Acoustic characteristics of lexical pitch accent in cross-dialect of Korean: on disyllabic words*

Jungsun Kim
(Yeungnam University)

Kim, Jungsun. 2010. Acoustic characteristics of lexical pitch accent in cross-dialect of Korean: on disyllabic words. *Studies in Phonetics, Phonology and Morphology* 16.2. 173-194. This paper investigates the acoustic properties of lexical pitch accent contrasts produced by native and non-native dialect speakers in cross-dialect of Korean. Specifically, it focuses on examining whether the f0 pitch contour in the prosody production of adults and children has a dialect-specific effect. The current experiment examines the acoustic characteristics of pitch accent minimal pairs produced by adult speakers of these two dialects, and those of disyllabic words by child and adult speakers. The results show evidence for lexical categories of pitch accent in native dialect speakers (i.e., North Kyungsang), but not in non-native dialect speakers (i.e., South Cholla). Specifically, all the measurement (i.e., peak f0, f0 range, turning point of f0, and the difference of the f0 values at the mid point of the first and second vowels) showed a difference between the two dialect speakers. Additionally, for the North Kyungsang adult speakers, the turning point of f0 was a better measure for detecting the lexical pitch accent categories. The results of the adult speakers from the two dialect groups were supported by the f0 difference of the first and second vowels produced by the North Kyungsang and South Cholla child speakers. **(Yeungnam University)**

Keywords**:** pitch accent, lexical categories, Kyungsang, Cholla, prosody production

1. Introduction

This paper concerns the acoustic characteristics of lexical pitch accent produced by adult and child speakers. Lexical prosody such as tone, pitch accent, and stress can be represented in terms of fundamental frequency (f0) with or without the changes of intensity, duration, and various other correlates (Fry 1955, 1965; Beckman 1986; Dickey 1996; Gandour 1978; Sekiguchi and Nakajima 1999). This paper examines the differences in pitch for pitch accent productions by child and adult speakers of lexical accent and non-accent varieties of Korean.

Among many aspects of pitch movement, the current study examines alignment characteristics in varieties of Korean. Tone alignment in the acquisition process of prosodic features also shows different patterns depending on a native language or dialect (Grabe *et al*. 2000; Atterer and Ladd 2004; Ladd *et al*. 2009). The difference in tone alignment between regional varieties is attributed to the interaction between linguistic

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environment and phonetic learning. Ladd *et al.* (2009) found different phonetic details in the tonal alignment of regional varieties in British English, and nuclear peaks appear with different alignment in different languages (i.e., English and Dutch) and dialects (i.e., Scottish Standard English and Southern British English). Specifically, nuclear peak alignment of English and Southern British English occurs earlier than Dutch and Scottish Standard English. Further, prenuclear peak is earlier for Southern British English. Atterer and Ladd (2004) discussed how the pitch contour of f0 maxima and minima interacted with segmental anchoring in Northern and Southern German. This study found that German native speakers carried over native pitch contours even when they spoke another language such as English, and peak alignment is later than Greek, English, and Dutch. In regional varieties, peak alignment in Northern German is earlier than in Southern German. Arvaniti and Garding (2007) examined the different intonational contours in American English dialectal variants, and found that speakers of one dialect (i.e., Minnesotan) weakened certain pitch contours such as the contrasts between H* and L+H* when they read the experimental script, while speakers of another dialect (i.e., Southern Californian) used the L+H* systematically when emphasizing contrast.

Among previous phonetic studies of Korean dialectal variants, recently Jun *et al.* (2006) and H-S Lee (2008) examined the North Kyungsang dialect, S-E Chang (2007) the South Kyungsang dialect, and S-A Jun (1993, 1998) and K-C Park (2003) the South Cholla and Seoul dialects. Previous research (N-J Kim 1997; Jun *et al*. 2006) examined phonological contrasts in Kyungsang Korean, describing three contrasting pitch accent categories as HL, HH, and LH. The accent type, HL, was assigned in the second to last syllable of a word, HH in the initial two syllables, and LH in the last syllable. Jun *et al.* (2006) and S-A Jun (1993, 1998) also discussed the phonetic details of tonal alignment in these two regional varieties. Jun *et al.* (2006) argued that the lexical pitch accent system of North Kyungsang Korean can be described as L+H* for the relevant lexical items, where the accents are rising from low to high, and the high (as indicated by the star) is aligned with the accented syllable. On the other hand, S-A Jun (1993, 1998) proposed that, in the South Cholla dialect, the property of intonation changes depending on the laryngeal feature of the word-initial segment. That is, when a word beginning with a [+stiff vocal folds] laryngeal feature begins an accentual phrase, the accentual phrase shows a high-high-low f0 contour, but if the phrase-initial word does not begin with this laryngeal feature, the phrase shows a low-high-low f0 contour. Therefore, the South Cholla dialect contains pitch contours, but they are simply intonational markers of an accentual phrase

Studies on the acquisition of suprasegmental features have shown that children acquire prosodic features earlier than segmental features (Lenneberg 1967; Crystal 1973; Kirk 1973; Li and Thompson 1977; Tse 1978). Studies on the acquisition of prosody by 5 to 7 years old children

are very rare. Studies on the acquisition of prosodic features by infants have shown that infants acquire the prosodic features of their native language quite early. Hallé *et al.* (1991)'s study on infant prosody found that prosodic patterns in disyllabic vocalizations by French and Japanese infants at eighteen months of age were dependent on the native language. That is, the f0 contours such as rising and falling and lengthening of final syllables were correspondent to language-specific prosodic properties. Japanese infants showed a falling f0 contour, whereas French infants showed a rising contour, along with an especially long final syllable.

