

The heterogeneous engagement of the language network during statistical learning

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Background

Statistical Learning (SL), a type of implicit learning from sensory inputs, is central to the theory of language acquisition (Frost et al., 2019; Newport & Aslin, 2004). Recent behavioral research has demonstrated a reciprocal relationship between prior language experiences and performance in SL (Siegelman et al., 2017; Elaza et al., 2022).

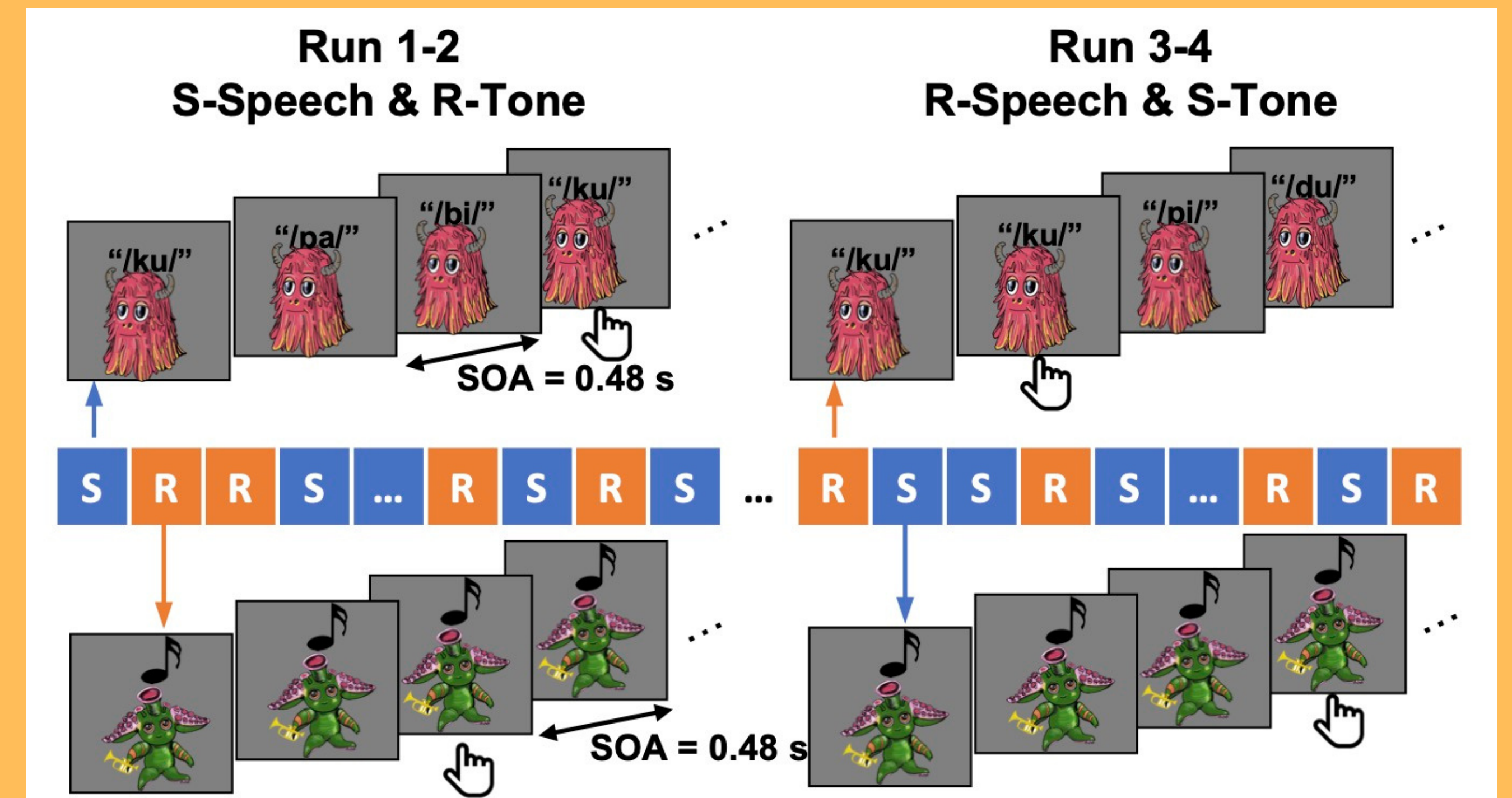
Despite the significant overlap between SL and language in their richness of regularities, it remains unknown whether the neural network involved in language processing is similarly engaged in SL.

