Evidence of /l/-/r/ contrast in Korean

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Abstract

This paper reports an investigation of the nature of allophonic variation in the single liquid phoneme of standard Korean. Alveolar tap and alveolar lateral allophones are in strict complementation, and an intervocalic length contrast of singleton tap vs. geminate lateral also arises on the surface. These are sometimes cited as reasons Koreans do better at the English /l/-/r/ distinction than other learners who similarly lack an underlying L1 contrast.

To investigate native perception of the two intervocalic possibilities, waveform editing was used to eliminate the duration difference between geminate laterals and singleton taps in recordings of natural speech. In a forced-choice test, all listeners identify the edited stimuli as containing the lateral (90.5% identification rate), suggesting that duration is not a deciding factor in identification. Instead, Korean L1 speakers appear sensitive to non-durational differences, and thus effectively have a latent /l/-/r/ contrast.

Keywords: Phonetics, Korean, Speech Perception

1. Introduction

The difficulty of the English /l/-/r/contrast for Japanese and Korean L1 speakers is a well documented phenomenon. This contrast is difficult because of the difference in phonological status of this contrast in the respective languages; in English, it is a phonemic contrast where as in Korean and Japanese, it is an allophonic difference.

Recent perception studies by Ingram & Park [4] and Hazan et. al [3] have shown that despite the fact that both Japanese and Korean have one liquid in their respective liquid phoneme inventories and similar phonotactic limitations, Korean L1 speakers perform better than Japanese L1 speakers in English /l/-/r/ distinction. This has been attributed to the allophonic variation of the Korean liquid phoneme. While both Korean and Japanese have laterals and taps/flaps as allophones, the two allophones – the alveolar lateral [l] and the tap/flap [ɾ] – appear in free distribution in Japanese but in complementary distribution in Korean. The tap appears in onset position and the lateral approximant appears elsewhere. Most importantly, the lateral and the tap also appear in contrast in intervocalic position in Korean, giving a singleton (tap) versus geminate (lateral) liquid length contrast.

It is posited that the existence of the intervocalic contrast makes it easier for Korean L1 speakers to learn the English /l/-/r/ contrast in intervocalic position. In existing models of phonetic perception in second language acquisition, such as Flege's Speech Language Model [2] and Best's Perceptual Assimilation Model [1], perceptual similarity of L2 sounds to L1 sounds strongly influences the predicted relative difficulty of different non-native contrasts. However, the overall classification of rhotic segments, such as the alveolar tap and the post alveolar approximant, can be traced to historical connection between subgroups of rhotics. Ladefoged & Maddieson [6] suggest the choice of the letter <r> to represent them all rather than any shared phonetic attributes.

Furthermore, studies by Hazan et. al [3] and Lee & Lee [7] show that Koreans perform identification of the English /l/-/r/ contrast generally well in word initial and consonant cluster position, two syllabic positions that liquids do not occur in Korean. This would suggest that a linguistic phonetic analysis of L1-L2 transfer does not wholly account for Korean L1 speakers' performance of the English /l/-/r/contrast.

This paper investigates spectral differences and the role of acoustic cues in the identification of the two liquid allophones by Korean L1 speakers. The two Korean liquid allophones differ greatly in duration when intervocalic. The effect of duration on Korean liquid allophone identification is examined in this study.

2. METHOD

2.1. Material

Tokens of /ll/-[ll] and /l/-[ɾ] intervocalic minimal pairs in Korean in /a_a/, /i_i/, /o_o/ environments were recorded by two Korean speakers, one male and one female. The speakers were of similar ages (27 and 24 years respectively) and were both native speakers of Standard Korean. There were three minimal pairs for each vowel environment and they were repeated once. This resulted in a total of 54 tokens overall. Each token was a commonly occurring word in the language. The tokens were recorded in an anechoic chamber and were digitized at a 20kHz sampling rate with 16-bit amplitude quantization.

The geminate lateral tokens were then edited to match the mean duration of the Korean tap in intervocalic position. In order to measure mean duration of [ll] (98ms) and [ɾ] (46.6 ms), recordings of /ata/, /iti/, /oto/ (/t/ is the same place alveolar stop) were also taken and the mean duration of the preceding vowel was measured. Then, the duration of tokens [ll] and [ɾ] were measured from the end of the vowel duration taken from the stops to the end of formant transitions in the segments. The mean duration of the tap was measured by vowel environment and each [ll] token was edited to the duration of the tap.