Studies have also shown that the speech of mothers, motherese, influences the acquisition of prosody. Liu *et al.* (2007) focused on the exaggeration of tonal contrasts in infant-directed speech by mothers. The generalization that high pitch is one of the prosodic properties in conversations between mothers and infants (Ferguson 1964; Fernald *et al*. 1989) is attributed to the acquisition of a salient feature, which, in Chinese, is a phonemic category. Grieser and Kuhl (1988) found that the maternal speech directed to two-month-old infants whose mother tongue was Mandarin Chinese replicated the heightened pitch and exaggerated duration observed in English and German which are non-tonal languages. This implies that these features are universal prosodic properties of native sounds. Masataka (1992) observed the motherese of Japanese mothers with infants, and suggested that the lexical properties of pitch accent are acquired from maternal speech. S-A Jun (2005) examined the production data of an infant between 2 and 22 months of age, and showed that maternal speech influenced the prosody acquisition of the infant.

This paper concerns the acoustic properties of lexical pitch accent contrasts produced by speakers native to lexical and non-lexical dialects of Korean. Specifically, it focuses on examining whether the f0 contour in the prosody production of adults and children has dialect-specific differences. The relevant pitch contour of each dialect needs to be probed in the process of phonological acquisition. The production of lexical pitch accent categories by the child speakers from the North Kyungsang and South Cholla regions will explain the production performance of the adult speakers from the two dialect groups.

2. Experimental Method

2.1 Participants[1]

The adult and child participants were recruited from the central regions of

[1] In this experiment, the child participants were recruited to confirm the results from the adult participants between the two dialect groups. Due to the problem of recruiting child participants from each dialect region, the numbers of adult and child participants for each dialect group are not identical. However, the production data of child participants between the two dialect groups support the results of the adult participants, as shown in section 3.

North Kyungsang and South Cholla. In the North Kyungsang region, the age of the adult participants ranged from 19 to 33 years old, and the children participants from 5 to 7 years old. Ten adult and eight child participants took part in the experiment. In the South Cholla region, the age of the adult participants ranged from 32 to 39 years old, and the child participants from 5 to 7 years old. Ten adults and six children participated. All participants were compensated financially. There were no reported hearings or speaking impairments in any of the participants. Table 1 shows demographic information on adult participants from the two dialect groups, while Table 2 shows that for child participants.

Table 1. Demographic information of North Kyungsang and South Cholla adult participants

Group	Subject	Sex	Age	Residential history
KS	1	female	21	Daegu
	2	female	26	Daegu
	3	female	33	Daegu
	4	female	23	Daugu
	5	female	23	Daegu
	6	female	22	Daegu
	7	female	19	Daegu
	8	male	27	Daegu
	9	male	28	Daegu
	10	male	27	Daegu
CL	1	female	39	Kwangju
	2	female	37	Kwangju
	3	female	32	Kwangju
	4	female	36	Kwangju
	5	female	37	Kwangju
	6	female	36	Kwangju
	7	female	36	Kwangju
	8	female	37	Kwangju
	9	female	39	Kwangju
	10	female	36	Kwangju

Table 2. Demographic information of North Kyungsang and South Cholla child participants

Group	Subject	Sex	Age	Residential history
KS	1	female	7	Daegu
	2	female	6	Daegu
	3	female	7	Daegu
	4	female	5	Daegu
	5	male	6	Daegu
	6	male	6	Daegu
	7	male	7	Daegu
	8	male	6	Daegu
CL	1	female	6	Kwangju
	2	female	6	Kwangju
	3	female	7	Kwangju
	4	male	6	Kwangju
	5	male	5	Kwangju
	6	male	6	Kwangju

2.2 Stimuli[2]

The current experiment examines the acoustic characteristics of pitch accent minimal pairs (See Appendix A) by adult speakers of two dialects, North Kyungsang and South Cholla. In addition, to support the results of pitch accent minimal pairs produced by the two dialect groups, the acoustic characteristics of the disyllabic words (See Appendix B) are also examined. For the production task of the adult participants, stimuli related to pitch

[2] According to previous studies (G-R Kim 1988, N-J Kim 1997), some words with the HH pattern in North Kyungsang Korean tended to have long vowel in the first vowel. For the North Kyungsang and South Cholla speakers who participated in the current study, there were no vowel length contrasts for the first vowels in [móɾe] 'sand' and [móɾé] 'the day after tomorrow', and [yaŋmó] 'wool', and [yáŋmó] 'adoptive mother'. Regarding the vowel duration measurement, the *t* test results showed that the two pairs [móɾe] and [móɾé] (p = .189) and [yaŋmó] and [yáŋmó] (p = .200) for the North Kyungsang speakers were not significantly different. For the South Cholla speakers, the two pairs [móɾe] and [móɾé] (p = .225) and [yaŋmó] and [yáŋmó] (p = .733) were not significantly different. For the young generation, the vowel length distinctions have shown gradual loss, and this may be a difference among Korean dialects. The relation between vowel length difference and pitch contour in the pitch accent system of Korean needs to be investigated in future research.

The two pairs [moi] 'feed' and [moí] 'conspiracy', and [móɾe] 'sand' and [móɾé] 'the day after tomorrow' differ in Korean orthography. Before the experiment, the two dialect speakers confirmed that these minimal pairs have the same sounds when they pronounced them, regardless of the different orthography. Moreover, the pair [móɾe] and [móɾé] has been used for pitch accent contrast in previous studies by G-R Kim (1988), S-E Chang (2007), and H-S Lee (2008).

The current experiment was focused on the location of lexical pitch accent on disyllabic words, because I could not find the pitch accent minimal pairs with three or four syllables. In the case of monosyllabic words, high tone can be extended to an affix.

accent minimal pairs were given. For the minimal pairs, three sets with different meanings (e.g., [mói] 'feed', [moi̋] 'conspiracy'; [móɾe] 'sand', [móɾé] 'the day after tomorrow'; [yaŋmó] 'wool', [yáŋmó] 'adoptive mother') were used for adult participants from the two dialect regions. In order to reduce the variation in f0 values across the target words produced by the South Cholla speakers, all words were chosen to begin with a low tone in the South Cholla dialect, i.e., having no [+stiff vocal folds] laryngeal feature.

