Effects of Intonational Patterns on Processing of Relative Clauses in Japanese

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Outline

Background
- Intonational Pattern
- Processing of Relative Clause

Experiment
- Procedure
- Result

Discussion
- General Discussion
- Further Issue
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(1) Japanese intonation is formed by
   a. Initial Lowering
   b. Downstep
   c. Lexical pitch accent
(1) Japanese intonation is formed by
   a. Initial Lowering
   b. Downstep
   c. Lexical pitch accent
(2) Initial Lowering
   a. A Low-High rise at left edge of a Minor Phrase (MiP)
   b. Regardless of its specification of accentedness

\[ \text{Yamamori-ga} \quad \text{Naomi-o} \quad (\text{yonda}) \]
(3) Factors on MiP formation 1: Accentedness

a. Accented PW forms a PW which is independent from the following PW.

(Aómori-no obáasan)

Accented Accented

(Aómori-no obasan)

Accented Unaccented

Two MiPs

Two MiPs
(3) Factors on MiP formation 1: Accentedness

b. Unaccented PW forms one MiP with the following PW.

(Oomori-no obāasan)  (Oomori-no obasan)
Unaccented  Accented  Unaccented  Unaccented

No Initial Lowering!
(4) Factors on MiP formation 2: Syntax

- Left edge of XP = MiP boundary. (Selkirk and Tateishi 1988, Kubozono 1993 others)

( Naomi-NOM) (America-LOC ) (obasan-DAT)(tegami-ACC okutta)
(4) Factors on MiP formation 2: Syntax
- Left edge of XP = MiP boundary. (Selkirk and Tateishi 1988, Kubozono 1993 others)

(Naomi-NOM) (America-GEN) (obasan-DAT) (tegami-ACC okutta)

No Initial Lowering!

![Graph showing intonational pattern of Japanese with pitch and time axes.]
(5) Downstep (or Catathesis)

- Pitch lowering triggered by lexical accent (HL fall)

(Náoya-no obáasan)  (Naomi-no obáasan)
Accented  Accented  Unaccented  Accented

![Downstep!](image)
Intonational Pattern of Japanese

(6) Syntactic factor on Downstep

- At the left edge of XP, Downstep is weakened/blocke(d (Selkirk and Tateishi 1991, Kubozono 1993, Ishihara 2008 etc.)

a.

![Diagram showing pitch and time changes in Japanese intonation]

**Japanese Text:**

Moríoka-LOC Náoya-GEN obáasan-DAT tegami-ACC okutta
(6) Syntactic factor on Downstep

- At the left edge of XP, Downstep is weakened/blocking (Selkirk and Tateishi 1991, Kubozono 1993, Ishihara 2008 etc.)

b.

```
Moríoka-LOC Náoya-NOM obáasan-DAT tegami-ACC okutta
```

![Graph showing intonational pattern with time and pitch values]
(7) Summary

a. Japanese Intonation
   - Initial Lowering (F0-rise)
   - Downstep (Reduction of pitch range)

b. A prosodic marker of the left edge of XP
   - Obligatory LH-rise
   - Reset of reduced pitch range
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Let us consider!

(8) What is the following word?

a. Yamada-ga Naomi-o yonda/hometa/sikatta
   Yamada-NOM Naomi-ACC called/praised/scold

b. Yamada-ga Naomi-ni atta/horeta/ayamatta
   Yamada-NOM Naomi-DAT met/fall:in/apologize
(9) Narrowing-down of subsequent elements
   a. The parser (reader/listener) narrows down subsequent elements before they appear.
   b. In narrowing down,
      - Case markers
      - Animacy
      - Negative concordance
      etc. function as factors. (see Muraoka 2008 for review)
(10) Reanalysis

- Does the sentence end?
  
  Yamada-ga Naomi-o yonda syoonen-ni
  Yamada-NOM Naomi-ACC called boy-DAT

- **Rean**alysis
  - simple sentence
(10) Reanalysis

- The sentence has not ended.

  Yamada-ga Naomi-o yonda syoonen-ni
  Yamada-NOM Naomi-ACC called boy-DAT

- Reanalysis
  - simple sentence $\rightarrow$ complex sentence
Let us consider again!

