Introduction

Generally, closure duration is a primary cue used to distinguish plosive geminate and singleton stops (Fukui, 1978). However, closure duration is not an absolute value. It is relative. That is, closure duration is controlled by the neighboring phonemes. However, it is not yet clear what factors affect the closure duration at the perceptual boundary between geminate and singleton stops by either Japanese native speakers or by Korean learners of Japanese.

Accordingly, this paper investigates the relationship between the preceding vowel and the closure duration at the perceptual boundary by Japanese native speakers and Korean learners of Japanese.

Concretely, this paper’s research questions are as follows. First, what is the relationship between the preceding vowel length and the perceptual boundary of the geminate and singleton stops? Second, what are the differences, if any, between the perceptual boundary of Korean learners of Japanese and that of Japanese native speakers?

Method

Participants

Eighteen native speakers of Japanese from Tokyo and forty-five Korean Japanese learners participated in the study. They exhibited no symptoms of hearing disability and were compensated for their participation.

Stimuli

The materials were three pairs of 2 mora and 3 mora words which contrasted singleton and geminate stops (/aka/-/akka/, /saka/-/sakka/, /raka/-/rakka). Each item was produced both in isolation and embedded in a carrier sentence: for example, watasiwa ___to iimasita (I said ____). A female Japanese speaker spoke the items with an LH-type pitch accent at a normal speaking rate. The materials were digitally recorded.

A stimulus set was created from the materials by acoustically modifying the duration of the previous vowel and the closure of the unvoiced plosive between the first and second mora of each word. Two preceding vowel lengths (PV, long and short) were used and the length of the stop was modified to provide samples varying by 20ms in length by either inserting silence or removing part of the closure.

Procedure

Each subject heard each stimulus a single time and was asked to judge whether he or she heard had heard a 3-mora or 2-mora word. Feedback was not provided during the judgment task. To analyze the results, the perceptual boundary point (B.P.) was defined as the point which measured a 0.5 response rate on the logistic curve for each item between geminate and singleton stops.

Results

The results for the first research question are as follow. The perceptual boundary point is longer when the preceding vowel length was shorter (see Table 1). A repeated measured ANOVA revealed main effects for the length of the preceding vowel [F(1, 61)=416.0, p<0.001]. This result indicates the perceptual boundary of the geminate and singleton stop significantly depends on the length of the preceding vowel.

The results for the second question are as follows. The B.P was different between the Japanese native speakers and Korean learners of Japanese on all items. The ANOVA also revealed main effects of the preceding vowel between groups [F(1, 61)=6463.9, p<0.001]. Moreover, the analysis determined that some Korean learners of Japanese were not able to distinguish between geminate and singleton stops.
**Table 1: Perceptual boundary point results**

<table>
<thead>
<tr>
<th>items</th>
<th>Preceding Vowel (ms)</th>
<th>Korean Speakers (N=45)</th>
<th>Japanese Speakers (N=18)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>B.P mean</td>
<td>SD</td>
</tr>
<tr>
<td>/aka/-akka/</td>
<td>115</td>
<td>112.5</td>
<td>11.5</td>
</tr>
<tr>
<td></td>
<td>91</td>
<td>123.7</td>
<td>11.0</td>
</tr>
<tr>
<td>/saka/-sakka/</td>
<td>94</td>
<td>92.8</td>
<td>11.8</td>
</tr>
<tr>
<td></td>
<td>73</td>
<td>103.9</td>
<td>12.4</td>
</tr>
<tr>
<td>/raka/-rakka/</td>
<td>116</td>
<td>93.2</td>
<td>13.3</td>
</tr>
<tr>
<td></td>
<td>99</td>
<td>95.6</td>
<td>16.7</td>
</tr>
</tbody>
</table>

**Discussion**

The results of this study demonstrated there was a compensation effect observed in the perceptual boundaries when the prior vowel was shortened. Thus, there is a possibility that the perceptual units of geminate/ single stops are based on a VC structure. These results coincide with results reported by Ofuka et al. (2005).

However, the results of this study suggest that further investigation is necessary before these conclusions can be extended further. Particularly, the effects of segment duration including the preceding mora, or the preceding consonant need to be further investigated.

Finally, it was determined that while Korean learners perceive the geminate/ singleton stop as a part of a VC unit the same as native speakers, the perceptual boundary is perceived differently. This difference is possibly related to the extent of temporary compensation. Further investigation is necessary to determine if this temporary compensation is a unique durational characteristic of Japanese mora timing. Related to this is Kato et al.’s (1997, 1999) hypothesis which predicts that the segmental duration is fundamental to the temporal unit controlling Japanese timing. If this is the case, so, the possibility remains that the temporal unit of the Korean affects how Korean learners of Japanese distinguish geminate and singleton stops. This needs verification in future research.

**References**


