

## Cross-generational Change of /o/ and /u/ in Seoul Korean I: Proximity in Vowel Space\*

Han, Jeong-Im<sup>1)</sup> · Kang, Hyunsook<sup>2)</sup>

### ABSTRACT

This study examined cross-generational changes in the vowel system of Seoul Korean. Acoustic analyses of the vowel formants of /o/ and /u/, and their Euclidean distances in the vowel space were undertaken to explore an on-going merger of these two vowels as proposed in previous acoustic studies and a phonological analysis by Chae (1999). A robust cross-generational change of /o/ and /u/ was found, more evident for female speakers than for male speakers. For female speakers, with each successive generation, /o/ became increasingly approximated with /u/, regardless of the syllable positions that the target vowels were posited, whereas the cross-generational differences in the Euclidean distances were only shown in the second syllable position for the male speakers. These results demonstrate that 1) women are more advanced than men in the on-going approximation of /o/ and /u/; 2) the approximation of /o/ and /u/ is common in the non-initial position. Taken together, the merger of /o/ and /u/ appears to be in progress in Seoul Korean.

**Keywords:** Korean vowels, /o/, /u/, merger, cross-generational change, Euclidean distance, F1, F2

### 1. Introduction

The primary goal of this paper is to better understand an on-going vowel change in Seoul Korean by observing how vowel variants are transmitted over three age groups of speakers. It involves the so-called raising of the mid back vowel /o/ and the subsequent approximation of /o/ and /u/. Several acoustic and/or phonological studies observed this change in a limited set of speakers, or a limited set of lexical words. In the present study, we examine how /o/ and /u/ have changed across three age groups of speakers: 20's, 30's and 40'/early 50's. The apparent-time method we take in this paper

is based on the assumption by Labov's model of transmission and incrementation that once the learned linguistic system stabilizes when children reach young adulthood, no structural changes to the vowel system are to be expected, and this system is transmitted to the next generation (Labov, 2001, 2007; cf. Harrington, 2006). Thus the vowel system of the adult subjects participating in this study is not assumed to undergo further structural changes itself if they stay in the same speech community. Additionally, the inclusion of the above three age groups (20's to early 50's) in particular is based on the results of previous phonetic studies that the change of /o/ and /u/ seems to occur quite recently and thus the speakers over the 50's need not be examined.

The raising of /o/ to /u/ was first documented in the phonological literature. Chae (1999) showed that this change took place historically in some lexical words. It started around the late 1900, and has gone to completion in certain types of lexical words, whereas it is currently underway in other types of words. For example, the vowel /o/ is completely changed to /u/ in many pure Korean words as in *halu* 'one day' (<- *halo*),

1) Konkuk University, jhan@konkuk.ac.kr

2) Hanyang University, hskang@hanyang.ac.kr

This paper was written as part of Konkuk University's research support program for its faculty on sabbatical leave in 2012. We would like to thank all the participants and Tae-Hwan Choi for his help with statistics.

Received: May 1, 2013

Revised: June 12, 2013

Accepted: June 24, 2013

*motu* ‘everybody’ (<- *moto*), and *cacu* ‘often’ (<- *caco*). The vowel /u/ in the second syllable of the words in these examples was all developed from /o/ historically. On the other hand, some types of words are undergoing this vowel change, which are grammatical endings such as nominal or verbal endings (*to* ‘also’, *ko* ‘and’). The vowel /o/ in these types of words is frequently pronounced as [u], even though it is not a standard form. Based on these examples, Chae (1999) argued that raising of /o/ to /u/ in non-initial position of words is in progress in Seoul Korean. This change was not necessarily shown to be phonologically conditioned, but rather influenced by various socio-linguistic factors such as gender, social class and age. According to Chae (1999), it appears that this change is more frequently found in younger speakers than old speakers, in females than males, and in lower class than upper class.

