

The vowels of Cheju

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This paper investigates acoustic qualities of monophthong vowels of Cheju spoken by rural and urban speakers mostly in their 60 - 70s. We examined the first and second formants (F1 and F2) of vowels with reference to how vowels are spaced in the bark scaled vowel space. One of the obvious findings is that quite a few Cheju speakers do make clear distinctions between **e** and **æ**, and **o** and **ʌ**. When the urban and rural data were considered separately, and were compared with those about 50 years ago, a few generalizations appear to fall out: (1) the mergers of **e/æ** and **o/ʌ** are in progress in Cheju; (2) the mergers spread from the urban to the rural area; (3) the **e/æ** merger started earlier than the **o/ʌ** merger; and (4) at least for the urban Cheju speakers, the merger is best accounted for by the *merger-by-transfer* model, a unidirectional change in which one phonemic category becomes another (cf. Labov, 1994). Further, when our data are compared with other acoustic data available (including studies of the standard Korean in the 1960s and 1990s), it suggests that the directionality of the diachronic sound change is guided by both auditorily and articulatorily based principles such as contrast maximization and effort minimization principles.

1. Introduction

Cheju is the form of Korean spoken on Cheju Island, one of the eight provinces of the country. Although Cheju is not mutually intelligible with Standard Korean, it has been considered to be one of the six dialects in South Korea. In this paper we will take no stand on whether Cheju is a dialect of Korean or a separate language. Our purpose here is simply to compare the vowels of Cheju with those of what we will refer to as Korean, meaning Standard Korean as spoken in Seoul. It is generally agreed that Cheju is currently in the process of changing from a 9 vowel system to a 7 vowel system, as shown in Figures 1a and b. The 9 vowel system is found in the dialect of the older generation of Cheju speakers, and the 7 vowel system is found in the dialect of the younger generation (Kim 1963, Hyeon 1964a, 1985, Jung 1995).

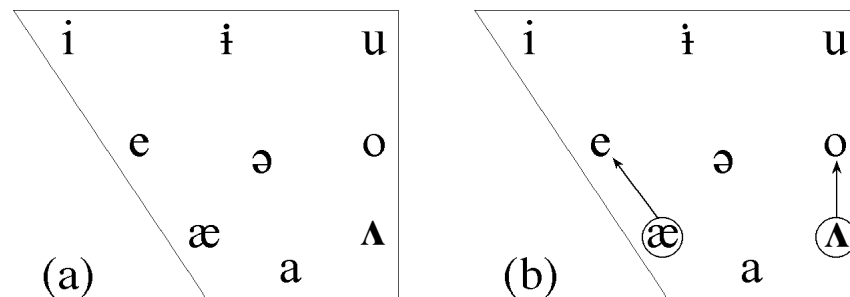


Figure 1. Two vowel systems in Cheju. The 9 vowel system in (a) is found in the older generation and the 7 vowel system in (b) is found in the younger generation (Jung 1995)

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Historically, in Middle Korean, Λ (known as *alae a* ‘below a’, named after its location in the old hangul paradigm) contrasted with \circ in rounding and in vowel height (Jung 1995), but it disappeared in Standard Korean in the late 1800s (Lee 1972, Huh 1980). (Note that the symbol Λ is used to refer to the unrounded counterpart of \circ simply for the sake of simplicity, but its exact phonetic values in the vowel space may not correspond to those of Λ in the IPA vowel chart.)

In Cheju, however, it has been claimed that Λ has not been completely lost, and still contrasts with \circ in the speech of the older generation of Cheju speakers, as exemplified by the minimal pair *tol* ‘rock’ and *tal* ‘moon’ (Jung 1995). The presence of Λ in the speech of these speakers would allow us to have some insight into the nature of this sound in middle Korean.

The other vowel that exists in the 9 vowel system but not in the 7 vowel system in Cheju is the mid-low or low front vowel æ , which is sometimes transcribed as ɛ . In this paper, we will use æ for this mid-low front vowel, noting, however, that we are not suggesting that this vowel is the equivalent of the English vowel ‘a’ as in ‘apple’ which is often transcribed with the symbol æ . The merger of e and æ is in progress in Cheju Korean (Jung 1995), and this is believed to be also true in Seoul Korean (Hong 1991, Kang 1996).

The phonetic structures of Cheju vowels have not been intensively studied. The only acoustic study that we have found in the literature is by Kim (1980). Kim reported F1 and F2 values of vowels in various phonetic contexts from one male speaker, 80 years of age at the time of recording in 1969. The speaker had not been exposed very much to (Seoul) Korean. The average values of F1 and F2 for monophthong vowels as reported by Kim are plotted in Figure 2, where the vertical axis shows F1 values and the horizontal axis shows F2 values in Hz. As can be seen in the figure, these vowels are quite symmetrically distributed in the F1-F2 plane, and there are clear differences between e and æ and between \circ and Λ .

