The effect of lexical stratum on perception of contrast

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Perception is influenced by NL phoneme categories and phonotactic restrictions

• [r]-[l] continuum perceived as 2 categories by English speakers, as 1 by Japanese speakers (Miyawaki et al. 1975).

• Ambiguous [r...l] perceived as [r] after [t], as [l] after [s] by English speakers (Massaro & Cohen 1983).

• Illegal CC perceived as CVC by Japanese speakers (e.g. ebzo as ebuza) (Dupoux et al. 1999).

This talk

**Question:** What if a single native language contains coexisting grammars with distinct phoneme categories and phonotactic restrictions?

**Domain of investigation:** Japanese lexical strata.

Japanese strata impose different restrictions on phonological structures


<table>
<thead>
<tr>
<th>Strata</th>
<th>Singleton [p]</th>
<th>Voiced geminate obstruent</th>
<th>Nasal-voiceless stop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yamato</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Sino-Japanese</td>
<td>no</td>
<td>no</td>
<td>yes (sampo ‘walk’)</td>
</tr>
<tr>
<td>Foreign</td>
<td>yes (peepaa ‘paper’)</td>
<td>yes (beddo ‘bed’)</td>
<td>yes (tenko ‘tent’)</td>
</tr>
</tbody>
</table>

Moreton & Amano 1999: Cues to stratum affect perception

• J speakers identified nonwords *CoC[a...aa]* as *CoCa* or *CoCaay*.

• [aa] is possible only in foreign stratum.

• Cs provided cues to stratum membership.

<table>
<thead>
<tr>
<th>Contextual cues</th>
<th>[p], [φp]</th>
<th>[ry], [by]</th>
<th>[t], [r]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Foreign</td>
<td>yes</td>
<td>no</td>
<td>yes</td>
</tr>
</tbody>
</table>

Results

**Ambiguous [a...aa] was more likely to be categorized as**

• **short** in Sino-Japanese cue context (*[aa]*).

• **long** in foreign cue context (where [a]-[aa] contrast is possible).

→ Contextual cues to stratum affiliation affected position of category boundaries.
Could knowledge of stratum membership alone affect category boundaries (in the absence of overt phonological cues to stratal affiliation)?

Subjects identified ambiguous stimuli created by lengthening final [a] or voiced stop in real words (e.g., mos[a...aa] identified as mosa or mosaa).

<table>
<thead>
<tr>
<th>Real word</th>
<th>Nonword</th>
</tr>
</thead>
<tbody>
<tr>
<td>mosa ‘tough guy’</td>
<td>*mosaa</td>
</tr>
<tr>
<td>togu ‘sharpen’</td>
<td>*toggu</td>
</tr>
<tr>
<td>nasa ‘NASA’</td>
<td>nasaa</td>
</tr>
<tr>
<td>magu ‘mug’</td>
<td>maggu</td>
</tr>
</tbody>
</table>

Results

Ambiguous [a...aa] and [g...gg] more likely to be categorized as

- **short** in words of native origin (*[aa], *[gg]).
- **long** in words of foreign origin (where contrasts are possible).

→ Knowledge of stratum affected position of category boundaries, even in the absence of overt phonological cues to stratal affiliation.

Our Question

- Cues to stratal affiliation affect categorization, suggesting that speakers may use different perceptual strategies for different strata.

- Can contextual cues to stratal affiliation also affect the ability to **discriminate** contrast?

Contrasts of interest: **si/shi** and **ti/chi**

Itô & Mester 1995, 1999; Crawford 2007, 2008: possibility of contrast determined by stratum

<table>
<thead>
<tr>
<th>Possible contrast?</th>
<th>si vs. shi (sh for E [ʃ], J [ʃ])</th>
<th>ti vs. chi (ch for [tʃ])</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Foreign</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td>(kas+i &gt; kashi ‘a loan’)</td>
<td>(kat+i &gt; kachi ‘a win’)</td>
<td>(shifuudo ‘seafood’) (shitibanku ‘Citibank’)</td>
</tr>
</tbody>
</table>

Experiment I

Subjects: 14 Japanese NSs (in Japan)
25 English NSs (in U.S.)