Acoustic studies have also documented the vowel change of /o/ and /u/. In most experimental work presented before 2000, the vowels /o/ and /u/ were shown to be clearly distinguished such as a mid back vowel (/o/) and a high back vowel (/u/). In Yang (1996), for instance, twenty Seoul Korean native speakers (10 for each male and female) with an age of 18 to 27 years participated in the recording of the Korean non-words 'h(V)da' where V=/a, e, ε, i, o, u, i, ʌ, y, ø/. His results showed that both male and female speakers produced /u/ which was clearly distinguished from /o/ (and /i/). The mean F1 and F2 values of /u/ were 369 Hz and 981 Hz for males, and 422 Hz and 1021 Hz for females, whereas those of /o/ were 453 Hz and 945 Hz for males and 499 Hz and 1029 Hz for females. However, more recent experimental work observed that /o/ and /u/ become closer. Seong (2004) measured the Korean monophthongs produced by five males and five females in their late 20's or mid 30's, and /o/ and /u/ were shown to be approximated together. There was a gender difference in that the distance between these two vowels was statistically different for female speakers, but not for male speakers. Similar results were shown in Kim et al. (2006) where tokens of /o/ and /u/ were overlapped, without significant differences. Moon (2006) also showed that these two vowels were very close, but still with statistically significant differences. Jang and Shin (2006) directly compared the vowel productions of the two generations of female speakers using Southern Dialect (Daegu Dialect) (20's vs. 40's) as well as female speakers using Seoul Dialect in their 20's, and showed that younger speakers of Southern Dialect showed shorter distance between /o/ and /u/ in the vowel plane than old speakers but longer distance than young speakers of

Seoul Dialect. The authors attributed this result to the influence of Seoul Dialect to the younger speakers of Southern Dialect. Similarly, Kim (2012) measured the Korean monophthongs produced by 10 native speakers of Korean (using standard Korean) (five for each male and female) and found that /o/ was raised to the position of /u/ and subsequently /u/ was fronted toward /i/.

As such, comparison of previous studies such as Yang (1996) and rather recent work separated by an interval of more than 10 years demonstrates that there are discernible age-based differences of formant values between /o/ and /u/. It appears that distance between /o/ and /u/ decreases progressively with successively younger age group, creating considerable confusion between these two vowels.

In addition, closeness between the vowels /o/ and /u/ is observed in recent loanword adaptation. When English words are borrowed into Korean, English sounds are usually adapted as the most similar Korean sounds in perception (H. Kang, 1996; Y. Kang, 2003). As Korean has no diphthongs, they are adapted as two different vowels each of which is included in two separate syllables in loanwords. For example, ‘cake’, ‘site’, and ‘join’ are adapted as [k<sup>h</sup>e.i.k<sup>h</sup>i], [S<sup>\*</sup>a.i.t<sup>h</sup>i] and [dʒo.in]. Interestingly, when English words with an /oʊ/ diphthong are borrowed as in ‘boat’ and ‘note’, this particular diphthong is adapted as a monophthong, [o], as in /bo.t<sup>h</sup>i/ and /no.t<sup>h</sup>i/ rather than as two separate vowels (/bo.u.t<sup>h</sup>i/ and /no.u.t<sup>h</sup>i/). We suspect that diphthongs whose two members show sharp acoustic differences from each other are adapted as two separate phonemes into Korean, (e.g., [aɪ], [eɪ], [oɪ]). However, if two members of a diphthong are close to each other as in /oʊ/, then they are rather adapted as a monophthong which carries the prominence. In this case, it is /o/, not /u/, since English /oʊ/ is an off-glide diphthong.

The existing literature thus provides some information about the historical change of /o/ to /u/ in certain types of lexical words, and preliminary results of phonetic work about the raising of /o/ toward /u/. However, each study provides a rather fragmented look at the vowel change between /o/ and /u/ without a specific experimental work on the historical change. No single study examined the process of vowel change by observing how these two vowels are transmitted over generations of speakers. The current study is designed to provide a much more systematic analysis of this vowel change. We explicitly examine how /o/ and /u/ are produced differently across three age groups of speakers: 20's, 30's and 40'/50's.

Our approach to explore the vowel change is implemented by measuring the Euclidean distance between /o/ and /u/ in the two-dimensional F1 by F2 plane, based on the F1 and F2 values of each vowel nucleus. This is based on the assumption that vowels are more or less static targets and their positional movement in the vowel space is the only change transmitted across age groups. We draw attention to whether the distance between these two vowels is shortened by each successive age group.

