Introduction

- **Japanese:** bimoraic minimality (e.g., Poser 1990, Itô 1990)
- **Experiment I:** monomoraic noun lengthening
  - Vowel length contrast: incompletely neutralized
- **Experiment II:** number recitation lengthening
  - Vowel length contrast: completely neutralized
- One phonological constraint → complete and incomplete neutralization

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### Complete neutralization

- Complete neutralization: two underlyingly distinct segments become identical
- **Classically-cited case:** German final devoicing (Trubetzkoy 1939/1969, p. 225; Bloomfield 1933/1984, pp. 218-219; Jakobson et al. 1952/1975, p. 9; Hyman 1975, pp. 29, 71-72)
- **The classic picture:**
  - /ʁɑt/ ‘advice’ → [ʁɑt]
  - /ʁad/ ‘wheel’

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### Incomplete neutralization

- Incomplete neutralization: two underlyingly distinct segments become nearly identical
- Some small trace of the underlying distinction is manifested on the surface, in the direction of the canonical realization of the contrast
  - /Χ/ → [Z(αF)] / (Context A)
  - /Y/ → [Z(βF)] / (Context A)
German devoicing, redux

■ German devoicing is actually incompletely neutralizing (Port and O’Dell 1985)
  ■ /ʁɑt/ ≠ /ʁɑd/, even on the surface

Commonly-cited cases of incomplete neutralization

■ German final devoicing (Port and O’Dell 1985, Mittleb 1981a,b, Dinnsen and Garcia-Zamor 1971, though see Fourakis and Iverson 1984)
■ Catalan final devoicing (Dinnsen and Charles-Luce 1984)
■ Polish final devoicing (Slowiaczek and Dinnsen 1985, Slowiaczek and Szymanska 1989)
■ Russian final devoicing (Dmitrieva 2005)
■ Dutch final devoicing (Warner et al. 2004, though see Warner et al. 2006)

Phonetic duration and phonological length

Incomplete neutralization: often small surface difference in phonetic duration

but

We know of no previously-reported cases of incompletely neutralized phonological length distinctions

1 See discussion of trochaic lengthening in Hayes (1995) and final lengthening in Chickasaw in Gordon and Munro (2007), which suggest that vowel lengthening might be an area rich for investigation.

Questions

(1) Can we expand the typology of incomplete neutralization to include new types of phonological contrasts?

(2) When we say that a contrast is (in)completely neutralized, what is the scope of that claim?
Japanese prefers minimally bimoraic words \cite{Poser1990, Itô1990}

Nicknames map to bimoraic units

<table>
<thead>
<tr>
<th>Name</th>
<th>Possible Nickname</th>
<th>Impossible Nickname</th>
</tr>
</thead>
<tbody>
<tr>
<td>yumiko</td>
<td>(yumi)$_1$-chaN</td>
<td>*(yu)$_1$-chaN (1 mora)</td>
</tr>
<tr>
<td>megumi</td>
<td>(megu)$_1$-chaN</td>
<td>*(me)$_1$-chaN (1 mora)</td>
</tr>
<tr>
<td>keiko</td>
<td>(kei)$_1$-chaN</td>
<td>*(ke)$_1$-chaN (1 mora)</td>
</tr>
<tr>
<td>se</td>
<td>(see)$_1$-chaN</td>
<td>*(se)$_1$-chaN (1 mora)</td>
</tr>
</tbody>
</table>

Monomoraic noun lengthening

Nouns with case particles

- Japanese has monomoraic nouns (e.g., *ki* ‘tree’)
- A case particle (e.g., *ga* ‘nom’) can provide the second mora

Examples from Mori (2002)

Monomoraic noun lengthening

Nouns without case particles

Case particles can be dropped in colloquial speech

1. a. me-*ga* akai-yo
   b. me-*Ø* akai-yo
      ‘(Your) eyes are red’
2. a. te-*o* aratta?
   b. te-*Ø* aratta?
      ‘(Did you) wash (your) hands?’

Examples from Mori (2002)
Monomoraic noun lengthening
Nouns without case particles

...But:
■ Japanese bimoraic syllables are generally 66–80% longer than monomoraic syllables (Beckman 1982, Hoequist 1983)
■ Why only 40–50% longer, then?
  ■ Mori (2002): to preserve the length contrast

Motivation for Experiment I
Two subclaims to prove incomplete neutralization:
■ lengthened nouns > short nouns (Mori 2002, but for only two nouns)
■ long nouns > lengthened nouns
  ■ Never shown for nouns with identical segmental content
■ Most cases of incomplete neutralization: devoicing, feature/segment-level contrasts
■ Itô (1990): Japanese bimoraicity requirement is ‘deep’ or ‘early’ in phonology
Stimuli

