



Linguistic and social factors affecting the /i/ and /ʌ/ dispersion in Kyungsang Korean*

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Abstract

The current study investigated the productions of /i/ and /ʌ/ in Kyungsang Korean, which is known for undergoing a dispersion for the younger generation. Specifically, to identify the nature of /i/ and /ʌ/ in Kyungsang Korean, this study examined the linguistic and social factors affecting directions and degrees of the /i/-/ʌ/ dispersion. Sixteen young speakers of Kyungsang Korean repeated 112 (near) minimal pairs containing the two target vowels. The formant values of each production as well as the Euclidean distance between the two vowels were analyzed for four manipulated factors: gender (male vs. female), the existence of carrier phrases (words in isolation vs. words with a carrier phrase), the lexical status of stimulus words (real-word pairs vs. nonsense-word pairs), and the vowel position within a word (word-initial positions vs. word-final positions). The results indicated that the female speakers produced the two target vowels more distinctively than the male speakers, and so did when the words were produced in isolation. The results also revealed that the Euclidean distances were greater for the real-word pairs and in word-initial positions. Overall, the results suggested that the Kyungsang Korean speakers in their 20s could distinctively produce the two vowels /i/ and /ʌ/, but this vowel dispersion is not a completed process, but an ongoing one.

Keywords: vowel change, /i/-/ʌ/ dispersion, Kyungsang Korean, Korean dialect, sociophonetics

1. Introduction

Previous research indicated that Korean vowels have undergone a few changes such as an approximation between /o/ and /u/ (e.g., Han & Kang, 2013; Kang & Han, 2013; Yoon & Kim, 2015; Igeta *et al.*, 2017). Especially, most of these studies focused on vowel changes in Seoul Korean, the standard Korean, but relatively fewer studies investigated vowel changes in other than Seoul dialect (e.g., Seong, 2005; Jang & Shin, 2006; Lee *et al.*, 2017). For example, Lee and her colleagues (2017) investigated the production of four Korean non-front vowels (/i/, /ʌ/, /o/, /u/) by young and old speakers from 4 different regions. Their results showed that whether or not /o/ and /u/ became closer depended not only on the generation but also on

the speakers' dialects. This suggested that the types and directions of sound changes vary with different dialects of a language.

Among various Korean dialects, Kyungsang Korean, spoken in the southeast region of Korea, is also known for undergoing another vowel change. Originally, Kyungsang Korean was reported to have six monophthongs while Seoul Korean has seven (Kwak, 2003; Kim, 1997): speakers of Kyungsang Korean did not distinguish the high central vowel /i/ and the mid back vowel /ʌ/ in their production. Kim (1997), for instance, proved that both /i/ and /ʌ/ were produced as the mid-central vowel /ə/ (i.e., the F1 range was 420~550Hz, and the F2 range was 1100~1500Hz). However, some recent studies have reported that Kyungsang Korean speakers in their 20s distinctively produced the two vowels /i/ and /ʌ/ (Jang &

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Shin, 2006, 2007; Kim *et al.*, 2006; Lee *et al.*, 2017). Specifically, Jang & Shin (2006) analyzed the productions of /i/ and /ɛ/ by 20 Kyungsang Korean speakers, half in their 20s and the rest in their 40s. The results revealed a vowel change in Kyungsang dialect: the Kyungsang dialect speakers in their 40s could not differentiate the two vowels, whereas young Kyungsang dialect speakers successfully distinguished /i/ and /ɛ/ in their production. These results demonstrated the ongoing dispersion of /i/ and /ɛ/ in Kyungsang Korean, and therefore the Kyungsang Korean vowels have undergone a sound change with the direction of having a seven vowel system as the standard Korean.

In addition to the existence of a sound change, much literature suggested some linguistic and social factors affecting directions and degrees of a sound change. For many languages and dialects, one of the most widely studied factors was speakers' gender (e.g., Labov *et al.*, 2005; Jang & Shin, 2007; Clopper & Smiljanic, 2011; Labov, 2011; Lee *et al.*, 2017). The research on gender effect insists that female speakers in general tend to lead sound changes, so the degree of a sound change by female speakers is usually greater than that by male speakers. This tendency was also noted in the /i-/ɛ/ dispersion in Kyungsang Korean, in that the difference between /i/ and /ɛ/ was greater for young female Kyungsang Korean speakers than that for male ones (Jang & Shin, 2007; Lee *et al.*, 2017). However, these studies only examined the effect of social factors, and few researched the linguistic factors affecting the degree of the /i-/ɛ/ dispersion¹. Specifically, since most of the aforementioned studies analyzed quite a limited number of stimulus words (i.e., three words per vowel in Jang & Shin, 2006, 2007; nine per vowel in Lee *et al.*, 2017), their findings are not sufficient to recognize the effect of linguistic factors on the degree of the vowel change in Kyungsang Korean.