This resulted in a total of 108 tokens containing the three sets of liquid tokens [ll]-[ɾ]- edited[l] which were then were used in the identification experiment.

2.2. Subjects

The identification experiment involved 10 native Korean subjects (5 male, 5 female), chosen on the basis of length of residency in the UK, education, and age.

All 10 subjects were between the ages of 25 – 34 years, and had been in the UK for less than 12 months with the exception of 1 subject who had been in the UK for 18 months. None of them had special English language training from native English speakers until they arrived in the UK and were all monolingual. All subjects had a Modern Standard Korean accent. Only one subject had previous phonetic training experience.

The listeners received a small payment for their participation in the test.

2.3. Experimental Task

A forced choice identification test was designed using Praat. All the words were presented in a carrier sentence '_____ 이라고 반복하십시오.' ("Please repeat _____.")

The instructions were given both verbally and on an instruction sheet. Each subject was asked whether the missing blank word they heard was a '르' word ([ɾ] word) or a '르르' word ([ll] word). The two test answers were shown on a two button display computer screen. If they heard a '르' word, subjects were asked to press the "L" button; if they heard a a '르르' word, subject were asked to press the "LL" button. The subjects were allowed to hear one repetition of the word if they wished. There was a practice session of five sentences before they started the test

Each subject was presented with 108 sentences, 27 words repeated twice each from the two speakers. They were presented in randomized order and subjects were allowed a pause every 20 sentences. The test took about 10-15 minutes to complete. No feedback was given during the test.

3. RESULTS

3.1. Identification Results

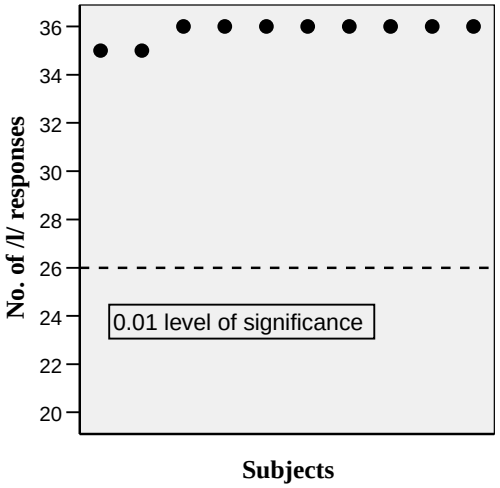
		stimulus			Total
		[ll]	[ɾ]	edited [l]	
answer	[ll]	351	2	324	677
	[ɾ]	9	358	36	403
Total		360	360	360	1080

Table 1. Results for identification test

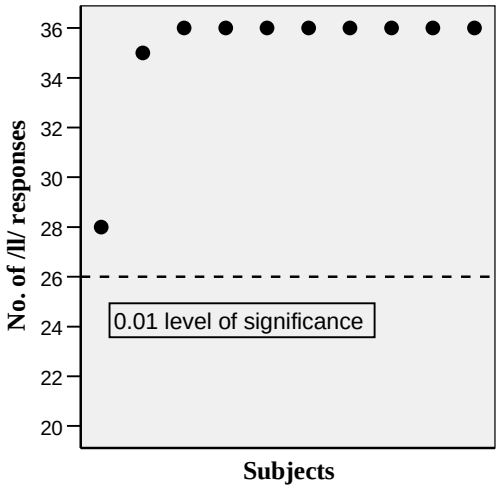
The percentage of responses for the three tokens was calculated. Of the three tokens, [ɾ] was the most correctly identified with 99.4% of responses identifying it as [ɾ] while [ll] was 97.5% identified correctly. The results for the edited duration [l] tokens shows that they were 90.5% identified as [ll] and 9.5% as [ɾ]. All ten subjects responded above the 0.01 level of significance (26 out of 36 responses) for each group of stimuli.

The results and the binomial statistical analysis, plotted for each token in Graph 1, Graph 2 and Graph 3 show that the subjects identified [ll]

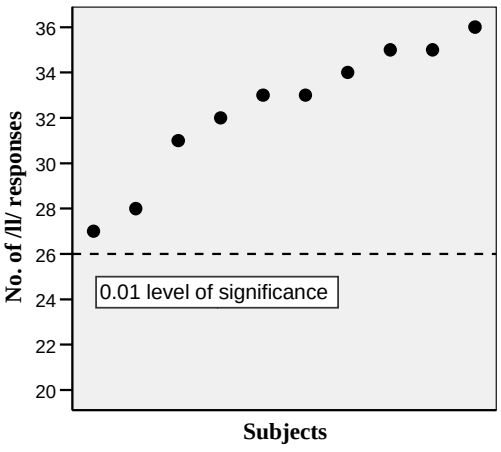
tokens as [ll], [ɾ] tokens as [ɾ] and edited [l] tokens as [ll] statically significantly..