## 2. Method

### 2.1 Participants

Thirty-six adult speakers of Seoul Korean participated in the study. The participants were all born, raised and had spent most of their lives in Seoul, Korea, and most of their parents were also raised in Seoul. They fall into three age groups: 20's, 30's, and 40's/early 50's. In each age group, there were 12 speakers (six males and six females). The mean ages of each group speakers were 22.8 (21-26) for the 20's, 34.8 (31-39) for the 30's, 47.4 (41-53) for the 40's/50's. None of the speakers reported any speech disorders, and they were all paid for their participation.

### 2.2 Stimuli

The target sounds were Korean monophthongs, /o/ and /u/, but all eight Korean monophthongs were recorded for direct comparison. They were included in Korean bisyllabic pseudowords with a  $V_1CV_2$  structure where  $V_1$  or  $V_2$  was one of the eight Korean monophthongs such as /a, e, ε, i, o, u, ɨ, ʌ/, and the intervening consonant was one of /p, t, k/. The inclusion of all eight vowels and three consonantal places was for neutralizing the coarticulatory effects of adjacent segments to the formant values of the target vowel. Although the target words were designed to be nonsense-words to avoid the possible effects of word familiarity, the words did not violate Korean phonotactic constraints. Each word was recorded embedded in the frame sentence: 'c<sup>h</sup>ənc<sup>h</sup>ənhɨ \_\_\_ hasejo' ('Please do (say) \_\_\_ slowly').

### 2.3 Procedure

We recorded the participants individually in a sound-proof booth by using a Shure KSM10 microphone and a Tascam (HD-P2) solid-state recorder. Before recording, the participants completed a questionnaire on their biographical and language

backgrounds and read the test words once. Each recording lasted approximately 30 minutes. The recorded tokens were digitized in Praat at a sampling rate of 44.1 kHz and saved as 16-bit computer audio files to be used in the acoustic measurements. The F1 and F2 values were extracted automatically in the steady state for each token, using Praat. The exact position for the steady state was determined manually by researchers. When extracting the F1 and F2 values, care was taken to draw the frequency measurement from the steady state of the vowel in order to minimize the effect of the adjacent consonant and vowel. All automatically measured formants were checked by two researchers, and any disagreements and errors were hand-corrected when necessary. In order to compare the degree of separation between /o/ and /u/ across age group, the Euclidean distances between these two vowel points were measured. Euclidean distances are frequently used to calculate the proximities of the centers of overlapping or possibly merged vowel classes in F1 x F2 space (e.g., Hay, Jannedy, & Mendoza-Denton, 1999), using the formula in Equation (1).

$$(1) d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

In Equation (1),  $x$  refers to F2 and  $y$  to F1 of the two vowels, /o/ and /u/. This is the 'distance formula' by which we calculate the length of a line with ends defined by two points having coordinates  $(x_1, y_1)$  for the vowel /o/ and  $(x_2, y_2)$  for the vowel /u/ (Di Paolo & Yaeger-Dror, 2011). Because it compares the relative closeness of the two vowels, it enables us to directly compare the formant values across three age-group speakers without the need for normalization (MacLagan & Hay, to appear). The total number of tokens for analysis was 6912 (3 age groups (20's, 30's, 40's/50's) x 12 speakers (6 males, 6 females) x 192 tokens (8  $V_1$  x 3 intervening consonants x 8  $V_2$ )).

## 3. Results

We begin the presentation of the results with cross-generational displays of mean relative positions of all eight vowels in the two-dimensional (F1 x F2) acoustic vowel space, for both male (Figure 1) and female (Figure 2) speakers in the first syllable position.

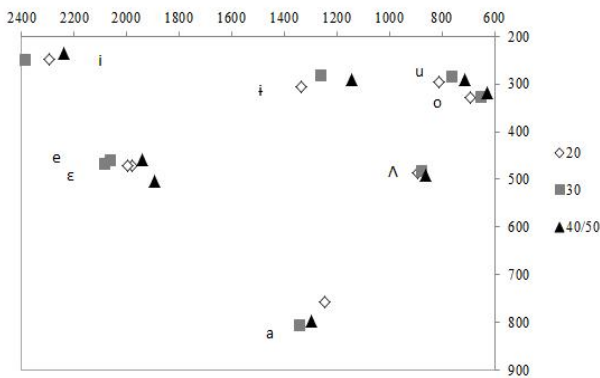


Figure 1. Cross-generational vowel dispersion patterns for Korean male speakers in the first-syllable position