The disyllabic words were produced by both adult and child participants to identify the lexical status of lexical pitch accent. Because they were added to confirm the production data of pitch accent minimal pairs between the two dialect groups, three adult speakers among the participants who had participated in the production task of pitch accent minimal pairs were selected again from each dialect group. For the production task of child participants in both regions, only the disyllabic words were employed to increase the likelihood that the children were familiar with the words.

2.3 Procedure

The pitch accent minimal pairs were embedded in sentences (See Appendix A). In the production task of the pitch accent minimal pairs, a question-answer pair was employed. In the answer sentence, the target words were focused, and focused words were underlined in the sentences for the adult participants. When the adult participants read the experimental sentences, they inserted a pause before and after the target words. Ten adult North Kyungsang speakers and ten adult South Cholla speakers were asked to read the sentences containing the target words, and their reading was recorded by Wavesurfer software on a laptop computer. The script for pitch accent minimal pairs included six carrier sentences, and for the recording, the sentences were repeated six times in random order. In total, there were 720 repetitions which consisted of 6 target words × 6 repetitions × 10 participants × 2 dialect groups.

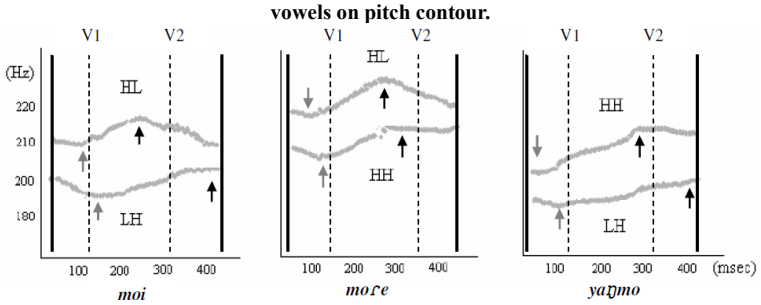
For the disyllabic words, picture cards with two-syllable words were used for both adult and child participants. In the picture naming task, the participants were asked to name the object in each picture on the card. Three North Kyungsang and three South Cholla adults were selected for the adult group. Eight North Kyungsang children and six South Cholla children took part in the child group. In total, there were 528 repetitions for the North Kyungsang adult and child participants, consisting of 48 words × (3 adults + 8 children); there were 432 for the South Cholla adult and child participants, consisting of 48 words × (3 adults + 6 children).

2.4 Measurement

The measurements described below are undertaken to extract physical

properties that are particularly indicative of the pitch accent contrasts in the North Kyungsang variety. For the measurement of pitch accent minimal pairs, the values of f0 at the mid point of the first and second vowels, the low and peak f0 of the pitch contour, duration of the word, and duration of the falling contour were measured. F0 values were extracted using Wavesurfer.

Figure 1. Measurement points of pitch accent contours for three minimal pairs. The solid lines indicate the onset and offset of a word. The black arrows indicate peak f0 and the gray arrows low f0. The dotted lines indicate the mid point of the first and second vowels on pitch contour.



Low f0 was measured at the lowest location of the pitch contour, and peak f0 at the highest point. The duration of a word was acoustically measured as the range between the onset and offset of a word. The falling contour was measured from the location of peak f0 to the offset of the word. For the disyllable words, f0 of the mid point of the first and second vowels was measured. In the acoustic analysis of each pitch accent category, peak f0, f0 range (the difference between highest and lowest f0), and the turning point of f0 as in the formula of (1) were considered. The formula in (1) was revised from Liu *et al.* (2007). The relative turning point shows the relative timing of the falling contour divided by the duration of the word. That is, in Figure 1, the relative turning point of f0 for HL is earlier than HH or LH, because the location of peak f0 is earlier than the other two patterns. LH has a very late turning point or does not in Figure 1.

(1) Relative turning point of f0
= (Duration of falling contour / Duration of a word) × 100%

3. Data Analysis and Results[3]

To determine whether two dialect groups (i.e., North Kyungsang and South Cholla) are different, a repeated measures analysis of variance was conducted. Between-subject factors are the dialect groups in Figures 2 - 6, and the age groups of adult and child speakers in Figures 7 and 8. Within-subject factors are the three pitch accent patterns. The main effect in the two dialect groups is evaluated to examine the different pitch contours between North Kyungsang and South Cholla speakers. To provide a specific analysis between the two dialect groups, the main effect of pitch accent patterns and their interactions with each group are also evaluated. If data violate the assumption of sphericity (i.e., the equality of variances of the differences between conditions), the Greenhouse-Geisser correction is used. That is, if Mauchly's test of sphericity is significant, the Greenhouse-Geisser correction is reported. If Mauchly's test of sphericity is not significant, Sphericity Assumed is reported. For the variance of lexical pitch accent categories within a group, the Bonferroni procedure for post-hoc comparisons was employed. This test was conducted to determine whether the three lexical pitch accent categories are distinguished in terms of phonological categories such as HL, HH, and LH for each dialectal group. In addition, *t*-tests were run to determine whether there is a difference in the pitch accent patterns produced by child speakers from the two regions.

The following sections show the analysis of the peak f0, f0 range, the turning point of f0 for pitch accent minimal pairs, and the difference of the f0 values at the mid point of the first and second vowels from North Kyungsang and South Cholla adult and child speakers for the disyllabic words.

