Neural Correlates of Phonological Sequencing
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Introduction

Left lateral frontal cortex is associated with both language and cognitive control. Recent studies have examined the role of control functions (e.g., selection) in language processing. We previously reported that patients with left frontal lesions, specifically to BA 44/6 extending dorsally to BA 44/6/9, are impaired in “selection for position,” or flexibly sequencing words [1]. A subsequent study found that these patients were impaired specifically in sequencing phonological (cf. semantic) representations [2]. The current study uses fMRI to further elucidate the neural basis of phonological sequencing. Specifically, we sought convergent evidence for the involvement of the posterior portion of the left inferior frontal cortex (BA 44/6) in selecting between phonological representations [1,2].

Methods

- 14 healthy, right-handed English-speaking adults (7 female, 19-35, mean age = 22.6).
- 2x2 design (syllables/words x concurrent/consecutive).
- Task: See 4-item sequences of syllables (la, ma, na) or words (log, map, net) presented concurrently or consecutively. Press corresponding buttons in correct order.
- 2 runs (1 syllable, 1 word counterbalanced across subjects). 2 blocks/run of each experimental task (ABBA order counterbalanced) and baseline task.

Results

- Behavioral Results:
  - Accuracy: Syll-Conc=84%, Syll-Conc=90%, Word-Conc=88%, Word-Conc=92%
  - Interference score (see 2) = ((Item 1 RT for concurrent – Item 1 RT for consecutive) + (Item 2 RT for concurrent – Item 2 RT for consecutive))/(Average RT for items 1 and 2 in consecutive)
  - Syllable interference score=4.48; t(1,13)=1.55, p=.15
  - Word interference score=7.96; t(1,13)=2.66, p<.05
  - Difference between the two scores ns

- Other ROI Analyses:
  - BA 45/47: Stim F(1,13)=3.59, p=.08 Syll=Word (less deactivated)
  - BA 21: Stim F(1,13)=3.66, p=.08 Syll=Word
  - BA 6: No Effects

Discussion

- Convergent evidence for involvement of left frontal/premotor junction in phonological sequencing. These ROIs showed Concurrent > Consecutive activation, consistent with their hypothesized role in selection amongst phonological representations [1,2].
- BA 40 profile similar to BA 44/6 ROIs. Consistent with the dorsal pathway’s role in phonological processing.
- More anterior inferior frontal region (BA 45/47) did NOT show this profile, suggesting potential sub-specialization.
- Future studies should extend these findings to more naturalistic sentence production paradigms.

References


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