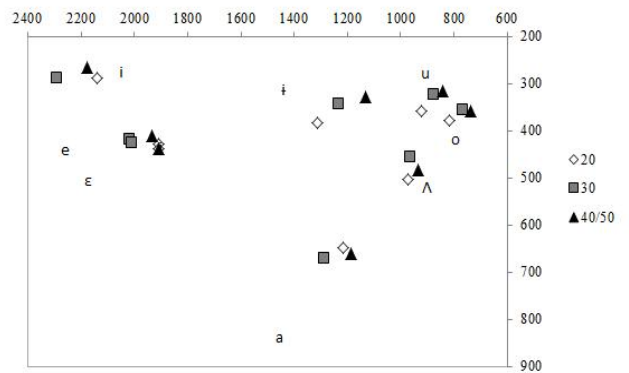


Figure 3. Cross-generational vowel dispersion patterns for Korean male speakers in the second-syllable position

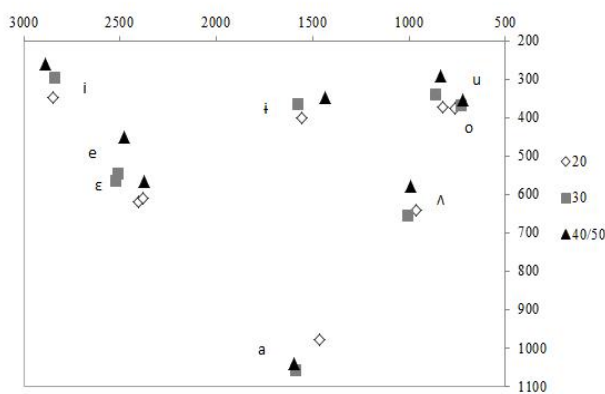


Figure 2. Cross-generational vowel dispersion patterns for Korean female speakers in the first-syllable position

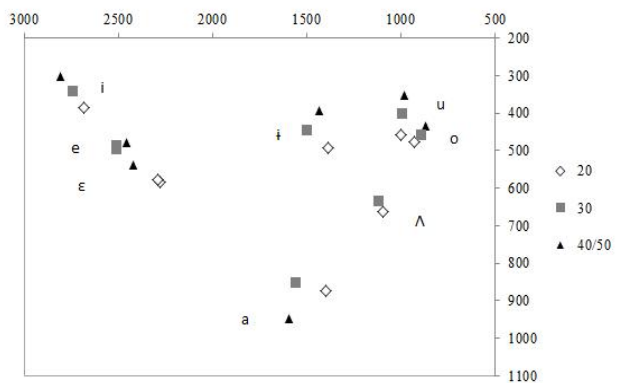


Figure 4. Cross-generational vowel dispersion patterns for Korean female speakers in the second-syllable position

Overall, the cross-generational change of /o/ and /u/ appears to be conditioned by gender. With each successively younger generation, the vowels /o/ and /u/ produced by female speakers become progressively approximated, whereas these two vowels remain unaffected by speaker age for male speakers. Looking at the Figure 2, female speakers in their 20's appear to produce these two vowels with little distinction, whereas older speakers maintain difference between these two vowels in terms of both F1 and F2.

In Figures 3 and 4, the cross-generational displays of eight vowels are shown in the vowel space, for male and female speakers in the second syllable position, respectively. As compared with the results for the first syllable position, the vowels in the second syllable were produced in a smaller vowel space. However, the overall cross-generational pattern for the vowel change of /o/ and /u/ appears to be similar between the two syllable positions in that the distance between /o/ and /u/ appears to be similar between these two positions.

In the following, results of the mean Euclidean distances between /o/ and /u/ broken down by age group, syllable position, and gender were presented in Figure 5 (for the first-syllable position) and Figure 6 (for the second-syllable position).

