What can linguists do for the brain and vice versa?

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Syntax?

Phonology?

Semantics?

Bill the brain scientist

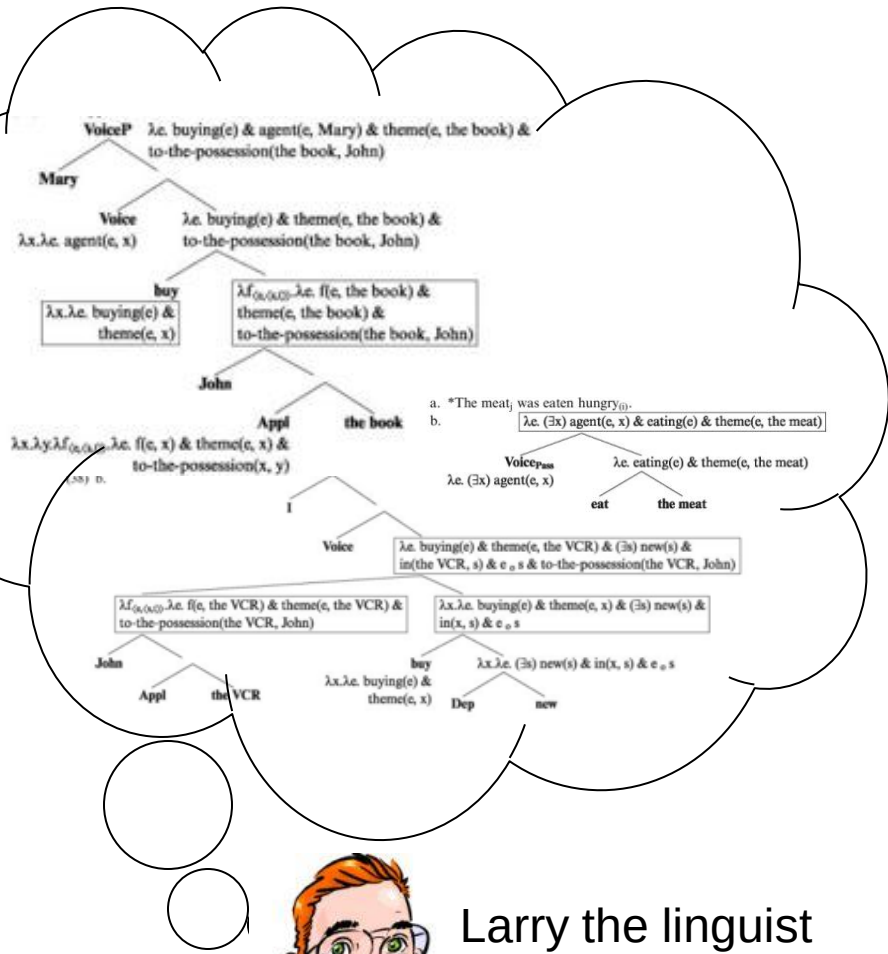
Larry the linguist

Syntax?

