2aSC10

The Degree of Word-Initial Low Tone in Japanese:

Syntactic Boundaries and Speech Rate

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Goal is to show:

(i) Word-initial low pitch may be retained in some degree in connected speech, contra previous theoretical studies.
(ii) The degree of low depends on speech rate and the number of syntactic boundaries between the word and the immediately preceding word.
(iii) The phenomena can be explained by syntax-phonology mapping and silent demibeat deletion (Tokizaki 1999, 2006).

Previous studies:
Word-initial low tone deletion
1. a. amai ‘sweet’
   L HH
2. b. momo ‘peach’
   L H

(2) amai momo ‘sweet peaches’
LHH L H
-> LHH H H (Initial low deletion)

It has been claimed that initial low is assimilated to the high pitch in connected speech (cf. Selkirk and Tateishi 1988).

Q: Is the word-initial low pitch deleted completely?
A: No.
The word-initial low pitch may be retained in some degree, which depends on:
(i) speech rate
(ii) the numbers of syntactic boundaries between the word and its immediately preceding word.

(3) momo-to nira ‘sweet peach’
L H H LH ->
L H H LH/MidH/HH (initial low may be retained)

Experiments
Four native speakers of Japanese are asked to read out printed sentences twice at three speech rates: slow, normal, and fast.
The pitch difference between the first and the second mora of the unaccented word is calculated.

(4) [Momo-to nira-o] … nira
   peach-and leek-Acc L H in isolated form

(5) [[Amai momo-to] nira-o] …
   sweet peach-and leek-Acc

Test sentences
(4) Momo-to nira-o yome-ni ageta
   peach-and leek-Acc daughter-in-law gave
   ‘I gave my daughter-in-law peaches and leek.’

(5) Amai momo-to nira-o yome-ni ageta
   sweet peach-and leek-Acc daughter-in-law gave
   ‘I gave my daughter-in-law sweet peaches and leek.’

Amai ‘sweet’ modifies momo ‘peach’ only, because nira ‘leeks’ are not sweet. [[Amai momo-to] nira.]
Pitch difference between the first and the second mora: momo-to nira-o (ex. Subject 1)

<table>
<thead>
<tr>
<th>Subject</th>
<th>Rate/pos.</th>
<th>to</th>
<th>ni</th>
<th>ri-nil</th>
<th>ri-nil av 1&amp;2</th>
</tr>
</thead>
<tbody>
<tr>
<td>slow1</td>
<td>273.58</td>
<td>205.02</td>
<td>206.74</td>
<td>1.72</td>
<td></td>
</tr>
<tr>
<td>slow2</td>
<td>258.02</td>
<td>191.65</td>
<td>194.74</td>
<td>3.09</td>
<td>slow 2.405</td>
</tr>
<tr>
<td>normal1</td>
<td>298.43</td>
<td>244.39</td>
<td>241.76</td>
<td>-2.63</td>
<td></td>
</tr>
<tr>
<td>normal2</td>
<td>247.15</td>
<td>204.05</td>
<td>209.87</td>
<td>5.82</td>
<td>normal 1.585</td>
</tr>
<tr>
<td>fast1</td>
<td>288.42</td>
<td>237.45</td>
<td>238.83</td>
<td>1.48</td>
<td></td>
</tr>
<tr>
<td>fast2</td>
<td>262.44</td>
<td>224.56</td>
<td>227.43</td>
<td>2.87</td>
<td>fast 2.175</td>
</tr>
</tbody>
</table>

An example of the result (Subject 1). The numbers in ri-nil show pitch difference of the first (ni) and the second (ri) mora, i.e. the degree of initial low. Initial low is retained in connected speech.

