Evidence from priming for hierarchical representation in syntactic structure

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Empirical basis of grammars

- Grammars are theories of the mental representation of linguistic phenomena
- How to empirically verify these theories?
- Traditional method: acceptability judgments
Problems with acceptability judgments
New technique - syntactic priming
Case studies
  - Passives
  - NP structure
Conclusions
Problems with acceptability judgments

- Difficult to isolate the effects of grammaticality from other factors (Schutze 1996; Fanselow and Frisch 2004)
- Sentences that are hard to process are also less acceptable:
  - Garden paths, multiple center-embedding, etc.
- Violations of the same grammatical constraint can vary in acceptability
German dislocated NPs (Fanselow and Frisch 2004)

- Dislocation of Det from Nom:
  alte Professoren liebt sie keine
  old.pl professors.pl loves she no.pl
  ‘she loves no old professors’

- Not for singular count nouns:
  *alten Professor liebt sie keinen
  old.sg professor.sg loves she no.sg

- But, improves if N is ambiguous:
  Koffer hat sie keinen
  suitcase.sg/pl has she no.sg
Another empirical technique

- Is there another method that is sensitive to differences in cognitive representation?
- Yes: syntactic priming!
Priming

What is it?
- If two stimuli are related only along one particular dimension, and
- the processing of one stimulus affects the processing of the other for reasons attributable to that relationship

Why is it useful?
- we can infer that the cognitive system is sensitive to that dimension, and that it treats the two stimuli as related within that dimension

(Branigan, et al 1995)
Syntactic priming (Bock 1986)

- Processing one construction facilitates the processing of subsequent similar construction(s)
  - e.g. makes it more likely to be produced

- Can be used to test hypotheses about cognitive representation of syntactic structure (Branigan et al 1995)
Representation of Passives: Locative *by*-primes

Bock and Loebell (1990)
Method

Picture description:

**ACTIVE:**
ONE OF THE FANS PUNCHED THE REFEREE.

**PASSIVE:**
THE REFEREE WAS PUNCHED BY ONE OF THE FANS.

**TARGET PICTURES**
Materials

Passive
Locative
Active

The construction worker was hit by the bulldozer.
The construction worker was digging by the bulldozer.
The construction worker drove the bulldozer.

Passive
Locative
Active

The minister was cut by the broken stained glass window.
The minister was praying by the broken stained glass window.
The minister fixed the broken stained glass window.
Results

The graph shows the proportion of passives in different priming conditions. The conditions are: Passive, Locative, and Control. The proportions are as follows:

- Passive: 0.79
- Locative: 0.80
- Control: 0.74
Interim summary

- Passives and locatives with by-phrases share representation
- Consistent with lexicalist models of passive, but not transformational models
Relative clause attachment
(Scheepers 2003; Desmet et al 2006)
Don mentioned the servant of the actress who was on the balcony.

High:

Low:
Methods

- Sentence completion (Pickering and Branigan 1998)
- Force particular RC attachment in prime by manipulating (Desmet et al 2006):
  - Humanness of relativizer
  - Number (sg/pl) of nouns
- e.g:
  - Prime: The audience applauded the play of the director who
  - Target: The shopper insulted the employees of the storeowner who
Results

- German RC attachment (Scheepers 2003):

<table>
<thead>
<tr>
<th></th>
<th>HA target</th>
<th>LA target</th>
<th>UC target</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA prime</td>
<td>104 (44%)</td>
<td>116 (50%)</td>
<td>14 (6%)</td>
</tr>
<tr>
<td>LA prime</td>
<td>66 (29%)</td>
<td>149 (65%)</td>
<td>14 (6%)</td>
</tr>
<tr>
<td>BL prime</td>
<td>75 (33%)</td>
<td>142 (62%)</td>
<td>14 (6%)</td>
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- Argued for hierarchical representation of NPs
But...

Representation could be linear dependencies (a la Dependency Grammar, Tesniere 1959), not hierarchical trees:

- Don mentioned the servant of the actress who was on the balcony
- Don mentioned the servant of the actress who was on the balcony
Empirical consequences

• With dependency representation, predict same priming of RC attachment regardless of internal NP structure

\[ \text{the sale of any crops in California that don't meet the initiative's standards} \]

\[ \text{the sale of any crops of wheat that don't meet the initiative's standards} \]
Sentence-completion Experiment
Design

- Attachment height (2) x NP structure (2)
- Prime:
  - David had…
  - Flat:
    - HI - the chat with the grandmothers about the child who are
    - LO - the chat with the grandmothers about the child who is
  - Embedded:
    - HI - the chat with the grandmothers of the child who are
    - LO - the chat with the grandmothers of the child who is
- Target - embedded NP structure:
  - Emily heeded the warning of the hunters of the fugitive who
Methods and analysis

- 25 subjects, 24 items
- Subjects completed list of incomplete sentences (expt’al items and fillers) at a computer
- Responses modeled by mixed-model logistic regression
  - Controls for random effects of Subject and Item
Results

- Significant interaction between height and NP structure ($p<.03$)
- No main effects
Summary

- Relative clause attachment height can be primed
- BUT, only when the prime and target NPs have the same internal structure
- Evidence for hierarchical representation of RC attachment, unlike dependency grammars
Conclusions

- English NPs represented by hierarchical, CFG-like representations, rather than DG
- Syntactic priming can be used to test theories of grammar
  - Simple experimental methodologies (sentence completion, picture description)
  - Also can be found in corpora (Szmrecsanyi 2005; Gries 2005)
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Slides at: www.stanford.edu/~snider