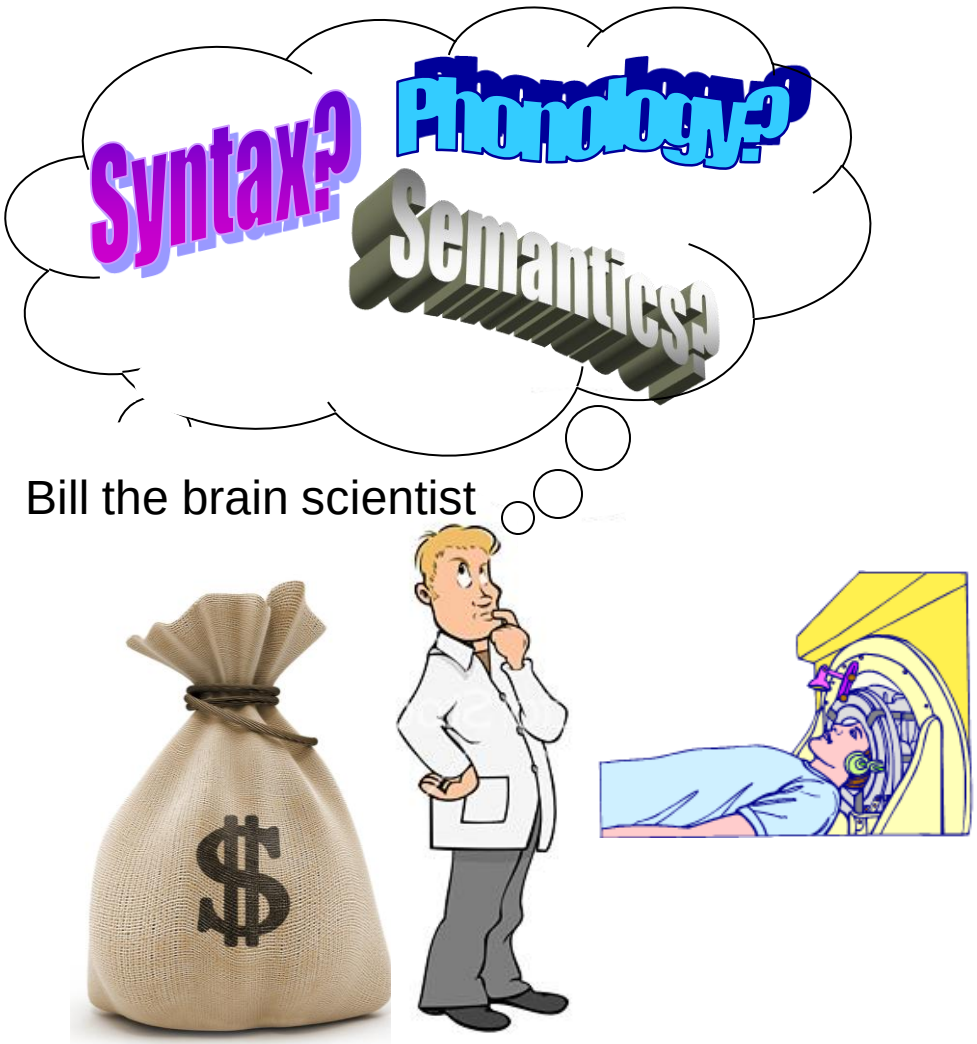
Phonology?

Semantics?