Research Question

Are language networks engaged during linguistic SL, and how?

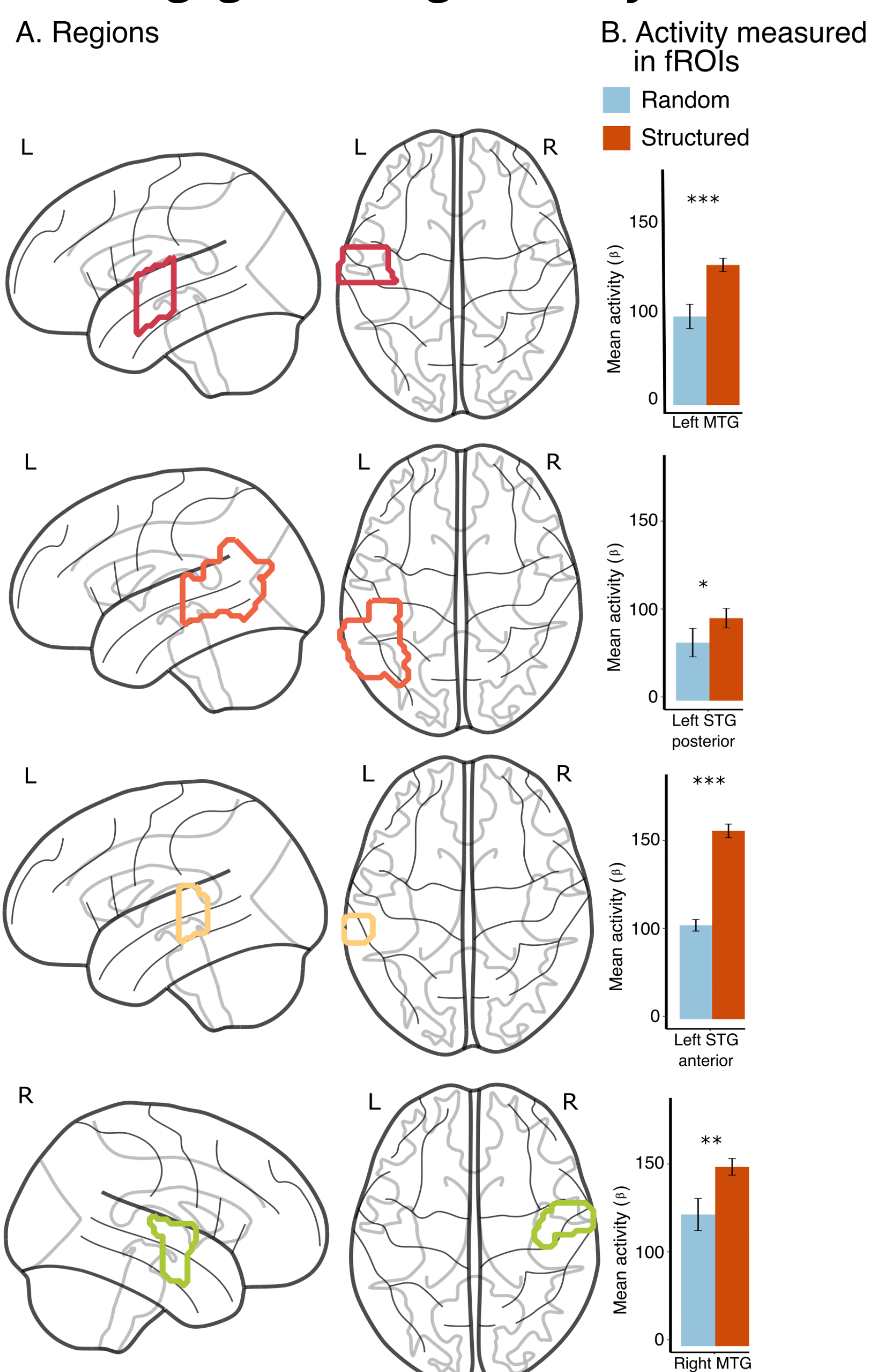
Method

Twenty-two adults ($M_{age} = 19.87$, $SD_{age} = 1.25$) completed an auditory SL fMRI task (adapted from Saffran et al., 1996; 1999; Schneider et al., 2020) and an auditory language localizer fMRI task (Scott et al., 2017; Fedorenko et al., 2014).