Of many linguistic factors, researchers have studied the effect of prosodic prominence on vowel changes (Cole *et al.*, 2010; Han & Kang, 2013; Yoon & Kim, 2015). To test the effect of prosodic prominence, Cole and her colleagues (2010) compared the vowel productions under contrastive focus conditions with those under broad focus, and Han & Kang (2013) examined the effect of vowel positions within a word. First, Cole and her colleagues investigated the ongoing merger of /e/ and /ɛ/ in Chicago American English. Their results revealed that the vowels in the prosodically prominent condition (contrastive focus) were more distant than those in the less prominent condition (broad focus). Then, they argued that the results supported the Hyperarticulation Hypothesis—which insisted that the vowels in prominent positions were produced in more peripheral areas of a vowel space. The results, however, were inconsistent with the Prominence-Shift Hypothesis—which insisted that more advanced vowel changes occurred for the vowels in prosodically prominent positions than for those in less prominent ones. This effect of prosodic prominence was also tested for Korean vowel changes. Han & Kang (2013), for example, examined the Seoul Korean /o/ and /u/ merger using words with a V₁CV₂ sequence, and found the significantly greater approximation of the two vowels for V₂ than for V₁. This finding could be explained to support the Hyperarticulation Hypothesis from Cole *et al.* (2010),

since in Korean the word-initial position (V₁) is considered to be prosodically more prominent than the non-initial position (Cho & Keating, 2001). That is, because the /o/ and /u/ in V₁ were more prosodically prominent, the speakers produced them in a more distinguishable manner, which then made the two vowels less close to each other. Taken altogether, these studies implied that the extent to which two merging vowels become closer is smaller when the vowels are in prosodically prominent positions than in less prominent positions.

With respect to the effect of prosodic prominence on the degree of vowel changes, Jacewicz *et al.* (2011a, b) examined the English vowel changes using the target vowels in isolation (i.e., /hVd/) and the vowels in set of sentences with (e.g., Ted thinks the fall BIDS are low) and without the sentential stress (e.g., Ted thinks the fall bids are LOW). They found the effect of prosodic prominence on the degree of vowel changes; namely, the vowels under sentential stress conditions were produced with longer duration and in a more peripheral area of a vowel space. They also showed the effect of the existence of carrier phrases, in that the isolated words occupied a more peripheral area than even with the vowels with sentential stress. This effect of carrier phrases was noted in Korean vowel productions. For example, Jeong (1997) indicated that most of the Seoul Korean vowels in /hVd/ conditions were located in a more peripheral area of a vowel space than those produced within a sentence of /na.nin ___ i.ra.ko.han.da/ for 'I said ___.' Together, these findings insist that the vowels could be more hyperarticulated even when they were produced in isolation than when they were produced within a carrier phrase and/or when they carried prosodic prominence (i.e., sentential stress). Therefore, in the case of vowel change, we could expect the greater differences for the vowels produced without carrier phrases than those produced within carrier phrases.

Another linguistic factor affecting the degree of a vowel change is the lexical status of stimulus words (i.e., whether a phonemic sequence forms a real word or a nonsense word). Especially, Hay *et al.* (2013) studied this effect in order to investigate the mental representations of the merged vowels: whether the two vowels were fully merged into one phonemic category or still owned two separate categories. The reason for using nonsense words was based on the idea that an abstract phonemic category for a certain sound would be established by numerous episodic memories from real-word production and perception of the sound; and that using nonsense words could force a speaker to directly access to the abstract level without interference of episodic memories. That is, if the two vowels shared only one phonemic category, no difference between real and nonsense words would be expected or even the vowels in real words could show less overlapping due to stored somewhat-fuzzy episodic memories of the real words. On the other hand, if the two vowels were not fully merged into a single phonemic category, less overlapping between the target vowels for nonsense words could be expected since speakers would rather produce the vowels of nonsense words solely depending on the distinct phonemic categories. With this prediction, Hay and her colleagues investigated the /e/ and /æ/ merger in New Zealand

¹ Lee *et al.* (2017) manipulated their stimuli with respect to the position of the vowels within a word as well as the type of words (lexical vs. grammatical morphemes), but the effect of these factors were not separately tested in their analyses.

