

Functional dissociation of language and working memory revealed by pattern analysis of subject-specific conjunction maps



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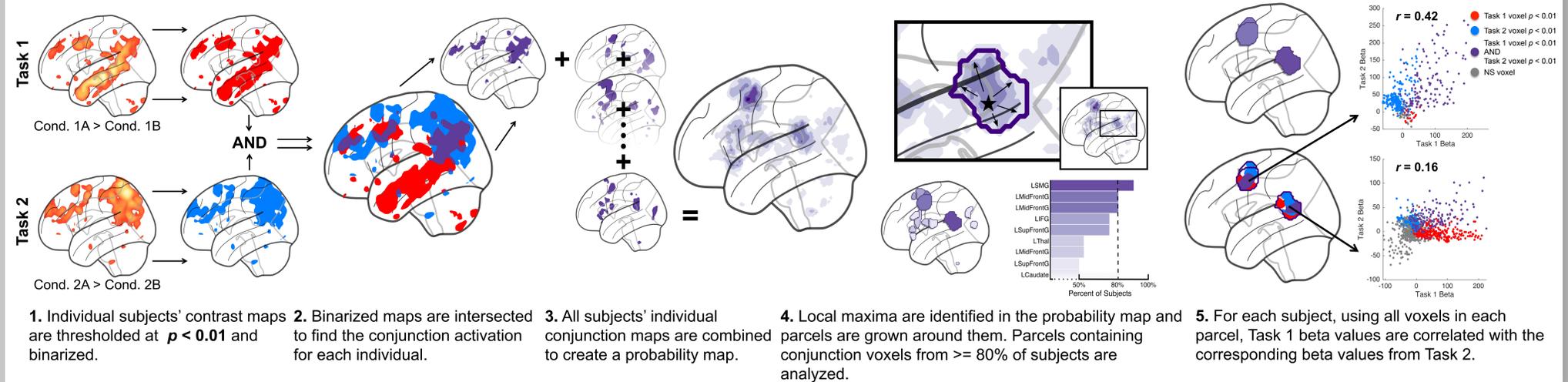
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Summary

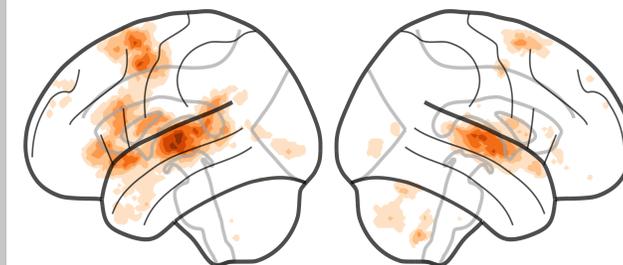
- Separable brain networks with opposing functional specificity are thought to support language and working memory (WM) (Fedorenko et al. 2010; 2012), however consistent exceptions have been observed in neuroimaging of **verbal working memory (VWM)** tasks.
- Here, we compare and contrast activation in the brains of individual subjects evoked during functional magnetic resonance imaging (fMRI) of **language**, **VWM**, and **spatial working memory (SWM)** tasks.
- In a majority of participants, significant overlapping activity between **language and VWM** was found in 8 brain areas with median $r = 0.12$, 3 brain areas showed overlap between **language and SWM** with median $r = -0.05$, and 16 regions were identified as showing overlap between **VWM and SWM**, with highly correlated patterns of activity across these tasks in each region (median $r = 0.44$).
- **In regions showing overlap between language and WM, correlations between the tasks were relatively low.** These results indicate that, even in regions where there is overlap in functional activation (conjunction) between language and verbal or spatial working memory, the degree of neurocomputational convergence is minimal.

