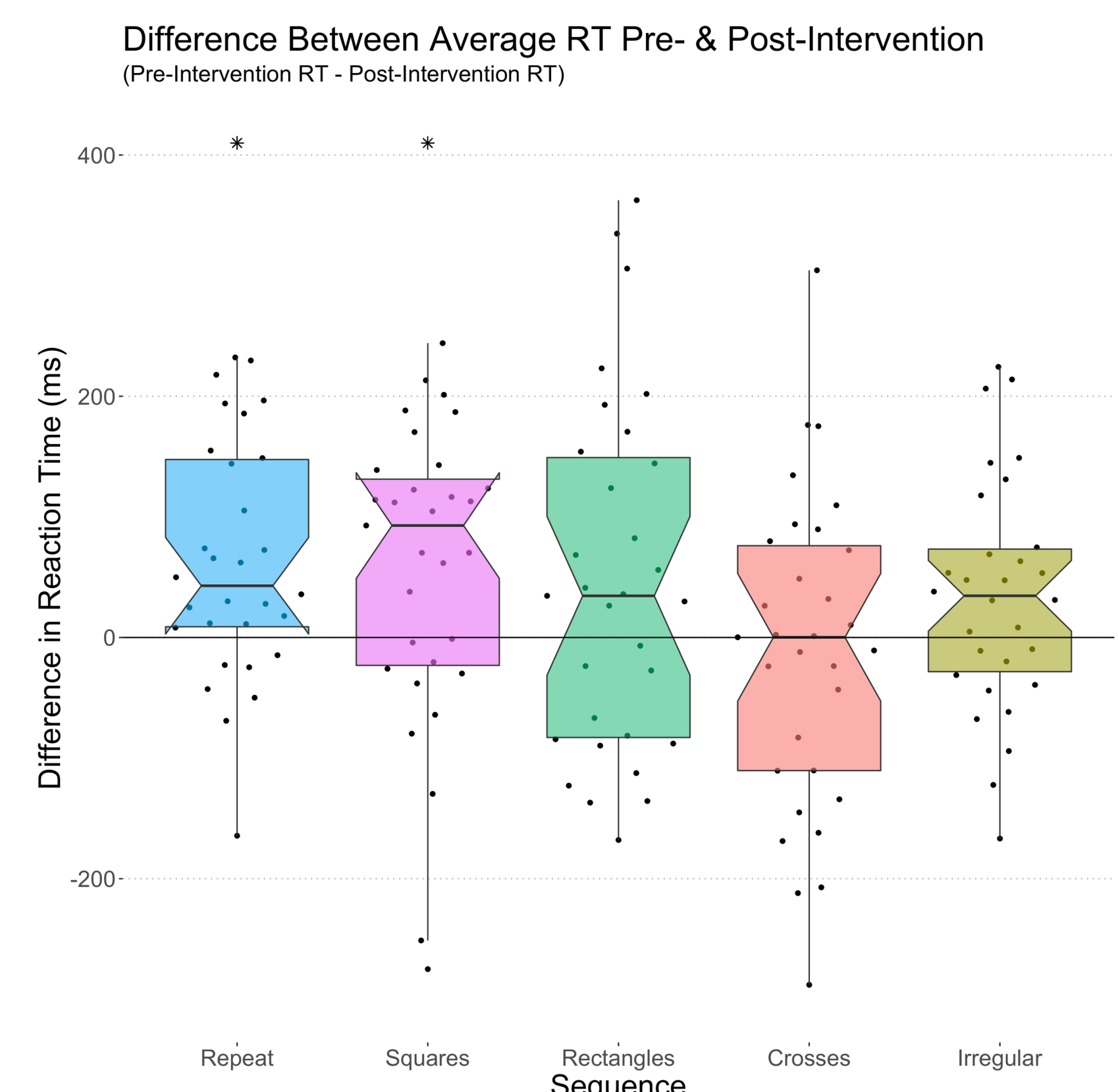