Bill the brain scientist

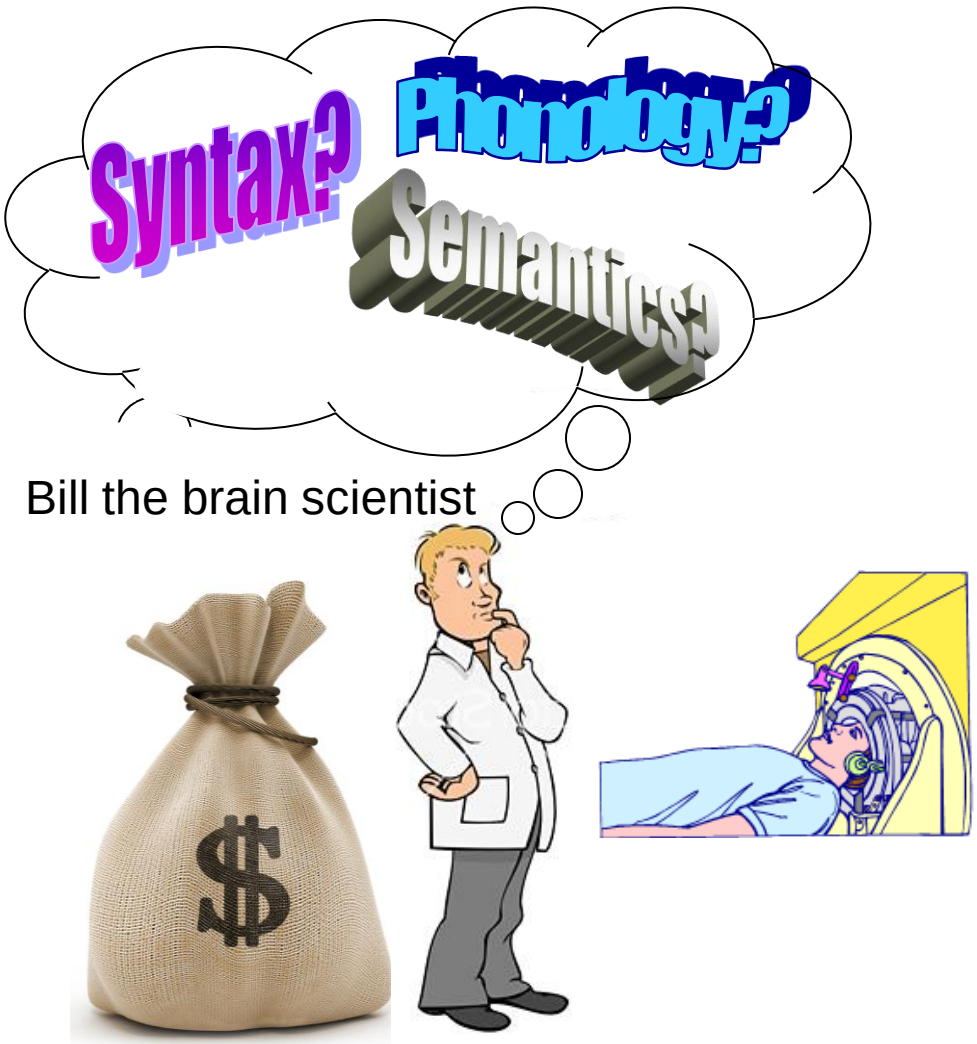


Larry the linguist



- 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 $Bill_i$ that Linguistics can make him_i even happier (i.e., a better a 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

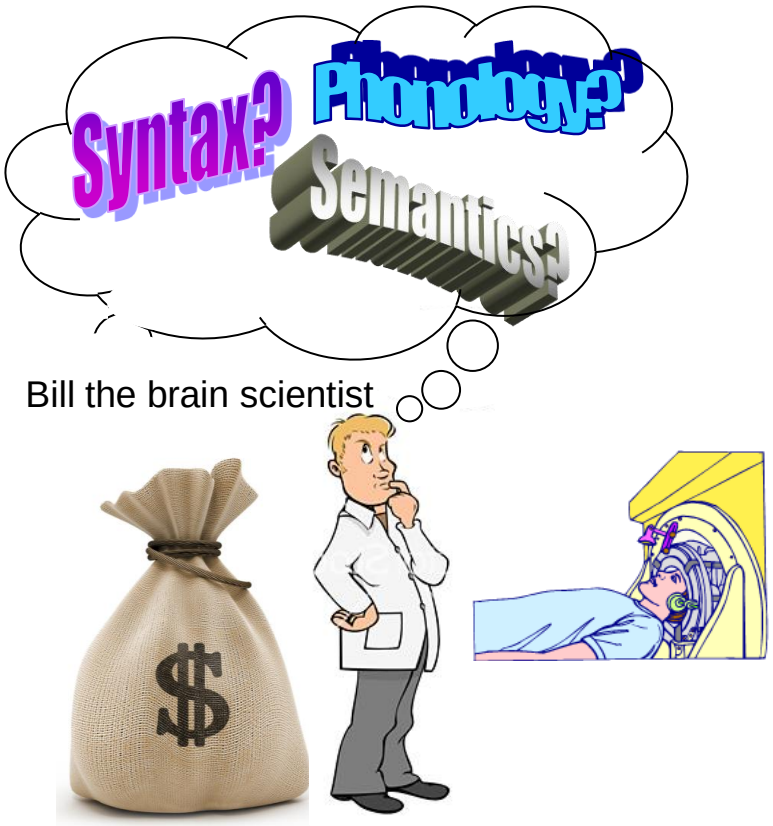
- Words don't mean what you think they do.
  - E.g., "semantics" ≠

    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.