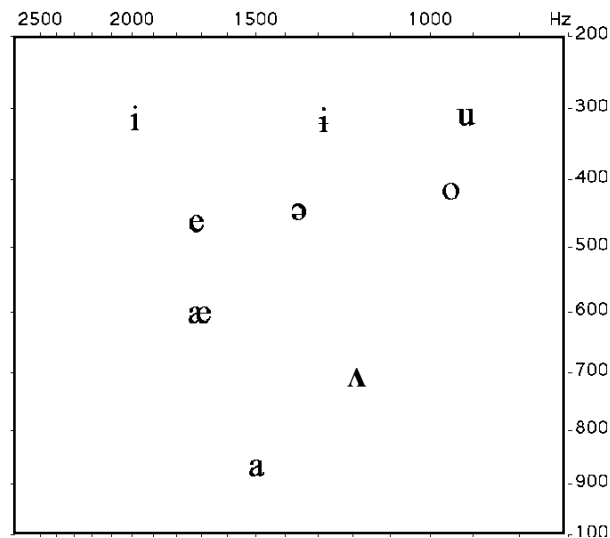


Figure 2. The formant values of 9 vowels produced by an 80 year old male speaker as of 1969. The formant values of each vowel are based on the mean values in H.K. Kim (1980).

2. Procedure

This paper is based on recordings of eight male speakers of Cheju. Three speakers (S1-S3), aged 55, 61 and 68, were recorded in Cheju city, and the other five speakers (S4-S8) were recorded in the more mountainous area of southern Cheju (Namcheju-kun), in two villages: Shinrye-ri and Uikwi-ri. The five men in this region were between 66 and 74 years old. All the speakers understood Korean, were literate, and above average in their socioeconomic status. Each of the eight speakers was recorded using a close-talking, noise-canceling Shure microphone and a Sony DAT recorder. Further details of the recording procedures are given in Cho, Jun and Ladefoged (to appear, this volume), a paper discussing the consonants of Cheju based on data recorded at the same time.

The three sets of words used for the analysis of vowel quality in this study are shown in Table 1a-c, in a broad phonetic transcription, using the diacritic ‘*’ to mark fortis obstruents. The first set has vowels after a velar stop, the second after a denti-alveolar stop. The third set contains additional words suitable for the e/æ comparison. The third column in Table 1a and 1b indicates which speakers produced which words. Two different words were used for the vowels **i**, **e**, **æ**, **o**, **u** because the speakers from the rural area were not comfortable pronouncing the words that the speakers in the town had found satisfactory.

Recordings were digitized into a computer at a sampling rate of 10 kHz. The first two formant frequencies were measured using the Kay Elemetrics MultiSpeech system. For each token, a steady state portion was found near the mid point of the vowel, and superimposed LPC and FFT spectra were calculated with 30 ms and 25.6 ms frames, respectively. The formant values were usually determined from the LPC spectra (with 12 or 14 coefficients), using the FFT spectra (and sometimes formant history tracking) as supplementary checks.

Table 1. Words recorded for the analysis of vowels in a word initial syllable.

(a) After velar stop

Vowel	Words in isolation	Speakers	Gloss
i	k*<i>i</i>əmtʃə	S1-S3	‘to fit’
	k*<i>i</i>tʃimalla	S4-S8	‘don’t fit it’
e	k*<i>e</i>əmtʃə	S1-S3	‘to break (glass)’
	k*<i>e</i>tʃimalla	S4-S8	‘don’t break it’
æ	kæəmsə	S1-S3	‘to clear (sky)’
	kæʃimalla	S4-S8	‘don’t fold (a blanket)’
ɪ	k*<i>ɪ</i>la	all	to turn off (light)
ə	kəlla(ke)	all	to hang
a	kalk*<i>ə</i>jə	all	to plow
ʌ	kʌlla	all	to grind (knife)
o	k*<i>o</i>əmtʃə	S1-S3	to twist (knot)
	k*<i>o</i>tʃimala	S4-S8	not to twist (knot)
u	k*<i>u</i>əmtʃə	S1-S3	to dream
	k*<i>u</i>tʃi anjəttʃə	S4-S8	(I) did not dream