English and the /ɑ/ and /ɔ/ merger in American English. Their results revealed that the distances between the target vowels were greater for the nonsense-word pairs than those for the real-word pairs. The results, therefore, implied that the /e/ and /æ/ in New Zealand English and the /ɑ/ and /ɔ/ in American English still owned their own categories in the speakers' mental representation, and the merging processes of these vowels were not fully completed yet.

The purpose of the current study is to investigate the /i/-/ʌ/ dispersion in Kyungsang Korean. Specifically, the current study aimed to examine the effects of various linguistic and social factors on the vowel dispersion using larger number of various stimulus words. In order to test these effects on the degree and direction of Kyungsang Korean /i/ and /ʌ/ and to identify the nature of /i/ and /ʌ/ productions in Kyungsang Korean, this study manipulated four factors: gender, the existence of a carrier phrase, the vowel position within a word, and the lexical status of stimulus words.

Considering the findings from the previous research, the following patterns are expected with respect to the four manipulated factors. First, regarding the gender effect, the degree of the /i/-/ʌ/ dispersion will be greater for female speakers than that for male speakers. Next, in terms of the existence of a carrier phrase, the greater /i/-/ʌ/ dispersion will be noted when the target vowels were produced in isolation than when they were produced within a carrier phrase.

As for the other two factors of interest, both predicting a result and understanding the finding are important. In terms of the effect of the vowel position within a word, the distance between /i/ and /ʌ/ will be greater when the vowels were produced in word-initial positions (i.e., prosodically more prominent position) than when they were in non-initial positions. Different from vowel mergers, the greater distance between the two dispersing vowels could be expected by both the Hyperarticulation Hypothesis and the Prominence-Shift Hypothesis. In other words, following the Hyperarticulation Hypothesis, the vowels in prosodically prominent positions would occupy a more peripheral area in a vowel space, so the distance between the two vowels in word-initial positions could be greater than those in word-final positions. In addition, since the Prominence-Shift Hypothesis suggested more advanced sound change in prosodically prominent conditions, the greater amount of the vowel dispersion could be obtained for word-initial vowels than for word-final vowels.

To predict possible patterns for the effect of the stimuli's lexical status, it is necessary to consider the direction of the /i/ and /ʌ/ vowel change first. That is, unlike Hay *et al.* (2013), the current study examined the vowel dispersion instead of vowel mergers. Recall that the distance between the two vowels was expected to be greater for real words when the vowels were fully merged, whereas the distance was expected to be greater for nonsense words when the vowels were not yet completely merged. However, the opposite pattern should be predicted in the case of the vowel dispersion. Specifically, if the dispersion process completes as two separate phonemic categories in the speakers' mental representations, the distance for nonsense words will be greater than that for real words. On the other hand, if the two vowels are not fully separated, but share some areas of their phonemic categories, the distance for real

words will be greater. Again, this prediction comes from the idea that speakers depended solely on their mental representation of a sound when producing nonsense words, while speakers could depend on both mental representation and somewhat fuzzy clouds of episodic memories when producing real words.

2. Method

2.1. Participants

Sixteen speakers of Kyungsang Korean participated in the current study. All of them were born and raised in Busan, the biggest city located in the southeast region of the Kyungsang province. None of the participants have spent more than a year in other countries or other cities in Korea. All were undergraduate students at a university in Busan, so all of them were in their 20s. Half of the participants ($n = 8$) were male speakers, and the rest were female speakers. The speakers voluntarily participated in the current study.

2.2. Stimuli and Procedure

All participants were asked to read three sets of word lists: (i) eight Korean monophthongs (/ɑ, ʌ, i, o, u, ɪ, æ, e/), (ii) monosyllabic words with two target vowels /i/ and /ʌ/, and (iii) 2-to-4 syllable words with two target vowels. Hereafter, the first set will be referred to as Control set, the second as Monosyllable set, and the last as Word set.

Monosyllable set was used to test the effect of the lexical status. Therefore, out of 65 pairs of monosyllabic words, 16 were pairs of real words (e.g., /sin/ for 'victory' and /sʌŋ/ for 'castle'), while the rest were pairs of a real and a matched nonsense word. Among 49 nonsense pairs, 33 were the pairs with /i/ nonsense words (e.g., /nʌ/ for 'you' and /ni/) and the rest were the pairs with /ʌ/ nonsense ones (e.g., /im/ for 'tone' and /ʌm/). To analyze as much productions of the target vowels as possible, all possible combination of preceding and following consonants were selected excluding the pair with both nonsense words such as /pik/ and /pʌk/. The lexical status of each word was determined by an online dictionary².

