

Typical and atypical development of visual scene categorization and navigation systems in humans



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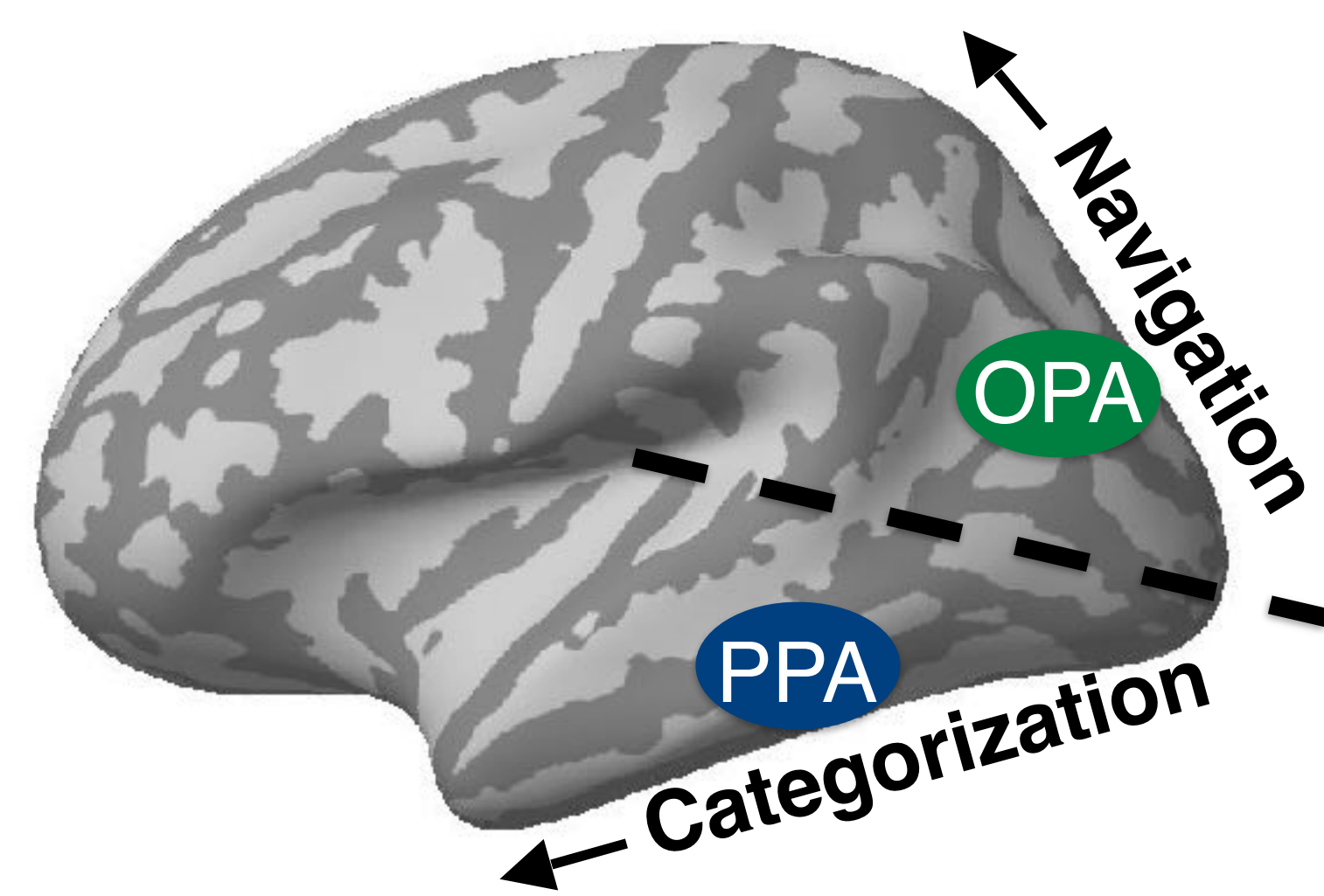
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Introduction

Recent functional MRI (fMRI) evidence suggests that human visual scene processing is supported by at least two functionally distinct systems¹⁻³:

1. **visually-guided navigation**, involving the occipital place area (OPA),
2. **scene categorization** (e.g., recognizing a city vs. a beach), involving the parahippocampal place area (PPA).