Yamada-ga Naomi-o yonda syoonen-ni _________
Yamada-NOM Naomi-ACC called boy-DAT
(11) Second-pass ambiguity

b. Yamada-ga Naomi-o yonda syoonen-ni syookaisita.

Yamada-NOM Naomi-ACC called boy-DAT consulted/introduced
(12) Early Opening type sentence
- Main predicates (V2)= 2-place
- N2=Relative clause
Processing of Relative Clause

(13) Late Opening type sentence


- Main predicates (V2) = 3-place
- N2 = Main clause (or Relative clause)
Detection of Opening point

a. Visual presentations (silent reading),
   There is no difference other than the main predicate between EO and LO.
EO: Yamada-ga Naomi-o yonda syoonen-ni ootaisita.
LO: Yamada-ga Naomi-o yonda syoonen-ni syookaisita.
(14) Detection of Opening point
a. Visual presentations (silent reading),
   
   There is no difference other than the main predicate between EO and LO.
   
   EO: Yamada-ga Naomi-o yonda syoonen-ni ootaisita.
   LO: Yamada-ga Naomi-o yonda syoonen-ni syookaisita.
   → You cannot detect the opening point before the main verb (ootaisita/syookaisita) appear.
(14) Detection of Opening point

a. Visual presentations (silent reading),
   There is no difference other than the main predicate between EO and LO.

EO: Yamada-ga Naomi-o yonda syoonen-ni ootaisita.
LO: Yamada-ga Naomi-o yonda syoonen-ni syookaisita.

→ You cannot detect the opening point before the main verb (ootaisita/syookaisita) appear.

b. Auditory presentations (oral reading)
   Intonational patterns are different between EO and LO.
(15) Syntax – intonation matching (Unaccented)

a. EO:

```
N1-NOM  N2-ACC  V1  N3-DAT  V2

[–Initial Lowering]
```

b. LO:

```
N1-NOM  N2-ACC  V1  N3-DAT  V2

[+Initial Lowering]
```
(16) Sample F0 (N2&V1 = Unaccented)

a. Early Opening

Yamada-ga Naomi-o yonda syoonen-ni ootaisita.

---

b. Late Opening

Yamada-ga Naomi-o yonda syoonen-ni syookaisita.
(17) Syntax – intonation matching (Accented)

a. EO:

```
  N1-NOM  N2-ACC  V1  N3-DAT  V2
   \      \     \     \   \[+Downstep]\     
    N1-NOM  N2-ACC  V1  N3-DAT  V2
```

b. LO:

```
  N1-NOM  N2-ACC  V1  N3-DAT  V2
   \      \     \     \   \[-Downstep]\     
    N1-NOM  N2-ACC  V1  N3-DAT  V2
```
(18) Sample F0 (N2&V1 = Accented)

- Early Opening
  Yamada-ga Náoya-o manéita syoonen-ni ootaisita.

- Late Opening
  Yamada-ga Náoya-o manéita syoonen-ni syookaisita.
(19) Summary

- Two types of complex sentences
  - EO-type: N1-NOM [N2-ACC V1] N3-DAT V2
  - LO-type: N1-NOM N2-ACC [V1] N3-DAT V2

- Initial Lowering on V1
  - No – EO
  - Yes – LO

- Downstep on V1
  - Yes – EO
  - No – LO

- Question
  Are these prosodic differences used as a cue for detecting the opening point of relative clauses?
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(20) Issues

- Does prosody affect increment sentence processing?
  → Prosody – syntax matching issue
- If Yes, is there a difference between accented words and unaccented words in sentence processing?
  → Accentedness issue
Issues

- EO-syntax – EO-prosody
  - Accented
  - Unaccented
- EO-syntax – LO-prosody
  - Accented
  - Unaccented
- LO-syntax – EO-prosody
  - Accented
  - Unaccented
- LO-syntax – LO-prosody
  - Accented
  - Unaccented
Procedure

Issues

- EO-syntax – EO-prosody
  - Accented
  - Unaccented
- EO-syntax – LO-prosody
  - Accented
  - Unaccented
- LO-syntax – EO-prosody
  - Accented
  - Unaccented
- LO-syntax – LO-prosody
  - Accented
  - Unaccented
(21) Global ambiguity in LO-type syntactic structure