Pitch difference between the first and the second mora: momo-to nira-o

<table>
<thead>
<tr>
<th>Rate/Subj</th>
<th>Subj 1</th>
<th>Subj 2</th>
<th>Subj 3</th>
<th>Subj 4</th>
<th>av 1-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slow 1</td>
<td>1.72</td>
<td>3.44</td>
<td>3.85</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Slow 2</td>
<td>3.09</td>
<td>3.24</td>
<td>14.65</td>
<td></td>
<td>7.7</td>
</tr>
<tr>
<td>Slow av</td>
<td>2.405</td>
<td>3.34</td>
<td>9.25</td>
<td>6.85</td>
<td>5.4612</td>
</tr>
<tr>
<td>Normal 1</td>
<td>-2.63</td>
<td>3.17</td>
<td>2.97</td>
<td>14.51</td>
<td></td>
</tr>
<tr>
<td>Normal 2</td>
<td>5.82</td>
<td>2.91</td>
<td>9.24</td>
<td>5.98</td>
<td></td>
</tr>
<tr>
<td>Normal av</td>
<td>1.585</td>
<td>3.04</td>
<td>6.105</td>
<td>10.245</td>
<td>5.2462</td>
</tr>
<tr>
<td>Fast 1</td>
<td>1.48</td>
<td>2.37</td>
<td>5.33</td>
<td>13.97</td>
<td></td>
</tr>
<tr>
<td>Fast 2</td>
<td>2.87</td>
<td>1.29</td>
<td>4.94</td>
<td>17.25</td>
<td></td>
</tr>
<tr>
<td>Fast av</td>
<td>2.175</td>
<td>1.83</td>
<td>5.135</td>
<td>15.61</td>
<td>6.1875</td>
</tr>
</tbody>
</table>

Only Subject 4 shows increasing degree of initial low with increasing speech rate. Subject 4 uses intentional pause before ni.

Pitch difference and speech rate

(4) momo-to nira-o: Subj 1-4

The degree of initial low decreases from slow to normal, and increases from normal to fast (because of Subject 4).

Pitch difference and speech rate

(4) momo-to nira-o: Subj 1-3

To sum, the degree of initial low decreases as speech rate increases. (Note that Subject 4 is omitted here.)

Constituent boundary and pitch difference: [(ama-i momo-to) nira-o]

<table>
<thead>
<tr>
<th>Subject</th>
<th>to</th>
<th>ni</th>
<th>ri-nil</th>
<th>ri-nil av 1&amp;2</th>
</tr>
</thead>
<tbody>
<tr>
<td>slow1</td>
<td>262.48</td>
<td>192.97</td>
<td>199.38</td>
<td>6.41</td>
</tr>
<tr>
<td>slow2</td>
<td>240.87</td>
<td>192.81</td>
<td>195.66</td>
<td>2.85</td>
</tr>
<tr>
<td>normal1</td>
<td>275.28</td>
<td>216.04</td>
<td>223.22</td>
<td>7.18</td>
</tr>
<tr>
<td>normal2</td>
<td>241.51</td>
<td>204.89</td>
<td>209.54</td>
<td>4.65</td>
</tr>
<tr>
<td>fast1</td>
<td>254.83</td>
<td>215.18</td>
<td>221.89</td>
<td>6.71</td>
</tr>
<tr>
<td>fast2</td>
<td>239.32</td>
<td>200.88</td>
<td>205.91</td>
<td>5.03</td>
</tr>
</tbody>
</table>

Ama ‘sweet’ is added to momo-to ‘peach-and’, making a constituent boundary before nira ‘leek’. An example of the result (Subject 1).
Pitch difference between the first and the second mora: \([\text{amai momo-to} \text{ nira-o}]\) S1-4

<table>
<thead>
<tr>
<th></th>
<th>Subj 1</th>
<th>Subj 2</th>
<th>Subj 3</th>
<th>Subj 4</th>
<th>av Subj 1-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>slow</td>
<td>6.41</td>
<td>5.41</td>
<td>5.11</td>
<td>5.79</td>
<td></td>
</tr>
<tr>
<td>slow av</td>
<td>4.63</td>
<td>4.3</td>
<td>4.81</td>
<td>5.215</td>
<td>4.7387</td>
</tr>
<tr>
<td>normal</td>
<td>7.18</td>
<td>5.54</td>
<td>9.08</td>
<td>8.11</td>
<td></td>
</tr>
<tr>
<td>normal av</td>
<td>4.65</td>
<td>7.2</td>
<td>2.3</td>
<td>7.67</td>
<td></td>
</tr>
<tr>
<td>fast</td>
<td>6.71</td>
<td>4.98</td>
<td>6.12</td>
<td>9.95</td>
<td></td>
</tr>
<tr>
<td>fast av</td>
<td>5.03</td>
<td>0.82</td>
<td>9.18</td>
<td>18.26</td>
<td></td>
</tr>
<tr>
<td>fast av</td>
<td>5.87</td>
<td>2.08</td>
<td>7.56</td>
<td>14.115</td>
<td>7.40625</td>
</tr>
</tbody>
</table>

