The heterogeneous engagement of the language network during statistical learning

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Background

Recent behavioral research has demonstrated a reciprocal relationship between prior language experiences and performance in statistical learning (SL).

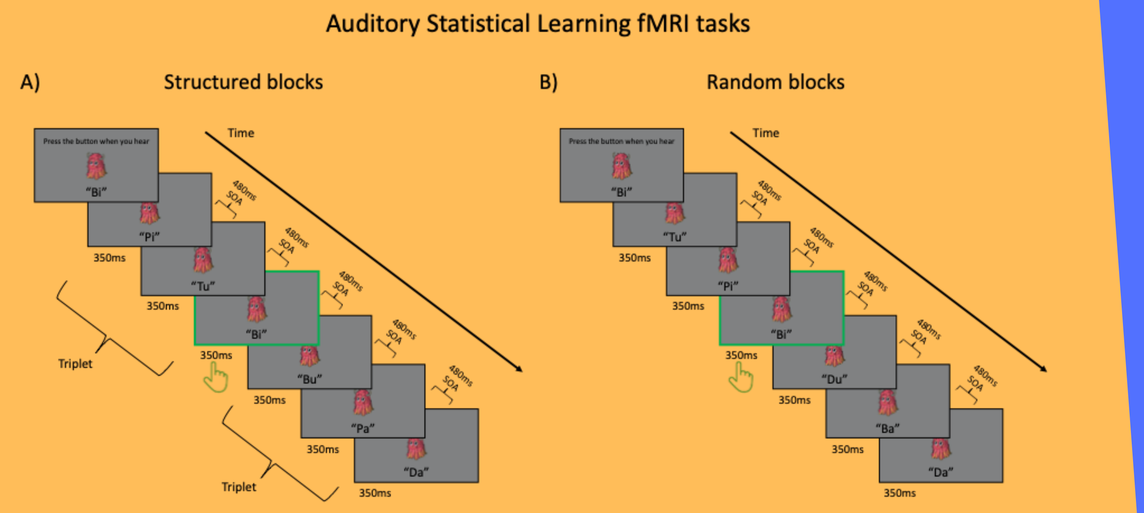
Despite the significant overlap between SL and language in their richness of regularities, it remains unknown whether the neural network involved in language processing is similarly engaged in SL.

Goal

To identify the functional neural profiles of auditory SL among individuals, and whether these patterns of activity are similar to those engaged during language processing.

Method

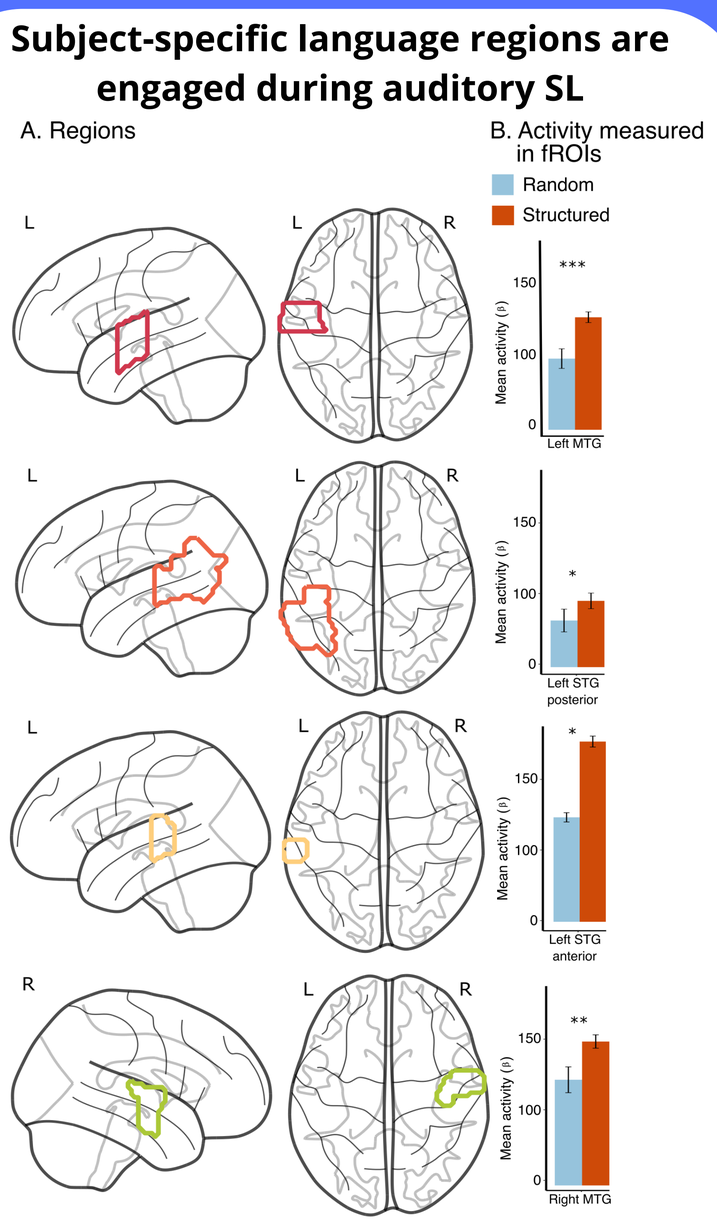
- Twenty-two adults (*M*age = 19.87, *SD*age = 1.25) completed an auditory SL fMRI task (Schneider et al., 2020) and an auditory language localizer fMRI task (Scott et al., 2017).