Research Questions:

1. Do these systems arise along differential timelines in typical development?
2. Are these systems causally dissociable?

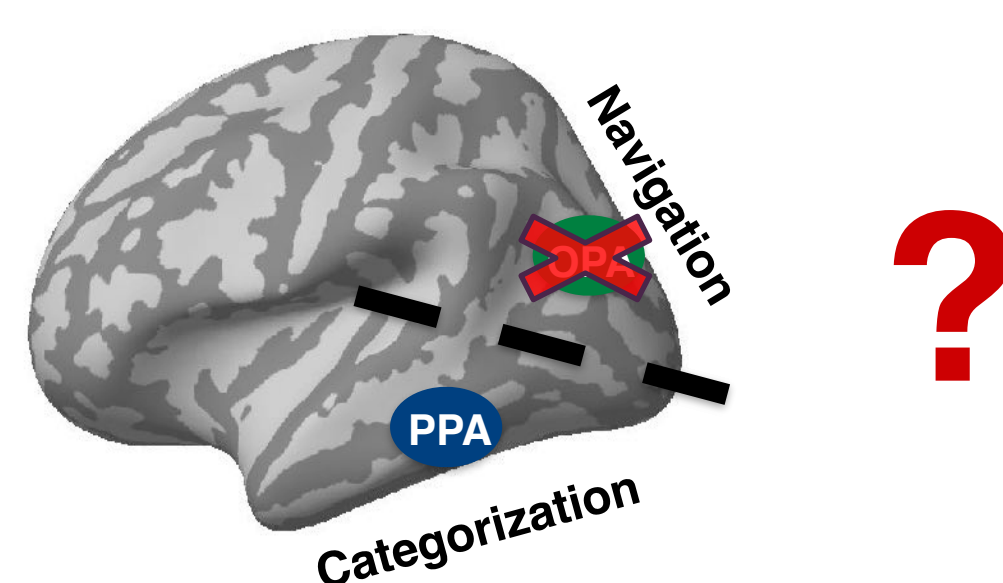
If yes, these results would provide further (and stronger) support for the proposed two systems in visual scene processing.

Williams Syndrome (WS)



- Developmental disorder caused by a microdeletion implicating ~28 genes
- Mild to moderate intellectual disability (low IQ)
- **Cortical thinning in and around the OPA⁴**