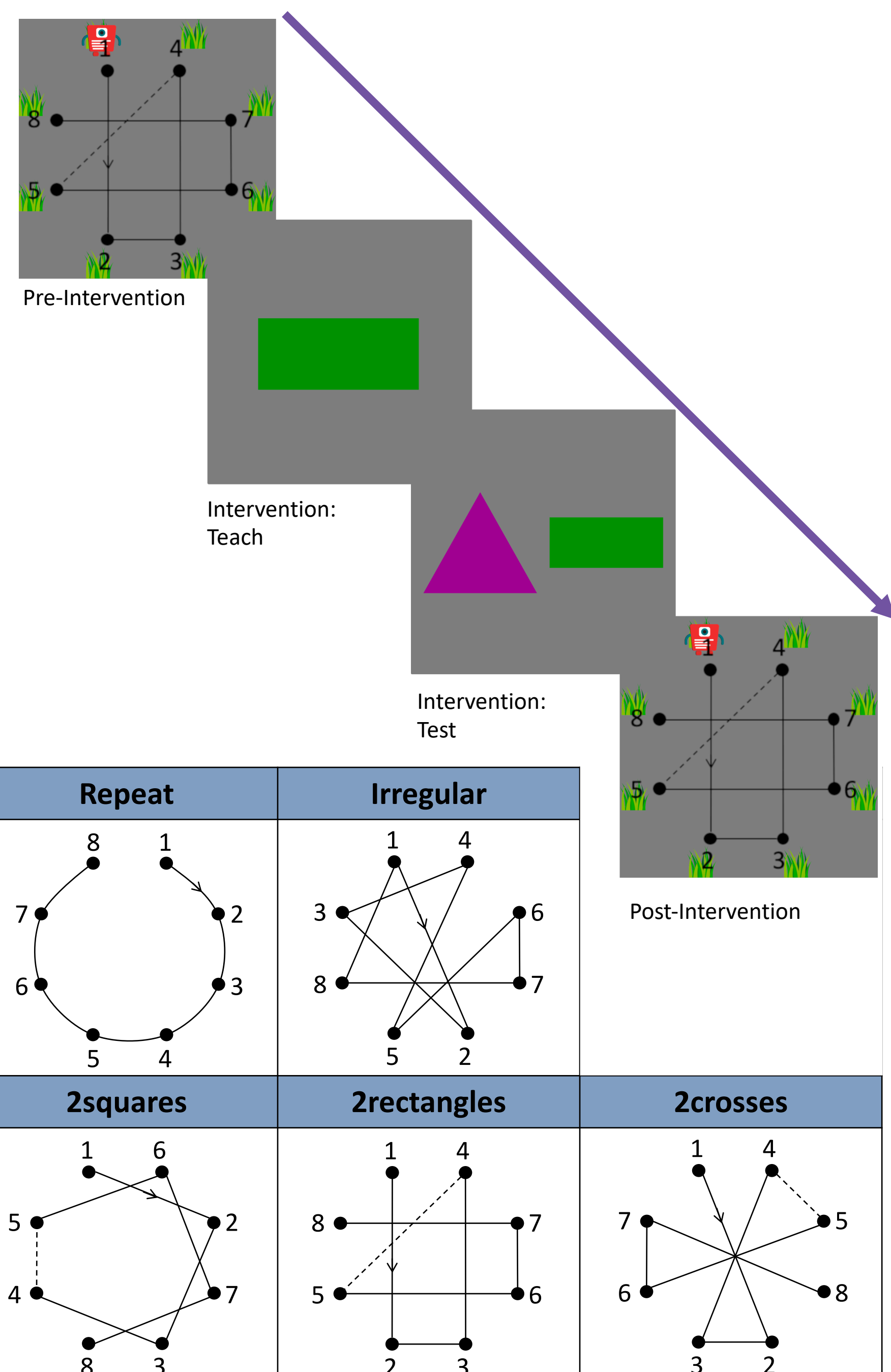


