

Measuring language-evoked activation in the brains of awake toddlers using fMRI



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BACKGROUND

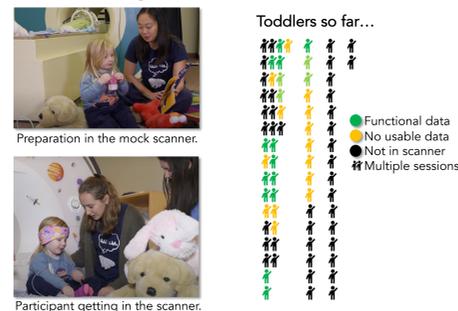
- Toddlers undergo rapid changes in their language production and comprehension skills¹.
- Some previous fMRI studies have investigated speech processing in infants² and toddlers³ during natural sleep.
- To better understand the neural basis of language comprehension in toddlers, we designed a novel fMRI task⁴ that embeds a language control (backwards speech) in movie clips from *Sesame Street*. In preliminary analyses, we ask:

- 1 Can we measure a language response in toddlers?
- 2 Is language-evoked activation left-lateralized in toddlers?
- 3 Do language regions respond differently to observed conversation than language directed to the child in toddlers?

METHODS

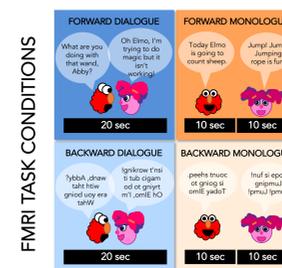
PARTICIPANTS

Toddler Participants: N=9 with T1s included in preliminary analyses (age: mean(SD) = 31.5(3.9) months, range 25-36 months)



Adult Participants: N=20 (age: mean(SD) = 23.9(3.7) years, range 18-30 years)

FMRI TASK



Participants passively watched 20-second edited clips from episodes of *Sesame Street*.

LANGUAGE CONTRAST



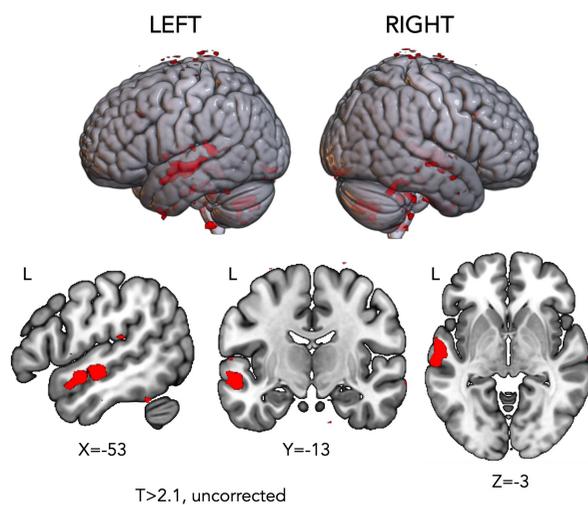
PRELIMINARY ANALYSES

- 1 **GROUP WHOLE BRAIN ANALYSIS**
- 2 **LATERALIZATION**
Lateralization index was calculated for each individual using the formula: $LI = (V_{left} - V_{right} + 1) / (V_{left} + V_{right} + 2)$, where $V = \#$ suprathreshold voxels⁵⁻⁶ in left language search spaces⁷ and their mirrored right hemisphere homologue search spaces (cluster threshold of $k=10$ voxels).
- 3 **SUBJECT-SPECIFIC FUNCTIONAL REGIONS OF INTEREST**
Subject-specific functional regions of interest⁷⁻⁹ (ssfROIs) were defined as the top 100 voxels for the language contrast using independent runs of the task. Average magnitude (betas) per condition were iteratively extracted from these ssfROIs, using held-out runs.