Table 1. Cont'd

(b) After denti-alveolar stop

Vowel	Words in isolation	Speakers	Gloss
i	t*i	all	band (waist)
e	teəttfə t*etfimalla	S1-S3 S4-S8	to get burned not to take off
æ	tæəttfə tætfimalla	S1-S3 S4-S8	to touch do not touch
ɪ	tɪləttfə	all	to encumber money
ə	tʰələttfə tʰələpulla	S1-S2 S3-S8	to dust
a	tʰattfə	all	to burn
ʌ	tʌləttfə	all	to sew on a button
o	toləttfə	all	to go around
u	tuəstfə tutfimalla	S1-S3 S4-S8	to place do not place

(c) Front mid/low vowel pairs in monosyllabic words

Vowel	Words in isolation	Gloss
e	pe	hemp cloth
æ	pæ	thick rope
e	se	tongue
æ	sæ	material (roof)
e	k^he(ta)	to chap
æ	k^hæ(ta)	It is k ^h æ (game)!

3. Results

Figure 3 shows the vowel distribution across speakers and consonants (**t** and **k**) in the plane of the first two formants of the vowels, plotted on a Bark scale, using the UCLA Plot Formants program. This program was also used to draw ellipses with a radius of two standard deviations along the axes of the first two principal components of the distribution.

This plot appears to show that there is considerable confusion among these vowels. The vowel space between **e** and **æ** and between **o** and **ʌ** is substantially overlapped and there is a large variation for **u** in the F2 dimension. In what follows, we will examine the distribution of vowel space and the variability of front/back mid vowels and **u**, considering factors such as speaker, region, and segmental context. When we do so, it will be apparent that much of the confusion can be resolved.

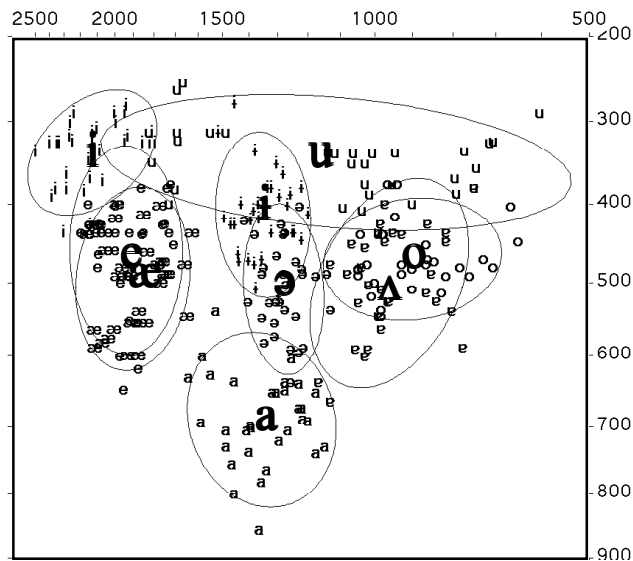


Figure 3. Formant plot of Cheju vowels across speakers and consonantal contexts.

3.1 Front mid vowels: e and æ distinction

Part of the spread in the data for the **e** and **æ** vowels can be ascribed to a problem with the word list. Owing to confusions in the mapping between Cheju sound and Korean orthography, the words **k**e*amtʃə** (recorded by the urban speakers) and **k**e*tʃimalla** (recorded by the rural speakers) were written in a way that indicated a pronunciation that might not correspond to their pronunciation when not reading. . As we do not know how our speakers were affected by the orthography, we leave these words out of our detailed analyses, focusing on the **e** and **æ** in /t_/ context.

In order to see whether there were differences between the urban and rural speakers, the data were submitted to a two way ANOVA with factors Vowel, and Region. With the first formant (F1) as the dependent variable, there were significant effects for both factors ($F(1, 28) = 12,085, p < .001$ for the **e/æ** difference; $F(1, 28) = 4.253, p < .05$ for the Urban/Rural difference. For the second formant (F2), none of the factors had a significant effect. Since the Region significantly influenced the vowel production, the vowels are plotted separated by Region in Figures 4a and 4b, for the urban speakers and the rural speakers, respectively.

Pairwise *posthoc* comparisons show that urban speakers did not distinguish between **e** and **æ** in both F1 and F2, **as seen in** Figure 4a, while rural speakers did make a significant distinction between these two vowels in F1 ($p < .0001$) as seen in Figure 4b— **æ** has a higher average F1 value than **e**, i.e. **æ** is a lower vowel than **e**.

When we examine the formant values of **e** and **æ** in the monosyllabic words (Table 1c, Figure 6), it is clear that the rural speakers fully distinguish these two mid front vowels, but the

urban speakers, even though they were in their 60's, do not. For the rural speakers, F1 is significantly greater for **æ** than for **e**, and has a similar value to that in the **æ** produced by the 80 year old speaker in 1969, as shown in Figure 2. However, our data suggest that even the rural speakers of Cheju do not make a distinction between **e** and **æ** as clearly as the distinction made 50 years ago.