## Methods and Behavioral Results

36 Children between the ages of 3.5-6.17 years (mean = 4.89, median = 5)

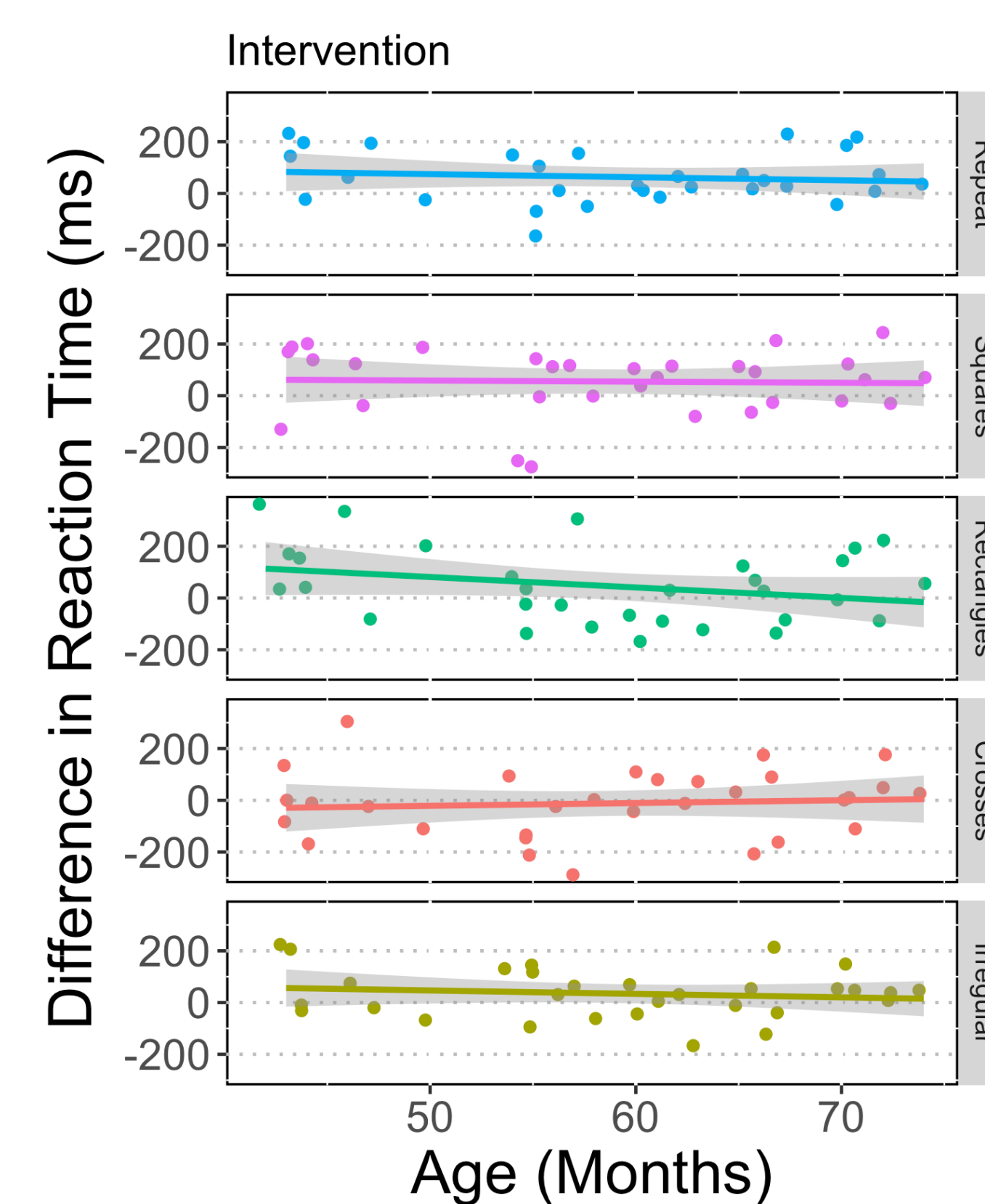
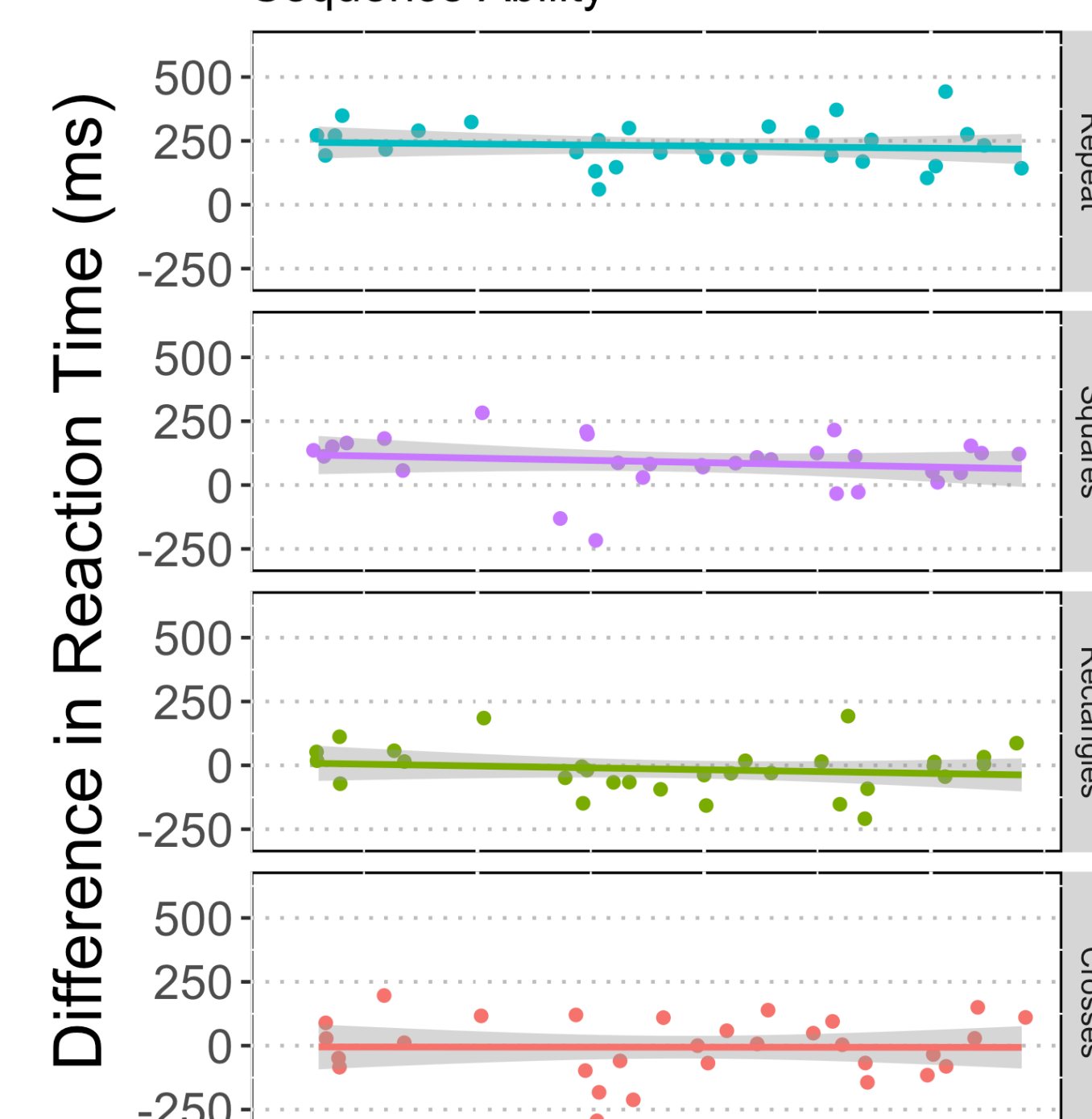
2 Sessions, each lasting approximately 16 minutes

