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Hiroshima Jogakuin University

# Explicit prosodic information and parsing

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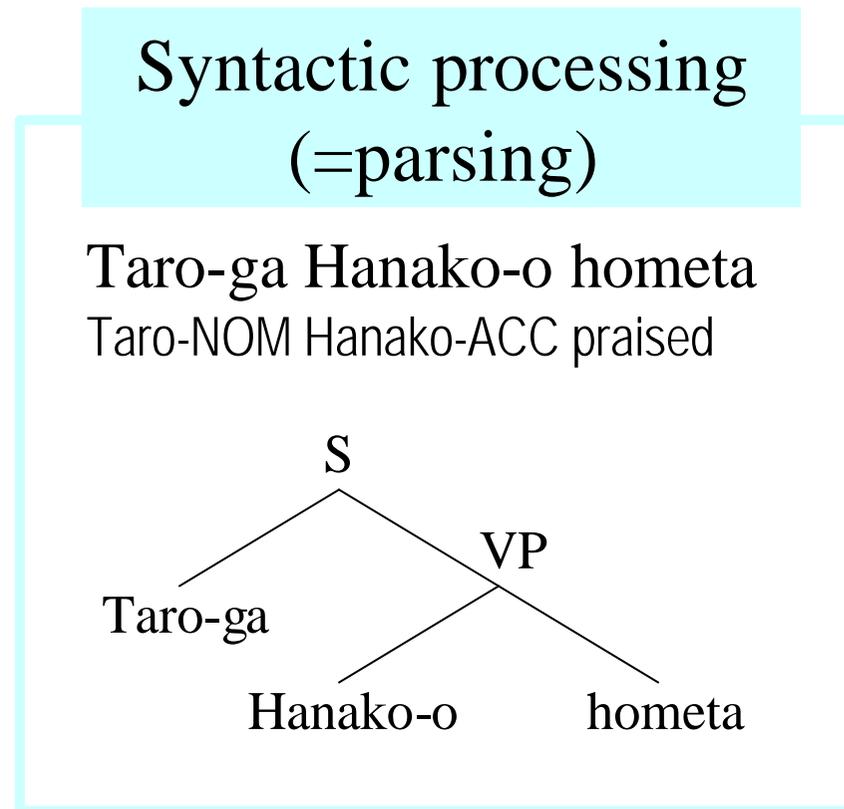
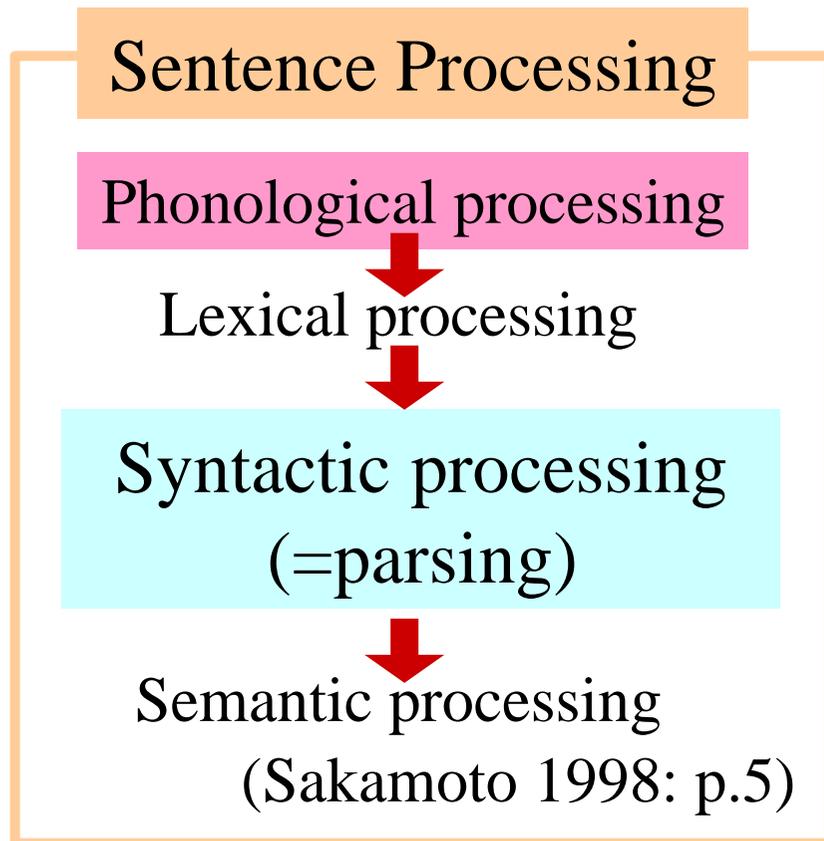
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# Sentence Processing