Word set was to examine the effect of the vowel position within a word on the /i/-/ʌ/ dispersion. Similar to Monosyllable set, 94 words were selected with different combinations of preceding and following consonants and vowels. Out of 47 pairs, 28 were the words with the target vowel in the initial syllable (e.g., /nil.da/ for 'to increase' and /nʌl.da/ for 'to hang'), and the rest were the words with the target vowel in the final position (e.g., /kʌl.sin/ for 'the final' and /kʌl.sʌŋ/ for 'organization'). If possible, bisyllabic words were selected, but seven pairs contained trisyllabic words, and two contained four-syllabic words. Without the proper word to form a minimal pair, near minimal pairs (e.g., /to.ip/ for 'a capital' and /teo.ʌp/ for 'a work') were also used; and 22 out of 47 pairs were near minimal pairs.

The experiment was conducted in a quiet office. The participants' speech was digitally recorded to a SONY PCM-M10. The words in Monosyllable set and Word set were presented with pre-randomized order. All participants started with Control set. Some speakers completed Word set prior to Monosyllable set, and vice versa.

2 Interjections were not included as real words, and frequently used bound morphemes, such as /nin/ for a topic marker, were considered as real words.

Between Monosyllable and Word set, each speaker read a filler word list.

The last manipulation was the existence of a carrier phrase /tei.kim ___ mal.ha.se.yo/ for ‘say ___ now.’ All participants completed Control set without the carrier phrase and repeated each vowel three times. Half of the participants from each gender group were asked to read each stimulus word with the carrier phrase (carrier-phrase group), while the rest were to read without it (isolation group). Due to the time limit in the experiment, the carrier-phrase group repeated each word twice, but the isolation group repeated each word three times.

2.3. Measurement

A total of 9,248 vowel productions were analyzed using *Praat*. The steady state of all these vowels were manually segmented by auditory and visual cues from waveforms and spectrograms. The average F1 and F2 values of the vowel’s steady state were measured using *Praat* script with the recommended settings for each gender group. Then, the researcher rechecked severe outliers, and the formant values of these outlier vowels were hand-measured and manually corrected.

3. Results

Before testing the effect of the manipulated factors on the degree of the /i/-/ʌ/ dispersion in KyungSang Korean, the formant values of six monophthongs were analyzed³. This analysis was not only to indicate the younger generation’s overall vowel productions of KyungSang Korean, but also to compare the obtained values with those in the previous research and justify the experiment and analyses. The mean F1 and F2 values for each vowel and each speaker are shown in <Figure 1>.

The visual inspection of <Figure 1> revealed more variations for the female speakers’ vowel productions than the male speakers’ one except high back vowels (/o/ and /u/). Also, the male speakers used somewhat smaller vowel spaces than the female speakers⁴, which was consistent with the previous literature (Oh, 2012; Lee *et al.*, 2016). The comparison of the obtained formant values with those in the previous literature showed the similar patterns with some differences. Specifically, the /a/ in the current study was produced further back than the /a/ in Seoul (Oh, 2012) and KyungSang Korean (Kim *et al.*, 2006). This pattern was especially noticeable for female speakers ($M_{F2} = 1338$ for the /a/ in the current study; $M_{F2} = 1688$ for the Seoul /a/ in Oh, 2012; $M_{F2} = 1713$ for the KyungSang /a/ in Jang & Shin, 2006). It is difficult to determine whether or not this backward /a/ implied another vowel change in KyungSang Korean, so this finding could be examined in future studies.

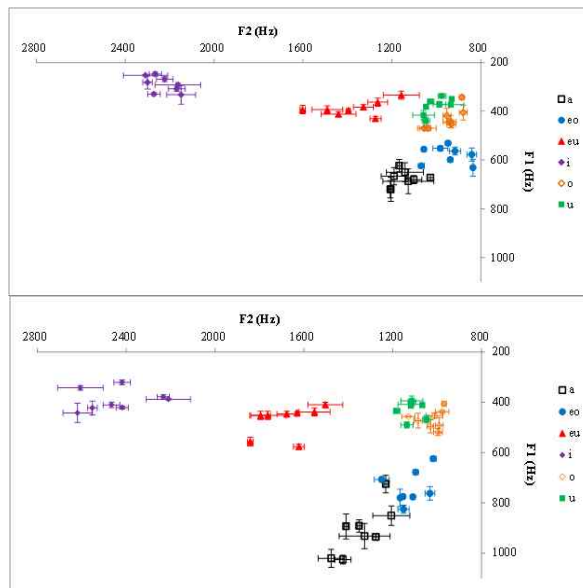


Figure 1. Mean F1 and F2 values are presented as a function of vowel and speaker with standard deviation error bars. The top figure is for male speakers and the bottom is for female ones. (Here, eo for /ʌ/ and eu for /i/).