Predict navigation impaired, while categorization spared



Tasks



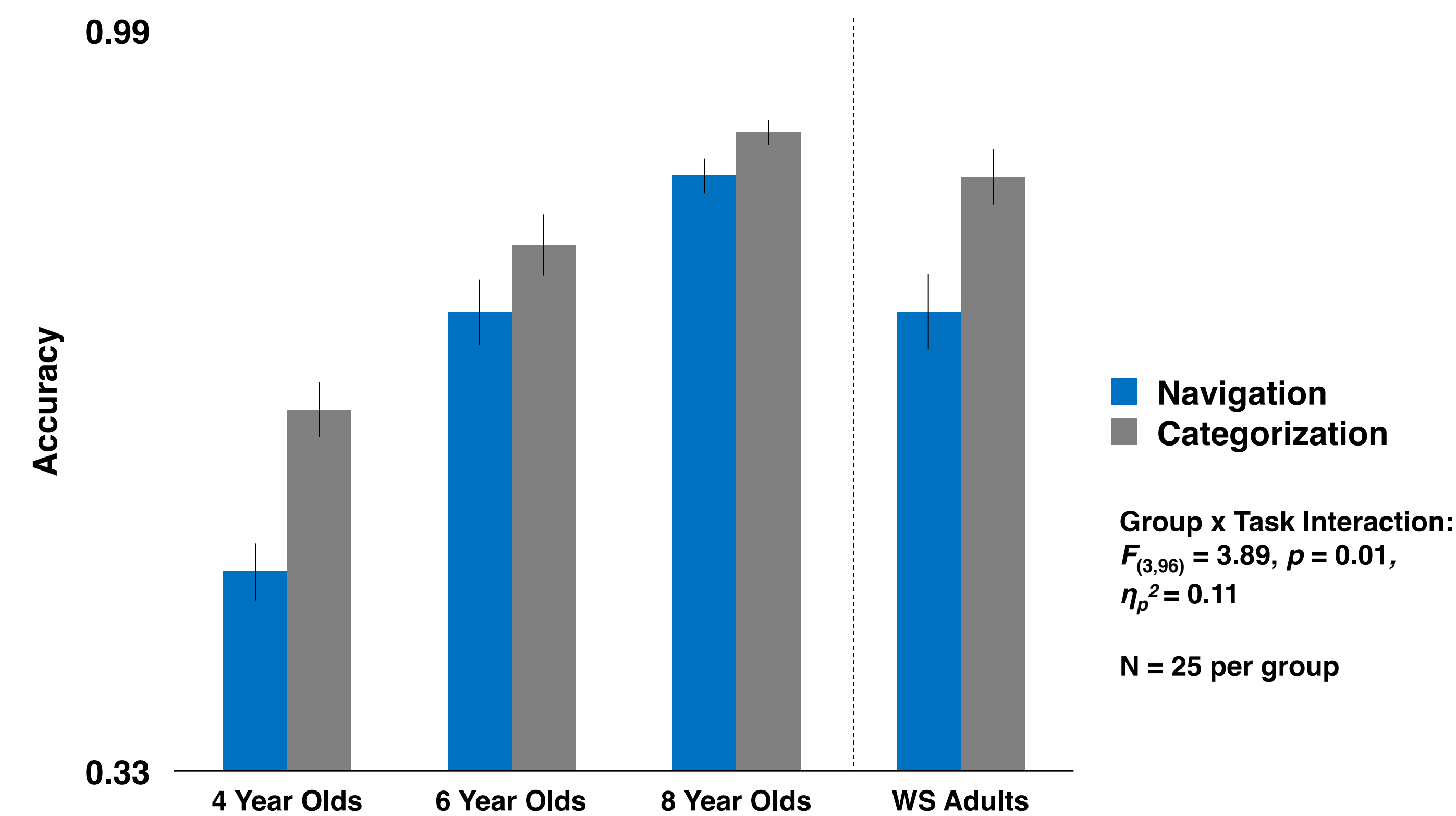
500 ms stimulus presentation, non-speeded 3AFC

Categorization: kitchen, living room, or bedroom? (say aloud)
Navigation: Can you leave out of the left, center, or right door, following a complete path on the floor? (via pointing)

Results

Do navigation and categorization develop along differential timelines in typical development? YES