3.2 Back mid vowels: **o** and **ʌ** distinction

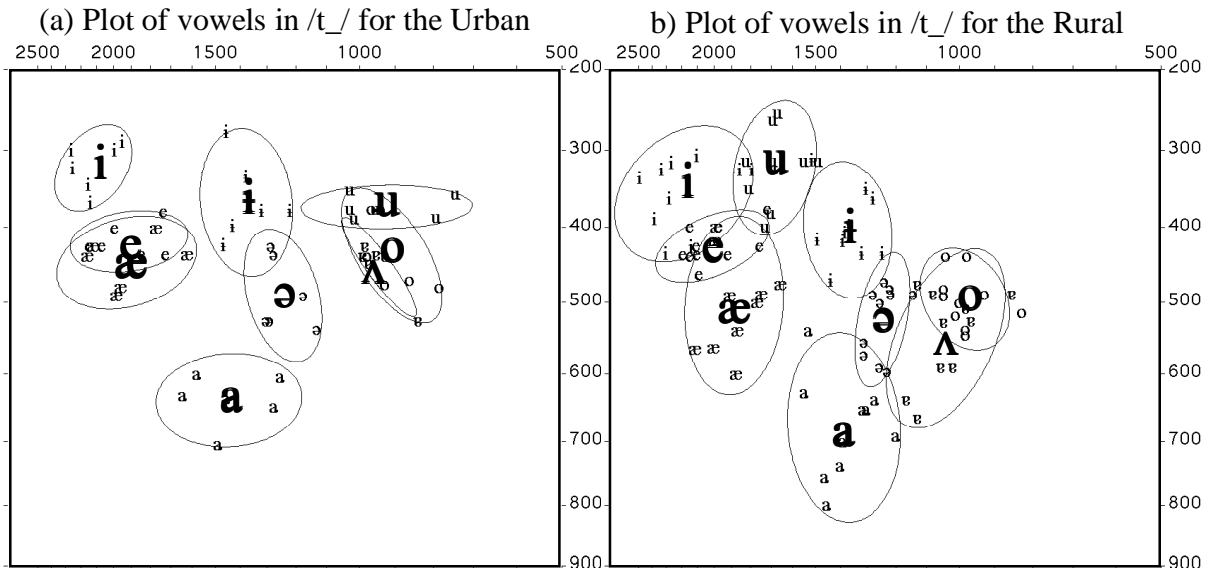
Figures 4 and 5 show that there is a difference between **o** and **ʌ** for both urban and rural speakers. The urban speakers make the **o/ʌ** distinction by employing an F2 (backness) difference. As can be seen in Figures 4a and 5a, they tend to make **o** less front than **ʌ**. This difference was significant only in the /k_/ context ($t=3.107$, $p = 0.01$), but not in the /t_/ context. On the other hand, the rural speakers make the **o/ʌ** distinction by employing an F1 (height) difference. As shown in Figures 4b and 5b, **ʌ** is generally lower than **o** and the differences are significant in the /t_/ context for all six speakers. In the /k_/ context, all but one speaker (S6) showed a significant difference in F1 ($t=2.522$, $p = .0244$). It seems that this distinction is in the process of being lost among urban speakers, even those in their 60s, but is better preserved among rural speakers of a similar age, although one of the rural speakers did not show any difference at all—again indicating a move towards a merger, even by the rural speakers. However, the distinction is not as clear as it was a half a century ago (see Figure 2 for the result reported in Kim, 1980). The rural speakers seem to lower the rounded mid back vowel, **o**, and raise and retract the unrounded vowel, **ʌ**, compared to the earlier data, thus weakening the contrast between these two vowels in both the height and the front/back dimension.

