Perception of English /r/ and /l/ by Native Speakers of Japanese under the Condition of Onset Lengthening*

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1 Introduction

Certain English sounds have been acknowledged as being difficult for native speakers of Japanese to acquire. In fact, it is reasonable to say that English liquids, i.e., /r/ and /l/, are two of the most confusing sounds for Japanese speakers [1–4]. According to the difficulty ranking of English consonants for middle high-school students devised by Shirahata (2002) [5], the /r/-/l/ contrast stands second on the list. However, this does not mean that the contrast is unable to be learned by native speakers of Japanese. Lively *et al.* (1992, 1994) [3, 4] suggests that perceptual training with an appropriate amount of stimulus variability leads to long-term retention of phonetic categories.

On the other hand, recent research has reported a peculiar pattern of English liquid perception, more concretely, perceptual assimilation [6], by Japanese speakers. In the study of Guinon *et al.* (2000) [7], they found that the English mono-syllables /ra/ and /la/ were perceived as /ura/ and /ula/ by native speakers of Japanese. Because such perceptual patterns cannot be explained in terms of Japanese phonotactics or perceptual assimilation, an experiment was conducted in a later study [8] to investigate the phenomenon more closely. In Tomaru *et al.* (2016) [8], native speakers of Japanese were presented with the English syllables /ra/ and /la/ with the beginning of the first consonants variously lengthened (onset lengthening) as follows: 0 ms, 50 ms, 100 ms, 150 ms and 200 ms. They found that when the onset of /r/ was lengthened by more than 100 ms, Japanese speakers were likely to hear a nonexistent illusionary /u/ before the /r/. In other words, the English /ra/ syllable was likely to be heard as /ura/ by native speakers of Japanese if the beginning of the /r/ lasted more than 100 ms.

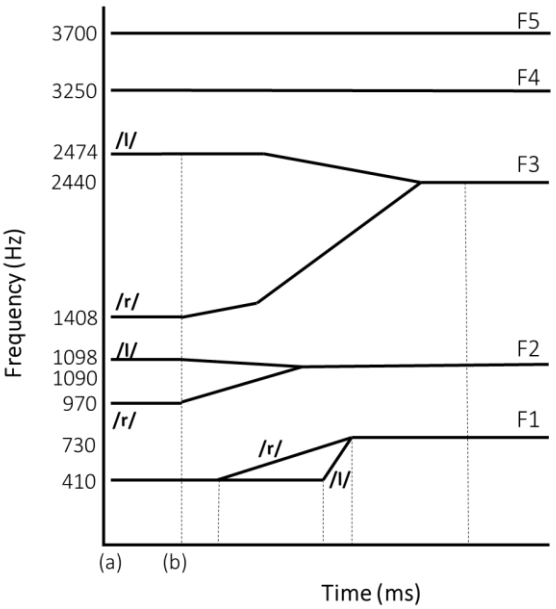

Fig. 1 Schematic trajectories of /r/ and /l/ formant transitions.

The primary aim of the study by Tomaru *et al.* (2016) [8] was to investigate under what conditions Japanese speakers hear an illusionary /u/ before onset. In the present study, we attempted to examine whether onset lengthening has any impact on Japanese speakers' ability to discriminate /r/ from /l/.

2 Experiment

2.1 Materials and Participants

We employed the same stimuli that had been used in the study by Tomaru *et al.* (2016) [8]; those stimuli had been created using a cascade formant synthesizer [9, 10]. All /r/ stimuli had the same steady-state and transition formant frequency

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values for the first five formants (F1 through F5). Likewise, all /l/ stimuli had the same steady-state and transition values. However, the length of the beginning of the consonant before the transition (the length between points (a) and (b) in Fig. 1) was different for the following five conditions: 0 ms, 50 ms, 100 ms, 150 ms and 200 ms. Therefore, the total duration of onset was lengthened. The total duration of stimuli also varied from 250 to 450 ms depending on the length of onset.

Four of the 10 participants who participated in the study by Tomaru *et al.* (2016) [8] came back to participate in the present experiment.

2.2 Methods

Participants were presented with stimuli and asked to perform a two-alternative forced- choice task. That is, they were asked to identify the English syllables they heard by selecting from two choices, /ra/ or /la/, appearing on a computer screen.

There were 10 repetitions of each stimulus, so the participants made a total of 100 judgments (two consonants × five conditions × ten repetitions = 100). The experiment was carried out using the Praat software [11].

2.3 Results

Overall percentage of /la/ response (Fig. 2) shows that Japanese speakers accurately identified /l/ stimuli under all conditions. On the other hand, the percentage of /ra/ (Fig. 2) increased from an average of 58% under the 0 ms condition to 90% under the 50 and 100 ms conditions, and then to 100% under the 150 and 200 ms conditions.

3 Discussion

The results of the present study suggest that Japanese speakers have no problems identifying /l/ under all conditions. On the other hand, the identification accuracy decreases for /r/ under the 0 ms condition, but it increases when the onset is lengthened by more than 50 ms. Therefore, native speakers of Japanese appear to be better at discriminating /r/ from /l/ when these consonants are sufficiently long. In addition, the findings of an informal pilot experiment suggest that native speakers of English do not hear an illusionary /u/ before /r/ or /l/ sounds under any onset length. In

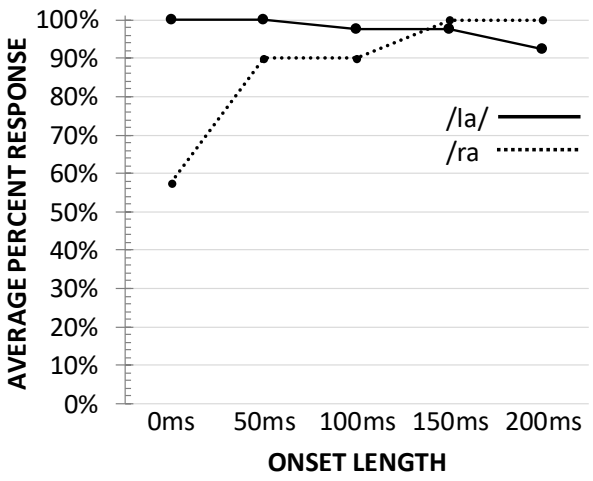

Fig 2. Average /la/ and /ra/ response.

fact, stimuli with longer onsets were judged as better examples of English /r/ and /l/. Therefore, it is implied that longer /r/ and /l/ sounds may allow Japanese speakers' better perception and pronunciation of /r/ and /l/.

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