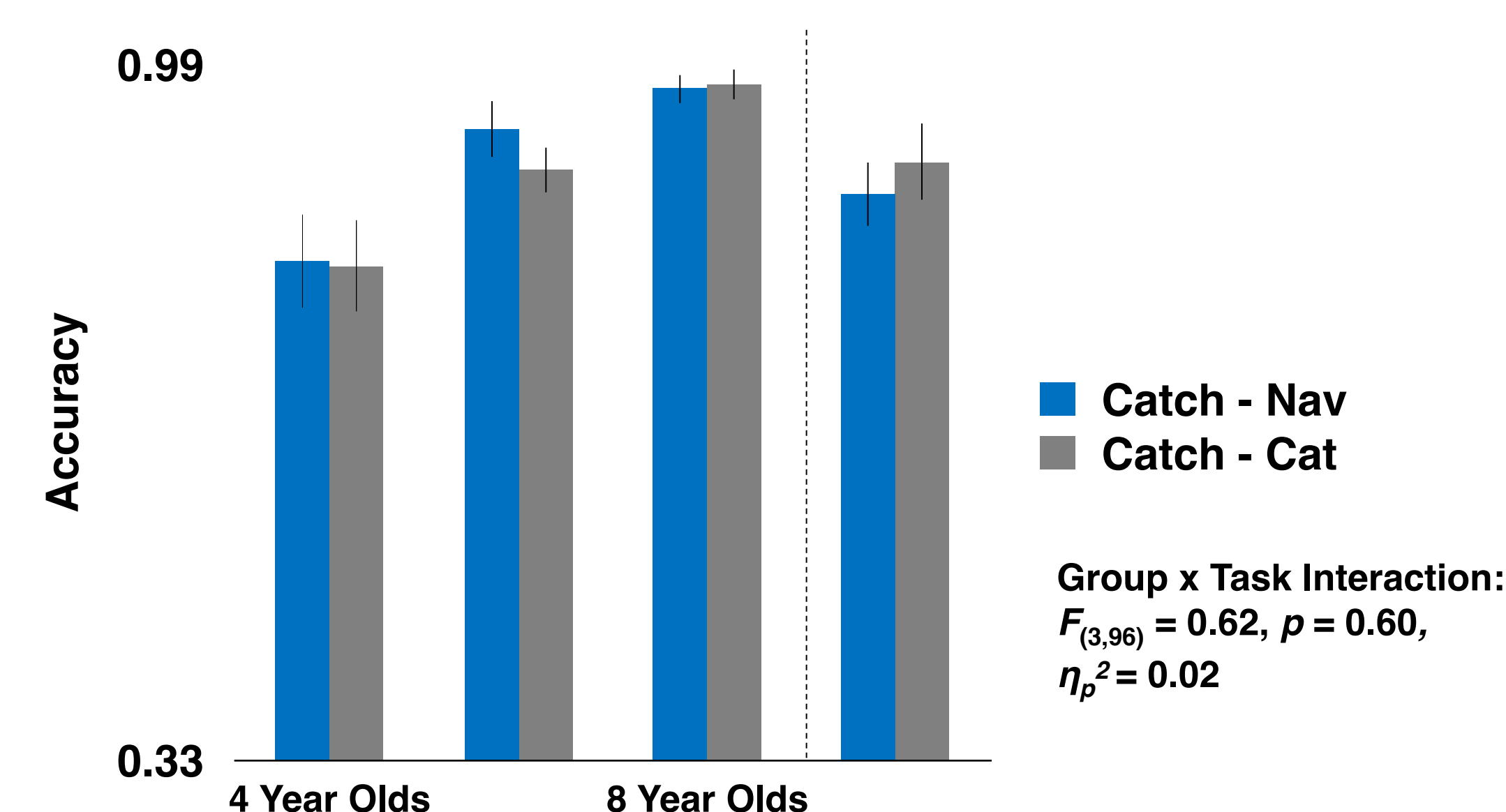
Are WS adults selectively impaired in navigation? YES



BUT maybe WS adults or children...

