경상방언과 표준말의 모음길이: 음향학적 분석

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Vowel Duration in the Kyungsang Dialect and Standard Korean: An Acoustic Analysis

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0. Introduction

This paper aims to acoustically examine whether Modern Korean has the phonemic distinction of vowel length, based on six male subjects for Standard Korean and the Kyungsang dialect.

In the literature, many linguists have assumed the phonemic distinction of vowel length in Modern Korean (e.g., W.-C. Kim (1972); C.-W. Kim (1976); B.-K. Lee (1979); Y.-S. Kim (1993); H.-S. Sohn (1987, 1997); Y.-S. Lee (1993, 1996); Y.-H. Chung (1997)). They claim that the vowel length contrast not only appears in lexical words, as in *ma:l* 'speech' vs. *mal* 'horse', but also causes the phonological process of Compensatory Lengthening , as in *pwa:* 'see' contracted from *po+a*. However, as for the vowel length contrast, there is much disagreement over the data among linguists; C.-W. Kim (1976), for example, proposes that the vowel of *pwa:* is short, while many others consider it to be long. Furthermore, there are phonetic studies which report that the ratios of vowel length between short vowels and long vowels have been considerably reduced within around thirty years in Modern Korean. In his acoustic study of vowel duration in Korean, Ko (1988) found that the ratio of so-called short and long vowels in isolation was 1:1.95, whereas the ratio of the same vowels in context was reduced into 1:1.41. Ko's results of the vowel length ratio in isolation show that the ratios of vowel length between short and long vowels were considerably reduced compared to the findings in Han (1964) that the ratios of Korean vowel length in isolation were 1:2.51. Of interest is also a recent phonetic study by Park (to appear), according to which when exposed to the Australian English back vowels [a] and [a:], Japanese subjects, whose language has the phonemic distinction of vowel length, eminently perceived the vowel length distinction, whereas Korean subjects just identified 55% of the vowel tokens for vowel length contrast. Thus Park's study suggests that vowel length distinction may not exist in Modern Korean.

In order to examine whether vowel length has a distinctive role differentiating meanings of words in Modern Korean, we conducted an acoustic experiment of Korean vowels. In our acoustic study we particularly investigated the following two questions: a) whether we have phonemic vowel length distinction in lexical words; b) whether we also have phonemic vowel length distinction in phonological processes such as Compensatory Lengthening triggered by Glide Formation; and c) whether dialects are different in vowel length distinction. To answer the last question, we looked into vowel length of Standard Korean spoken by educated middle-class in Seoul, the capital of South Korea and the Kyungsang dialect in this study.

This paper is organized as follows: Section 1 explicates our experiment of Korean vowel length; section 2 entails a discussion of our acoustic data; and section 3 is a brief conclusion of our study.

1. Experiment

In this section we divide our experiment into two subsections -- methods/analysis and results.

1.1. Methods and Analysis

Six male native speakers, all freshmen at Sogang University, took part in this experiment. Of the six speakers, three were born and grew up in Seoul and the other three in the Kyungsang province. None of the speakers had any known speech or hearing disorders.

We prepared test words which have often been referred to with respect to Korean vowel length distinction in the literature, as shown in (1).

(1) a. lexical words

mal	'horse'	ma:l	'speech'
nun	'eye'	nu:n	'snow'
ka͡tsi	'eggplant'	ka:͡tsi	'branch'
pam	'night'	pa:m	'chestnut'
mut+ta	'to bury'	mu:t+ta	'to ask'
mul+ta	'to bite'	mu:l+ta	'to reimburse'
͡tsək+ta	'to write down'	͡tsə:k+ta	'to be little'

b. words related to compensatory lengthening

po+a → pwa: (po+ta 'to see')

ki+ə	→	kjə:	(ki+ta	'to crawl)
pi+ə	→	pjə:	(pi+ta	'to empty')
p^hi+ə	→	p^hjə:	(p^hi+ta	'to bloom')
k'u+ə	→	k'wə:	(k'u+ta	'to dream')
tu+ə	→	twə:	(tu+ta	'to put')
moi+ə	→	mojə:	(moi+ta	'to gather')
(o+a)[1]	→	wa:	(o+ta	'to come')

The literature suggests that first vowels of the test words in the first column in (1a) are short, whereas those in the second column in (1a) are long. The vowel length of the two-syllable test words in (1b) has been considered to be maintained equally even when the words are reduced to a single syllable as a result of Glide Formation. The maintenance of vowel length of the original uncontracted words is called Compensatory Lengthening.