What is the Parser?

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



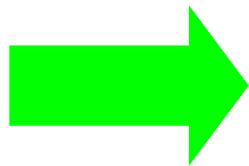
# Delayed parsing or Incremental parsing

## 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<sub>i</sub> sin'yaku-o kokorokara  
Morishita-NOM new medicine-ACC truly  
sin'yoosita ] yuuzintati<sub>i</sub>-ni atta.  
trusted friends-DAT met

"Morishita met the friends who truly trusted the new medicine."

(3): Late Opening:

Morisita<sub>i</sub>-ga sin'yaku-o [ ec<sub>i</sub> ec<sub>j</sub> kokorokara  
Morishita-NOM new medicine-ACC truly  
sin'yoosita ] yuuzintati<sub>j</sub>-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**.

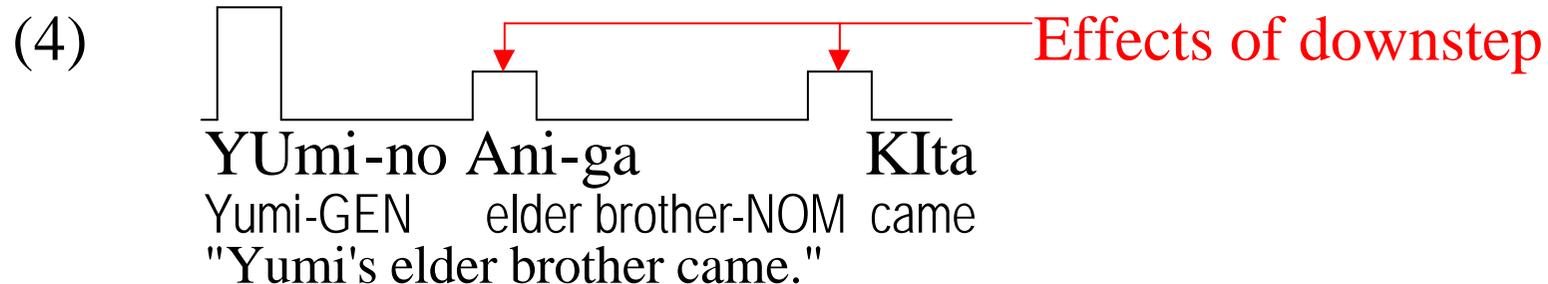
Which factor has a great influence  
on resolving ambiguity?



# MajP boundary and syntactic structure

Major phrase (McCawley 1968)

the domain for the effect of downstep.



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:

[<sub>IP</sub> Morisita-ga [<sub>VP</sub> [<sub>NP</sub> [<sub>CP</sub> [<sub>IP</sub> ec<sub>i</sub> [<sub>VP</sub> sin'yaku-o kokorokara  
Morishita-NOM new medicine-ACC truly  
sin'yoosita]]] yuuzintati<sub>i</sub>-ni] atta]].  
trusted friends-DAT met  
"Morishita met the friends who truly trusted the new medicine."