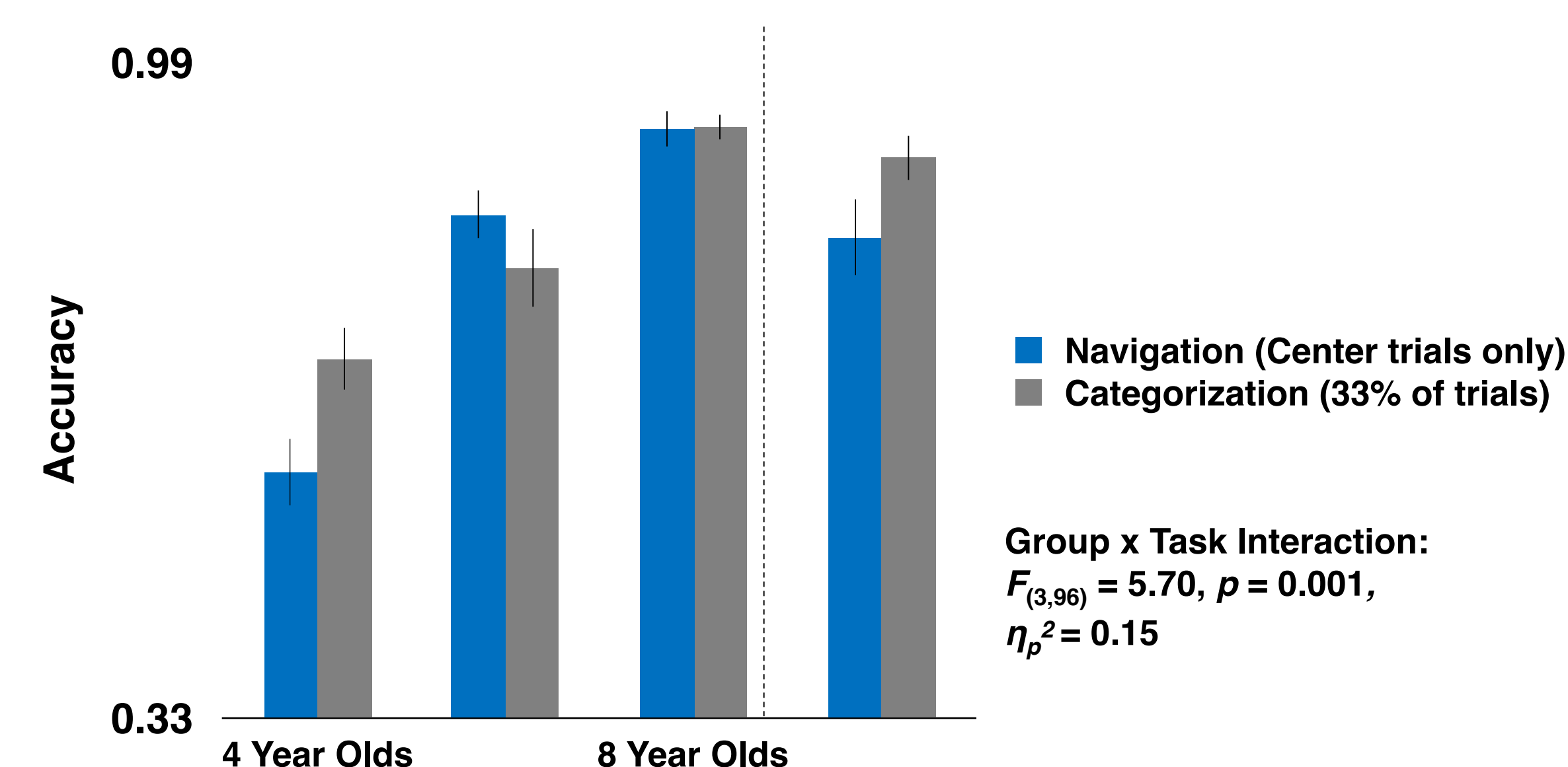
Did not understand or pay attention? NO

Performance on slower (2s presentation) "catch" trials:



Are simply deficient in left versus right? NO

Performance with left and right trials excluded:



Discussion

These findings provide the first developmental and causal evidence for dissociable visually-guided navigation and scene categorization systems.