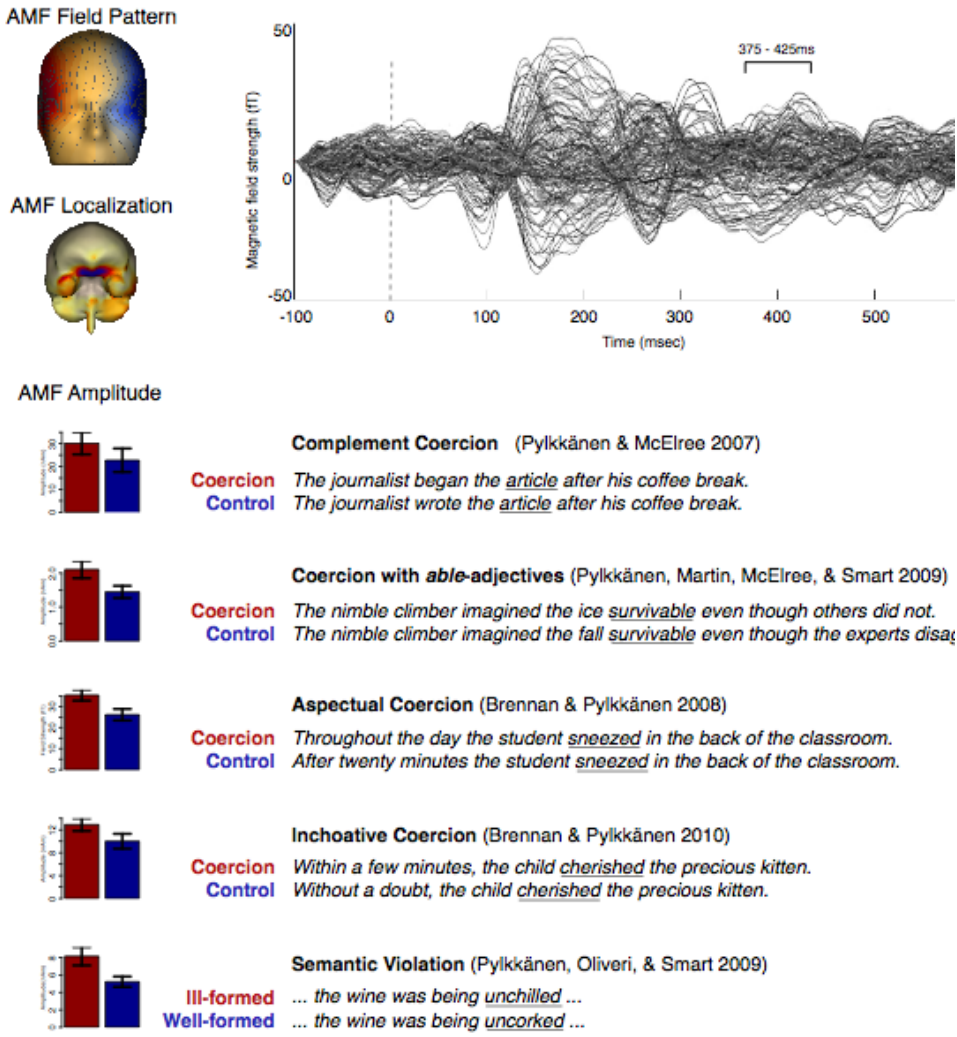
Questions in a theoretically grounded cognitive neuroscience of syntax & semantics

- 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

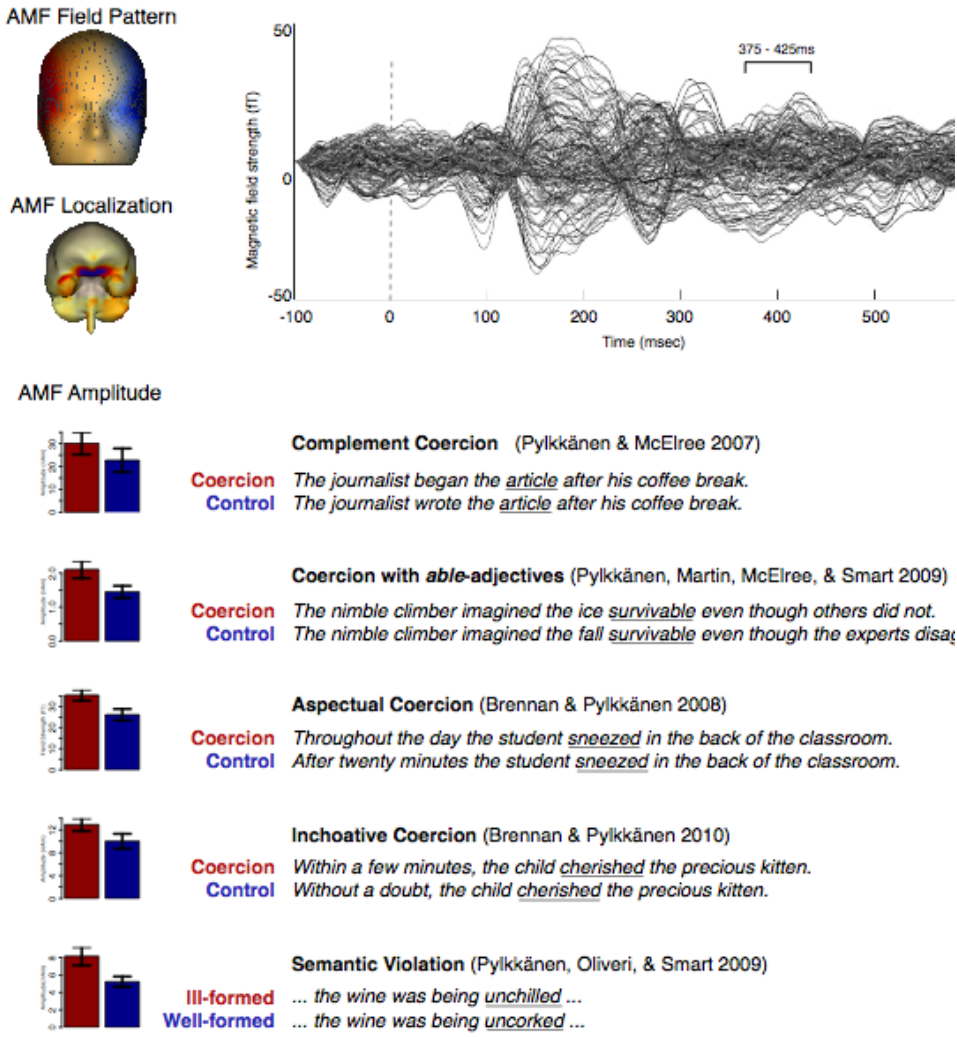
- Vary semantic composition while keeping syntactic structure maximally constant.
  - A variety of typemismatch/coercion expressions
- Anterior Midline Field (AMF) activity localizing in ventromedial prefrontal cortex (vmPFC) systematically enhanced for typemismatch expressions.



