Is allophonic variation in Japanese /r/ a factor in Japanese listeners’ difficulty in perceiving English /l-/?

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Abstract: American English listeners’ perception of Japanese /r/ was studied in order to explore allophonic variation of Japanese /r/ as a factor in Japanese listeners’ difficulty in discriminating the English /l-/ contrast. Stimuli were 3 tokens each of 152 Japanese words with /r/ in all phonotactically possible contexts produced by 2 Japanese speakers. American English listeners identified the stimuli according to 8 response categories. Results showed significant effects of syllable structure and vowel quality, with acoustic measures of the stimuli generally consistent with the response patterns. Findings are compared with the results of a recent training study with Japanese listeners on English /l-/.

INTRODUCTION

Japanese listeners’ difficulty in perceiving the English liquid contrast (/l-/ has been attributed to various phonological and phonetic factors (e.g., 1, 2). A possible contributing factor is allophonic variation in the Japanese “liquid”, which is often realized as a flap [r], but sometimes has more approximant-like realizations. The phonetic similarity or dissimilarity of the Japanese variants to the English liquids may influence Japanese listeners’ ability to discriminate the English sounds. We investigated this tentative link by testing American English (AE) listeners’ perception of Japanese /r/ across a range of phonetic contexts. By exploring all phonotactically possible contexts, this work expands on earlier studies along similar lines (3, 4).

PERCEPTUAL TEST

Stimuli were 152 Japanese words containing /r/ in different vocalic (/i e a o u/), syllabic (initial, intervocalic, and consonant cluster) and pitch accent (accented or not) contexts. Two Japanese speakers read multiple randomizations of the list; 3 instances of each token were digitized and organized into identification test sequences. Each trial consisted of 3 sequential repetitions of the test item; there was a total of 912 trials. Twelve AE listeners identified each item as "l", "r", "D" (= [r]), "d", "t", "identifiable other sound" (listeners indicated that sound), "no sound", or "unidentifiable sound".

Figure 1 gives listeners’ pooled responses according to syllabic (top row) and vocalic (bottom row) contexts. Syllable structure significantly affected response choices: Japanese /r/ sounded more stop-like ("D", "d", "t") in consonant clusters and more liquid-like ("r", "l") in prevocalic (V_V, V_V) contexts [F(2,11)=182.64, p<0.001]. However, liquid responses were usually "r" intervocically, compared with "l" initially. Vowel quality also had a significant effect: Japanese /l/ elicited more stop/flip responses in high vowel contexts and more liquid responses in lower vowel contexts [F(4,11)=144.29, p<0.001]. Pitch accent had no overall effect on listeners’ responses.

ACOUSTIC ANALYSIS

To assess the acoustic properties underlying the perceptual responses, the stimuli eliciting the most robust perceptual patterns (usually, those eliciting 80% or more responses of a particular category) were analyzed acoustically. Stimuli identified as liquids, as opposed to those identified as stops/flaps showed significantly more energy (in dB) during "closure" [t(98)=16.01 (Speaker 1) and 8.36 (Speaker 2), p<0.001] and were significantly less likely to have detectable release bursts [X(1)=25.50 (Sp 1) and 17.65 (Sp 2), p<0.001]. The primary measure of the /l-/ difference was F3 frequency; as expected, stimuli identified as "l" had significantly higher F3 values than those labeled "r", although this finding held only for one speaker's tokens [Sp 2: t(48)=5.11, p<0.001].
FIGURE 1. Percent responses (8 possible response types) according to syllable position (top row) and vowel context (bottom row). NS = "no sound", US = "unidentifiable sound", IOS = "identifiable other sound".

DISCUSSION

Is there a relation between these patterns of AE listeners' perception of Japanese /r/ and previous findings on Japanese listeners' perception of English /r/? Although different phonotactic constraints in these languages limit syllable structure comparisons (e.g., Japanese /r/ does not occur word finally), overlapping contexts include consonant clusters. Akahane-Yamada et al.'s (5) training study with Japanese listeners on English /r/ found that performance was poorest on initial consonant clusters (C_V); other perceptual studies also report particular difficulties with consonant contexts (2, 6). These results coincide with the present finding that Japanese /r/ is the least liquid-like in consonant clusters. Comparisons of effects of vowel context are also restricted — in this case, because most studies do not report findings in these terms. However, detailed comparison with Akahane-Yamada et al.'s data shows no clear link. This may mean that vowel quality is irrelevant to Japanese listeners' difficulties with /r/, or that more systematic control for this property in training stimuli would be needed for vowel effects to emerge.

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REFERENCES