What can linguists do for the brain and vice versa?

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Syntax? Phenology? Semantics?

Bill the brain scientist

Larry the linguist
Syntax?  Phonology?  Semantics?

Bill the brain scientist

Larry the linguist
• Huge pressure in every branch of Psychology to engage with the brain sciences.

• If the cognitive neuroscience of language has nothing to do with Linguistics, Linguistics will be in trouble.
The harsh reality

- Bill is not about to become a linguist (Bill is not unhappy).
- It is on Larry to show Bill that Linguistics can make him even happier (i.e., a better brain scientist).
How to impress Bill the brain scientist

• Write in way that Bill can understand.
  – General cognitive science and psychology journals should publish the most important work in Linguistics.

• Collaborate with Bill.

• Lead by example. Get sufficiently cross-trained to be able to marry Linguistics and brain science yourself.
Linguist enters cognitive neuroscience: The lay of the land

• Words don’t mean what you think they do.
  – E.g., “semantics” ≠
    the representations and computations by which an interpretation is constructed for an expression
    but rather “semantics” =
    either distinctions such as tools vs. animals or world knowledge

• Focus on tasks (e.g., localizing judgments about rhyme vs. plausibility) as opposed to breaking down the language system into subcomputations as given by a cognitive model.
• Bill has done a lot of studies on “syntax” and “semantics” but one is almost always confounded by the other.
Questions in a theoretically grounded cognitive neuroscience of syntax & semantics

• Are syntactic and semantic composition empirically dissociable computations to begin with?
  – If they are, still, how would you go about dissociating them, given compositionality?

• Within semantic composition, do formal rules such as predicate modification and function application correspond to distinct neural computations?
Can we isolate a brain index of (some type of) semantic composition?

In MEG

• Vary semantic composition while keeping syntactic structure maximally constant.
  – A variety of typemismatch/coercion expressions

• Anterior Midline Field (AMF) activity localizing in ventromedial prefrontal cortex (vmPFC) systematically enhanced for typemismatch expressions.

Pylkkänen, Brennan, & Bemis, 2011, LCP
Can we isolate a brain index of (some type of) semantic composition?

• Is this activity reflective of (a) mismatch resolution specifically or (b) composition more generally?

Pylkkänen, Brennan, & Bemis, 2011, LCP
Intersecting nouns and adjectives

- VmPFC not tied to mismatch resolution.
- Left anterior temporal lobe (LATL)?
  - Large prior literature implicating the LATL for some aspect of sentence comprehension.
  - Baron & Osherson, 2010: Conceptual combination

Bemis & Pylkkänen, 2011, *Journal of Neuroscience*
## Predicate modification vs. function application in MEG

<table>
<thead>
<tr>
<th>Modification</th>
<th>Argument Saturation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Adjective-Noun</strong></td>
<td><strong>Verb-Noun</strong></td>
</tr>
<tr>
<td><strong>Adverb-Verb</strong></td>
<td><strong>very soft</strong></td>
</tr>
<tr>
<td><strong>Adverb-Adjective</strong></td>
<td><strong>black sweater</strong></td>
</tr>
</tbody>
</table>

### Figure

- **Modification** vs. **Argument Saturation** by subtype.
- **Two word** vs. **One word** comparisons.

*Westerlund & Pylkkänen, 2011 Neurobiology of Language Conference.*
Predicate modification vs. function application in MEG

- LATL effect restricted to predicate modification and general across different instances of PM.
- Ventromedial effect observed for both.
- No general effect of function application.

Westerlund & Pylkkänen, 2011 Neurobiology of Language Conference.
Syntax and semantics dissociate in both time and space in ways that is at least partially compatible with extant factorial results.
Bill and Larry happily ever after?

- A lot of work remains to be done before Linguistics is seamlessly integrated into the cognitive neurosciences.
- The clearly defined operations of Linguistic Theory hold the promise of making cognitive neuroscience better cognitive science.
- For the linguist, there are no short cuts. The brain is not going to give linguists quick diagnostics to decide between theories, but ultimately, understanding the brain bases of the computations we talk about and understanding their relations to similar computations in other domains should be transformative to Linguistics.
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