Pylkkänen, Brennan, & Bemis, 2011, *LCP*

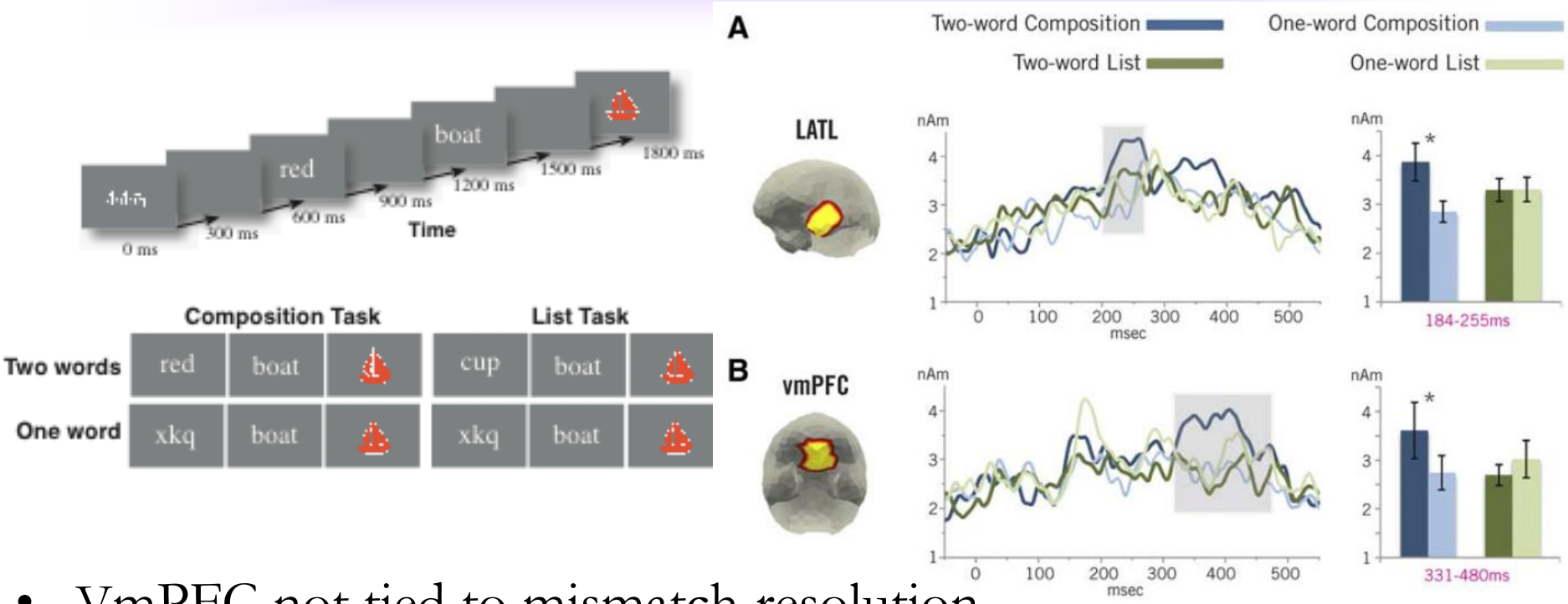
Can we isolate a brain index of (some type of) semantic composition?