Analysis Methods

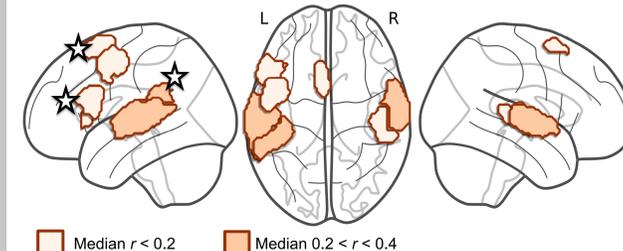


Language/Speech and Verbal Working Memory

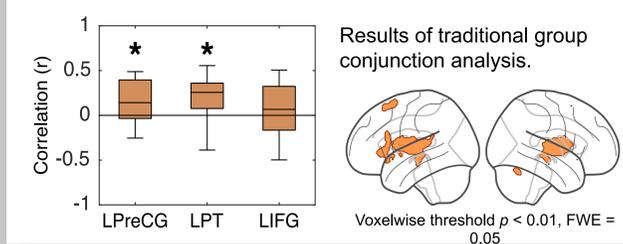
Results: Probability Maps



Results: Parcels that encompass conjunction voxels from 80% or more subjects

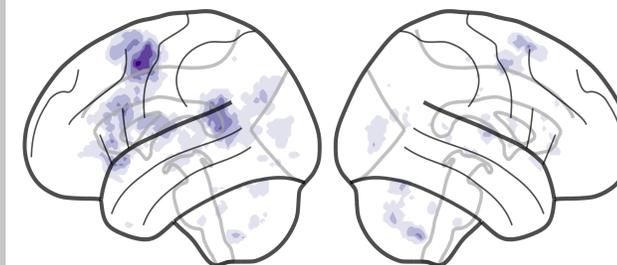


Results: Correlations from three representative parcels

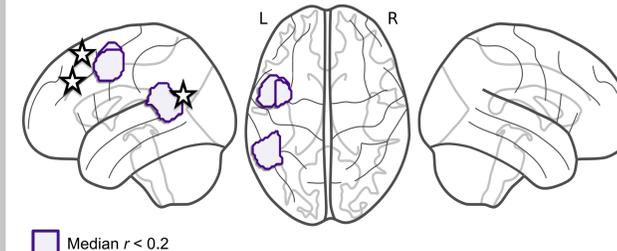


Language/Speech and Spatial Working Memory

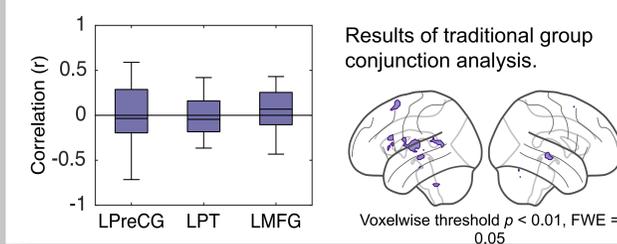
Results: Probability Maps



Results: Parcels that encompass conjunction voxels from 80% or more subjects

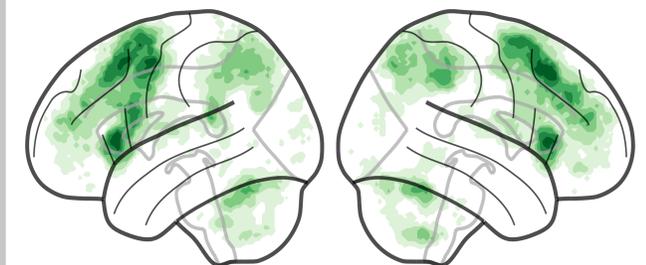


Results: Correlations from three representative parcels

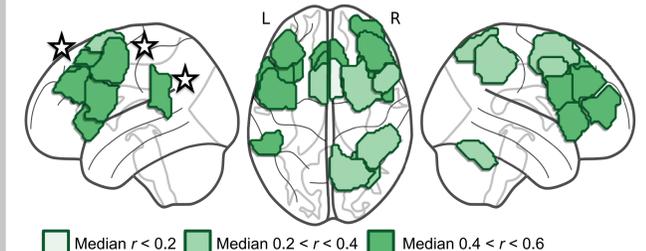


Verbal and Spatial Working Memory

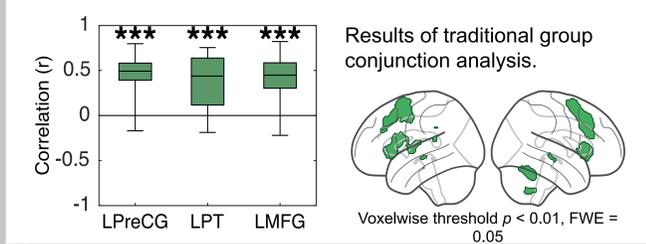
Results: Probability Maps



Results: Parcels that encompass conjunction voxels from 80% or more subjects



Results: Correlations from three representative parcels



fMRI Tasks

Participants: 20 fluent English-speaking adults (12 female; age 19-32 years, $M = 24.1$ years)

Language/Speech Task Design

fMRI Runs: 2 per session, 16 passive listening blocks per run + rest, one 18-second audio clip per block

Intact Speech vs Degraded Speech

Acquisition: Continuous-sampling block design, using simultaneous multislice imaging (TR=0.75s).

Verbal Working Memory: Digit Span

fMRI Runs: 2 per session, 8 blocks per run + rest, 4 trials per block, Easy blocks lasted 18 seconds, Hard blocks lasted 27 seconds

Easy - Three Item Sequences

Hard - Six Item Sequences

Hear "six, one, two." Hear "six, two, one." Respond SAME or DIFFERENT

Hear "eight, four, two, seven, six, three." Hear "eight, four, two, six, seven, three." Respond SAME or DIFFERENT

Spatial Working Memory: Corsi Blocks

fMRI Runs: 2 per session, 8 blocks per run + rest, 4 trials per block, Easy blocks lasted 18 seconds, Hard blocks lasted 27 seconds

Easy - Three Item Sequences

Hard - Six Item Sequences

Respond SAME or DIFFERENT

Analysis: GLMs were computed in each run of each task and then data were aligned to a common MNI template.

