Lexical Mediation of Reduplication Effects in Arabic Speakers: Implications for Associationist Accounts of Word Formation

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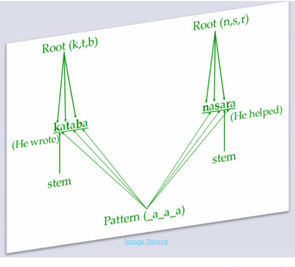
Significance

- Generativity, the ability to produce and comprehend novel forms, is the hallmark of both language and thought.
- Our goal is to understand how the ability to generate infinite forms shapes linguistic processing.

Background

- Rule account: The use of abstract rule or constraint knowledge (Chomsky and Halle, 1968),
- Analogy account: The use of analogy, similarity to stored tokens (Rumelhart & McClelland, 1988).
- The debate over these accounts has been mostly around the issue of phonological generalizations (see Berent (2001) for a review), specifically related to co-occurrence restrictions on Semitic roots.

The Structure of Semitic Roots



- Word = Root + Word Pattern
- There are constraints on copying (reduplication) within roots
  - ABB (e.g., jnn)
  - *AAB (e.g., *jjn)
- This generative behavior is explained by the obligatory contour principle (OCP (McCarthy, 1986).

Case Study

- **Berent (2002):** Hebrew speakers were faster at rejecting nonwords in the form of AAB compared to ABB.
- **Question**: What mechanism is responsible for assisting a speaker in knowing that a novel ABB form could be an acceptable root for a word, but AAB could not?
  - **H1**: Due to a rule use (OCP) (Berent, 2002).
  - **H2**: Due to the similarity to already existing ABB forms vs. no words to compare with for AAB forms.
- **Gow et al. (D22):** Neural decoding techniques were used to show that a bilateral set of temporal lobe regions stores reduplication patterns. These areas of the brain also encode wordform representations.

Predictions

- **Rule:** There will be an interaction between acoustic-phonetic processing ROI (pSTG) and hypothesized rule areas of the brain (frontal cortex (e.g., LIFG) ROIs).
- **Analogy:** There will be an interaction between the acoustic-phonetic processing ROI (pSTG) and wordform areas that are part of recognizing and producing words (e.g., dorsal and ventral lexica).

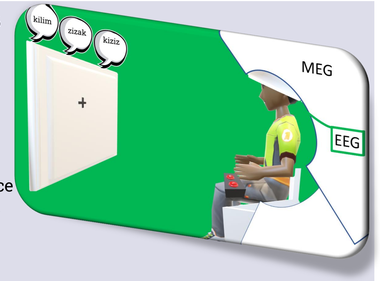
Method

Abstract Pattern	Example
ABB	kiziz, damum
AAB	zizak, mimad
ABC	hifiz, kilim

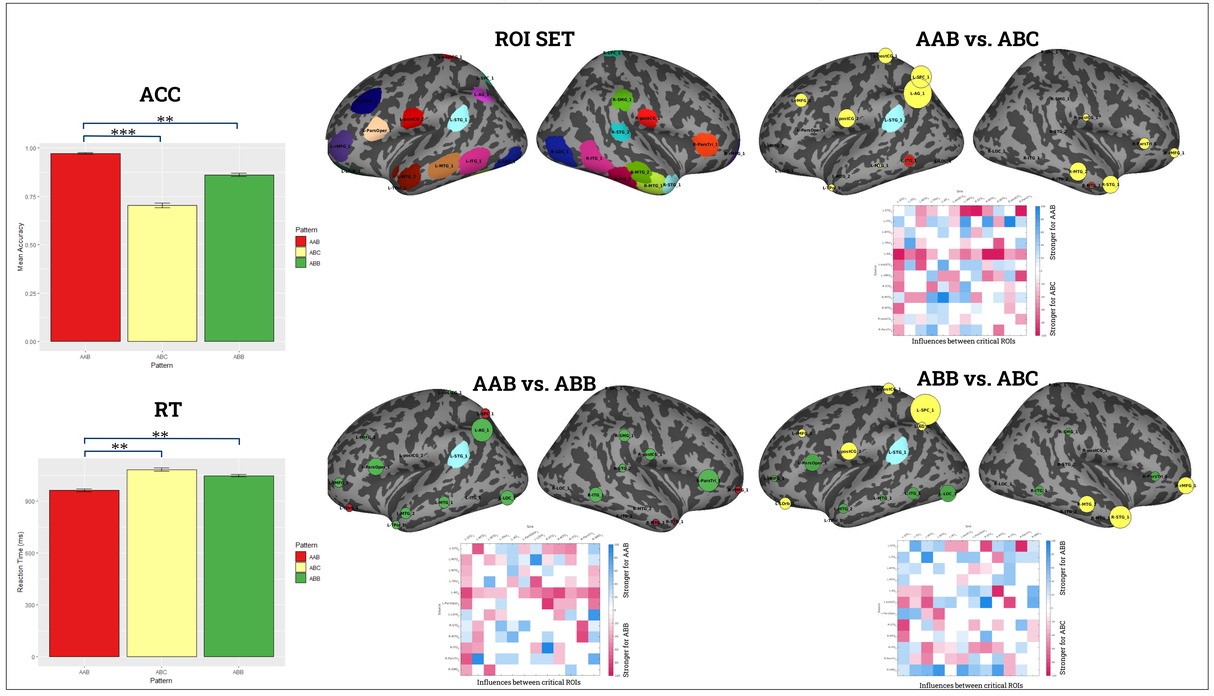
- 160 nonwords were recorded for each type of root pattern and all items were recorded by a native speaker of Modern Standard Arabic (MSA) who recorded 20 real Arabic words as well.
- Duration of all the stimuli was 500 ms.
- An auditory lexical decision task was used with 1160 trials. In each trial, native speakers of MSA heard a word or nonword and were asked to press one of two buttons to signify if they thought the item was a word or nonword.
- Reaction time and accuracy data were collected in the experiment.

Imaging

- Simultaneous MEG (306 channel) and EEG (70 channel) + 3T MRI anatomical data
- High spatiotemporal resolution MR constrained MEG/EEG minimum-norm estimates of source space activity over all cortical surfaces are created.



- Effective connectivity measured with ROI based Kalman-filter driven Granger Causality analyses were conducted using the GPS software package developed by our group (https://www.martinos.org/software/gps).
- Separate analyses were run for each pattern using a common set of data-defined ROIs.



Discussion & Conclusion

- We replicated the Berent (2002) results: our subjects were faster and more accurate at rejecting nonwords in the form of AAB compared to ABB. Surprisingly, they were slower and less accurate at rejecting nonwords in the form of ABC nonwords.
- Our ROI set was based on 5 subjects. Hopefully with more subjects we will have a more robust ROI set.
  - AAB-ABB: right temporal ROIs influence pSTG for AAB forms, whereas for ABB forms, left temporal, bilateral LIFG regions.
  - AAB-ABC: two ROIs in temporal areas influence pSTG for AAB forms, whereas for ABC forms, a bigger bilateral network.
  - ABB-ABC: left temporal and bilateral LIFG regions influence pSTG for ABB forms, whereas for ABC forms, bilateral control ROIs.
- Our preliminary results show that both wordform and hypothesized rule areas drive acoustic-phonetic processing in pSTG.

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