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



Pylkkänen, Brennan, & Bemis, 2011, *LCP*

Intersecting nouns and adjectives

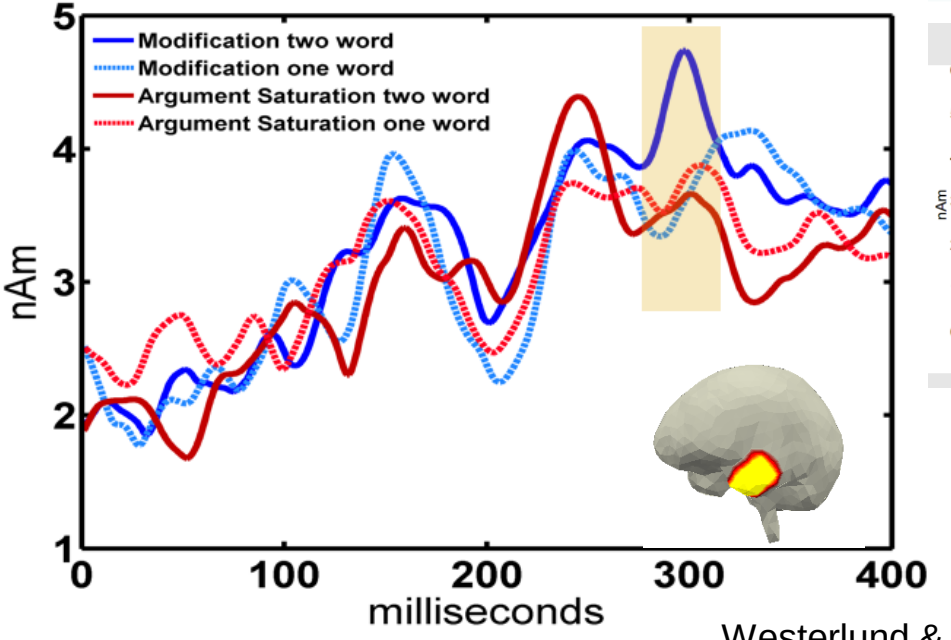


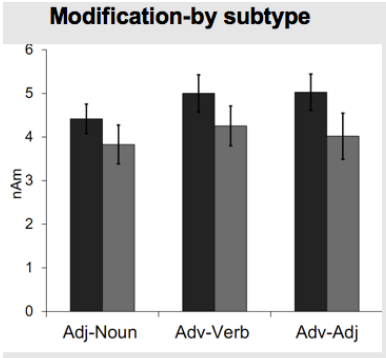
- VmPFC not tied to mismatch resolution.
- Left anterior temporal lobe (LATL)?
  - Large prior literature implicating the LATL for some aspect of sentence comprehension.
  - Baron & Osherson, 2010: Conceptual combination

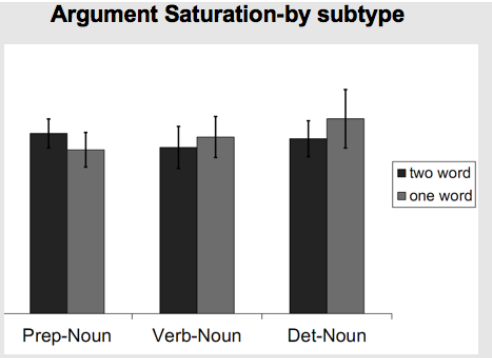
Bemis & Pylkkänen, 2011, *Journal of Neuroscience*

Predicate modification vs. function application in MEG

	Modification			Argument Saturation		
	Adjective-Noun	Adverb-Verb	Adverb-Adjective	Verb-Noun	Preposition-Noun	Determiner-Noun
Two word	black **sweater**	never **jogged**	very **soft**	eats **meat**	in **Italy**	Tarzan's **vine**
One word	rkgjg **sweater**	nhcny **jogged**	rmwz **soft**	trwq **meat**	xq **Italy**	fkbczswh **vine**



