Explicit prosodic information and parsing

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Sentence Processing

What is the Parser?

The parser is the human cognitive-mechanism responsible for computation of syntactic structure.

Sentence Processing

Phonological processing

Lexical processing

Syntactic processing (=parsing)

Semantic processing

(Sakamoto 1998: p.5)

Syntactic processing (=parsing)

Taro-ga Hanako-o hometa

Taro-NOM Hanako-ACC praised

S

VP

Taro-ga

Hanako-o

hometa
Delayed parsing or Incremental parsing

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

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

We accept the hypothesis that the parser build a parsing tree incrementally.
The ambiguity in relative clauses

(1) Morisita-ga sin'yaku-o kokorokara sin'yoosita yuuzintati-ni
    Morishita-NOM new medicine-ACC truly trusted friends-DAT

ambiguous!

(2): Early Opening:
Morisita-ga [ ec_i sin'yaku-o kokorokara
Morishita-NOM new medicine-ACC truly
    sin'yoosita ] yuuzintati_i-ni atta.
    trusted friends-DAT met
"Morishita met the friends who truly trusted the new medicine."

(3): Late Opening:
Morisita_i-ga sin'yaku-o [ ec_i ec_j kokorokara
Morishita-NOM new medicine-ACC truly
    sin'yoosita] yuuzintati_j-ni miseta.
    trusted friends-DAT showed
"Morishita showed the new medicine to the friends who truly trusted."
Resolution of ambiguity

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

i) 2-place predicate is inputted  ➔ EO sentence
   The parser recognizes that accusative marked NP (i.e. sin'yaku-o) occupies the object position in relative clause.

ii) 3-place predicate is inputted  ➔ LO sentences
    The parser recognizes that accusative marked NP (i.e. sin'yaku-o) occupies the object position in matrix clause.

Which factor has a great influence on resolving ambiguity?
Factors of processing cost

Structural complexity (Mazuka & Itoh 1995):
Processing cost depends on the structural complexity. EO sentences need one empty category, but LO sentences need two empty categories.

Processing cost: LO > EO

Property of relative head (Hirose & Inoue 1998):
The animacy of the relative head has an influence on resolving ambiguity.
Relative head: animate ▷ ambiguous (AGENT or THEME)
inanimate ▷ unambiguous (THEME only)

Processing cost: animate head noun > inanimate head noun
MajP boundary and syntactic structure

Major phrase (McCawley 1968)
the domain for the effect of downstep.

\(4\) Effects of downstep

\[
y\text{YUm}-\text{no} \quad \text{Ani-ga} \quad \text{KI}ta
\]
Yumi-GEN elder brother-NOM came
"Yumi's elder brother came."

Syntactic condition on Major phrasing:
Major Phrase: \{Left, XP\}

"the left edge of every XP in syntactic structure must coincide with the limits of some Major Phrase(s) in phonological representation." (Selkirk & Tateishi 1991: p.529)
Syntactic structure of EO sentence and LO sentence

(5) Early Opening:
\[
[\text{IP Morisita}-ga [\text{VP [\text{NP [\text{IP ec \_i [\text{VP sin'yaku-o \_kokorokara Morishita-NOM new medicine-ACC truly sin'yoosita]] yuuzintati \_ni] atta}]]]. trusted friends-DAT met }
"Morishita met the friends who truly trusted the new medicine."
\]

(6) Late Opening:
\[
[\text{IP Morisita \_i-ga [\text{VP sin'yaku-o [\text{NP [\text{IP ec \_i [\text{VP ec \_j Morishita-NOM new medicine-ACC kokorokara sin'yoosita]] yuuzintati \_ni] miseta}]]]. truly trusted friends-DAT showed }
"Morishita showed the new medicine to the friends who truly trusted."
\]
Where is MajP boundaries?

Predictions from Selkirk & Tateishi

(7) Early Opening:
Morisita-ga # sin'yaku-o kokorokara sin'yoosita
Morishita-NOM new medicine-ACC truly trusted
yuuzintati-ni atta.
friends-DAT met
"Morishita met the friends who truly trusted the new medicine."

(8) Late Opening:
Morisita-ga # sin'yaku-o # kokorokara sin'yoosita
Morishita-NOM new medicine-ACC truly trusted
yuuzintati-ni miseta.
friends-DAT showed
"Morishita showed the new medicine to the friends who truly trusted."

"#" denotes MajP boundary.
Experiment on Production

Uyeno et al. (1980)

(9) a. Kinoo moratta ringo-o tabeta.
    Yesterday received apple-ACC ate.

    b. Interpretation I:
       Yesterday received apple-ACC ate.
       "Yesterday I ate an apple which I received"

    c. Interpretation II:
       Yesterday received apple-ACC ate.
       "I ate an apple which I received yesterday"

Pitch-range resetting positions accorded with left clause boundaries.
Effects of prosody in silent readings

The implicit prosody hypothesis (IPH):

In silent readings, a default prosodic contours is projected onto the stimulus, and it may influence syntactic ambiguity resolution. Other things being equal, the parser favors the syntactic analysis associated with the most natural (default) prosodic contour for construction. (Fodor 2002: p.113)

Hirose (2002) reported some experiments which are good evidences to show that IPH is at work in Japanese sentence processing.
Implicit prosodic effects in Japanese

Hirose (2002)

• frame-by-frame presentation, self-paced reading experiment

(10) +MajP boundary:
Hosokawa-to Morisita-ga sin'yaku-o [ ec_i, ec_j
Hosokawa-and Morishita-NOM new medicine-ACC
{MajP                         } {MajP
  kokorokara sin'yoosita] yuuzintati-ni miseta.
  truly trusted friends-DAT showed
"Hosokawa and Morishita showed the new medicine to the friends who truly trusted."