3.3 The variability of **u**

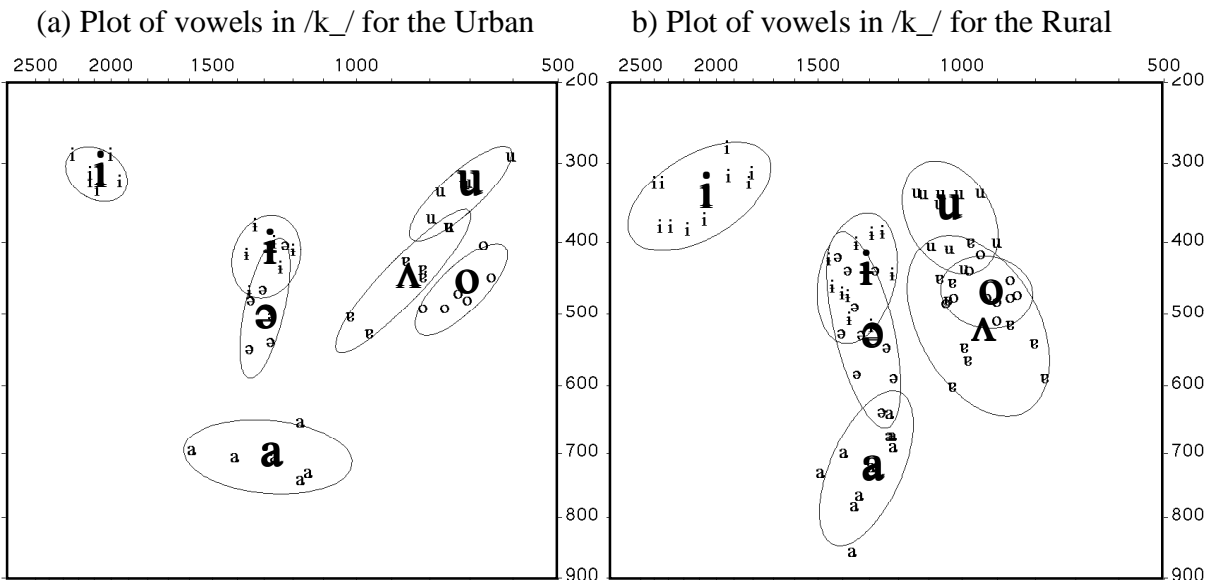
As noticed earlier in Figure 3, there is great variation in the distribution of tokens for **u**. A comparison of the four graphs in Figures 4 and 5 shows that rural speakers have more variation than urban speakers. In both speaker groups, **u** is fronter (i.e., higher F2 values) in t_ context than k_ context ($F(1, 28)=17.532$, $p < 0.001$), but the degree is much stronger in the rural speakers' data. In addition, the frontness of **u** in each context is stronger in rural speakers' data than in urban speakers' data. Much of this variation is due to the coarticulatory effect of the adjacent segment. Figure 7(a) shows the effect of the preceding consonant on the formant value of **u** in two different following contexts (before **ə** in the left panel, and before **tʃi** in the right panel). The arrows indicate fronting of **u** when it is in t_ context compared to when it is in k_ context. In other words, speakers make **u** more fronted after the front consonant **t**, and such fronting is not made when the preceding consonant is **k**.

In addition to the fronting due to the preceding context, the data also show that F2 values of **u** are influenced by the following context. The urban speakers produced **u** in words where the following context is **ə** as in **tuətʃə** ('to place') and **k*uəmtʃə** ('to dream') while the rural speakers produced **u** followed by **tʃi** as in **tutʃimalla** ('do not place') and **k*utʃi anjəttʃə** ('(I) did not dream'). This different context significantly influenced the production of **u**. Figure 7b illustrates that **u** is more fronted (with a greater F2) when followed by **tʃi** than when followed by **ə**, and this is statistically significant ($F(1, 28) = 31.124$, $p < .0001$ for F2). This suggests a significant effect of anticipatory coarticulation between **u** and the following segment, and

explains why rural speakers show more context effect in the F2 dimension than urban speakers. In sum, the variation of **u** is due to the coarticulatory effect of adjacent segments, and the difference between urban and rural speakers is not related to a regional feature, but is caused by different word sets. Our data show that in general other back vowels are also fronted by the following **tʃi** context, but the effect is especially large in **u**.

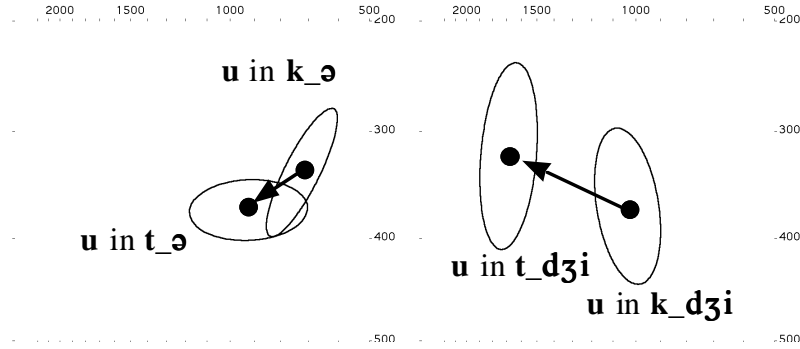


Figures 4. Formant plots of vowels in /t_/ context for (a) the urban speakers and (b) the rural speakers.



Figures 5. Formant plots of vowels in /k_/ context for (a) the urban speakers and (b) the rural speakers.