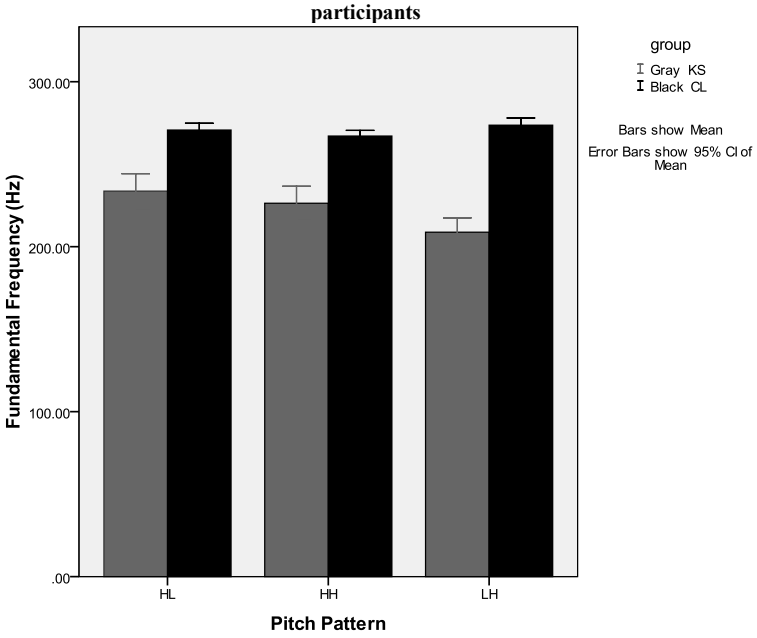
3.1 Peak f0

Figure 2 plots the mean f0 in Hz at the peak of the pitch contour for each pitch accent pattern by North Kyungsang and South Cholla adult participants. For the peak f0 of the three pitch accent patterns, HL, HH, LH, the performance in the two dialectal groups was significantly different (F (1, 238) = 86.627, $p < .001$). The main effect of accent patterns was

[3] The North Kyungsang speakers who participated in the current study consist of 3 males and 7 females. The peak f0, f0 range, and turning point of f0 between the North Kyungsang female speakers and South Cholla female speakers were compared to confirm the results of Figures 2 - 4, due to the effect of pitch contour produced by the North Kyungsang male speakers. In the comparison of the North Kyungsang and South Cholla female speakers, the peak f0 (F (1, 202) = 31.999, $p < .001$), f0 range ((F (1, 201) = 39.704, $p < .001$), and turning point of f0 (F (1, 202) = 538.141, $p < .001$) were significantly different. This difference between the North Kyungsang and South Cholla female speakers supports the results of Figures 2 – 4, which include the North Kyungsang male speakers.

significantly different (F (1.851, 440.567) [4] = 23.308, $p < .001$). The interaction between the three pitch accent patterns and groups was also significant (F (1.851, 440.567) = 44.216, $p < .001$). Regarding the three types of lexical pitch accent categories by North Kyungsang and South Cholla participants, post hoc tests for the interaction between three pitch accent patterns and groups showed that for North Kyungsang participants, the pairs of HL and HH ($p = .001$), HL and LH ($p < .001$), and LH and HH ($p < .001$) were all significantly different. The HL patterns had higher peak f0 than the HH patterns, which were, in turn, higher than the LH patterns. However, for the three pitch accent patterns by South Cholla participants, post hoc tests indicated that the pairs of pitch accent patterns, HL and HH ($p = .196$), HL and LH ($p = .741$) were not significantly different, but the pair of HH and LH ($p = .013$) was significantly different.

Figure 2. Peak f0 in Hz by North Kyungsang (KS) and South Cholla (CL) adult participants



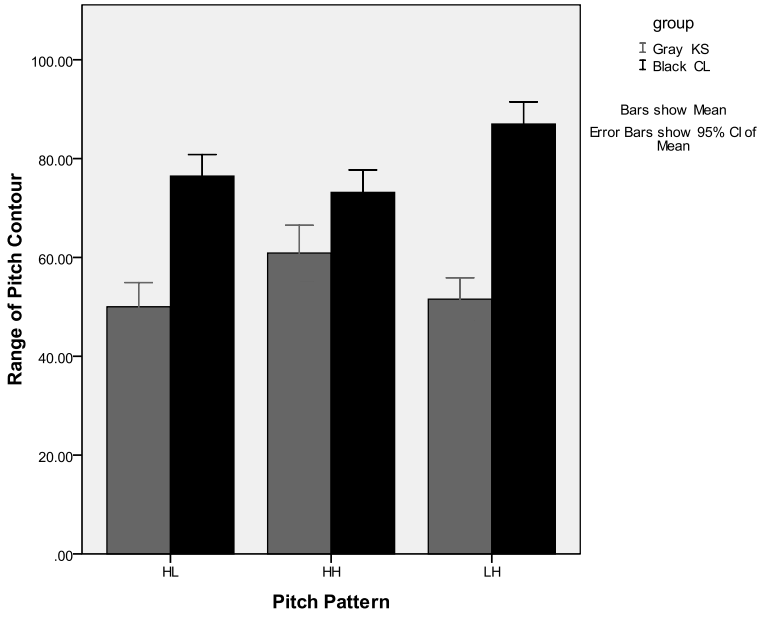
3.2 f0 range

Figure 3 plots the mean values of f0 range by adult participants of the North Kyungsang and South Cholla regions. For f0 range by North

[4] The Greenhouse-Geisser correction was used because Mauchly's test of sphericity was significant.

Kyungsang and South Cholla participants, the performance in the two groups was significantly different (F (1, 238) = 77.650, $p < .001$). The main effect of pitch accent patterns was also significant (F (2, 476) = 6.621, $p = .001$), and the interaction of three pitch accent patterns and groups was also significant (F (2, 476) = 24.221, $p < .001$). With respect to the three pitch accent patterns by North Kyungsang and South Cholla participants, post hoc tests for the interaction of the three pitch accent patterns and groups indicated that for North Kyungsang participants, the pairs of HL and HH ($p < .001$) and HH and LH ($p < .001$) were significantly different, but the pair of HL and LH ($p = 1.0$) was not. The HH patterns have a larger range than the other two patterns. For the three types of pitch accent patterns by South Cholla participants, post hoc tests also indicated significant differences; the pairs of HL and LH ($p < .001$) and HH and LH ($p < .001$) were significantly different, but the pair of HL and HH ($p = .483$) was not.

