Nonword repetition recruits distinct and overlapping nodes of language and working memory networks
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Summary
- Phonological working memory (PWM) is the process of maintaining sounds important for speech and language in short term memory. This process is believed to be a crucial component for typical language development.
- Here we examined the functional responses within regions sensitive to PWM load during nonword repetition, in order to better understand what types of computations these brain areas support.
- Participants completed three tasks during neuroimaging: (1) nonword repetition (including control conditions with real words), (2) passive listening to language/speech, and a (3) verbal working memory task (digit span).
- We localized functional regions of interest (ROIs) responsive to PWM load in individual subjects, and tested their responses during language and verbal working memory tasks.
- By describing the functional profiles of PWM brain regions, we have uncovered evidence for the involvement of canonical speech regions (superior temporal gyrus; STG) and dual language/working memory convergent regions in the dorsal stream.

Analysis Methods
In order to provide a detailed description of the functional properties of PWM regions within individual subjects, we employed group constrained subject-specific (GCSS) analysis (Fedorenko et al., 2010; Julian et al., 2012; Scott et al., 2018). With this technique, we addressed the following questions:

What are the functional profiles of PWM brain regions in individuals?

Are the patterns of activity similar between two tasks? Even if a region is sensitive to a separate contrast, the pattern of activity is not necessarily the same. We correlated voxels from two tasks across the entire parcel to assess the similarity in patterns of activation.

Analysis of fMRI data
Participants: 20 fluent English-speaking adults (12 female; age 19-32 years, M = 24.1 years).

Nonword Repetition Design

<table>
<thead>
<tr>
<th>Task</th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Words</td>
<td>4 syl.</td>
<td>4 syl.</td>
<td>4 syl.</td>
</tr>
<tr>
<td>Nonwords</td>
<td>4 syl.</td>
<td>4 syl.</td>
<td>4 syl.</td>
</tr>
</tbody>
</table>

Language/Speech Task Design

<table>
<thead>
<tr>
<th>Task</th>
<th>Block 1</th>
<th>Block 2</th>
<th>Block 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Speech</td>
<td>4 syl.</td>
<td>4 syl.</td>
<td>4 syl.</td>
</tr>
<tr>
<td>Nonwords</td>
<td>4 syl.</td>
<td>4 syl.</td>
<td>4 syl.</td>
</tr>
</tbody>
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Figure Legend
- Significance was evaluated after correcting for replications of each test across regions: n.s. p > 0.001, * p < 0.001, ** p < 0.01, *** p < 0.05.

Results
1. Which brain regions show significant activation during PWM (4 syl. > 1 syl. nonwords)?

2. Are these brain regions modulated during repetition of real words?

3. Do these brain areas respond significantly to language or verbal working memory?

4. How similar are the patterns of activation between nonword repetition and language or verbal working memory?

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