(a) Effect of the preceding C on u



(b) Effect of the following V on u

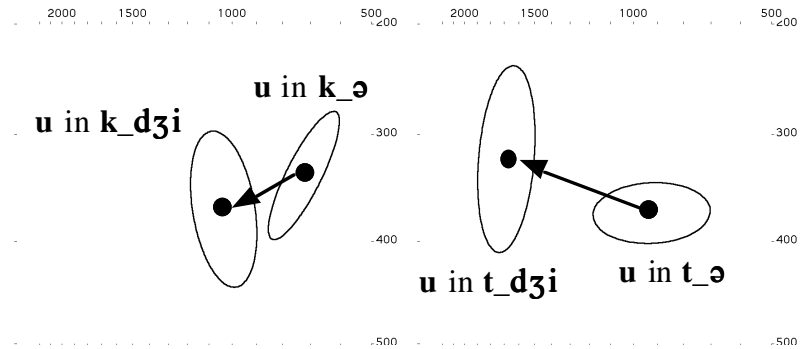


Figure 7. Variation of **u** due to the adjacent context, showing coarticulatory effect.

4. Summary and discussion

In this paper, we examined the vowel space of Cheju with a primary focus on **e/æ** and **o/ʌ** differences and the variation of **u**. There is strong evidence that the rural speakers have an **e/æ** distinction in their clear speech, whereas the urban speakers, even in their 60s, seem to have lost it entirely. Second, both groups make the **o/ʌ** distinction to some extent. The rural speakers made a consistent distinction in F1, and the urban speakers made a distinction in F2 for half of the data recorded. Third, we observed a great deal of variability for **u**, which is primarily due to coarticulatory effects.

Our data suggest that the mergers of **e/æ** and **o/ʌ** are in progress in Cheju. Such transitory status can be seen in that **e/æ** or **o/ʌ** distinctions were made by the rural speakers most of the time, but rarely by the urban speakers of a similar age. This is presumably because the rural speakers are more conservative, and, as a result, tend to preserve the contrasts. This is reminiscent of a case reported by Trudgill (1974) where a pattern of merger is detected around an urban center and spreads to the rural area. Labov (1994, p. 313) explains that “dialect geography is one of the most powerful tools available for interpreting the past by means of data drawn from the present.” In other words, by the investigation of the forms spoken in an isolated rural area,

we could possibly infer what the old forms would be like. In fact, some of the **e/æ** distinctions made by our rural speakers are very similar to those made by the old speaker in Kim's 1969 study. In addition, the direct comparison between the present day urban speakers's data and the data in Kim's 1969 study shows that the merger is in progress.

Our data also suggest that the **e/æ** merger started earlier than the **o/ʌ** merger in Cheju. Urban speakers in our study completely lost the **e/æ** distinction but still partially preserve the **o/ʌ** distinction. A supporting example is that there is a complete overlapping for the **e/æ** pair while a clear **o/ʌ** distinction is made by the same urban speakers, as seen in Figure 5a. This supports the informal observation shared by the researchers of Cheju; it has been believed that in general the loss of **o/ʌ** distinction is found among speakers in their mid 50s and younger while the loss of **e/æ** distinction is found among speakers in their 60s and younger.

It is interesting to note that the order of merger in Cheju between these two pairs is the opposite of that in Standard Korean. In mainland Korean, the **o/ʌ** merger occurred in late 1700s (e.g., Lee 1972; Huh 1980), and the **e/æ** merger has been in progress in the past several decades (cf. Hong 1991). Jung (1995) posits that the loss of contrast in non-high front vowels (the **e/æ** merger) that is in progress in Standard Korean is driven by pressure from the system. With only two back non-low vowels (**u** and **o**, after the loss of **ʌ**) and three front non-low vowels (**i**, **e**, and **æ**), the system is losing the **e/æ** distinction to make the vowel system more symmetric. Along the same line, we could posit that in Cheju, the **e/æ** merger started first and the **o/ʌ** merger follows to make the vowel system symmetric. It is believed that Cheju lost the **e/æ** distinction earlier than mainland Korean due to the confusion in the mapping between sound and the standard orthography. That is, as mentioned earlier, the vowel **æ** symbol in Korean is sometimes mapped to Cheju **æ** and sometimes to Cheju **e**.

