

# A Study of the Effects of Similarity on L2 Phone Acquisition: An Experimental Study of the Korean Vowels Produced by Japanese Learners

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## ABSTRACT

The aims of this study were to examine the acoustic features of Korean and Japanese vowels, and to determine whether new phones that do not have counterparts in Japanese or similar phones that have counterparts improve more from learning. This study consisted of three parts. In Experiment I, a speech production test was performed to observe the acoustic features of Korean and Japanese vowels. In Experiment II, the speech production of Korean vowels produced by Koreans, advanced Japanese learners of Korean, and beginning Japanese learners of Korean was investigated. In Experiment III, a speech perception study of Korean vowels produced by the two Japanese learner groups was conducted to observe the effect of learning on acquiring L2 phones. The conclusion drawn from the study was that the similar phones produced by Japanese show more similarity with those of Koreans than new phones in terms of F1 and F2, but Japanese learners of Korean displayed more improvement in new phones from learning.

**Keywords:** vowel production, formant frequency, L2 phone acquisition

## 1. Introduction

With Scovel (1969) as the central figure, many researchers have maintained that it is impossible, or nearly impossible, to master a language without a foreign accent after puberty, and that this inability is related to the permanent lateralization of the human brain. Since then, there have been trials incorporating a variety of aspects such as neurological factors, age, L1 system, amount of L1 use, and experience in L2 to explain the factors that are closely related to L2 learners' inability to achieve native-like pronunciation. Of them, Flege presented a few interesting factors mainly related to similarity of phones between L1 and L2, and experience in L2.

Flege (1987) and Flege et al. (1997) discovered a specific factor relating to the limits on phonetic accuracy in foreign language speech production regarding the "interlingual identification" of L1 and L2 phones.<sup>1)</sup> Similarity or dissimilarity of phones between L1 and L2 affects L2 learners'

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learning of L2 phones since the phonetic space of adults is restructured during L2 learning. Moreover, equivalence classification prevents experienced L2 learners from producing similar L2 phones, the phonemes that have the equivalent phonemes in the phoneme list of L1 in terms of IPA, but not new L2 phones, the phonemes that do not have equivalent phonemes in the phoneme list of L1.

Flege's arguments, however, are partially inconsistent with the arguments of language transfer theory in Second Language Acquisition. The theory of language transfer claims that in cases where the target language differs from L1, negative transfer, namely interference, occurs, and in cases where L1 and L2 are similar in their patterns, positive transfer occurs (Ellis, 1994). In addition, the findings of Flege (1984) demonstrate incompatibility with the results of Flege (1987), which support the hypothesis that equivalence classification prevents experienced L2 learners from producing similar L2 phones, but not new L2 phones. Flege (1984) claims that L2 learners' ability to produce new phones does not benefit from additional L2 experience, whereas there is an effect of experience on L2 learners' ability to produce similar phones.<sup>2)</sup> And, thus, it seems that more research is needed in order to judge the degree of difficulty in acquiring new L2 phones and similar L2 phones.

Japanese learners of Korean have enormous difficulty mastering the speech production of Korean vowels due to the fact that the Korean language has seven vowels, while the Japanese language has only five (Woo, 1998; Kwon, 2004). The vowel systems of Korean and Japanese, from the viewpoint of contrastive analysis, can be demonstrated as seen in the two tables below. Accordingly, of the seven Korean simple vowels, only /a/, /o/, /u/, /e/, and /i/ are similar phones to the Japanese learners of Korean, while /ʌ/ and /ɨ/ become new phones to them.

Table 1. Vowels in Korean

	Front	Back
High	/i/	/ɨ/, /u/
Middle	/e/	/ʌ/, /o/
Low		/a/

1) "Interlingual identification" is the hypothesis that when an L2 phone is "identified" with an L1 phone, the L1 phone will be used in its place. Such interlingual identification appears to depend on the auditory, and perhaps articulatory, similarity of L1 and L2 (Flege, 1984).

2) Similar phones are L2 phones that have counterparts in L1 in terms of IPA, while new phones are L2 phones that do not have counterparts in L1 in terms of IPA.

Table 2. Vowels in Japanese

	Front	Back
High	/i/	/u/
Middle	/e/	/o/
Low		/a/

For this study, the two following research questions were raised:

First, of the new phones and similar phones of Korean vowels, which are more difficult for Japanese learners of Korean to pronounce? Namely, between the new phones and similar phones of Korean vowels produced by Japanese learners, which would show more discrepancy with those of Korean native speakers regarding acoustic features?