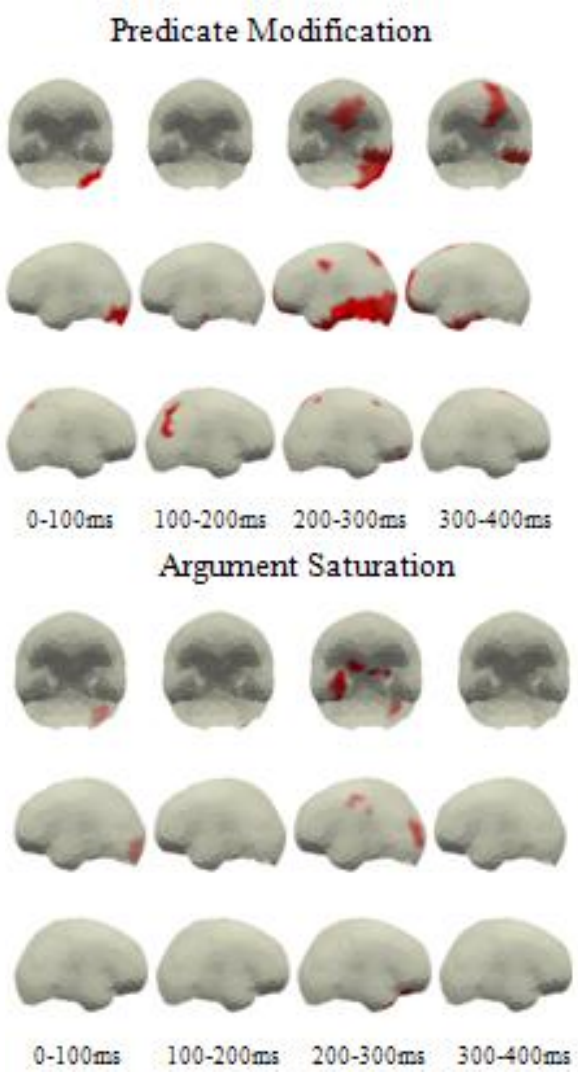




Westerlund & Pylkkänen, 2011 Neurobiology of Language Conference.

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.



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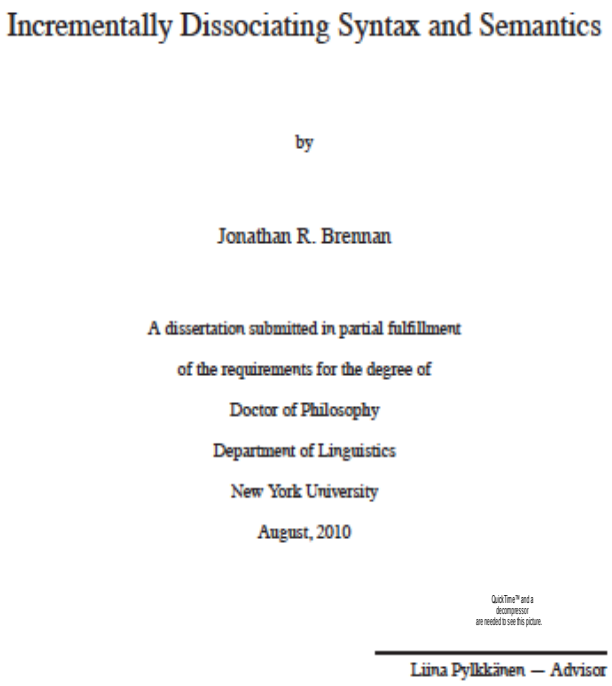

Incrementally Dissociating Syntax and Semantics

by

Jonathan R. Brennan

A dissertation submitted in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

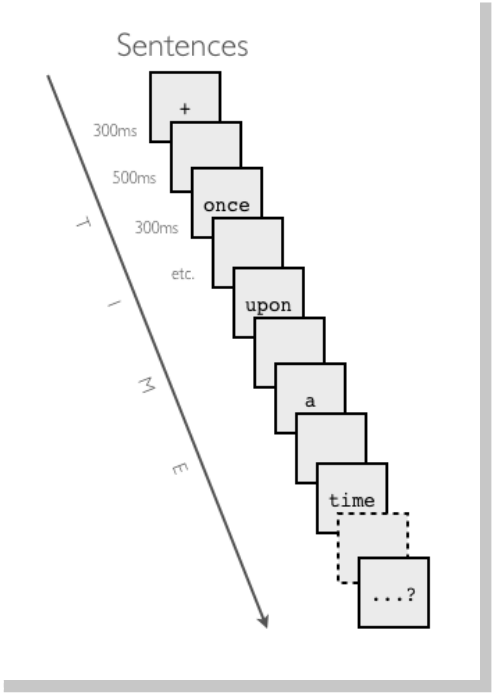
Department of Linguistics

New York University

August, 2010

QuickTime™ and a decompressor are needed to see this picture.

