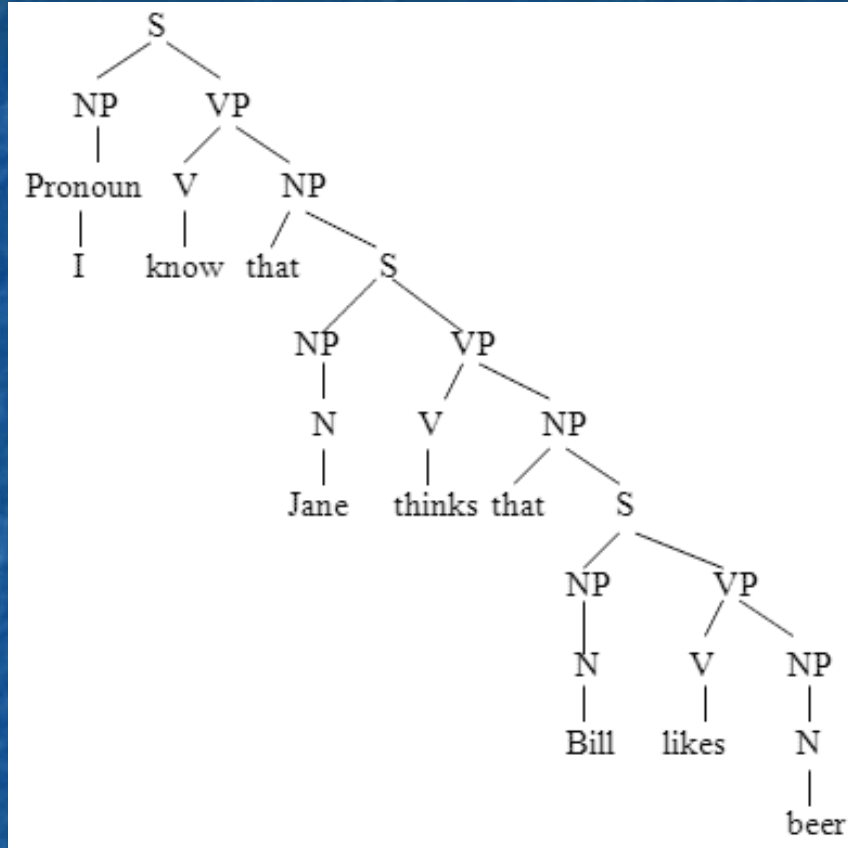


Cognitive Neuroscience of Language:

14: Syntax and the normal brain

Richard Shillcock

Goals



Look at how syntax is processed in the brain and assess the claim regarding the autonomy of syntax. Is syntactic processing distinguishable from semantic processing?

Reading

Friederici, A.D., Bahlmann, J., Heim, S., Schubotz, R.I., & Anwander, A. (2006). The brain differentiates human and non-human grammars: Functional localization and structural connectivity. *PNAS*, *103*, 2458–2463.

Hagoort, P. (2003). Interplay between Syntax and Semantics during Sentence Comprehension: ERP Effects of Combining Syntactic and Semantic Violations. *Journal of Cognitive Neuroscience*, *15*, 883–899.

Psycholinguistics and the study of syntactic processing

The horse raced past the barn fell

The old man the boats

The study of ambiguity and garden-pathing

Principle-based, constraint-based, exposure-based models

Perception versus production

Listening versus reading ...

Psycholinguistics and the study of syntactic processing

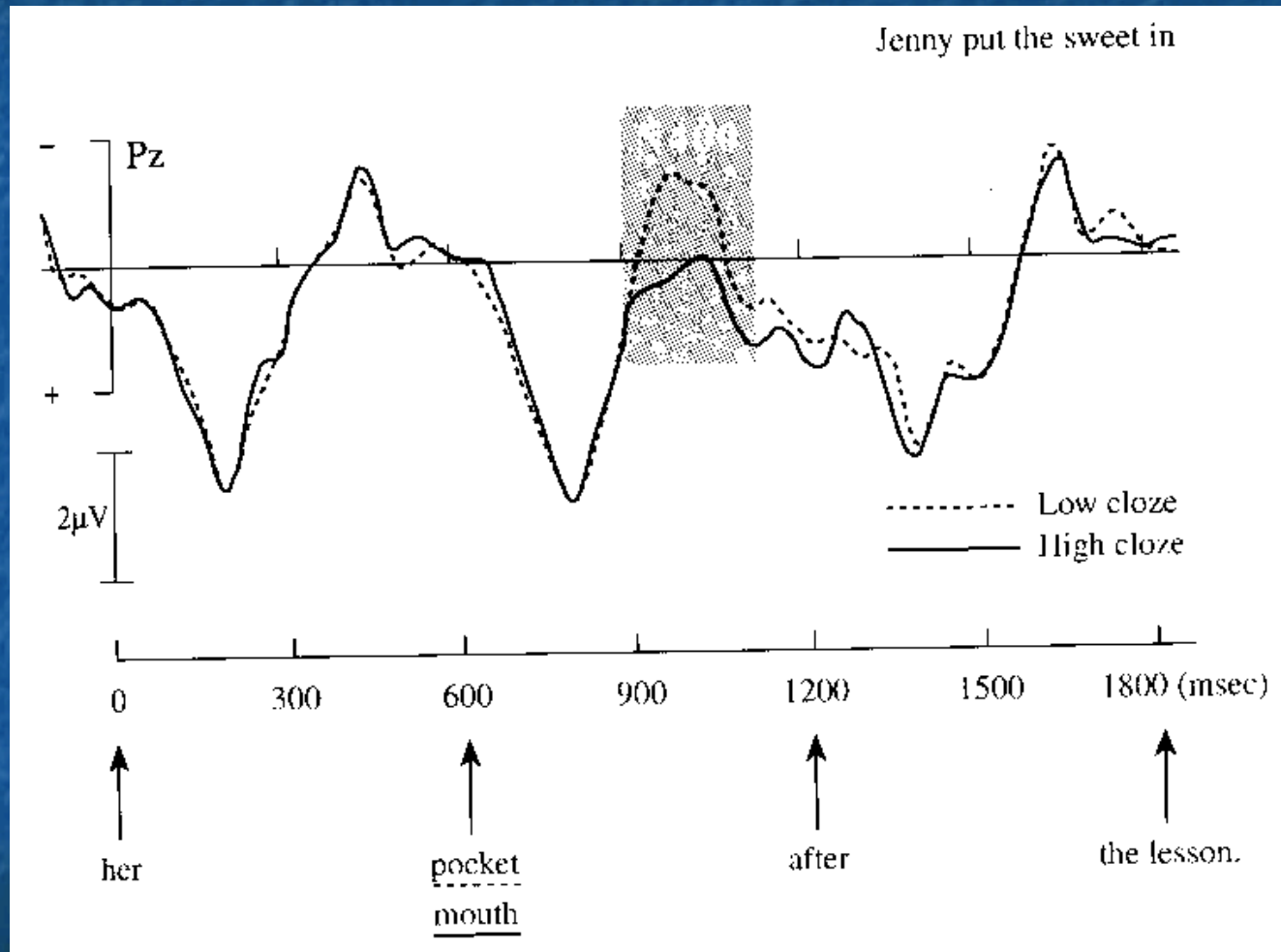
General versus dedicated memory resources

