NEURAL CORRELATES FOR SILENT MEANING

INTRODUCTION & BACKGROUND

- Complement coercion is a sentence-level semantic process in which an event-selecting verb (begin) coerces the meaning of its complement noun from an entity to an event. [1,2]
- Allows the verb to compose with its complement.
- Reflectively contributes implicit meaning to the sentence.
- Does not involve violation of grammaticality or selectivity.

PREVIOUS RESEARCH

- Studies using reading times [3-4], eye movements [4,5], speed-accuracy trade-off [6], ERP [7], and MEG [8] find a processing cost for coercion.
- ERP: N400 effect with even scalp distribution.
- MEG: Anterior Midline Field originating from ventromedial prefrontal cortex (vmPFC).

CORTICAL NETWORK FOR SEMANTICS

Middle Temporal Gyrus (MTG)
- lexical selection, lexical activation

 Inferior Frontal Gyrus (IFG)
- lexical selection, controlled retrieval

Anterior Temporal Cortex (ATC)
- basic combinatorics, contextual integration


CURRENT STUDY

- What are the underlying neural correlates of complement coercion? How does complement coercion map onto the known cortical network for semantics?
- Investigated the neural response to complement coercion using event-related functional MRI.

METHODS

- 19 controls (7 male, 20.5 ± 2.79 years), 4 conditions (224 items).
- Control verbs normed to be most frequent in Saby began to V IP and frequency matched (COBUILD frequencies, Control: 460, Coercion: 554; rt(221)=1.703, p=0.09)
- Sentences presented word-by-word (300ms content word, 200ms function word, 100ms ISI). Subjects made an acceptability judgment after completing each sentence.
- Echo planar imaging on a 3T GE Signa EXCITE scanner, 8-channel head coil (34 contiguous 3mm axial slices, 27.7ms TE, 2500ms TR, 80° flip angle, 22cm FOV, 64x64 matrix and ramp sampling). Deconvolution and ANOVAs using AFNI.

RESULTS

- Subjects accepted coercion and control (1,2) and rejected semantic and syntactic violations (3,4) with 80% or higher accuracy.

Coercion - Control

Grammatical - Ungrammatical

Brain Region /L Volume (mm³) Mean r-value Mean r-coordinate % syng. Critr

Coercion

Control

MTG

BA 45 L 113 3.62 (99 - 22.10) 1.14 0.78 AG L 554 3.85 (65, 60) -0.14 -0.37

IFG L 384 3.55 (99, 22.10) 1.10 0.79 IPL L 624 3.76 (29, 30, 57) -0.22 -0.07

MDD L 220 5.88 (31, 35, -9) 0.21 0.42 MTG L 1418 3.73 (45, 65, -29) -0.07 -0.17

SPL L 256 -3.59 (36, 53, 59) -0.15 0.16 SFG L 427 3.59 (6, -58, 23) -0.06 -0.53

AG R 346 3.96 (45, 65, 52) -0.08 -0.42

MTG L 355 3.96 (65, 65, 28) -0.19 -0.36

CONCLUSIONS

- Coercion processes differentially activate a subset of neural regions thought to be involved in semantic processing.

CENTRAL ROLE OF IFG

- Increased differential IFG activity in coercion may reflect:
  - Detection of compositional errors
  - Deeper processing of the semantic relationship between the event verb and complement noun.
  - Controlled retrieval of lexical (qualia [11]) structure.

OTHER NEURAL DIFFERENCES

- Reduced differential MTG (and SPL/IPL) activity may reflect lexical frequency and ease of lexical access from priming.

COMPOSITIONALITY VS. VIOLATION

- Regions thought to be involved in combinatorial and contextual processing are not differentially affected by coercion processes.
- Appear to be more related to grammaticality and selectivity, not compositionality.

REFERENCES & ACKNOWLEDGEMENTS


Coercion - Control

Increased differential activity: L IFG.
- Decreased differential activity: L MTG, L IPL.

Grammatical - Ungrammatical

Increased differential activity: L/R AG, L ATC.

Signa-to-noise ratio

Location of vmPFC, coordinate (0, -49, 36) [8]

Materials

(1) Coercion Condition: The novelist began the book before break.
(2) Control Condition: The novelist wrote the book before break.
(3) Semantic Violation: The novelist annoyed the book before break.
(4) Syntactic Violation: The novelist wrote the book before break.