Liina Pylkkänen — Advisor

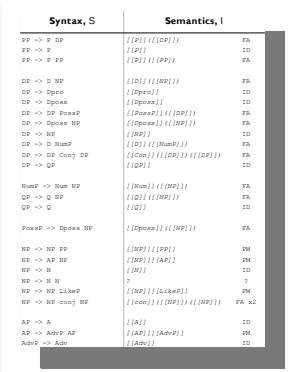


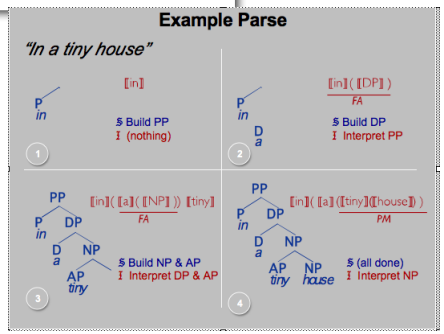
Stabler's 1991 Non-Pedestrian Algorithm

Given a set of lexical items L, a set of syntactic rules S, a set of semantic rules I, and a list T consisting of lexical items drawn from L,

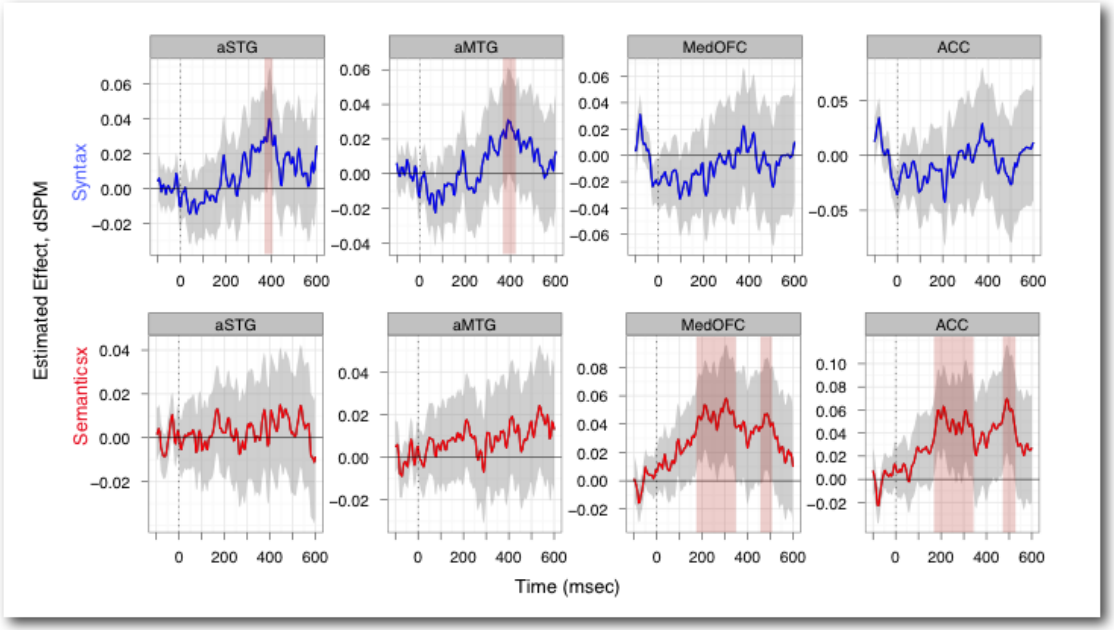
Where *Word* is a variable over lexical items,
And *moveOn* is a boolean variable with an initial value of FALSE,

For each *Word* in the input list T, moving from left to right,
  Until *moveOn* is TRUE
    If a rule from I can be applied, do so
    Else, if a rule from S can be applied, do so
      Else, add information for the lexical item in L that corresponds to *Word*
      And set *moveOn* to TRUE
  End Until
End For

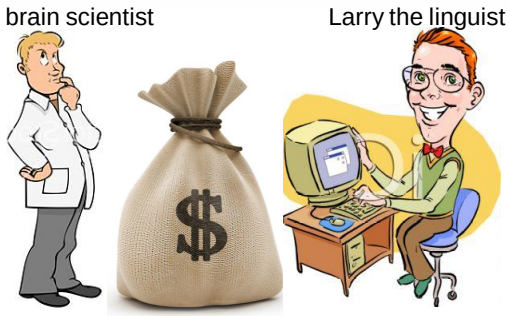




Syntax and semantics dissociate in both time and space in ways that is at least partially compatible with extant factorial results.



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.

THANK YOU

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