- 11 sets of three sentences (n=33)
  - Monomoraic noun, with a particle (‘short/prt’)  
  - Monomoraic noun, without a particle (‘short/Ø’)  
  - Underlyingly long noun (‘long’)
- Nouns within each set had the same segmental content  
  - Accent was matched in 9 sets
- Standard Japanese orthography
- Long vowels indicated by either (a) kanji alone, or (b) kana with a length mark (ー)
- See appendix

Some 'long' morphemes written with kanji, had they been written in hiragana, would have been written as diphthongs. They are generally pronounced as long monophthongs, in spite of this orthographic convention (see Vance 2008, pp.63-68, for discussion).

Participants and recording information

- Participants
  - 7 native speakers of Japanese (one excluded)  
  - Undergrad and grad students at Japanese universities  
  - Paid ¥500 (~$5)
- Recording details
  - Sound-attenuated room at International Christian University (Tokyo, Japan)  
  - TASCAM DR-40 recorder

Procedure

- Speakers practiced all items once
- Read all 33 sentences in random order  
  - Speakers were instructed not to pause mid-sentence
- Repeated 9 more times, re-randomized each time
Acoustic measurements

- Vowel duration

![Image of acoustic measurements](image.png)

A three-way distinction

Vowel duration

Mean vowel durations
- short/prt: 73.54ms
- short/Ø: 119.19ms
- long: 145.74ms

Statistical analysis

Linear mixed model (via lme4 package in R).
- Vowel duration was regressed against condition (short, lengthened, underlyingly long) as a fixed factor, and speaker and item as random factors
  - Planned contrasts (treatment coding): short vs. lengthened nouns, and lengthened vs. underlyingly long nouns.

Results

Statistical significance

Condition has a significant effect on measured vowel duration

- Short/prt vs. short/Ø: mean difference -45.65ms, $t = -8.018$, $p < 0.001$
- Long vs. short/Ø: mean difference 26.55ms, $t = 1.369$, $p < 0.05$

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3 $p$ values estimated by Markov Chain Monte Carlo method, via languageR package in R.
4 A t-test confirms the significance fo the long vs. short/Ø vowel length distinction: $t(1278.99) = -14.90$, $p < 0.001$
The pattern holds for all sets

And for all 6 speakers

Conclusions

Monomoraic nouns lengthen to meet the bimoraicity requirement

Vowel length is incompletely neutralized in this context

Implications for incomplete neutralization

- Most cases of incomplete neutralization are based on final devoicing
- Languages can incompletely neutralize a very different type of contrast (phonological length)
- A truly phonological process that leads to a case of incomplete neutralization which can’t be relegated to phonetic implementation
Experiment II

- Is the vowel length contrast incompletely neutralized everywhere in Japanese?
- Lengthening in a number recitation context, motivated by bimoraic minimality

Stimuli

Main stimuli sets

- 2 sets of three phrases
  - Monomoraic number, non-lengthening context (‘teens’)
    - (juuu-ni) ten-two (=12) NUM from
  - Monomoraic number, lengthening context (‘recitation’)
    - ichi (ni) san roku one two three six
  - Long noun, with identical segmental content (‘long’)
    - ano (nni) san tachi those older.brother HON PL
- Target words shared segmental content, modulo vowel length
- Frames in matched in mora count

Telephone number recitation (Itô 1990)

- Each digit in a phone number stands as its own prosodic word
- If the digit has more than one mora, it gets used with no modification
  - 3: saN (μμ)
- If the digit has a bimoraic allomorph, that one gets used
  - 4: yoN (μμ), *shi (μ)
- If a bimoraic allomorph does not exist, the digit is lengthened
  - 5: /go/ → [goo], *[go]

A sample phone number

<table>
<thead>
<tr>
<th>4</th>
<th>5</th>
<th>9</th>
<th>-</th>
<th>3</th>
<th>2</th>
<th>8</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>yoN</td>
<td>goo</td>
<td>kyuuu</td>
<td>(no) saN</td>
<td>nii</td>
<td>hachi</td>
<td>yoN</td>
<td></td>
</tr>
<tr>
<td>*shi</td>
<td>*go</td>
<td>*ni</td>
<td>*shi</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Additional stimuli sets

- ‘Bimoraic’ set (expectation: no lengthening)
  - san ‘3’ in ‘teens’ and ‘recitation’ contexts
- ‘Alternators’ (expectation: bimoraic allomorph)
  - shi/yon ‘4’ and ku/kyuu ‘9’ in ‘recitation’ context
**Participants, recording information, procedure, and statistics**

All details as in Experiment I, except:
- 12 native speakers of Japanese (different from Experiment I)
- Each speaker read all items in random order 7 times

**Results**

**Statistical significance**

- ‘recitation’ (lengthened) vowels were significantly longer than ‘teens’ (short) vowels
  - mean difference: 75.92ms
  - \( t = 10.586 \)
  - \( p < 0.001 \)
- ‘recitation’ (lengthened) vowels are not significantly different from ‘long’ vowels
  - mean difference: 13.85ms
  - \( t = 1.90 \)
  - n.s.