Quicker RT in speech structured vs random blocks ($t = -1.93$, $p = 0.03$).

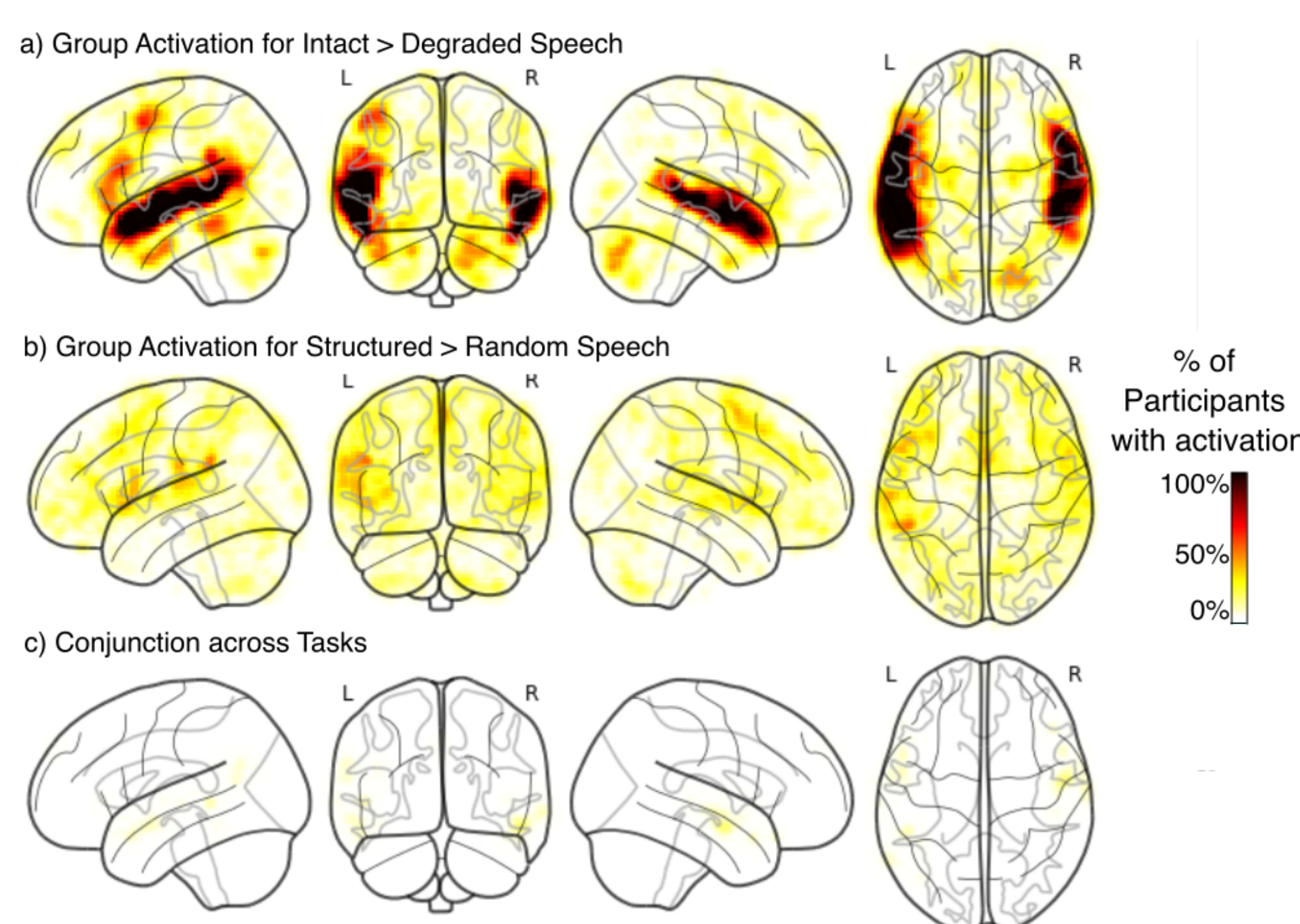
Subject-specific language regions are engaged during auditory SL



A set of functional regions of interest (fROI) were generated from the language localizer task. Within these fROIs the bilateral superior and middle temporal gyri were activated during the SL task.

