Delayed parsing or incremental parsing

Delayed Parsing:
Only when a head of sentence is received, the parser starts to integrating NPs and verb to a parsing tree. (Pritchett 1992)

Incremental Parsing:
The parser integrates NPs to parsing tree before a head of sentence is received. (Kanide & Mitchell 1999, Miyamoto 2002, and others)

We accept the hypothesis that the parser builds a parsing tree incrementally.

The ambiguity in relative clauses

1) Furuhashi-san ga Takasima-san o tasuketa seinen-ni …
Furuhashi Mr.:NOM Takasima Mr.:ACC helped the young man:DAT
ambiguous !

2) Early Opening:
Furuhashi-san ga [ec] Takasima-san o tasuketa
Furuhashi Mr.:NOM Takasima Mr.:ACC helped
seinenn-ni sigamituita.
the young man:DAT clung to
"Mr. Furuhashi clung to the young man who helped Mr. Takasima."

3) Late Opening:
Furuhashi-san ga Takasima-san o [ec] Takasima-san o
tasuketa
Furuhashi Mr.:NOM Takasima Mr.:ACC helped
seinenn-ni syoookaisita.
the young man:DAT introduced
"Mr. Furuhashi, introduced Mr. Takasima to the young man whom he helped."

Sentence processing

What is the Parser?
The parser is the human cognitive-mechanism responsible for computing of syntactic structure.

Resolution of ambiguity

The structural ambiguity is resolved when a matrix predicate (i.e. verb) is received.

i) 2-place predicate (i.e. sigamituita) => EO sentence
The parser recognizes that the accusative marked NP (i.e. Takasima-san-o) occupies the object position in a relative clause.

ii) 3-place predicate (i.e. syoookaisita) => LO sentence
The parser recognizes that the accusative marked NP (i.e. Takasima-san-o) occupies the object position in a matrix clause.

Before a matrix predicate is inputted, only prosodic information may be available in resolving the ambiguity.

MajP boundary and syntactic structure

Major phrase (McCawley 1968): The domain of downstep.
Downstep: Lowering of pitch range after an accented syllable.

Effects of downstep

Syntactic condition on Downstep (or Major Phrasing):
- If there is a left-boundary of a phrase, then the effect of the downstep becomes weak (or is blocked). (Selkirk and Tateishi 1991, Kubozono 1988, and others)
- Major Phrase: [Left, XP] (Selkirk & Tateishi 1991: p.529)
Syntactic structure of EO sentence and LO sentence

(5) Early Opening:
Furuhashi-san-ga [CP ec_{SUB} Takasima-san-o] takasuketa
Furuhashi-Mt-NOM Takasima-Mt-ACC helped
seinenni sigamituita.
the young man-DAT clung to
"Mr. Furuhashi clung to the young man who helped Mr. Takasima."

(6) Late Opening:
Furuhashi-san-ga [CP Takasima-san-o [CP ec_{SUB} ec_{OBJ} takasuketa]]
Furuhashi-Mt-NOM Takasima-Mt-ACC helped
seinenni sigamituita.
the young man-DAT introduced
"Mr. Furuhashi introduced Mr. Takasima to the young man whom he
helped."

Where are MajP boundaries?

Predictions from Selkirk & Tateishi

(7) Early Opening:
Furuhashi-san-ga # Takasima-san-o takasuketa seinenni
Furuhashi-Mt-NOM Takasima-Mt-ACC helped
sigamituita.
clung to
"Mr. Furuhashi clung to the young man who helped Mr. Takasima."

(8) Late Opening:
Furuhashi-san-ga # Takasima-san-o # takasuketa seinenni
Furuhashi-Mt-NOM Takasima-Mt-ACC helped
sigamituita.
introduced
"Mr. Furuhashi introduced Mr. Takasima to the young man whom he
helped."

□ "#" denotes MajP boundary.

Aim of this study

Prosodic information is sensitive to syntactic structures.

Does prosodic information affect on reanalysis process?

• With employing auditory stimulus, we investigate the effects of pitch contour information and temporal information (i.e. pause) in reanalysis process.
• Is there any difference between first-pass analysis and reanalysis processes?

Previous study (Cont.)

Azuma's conclusion:
• Pitch contour information is most important prosodic information which denotes a syntactic boundary.
• Temporal information (i.e. pause) does not contribute much to denoting a syntactic boundary as pitch contour information does.

Remaining problem:
• The stimulus employed in his experiment does not invoke reanalysis process. He investigated only first-pass analysis process, and it is not clear whether his conclusion can apply to reanalysis process.

Previous study

Azuma (1997)

Nara-de taoreta kodomo-o hakonda
At-Nara felt child-ACC carried

Globally ambiguous
1) [Nara-de taoreta kodomo-o] hakonda
At-Nara felt child-ACC carried
"(Someone) carried the child who fell at Nara"
2) Nara-de [taoreta kodomo-o] hakonda
At-Nara felt child-ACC carried
"At Nara (Someone) carried the child who fell"

• He manipulated both the pitch contour and the length of pause at "Nada-de" and "taoreta", and asked the subjects to choose the preferred interpretation.