The status of different types of information

Independent syntactic output

The N400 effect

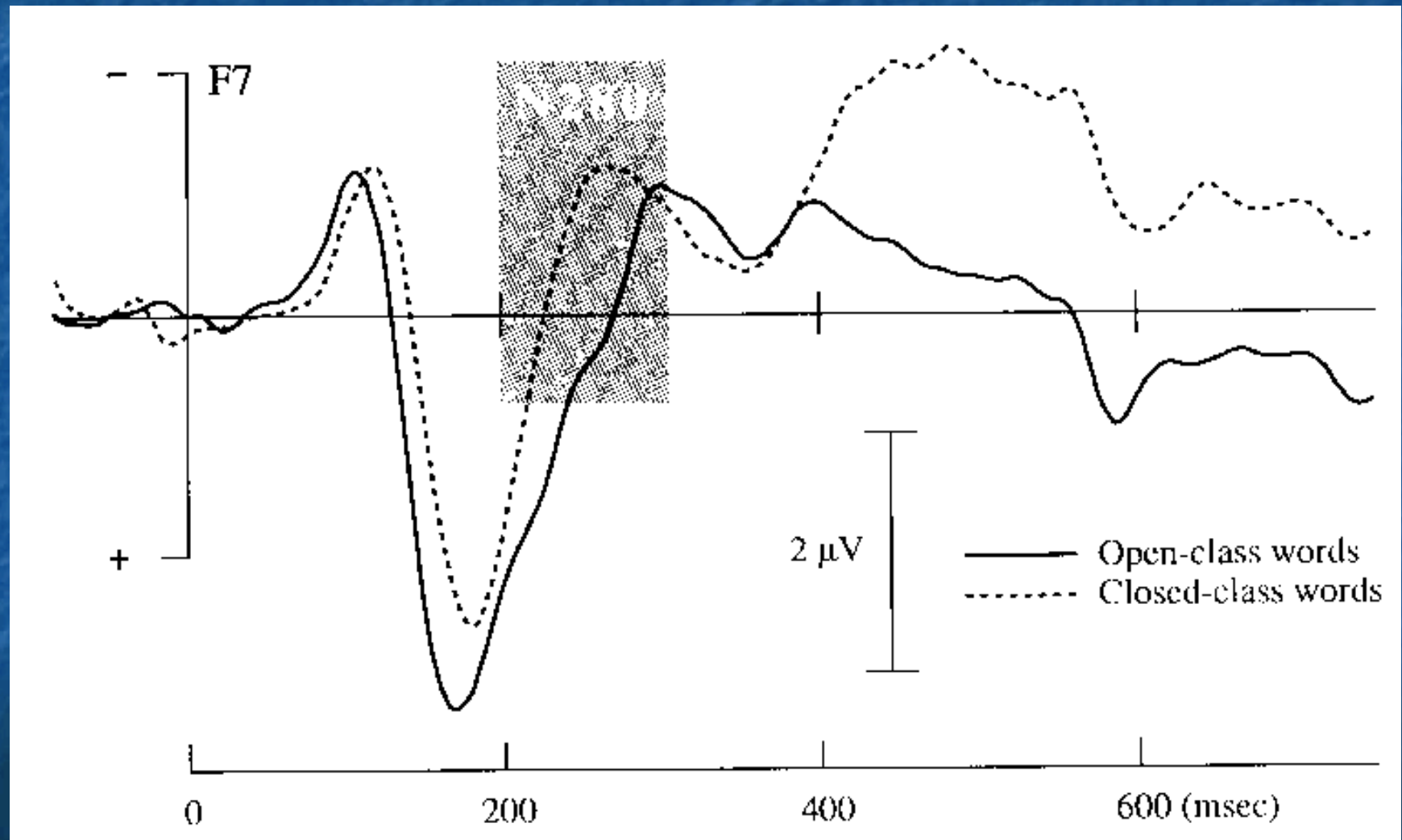
Hagoort & Brown (1994)