Pitch difference between the first and the second mora: \([\text{amai momo-to} \text{ nira-o}]\) S1-3

<table>
<thead>
<tr>
<th>subject</th>
<th>subject 1</th>
<th>subject 2</th>
<th>subject 3</th>
<th>av S1-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>s1</td>
<td>6.41</td>
<td>5.41</td>
<td>5.11</td>
<td></td>
</tr>
<tr>
<td>s2</td>
<td>2.85</td>
<td>3.19</td>
<td>4.51</td>
<td></td>
</tr>
<tr>
<td>average</td>
<td>4.63</td>
<td>4.3</td>
<td>4.81</td>
<td>4.58</td>
</tr>
<tr>
<td>n1</td>
<td>7.18</td>
<td>5.54</td>
<td>9.09</td>
<td></td>
</tr>
<tr>
<td>n2</td>
<td>4.65</td>
<td>7.2</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>average</td>
<td>5.915</td>
<td>6.37</td>
<td>5.695</td>
<td>5.99333</td>
</tr>
<tr>
<td>t1</td>
<td>6.71</td>
<td>4.98</td>
<td>6.12</td>
<td></td>
</tr>
<tr>
<td>t2</td>
<td>5.03</td>
<td>-0.82</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>average</td>
<td>5.87</td>
<td>2.08</td>
<td>7.56</td>
<td>5.17</td>
</tr>
</tbody>
</table>

Pitch difference increases as speech rate increases. (71)

Pitch difference is maximum at the normal speech rate. (Note that Subject 4 is omitted.) Small pitch difference at the low speech rate might be attributed to mora-to-mora pronunciation.

[momo-to nira-o] vs \([\text{amai momo-to} \text{ nira-o}]\)

Pitch difference is larger in \([\text{amai momo-to} \text{ nira-o}]\) than in [momo-to-nira-o] at normal and fast rates (but not at slow), which shows the effect of syntactic boundary on pitch.

Syntax-phonology mapping and assimilation blocking by silent demibeats

(13) Syntax Spell-Out Phonetic Form

\[
\{ \} \rightarrow \Delta \quad (\text{silent demibeat})
\]

(c.f. Selkirk 1984)

(14) \([\text{[momo-to] nira-o]}\]

\[\begin{array}{c}
\begin{array}{c}
\text{momo-to} \\
\text{ nira-o}
\end{array} \\
\text{H}
\end{array} \rightarrow \begin{array}{c}
\begin{array}{c}
\text{L}
\end{array} \\
\text{H}
\end{array} \]

3 demibeats block assimilation to H

\([\text{[amai] momo-to]} [\text{ nira-o]}]\)

\[\begin{array}{c}
\begin{array}{c}
\text{amai} \\
\text{momo-to} \\
\text{ nira-o}
\end{array} \\
\text{H}
\end{array} \rightarrow \begin{array}{c}
\begin{array}{c}
\text{L}
\end{array} \\
\text{H}
\end{array} \]

3 demibeats block assimilation to H
More silent demibeats are deleted as speech rate increases

(15) Delete $n$ silent demibeats between words.
(n: a natural number corresponding to rate)

(16) \[\box{[momo-to] [nira-o]}\]

\[
\begin{align*}
\text{momo-to } & \text{ nira-o } \text{ } \text{ (slow: } n=0) \text{ } (H \text{ } L \text{ } H \rightarrow \text{ } H \text{ } H \text{ } H) \\
\text{momo-to } & \text{ nira-o } \text{ } \text{ (normal: } n=1) \text{ } (H \text{ } L \text{ } H \rightarrow \text{ } H \text{ } M \text{ } H \text{ } H) \\
\text{momo-to } & \text{ nira-o } \text{ } \text{ (fast: } n=2) \text{ } (H \text{ } L \text{ } H \rightarrow \text{ } H \text{ } H \text{ } H)
\end{align*}
\]

The same is expected but see Slide 16. Life is not that simple ...

\[\text{[ama]-[ [momo-to]] [nira-o]}\]

\[\text{xxx amai } \text{ [momo-to] } \text{ nira-o } \text{ } \text{xxx}\]

Conclusion

- Word-initial low tone may be retained in some degree in connected speech.
- Low tone becomes higher as the speech rate increases.
- Low tone does not become higher if it immediately follows a constituent boundary.
- These phenomena can be explained by the bare mapping (Tokizaki 1999, 2006).

References