Experiment

Furuhashi-san-ga [CP ec_{SUB} Takasima-san-o takasuketa]
Furuhashi-Mt-NOM Takasima-Mt-ACC helped
seinenni sigamituita.
the young man-DAT clung to
"Mr. Furuhashi clung to the young man who helped Mr. Takasima."

Factor I: Position of prosodic information (ProInfo)

i) Matched Condition:
NP_{Nom}: ProInfo [NP_{ACC} V_{RC}] NP_{DAT} V_{minus}

ii) Mismatch Condition:
NP_{Nom}: ProInfo [NP_{ACC} ProInfo V_{RC}] NP_{DAT} V_{minus}

Factor II: Types of prosodic information

i) Only pitch counter resetting (pitch contour information) => %
ii) Pitch counter resetting + pause (temporal information) => %+P
Conditions

**Condition I: Matched – Only %**
Furushasi-san-go % Takasima-san-o tasuketa seinen-ni sigamituita.
Furushasi-Mr.-NOM Takasima-Mr.-ACC helped the young man-DAT clung to

**Condition II: Mismatch – Only %**
Furushasi-san-go % Takasima-san-o % tasuketa seinen-ni sigamituita.
Furushasi-Mr.-NOM Takasima-Mr.-ACC helped the young man-DAT clung to

**Condition III: Matched – +%P**
Furushasi-san-go +%P Takasima-san-o +%P tasuketa seinen-ni sigamituita.
Furushasi-Mr.-NOM Takasima-Mr.-ACC helped the young man-DAT clung to
"Mr.Furushasi clung to the young man who helped Mr.Takasima."

**Condition IV: Mismatch – +%P**
Furushasi-san-go +%P Takasima-san-o +%P tasuketa seinen-ni sigamituita.
Furushasi-Mr.-NOM Takasima-Mr.-ACC helped the young man-DAT clung to

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**Participants:**
29 native speakers of Japanese. They were graduate and undergraduate students of Kyushu University. One of them was omitted because his error rate was over 20%.

**Procedure:**
Participants listened to the stimulus sentences and answered correctness of the stimulus sentence with buttons.

**Materials:**
36 sets of sentence pairs as (I)-(IV) above.

---

**Result (1)**

<table>
<thead>
<tr>
<th></th>
<th>NP-NOM</th>
<th>NP-ACC</th>
<th>V(RC)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Condition I</strong></td>
<td>202.6</td>
<td>%</td>
<td>201.7</td>
</tr>
<tr>
<td><strong>Condition II</strong></td>
<td>200.9</td>
<td>%</td>
<td>200.0</td>
</tr>
<tr>
<td><strong>Condition III</strong></td>
<td>202.2</td>
<td>+%P</td>
<td>204.5</td>
</tr>
<tr>
<td><strong>Condition IV</strong></td>
<td>201.4</td>
<td>+%P</td>
<td>201.0</td>
</tr>
</tbody>
</table>

**Only %**
**% + P**

---

**Statistical analysis (RT)**

- Main effect of position of prosodic information:
  \[ F_1(1, 27) = 6.91, p < .05, F_2 (1, 35) = 9.10, p < .005 \]
  "Mismatch condition" > "Match condition"

- Main effect of types of prosodic information:
  \[ F_1(1, 27) = 19.46, p < .001, F_2 (1, 35) = 6.02, p < .05 \]
  "% +P" > "Only %"

- Interaction (position x type):
  \[ F_1 < 1, F_2 < 1. \]
Result (2)

Error Rate (%)

<table>
<thead>
<tr>
<th></th>
<th>only %</th>
<th>% + P</th>
</tr>
</thead>
<tbody>
<tr>
<td>match</td>
<td>5.18</td>
<td>3.17</td>
</tr>
<tr>
<td>mismatch</td>
<td>5.56</td>
<td>9.92</td>
</tr>
</tbody>
</table>

Pause and informational structure

- In speech production process, discourse information (e.g. focus) has great influence on the pause length.
- Existence of a salient pause induces the language processor to start processing discourse information.
- Simultaneous processing of both syntactic information and discourse one invokes more processing difficulty.
- This processing difficulty results in longer reaction time in %+P (Con III & IV).

Statistical analysis (ER)

- Main effect of position of prosodic information:
  \[ F_1(1, 27) = 5.44, p < .05, F_2(1, 35) = 4.29, p < .05. \]
  
- Main effect of types of prosodic information:
  \[ F_1 < 1, F_2 < 1. \]

- Interaction (position x type):
  \[ F_1(1, 27) = 2.76, p = .11, F_2(1, 35) = 5.53, p < .05. \]

Thank you!

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References


Conclusion

- Similarity between first-pass and reanalysis:
  - Pitch contour information affects not only on first-pass but also on reanalysis processes.

- Difference between first-pass and reanalysis:
  - In first-pass process, temporal information (i.e. pause) also contributes to denoting a syntactic boundary.
  - In reanalysis process, temporal information increases processing difficulty.


This PowerPoint file: http://www.kyushu-u.ac.jp/~sakamoto/muraoka/2005pf.pdf