Grammaticality and Parsability in Sentence Processing

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Typical questions syntacticians ask of their friends:

Does this sentence sound good (I mean, grammatical) to you?
這個句子聽起來可以嗎？
Hmm, sounds weird. (after repeating several times) maybe it's alright. But, I wouldn't say so myself.
好像可以，但是我不會這樣講。
聽起來怪怪的，哪裡找來的句子，像是英文翻譯過來的。我們中文不會這麼說吧。

Bever (1970)
"The influence of speech performance on linguistic structure."

"It is simultaneously the greatest virtue and failing of linguistic theory that sequence acceptability judgments are used as the basic data."

Bever (1970)
"The cognitive basis for linguistic structures."

Important factors in accessing our linguistic competence:
Perceptual strategies in general cognition.
Perceptual strategies in language—NVN
Bever (1970): Perceptual illusions can be misleading.


“Grammar is in trouble and needs help. (20)”

“Salience of one interpretation [can be] so much greater than the other, that the other is totally suppressed, perceptually. (22)”


- Suggestions on grammatical judgments:
  - Generative grammarians should rely on more than grammaticality judgments when developing theories of structure.
  - The methods of collecting judgments should be improved.

Lessons we should have learned in the past 40 years.

- Grammar resides in human beings who are finite in their ability to cognize.
- Linguists should pay attention to the potential "cognitive" and/or "perceptual" factors in grammaticality judgments so that grammar can be minimized.

- Generative Grammar
- “Knowledge of Language”
  - The nature of this knowledge
  - How is it acquired?
  - How is it used?

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- “Linguistics is a part of psychology, and ultimately biology. (23)”

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Issues

- Factors that affect grammaticality judgments
- **parsability**
- Are ungrammatical sentences actually difficult sentences?
  1. Processing of relative clauses with nested dependencies
  2. Thematic mappings of Mandarin RVCs (Resultative Verb Compounds)

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The one thing that psychologists care about most in their methodology

**Confounds**
### The goal of sentence processing research
- To figure out how grammaticality among other factors affect the way we understand sentences

### Factors that affect grammaticality judgments

**Factors that affect grammaticality judgments** (Schütze, 1996)
- **Subject-related** factors (Individual differences)
  - Capacity of working memory
  - Handedness
  - Linguistic training
  - Literacy and education

### Factors that affect the goodness of a sentence

**Factors that affect the goodness of a sentence** (Schütze, 1996)
- **Task-related** factors
  - Instructions
  - Order of presentation
  - Repetition
  - Mental state
  - Judgment strategy
  - Modality and register
  - Speed

### Factors that affect the goodness of a sentence

**Factors that affect the goodness of a sentence** (Schütze, 1996)
- **Task-related** factors
  - Stimuli
    - Context
    - Meaning
    - Parsability
    - Frequency
    - Lexical content
    - Morphology and spelling
    - Rhetorical structure

### Parsability as the basis for some grammaticality judgments
- Some sentences can be so difficult that subjects decide that they are not possible (to understand?).
- Subjects confuse implausibility or difficulty with ungrammaticality and decide that certain sentences are ungrammatical.
Parsability
- Sentences that take a lot of WM to parse.
- Sentences that are misparsed and a correct parse was never reached.

1. Sentences beyond normal working memory capacity
- One classic example has been the processing difficulty with nested dependencies.

1. Sentences beyond normal working memory capacity
- For instance:

Limited working memory for sentence processing
- Center embeddings are difficult.
  (Bever, 1970; Miller & Chomsky, 1963; Gibson, 1998)

Experiment 1—Self-paced reading of sentences with Mandarin relative clauses (Lin, 2006 & 2007)
- 1a: sentences with single RCs
- 1b: sentences with double RCs
Some properties of Mandarin RCs
- They are prenominal.
- The gap appears before the fillers.
- There are two kinds of embeddings—
  - Serial embeddings
  - Nested embeddings

Some facts about Mandarin RCs
- Sentences with single RCs:
  .. [GAP] .............. [FILLER] ... 