All the test words were embedded in the frame sentences [han sarams'ik _____ parimhasejo] 'Please pronounce ____, one person at a time.' The sentences with test words were presented in lists in Korean orthography. On each page they were randomized with two filler sentences on the top and the bottom to reduce any bias in pronunciation. Each subject familiarized himself with test words by reading them a few times before recording and was asked to read them as naturally as possible during recording. He was then asked to read the sentences three times at normal speed, and was tape-recorded in a sound-treated room at Sogang University, using a cardioid microphone (Audio-Technical AT818E) and high-quality cassette recorder (TEAC X2000M). The second and third repetitions of all sentences were digitized onto CSL at a sampling rate of 16 kHz with 16-bit resolution, and then stored as files to be processed by the commercial software package MULTI-SPEECH (model 3700). The total number of target words was 384 (32 words x 2 repetitions x 6 speakers). The vowel duration of the test words was measured independently by the two authors and their mean values were taken, based on the fact that the correlation of vowel duration measured by the two authors was above 0.9. Thus the real total number of target words was 768.

For each target word, the duration of the vowel in question was measured on the basis of both wideband spectrograms and waveforms. Vowel onset was considered to be the onset of the second formant, and vowel offset was taken as the offset of the second formant. When a vowel of a test word was followed by a nasal or a liquid, the transitional part into a following sonorant consonant was excluded.

1.2. Results

In this subsection we will present first our phonetic results of the lexical words in (1a). Then we will present our data of the words in relation to Compensatory Lengthening in (1b).

As for the lexical word-pairs in (1a), mean vowel durations are presented for the Kyungsang speakers and Standard Korean speakers in Table 1; the ratios of short and long vowels for each test word-pair are given in parenthesis. Compared with short-vowel test words, most long-vowel test words were relatively longer in Kyungsang speakers, except for two test word-pairs: in the test word-pairs *nun* 'eye' vs. *nu:n* 'snow' and *mul+ta* 'to bite' vs. *mu:l+ta* 'to reimburse', the long vowels of the second words *nu:n* and *mu:l+ta* were shorter than the so-called short vowels of the first words *nun* and *mul+ta*. This kind of reversal was found in the word-pair *mul+ta* 'to bite' vs. *mu:l+ta* 'to reimburse' among the Standard Korean speakers.

(Table 1 here)

Separate pairwise two-tailed *t*-tests for vowel duration, using short and long vowel distinction are presented in Table 2.[2]

(Table 2 here)

The separate pairwise two-tailed *t*-tests in Table 2 reveal that among Kyungsang speakers, four of the lexical word-pairs -- *ka$\widehat{ts}$i / ka:$\widehat{ts}$i, pam / pa:m, mut+ta / mu:t+ta* and *$\widehat{ts}$ək+ta / $\widehat{ts}$ə:k+ta* -- are significant in terms of vowel length distinction, whereas the other three lexical word-pairs are not significant. In contrast, the *t*-tests revealed that among Standard Korean speakers none of the lexical word-pairs was significant in terms of vowel length distinction.

As for the compensatory lengthening pairs as in (1b), the mean vowel durations of full, uncontracted words and the corresponding contracted words triggered by Glide Formation are presented for Kyungsang and Standard Korean speakers, as in Table 3.

(Table 3 here)

Table 3 shows that vowel durations are different in two forms, namely, full forms and contracted forms. Vowels in the contracted forms are somewhat shortened. Interesting is that vowel durational difference between the two forms is a little bit larger in Standard Korean. The ratios of full forms to contracted forms in the Kyungsang dialect and Standard Korean are 1.19 and 1.24, respectively.

(Table 4 here)

Table 4 shows that in Standard Korean speakers, the durational difference between the two forms - full forms and contracted forms - is statistically significant. In the Kyungsang dialect, however, some of the test words show non-significant values. The test words of *ki+ə / kjə:*, *o+a / wa:*, and *pi+ə / pjə:* are the same length between two forms and the durational difference between two forms in *tu+ə / twə:* is quite marginal.

The consideration of the above four tables indicates that only the Kyungsang speakers partially have vowel length distinction in both lexical word-pairs and compensatory lengthening word-pairs. To more closely see how such a partial vowel length distinction in the dialect is realized in individual speakers, we present the individual differences in the lexical word-pairs and compensatory lengthening word-pairs in Tables 5 and 6, respectively.