Analysis & Results

Lack of spatial convergence during SL



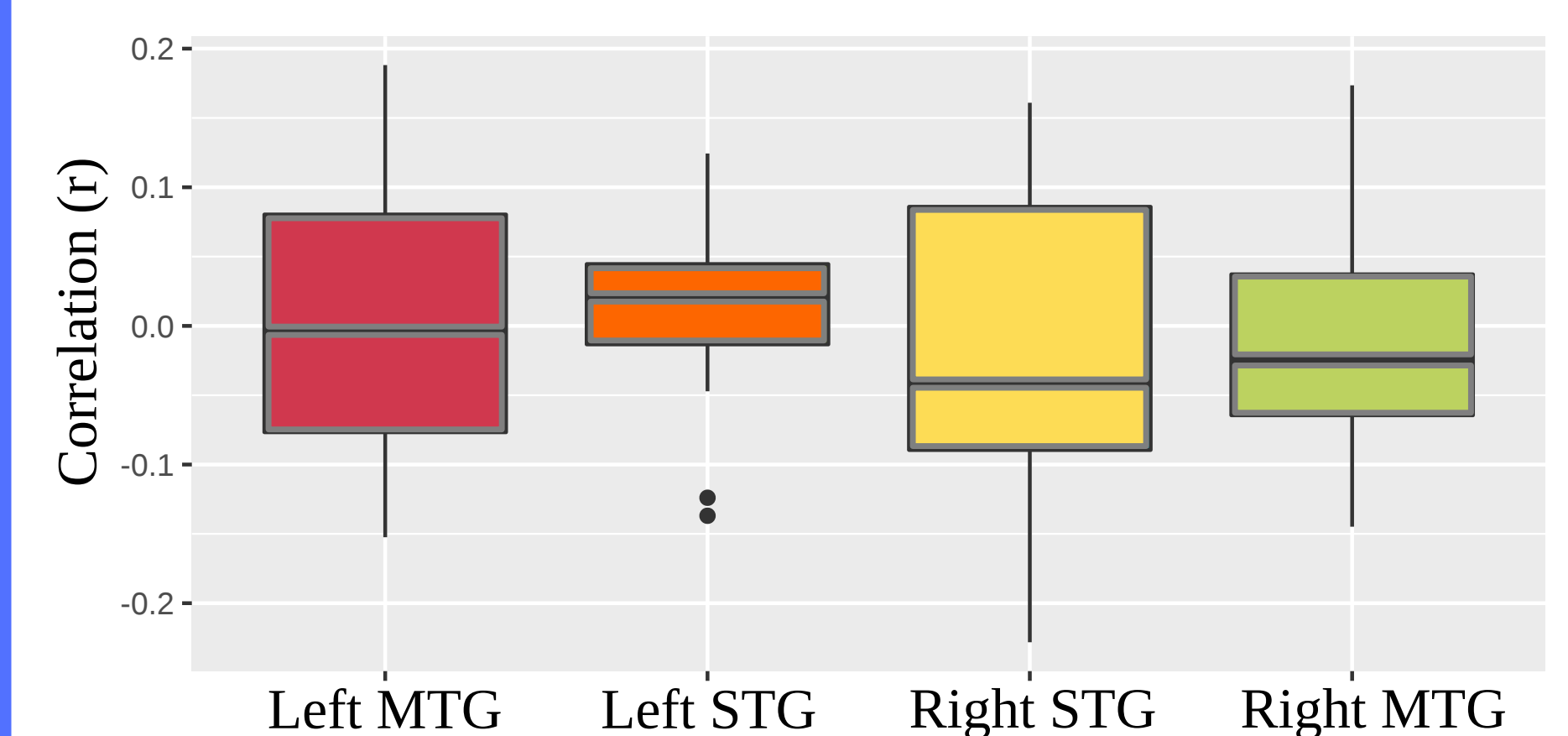
Due to substantial inter-subject heterogeneity in brain activation during SL, we did not identify any conjunction parcel across learners.