## (6) Late Opening:

[<sub>IP</sub> Morisita<sub>i</sub>-ga [<sub>VP</sub> sin'yaku-o [<sub>NP</sub> [<sub>CP</sub> [<sub>IP</sub> ec<sub>i</sub> [<sub>VP</sub> ec<sub>j</sub>  
Morishita-NOM new medicine-ACC  
kokorokara sin'yoosita]]] yuuzintati<sub>i</sub>-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:

Kinoo [<sub>NP</sub> [<sub>CP</sub> moratta] ringo-o] tabeta.  
Yesterday received apple-ACC ate.  
"Yesterday I ate an apple which I received"

c. Interpretation II:

[<sub>NP</sub> Kinoo [<sub>CP</sub> moratta] ringo-o] tabeta.  
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<sub>i</sub> ec<sub>j</sub>  
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:

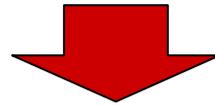
Morisita-ga sin'yaku-o [ ec<sub>i</sub> ec<sub>j</sub> kokorokara sin'yoosita]  
Morishita-NOM new medicine-ACC truly trusted  
{MajP } {MajP

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  
(11) (12)



**This result serves as evidence of the IPH.**

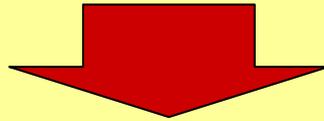
There was no study which investigated the effects of prosody in processing relative clause with using auditory stimulus.



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<sub>i</sub> Tomonori-o nessinni kyouikusiteita] sensei<sub>i</sub> -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

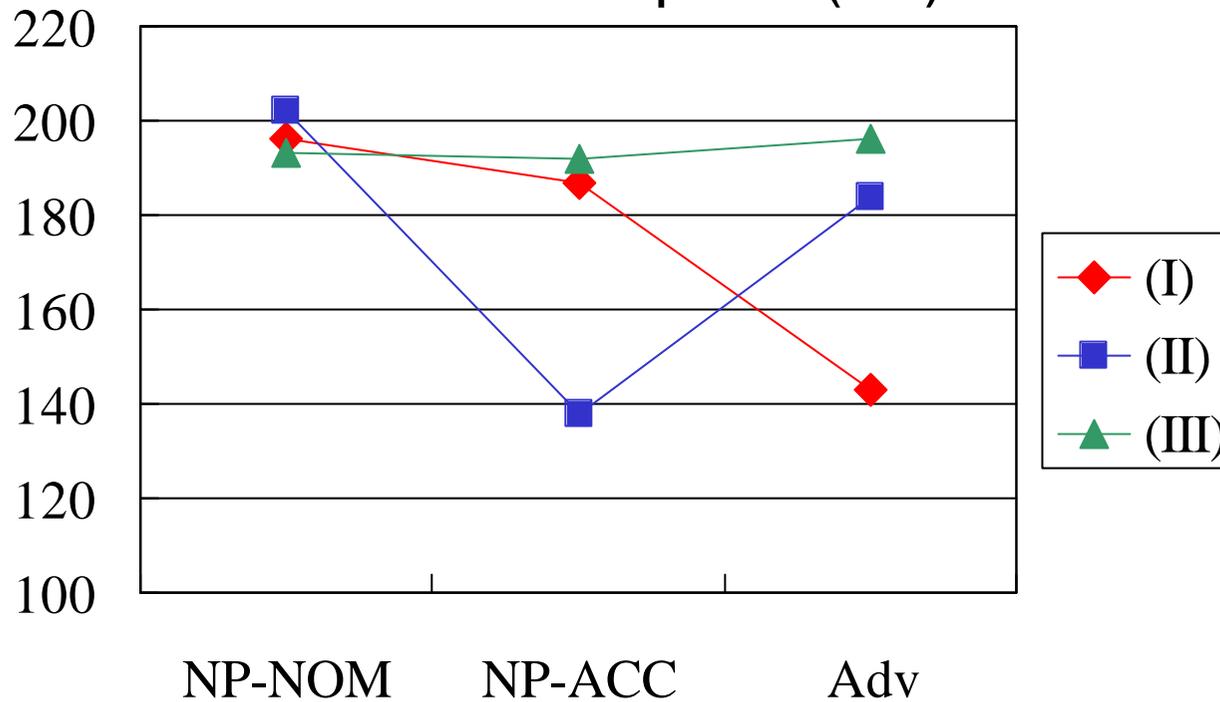
(II) A Pitch-range resetting didn't accord with a left clause  
boundary :