4.1. *Mechanism of mergers*

Now a question arises as to by what route two phonemes become one. Labov (1994, pp. 321-323) suggested three models to account for different kinds of mergers that have been observed in sound changes. The first type of merger processes is *merger by approximation*—i.e., phonetic targets of two distinctive sounds are gradually approximated until they become non-distinctive. In this type we expect the two sounds are merged into an intermediate phonetic form. The second type of merger occurs by means of *merger by transfer*. This process is a unidirectional change in which one phonemic category becomes another. In general, merger by transfer takes place when one form becomes a social prestige, being dominantly used in an established standard language. The last process is *merger by expansion*—i.e., the new phonetic space is expanded to range over phonetic spaces of two phonemes that are merged. In other words, the new phonetic space falls neither on an intermediate range (as in merger by approximation) nor on the phonetic space that belongs to either one of the phonemes that are merged (as in merger by transfer).

It is not entirely clear from the data available to us what kind of merger process is taking place in Cheju. On the one hand, the new phonetic space for the **e/æ** for urban speakers as seen in Figure 4a appears to be best accounted for by the merger-by-transfer model which predicts a unidirectional change. In other words, the phonetic space of **æ** seems to re-map to that of **e**. This can be more clearly seen in monosyllabic words in Figure 6. On the other hand, the **o/ʌ** merger show inconsistent patterns between urban and rural speakers. The merger in Figure 4a (as produced by urban speakers) fits into the merger-by-transfer model—i.e., the tokens are clustered around the phonetic space for **o**. By contrast, the merger shown in Figure 4b (rural

speakers) indicate that, although there is no complete merger, merger-by-approximation appears to be in progress,—i.e., the phonetic space for **o** is relatively lowered. Though more systematic data are required to examine the exact mechanism of the merger that is in progress in Cheju, what emerges from the data available is that at least the merger for the urban speakers is best accounted for by the merger-by-transfer model.

In the next section we will examine vowel spaces in Seoul Korean and Cheju synchronically and diachronically, and discuss the sound change related to the principles of the maximal perceptual contrast and minimal articulation.

4.2 *Dispersion theory and sound change*

So far, we have compared the two pairs of mid vowels in Cheju at two time frames separated by about 50 years. In this section, we will examine the vowel system of Seoul Korean roughly at the same time frame as Cheju data, and compare Seoul Korean data with Cheju data. As the vowel system of Seoul Korean at the two time frames, we will use data from Han (1963) and Yang (1996).

Middle Korean had **ʌ**, as in present day Cheju. In late 1700s Seoul Korean lost **ʌ** (Huh 1980) and now has an 8 vowel system, if they have **e/æ** distinction, or a 7 vowel system, if not (Kang 1997). Figure 8 illustrates vowel systems of (a) Seoul Korean and (b) Cheju. Figure 8a compares the present day vowel system of Seoul Korean (Yang 1996) with that in 1960s (Han 1963), and Figure 8b compares the present Cheju data with Kim's (1980) Cheju data. Note that the Cheju data from the present study are pooled from both urban and rural speakers except for [u] which is based on urban speakers' data only, due to the extreme fronting of rural speakers' data influenced by the following segments (see section 3.3 and Figure 4b). As a result, both **e/æ** and **o/ʌ** distinctions are merged in the Present Study plot in Figure 8b.

In Figure 8a, there seems to be a clear distinction between **e/æ** in Yang's (1996) data (the mean difference is 99 Hz in F2). However, the large standard deviations (75 Hz and 105 Hz for **e** and **æ**, respectively) suggests that the difference is not statistically significant. In fact, Lee, Kim, and Hong (1997) showed in their study of the vowel qualities of media language that there is no substantial difference between **e** and **æ** in the present day Seoul Korean. They also compared their own media data with Han's and Yang's data and showed that the vowel space is smaller for the normally spoken media data, due to the reduction and the contextual influence. In sum, Seoul Korean had 8 vowels in 1960s (i.e., Han's data), and 7 vowels in 1990s (i.e., Yang's data), while Cheju had 9 vowels in Kim's study and 7 vowels (or 8 for rural speakers) in the present study.