Distinct from Left Anterior Negativity (LAN) effects 6

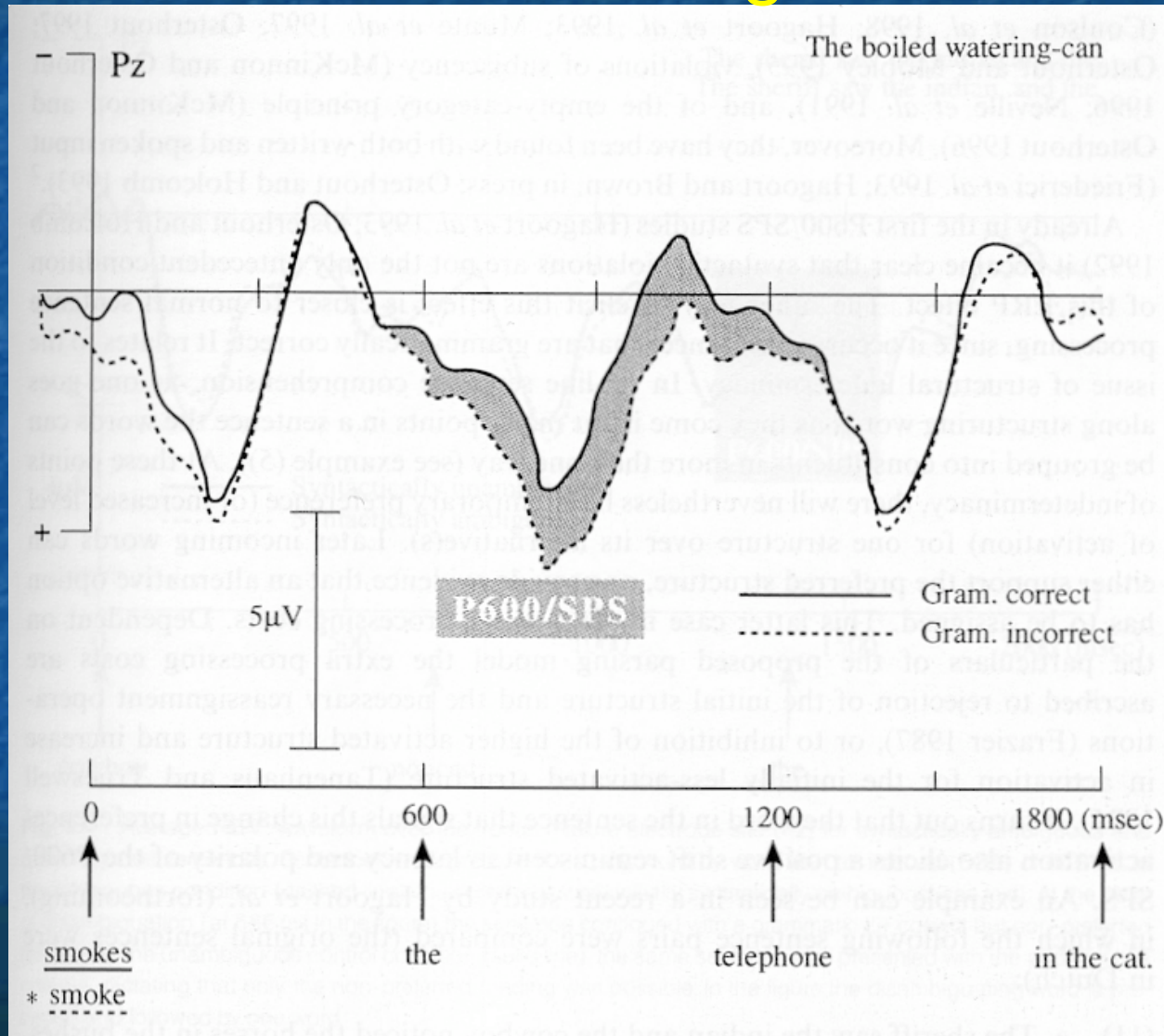
Open/closed class difference?

Brown, Hagoort & ter Keurs (1999)