(11) -MajP boundary:
Morisita-ga sin'yaku-o [ ec_i, ec_j kokorokara sin'yoosita]
Morishita-NOM new medicine-ACC truly trusted
{MajP                         } {MajP
  yuuzintati-ni miseta.
  friends-DAT showed
"Morishita showed the new medicine to the friends who truly trusted."
The result of Hirose (2002):

The reading time of head noun (yuuzintati-ni "friends-DAT"):
- the -MajP boundary version > the +MajP boundary version

This result serves as evidence of the IPH.

There was no study which investigated the effects of prosody in processing relative clause with using auditory stimulus.

We must draw attention to explicit prosody effects.
Aim of this study

Pitch-range resetting must occur at MajP boundaries.

Do pitch-range resettings effect on sentence processing?

With auditory stimulus, we investigated the relation between left clause boundary and pitch-range resetting.

We used only Early Opening sentences to avoid the effects of structural complexity in our experiments.
Experiment

Yonemura-ga [ ec\textsubscript{i} Tomonori-o nessinni kyouikusiteita] sensei \textsubscript{i} -ni
Yonemura-NOM Tomonori-ACC eagerly had educated teacher-DAT
kyoozai-o kasita.
teaching materials lend
"Yonemura lend the teaching materials to the teacher who had educated Tomonori eagerly."

Three possibilities of phrasing ( "[" denotes a left clause boundary)

(I) NP-NOM [ NP-ACC Adv • • •
        {MajP    } {MajP

(II) NP-NOM [ NP-ACC Adv • • •
        {MajP          } {MajP

(III) NP-NOM [ NP-ACC Adv • • •
        {MajP    } {MajP    } {MajP
(I) A pitch-range resetting accorded with a left clause boundary:
Yonemura-ga # Tomonori-o nessinni kyooikusiteita sensee-ni
Yonemura-NOM Tomonori-ACC eagerly had educated teacher-DAT
kyoozai-o kasita.
teaching materials-ACC lend

(II) A Pitch-range resetting didn't accord with a left clause boundary:
Yonemura-ga Tomonori-o # nessinni kyooikusiteita sensee-ni
Yonemura-NOM Tomonori-ACC eagerly had educated teacher-DAT
kyoozai-o kasita.
teaching materials-ACC lend

(III) One Pitch-range resetting "#_i" accorded with a left clause boundary, but the other Pitch-range resetting "#_ii" didn't accord with a left clause boundary:
Yonemura-ga #_i Tomonori-o #_ii nessinni kyooikusiteita
Yonemura-NOM Tomonori-ACC eagerly had educated
sensee-ni kyoozai-o kasita.
teacher-DAT teaching materials-ACC lend
<table>
<thead>
<tr>
<th>Condition</th>
<th>NP-NOM</th>
<th>NP-ACC</th>
<th>Adv</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>196.125</td>
<td>#186.533</td>
<td>143.408</td>
</tr>
<tr>
<td>II</td>
<td>201.957</td>
<td>138.075</td>
<td>#184.335</td>
</tr>
<tr>
<td>III</td>
<td>193.396</td>
<td>#191.642</td>
<td>#ii195.950</td>
</tr>
</tbody>
</table>
• Participants:
  27 native speakers of Japanese. They were graduate and undergraduate students of Kyushu University.

• Procedure:
  Participants heard the stimulus sentences and answered questions. The questions were displayed on the computer screen and they were yes/no questions like (12). We recorded decision time and correctness.

(12) Samples of questions
  a. Yonemura-ga kyoozai-o kasita. □ Yes
     Yonemura-NOM teaching materials-ACC lend
  b. Tomonori-ga kyoozai-o kasita. □ No
     Tomonori-NOM teaching materials-ACC lend

• Materials:
  24 sets of sentence pairs as (I)-(III) above.
## Results

<table>
<thead>
<tr>
<th>Condition</th>
<th>RT (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition I</td>
<td>2510</td>
</tr>
<tr>
<td>Condition II</td>
<td>2613</td>
</tr>
<tr>
<td>Condition III</td>
<td>2433</td>
</tr>
</tbody>
</table>

\[ F_1(2,26)=1.214, \ p=.3052, \ F_2(2,23)=2.380 \ p=.1039 \]
Error Rate

<table>
<thead>
<tr>
<th>Condition</th>
<th>ER (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>20.37</td>
</tr>
<tr>
<td>II</td>
<td>20.37</td>
</tr>
<tr>
<td>III</td>
<td>17.59</td>
</tr>
</tbody>
</table>

\[ F_1(2,26)=0.241, \ p=.7866, \ F_2(2,23)=0.675, \ p=.5141 \]
Discussion

These results do not show that the pitch-range resetting effects on relative clause processing in Japanese.

Syntactic Structure

Production (Uyeno et al.)
Effective

Processing (This study)
Non-effective

Pitch resetting
"Reliable" information for the parser

MajP boundary inducers:

- Pitch-range resetting
- Obligatory initial lowering
- Making a pause

Only pitch contour information is not reliable for the parser to assign the left clause boundary.

Phonological Processing
Sufficient to recognize a MajP boundary

Syntactic Processing (Parsing)
Not reliable to assign a left clause boundary
Acknowledgement
This research was supported in part of the Center for the Study of Language Performance, faculty of humanities, Kyushu university. (http://www.lit.kyushu-u.ac.jp/~cslp/)

Reference


This PowerPoint file: http://bun.lit.kyushu-u.ac.jp/~sakamoto/muraoka/2004pf.pdf