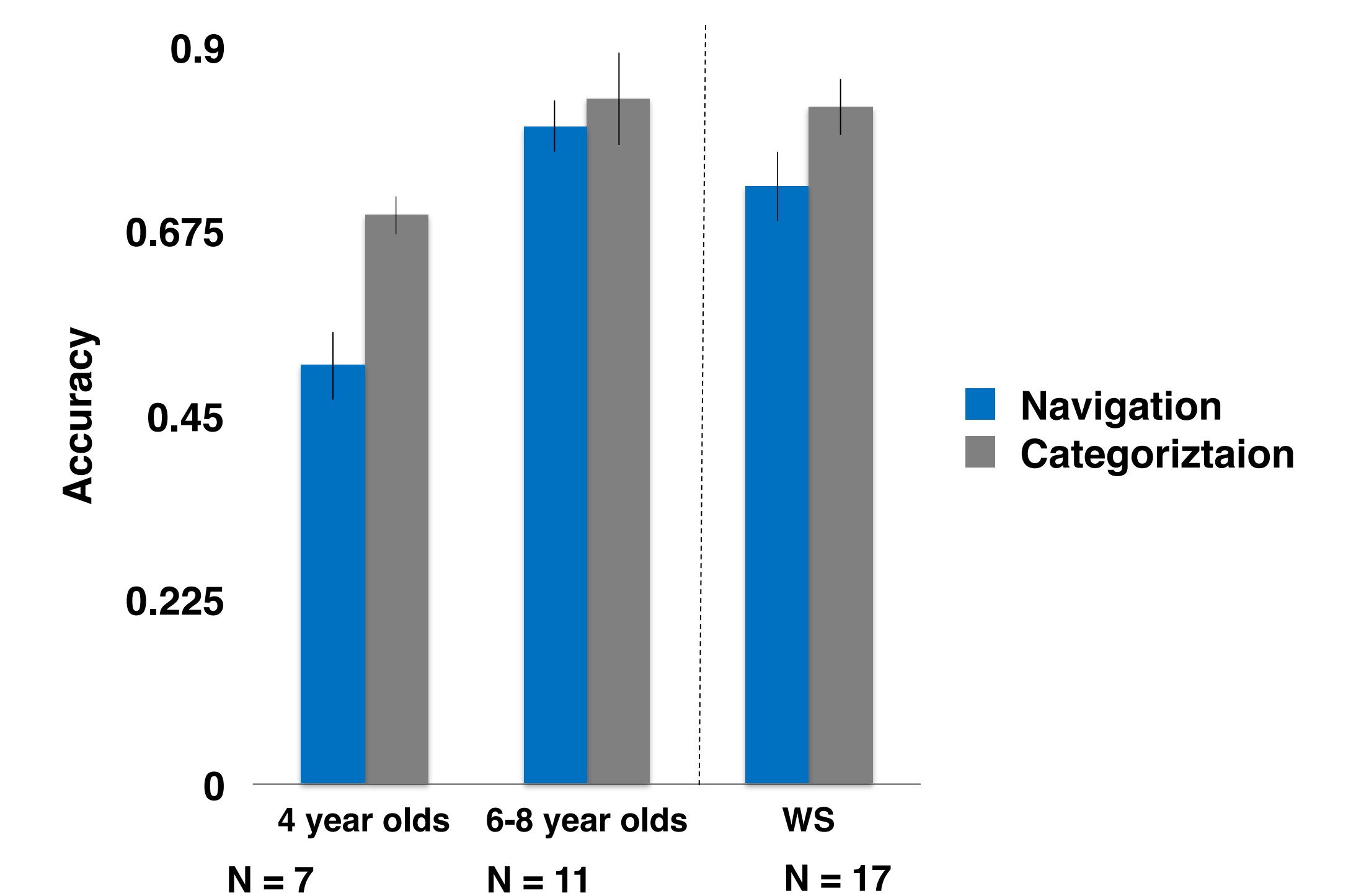
In particular, the navigation system is slower to develop in typical development, and more susceptible to damage in atypical development, than the categorization system.

Results further suggest that this distinction may have a genetic basis.

Next Steps

Can these findings be explained by earlier developing/intact object perception?

Categorization task based on layouts, not objects



Future Directions: fMRI

Typical Development: Predict OPA comes online later in development than PPA

WS: Predict dysfunctional OPA not PPA

References

1. Dilks et al. (2011). *J Neuro*, 31, 11305-11312
2. Persichetti and Dilks (2016). *Cortex*, 77, 155-163.
3. Kamps et al. (2016). *Cortex*, 83, 17-26
4. Meyer-Lindenberg et al., (2006). *Nat Rev Neuro*, 7, 380-393.

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