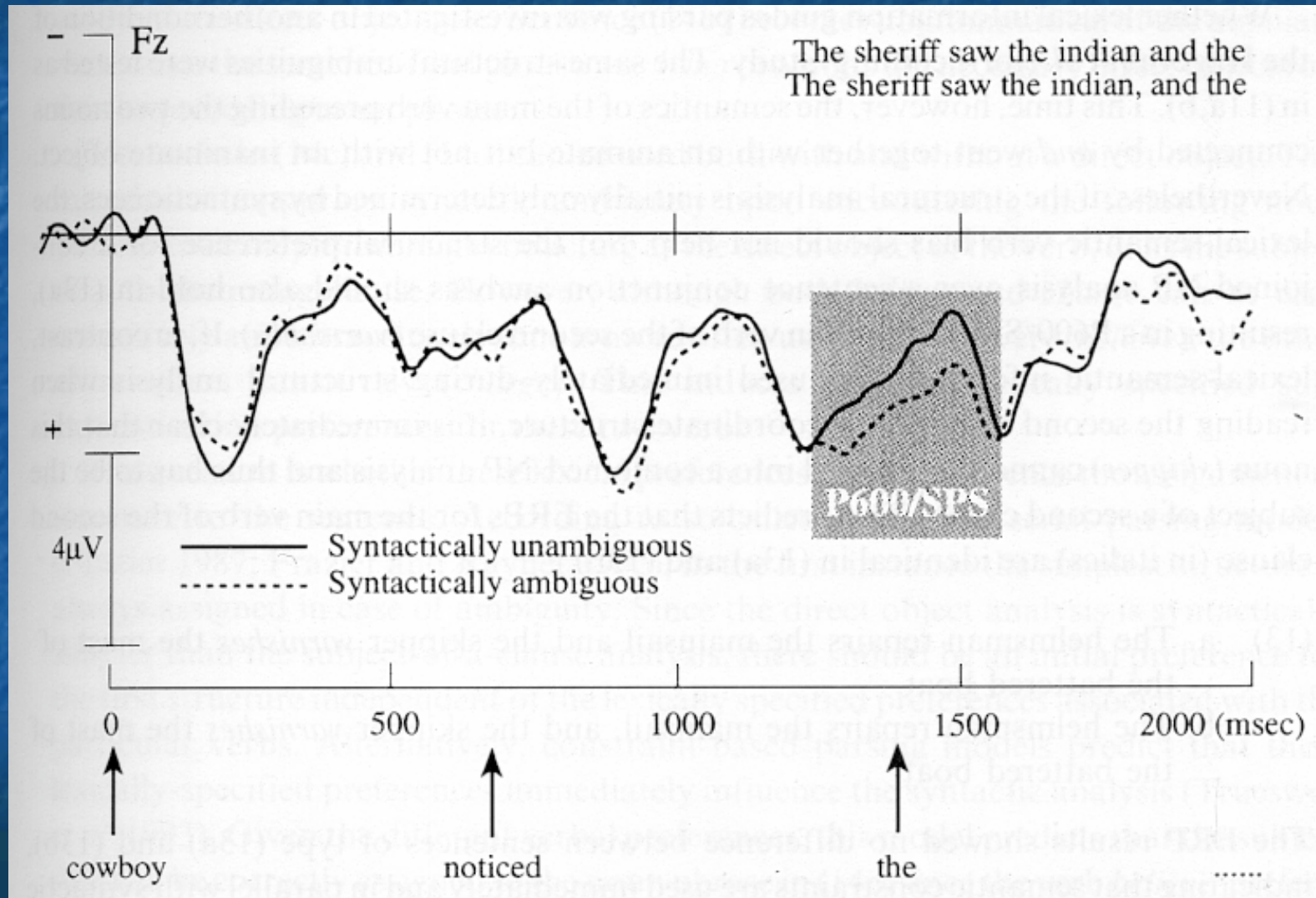


P600/SPS (Syntactic Positive Shift)

Hagoort & Brown (1994)