- Lengthened ‘recitation’ vowels were slightly longer than ‘long’ numbers (mean difference: 13.85ms, \( t = 1.90 \), n.s.)
- Bimoraic set: comparable difference
  - ‘recitation’ vowels were 15.92ms longer than ‘teens’ vowels
- The ‘recitation’ condition may induce \( \approx 15 \text{ms} \) of lengthening beyond bimoraic lengthening


Alternator sets

- All speakers produced all tokens of all items using the bimoraic allomorph (i.e., yoN for ‘4’ and kyyu for ‘9’)

Introduction

Experiment I

Discussion

Experiment II

Discussion

Alternator sets

- The short/long vowel length contrast appears to be completely neutralized in number recitation
- This lengthening is due to the same bimoraicity requirement as in Experiment I
- Non-significant difference between ‘recitation’ and ‘long’ vowels
  - Bimoraicity-lengthening + ≈15ms additional lengthening

Summary

- Experiment I: short/long vowel length contrast is incompletely neutralized in monomoraic noun lengthening
- Experiment II: short/long vowel length contrast appears completely neutralized in number recitation

- Duration-based length contrasts can be incompletely neutralized (Experiment I)
- A given contrast can be incompletely neutralized by one phonological process, but completely neutralized by a related process in the same language (Experiments I and II)

Where does the difference come from?

A working hypothesis...

- Lexical vs. post-lexical levels (Kiparsky 1982a,b, 1985, Mohanan 1982, Kisse and Shaw 1985)
- Monomoraic noun lengthening is conditioned by syntactic particles dropping (→ post-lexical)
- Allomorph selection in number recitation is affected by bimoraicity (→ lexical)
- Structure preservation (Kiparsky 1982a): lexical processes cannot introduce new segments
Hypothesis

- Hypothesis: Only post-lexical processes can introduce incompletely neutralized contrasts

- Preliminary typological support:
  - Devoicing in Russian is incomplete (Dmitrieva et al. 2010), and occurs across word-boundaries (Padgett 2011)
  - Flapping in American English is incomplete (Braver under review; Herd et al. 2010) and occurs across word-boundaries
  AND
  - Manner neutralization in Korean codas is complete (Kim and Jongman 1996), and lexical (Kang 1993)

Thanks!

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References

Braver, Aaron (under review). *Imperceptible Incomplete Neutralization: Production, Identification, and Discrimination of /d/ and /t/ Flaps in American English*.
References II


### Appendix: Experiment I Stimuli, Part I

<table>
<thead>
<tr>
<th>Japanese orthography</th>
<th>Transcription</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>木が倒れた。</td>
<td>ki ga taore-ta</td>
<td>tree NOM fall-PST</td>
</tr>
<tr>
<td>木倒れた。</td>
<td>ki taore-ta</td>
<td>tree NOM fall-PST</td>
</tr>
<tr>
<td>見つけた。</td>
<td>kii mitsukat-ta</td>
<td>key find-PST</td>
</tr>
<tr>
<td>木が倒れた。</td>
<td>na ga nie-ta</td>
<td>vegetable NOM cook-PST</td>
</tr>
<tr>
<td>見つけた。</td>
<td>&quot;naa&quot; to iw-are-ta</td>
<td>&quot;DISC&quot; COMP say-PST-PST</td>
</tr>
<tr>
<td>落ちた。</td>
<td>hi ga kie-ta</td>
<td>fire NOM go.out-PST</td>
</tr>
<tr>
<td>落ちた。</td>
<td>hi kie-ta</td>
<td>fire go.out-PST</td>
</tr>
<tr>
<td>火消し。</td>
<td>&quot;hii&quot; to sakan-da</td>
<td>&quot;INTERJECT.&quot; COMP shout-PST</td>
</tr>
<tr>
<td>火消し。</td>
<td>su ga nai</td>
<td>vinegar NOM NEG</td>
</tr>
<tr>
<td>消え。</td>
<td>su nai</td>
<td>vinegar NEG</td>
</tr>
<tr>
<td>スーと見つけた。</td>
<td>sun ga mitsukar-anai</td>
<td>Sue NOM find NEG</td>
</tr>
</tbody>
</table>

(continued...)