- Main verb = 3-place, Relative verb = 2-place
- Apparent Noun = 3 \rightarrow Empty categories = 2
  - Too many possible interpretations!!
    b. Yamada-NOM Naoya-ACC [e1-NOM e2-ACC maneita] syoonen-DAT syookaisita
    c. Yamada-NOM Naoya-ACC [e1-NOM e2-ACC maneita] syoonen-DAT syookaisita
    d. Yamada-NOM Naoya-ACC [e1-NOM e2-ACC maneita] syoonen-DAT syookaisita
    e. Yamada-NOM e1-ACC [e2-NOM Naoya-ACC maneita] syoonen-DAT syookaisita

(There are, of course, other possibilities.)
(22) Sample F0 of unaccented conditions

Huzítani-san-ga Hirayama-san-o tuihoosita katyoo-ni mikatasita

a. EO prosody – Unaccented (EU) condition

b. LO prosody – Unaccented (LU) condition
(23) Sample F0 of accented conditions
Huzítani-san-ga Nisízaki-san-o oidásita katyoo-ni mikatasita
a. EO prosody – Accented (EA) condition

b. LO prosody – Accented (LA) condition
(24) Control of stimuli
   a. Lexical property of N2 and V1
      ◆ Mora length
      ◆ Word frequency
   b. Naturalness of matrix VP
(25) Control of stimuli 1: Lexical property

a. Mora length and frequency of a word affect its recognition.

N1      N2      V1      N3      V2
U: Huzítani-san-ga Hirayama-san-o tuihoosita katyoo-ni mikatasita
A: Huzítani-san-ga Nisízaki-san-o oidásita katyoo-ni mikatasita
(25) Control of stimuli 1: Lexical property

b. Mora length of N2 and V1

<table>
<thead>
<tr>
<th></th>
<th>N1</th>
<th>N2</th>
<th>V1</th>
<th>N3</th>
<th>V2</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>Huzítani-san-ga</td>
<td>Hirayama-san-o tuihoosita</td>
<td>katyoo-ni mikatasita</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Huzítani-san-ga</td>
<td>Nisízaki-san-o oidásita</td>
<td>katyoo-ni mikatasita</td>
<td></td>
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</tr>
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</table>

![Graph showing the comparison of accented and unaccented syllables in N2 and V1.](image)

- For N2: $p = 1.00$
- For V1: $p = 0.91$
(25) Control of stimuli 1: Lexical property
c. Word frequency of N2 and V1

<table>
<thead>
<tr>
<th>N1</th>
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<th>N3</th>
<th>V2</th>
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<tr>
<td>U: Huzítani-san-ga Hirayama-san-o tuihoosita kattyoo-ni mikatasita</td>
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</tbody>
</table>

\[ p = .23 \]

\[ p = .43 \]
(26) Control of stimuli 2: Naturalness

a. Materials: 32 pairs of sentences
   - Accented condition
     Ándoo-san-o syóotaisita ooeru-ni sittosita.
     Ando-Mr.-acc invited OL-dat was:jealous
   - Unaccented condition
     Yamanaka-san-o sasotta ooeru-ni sittosita.
     Yamanaka-Mr.-acc invited OL-dat was:jealous

b. Participants:
   34 undergraduate students in Kumamoto area

c. Procedure:
   Marking an appropriate point for each sentence from "very natural" (5) to "extremely unnatural" (1)
(26) Control of stimuli 2: Naturalness

d. Result

- Both the lexical property of N2 and V1 and naturalness of matrix VP were appropriately controlled between Accented conditions and Unaccented conditions.

\[ p = .88 \]
Procedure

(27) Stimuli recording

a. Male speaker of Tokyo Japanese
b. 28 years 3 months
c. Mean F0 of initial valley and peak
(28) Procedure of main experiment

a. Number of sentences
   - 32 sets of ‘Yes'-response sentences containing four conditions
   - 32 sets of ‘No'-response sentences
   - 28 filler sentences
   - Sets of 'yes'-response sentences are distributed in a Latin Square.