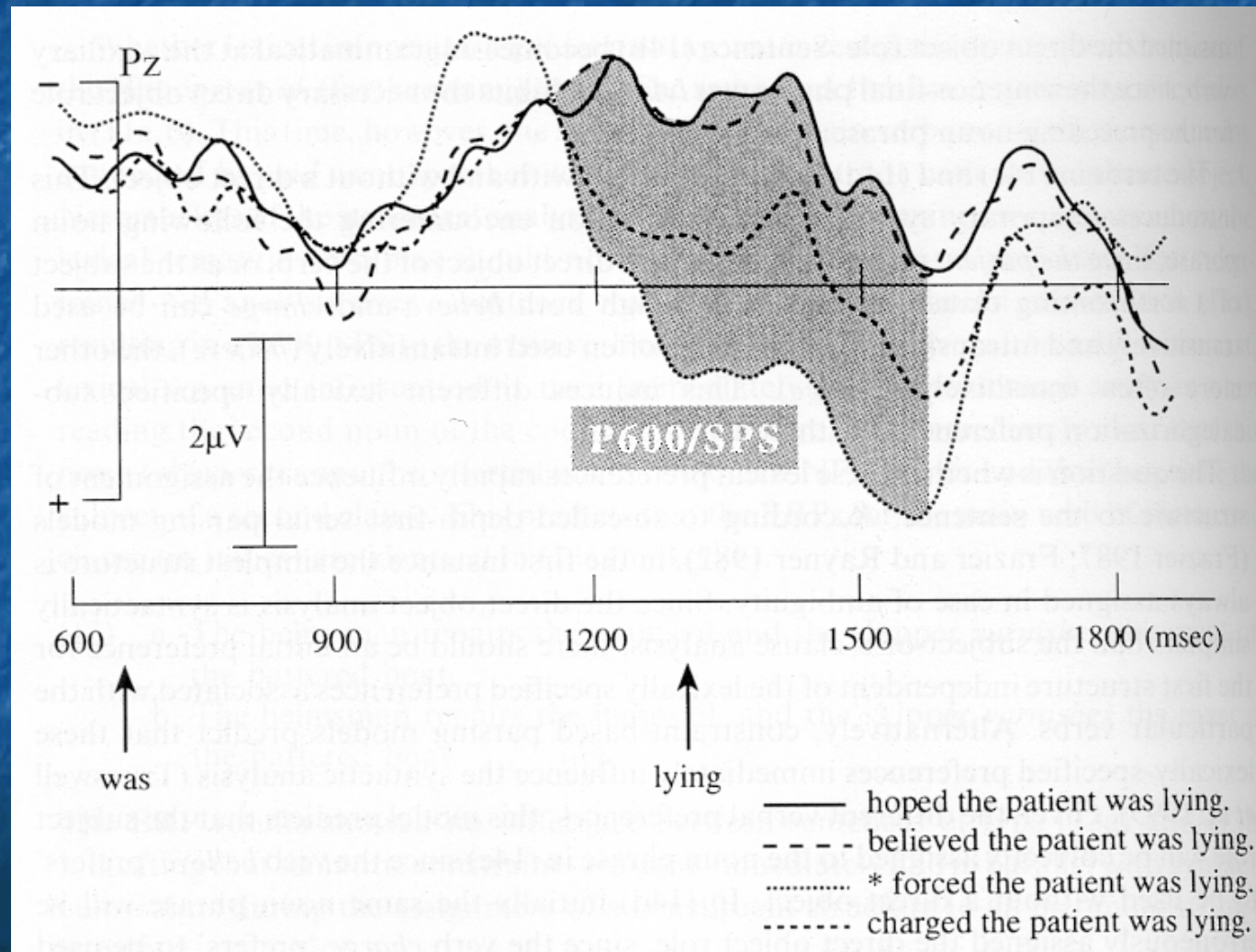


P600 and syntactic disambiguation



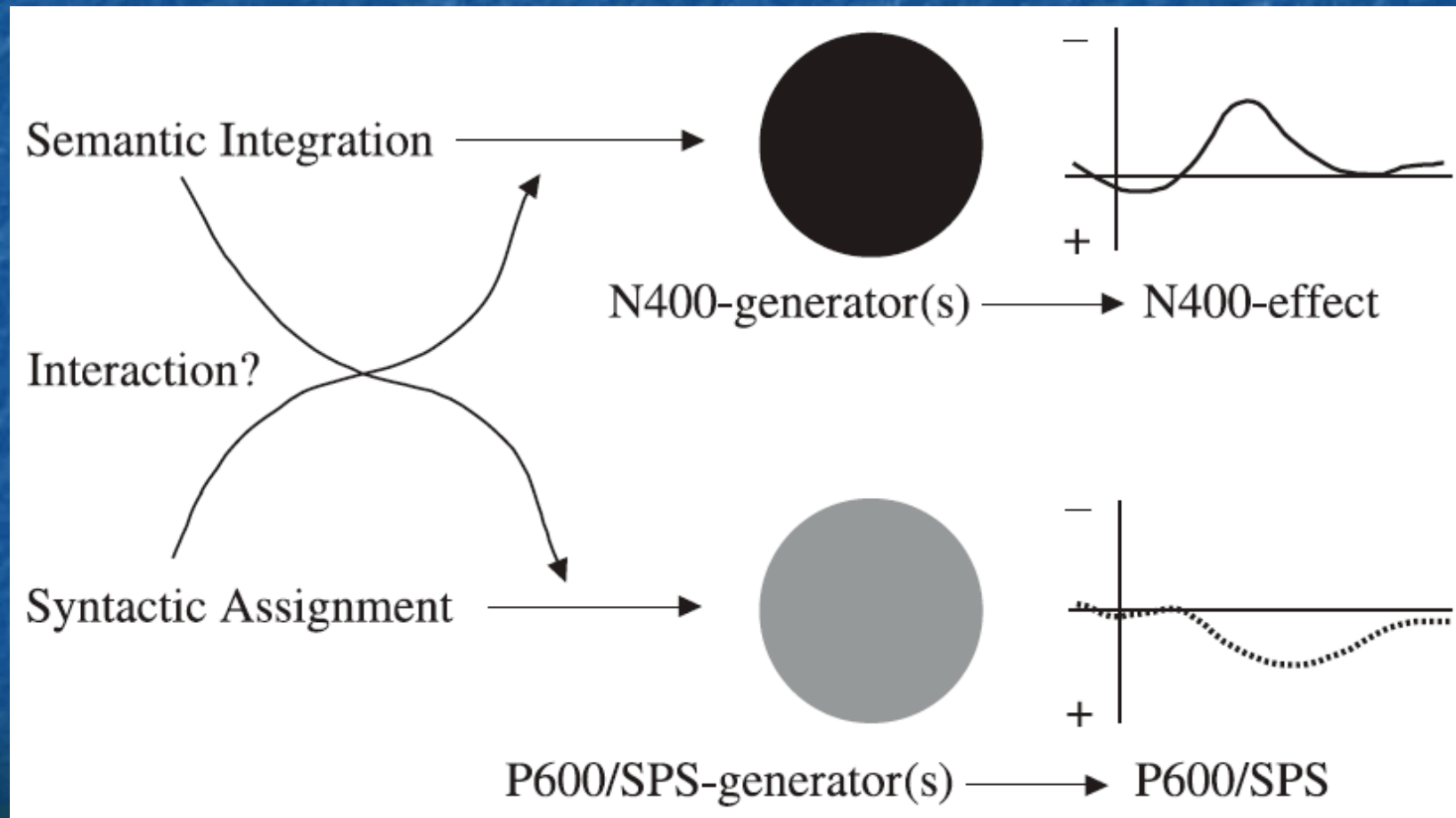
SPS and lexical preferences

Osterhout et al. (1994)



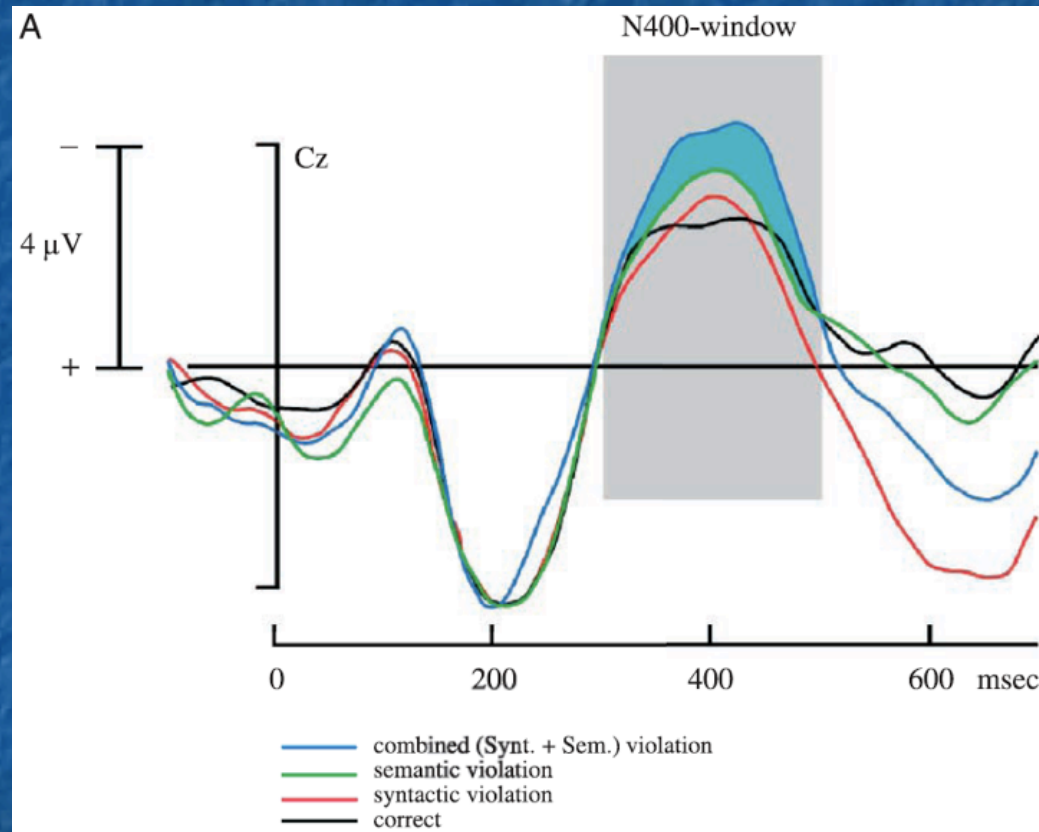
Syntax and semantics

Hagoort (2003)