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 "#<sub>i</sub>" accorded with a left clause  
boundary, but the other Pitch-range resetting "#<sub>ii</sub>" didn't accord  
with a left clause boundary:

Yonemura-ga #<sub>i</sub> Tomonori-o #<sub>ii</sub> nessinni kyooikusiteita  
Yonemura-NOM Tomonori-ACC eagerly had educated  
sensee-ni kyoozai-o kasita.  
teacher-DAT teaching materials-ACC lend

Mean of F0 peak (Hz)



	NP-NOM	NP-ACC	Adv
Condition I	196.125	# 186.533	143.408
Condition II	201.957	138.075	# 184.335
Condition III	193.396	# <sub>i</sub> 191.642	# <sub>ii</sub> 195.950

- 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

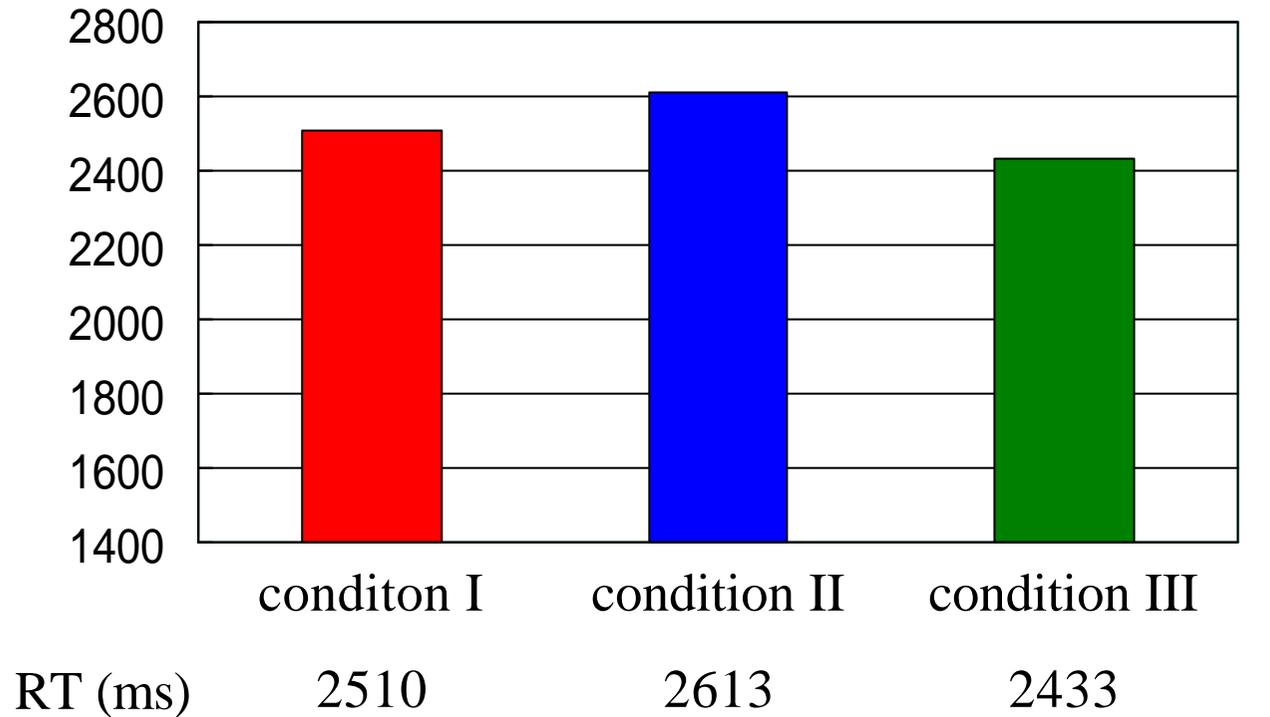
- |    |              |                        |         |     |
|----|--------------|------------------------|---------|-----|
| a. | Yonemura-ga  | kyoozai-o              | kasita. | Yes |
|    | Yonemura-NOM | teaching materials-ACC | lend    |     |
| b. | Tomonori-ga  | kyoozai-o              | kasita. | No  |
|    | Tomonori-NOM | teaching materials-ACC | lend    |     |