Figure 3. Mean of f0 range by North Kyungsang and South Cholla adult participants

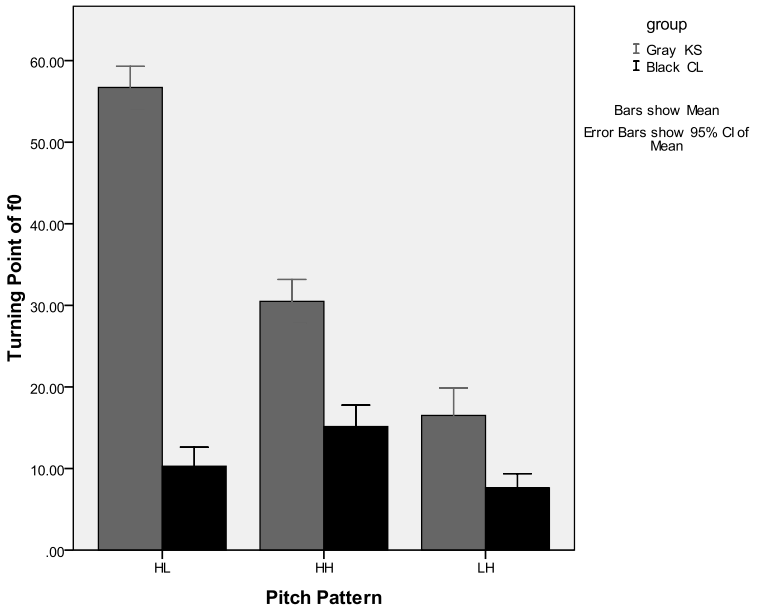


3.3 The turning point of f0

Figure 4 plots the mean values of the timing of the turning point of f0 by adult participants of the North Kyungsang and South Cholla regions. The main effect of the two dialect groups was significant (F (1, 238) = 319.345,

$p < .001$), the main effect of the three pitch accent patterns was significant (F (2, 476) = 171.473, $p < .001$), and the interaction of pitch accent and group was significant (F (2, 476) = 150.625, $p < .001$). In the interaction between different pitch accent patterns and groups, based on the three lexical pitch accent categories by North Kyungsang participants, post hoc tests indicated that the three pairs, HL and HH ($p < .001$), HL and LH ($p < .001$), HH and LH ($p < .001$) were all significantly different. For the three different pitch patterns by South Cholla participants, post hoc tests showed that the pairs of HL and HH ($p = .010$) and HH and LH ($p < .001$) were significantly different, but the pair of HL and LH ($p = .347$) was not significantly different. As can be seen in Figure 4, the differences between the three categories for the North Kyungsang speakers are much larger in magnitude than were the measures of f0 peak frequency and range; the HL patterns have much earlier turning points, before the mid-point of the word, while the LH patterns have very late peaks, and the HH patterns lie in between these extremes. The South Cholla productions all have late peaks, akin to the LH pattern.

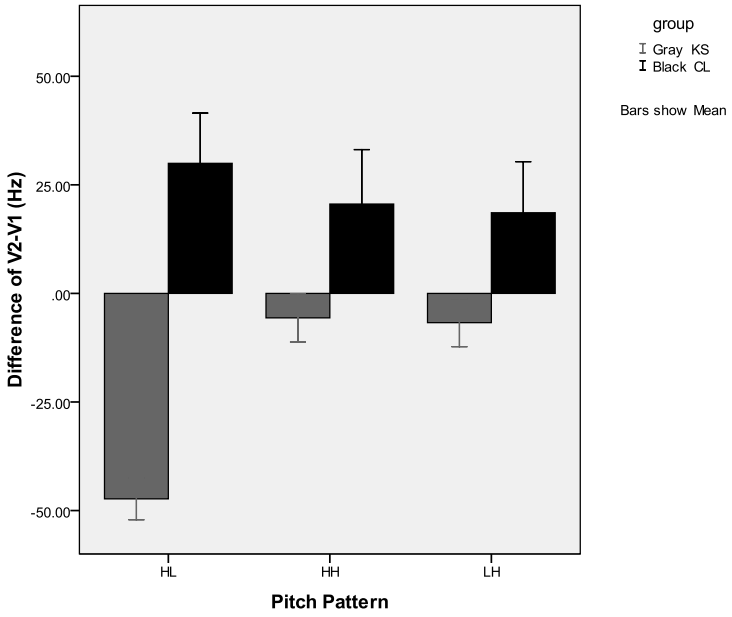
Figure 4. Mean of the turning point of f0 by North Kyungsang and South Cholla adult participants. Low values indicate later turning points.



3.4 The different values in Hz between the first and second vowels in disyllabic words by adult speakers

Figure 5 illustrates the different values in Hz between the mid points of the first and second vowels by North Kyungsang and South Cholla adult participants. The performance between the two dialectal groups was significantly different (F (1, 130) = 74.944, $p < .001$). The main effect of the three pitch accent patterns was significant (F (2, 260) = 11.605, $p < .001$), as was the interaction between three pitch accent patterns and two groups (F (2, 260) = 32.312, $p < .001$). In the interaction of pitch accent patterns and groups, for three lexical pitch accent categories by North Kyungsang participants, post hoc tests indicated that the pairs of HL and HH ($p < .001$) and HL and LH ($p < .001$) were significantly different, but the pair of HH and LH ($p = 1.0$) was not. For South Cholla participants, post hoc tests indicated that the three pairs of HL and HH ($p = .218$), HL and LH ($p = .119$), and HH and LH ($p = 1.0$) were not significantly different.