- Session 1 was our "Geometric Sequences" task
- Session 2 had additional batteries
  - Visual-spatial working memory tasks from the *Weschler Preschool and Primary Scale of Intelligence* (WPPSI-4) (Zoo Locations and Picture Memory tasks)
  - Number knowledge tasks (Counting, *How Many?*, and *Give-N* tasks)



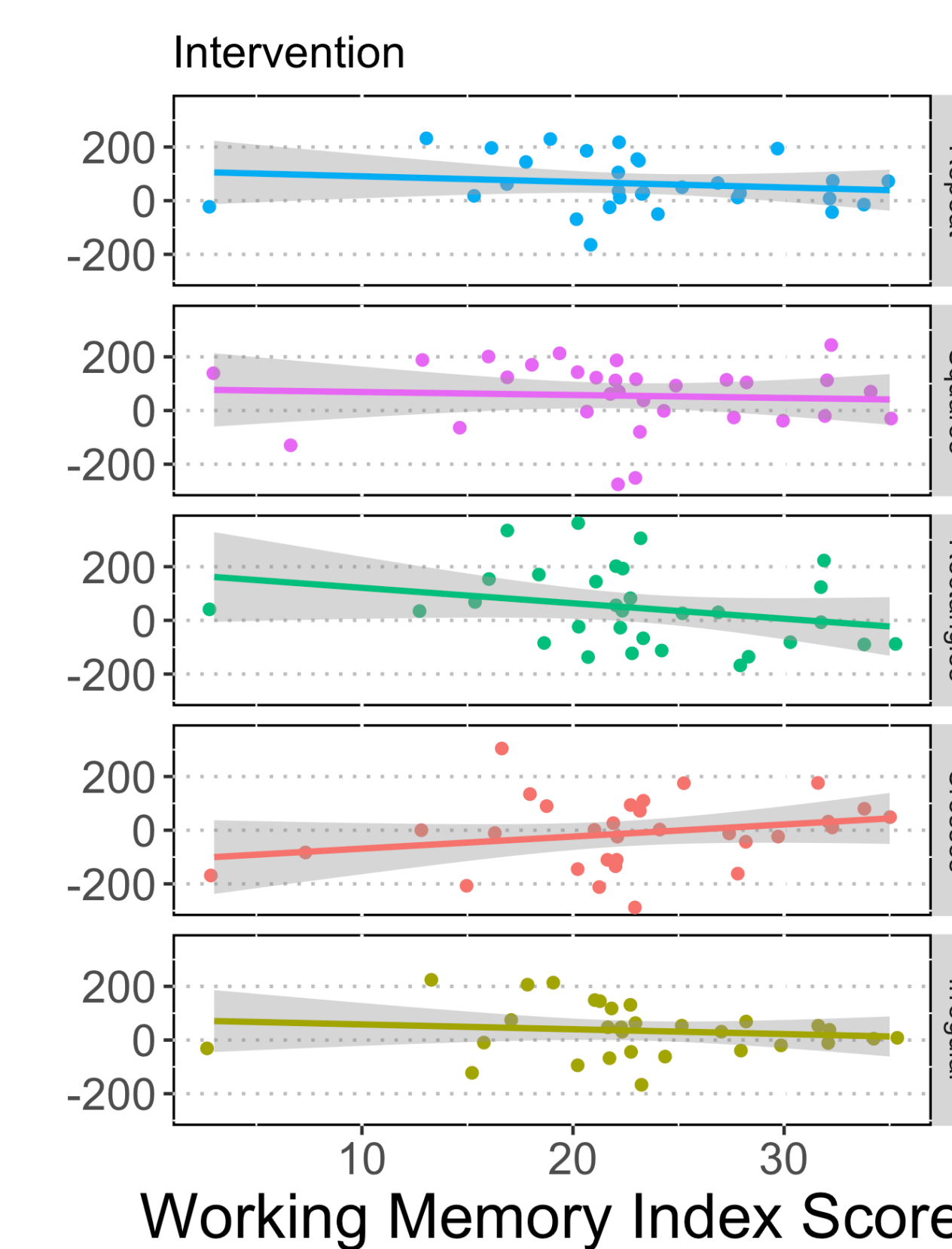
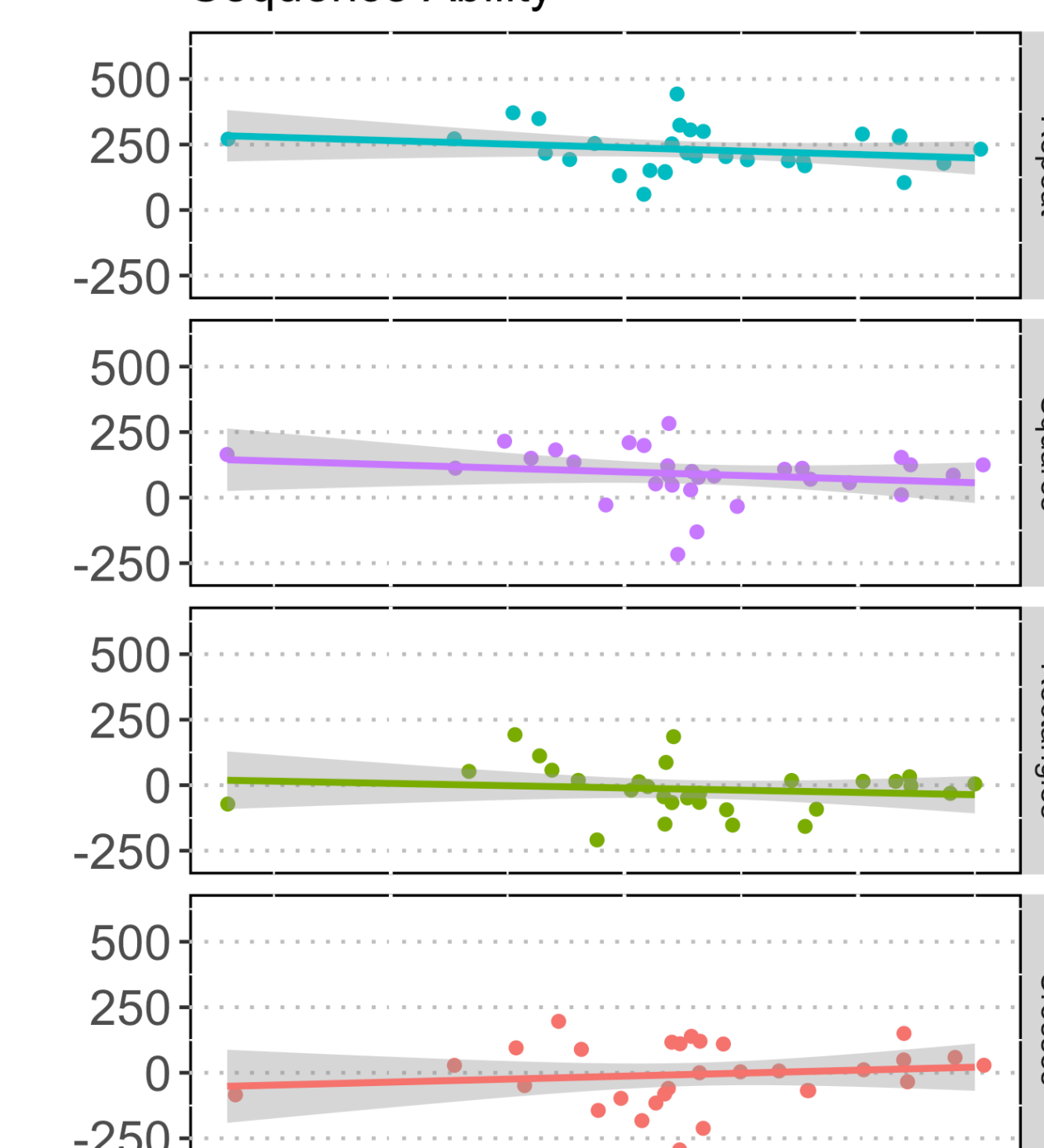
### Age Effects

Sequence Ability



### Working Memory Effects

Sequence Ability



## Conclusions

- ❖ Preschoolers identified better than chance sequences using rotations, axial symmetries, and up to 2-level embeddings.
- ❖ The explicit knowledge of geometrical shapes did not help them to identify 3-level embeddings.
- ❖ Preschoolers' difficulties do not come from spatial memory span limitations, but from a yet incomplete "language of geometry".

## References and acknowledgments

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