- In the SL task, individuals were exposed to structured and random sequences of syllables
- In the language localizer task, individuals were exposed to intact speech (Alice in Wonderland) and degraded speech (unintelligible).

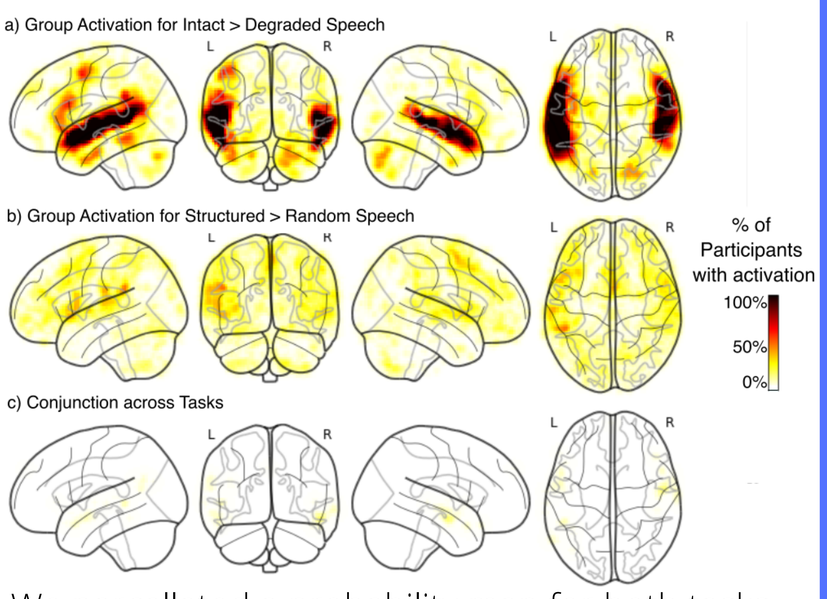
Analysis & Results

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.

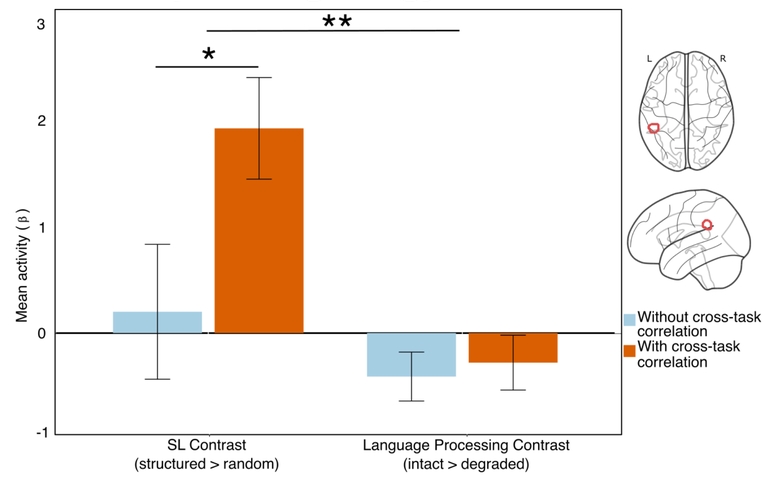
Lack of spatial convergence in the neural basis of language processing and auditory SL



We parcellated a probability map for both tasks, computing the degree of conjunction between these maps. Due to inter-subject heterogeneity in brain activation during SL, there was no significant conjunction in these same regions across learners.

BOLD activation patterns among those 10% voxels activated for each task within language parcels were also not correlated.

Common activation pattern during both SL and language processing at left supramarginal gyrus (SMG).



Using a 3-voxel radius spherical searchlight, we calculated the local correlation coefficient between the two tasks centered on each voxel throughout the whole brain. Significant correlation between tasks was uncovered in one fROI, the LSMG (60% of participants).

A repeated-measures ANOVA revealed a main effect of group ($F(1,20) = 11.18$, $p = 0.003$) and task ($F(1,20) = 4.45$, $p = 0.048$), as well as a moderately significant interaction ($F(20) = 3.59$, $p = .07$).

For the subset of participants who showed cross-task correlation in the LSMG, the LSMG was actively recruited for the auditory SL task, but not for the language task.

Take Home Message

Our findings suggest that while parts of the language network are involved in auditory SL, the specific regions vary substantially across individuals.

The computation undertaken by language-specific brain regions likely differs across individuals during language processing with meaning versus SL.

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References:

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