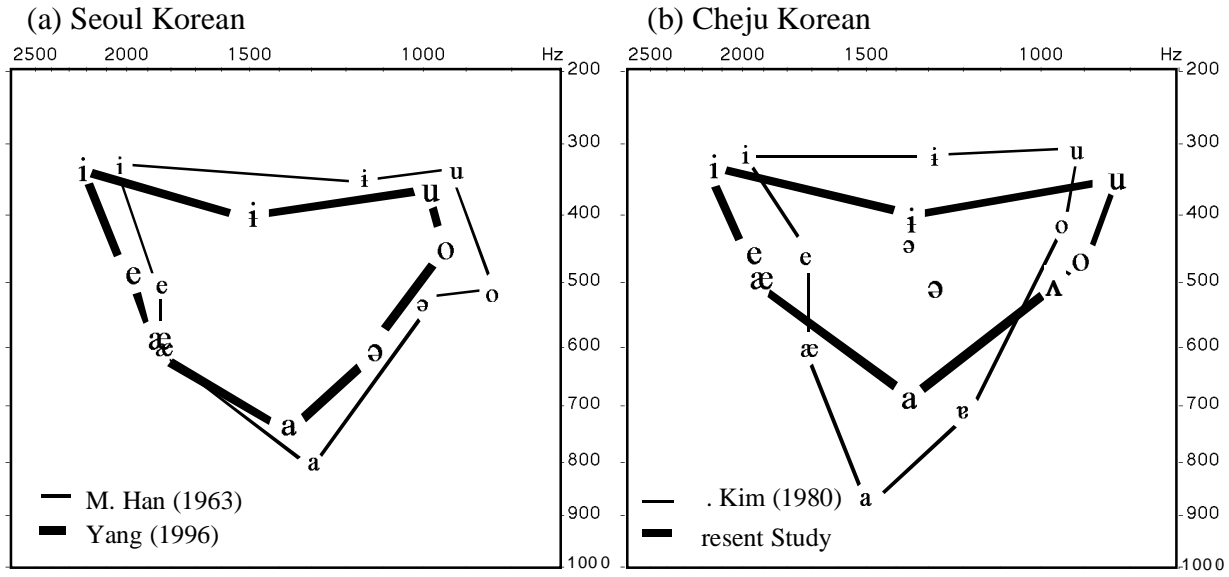


Figure 8. Comparisons between (a) Seoul Korean and (b) Cheju vowel systems at two time frames, current vs. 1960s. The vowel chart for Han (1963) was drawn based on her Informant 1's average values and Yang's (1996) data were based on 30 male Seoul speakers. The Kim (1980) data were collected in 1969.

Lindblom's revised dispersion theory (Lindblom 1986; Lindblom and Maddieson, 1988) predicts that, in a given system, contrastive vowels are spaced with a sufficient contrast. This principle of sufficient contrast can be observed in the location of the mid vowel ə and the low vowel a in Seoul Korean and Cheju. First, the vowel ə in Cheju is mid-central, whereas it is further back and lowered in Seoul Korean, taking the space of open-mid back vowels in the IPA chart (1999). This mid-centralness of the vowel ə is preserved in both the earlier and present day vowel systems of Cheju. We believe that this is due to the presence of contrast between ə against o or ʌ in Cheju. In Seoul Korean, on the other hand, it would not be necessary to keep ə in the central position. It seems that ə is instead moved to the open-mid back position, so that it could enhance the front/back contrast among vowels and make the system more symmetrical. That is, the comparison between Seoul Korean and Cheju allows us to infer that ə has been shifted from the central vowel space to the mid-back area in Seoul Korean, in order to achieve a sufficient contrast among vowels, a phenomenon in which the sound change is driven by the principle of contrast maximization.

Second, as shown in Figure 8b, within Cheju, a in the present study is much higher than that in Kim's study (by 139 Hz in F1). As discussed earlier, Cheju in 1960s had a 9 vowel system and had four vowels contrastive in vowel height, or F1 (e.g., i-e-æ-a or u-o-ʌ-a). This 9 vowel system seems to use a larger vowel space especially in the vowel height dimension, compared to the present Cheju vowel system in which there is a three way contrast in vowel height (i.e., i-e/æ-a or u-o/ʌ-a) due to the merger of e/æ and o/ʌ. Reducing the vowel space in the height dimension in the current Cheju system supports the sufficient contrast principle instead of the maximal contrast principle as originally proposed by Liljencrants and Lindblom (1972). The space reduction in the current Cheju system also supports the principle of articulatory effort maximization (e.g., Lindblom 1986, 1990; Flemming, 1995). These two

principles together predict that speakers minimize the articulatory effort to an extent that allows a sufficient contrast. Our data follow these principles. In the 9 vowel system, speakers make more effort to make an extreme **a**, or to open their mouth wider, in order to achieve a sufficient contrast between four vowels that are distinctive in vowel height, whereas in the 7 vowel system, speakers do not need to make such articulatory effort since less vowel space in height is required for sufficient contrast between three vowels. These auditorily and perceptually based principles together with the distribution and the inventories of the vowel system seem to guide the directionality of the diachronic sound change.

Acknowledgements

We thank Dr. Doheung Ko for providing us with the paper by Kim (1980), and Dr. Kee-Ho Kim for the paper by Lee, Kim, and Hong (1997). We also thank Dr. Chang-Myong Oh who helped us record in Cheju city, and Dr. Won-Bo Kim who helped us record in the rural areas and provided information of Cheju morphology. We are also grateful to all the Cheju speakers who recorded data for us.

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