Two routes to silent meaning distinguished in the brain

E. Matthew Husband¹, and Fernanda Ferreira²

¹Faculty of Linguistics, Philology, & Phonetics, University of Oxford
²Department of Psychology, University of South Carolina

Introduction & Background

Main Questions
.

- The phenomenon: Some sentences assert implicit activities as part of their meaning.

  (1) a. The reporter started the article. (implicit activity: semantic)
  b. The reporter needed the article. (implicit activity: syntactic)

- The insight: Linguistic theory suggests that different computations underlie different neural pathways related to either semantic or syntactic processing.

Current Study
.

- Investigate whether semantic and syntactic enrichment rely on different neural pathways using functional MRI.

Background
.

In linguistics:

- Semantic Enrichment: Research has proposed that aspectual transitive constructions like (1) involve a silent semantic actor (Pustejovsky, 1995; Jackendoff, 1997).
- Syntactic Enrichment: Further research has proposed that intensional transitive constructions like (2) involve a silent syntactic subject (Larson, Didden, & Ludlow, 1996; Harley, 2003).

In psycholinguistics:

- Previous research has found semantic enrichment to be costly across a variety of techniques (Pilfango & Zurif, 2001; McElree, et al., 2011; Traxler, et al., 2002; Pylytkånen & McElree, 2007; Kuperberg et al., 2010; Husband, Kelly, & Zhu, 2011). Previous research has also found semantic enrichment to be costly (Delogu, Vespignani, & Sanford, 2010; Delogu & Vespignani, 2012).

- Syntactic Enrichment: Further research has proposed that intensional transitive constructions like (2) involve a silent syntactic subject (Larson, Didden, & Ludlow, 1996; Harley, 2003). Previous research has also found syntactic enrichment to be costly (Delogu, Vespignani, & Sanford, 2010; Delogu & Vespignani, 2012).

Results

Accuracy

- Control: 90.7%; Anomalous, 96.8%; Semantic Enrichment, 84.4%; Syntactic Enrichment, 81.0%

Whole Brain Analysis

- Images are thresholded using clusters determined by z>2.3 and a (corrected) cluster significance threshold of p<0.05.

Semantic Enrichment - Control

Cortical Surface

Glass Brain

Syntactic Enrichment - Control

Cortical Surface

Glass Brain

General Methods

Subjects

- 13 native monolingual English speakers, right handed, no history of neurological impairment.

Materials

- 84 items (336 stimuli total).

Control condition verbs were normed to be the most likely to be the most frequent implicit activity provided.

Condition Sentence

<table>
<thead>
<tr>
<th>Control</th>
<th>Sentence</th>
<th>Semantic Enrichment</th>
<th>Syntactic Enrichment</th>
<th>Syntactic Anomaly</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Semantic Enrichment</td>
<td>The novelist wrote the book.</td>
<td>The novelist wrote the book.</td>
<td>The novelist began the book.</td>
<td>The novelist wanted the book.</td>
</tr>
</tbody>
</table>

Presentation

- Sentences were presented word-by-word using rapid series visual presentation. 400 msec/content word, 300 msec/function word, 100 msec ISI.

- All sentences were followed by an acceptability judgment.

Apparatus and Recording

- fMRI: echo planar imaging on a Siemens 3T scanner (8 channel head coil, 36 slices, 35 msec TE, 2150 msec TR, 90° flip angle, 208 mm FOV, 64x64 matrix).

Analysis

- fMRI preprocessing/analyses were conducted in FSL.

Preliminary ROI Analysis

Two Routes Distinguished

- Semantic enrichment (vs. control) sentences elicited increased activity in LIFG but not LAG.
- Core semantic processes recruit LIFG.
- LAG may not underlie core semantic processes (Husband, Kelly, & Zhu, 2011).

Summary & Conclusions

- Syntactic enrichment (vs. control) sentences elicited increased activity in LIFG, LATC, and ACC.
- Syntactic enrichment recruits a broader network, including LATC, an area underlying syntactic processes (Humphries, et al., 2010).
- ACC may reflect enhanced sensitivity to syntactic cues of an initial mismatch error.
- An increase in study power should reveal continuing significant effects.

Conclusions

- Not all inferences are created alike.

- Different underlying computations revealed though linguistic analysis systematically lead to different routes to meaning.

References


http://sites.google.com/site/embhusband/matthew.husband@ling-phil.ox.ac.uk ferreirf@mailbox.sc.edu