The next analyses with Monosyllable set and Word set were to investigate the various factors affecting the degree of the /i/-/ʌ/ dispersion in KyungSang Korean. Specifically, to examine the effect of lexical status, the F1 and F2 values of the target vowels from Monosyllable set were analyzed. First, the overall productions of /i/ and /ʌ/ were explored as a function of lexical status, and <Figure 2> presents these in a vowel space. The mean and the standard deviation F1 and F2 values by the factors of interest (gender, vowel, lexical status) are also shown in <Table 1>. The figure indicates that most of the /i/s and /ʌ/s were clustered regardless of their lexical status (see also <Table 1>), but that some overlaps between the two vowels were still noted. Therefore, it can be inferred that though young speakers of KyungSang Korean in general could distinctively produced the /i/ and /ʌ/ vowels, the incomplete phase of this change is revealed when combining the productions by various speakers and various neighboring segments.

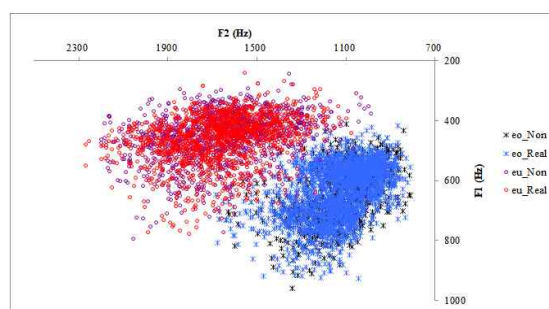


Figure 2. An F1 x F2 vowel space for all vowel productions in Monosyllable set as a function of vowel (eo for /ʌ/ vs. eu for /i/) and lexical status (Non for nonsense words vs. Real for real words)

3 The /æ/ and /e/ vowels were read and measured, but excluded from further analyses. This was because these two vowels were reported to be fully merged especially in younger generation across all dialects of Korean (e.g., Kim *et al.*, 2006; Oh, 2012) though written with different Korean letters.

4 These obtained patterns were consistently found when the values were normalized by Lobanov’s method of vowel normalization in Thomas & Tyler (2007).

Table 1. Mean F1 and F2 values, with Standard Deviation in Parentheses, of /i/ and /ʌ/ as a function of lexical status and gender

Vowel	Lexical Status	Male		Female	
		F1	F2	F1	F2
/ʌ/	Nonsense	577.2 (53.1)	1078.2 (126.3)	708.9 (82.9)	1172.6 (138.0)
	Real	573.7 (51.8)	1083.3 (138.9)	703.0 (78.0)	1178.9 (138.6)
/i/	Nonsense	408.4 (61.2)	1541.9 (178.5)	495.3 (71.6)	1766.5 (198.0)
	Real	419.5 (58.9)	1546.0 (153.0)	506.7 (77.7)	1779.9 (177.5)

As <Figure 2> and <Table 1> informed us the overall /i/ and /ʌ/ productions regarding its lexical status, the next analyses were conducted to specifically test the effect of lexical status on the degree of the /i/-/ʌ/ dispersion. To objectively compare the distance between the two target vowels without normalizing process, the current study used the Euclidean distances between the two target vowels, the most frequently used methods for vowel change research (e.g., Han & Kang, 2013; Hay *et al.*, 2013; Kang & Kong, 2016). The Euclidean distance was calculated with the F1 and F2 values of the two vowels in a minimal pair (e.g., /siŋ/ for ‘victory’ and /sʌŋ/ for ‘castle’) produced by the same speaker and the same repetition. The effects of lexical status (real vs. nonsense pair), gender (male vs. female), and carrier phrase (isolation vs. carrier-phrase) on the calculated Euclidean distances were tested in a three-way ANOVA. The result revealed a main effect of lexical status [$F(1, 2592) = 8.26, p = .004$], gender [$F(1, 2592) = 395.69, p < .001$], and carrier phrase [$F(1, 2592) = 17.32, p < .001$]. In detail, the distance between /i/ and /ʌ/ was longer for the real pairs ($M = 585.52, SD = 166.49$) than for the nonsense pairs ($M = 565.14, SD = 171.78$). Regarding the effect of gender, the distance was longer for female speakers ($M = 638.26, SD = 159.32$) than for male speakers ($M = 502.05, SD = 153.70$). Last, the distance was longer for the isolation group ($M = 582.59, SD = 163.31$) than for the carrier-phrase group ($M = 551.51, SD = 179.66$). The statistical analysis did not yield significant interaction for any possible combinations, but yielded a near significant interaction for gender and lexical status [$F(1, 2592) = 3.67, p = .056$]. This interaction is shown in <Figure 3>.