Points of interest to us
- Comprehension of sentences with single versus double RCs
- Comprehension of double RCs with serial versus nested dependencies

The tasks:
- Self-paced reading
- Comprehension questions

Exp1: self-paced reading of sentences with RCs

Materials: Nested versus serial dependencies in head-final RCs (Mandarin)
- 迷戀|絆倒|新郎|的|女生|的|軍人|背叛了|朋友。
- 迷戀|新郎|絆倒|的|女生|的|軍人|背叛了|朋友。
- 絆倒|新郎|的|女生|迷戀|的|軍人|背叛了|朋友。
- 新郎|絆倒|的|女生|迷戀|的|軍人|背叛了|朋友。
Nested versus serial dependencies in head-final RCs (Mandarin)

<table>
<thead>
<tr>
<th>Nested dependency</th>
<th>Serial dependency</th>
</tr>
</thead>
<tbody>
<tr>
<td>迷戀[xīn</td>
<td>郎</td>
</tr>
<tr>
<td>迷戀[xīn</td>
<td>郎</td>
</tr>
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</tbody>
</table>

a. Single versus double RCs

a. Single versus double RCs—average RTs per region

<table>
<thead>
<tr>
<th></th>
<th>Single RC</th>
<th>Double RC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average RTs</td>
<td>715</td>
<td>1103</td>
</tr>
</tbody>
</table>

Accuracy of comprehension

<table>
<thead>
<tr>
<th></th>
<th>Single RC</th>
<th>Double RC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average RTs</td>
<td>92%</td>
<td>68%</td>
</tr>
</tbody>
</table>

b. Serial versus nested dependencies—comprehension accuracy

<table>
<thead>
<tr>
<th></th>
<th>nested</th>
<th>serial</th>
<th>p &lt; 0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>41%</td>
<td>75%</td>
<td></td>
</tr>
</tbody>
</table>

b. Serial versus nested dependencies—RTs taken to answer the comprehension questions

<table>
<thead>
<tr>
<th></th>
<th>nested</th>
<th>serial</th>
<th>p &lt; 0.001</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTs</td>
<td>4453 ms</td>
<td>3627 ms</td>
<td></td>
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</table>
2. Complex thematic assignment in Mandarin verbal compounds

The parsability of a sentence can be a confound in its grammaticality judgments.

- 我追累了那隻狐狸 (I chase-tired that fox)
  
**Inspired by pilot studies of Yu-Bin Chen and Ray Huang.**

Question for a syntactician—
Why is (iv) ungrammatical?

Questions for an experimental syntactician—
1. Why is it difficult to attain (iii)?
2. Is (iv) really ungrammatical?
I chased the fox; I got tired.

The fox chased me; the fox got tired.

*The fox chased me; I got tired.*

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### The syntactic approach

- **Cheng and Huang (1994)**—movement based account (structure + aspectuality)
- **Li (1995, 1999)**—lexicalist account
  - Thematic hierarchy
  - Causative hierarchy
- **Her (2006)**—lexicalist account (LFG)


- Thematic Hierarchy
- Causative Hierarchy
- Well-formedness Condition on Mapping Argument Structure to Syntax:
  - Theta roles can be assigned contrary to the thematic hierarchy if the arguments receiving them are assigned c-roles in ways compatible with the causative hierarchy. (Li, 1995:269)

### Crucial sentences in Li (1995; cited from 1999)

1. **(12)a.** 我把那隻狐狸追累了
   
   但我今天已經追累了那隻狐狸了，實在走不動了。
   
   *I BA that fox chase-tired-asp*
   
   *I today already chase-tired-asp that fox LE; indeed can’t walk asp*
   
   ‘That fox is tired from my chasing it.’