Second, of the new phones and similar phones of Korean vowels, which are easier to acquire by learning? Namely, for Japanese learners, between new phones and similar phones, which would exhibit a greater improvement on the accuracy in pronunciation by learning?

In the present study, which consists of three parts, the back vowels /a/ and /o/ were investigated for similar phones, while /i/ and /u/ were investigated for new phones. In Experiment I, a speech production test was performed to observe the acoustic features of Korean vowels and Japanese vowels. In Experiment II, the speech production of Korean vowels produced by Korean native speakers, advanced Japanese learners of Korean, and beginning Japanese learners of Korean was investigated. In Experiment III, a speech perception study of Korean vowels produced by the two Japanese learner groups was conducted to observe the effects of learning on acquiring L2 phones.

## 2. Method

### 2.1 Experiments I and II

#### 2.1.1 Subjects

For Experiment I, six Korean native speakers (Ks) and six Japanese native speakers (Js) participated as subjects. Ks were graduate students in Korean Linguistics, while Js were Japanese who resided in Korea but had never studied Korean language. The subjects of Experiment II were six Korean native speakers (Ks), six Advanced Japanese learners of Korean (AJs), and six Beginning Japanese learners of Korean (BJs).<sup>3)</sup> The Korean native

3) Hereafter, Korean native speakers will simply be referred to as Ks, Japanese native speakers as Js, Advanced Japanese learners of Korean as AJs, and Beginning Japanese learners of Korean as BJs unless otherwise specified.

speakers (Ks) who participated in Experiment II were the same speakers in Experiment I, and AJs were those who had more than two years of formal education in Korean language, while BJs were those who were currently attending a language institute, had studied Korean language fewer than 6 months, and lived in Korea under 6 months. All speakers in the four groups were females between the ages of 25 and 38.

### 2.1.2 Experimental tools

The entire experiment was carried out in a laboratory equipped with *Computerized Speech Laboratory 4500* (Kay Elemetrics Corp.), and recording was performed with the microphone *SM 48*, which eliminates background noise efficiently. For the reading list, two sentences for each vowel were created, and three readings were duplicated and randomly arranged. Thus, a total of 432 tokens were recorded (18 speakers  $\times$  4 vowel types for each group  $\times$  2 types of carriers  $\times$  3 replicate productions). The vowels were placed in word context  $C_1C_2$ . Both the first consonant,  $C_1$ , and the second consonant,  $C_2$ , were the velar sound /g/ (examples of the words: *kaku* (furniture) and *kake* (stores) for Korean /a/, *kaki* (persimmon) and *kako* (past) for the Japanese /a/). Carrier phrases that would carry the words were \_\_\_\_\_*ka issimnida* (there is) for the Korean reading list, and \_\_\_\_\_*ga arimasu* (there is) for the Japanese reading list, respectively.

### 2.1.3 Procedures

The procedures of Experiment I were as follows: first, 12 speakers were asked to read the list, and each token (here, sentence) was recorded as a unit. Second, the first vowel part in each sentence was cut out. Editing was performed referring to the waveform and spectrogram of the sentences, and confirmed after listening to them. A 0.1 second period of sine waves was cut out so that the target vowel would not overlap with the adjacent consonants, hence the pure vowel parts were extracted.<sup>4)</sup> Third, LPC analysis was conducted, and the F1 and F2 of each stimulus were sought out through analyzing numerical values. For Experiment II, all data were collected in the same way as in Experiment I.

## 2.2. Experiment III

### 2.2.1 Subjects

The speech production of the two groups, AJs and BJs, was used for stimuli for Experiment III. The stimuli were randomly chosen from the data that were collected for Experiment II. The

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4) Although the editing method may have been improper to obtain the accurate formant frequencies of Korean vowels and Japanese vowels, it was certainly valid for gathering the speech data to observe the contrastive features of the two languages, since it was identically applied to the both languages, and the edited waves only included vowels.

listeners were ten Korean native speakers who did not participate in the previous experiments. They were also female graduate students in Korean linguistics, whose ages ranged from 25 to 35 years old.

### 2.2.2 Procedures

12 questions that contained 4 vowels, Korean /a/, /o/, /ʌ/, and /i/, were prepared, and, thus, a total of 120 questions were collected (10 listeners × 4 types of vowels × 3 replicate presentations). The ten listeners were asked to select the correct vowel to each stimulus on answer sheets that included seven choices (/a/, /o/, /ʌ/, /i/, /u/, /e/, and /ɪ/), which comprise the full list of Korean simple vowels.

