Is Left-Hemisphere Fronto-Temporal Connectivity Essential for Syntax?

Previous research:
- Syntax is supported by Left Inferior Frontal Gyrus (LIFG) & Left Posterior Middle/Inferior Temporal Gyrus (LpMTG) (Caplan et al., 1996; Tyler & Marslen-Wilson 2008; Tyler et al., 2010).
- In healthy controls, syntax involves increased connectivity between LIFG and LpMTG and other Left and Right hemisphere regions (Snipker et al., 2010).
- Studies with patients demonstrate which connections are essential for syntactic processing.

Present fMRI study:
- Examined the role of LF fronto-temporal connectivity in syntax using psychophysical interactions (PPI).
- Performed task-related effects using PASSIVE listening to spoken sentences varying in syntactic ambiguity & preference of disambiguation.
- Tested LH brain-damaged patients with variability in lesion location & syntactic processing ability.
- Correlated effective connectivity estimates with syntactic performance.

Aim: Determine which cortical connections are ESSENTIAL for preserved syntactic processing.

Materials

Participants:
- 14 LH brain-damaged patients, 15 matched controls.
- Patient group varied in:
  - Lesion location
  - Syntactic processing ability

Stimuli: Sentences varied in:
- Syntactic ambiguity: Ambiguous and Unambiguous
- Disambiguation preference: High (Dominant) and Low (Subordinate)
- DOM: No difference between dominant-ambiguous and subordinate sentences.
- SUB: Temporary conflict between preferred and observed disambiguation. Need for additional syntactic processing.

Measure of Syntactic Performance:
- Out-of-order Acceptability Judgement Task:
  - Stimuli in ERP study
  - All stimuli had acceptable continuations
  - Filled with unacceptable continuations

Behavioural Results

Patient Group Characteristics:
- Variability in syntactic processing capacity.
- Minimum semantic processing deficits.

Ambiguity task: Acceptability Judgement
- Control and patient group: similar response patterns
- Individual patients: variability in performance.

Imaging Methods

Background Tests

Effective Connectivity

Control-Group Results

FMRl Results: Controls

Which cortical connections support syntactic processing?

A. DOM - UNAMB: sentences disambiguation is consistent with preferred meaning.
   Prediction: No difference between DOM and UNAMB sentences.
   Results: H. G.

B. SUB - UNAMB: Disambiguation is consistent with preferred meaning leading to increased syntactic processing.
   Prediction: Increased LH fronto-temporal connectivity.
   Results: 1. LIFG * LpMTG predicts.
   2. RIFG * LpMTG predicts.

Patients

Which cortical connections are ESSENTIAL for syntax?

Correlation of Connectivity Estimates with Performance

A. DOM - UNAMB: Patients with syntactic impairment will show no behavioural difference.
   Prediction: Disruption of fronto-parietal-temporal connectivity correlates with reduced DOM-UNAMB differences (repaired syntax).
   Results: LIFG * LpMT predicts.

B. SUB - UNAMB: Patients with syntactic impairment will NOT show any difference and will perform additional syntactic analysis.
   Prediction: Disruption of fronto-parietal-temporal connectivity correlates with syntactic impairment (reduced SUB-UNAMB differences).
   Results: LIFG * LpMT predicts.

Summary

Healthy Controls:
- Syntactic re-analysis leads to increased effective connectivity within LH.
- A fronto-parietal-temporal network incl. LIFG, LpMTG, and LpMTG.

Patients:
- Decreased fronto-parietal-temporal connectivity correlates with impaired syntactic processing.

Conclusion:
- Fronto-parietal-temporal connectivity, predominantly in LH, is ESSENTIAL for preserved syntactic processing and damage to the network leads to syntactic processing deficits.