Syntax and semantics

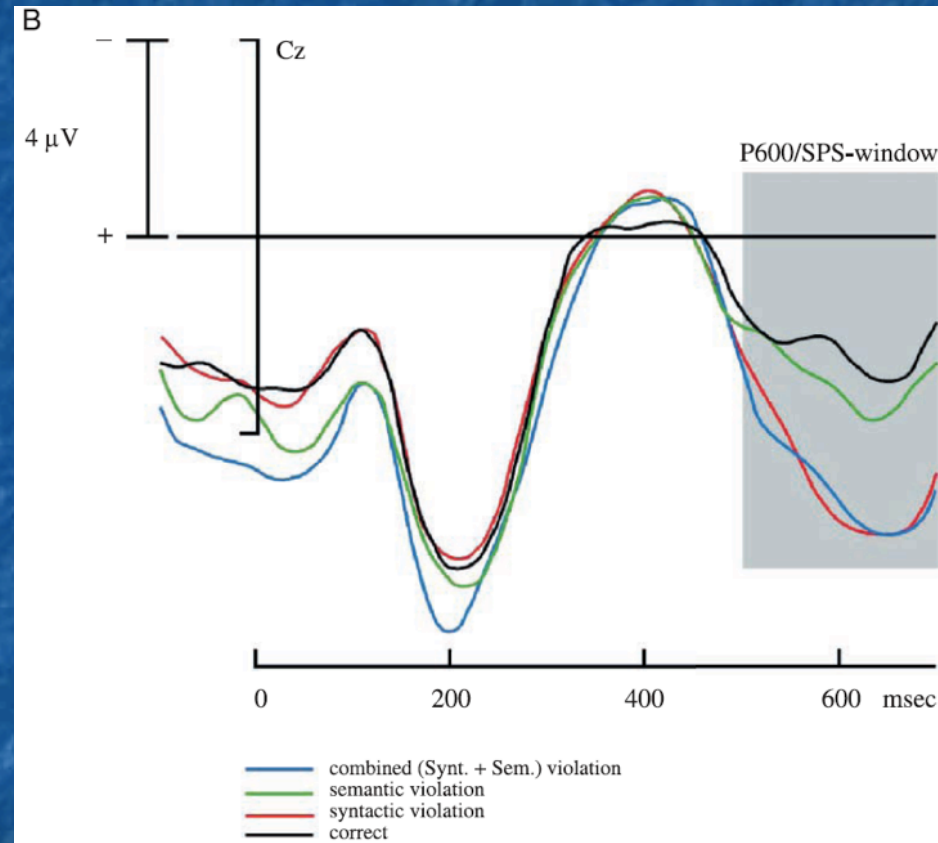
Hagoort (2003)



An N400 boost for combined syntactic and semantic violation

Syntax and semantics

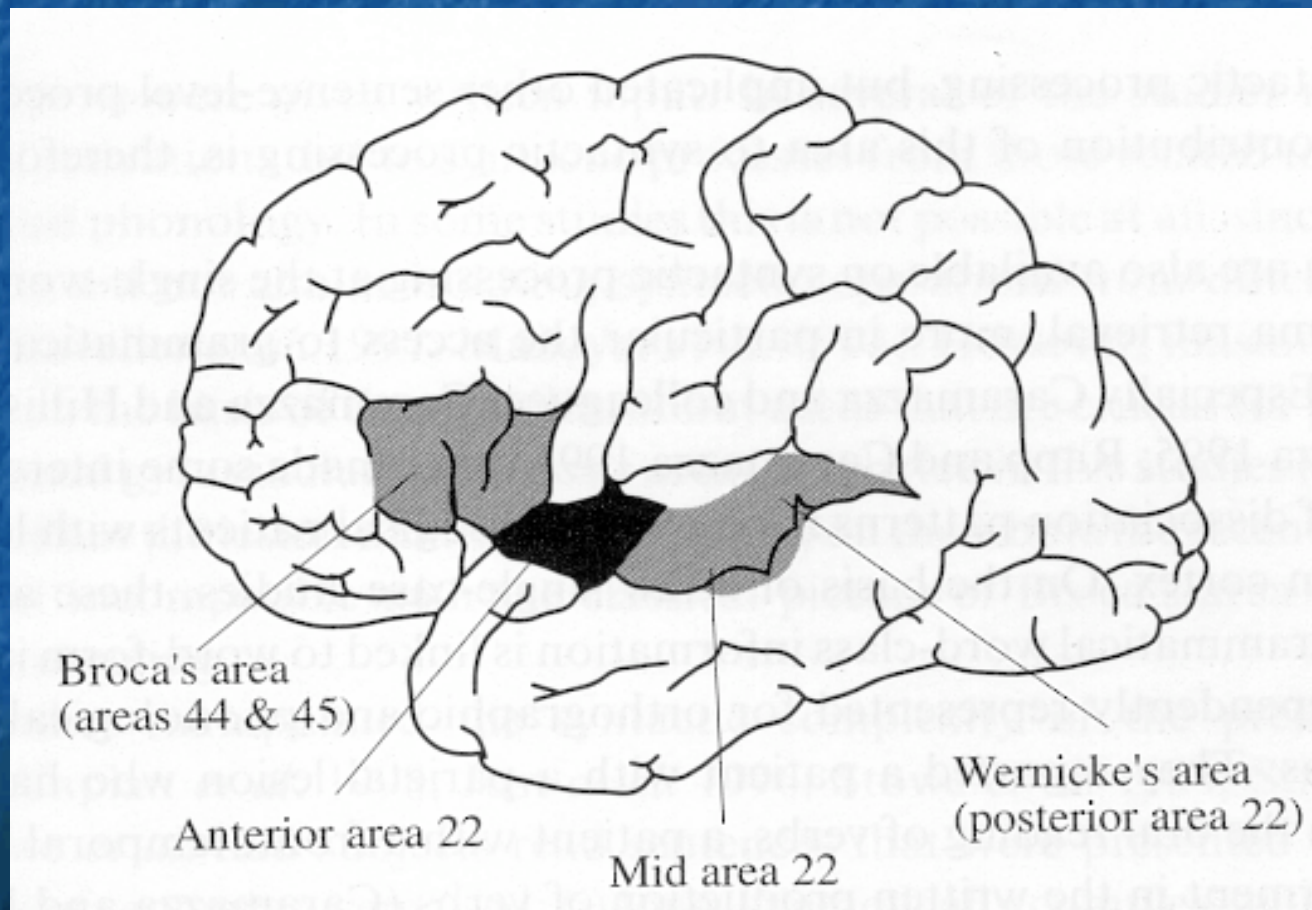
Hagoort (2003)