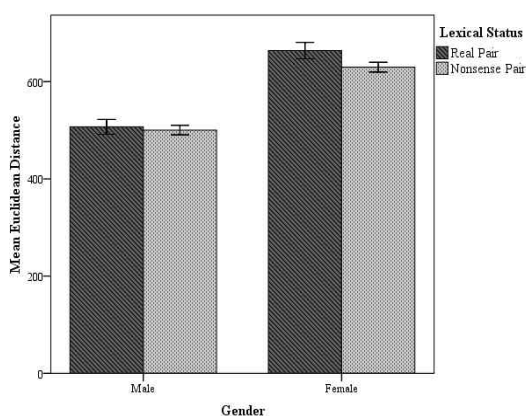


Figure 3. Mean Euclidean distance between /i/ and /ʌ/ as a function of lexical status and gender with 95% confidence interval error bars

<Figure 3> proved the effect of lexical status on the degree of the /i/-/ʌ/ dispersion, namely the longer Euclidean distances for the real word pairs. However, the significant difference was arisen solely from the female speakers (i.e., $t(1298) = 3.34, p = .001$). One possible explanation for the smaller (or even no) differences in the male speakers’ production can arise from the narrower vowel spaces by the male speakers as in <Figure 1>. As for the significant differences in the female speakers’ production, recall our prediction that the greater distance for the real word pairs implies the incomplete vowel dispersion. In other words, the longer distance for the real word pairs informs that the female speakers’ mental categories of /i/ and /ʌ/ are not fully separated although most of their productions are quite distinctive from each other.

Next, the F1 and F2 values of the vowels from Word set were analyzed to examine the effect of the vowel position within a word on the degree of the /i/-/ʌ/ dispersion. As the Monosyllable set, the overall productions of the two target vowels are visually presented in <Figure 4>. The mean and the standard deviation formant values as a function of the factors of interest (gender, vowel, within-word position) are also in <Table 2>.

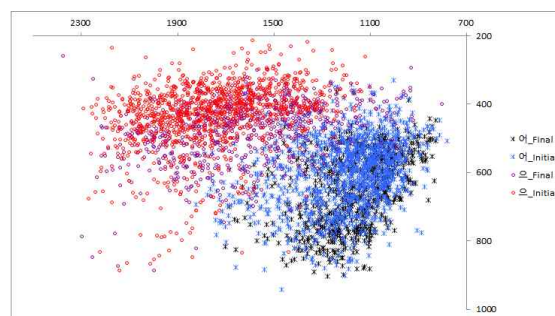


Figure 4. A vowel space for all vowel productions in Word set as a function of vowel (eo for /ʌ/ vs. eu for /i/) and within-word position (Initial vs. Final).

Table 2. Mean F1 and F2 values, with Standard Deviation in Parentheses, of /i/ and /ʌ/ as a function of within-word position and gender

Vowel	Within-word Position	Male		Female	
		F1	F2	F1	F2
/ʌ/	Initial	550.2 (89.8)	1195.7 (200.2)	654.3 (98.2)	1216.7 (167.7)
	Final	565.0 (56.2)	1115.8 (159.0)	734.3 (73.5)	1215.3 (134.1)
/i/	Initial	407.6 (103.5)	1641.2 (213.5)	454.5 (85.3)	1864.8 (213.9)
	Final	435.7 (81.1)	1539.1 (263.8)	516.3 (71.4)	1742.3 (248.2)

<Figure 4> shows that many of the target vowels were clustered into two separate areas similar to the result in <Figure 2>. However, different from the /i/ and /ʌ/ productions in Monosyllable set, the within-word position influenced the overall productions of the target vowels. As the mean formant values in <Table 2> also show, the /i/s in word-initial positions were produced in more peripheral areas of a vowel space than the /i/s in word-final positions for both male and female speakers. On the other hand, the /ʌ/s behaved differently

depending on the speakers gender in that the female speakers produced the word-final /ʌ/ in the lower area of a vowel space (i.e., larger F1 values) than the word-initial /ʌ/. For male speakers, the word-final /ʌ/ were produced in the further back area (i.e., slightly smaller F2 values) than the word-initial /ʌ/. <Figure 4> also indicates more overlaps between /i/ and /ʌ/ compared with <Figure 2>, and these overlaps occurred mainly between the word-final /i/ and the word-initial /ʌ/. In sum, these findings insist that the Kyungsang Korean /i/ and /ʌ/ productions were affected by whether the target vowels were in word-initial or word-final positions. These data also support the finding from Monosyllable set that the /i-/ʌ/ dispersion in Kyungsang Korean is still in progress when different speakers and neighboring segments are considered together.