- Materials:

24 sets of sentence pairs as (I)-(III) above.

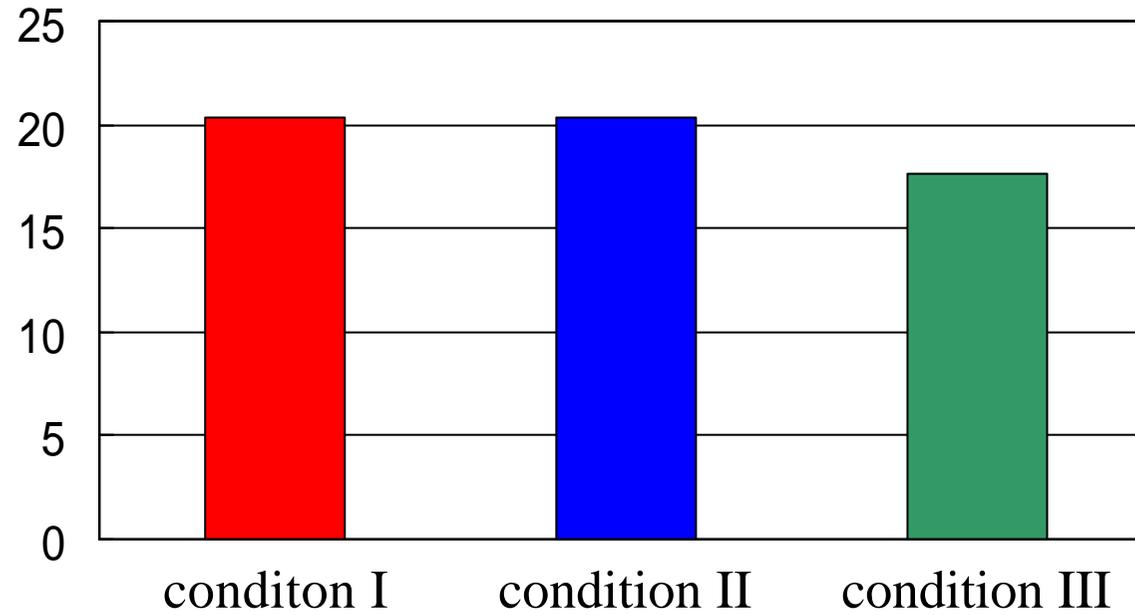
# Results

## Reaction Time



$F_1(2,26)=1.214, p=.3052, F_2(2,23)=2.380 p=.1039$

## Error Rate

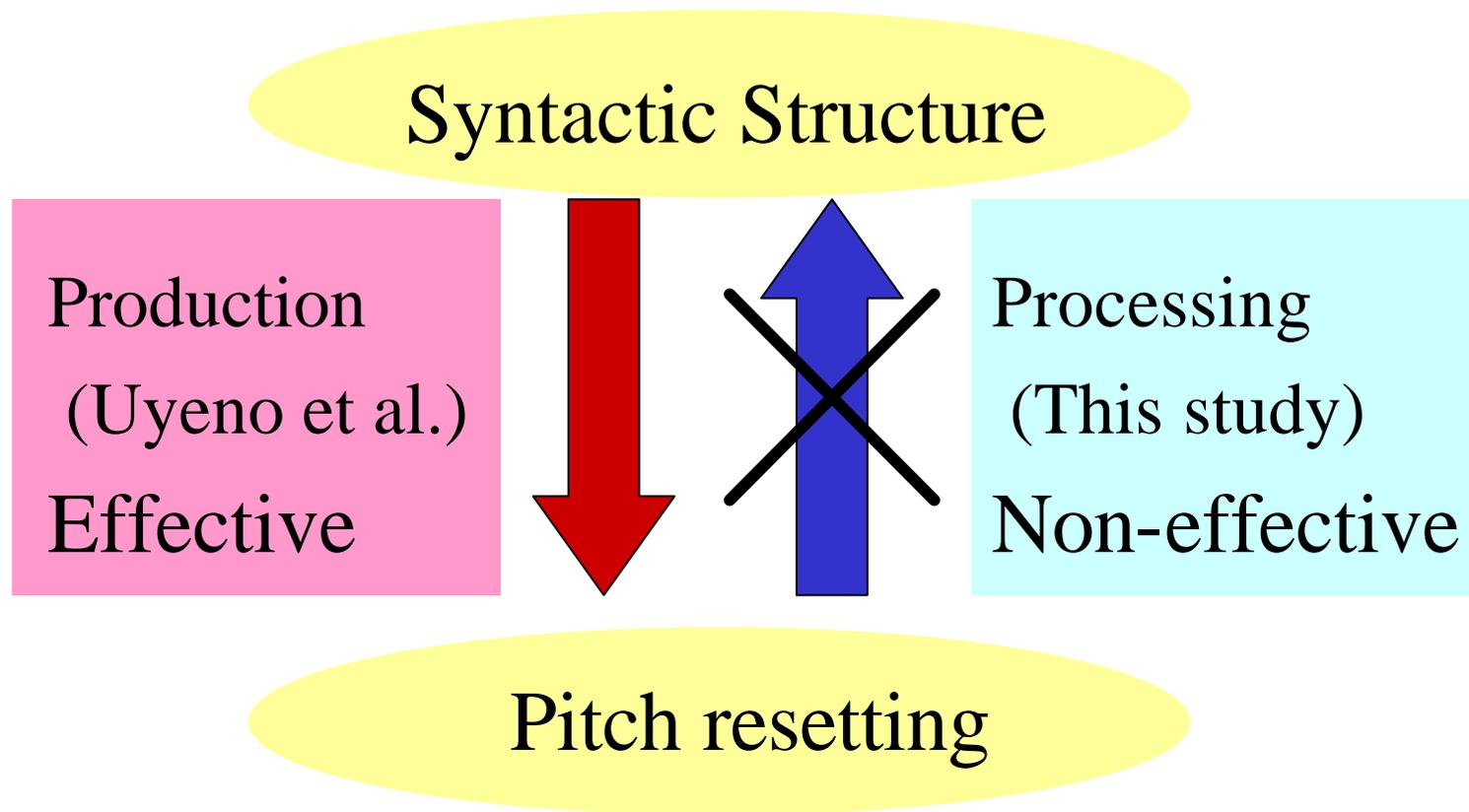


ER (%)      20.37                      20.37                      17.59

$F_1(2,26)=0.241, p=.7866, F_2(2,23)=0.675, p=.5141$

# Discussion

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



# "Reliable" information for the parser

MajP boundary inducers:

- Pitch-range resetting
  - Obligatory initial lowering
  - Making a pause
- } Pitch contour information
- Temporal information

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

Input: Pitch contour information only



Phonological Processing

Sufficient to recognize a MajP boundary

Syntactic Processing (Parsing)

Not reliable to assign a left clause boundary

## Acknowledgement

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