b. Participants
   - 28 undergraduate students at Kyushu University
Procedure

(28) Procedure of main experiment

c. Presentation
  ◆ an auditory stimulus from a headphone.

d. Instruction
  ◆ After listening to the stimuli, decide whether or not the sentence makes sense.
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(29) Reaction time
a. EO-prosody (Matched) < LO-prosody (Mismatched)
b. No significant difference for accentedness
c. No significant difference for interaction
Result

(30) Error rate

a. EO-prosody (Matched) < LO-prosody (Mismatched)
b. No significant difference for accentedness
c. No significant difference for interaction
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(31) Finding 1: Prosody – syntax matching
   a. Significant differences on reaction time and error rate are found in prosody – syntax matching.
   b. The result denotes that intonational pattern helps to detect the opening point of relative clauses.
   c. There is a longer reaction time and higher error rate as a result of the reanalysis process.
(32) Preference for 2-place predicates

- Yamada-NOM Naomi-ACC yonda syoonen-DAT ______
- Japanese speakers tend to fill a 2-place predicate in the blank. (Mazuka and Itoh 1995)
  → Preference: 2-place predicate > 3-place predicate
- The parser posits a phonologically null predicate ($pred$). (Muraoka 2008)
  Yamada-ga Naomi-o yonda
(32) Preference for 2-place predicates

- Yamada-NOM Naomi-ACC yonda syoonen-DAT ______
- Japanese speakers tend to fill a 2-place predicate in the blank. (Mazuka and Itoh 1995)
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Yamada-ga [Naomi-o yonda] syoonen-ni  *pred*
(33) RC processing with auditory presentation

**EO prosody [reanalysis = 0]**

Yamada-ga Naomi-o

**LO prosody [reanalysis = 0]**

Yamada-ga Naomi-o
(33) RC processing with auditory presentation

EO prosody [reanalysis = 0]
Yamada-ga Naomi-o yonda

LO prosody [reanalysis = 0]
Yamada-ga Naomi-o yonda
(33) RC processing with auditory presentation

EO prosody [reanalysis = 1]
Yamada-ga [Naomi-o yonda] syoonen-ni 2-place pred

LO prosody [reanalysis = 1]
Yamada-ga Naomi-o [yonda] syoonen-ni 3-place pred
(33) RC processing with auditory presentation

EO prosody [reanalysis = 1]

LO prosody [reanalysis = 2]
(33) RC processing with auditory presentation

EO prosody [reanalysis = 1]


LO prosody [reanalysis = 2]

Discussion

(34) Finding 2: Accented – unaccented contrast
a. No significant difference is found in accentedness.
b. The result implies that sentence processing is independent from lexical phonological information (=accentedness).
(35) This study conducted a decision-making experiment to investigate whether or not the parser uses prosodic cue in order to detect a left-clause boundary in Japanese.

Findings

a. Both Initial Lowering and Downstep work as a cue for detecting the opening point of relative clauses.

b. Contrast of accentedness does not make a significant difference for biasing of the opening point of relative clauses.
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Further Issue

(36) Degree of F0-rise at the relative verb
- **LO-prosody** > **EO-prosody** (Accented Condition)

![Graph showing N2-ACC and V1 with LO-prosody and EO-prosody curves]
Further Issue

(37) Factors on Minor Phrase formation

a. Syntax: The left edge of XP = the left edge of MiP
b. Rhythm: (i) Four PWs → two MiPs
   (ii) Four MiPs → two superiordinate MiPs
c. Phonology: Accented PW = rightmost PW of MiP
   (Selkirk and Tateishi 1988, Kubozono 1993, among others)
Further Issue

(38) Realization of Minor Phrase (F0-rise)

a. Selkirk et al.’s (2007) study
   syntax-driven F0-rise > phonology-driven F0-rise

b. Shinya et al.’s (2007) study
   syntax-driven F0-rise > rhythm-driven F0-rise
(39) **Accented – Unaccented**

Yonémura-NOM Náoya-ACC yonda syoonen-DAT ootaisita

**EO-prosody** 🎧  
**LO-prosody** 🎧
(40) Remaining Question

How do interpretations of a listener change depending on the degree of F0-rise?
Thank you!

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