The last analysis was to investigate the effect of within-word vowel position on the degree of the /i-/ʌ/ dispersion. Similar to Monosyllable set, the Euclidean distances between the two target vowels were calculated with the F1 and F2 values of the two vowels in a (near) minimal (e.g., /nil.da/ for ‘to increase’ and /nal.da/ for ‘to hang’). The effects of within-word position (initial vs. final), gender (male vs. female), and the existence of carrier phrases (isolation vs. carrier-phrase) were tested in a three-way ANOVA. The result revealed a main effect of within-word position [$F(1, 1872) = 70.27, p < .001$] and gender [$F(1, 1872) = 216.74, p < .001$], but no carrier-phrase effect was detected. Specifically, the distance between /i/ and /ʌ/ was longer when the target vowels were in word-initial position ($M = 598.20, SD = 229.60$) than when being in word-final position ($M = 517.81, SD = 212.09$). With respect to the effect of gender, the distance was longer for female speakers ($M = 644.82, SD = 210.84$) than for male speakers ($M = 486.57, SD = 212.85$). The three-way ANOVA yielded a significant interaction between carrier-phrase and gender [$F(1, 1872) = 6.58, p = .001$], but detailed comparison of the mean and standard error values for each groups informed that this significant interaction was mainly due to the main effect of gender. The analysis also yielded a significant interaction between gender and within-word position [$F(1, 1872) = 15.18, p < .001$], and this interaction is presented in <Figure 5>.

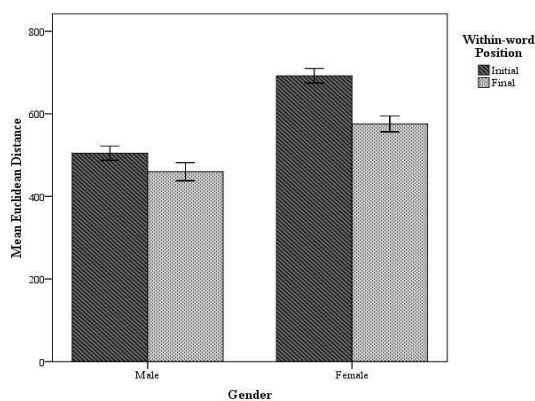


Figure 5. Mean Euclidean distance between /i/ and /ʌ/ as a function of within-word position and gender with 95% confidence interval error bars

As in <Figure 5>, the degree of the /i-/ʌ/ dispersion was affected by whether the target vowels were in word-initial or word-final positions. That is, both male and female speakers produced the word-initial /i/s and /ʌ/s more distinctively than the word-final /i/s

and /ʌ/s. Back to our prediction regarding the within-word position effect, both the Hyperarticulation Hypothesis and the Prominence-Shift Hypothesis expected the greater distance for vowels in prosodically prominent positions. In other words, the current findings were consistent with this prediction, and suggest that since the word-initial vowels were prosodically prominent, the speakers produced the vowels in a more peripheral manner. In addition, these findings imply the direction of this vowel change conforming to the Prominence-Shift Hypothesis. That is, the greater distances in word-initial positions indicate an advanced sound change in prominent positions, which then informs us the /i/ and /ʌ/ in Kyungsang Korean are still dispersing from each other.

4. Discussion and Conclusion

The current study investigated the productions of /i/ and /ʌ/ in Kyungsang Korean. Specifically, this study examined four linguistic and social factors (gender, the existence of carrier phrases, the lexical status of stimulus words, and vowel positions within a word) on the degrees of the /i-/ʌ/ dispersion. The findings with respect to these factors are as follows: (a) the young female speakers of Kyungsang dialect produced the target vowels /i/ and /ʌ/ much more distinctively than the male speakers, (b) the speakers produced the two vowels more distinctively when the vowels were produced in isolation than when they were with a carrier phrase, but this carrier-phrase effect was only significant for Monosyllable set, (c) the female speakers produced the two vowels more distinctively when they were in real words than when either was in a nonsense word, and (d) the distances between the two target vowels were significantly greater when the vowels were produced in word-initial positions than in word-final positions. These findings will be discussed to understand the Kyungsang Korean /i/ and /ʌ/ change happening in the younger generation.