## 3. Results

### 3.1 Experiment I

The mean values of F1 and F2 of Japanese /a/ produced by Japanese native speakers (Js) and of Korean /a/ produced by Korean native speakers (Ks) are presented in <Table 3>.

Table 3. Mean values of F1 and F2 of Japanese /a/, /o/ and of Korean /a/, /o/

Phones	F1	F2
	Mean (SD)	Mean (SD)
Korean /a/	937 (64)	1586 (124)
Japanese /a/	882 (86)	1591 (113)
Korean /o/	368 (30)	760 (92)
Japanese /o/	408 (42)	837 (106)

According to <Table 3>, the mean frequencies of F1 of Japanese /a/ are significantly different (by t-test with  $p < 0.01$ ) and a bit lower than the Korean ones, and the mean of F2 of Ks and Js are not significantly different (by t-test with  $p < 0.05$ ). Considering the relation of formant frequency values and articulations,<sup>5)</sup> the Japanese /a/ is assumed to be pronounced in a

5) According to Ladefoged (2001) and Johnson (2003), formant frequency and articulatory phonetics of vowels tend to be closely related. First, vowel height is negatively correlated with F1, and high vowels have low F1, and vice versa. And vowel frontness is correlated with F2, and front vowels have high F2, and vice versa. The correlation between the second formant frequency and the degree of backness of a vowel, however, is not as good as that between the first frequency and the vowel height. The second formant frequency is considerably affected by the degree of lip rounding as well as vowel height (Ladefoged, 2001).

higher position in the mouth than the Korean /a/.<sup>6)</sup> In addition, the Japanese /a/ is scattered over a wide area compared to the Korean one. Lindblom (1990) claimed that, in the adaptive dispersion view, listeners' abilities to hear vowel distinctions provide selectional pressure on segment inventories, and the vowels that can be most reliably distinguished from each other are those that are maximally distinct.<sup>7)</sup> The fact that the Japanese vowel /a/ is articulated over a wider space could be interpreted as being due to the fact that output constraints of Japanese vowels are less strict than Korean, since the inventory of Japanese vowels is smaller than that of Korean.<sup>8)</sup>

According to the mean values of /o/ produced by Js and Ks (Table 3), F1 of the Korean /o/ is estimated to be a bit lower than that of the Japanese /o/ ( $p < 0.01$ ), and F2 of the Korean /o/ is also significantly different from that of the Japanese /o/ ( $p < 0.01$ ). It is assumed that Korean vowel tongue height is higher and less fronted when producing the Korean /o/ compared to the Japanese /o/, and the results are consistent with Lee (1998).

### 3.2 Experiment II

The mean values of F1 and F2 of Korean /a/ and /o/ of Ks, AJs, and BJs are presented in <Table 4>, and the distributions of F1 and F2 of Korean /a/ and /o/ of the three groups are displayed in <Figure 6>. Regarding the distributions of /a/ of Ks, AJs and BJs, they are quite closely placed so that it is difficult even to judge which group is more proximate to Ks on the distribution map. The mean values of /a/ of the three groups also show the result that F1 of the AJs and BJs does not differ in F1 of /a/ since it does not reach significance. The distributions of F1 and F2 of Korean /o/ of the three groups show a similar result as that of /a/ since there is no sizable difference between BJs and AJs.

Table 4. Mean values of F1 and F2 of Korean /a/ and /o/ produced by three groups

Speakers	Korean /a/		Korean /o/	
	F1	F2	F1	F2
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
BJs	896 (90)	1590 (94)	408 (54)	837 (70)
AJs	870 (106)	1573 (137)	397 (55)	815 (105)
Ks	937 (64)	1508 (124)	368 (30)	760 (92)

6) The Japanese /a/ is articulated in a more fronted and less widely opened way than the Cardinal vowel /a/ (Koizumi, 1993), while the Korean /a/ is closer to /a/, especially when it is pronounced as an extended vowel (Lee, 1996).

7) Cited from Johnson (2003: 112).

8) This result, however, shows inconsistency with the results of Lee (1998), which displayed no significant difference in the acoustic analysis between Korean /a/ and Japanese /a/.

