The Structure of Language Processing: Neuropsychological Evidence

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Outline

• General architecture of language processing

• Neuropsychological evidence
  – Relations between syntactic and conceptual
  – Relations between syntactic & semantic
  – Lexical processing in sentence contexts

• Summary
General architecture: real-time language processing systems

Production and comprehension models: two faces of the language processor

- Three levels
- Two major streams
- Dependent on each other
- True for both
General architecture: real-time language processing systems

Lexical and structural processing streams
- Coordination problem
- Incremental parsing in comprehension:
  - real-time, earliest possible
- Reversed for production:
  - syntactic construction precedes phonological and prosodic
General architecture: real-time language processing systems

- Relations among processing types
  - Concurrent processing is assumed for both production and comprehension
    - phonological, syntactic, and semantic analyses
Neuropsychology review
Neuropsychological evidence for relations between syntactic and semantic processes

• Kutas and Hillyard (1980)
• N400: bilateral, larger over the right hemisphere, ERP response to semantic deviance, during reading sentence, e.g.
  – John spread the warm bread with butter(socks)
• Plausibility response
The scientist criticized Max's proof of the theorem.

The scientist criticized Max's event of the theorem.
Incremental syntactic assignments

- Garnsey, Tannenhaus, and Chapman (1989):
  - (a) The businessman knew which customers the secretary called at home
  - (b) the businessman knew which article the secretary called _ at home
  - (c) The businessman knew that the secretary called the customers at home
  - (d) The businessman knew that the secretary called the article _ at home
  - (e) the businessman knew which article the secretary called _ the library for
Syntactic response

- Osterhout and Holcomb (1992)
- SPS: sustained and widely distributed positive shift in the 500-900ms range
- Premature analysis & Integration
  - (a) The broker hoped to sell the stock
  - (b) *The broker persuaded _ to sell the stock
  - (c) The broker persuaded _ to sell the stock was sent to jail
  - (e) * The broker hoped to sell the stock was _ sent to jail
--- The broker hoped TO...
--- The broker persuaded TO...

--- persuaded to sell the stock WAS...
--- hoped to sell the stock WAS...

--- was sent to JAIL.
--- was sent to JAIL.
Different syntactic reflex

- Hagoort, Brown, and Groothusen (1993)
- No SPS for subcategorization
  - The son of the rich man boasts his father’s car
- SPS for phrase structure
  - Most of the visitors like the colorful very tulips in Holland
- SPS for agreement condition
  - The spoiled child throws the toys on the floor
AGREEMENT CONDITION, Midline Electrodes

- Fz

- Cz

- Pz

5μV

---

gram. correct

gram. incorrect

0 600 1200 1800 2400 3000

Het verwende kind *goolen het speelgoed op de grond.

het speelgoed op de grond.
PHRASE STRUCTURE CONDITION, Midline Electrodes

De echtgenoot schrikt van

---

gram. correct
gram. incorrect

---

5μV

---

0 600 1200 1800 2400 3000 3600

de nogal emotionele nogal reactie *reactie van zijn vrouw.
Other syntactic reflex

• Neville et al (1991)
• LAN: in the 300-500ms range, left, anterior as well as temporal parietal, complementary to N400
• LAN for phrase structure
• LAN for movement violation
  – Yes for specificity but without SPS
    • What did the scientist criticize Max’s proof of
  – No for subjacency but with SPS
    • What was a proof of criticized by the scientist
The scientist criticized a proof of the theorem.

---

The scientist criticized Max's proof of the theorem.
Phrase Structure Violation

LH

Temporal

Occipital

Subjacency Constraint Violation

LH

Temporal

Occipital

criticized by the
Other syntactic reflex (cont)

• Rosler et al (1993)
• LAN: in the 300-700ms range, left, anterior
• LAN for subcategorization but without SPS
  – The president is be greeted
  – The teacher is being fallen
Grand average: MORPHOSYNTAX (n=16)
- Correct
- Morph. Inc.
Missing syntactic reflex

- Subcategorization no SPS
- Subjacency no SPS
- Possible reason: interaction with N400
Working memory hypothesis

• Kluender and Kutas (1993)

• LAN may index processes associated with entering gap fillers in memory and then restoring them to interpretation sites encountered later in the sentence

• LAN in normal sentence with “wh” gap.
Have you forgotten that HE...?
Have you forgotten if HE...?
Have you forgotten who HE...?

L. Anterior Temporal

L. Central

L. Parieto-Temporal

2.0 μV
Lexical processing in sentence contexts

- Van Petten and Kutas (1991)
- CR and CI priming for short SOA
- CR only for long SOA
PRIME-TARGET
STIMULUS ONSET ASYNCHRONY

Filler

Homograph

--- Contextually appropriate targets
--.--.---- Contextually inappropriate targets
---------- Unrelated targets
Summary: SPS, LAN, etc.