Previous research on the vowel changes in Kyungsang Korean indicated that speakers in older generation could not differentiate /i/ and /ʌ/ in their production, so Kyungsang Korean used to have a six vowel system. However, the recent studies have found that owing to earlier and wider exposure to the standard Korean, younger speakers of Kyungsang Korean had a seven vowel system, like Seoul Korean, distinguishing the two vowels /i/ and /ʌ/ in their production (e.g., Jang & Shin, 2006, 2007; Kim *et al.*, 2006; Lee *et al.*, 2017). Overall, our results are consistent with these previous findings, in that the young speakers in Busan could distinctively produce the two vowels (e.g., see <Figure 1>, <Table 1>, and <Table 2>). In other words, a significant finding from the current study is that young speakers of Kyungsang Korean were able to differentiate the two target vowels even with a number of stimulus words in various kinds.

On the other hand, the results from the current study also revealed that the /i-/ʌ/ dispersion is not a completed process, but in progress. This section will discuss several evidence for this “ongoing” dispersion and suggest future directions to specifically test the evidence. The first evidence came from the overall productions of the two target vowels presented in <Figure 2> and <Figure 4>; namely, the area for /i/ and that for /ʌ/ in an F1 x F2 vowel space somewhat overlapped. Especially, the fact that this overlap was more remarkable for real word productions (see <Figure 4>) tells us that the productions of /i/ and /ʌ/ could still confuse hearers with their similar formant values in daily conversations. To specifically

examine how much the /i/-/ɛ/ dispersion occurs in daily spoken Kyungsang Korean, the future studies can be conducted for the two vowels produced in more casual settings such as paragraph-long materials or interviews.

Another evidence for the ongoing /i/-/ɛ/ dispersion results from the effect of within-word position, namely the greater distances between the two vowels when in word initials than in word finals. In addition, this effect of prosodic prominence was also noted with the manipulation of carrier phrases if we extend the concept of “prosodic prominence” into the types of the task (i.e., words in isolation vs. words in sentences) (Jacewicz *et al.*, 2011a, b). Taking these two factors together, the combined results suggest that the more advanced vowel dispersion appeared for prosodically prominent conditions (i.e., in word-initial positions or words in isolation). Following the Prominence-Shift Hypothesis (i.e., a sound change in prosodically prominent position is more advanced in its direction), the results imply that the /i/ and /ɛ/ change is in progress for young Kyungsang Koreans to the direction where the two vowels are distinct from each other. However, unlike the studies on vowel mergers, the current study could not directly test the two aforementioned hypotheses (the Prominence-Shift Hypothesis and the Hyperarticulation Hypothesis). To identify whether the current finding is due to a vowel dispersing process or due to a contrast enhancement by hyperarticulation, the current data can be compared with the data by Seoul Korean speakers, whose /i/ and /ɛ/ had not been merged.

The last, but the most apparent evidence for the ongoing /i/-/ɛ/ dispersion in Kyungsang Korean is the findings from Monosyllable set. Recall our prediction that the distances between /i/ and /ɛ/ would be longer for real word pairs if the dispersion process is not completed. This prediction was from Hay *et al.* (2013), which argued that speakers’ productions of nonsense words would solely depend on its abstract phonemic category while the productions of real words could depend both on the abstract category and the stored episodic memories about a certain sound. That is, if we assume the mental representations of the two target vowels are somewhat overlapped, we could find more distinct productions of the two target vowels for the minimal pairs with real words. As predicted, the female data in Monosyllable set showed that the Euclidean distances between the two vowels were significantly longer for the real pairs than for the nonsense pairs. The result, therefore, insists that the mental representations of the vowels /i/ and /ɛ/ are not completely separated, and the /i/-/ɛ/ dispersion process is not finished yet. This argument can be certainly tested when we analyze the nonsense and real word productions by older Kyungsang Koreans, whose /i/ and /ɛ/ are still similarly produced.

However, some results were surprising, so here the possible explanations for the unexpected findings will be discussed. One was that the effect of lexical status was obtained only for the female speakers’ productions, and the Euclidean distances for the real-word pairs and the nonsense-word pairs were almost the same for the male speakers. This pattern could also be understood in terms of the degree of this vowel change. That is, if we assume that the male speakers were less advanced in the vowel dispersion (as noted in most previous studies), their mental representations of the vowels /i/ and /ɛ/ could more overlap than the female speakers’ ones. Therefore, the real word productions of these less-dispersed vowels could be more strongly affected by the overlapped mental representations despite the input of the distinctive /i/ and /ɛ/ (i.e.,

from the standard Korean).

In sum, the four linguistic and social factors investigated in this study revealed that younger speakers Kyungsang Korean produced /i/ and /ɛ/ similarly to speakers of Seoul Korean. To be more precise, the dispersion of /i/ and /ɛ/ in Kyungsang Korean is ongoing but quite settled.

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