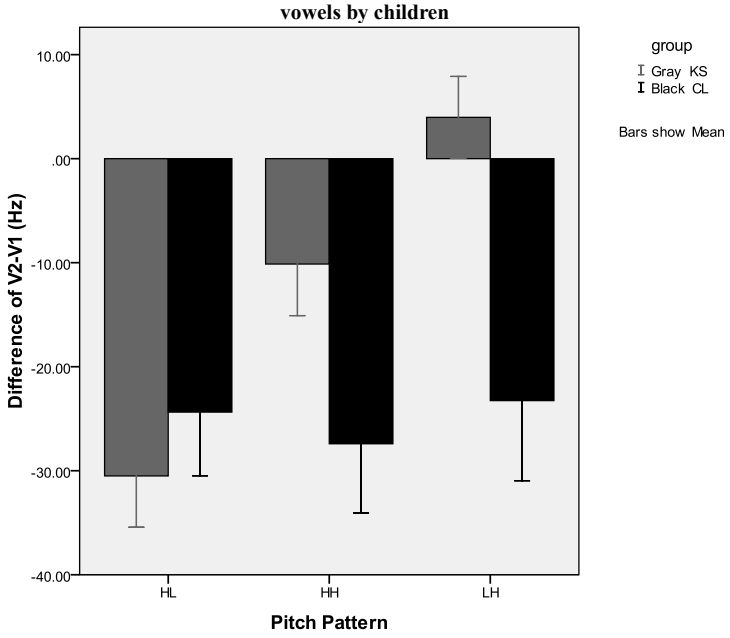
Figure 5: The different values in Hz between the mid points of the first and second vowels by adults



3.5 The different values in Hz between the first and second vowels in disyllabic words by child speakers

Figure 6 illustrates the different values in Hz between the mid point of the first and second vowels by North Kyungsang and South Cholla child participants. The main effect of the two groups was significant (F (1, 324) = 22.857, p < .001). For the difference of pitch accent patterns between the two groups, the mean of the two groups was compared, revealing a significant difference for HH (t (276) = 4.083, p < .001), and LH (t (213) = 6.173, p < .001), but not for HL (t (290) = -1.530, p = .127) between the two dialect groups. The main effect of the three pitch accent patterns was significant (F (2, 648) = 22.183, p < .001). The interaction between three pitch accent patterns and two groups was significant (F (2, 648) = 20.565, p < .001). For the three lexical pitch accent categories by North Kyungsang child participants, post hoc tests showed that the three pairs of HL and HH (p < .001), HL and LH (p < .001), and HH and LH (p< .001) were all significantly different. For the three types of lexical pitch accent categories by South Cholla participants, post hoc tests indicated that the three pairs of HL and HH (p = 1.0), HL and LH (p = 1.0), and HH and LH (p = .948) were not significantly different.

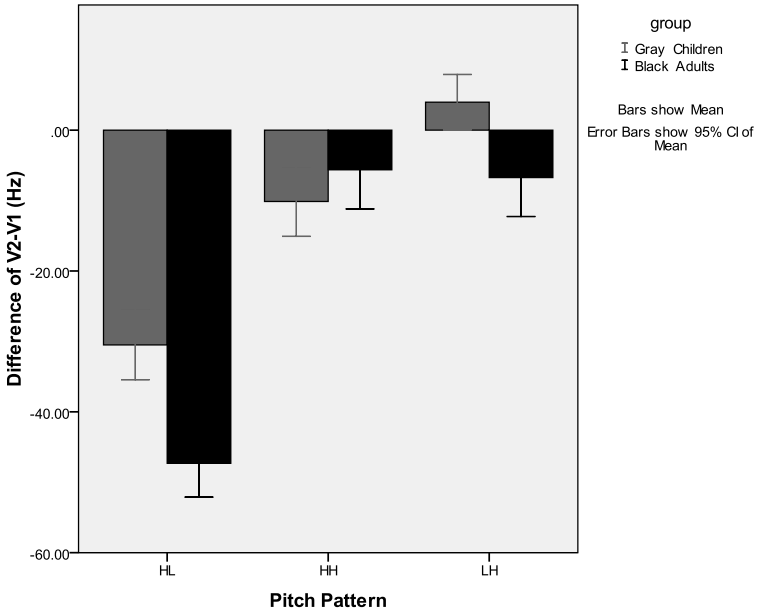
Figure 6. The different values in Hz between the mid points of the first and second vowels by children



3.6 The difference of pitch contour by North Kyungsang child and adult speakers

Figure 7 shows the difference of f0 values at the mid point of the first and second vowels in disyllabic words. The difference of pitch contour was compared for child and adult participants from the North Kyungsang region. The production performance between child and adult speakers was significantly different (F (1, 250) = 10.128, p = .002). This analysis reports that the production performance of the child speakers shows different patterns compared with the data of the adult speakers. The HL pattern for child speakers is different with other pitch contours such as the HH and LH pattern. For the HL pattern child speakers produced, the f0 value of the first vowel is higher than the second vowel, though there is a difference in f0 values between child and adult speakers. The adult speakers showed a different pattern related to the HL contour when compared to the other pitch accent patterns. The difference of f0 values between the first and second vowel of the HL pattern is the largest for child and adult speakers. For the LH pattern, child speakers showed the positive values of f0 and adult speakers showed the negative values of f0. But this difference between child and adult speakers for the HL pattern is larger than the LH pattern.