Stimuli: nonwords (LHH) produced by bilingual J-E

- \( \phi atiCV, \phi achiCV \) (foreign context)
- \( hyatiCV, hyachiCV \) (native context)

Task: ABX discrimination
(e.g., \( hyatire-hyahchire-hyatire \))
Expected results if discrimination is stratum-specific

- Stratum effect for J but not E listeners:
  - E: No difference for foreign vs. native context.
  - J: Better discrimination of ti/chi in foreign than native context.

- Manner effect for J but not E listeners:
  - E: No difference for ti/chi vs. si/shi.

Actual Results:

- No stratum effect for either J or E.
- But: manner effect for both J and E.

Questions

Question 1: Why was no stratum effect found for Japanese listeners? (Contra both Moreton & Amano and Gelbart & Kawahara studies)

Question 2: Why was a manner effect (better discrimination of ti/chi than si/shi) found for English listeners?

Q1: Why no stratum effect for J?
Possibility 1: Orthography

Gelbart & Kawahara 2007 presented options

- in katakana for foreign.
- in hiragana for native.

But: Moreton & Amano used only katakana, and “Gelbart (2005) obtained similar bias effects...in languages that do not use different orthographic systems for different strata...”

Q1: Why no stratum effect for J?
Possibility 2: Contrast type

- M&A, G&S: duration ([a] vs. [aa], [g] vs. [gg]).
- Our study: place, manner (ti vs. chi, si vs. shi).

Q1: Why no stratum effect for J?
Possibility 3: Task

This study: discrimination.

The discrimination task may have tapped into lower-level auditory processing, while the identification/categorization tasks tapped into phonological processing.
Q1: Why no stratum effect for J? Possibility 4: persistent discrimination

Results suggest perhaps the ability to perceive a contrast in one stratum cannot be ‘turned off’ for other strata (even where such contrasts are not possible).

Q2: Why manner effect for E? Possibility 1: Stimuli

Our stimuli were produced by a bilingual Japanese-English speaker (first language Japanese).

Could her production of s and sh (but not t and ch) be too different from canonical English productions?

Q2: Why manner effect for E? Possibility 4: persistent discrimination

- Japanese: ti/chi contrast possible in foreign stratum; si/shi contrast never possible.
- English: both contrasts possible.

BUT: Both Japanese and English speakers were significantly better at discriminating ti/chi than si/shi (p<.001).

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Experiment 2

Subjects: 16 English NSs (in US).

Stimuli: nonwords from Expt I produced by
- Japanese-English bilingual (from Expt 1)
- English NS.

Tasks:
1. Identification: e.g. hyatire or hyachire, hyasire or hyashire.
2. Goodness Rating: Participants grade t, ch, s, sh on a scale 1 (bad) - 5 (good).

Accuracy: No significant difference by speaker.

Goodness rating: Main effect of speaker for both sh and ch (both p<.005).
No significant goodness difference for *si*, *shi* vs. *ti*, *chi*

- English speakers did not rate the Japanese speaker’s *sh* as significantly worse than her *ch*.

- This suggests that the lower discriminability of *si/shi* vs. *ti/chi* is not simply an effect of lower acceptability of *shi* in the stimuli.

Q2: Why manner effect for E? Possibility 2: perceptual salience

Hypothesis: *ti/chi* distinction is inherently more salient than *si/shi* distinction (independent of native language).

Perceptual salience can also explain historical development

- Japanese speakers were originally exposed to both *si* and *ti* in foreign languages.

- Yet only *ti* became established in Japanese (e.g., *shitibanku* ‘Citibank’).

Contrast well established for younger speakers

Crawford 2007: “words first attested before about 1890 usually show the TI -> ČI adaptation pattern, while words first attested after about 1930 usually show the TI -> TI adaptation pattern instead…”

Shaw 2007, Shaw & Balusu 2010:
- For younger speakers, *ti/chi* are generally distinct.

Summary

- Cues to stratal affiliation affect categorization, but do not appear to affect discrimination.

- Both Japanese and English speakers show better discrimination of *ti/chi* than *si/shi*.

- If *ti/chi* are inherently more distinct than *si/shi*, this could explain the fact that only the first contrast became established in Japanese.

Thanks to

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Selected References

• Shaw, Jason. 2007. /r/-/ɾ/ contrast preservation in Japanese loans parasitic on segmental cues to prosodic structure. ICPhS XVI, 1365-1368.