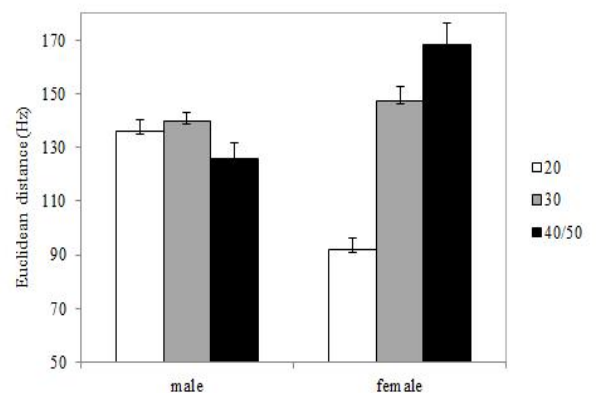


Figure 5. Euclidean distance between /o/ and /u/ in the first-syllable position for each age group

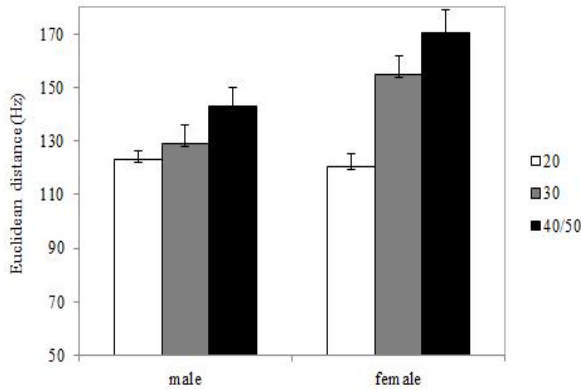


Figure 6. Euclidean distance between /o/ and /u/ in the second-syllable position for each age group

In Figure 5, we observe that in the first syllable position, the Euclidean distances are progressively reduced with each younger age group for female speakers, and particularly speakers in their 20's have significantly smaller distances between /o/ and /u/ than older speakers. However, such cross-generational changes are not shown in the results of male speakers. On the other hand, Figure 6 shows that in the second syllable position, the Euclidean distances are progressively reduced with each younger age group for both male and female speakers.

A repeated-measures ANOVA with the age group (20's vs. 30's vs. 40/50's), syllable position (1st vs. 2nd), and gender (male vs. female) as within-subject factors was conducted to analyze the Euclidean distances between /o/ and /u/. Only item analyses (F2) were done here due to relatively small number of subjects for each condition. There were significant main effects of the age group [ $F(2,46)=38.982, p=.000$ ], gender [ $F(1,23)=5.775, p<.05$ ], and significant interaction effects of the age group\*gender [ $F(2,46)=31.7, p=.000$ ], gender\*the syllable position [ $F(1,23)=5.775, p<.05$ ], and gender\*age\*syllable position [ $F(2,46)=7.30, p<.05$ ]. However, the effect of the syllable position [ $F(1,23)=1.691, p>.05$ ], and the interaction of the syllable position and the age group [ $F(2,46)=1.401, p>.05$ ] were not significant. Subsequent post-hoc analyses revealed that in the first syllable position, the Euclidean distances of all age groups differed significantly from one another for female speakers ( $p<.05$ ), but for male speakers, significant differences did not exist between any of the age groups ( $p>.05$ ). In the second syllable position, significant differences between 20's and 30's, and 20' and 40/50's, but not between 30's and 40/50's for female speakers, while for male speakers, significant differences were only found between 20's and 40/50's.

Based on the statistical results, we can summarize that in the first syllable of the target words, only female speakers showed the vowel change, whereas we found parallel positional changes between male and female speakers in the second syllable of the words, though the degree of change was less clear for male speakers. The results of male speakers might be attributed to the syllable position that the target vowel is posited. It was shown in Chae (1999) that the first syllable of the Korean words is likely to be produced with some accent and in fact the formant change of /o/ was shown to be frequently occurring in the non-initial syllable without any accent. The present results are in good agreement with the observation by Chae (1999) in that unlike the results for the first syllable position, the Euclidean distances are progressively reduced with each younger age group for both male and female speakers.

Taken together, in the first syllable of the target words, only female speakers showed the vowel change, whereas we found parallel positional changes between male and female speakers in the second syllable of the words.

#### 4. Discussion

This study investigated the change of /o/ and /u/ across three successive age groups of adult Seoul Korean speakers, 20's, 30's, and 40/50's. The results were presented in two ways: the overall formant patterns in F1 x F2 vowel space, and the Euclidean distances between /o/ and /u/. First, in the examination of the formant values produced by three age groups of speakers, it was shown that the F1 and F2 values of /o/ and /u/ became closer with successively younger age group for female speakers, but not for male speakers. Second, the Euclidean distance between /o/ and /u/ decreased progressively with successively younger age group for female speakers, whereas male speakers did show such significant differences only for the second syllable position.