(Tables 5 and 6 here)

Tables 5 shows that in the case of speaker 1, the long vowels of the second words *nu:n*, *katsi* and *mu:l+ta* were shorter than the so-called short vowels of the first words *nun*, *katsi* and *mul+ta*; speaker 2 had this kind of reversal in the word-pair *mul+ta* 'to bite' vs. *mu:l+ta* 'to reimburse'; and speakers 2 and 3 had the same vowel duration in the word-pair *nun* 'eye' vs. *nu:n* 'snow'. In Table 6 we can see that speaker 1 consistently had full forms longer than their contracted counterparts; speakers 2 and 3 had the same tendancy except for the two word-pairs *ki+ə/kjə:* and *pi+ə/pjə:*, and the one word-pair *o+a/wa:*, respectively.

2. Discussion

We have lexical words and compensatory lengthening pairs examined in two dialects, Standard Korean and Kyungsang, to see whether Modern Korean has phonemic vowel length distinction.

As for lexical words, the results of this study show that speakers of Standard Korean had no vowel length distinction, and that Kyungsang speakers had vowel length distinction in examined test words except for *nun / nu:n* and *mul+ta / mu:l+ta*. The results of the experiment demonstrate that the vowel length of the two pairs *nun / nu:n* and *mul+ta / mu:l+ta* in our Kyungsang speakers was found to be different from what it has been assumed to be in the literature: the mean vowel duration of *nu:n* 'snow' is shorter than that of *nun* 'eye', as shown in Table 1. This is also true of *mul+ta* 'to bite' and *mu:l+ta* 'to reimburse' not only in our Kyungsang speakers but also in the speakers of Standard Korean.

Compared with the phonetic results of Ko (1988), our study shows that the speakers had much less ratio of vowel length. As shown in Table 1, the mean ratios of so-called short vs. long vowels are 1: 1.15 in Kyungsang speakers, and 1: 1.09 in Standard Korean speakers. In Ko (1988), however, the ratio of short vs. long vowels in context was 1:1.41. Ko (1988) does not mention which dialects were concerned in his study, but regardless of which dialects were examined, the ratios of short vs. long vowels in Ko (1988) are much higher than those in this study. This indicates that the duration of short vs. long vowels in our speakers has been reduced.

Regarding compensatory lengthening pairs, Standard Korean speakers significantly differentiated all of the full forms and corresponding contracted forms, as shown in Table 4. However, in Kyungsang speakers only the half of the test words were significantly different. It would appear that Standard Korean speakers had no compensatory lengthening, whereas Kyungsang speakers had compensatory lengthening to some extent.

We can interpret discrepancies between the two dialects in two ways. One interpretation is concerned with a phonological account in relation to mora, as usually assumed in the literature. The other is related to the phonetic explanation of vowel length in comparison with other languages which are thought to have phonemic vowel length distinction.

In the first case, the phonological unit of mora has been assumed to explain vowel length disntiction. For instance, a long vowel with its two moras is differentiated from a short vowel which bears only a single mora. From this perspective we would suggest that Standard Korean speakers are not keen to moraic distinction between so-called long vs. short vowels. It might be that phonemic vowel length distinction disappears in Standard Korean, at least among the speakers surveyed in this study. On the other hand, Kyungsang speakers have demonstrated moraic distinction between long vs. short vowels, to some degree. It might be that phonemic vowel length distinction is mostly preserved in the Kyungsang dialect. Based on the moraic account of vowel length, we can clearly account for dialect differences in compensatory lengthening pairs. In Standard Korean two-syllable full forms have two moras, whereas their corresponding one-syllable forms have only a single mora, because there is no compensatory lengthening in this dialect. The moraic difference between the two forms leads to the difference in physical values of vowel duration in this dialect.

As for the Kyungsang dialect, in the test words which show no statistically significant durational difference, as in the second half of data in Table 4, we suggest that single-syllable contracted forms from two-syllable ones have two moras because they undergo Compensatory Lengthening after Glide Formation. The other half of the data without such durational difference can be explained in the same manner as in Standard Korean.