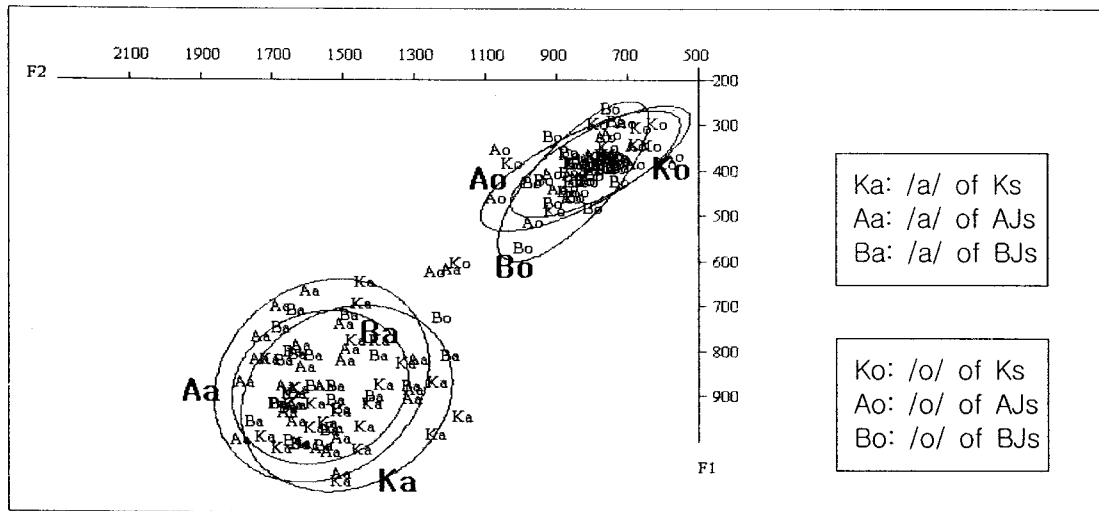


Figure 1. Distributional map of F1 and F2 of Korean /a/ and /o/ produced by three groups<sup>9)</sup>

According to <Table 5>, F1 and F2 of /ʌ/ of BJs and AJs are significantly different ( $p < 0.01$ ), and AJs show a greater similarity to Ks in the mean and the distribution F1 and of F2 of /ʌ/ (Figure 2). Considering the correlation between the F1 values and the vowel height, Japanese speakers' Korean /ʌ/ appears to be articulated in a higher position than Korean speakers' /ʌ/ (Table 5). In addition, BJs' F2 is significantly lower than Ks', while AJs' F2 is similar to Ks', and BJs' /ʌ/ is estimated to be formulated as a more backed vowel than Koreans' /ʌ/.

F1 of /i/ of AJs and BJs is not significantly different, but F2 of BJs and AJs is significantly different ( $p < 0.01$ ). The /i/ of AJs is also judged to demonstrate more similarity to that of Ks than BJs, since in <Figure 2> the ellipse of AJs is more overlapped with that of Ks, although the difference of AJs and BJs is not as obvious as in the case of /ʌ/.<sup>10)</sup>

Table 5. Mean values of F1 and F2 of Korean /ʌ/ and /i/ produced by three groups

Speaker	Korean /ʌ/		Korean /i/	
	F1 (SD)	F2 (SD)	F1 (SD)	F2 (SD)
BJs	474 (88)	776 (112)	418 (52)	1550 (93)
AJs	562 (82)	951 (90)	408 (59)	1508 (105)
Ks	741 (80)	1019 (112)	398 (56)	1433 (126)

9) JplotFormant v.14, a formant-plotting software released by the Department of Linguistics of UCLA, was utilized to formulate the distributional map of F1 and F2.

10) In the current research, high vowel devoicing was not observed for the high vowel /i/ since the /i/ was preceded by the voiceless sound /k/ but was followed by a voiced sound /g/ in between vowels, while high vowel devoicing only occurs between voiceless sounds (Kim, 1994; Kim and Niimi, 1996).