RESULTS

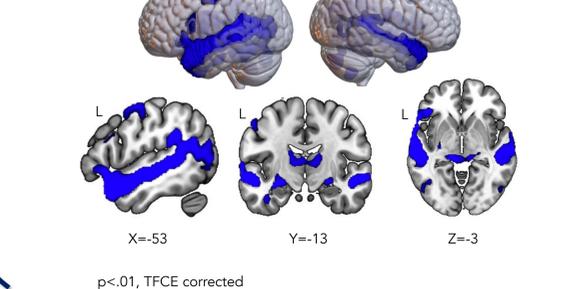
TODDLERS

1 WHOLE BRAIN

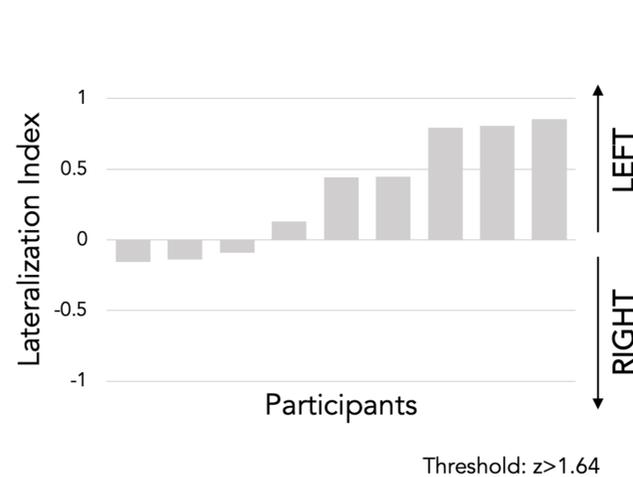


ADULTS

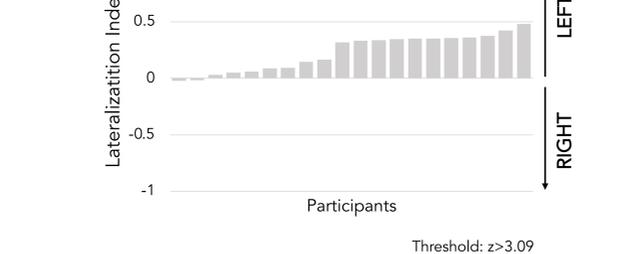
2 LATERALIZATION



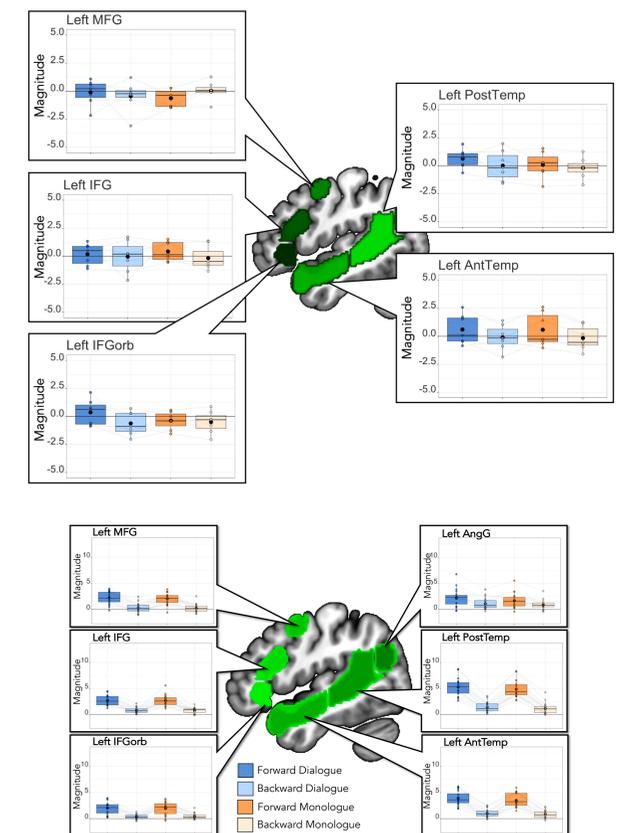
1 WHOLE BRAIN



2 LATERALIZATION



3 SUBJECT-SPECIFIC ROIS



CONCLUSIONS

Preliminary results suggest:

- 1 We can measure a language-evoked response in toddlers using awake fMRI.
- 2 Language responses may be left lateralized in toddlers.
- 3 Child-directedness of language stimuli may impact neural activity during language processing in toddlers.

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ACKNOWLEDGEMENTS

We would like to thank our funders: National Science Foundation Graduate Research Fellowship (to HAO) and Simons Foundation Autism Research Foundation (SFARI) grant. We would also like to thank the Athinoula A. Martinos Imaging Center at MIT; Kirsten Lydic, Hana Ro, Rebecca O'Connor, Sofia Riskin, Bianca Santi, Matthew Soza, Michelle Hung, Camille Osumah, and Haoyu Du; and our participants.