However, when we take into account the previous phonetic studies of Han (1964) and Ko (1988), it would appear that durational differences between long vs. short vowels have been gradually reduced over the past thirty years. Then we can raise a question of whether this kind of gradual vowel length reduction could occur if vowel length distinction were phonemic. As briefly mentioned in our introduction, Han (1964) reports that the ratio of short vs. long vowels in isolation was 1:2.51, whereas the ratio was reduced into 1: 1.95 in Ko (1988). In addition, the ratio of short vs. long vowels in context was 1: 1.41 in Ko (1988) but reduced into 1: 1.15 in our Kyungsang speakers.

As an answer to the question of whether gradual vowel length reduction could occur if vowel length distinction were phonemic, it would be worth taking a look at other languages which are considered to have phonemic vowel length duration. According to Hubbard (1995), the languages of Runyambo (a language of northwestern Tanzania) and Luganda (spoken in Uganda) have phonemic vowel length distinction. The measurement of short vs. long vowels of the two languages is presented in Table 7.

(Table 7 here)

As we can see in Table 7, the duration of long vowels of the two languages is twice as long as that of short vowels. Compared with the data of the two languages in Table 7, our data do not show such a doubly-long durational difference. The discrepancies of vowel length between the two African languages and Korean may lead us to conclude that the difference of physical values in vowel length cannot be attributed to a phonological account in Korean. Rather it might be purely phonetic.

In the explanation of vowel length, as a purely phonetic account assumed above, such a durational difference could be too small to be perceived distinctively; that is, distinction of long vs. short vowels and full vs. contracted forms in relation to Compensatory Lengthening. At this point, it is not certain whether physical durational difference may play a role in phonemic vowel length distinction. To further this investigation, a perceptual study of Korean vowels is needed in the future.

3. Conclusion

In this study we have examined whether Modern Korean has phonemic vowel length distinction, especially in the two dialects of Kyungsang and Standard Korean. Our results have shown that with respect to Standard Korean speakers, there was no vowel length distinction in both lexical and compensatory-lengthening words, and that in Kyungsang speakers vowel length distinction was partly preserved in the two contexts. As for the dialectal differences, two explanations have been provided, namely, phonological and phonetic interpretations of vowel length distinction.

Notes

[1]The test word *o+a* was used in our experiment though it is not a real word, because its contracted form *wa:* has been often cited as a representative case of Compensatory Lengthening.

[2]Note that the length difference in these two test words revealed as significant in a two-way ANOVA (p=.0263). From these two kinds of statical results we assume that the vowel length difference between *mal* and *ma:l* is significant.

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Table 1. Mean vowel durations (in ms) and the ratios of short to long vowels for the Kyungsang speakers and the Standard Korean speakers.

	Kyungsang speakers			Standard Korean speakers		
	short	long		short	long	
mal/ma:l	65.1	75.8	(1:1.16)	79	98.4	(1:1.25)
kat͡si/ka:t͡si	70.9	88.5	(1:1.25)	54.1	55.7	(1:1.03)
pam/pa:m	77.6	101	(1:1.30)	90.8	103.2	(1:1.14)
mut+ta/mu:t+ta	42.6	52.8	(1:1.24)	45.3	52	(1:1.15)
t͡sə k+ta/t͡sə:k+ta	50.2	61.1	(1:1.22)	41.4	43.8	(1:1.06)
nun/nu:n	61.8	56.4	(1:0.91)	64.5	70.2	(1:1.09)
mul+ta/mu:l+ta	50	47.7	(1:0.95)	48.3	46.8	(1:0.97)
mean ratio			(1:1.15)		(1:1.09)	

Table 2. T-tests of vowel duration of lexical words

	Kyungsang speakers		Standard Korean speakers	
mal/ma:l	t(11)=-1.9;	p=.0833	t(11)=-1.8;	p=.1011
nun/nu:n	t(11)=.9;	p=.4131	t(11)=-.9;	p=.3689
kat͡si/ka:t͡si	t(11)=-2.9;	p=.0144	t(11)=-.4;	p=.7107
pam/pa:m	t(11)=-2.8;	p=.018	t(11)=-1.7;	p=.1175
mut+ta/mu:t+ta	t(11)=-2.4;	p=.0379	t(11)=-1.6;	p=.1314
mul+ta/mu:l+ta	t(11)=.6;	p=.5884	t(11)=.5;	p=.6386
t͡sə k+ta/t͡sə:k+ta	t(11)=-2.4;	p=.0384	t(11)=-2.4;	p=.4989