Take Home Messages

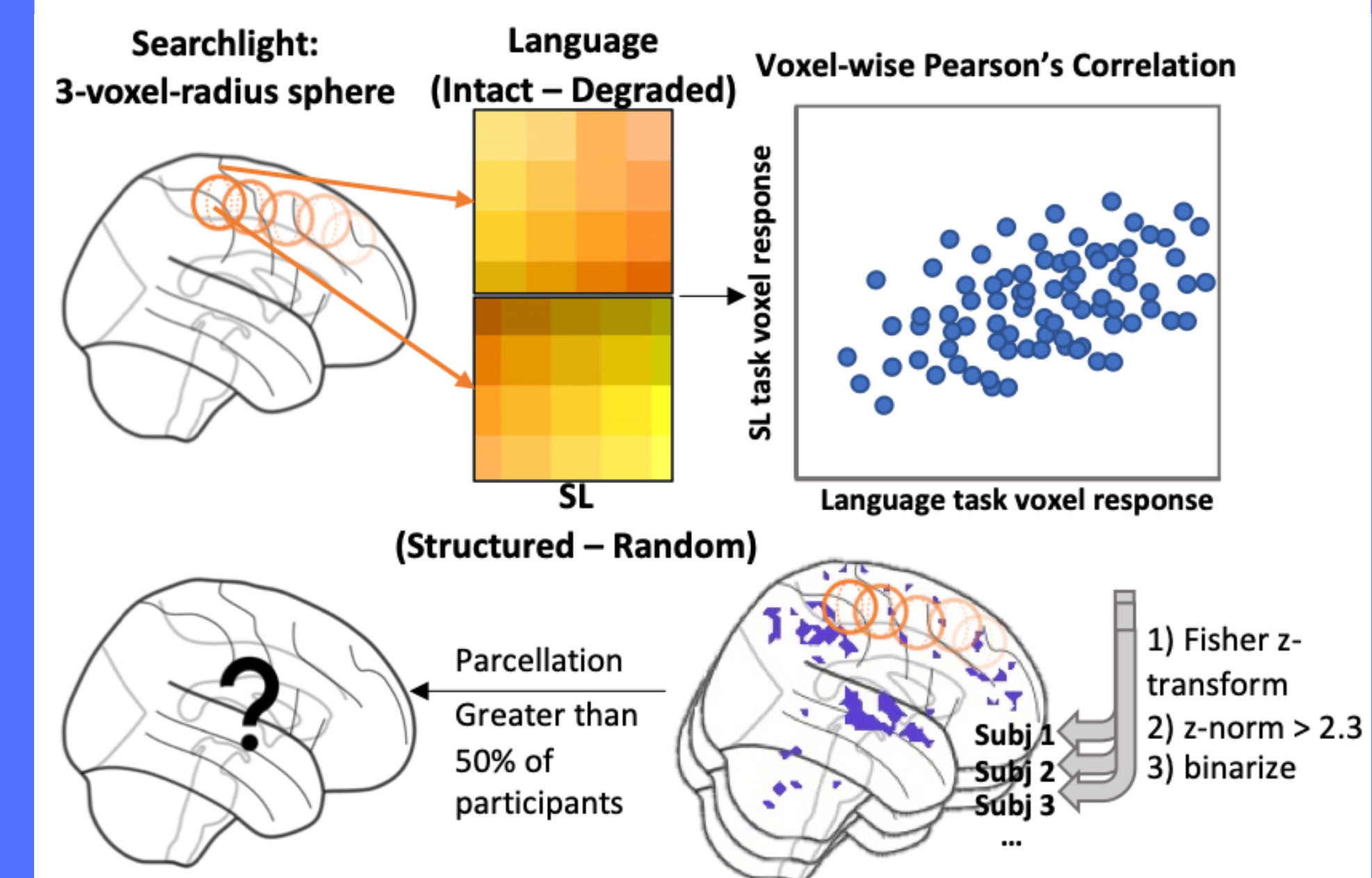
1. While parts of the language network are involved in linguistic SL, the specific subregions utilized for SL vary substantially across individuals.
2. The computation undertaken by mature language networks during SL is different from language processing with meaning, though the functional architecture of the latter might still constrain SL performance.
3. Future research will investigate the functions of developing language networks in children during SL (C27).

Multi-voxel activation patterns differ between SL and Language Processing

Local Pattern Similarity Analysis (Scott & Perrachione, 2019)



The mostly activated voxels in the language task were not among the mostly engaged subregion in each language parcel during SL.



No region showed significant cross-task correlations ($z > 2.3$) with more than 50% of participants, as determined by a whole-brain LPSA.

References for methods:

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- Scott, T. L., Gallée, J., & Fedorenko, E. (2017). A new fun and robust version of an fMRI localizer for the frontotemporal language system. *Cognitive neuroscience*, 8(3), 167-176.
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