No P600 semantic boost for combined syntactic and semantic violation

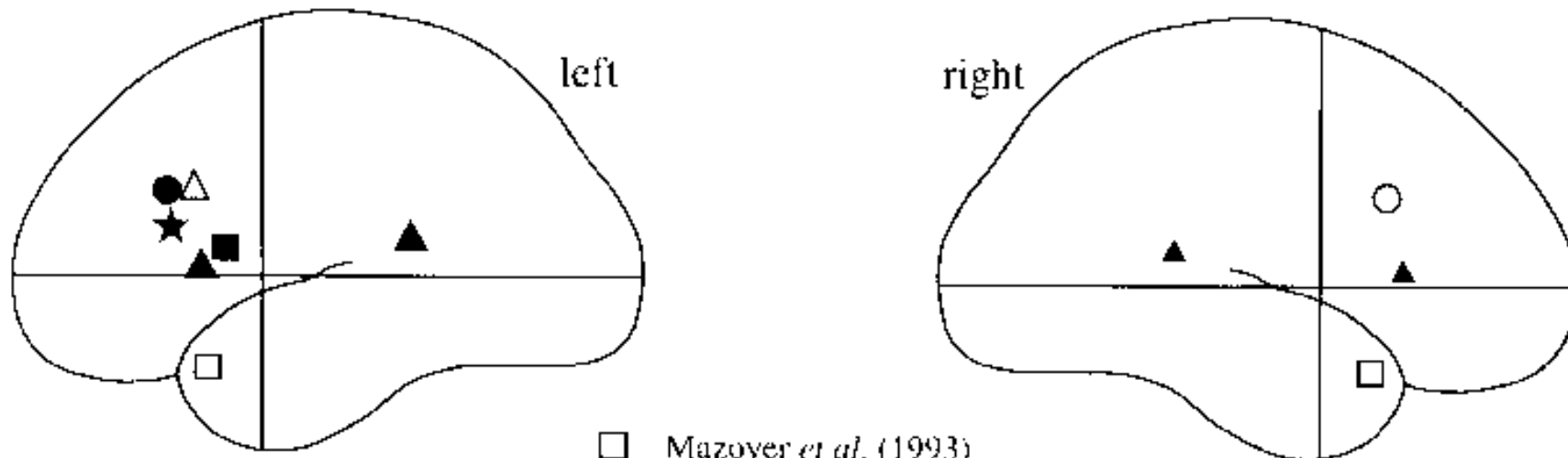
Area implicated in morphosyntactic impairment

Dronkers *et al.* (1998)



PET/fMRI data on normal syntactic processing

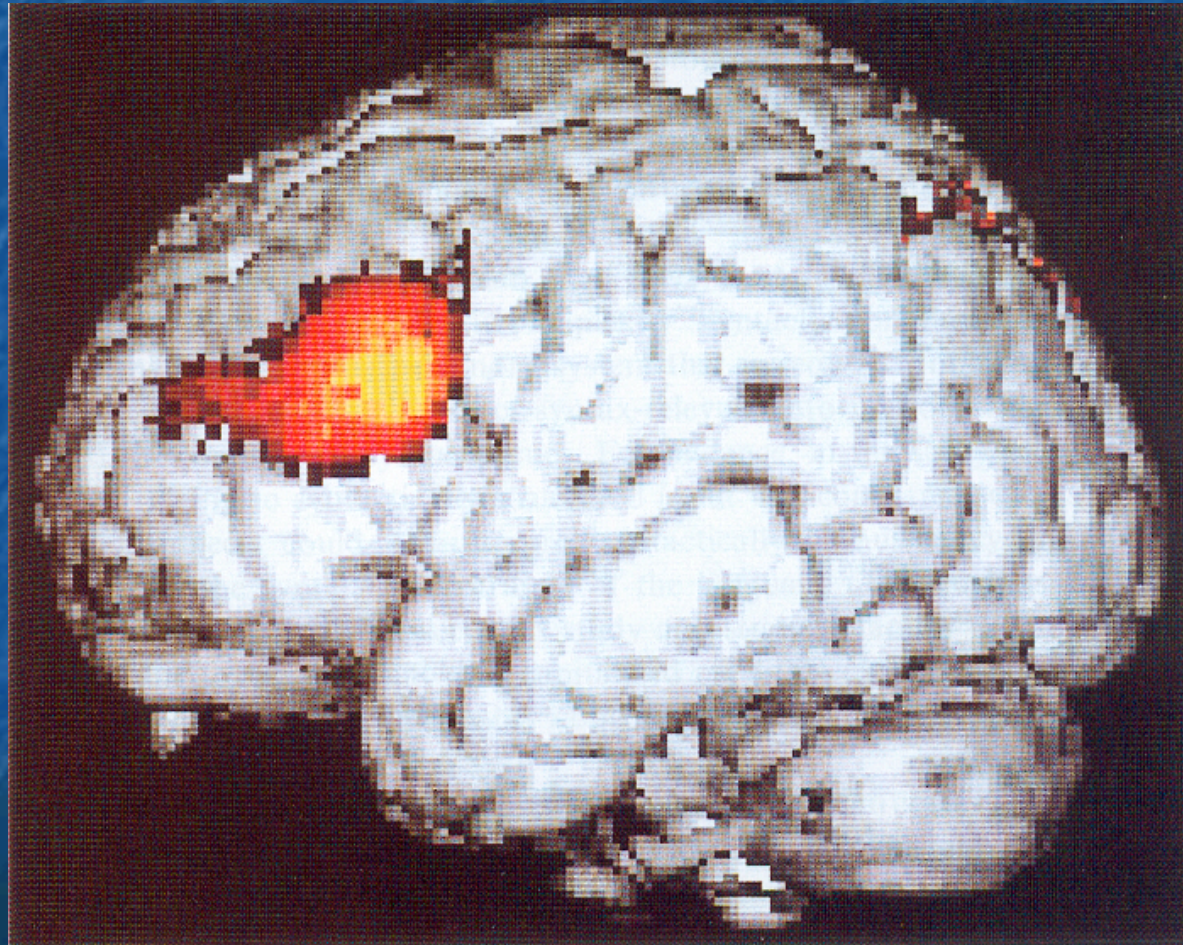
Lateral view



- Mazoyer *et al.* (1993)
- △ Stowe *et al.* (1994)
- Nichelli *et al.* (1995)
- Stromswold *et al.* (1996)
- ▲ Just *et al.* (1996b)
- Indefrey *et al.* (1996)
- ★ Caplan *et al.* (1998)