The results reported in this study provide evidence that the merging of /o/ and /u/ is in progress in Seoul Korean, though it is not completed yet, with noticeable distinction between these two vowels. The two vowels, /o/ and /u/, were shown to be closer in terms of both F1 and F2, and thus their distances in the acoustic space were shortened with successive younger age group. However, this change was also influenced by gender and the position that the target vowel occurred. The cross-generational change of /o/ and /u/ was most evident in female speakers and the non-initial syllable position.

First, as for the gender effect, previous sociolinguistic studies have observed two general tendencies on the role of the linguistic differentiation of men and women: first, in the stable sociolinguistic situation, men use a higher frequency of nonstandard forms than women; second, in the majority of linguistic changes, women use a higher frequency of the incoming forms than men (Labov, 1991). As for the first finding, men are known to be less influenced by the social stigma directed against the nonstandard forms, whereas women are likely to respond to overt prestige associated with them. For example, male speakers are found to use the colloquial form of the progressive ending '-ing' as in [in] more than females in many dialects of English (Labov, 1966; Houston, 1985). However, and more importantly to the present study, women are generally the innovators in the systematic sound changes that make up the major mechanisms of linguistic change. A large body of evidence shows that women are ahead of men in most of the linguistic changes in progress (Eckert, 1989; Di Paolo, 1988; Chambers and Hardwick, 1985 among others). For example, female speakers were in advance of males in the raising of 'o' and the backing of 'a' in the New York City (Labov, 1966). This trend might have to do with the asymmetry of the childcare situation (Labov, 1991) in that children learn the native language from their primary caregivers, who are women. The phonetic forms that the children are first exposed to are those used by women. Given the situation, they hear relatively advanced forms from their female caregivers and the later influence of the peer group in accelerating or retarding these forms can only operate on the basis of what has been first acquired (Oh, 2011). Therefore the asymmetry of the caregiving situation is likely to advance female-dominated changes and retard the male-dominated changes.

The present results also showed such a trend: in the first vowel of the target words, male speakers showed no significant difference in the distance between /o/ and /u/ across the three age groups, whereas the distance between /o/ and /u/ decreased progressively with successively younger age group for female speakers. This result indicates that women appear to be in advance of men in the on-going approximation of /o/ and /u/ (Maclagan, Gordon, & Lewis, 1999).

However, based on the data presented in the present results, it is not clear what causes the approximation of /o/ and /u/. The vowel /o/ may be raising toward /u/ as proposed in previous studies, or the vowel /u/ is lowering toward the position of /o/, or even both. As the vowel space that each speaker is using for

the production of Korean monophthongs is not uniform, normalization is necessary in order to clarify this issue, which we leave for future study.

Second, as for the effect of phonological position, there was shown to be a small but significant effect such that when we compared the overall formant patterns of /o/ and /u/ in the vowel space, there appeared to be similar patterns between those of the first syllable and those of the second syllable positions. However, the results of the Euclidean distances between these two vowels showed that in the first syllable position, the distances were progressively reduced with each younger age group only for female speakers, whereas in the second syllable position, both gender group speakers showed such cross-generational reduction pattern.

These results demonstrate that the on-going change of /o/ and /u/ appears to be more clearly manifested in the second syllable position. The syllable-position variability in this study reflects the difference in the rate of sound change that the vowel merger is earlier in the non-initial position than in the initial position which is in good agreement of the phonological analysis that the raising of /o/ to /u/ is common in unaccented syllables (Chae, 1999).

## References

- Chae, S.-y. (1999). The core-periphery structure in the Korean lexicon reflected in a phonological variation and change. *Studies in Phonetics, Phonology and Morphology*, 5, 217-236. (채서영 (1999). 음운변화에 나타난 한국어 어휘의 층위구조. 음성·음운·형태론연구, 5, 217-236.)
- Chambers, J.K., & Hardwick, M.F. (1985). Dialect homogeneity and incipient variation: Changes in progress in Toronto and Vancouver. In J Harris & R. Hawkins (Eds.), *Sheffield working papers in language and linguistics*, 2, 28-49. Sheffield: University of Sheffield School of Modern Languages and Linguistics.
- Di Paolo, M. (1988). Pronunciation and categorization in sound change. In K. Ferrara, B. Brown, K. Walters, & J. Baugh (Eds.) *Linguistic change and contact: NWAV XVI*, Austin: University of Texas Linguistic Forum, 30, 84-92.
- Di Paolo, M. & Yaeger-Dror, M. (2011). *Sociophonetics: A student's guide*. London and New York: Routledge.
- Eckert, P. (1989). The whole woman: Sex and gender differences in variation. *Language Variation and Change*, 1, 245-268.
- Harrington, J. (2006). An acoustic analysis of 'happy-tensing' in