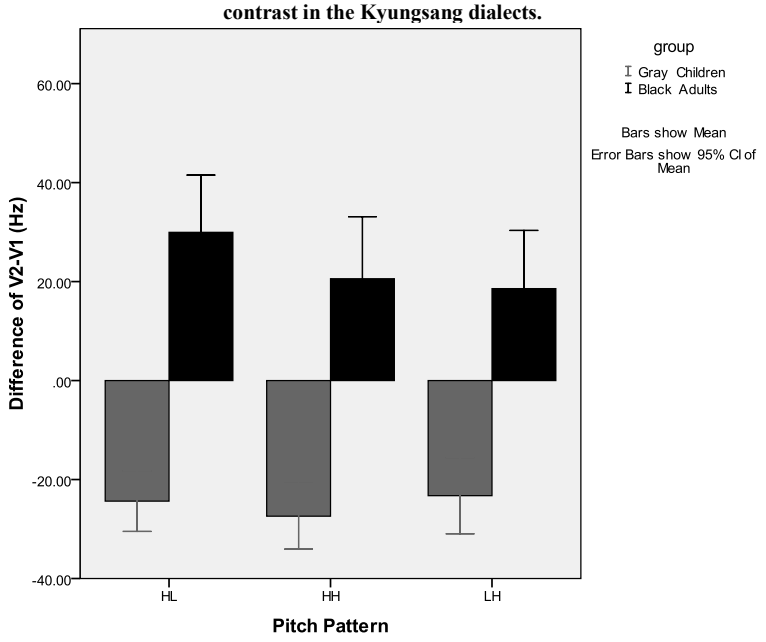
Figure 7. Pitch contour by North Kyungsang child and adult speakers for three different lexical accent patterns.



3.7 The difference of pitch contour by South Cholla child and adult speakers

Figure 8 shows the difference of f0 values at the mid point of the first and second vowels in disyllabic words by South Cholla child and adult speakers. The performance of South Cholla child and adult speakers was significantly different (F (1, 204) = 94.805, $p < .001$). The result shows the different patterns of pitch contours between the South Cholla child and adult speakers. The production of adult speakers for the pitch accent patterns shows a rising contour in which the f0 value of the second vowel is higher than that of the first vowel. The rising contour such LH is the intonation pattern of the South Cholla variety. In other words, when the phrase does not have an initial consonantal laryngeal feature, the tone patterns entails a rising pitch contour with a trailing low tone. However, the productions of South Cholla child speakers show a falling contour such as HL in which the f0 value of the first vowel is higher than that of the second vowel.

Figure 8. Pitch contour by South Cholla child and adult speakers for words that lexically contrast in the Kyungsang dialects.



4. Discussion

This paper concerns the difference in the production of the lexical pitch accent of North Kyungsang Korean, produced by North Kyungsang and South Cholla speakers. The general results from the production task showed that the acoustic characteristics of lexical pitch accent were distinctive in the North Kyungsang variety. Specifically, the current study examined lexical minimal pairs and disyllabic words with different lexical pitch accent categories, as produced by speakers of two different dialects. The f0 contour varied in the values of maxima and minima of f0 and f0 range. North Kyungsang adult speakers produced differences in the shape of pitch contour between lexical pitch accent minimal pairs, but South Cholla speakers did not. Kyungsang and Cholla children's data replicated the degree of lexical differentiation in the productions of the adults. The North Kyungsang child speakers distinguished the three lexical pitch accent categories, as did in the adult speakers, but the South Cholla child and adult speakers did not show a difference among the three pitch accent pairs.

Specifically, all the measurements (i.e., peak f0, f0 range, turning point of f0, and the difference of the f0 values at the mid point of the first and second vowels) showed a difference between the North Kyungsang and South Cholla adult speakers. Additionally, the measurement of the turning point of f0 values showed a clear difference of lexical categories for the North Kyungsang adult speakers. For the adult speakers, the turning point of f0 was a better measure for detecting the lexical pitch accent categories. The lexical categories of pitch accent were not clearly distinguished for the South Cholla adult speakers. Furthermore, the results of the adult speakers from the two dialect groups were supported by the f0 difference of the first and second vowels produced by the North Kyungsang and South Cholla child speakers. Also, the North Kyungsang child speakers distinguished the three pitch accent categories from the difference of the first and second vowels.

The results of the current study are in accord with previous studies of prosody acquisition. The effect of native sounds on prosodic cues has also been observed for lexical representation of other languages. In a study on the early influence of native prosodic cues in Swedish, Engstrand *et al.* (1991) found that, infants at seventeen months of age started to shape pitch contours in their productions to match the Swedish tonal system. Whalen *et al.* (1991) investigated repetitive babbling with two and three syllables by French and English infants between five and thirteen months of age, and found intonational differences. They measured f0 values in three places (early, middle, late) of two- and three-syllables utterances and found that the utterances of French infants showed a dominance of falling and rising pitch contours, while English infants showed a dominance of falling contours. This suggests that the prosodic properties of a native language

can interfere with the processing of prosodic information in the acquisition of other languages.

In the children's data, the overapplication of the falling contour (i.e., HL) may be a language-universal process favoring the falling contour during the process of phonological acquisition. In the tone acquisition of Mandarin-speaking children, Li and Thompson (1977) reported that falling tones are acquired before rising tones. Ohala and Ewan (1973) indicated that acquisition of rising tones requires more physiological effort. Hombert (1975) reported that falling tones are also perceived more accurately than rising tones. As in the acquisition of tone, South Cholla child participants tended to produce the falling contour, unlike adult participants. However, there are alternative explanations for this. The first possibility is that children use a phrase-final low boundary tone as the intonational marker, when they produce an isolated word. The other possibility is that because the vowel duration by child speakers is longer, their productions are more likely to include the peak of the phrasal high tone in the first syllable, and its peak is higher than the peak of the second vowel (de Jong, 2000). Based on the children's data in this paper, if children produced longer words, this needs to be considered as an alternative interpretation for the dominance of the falling contour. These alternative interpretations should be researched further in future work.

The linguistic environment influences the acquisition of a prosodic cue. In the current study, the lexical pitch accent categories produced by the two dialect groups reflect the shape of the pitch contour internally stored for each lexical item. The children's production of disyllabic words confirms the nature of the long-term lexical representation. The exposure for the long-term lexical representation indicates that lexical items are encoded in speech performance. The linguistic performance of the speakers of the two dialects, North Kyungsang and South Cholla, reflects the intrinsic encoding system. Five to seven year-old Kyungsang children showed a similar tonal pattern as adults, but the same age group of South Cholla children showed more deviation from the adult pattern. A longitudinal study is needed to investigate when children acquire adult-like pitch patterns in their native dialects.