Syntactic processing

Indefrey *et al.* (1998)



Aspects of syntactic processing

Friederici et al. (2006)

Local phrase structure

Identifying noun phrases, ... frontal operculum, left
IFG anterior, STG

Dependency relations

Cats that dogs chase BA 45 (STM?), LAN

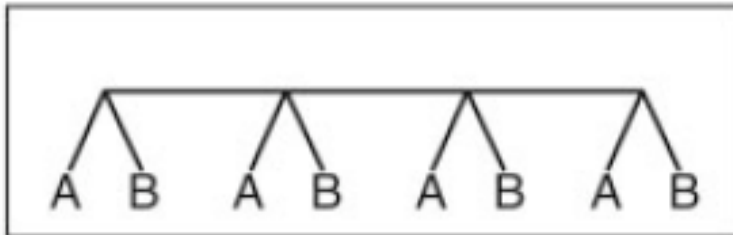
Syntactic integration

... with lexical information; garden paths ...
left posterior STG, P600

Aspects of syntactic processing

Friederici et al. (2006)

Finite State Grammar
 $(AB)^n$



cor/short: A B A B de bo gi fo
viol/short: A B A **A** de bo gi **le**
cor/long: A B A B A B A B le ku ri tu ne wo ti mo
viol/long: A B A B A B A **A** le ku ri tu ne wo ti **se**

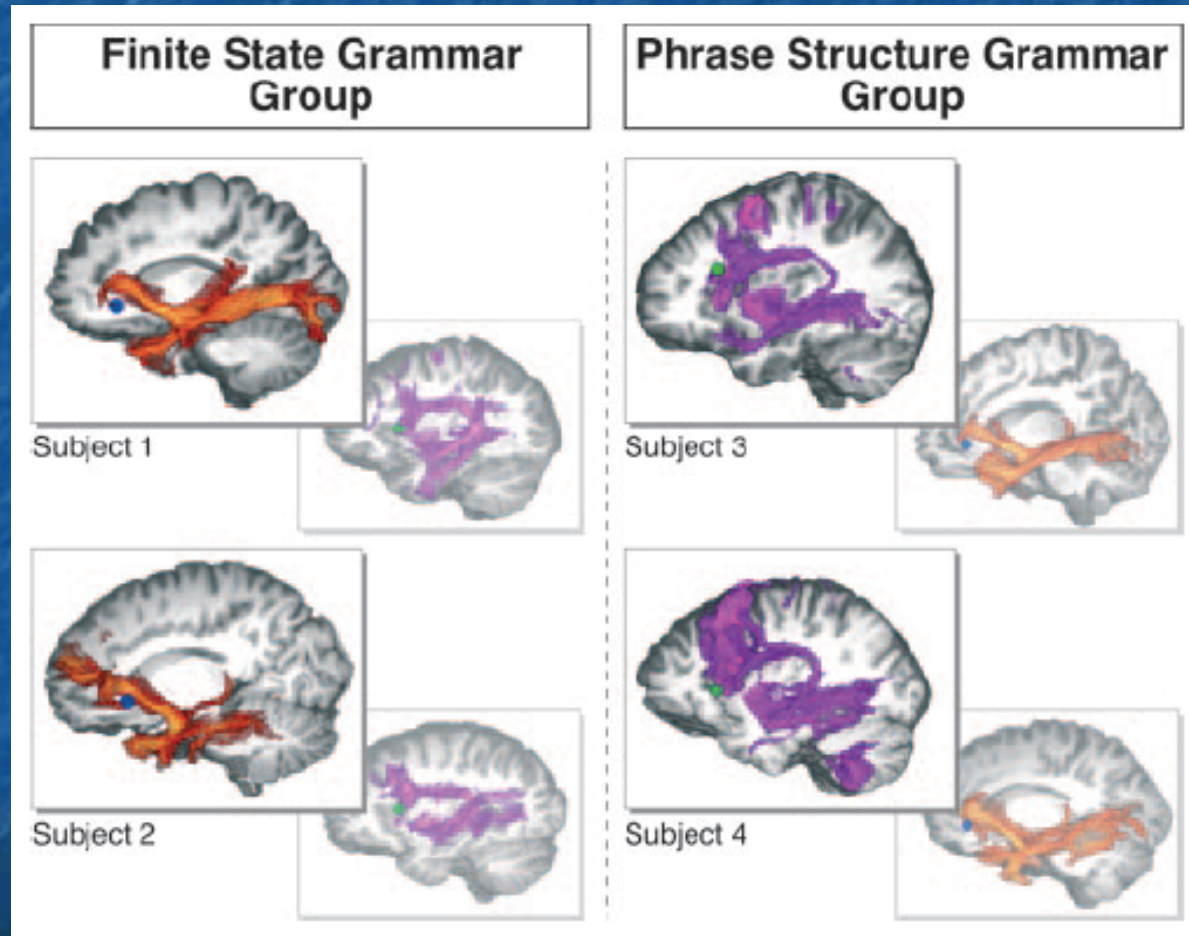
Phrase Structure Grammar
 A^nB^n



cor/short: A A B B ti le mo gu
viol/short: A A B **A** ti le mo **de**
cor/long: A A A A B B B B le ri se de ku bo fo tu
viol/long: A A A A B B B **A** le ri se de ku bo fo **gi**

Left frontal operculum vs BA 44/45

Friederici et al. (2006)



Conclusions

There is at least some degree of autonomy of representation/processing for syntax

Brain variation, especially for the higher functions, may be obscuring the situation