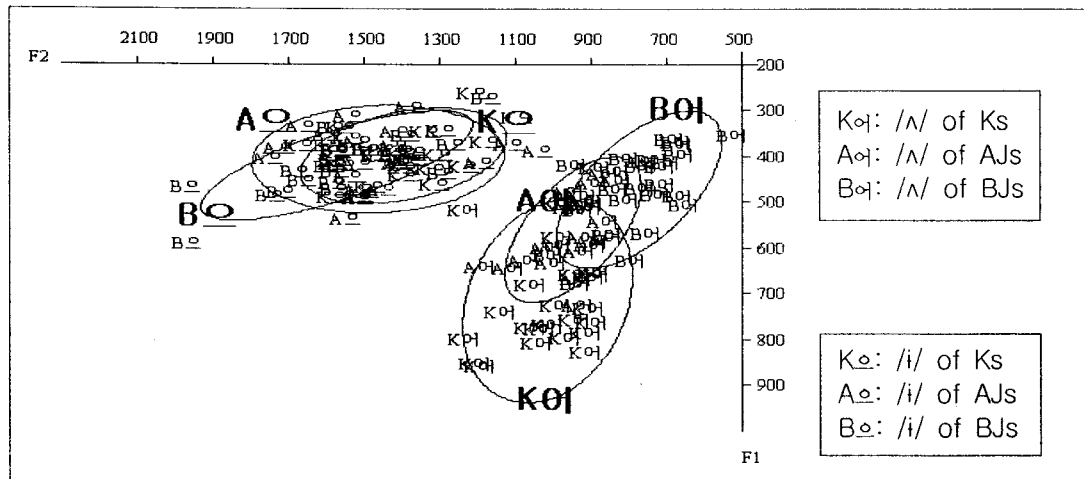


Figure 2. Distributional map of F1 and F2 of Korean /ʌ/ and /i/ produced by three groups

<Table 6> shows the results of the acoustic analysis of prevocalic /ʌ/ in second syllables of BJs and AJs. F1 and F2 of BJs and AJs are distant from those of /ʌ/ in between consonants, and they are rather strikingly closer to Ks' interconsonantal /ʌ/.<sup>11)</sup> This could be attributed to the change in the locus of /ʌ/. In addition, a speakers' fluency also seems to be related to the degree of changing the locus, since the least fluent group, BJs, appears to be the most distant numerical result from Ks in F1 and F2.

Table 6. Mean values of F1 and F2 of Korean prevocalic /ʌ/ produced by three groups

Speakers	Prevocalic /ʌ/ in the second syllable		Interconsonantal /ʌ/ in the first syllable	
	F1	F2	F1	F2
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
BJs	450 (87)	974 (185)	474 (88)	776 (112)
AJs	567 (103)	1304 (224)	562 (82)	951 (90)
Ks	829 (79)	1178 (164)	741 (80)	1019 (112)

### 3.3 Experiment III

<Table 7> presents the mean percent correct identification scores of F1 and F2 of the similar phones, and those of F1 and F2 of the new phones. It seems that similar phones are easier than new phones for Japanese learners of Korean to acquire, since the overall scores of similar phones, /a/ and /o/, are higher than those of new phones, /ʌ/ and /i/. In addition, there

11) Prevocalic /ʌ/ is /ʌ/ as in the sentence, *kʌkʌ issimnida* (there is that thing.) in the reading list, while interconsonantal /ʌ/ is /ʌ/ as in *kʌkʌkʌ issimnida* (there is there.) or *kʌkʌkʌkʌ issimnida* (there is a massive figure.).



is no substantial difference between BJs and AJs for similar phones, but there is considerable difference between BJs and AJs for new phones. New phones produced by AJs are more correctly perceived by Koreans than the new phones produced by BJs, while similar phones are perceived at a similar rate.

Table 7. The mean percent correct identification scores for similar phones and new phones

Speakers	Similar phones		New phones	
	/a/	/o/	/ʌ/	/i/
BJs	100	75	37.5	75
AJs	100	81.3	75	87.5

#### 4. Conclusions and Discussions

The first conclusion drawn from the study is that the speech production of similar phones that have counterparts, such as Korean /a/ and /o/ produced by Japanese, show more similarity with those produced by Koreans in terms of F1 and F2 than new phones that do not have counterparts in Japanese, such as /ʌ/ and /i/. These results suggest that similar phones are still easier for L2 learners to pronounce than new phones regardless of the level of learning. This indicates that L2 learners have less difficulty with pronouncing similar phones than new phones, and it also could support the argument that positive transfer occurs in the case where L1 and L2 are similar.

The second conclusion is that new phones produced by advanced learners are more proximate to L2 than those of beginning learners, while similar phones produced by advanced learners and beginning learners show a lack of significant difference. The new phones produced by advanced learners are also more correctly perceived by Koreans than those of beginning learners, while similar phones are perceived at a similar rate. Accordingly, learning, as a variable in acquiring L2 phones, has a greater effect on new phones than on similar phones. The results also may prove that learners fail to move on to the next passage in the sequence of learning similar phones, but succeed in progressing to the next passage in learning new phones since the non-native phones are assimilated into native phoneme categories in the early stages of learning in terms both of similar phones and new phones.<sup>12)</sup> The advanced learners, however, presented a greater improvement in accuracy in acquiring new phones.