Table 3. Mean vowel durations (in ms) and ratios of full to contracted forms for the Kyunsang speakers and the Standard Korean speakers:

	Kyungsang speakers			Standard Korean speakers		
	full	contracted		full	contracted	
ki+ə/kjə:	170	168	(1.01)	239	185	(1.29)
k'u+ə/k'wə:	172	133	(1.29)	251	190	(1.32)
o+a/wa:	229	203	(1.13)	291	267	(1.09)
tu+ə/twə:	178	157	(1.13)	237	191	(1.24)
p^hi+ə/p^hjə:	141	113	(1.25)	213	150	(1.42)
pi+ə/pjə:	186	169	(1.1)	246	190	(1.29)
po+a/pwa:	202	162	(1.25)	220	211	(1.04)
moi+ə/mojə:	188	137	(1.37)	232	188	(1.23)
mean			(1.19)			(1.24)

Table 4. T-tests of vowel duration of compensatory lengthening words

	Kyungsang		Standard Korean	
k'u+ə/k'wə:	t(11)=6.5;	p=.0001	t(11)=8.5;	p=.0001
p^hi+ə/p^hjə:	t(11)=6.4;	p=.0001	t(11)=5.4;	p=.0002
po+a/pwa:	t(11)=3.9;	p=.0025	t(11)=-3.5;	p=.0051
moi+ə/mojə:	t(11)=8.3;	p=.0001	t(11)=3;	p=.0127
ki+ə/kjə:	t(11)=.3;	p=.7721	t(11)=2.6;	p=.0235
o+a/wa:	t(11)=2.1;	p=.0577	t(11)=4;	p=.0019
tu+ə/twə:	t(11)=2.2;	p=.0495	t(11)=5.4;	p=.0002
pi+ə/pjə:	t(11)=2;	p=.0661	t(11)=2.8;	p=.0169

Table 5. Mean vowel durations (in ms) and ratios of short and long vowels for the Kyungsang speakers

	Speaker 1			Speaker 2			Speaker3		
	short	long		short	long		short	long	
mal/ma:l	68	69	(1:1.01)	64	78	(1:1.12)	63	81	(1:1.29)
nun/nu:n	**82**	**66**	**(1:0.8)**	**58**	**58**	**(1:1)**	**46**	**46**	**(1:1)**
kat͡si/ka:t͡si	**74**	**69**	**(1:0.93)**	62	79	(1:1.27)	77	118	(1:1.53)
pam/pa:m	75	130	(1:1.73)	79	86	(1:1.09)	80	87	(1:1.09)
mut+ta/mu:t+ta	45	60	(1:1.33)	41	42	(1:1.02)	43	57	(1:1.33)
mul+ta/mu:l+ta	**60**	**53**	**(1:0.88)**	**41**	**39**	**(1:0.95)**	50	51	(1:1.02)
t͡sək+ta/t͡sə:k+ta	51	80	(1:1.57)	43	46	(1:1.07)	57	58	(1:1.02)

Table 6. Mean vowel durations (in ms) and ratios of full to contracted forms for the Kyungsang speakers

	Speaker 1			Speaker 2			Speaker3		
	full	contracted		full	contracted		full	contracted	
k'u+ə/k'wə:	194	131	(1.48:1)	151	130	(1.16:1)	171	147	(1.16:1)
p^hi+ə/p^hjə:	145	112	(1.29:1)	124	110	(1.13:1)	155	118	(1.31:1)
po+a/pwa:	213	165	(1.29:1)	166	165	(1.01:1)	227	157	(1.45:1)
moi+ə/mojə:	196	134	(1.46:1)	150	108	(1.39:1)	216	171	(1.26:1)
ki+ə/kjə:	172	147	(1.17:1)	**137**	**164**	**(0.84:1)**	202	191	(1.06:1)
o+a/wa:	238	181	(1.31:1)	196	175	(1.12:1)	**252**	**254**	**(0.99:1)**
tu+ə/twə:	187	147	(1.27:1)	158	138	(1.14:1)	188	185	(1.02:1)
pi+ə/pjə:	183	144	(1.27:1)	**153**	**158**	**(0.97:1)**	223	205	(1.09:1)

Table 7. Vowel durations (in ms) and ratios to short vowels for Runyambo and Luganda (Hubbard 1995:174)

	Vowel durations		Ratios (to short vowels)
	short	long	
Runyambo	110	215	1.9
Luganda	98	240	2.5