2. **(12)b.** 那隻狐狸把我都追累了，可我還是追不上它。
   
   *That fox BA me even chase-tired-asp but I still can’t catch-up it*
   
   ‘I am already tired from chasing that fox, but I still can’t catch up.’

3. **(12)c.** 那隻狐狸把我都追累了，可我還是追不上它。
   
   *I BA that fox chase-tired-asp but I still can’t catch-up it*
   
   ‘I am already tired from chasing that fox, but I still can’t catch up.’
(12)d.

HYPOTHESES:
- Perceptual factor—NVN sequencing and thematic/causative mapping (Bever, 1970; Townsend & Bever, 2001)
- Multiply embedded null causatives are hard to parse

NVN sequences (Bever, 1970)
- Tend to be taken as Subject-Verb-Object
- Then interpreted as Agent-Action-Patient

Bever (1970), Townsend and Bever (2001)

The horse raced past the barn fell.

**main-clause analysis**

The horse raced past the barn fell.

**reduced RC analysis**

Chinese RCs with object topicalization (Lin, 2006)

The topicalized object is animate.
The topicalized object is *animate*. (Lin, 2006)

I chase-tired that fox

(i) I chased the fox; I got tired.
(ii) I chased the fox; the fox got tired.
(iii) The fox chased me; the fox got tired.
(iv) *The fox chased me; I got tired.

**Question for a syntactician—**

Why is (iv) ungrammatical?

**Questions for an experimental syntactician—**

1. Why is it difficult to attain (iii)?
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The processing approach

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Some preliminary evidence

Huang's (2007) survey

Ratings and interpretations from 10 native speakers of Chinese (in a questionnaire) with sentences like: 桃桃追累幼幼了 (Taotao chase-tired Youyou),

- None reported causatives as the primary meanings. That is, N1 is treated as the agent-theme, N2, the patient.
The processing approach

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Huang’s (2007) survey

Ratings and interpretations from 10 native speakers of Chinese (in a questionnaire) with sentences like:

1. 这件事忙累幼幼了 (This task busy-tired Youyou),
2. 媽媽的嘮叨煩死小寶了 (Mom’s nagging annoy-dead Xiaobao).

- All reported causatives as the primary meanings.

我追累了那隻狐狸
I chase-tired that fox

(i) chased(I, fox)&tired(I)
(ii) v\textunderscore cause(chased(I,fox), tired(fox))
(iii) v\textunderscore cause(I, chase(fox,I)&tired(fox))
(iv) v\textunderscore cause(I, v\textunderscore cause(chased(fox,I), tired(I))

我追累了那隻狐狸
I chase-tired that fox

(i) I chase-tired fox
(ii) I chase-tired fox
(iii) I CAUSE fox chase-tired I
(iv) I CAUSE fox chase-tired I
I chase-tired that fox

(i) chased(I, fox) & tired(I)

\[ \text{vcause(chased(I, fox), tired(fox))} \]

\[ \text{vcause(I, chase(fox, I)) & tired(fox)} \]

\[ \text{vcause(I, vcause(chased(fox, I), tired(I))} \]

\[ \text{Causative} \]

**Confound!**

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The processing approach

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Implications

- When a sentence/word is beyond comprehension, it is difficult to test its grammaticality.
- Grammaticality judgments from language users whose WMs are limited (linguists included) are not necessarily reliable.

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Other similar approaches

- “Superiority effects are the result of interacting processing preferences.” (Arnon et al., 2005; Frazier & Clifton, 2005)
- Processing evidence for strong versus weak islands (Kluender, 1998)
- Set theoretical approach to coordination (Cowart, yesterday)

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Concluding remarks

- These data rarely/never appear in the corpora given that they are not easy to parse/produce.
- Cases that we take as grammatically ill-formed may actually be “difficult” sentences.
Concluding remarks

- Sentences that do not make sense to the “miniJudges” are likely to be taken as ungrammatical.

- Only when processing/parsing accounts do not work should we resort to syntactic analyses!

Thank you.