Graph 1. Distribution of /l/ - [r] stimuli responses



Graph 2. Distribution of /ll/ - [ll] stimuli responses



Graph 3. Distribution of edited [l] stimuli responses

An independent t-test of the rate of error responses between the [ll] tokens and edited [l] showed that the error rate was significantly higher in the edited [l] tokens ($p<0.01$).

3.2. Edited [l] tokens

The effects of variables that could affect the answer for the tokens other than duration were examined. To check whether (i) vowel environment, (ii) speaker differences, (iii) inter-subject differences and (iv) the gender of the subjects had affected the responses of the edited [l] tokens, analysis of variance (one-way ANOVA) for these four treatment variables were applied. The statistical analysis revealed that none of the four variables statistically meaningfully affected responses ($p>0.01$) in the edited [l] tokens.

4. Discussion

This major goal of this study was to evaluate the impact of duration on liquid allophone identification by Korean L1 speakers. The general finding was that despite duration of the liquid allophones being different in production (reflecting the phonological length difference), Korean L1 speakers do not rely on duration as a cue in the identification of the liquid allophone. While the error rate of stimuli identified as [ɾ] is somewhat greater in the edited [l] tokens, the subjects overwhelmingly identified the "short" singleton lateral as a lateral rather than as a tap.

These results were not affected by gender of the listeners, inter-speaker differences, speaker differences or vowel environment.

This would suggest that Koreans are sensitive to the spectral differences between the alveolar lateral approximant and the alveolar tap even though they are traditionally regarded as allophones of the same phoneme. While the intervocalic contrast of the liquid is phonologically a length difference, the singleton vs. geminate consonant contrast model in Korean does not solely rely on duration differences.

The three types of geminate consonants that occur intervocalically in Korean phonology are nasals, stops and liquids. In all three cases, however, the duration differences are reinforced with a phonetic quality difference; for stops, it becomes a lenis vs. fortis distinction; for nasals it

becomes a nasal vs. heavily denasalized distinction; for liquids it becomes a tap vs. lateral approximant distinction. The singleton vs. geminate contrast in Korean could therefore be regarded as a subsidiary phonetic difference. The lenis and fortis stop distinction is a phonemic difference, not allophonic, in Korean. This could serve as the basis for the claim that there is a latent /l/-/r/ contrast in Korean that only surfaces in intervocalic position.

Instead of similarities between phonemes and allophones in L1 and L2, recent acoustic phonetic studies have concentrated on the spectral characteristics in the L1 and L2 phones and what cues and cue weighting strategies aid or hinder L2 perception. Studies by Iverson [5] and Lotto [8] suggest that Japanese L1 speakers have difficulty perceiving the English /l/-/r/ contrast because they are not sensitive to third formant differences.

To examine the implications for this study, certain spectral differences between the recorded native Korean liquid allophones were analyzed. Preliminary results show that the alveolar tap has a generally lower F3. This would suggest that acoustically, the Korean l-r contrast provides an acoustic cue that could be utilised in the L1-L2 equivalence classification of the English /l/-/r/ contrast. This has implications on the nature of transfer in L2 acquisition and the definition of non-native contrasts. Transfer of contrasts may not solely lie on the linguistic-phonetic level; it suggests that L2 learners are sensitive to fine phonetic detail in the L1 that aid or hinder L2 phone acquisition.

5. Conclusion

In summary, this paper has shown that while there is a significant durational difference in the production of Korean liquid allophones [l] and [ɾ] when they appear intervocalically, duration is not an overriding factor in distinguishing the contrast for Korean L1 speakers. Results indicate that the factors such as vowel environment, gender, speaker and subject did not affect the results and that Koreans are sensitive to spectral differences between the lateral approximant and the tap.

Future investigation should explore the exact nature of the acoustic cues Koreans use to differentiate the lateral and the tap and whether this has an impact on their performance of perceiving a /l/-/r/contrast in English.

6. References

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