- the queen's christmas broadcasts. *Journal of Phonetics*, 34, 136-164.
- Hay, J., Jenedy, S., & Mendoza-Denton, N. (1999). Oprah and /ay/: Lexical frequency, referee design and style. *Proceedings of the 14th International Congress of Phonetic Sciences*, San Francisco, August 1999, 1389-1392.
- Houston, A. (1985). *Continuity and changes in English morphology: The variable (ING)*. Ph.D. Dissertation, University of Pennsylvania.
- Jang, H. & Shin, J. (2006). An acoustic study on the generational difference of the monophthongs in the Daegu Dialect. *Malsori*, 57, 15-30.  
(장혜진, 신지영 (2006). 대구 방언 단모음의 세대 간 차이에 대한 음향 음성학적 연구. *말소리*, 57, 15-30.)
- Kang, H. (1996). English loanwords in Korean. *Studies in Phonetics, Phonology, and Morphology*, 2, 21-47.
- Kang, Y. (2003). Perceptual similarity in loanword adaptation: English postvocalic word-final stops in Korean. *Phonology*, 20, 219-273.
- Kim, J. (2012). *A one-year longitudinal study of Korean vowel production by Chinese learners of Korean*, Ph. D. Dissertation, Konkuk University.
- Kim, H., Song, J. & Kim, K.-H. (2006). A formant study of Korean vowels produced by Japanese learners of Korean. *Speech Sciences*, 13(3), 67-82.  
(김희성, 송지연, 김기호 (2006). 일본인 한국어 학습자의 한국어 모음 포먼트 연구, *음성과학*, 13(3), 67-82.)
- Labov, W. (1966). *The social stratification of English in New York City*. Washington, DC: Center for Applied Linguistics.
- Labov, W. (1991). The intersection of sex and social class in the course of linguistic change. *Language Variation and Change*, 2, 205-254.
- Labov, W. (2001). *Principles of linguistic change. Vol. 1: Social factors*. Oxford: Blackwell.
- Labov, W. (2007). Transmission and diffusion. *Language*, 83, 344-387.
- Maclagan, M. & Hay, J. (to appear). Getting *fed* up with our *feet*: Contrast maintenance and the New Zealand English 'short' front vowel shift. *Language Variation and Change*.
- Maclagan, M., Gordon, E., & Lewis, G. (1999). Women and sound change: Conservative and innovative behavior by the same speakers. *Language Variation and Change*, 11, 19-41.
- Moon, S.-J. (2006). A fundamental phonetic investigation of Korean monophthongs. *Malsori*, 62, 1-18.  
(문승재 (2006). 한국어 단모음의 음성학적 기반연구. *말소리*, 62, 1-18.)
- Oh, E. (2011). Effects of speaker gender on voice onset time in Korean stops. *Journal of Phonetics*, 39(1), 59-67.
- Seong, C.-J. (2004). An acoustic analysis on the Korean 8 monophthongs - with respect to the acoustic variables on the F1/F2 vowel space. *The Journal of the Acoustical Society of Korea*, 23(6). 454-461.  
(성철재 (2004). 한국어 단모음 8개에 대한 음향분석. *한국음향학회지*, 23(6), 454-461.)
- Yang, B. (1996). A comparative study of American English and Korean vowels produced by male and female speakers. *Journal of Phonetics*, 24, 245-261.
- **Han, Jeong-Im**  
Department of English  
Konkuk University  
120 Neungdong-ro, Gwangjin-gu  
Seoul, 143-701, Korea  
Email: jhan@konkuk.ac.kr
- **Kang, Hyunsook**  
Department of English Language and Culture  
Hanyang University, ERICA Campus  
1592, Sa-3 Dong, Sangnok-gu, Ansan-si  
Kyunggi-do, Korea  
Email: hskang@hanyang.ac.kr