Is Broca’s area essential for syntax?

- Role of Broca’s area (left BA 44, 45, 47) in syntax hotly debated
  - Variability in sub-regions claimed to be involved in syntax
  - Broca’s area involved in phonology and/or semantics as well?
  - Broca’s area involved in domain general processes?
  - Issues not resolved by means of neuropsychological or fMRI data alone
  - Need to combine measures of syntactic comprehension, neural integrity and neural activity in patients with LH damage to determine which brain regions are essential for preserved syntactic comprehension

Current study

- Combines these methods using patients with LH damage and a range of syntactic deficits
- Variability in lesion location and syntactic performance essential

If LIFG is essential for syntax ...

- Activity in LIFG will correlate with performance
- Damage to LIFG will impair performance
- Recruitment of extra regions will not preserve performance

Participants

- Chronic patients with left hemisphere injury:
  - n=14, 3F, age 34-77
- Controls, healthy, right-handed, native British English speakers: n=15, 8F, age 46-74

Imaging paradigm

- Participants listened attentively to sentences that varied in syntactic ambiguity
  - Passive listening avoids task-related modulation of IFG (Wright et al, 2011)
  - Manipulating syntactic ambiguity avoids complexity / working memory effects
- All sentences were grammatical: no violation-related activity

Unambiguous sentences (UNAMB):
- “John knew that gambling gangsters”
- “The boy chased the horse”

Ambiguous sentences (AMB):
- “John knew that gambling gangsters”
- “The boy chased the horse”

DOM: the preferred continuation of the ambiguous phrase

Sub: requires syntactic reanalysis to overturn the preferred reading

AMB-UNAMB: overall effect of ambiguity, handling multiple possible interpretations

SUB-DOM: effect of overturning the preferred interpretation

42 items per condition, 126 fillers, 42 non-speech baseline stimuli

Imaging

- Rapid event-related presentation; jittered interstimulus interval; 3x15 min functional scans
- Functional: continuous EPI, TR = 2s, TE = 30ms, voxel size = 3x3x3mm (0.75 gpa)
- Structural: T1-weighted MPRAGE, voxel size = 1 mm³
- fMRI analysis (SPM5): slice time correction, re-alignment, unified segmentation normalisation, 8m isotropic smoothing kernel, FFXT GLM = RFX t-tests and correlations
- VBM analysis (SPM5): structural images normalised, skull stripped and smoothed, RFX multiple regression against behavioural scores (global mean signal as confound)