Appendix A

These sentences were used for the production task. The experimental words are placed in carrier sentences. The ending part of each sentence was used for the North Kyungsang participants, and each ending part within parenthesis was used for the South Cholla participants. The acute accent inserted for the experimental words marks high tone.

A: 영미가 물하고 말했나? (말했니?)
B: 영미는 모이하고 말했는데예. (말했어.)
A: [yəŋmi-kɑ muĺ-hɑko mɑlhes-nɑ? (malhes-ni?)]
B: [yəŋmi-nɨn mói-hɑko mɑlhes-nɨnteye. (mɑlhes-ə.)]
'Did Youngmi say the word, water? Youngmi said feed.'

A: 영미가 의논하고 말했나? (말했니?)
B: 영미는 모이하고 말했는데예. (말했어.)
A: [yəŋmi-kɑ ɨjnon-hɑko mɑlhes-nɑ? (malhes-ni?)]
B: [yəŋmi-nɨn moí-hɑko mɑlhes-nɨnteye. (mɑlhes-ə.)]
'Did Youngmi say the word, consultation? Youngmi said conspiracy.'

A: 영미가 조개하고 말했나? (말했니?)
B: 영미는 모래하고 말했는데예. (말했어.)
A: [yəŋmi-kɑ tʃo̜ke-hɑko mɑlhes-nɑ? (malhes-ni?)]
B: [yəŋmi-nɨn mo̜ɾe-hɑko mɑlhes-nɨnteye. (mɑlhes-ə.)]
'Did Youngmi say the word, a clam? Youngmi said sand.'

A: 영미가 내일하고 말했나? (말했니?)
B: 영미는 모레하고 말했는데예. (말했어.)
A: [yəŋmi-kɑ neiĺ-hɑko mɑlhes-nɑ? (malhes-ni?)]
B: [yəŋmi-nɨn mó̜ɾé-hɑko mɑlhes-nɨnteye. (mɑlhes-ə.)]
'Did Youngmi say the word, tomorrow? Youngmi said the day after tomorrow.'

A: 영미가 계모하고 말했나? (말했니?)
B: 영미는 양모하고 말했는데예. (말했어.)
A: [yəŋmi-kɑ kyemo-́hɑko mɑlhes-nɑ? (malhes-ni?)]
B: [yəŋmi-nɨn yáŋmó-hɑko mɑlhes-nɨnteye. (mɑlhes-ə.)]
'Did Youngmi say the word, a stepmother? Youngmi said an adoptive mother.'

A: 영미가 양털하고 말했나? (말했니?)
B: 영미는 양모하고 말했는데예. (말했어.)
A: [yəŋmi-kɑ yɑŋtʰə́l-hɑko mɑlhes-nɑ? (malhes-ni?)]
B: [yəŋmi-nɨn yaŋmó-hɑko mɑlhes-nɨnteye. (mɑlhes-ə.)]
'Did Youngmi say the word, the hair that covers the body of sheep? Youngmi said wool.'

Appendix B

The disyllabic words were used in this study.

개미	[kemi]	HL	‘ant’
매미	[memi]	HL	‘cicada’
나비	[nɑpi]	HL	‘butterfly’
제비	[tʃepi]	HL	‘swallow’
돼지	[twetʃi]	HL	‘pig’
양파	[yɑŋpʰɑ]	HL	‘onion’
마늘	[mɑnɨl]	HL	‘garlic’
거울	[kəwul]	HL	‘mirror’
바지	[pɑtʃi]	HL	‘trousers’
양말	[yɑŋmɑl]	HL	‘socks’
계란	[kyeɾɑn]	HL	‘egg’
비누	[pinu]	HL	‘soap’
의자	[ɨjtʃɑ]	HL	‘chair’
접시	[tʃəpsi]	HL	‘plate’
가위	[kɑwi]	HL	‘scissors’
장구	[tʃɑŋku]	HL	‘hourglass-shaped drum’
나팔	[nɑpʰɑl]	HL	‘trumpet’
나무	[nɑmu]	LH	‘tree’
기린	[kiɾin]	LH	‘giraffe’
여우	[yəu]	LH	‘fox’
조개	[tʃoke]	LH	‘shellfish’
보리	[poɾi]	LH	‘barley’
장미	[tʃɑŋmi]	LH	‘rose’
기차	[kitʃʰɑ]	LH	‘train’
냄비	[nempi]	LH	‘pan’
모자	[motʃɑ]	LH	‘hat’
장화	[tʃɑŋhwɑ]	LH	‘boots’
가방	[kɑpɑŋ]	LH	‘bag’
우유	[uyu]	LH	‘milk’
무우	[muu]	LH	‘radish’
당근	[tɑŋkɨn]	LH	‘carrot’
오이	[oi]	LH	‘cucumber’
고추	[kotʃʰu]	LH	‘red pepper’
인형	[inhəyŋ]	LH	‘doll’
국화	[kukhwɑ]	HH	‘chrysanthemum’
공작	[koŋtʃɑk]	HH	‘peacockk’
오리	[oɾi]	HH	‘duck’
악어	[ɑkə]	HH	‘crocodile’
물개	[mulke]	HH	‘seal’
박쥐	[pɑktʃwi]	HH	‘bat’
늑대	[nɨkte]	HH	‘wolf’

낙타 [nɑkt^{h}ɑ]	HH	'camel'
염소 [yəmso]	HH	'goat'
안경 [ɑnkyəŋ]	HH	'glasses'
우산 [usɑn]	HH	'umbrella'
장갑 [tʃɑŋkɑp]	HH	'glove'
잠옷 [tʃɑmos]	HH	'nightclothes'
배추 [petʃ^{h}u]	HH	'Korean cabbage'

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Jungsun Kim
Department of English Language and Literature
Yeungnam University
214-1 Dae-Dong, Gyungsan, Gyungsangbuk-Do, Korea 712-749
e-mail: jngsnkim@gmail.com

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