Thus, it is the similarities between native and target language that tend to cause many problems in learning L2 phones, and structural identity between two languages does not

12) The L1 can delay initiation of passage through a sequence (Larsen-Freeman and Long, 1991).

necessarily result in positive transfer. This is consistent with the results of Flege (1987), Bohn and Flege (1992), and Baker and Trofimovich (2005), and supports Flege (1987)'s idea that the phonetic space of adults is restructured during L2 learning, and equivalence classification prevents experienced L2 learners from producing similar L2 phones, but not new L2 phones.

The results of the current study, on the other hand, seem to be contradictory with the results of Flege (1984), since his results exhibit that L2 learners' ability to produce new phones does not benefit from additional L2 experience, while experience improves L2 learner's ability in producing similar phones. However, when the length of learning period or experience of the subjects in the current research and Flege (1984) is compared, the former is shorter than the latter. In Flege (1984), in the case of the less experienced group, the length of time the inexperienced group used French to communicate was less than one year, but they had formerly studied French, the target language in high school, while in the current research, in the case of a purportedly experienced group, AJs, the length of time the learners studied and used Korean, the target language in the current research, was between two and three years. Considering the overall length the learners were exposed to the target language, in the early stages of language learning, new phones tend to be easier to improve by learning or experiencing, but in later stages (after using L2 on a regular basis for about 10 years with more than a few years of formal education), similar phones benefit more than new phones.

The findings of the current study also undermine Flege (1997)'s view that the age at which one is first exposed to L2 does play a significant role in perceiving and producing L2 vowels, while length of residing in the country of the target language plays an important role in perceiving and producing L2 consonants.

## References

- Baker, W. & Trofimovich, P. 2005. "Interaction of native- and second language vowel system(s) in early and late bilinguals." *Language and Speech* 48(1), 1-27.
- Bohn, O. & Flege, J. 1992. "The production of new and similar vowels by adult German learners of English." *Studies in Second Language Acquisition* 14, 131-158.
- Ellis, R. 1994. *The Study of Second Language Acquisition*. Oxford: Oxford University Press.
- Flege, J. 1984. "Limits on phonetic accuracy in foreign language speech production." *Journal of Acoustical Society of America* 76(3), 706-719.
- Flege, J. 1987. "The production of 'new' and 'similar' phones in a foreign language: evidence for the effect of equivalence classification." *Journal of Phonetics* 15, 47-65.
- Flege, J., Bohn, O. & Jang, S. 1997. "Effects of experience on non-native speakers' production and perception of English vowels." *Journal of Phonetics* 25, 437-470.
- Johnson, K. 2003. *Acoustics and Auditory Phonetics*, 2nd Ed., Oxford: Blackwell Publishing.
- Kim, H. 1994. "Acoustic studies of devoiced vowels in Korean." *Malsori* 27, 1-10.

- Kim, H. & Niimi, S. 1996. "Acoustic and aerodynamic studies of Korean vowel devoicing." *Journal of Acoustical Society of America* 100(4), 2659.
- Koizumi, T. 1993. *Nihongo Kyoshino Tameno Gengogaku Nyumon*, Tokyo: Taishukan Publishing.
- Kwon, S. 2004. *An Analysis of the Spelling Errors of Korean Learners: Focused on the Errors from the Difference between the Sound System of L1 and L2*. M.A. thesis, Ewha Womans University.
- Ladefoged, P. 2001. *A Course in Phonetics*, 4th Ed., Boston: Heinle & Heinle.
- Larsen-Freeman, D. and Long, M. 1991. *An Introduction to Second Language Acquisition Research*. New York: Longman.
- Lee, H. 1996. *Korean Phonetics*. Seoul: Teahaksa.
- Lee, J. 1998. "Experimental phonetic contrastive analysis on Korean and Japanese vowels." *Eoneohak* 22, 347-369.
- Scovel, T. 1969. "Foreign accents, language acquisition, and cerebral dominance." *Language Learning* 28, 245-254.
- Woo, I. 1998. "The pronunciation teaching method through the contrastive analysis between Korean and Japanese language." *Ijungeoneohak* 15, 319-347.

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