Proceedings of 2000 Seoul International Conference on Language and Computation

August 9 - August 11, 2000
Seoul, Korea
New Building, College of Business Administration, Korea University

Organized by
The Linguistic Society of Korea
Research Institute for Language & Information of Korea University
Yonsei Language Institute

The Status of High tone in North Kyungsang Korean: Evidence from a Phonetic Study

Woohyeok Chang and William Idsardi
University of Delaware

1. Introduction

The phonology of North Kyungsang Korean (NKK) has attracted a great deal of attention because of its intricate tone system (see K. Chung (1980), G.-R. Kim (1988), Y.-H. Chung (1991), N.-J. Kim (1997), S.-H. Kim (1999), etc.). For example, bare nominal stems, (those without suffixes or enclitics) display four different kinds of tonal patterns in NKK, as shown in (1).

(1) Four Types of Stems

a	A-type: [...HL]	pattern:	apúci 'father',	cóngi 'paper'
b	B-type: [...H]	pattern:	palám 'wind',	satalí 'ladder'
c	C-type: [HH...]	pattern:	hólángi 'tiger',	múcíke 'rainbow'
d	D-type: [H...]	pattern:	ácime 'aunt',	ménuli 'daughter-in-law'

It has been widely suggested in the literature that when two words are combined into a phrase, the high tone of one word survives while the other is deleted. Contrary to such previous studies, Kenstowicz and Sohn (1997) claim, based on phonetic investigations, that when words are grouped into a phonological phrase, the pitch contour the phrase does not arise from the deletion of high tones but rather from processes of downstep and upstep.

The main purpose of this study is to phonetically investigate the tone patterns of NKK, focusing on compounds and phrases. Specifically, we will examine the issue of high tone deletion versus downstep and upstep in NKK. Our results show that the high tone of one of the combined two words is drastically reduced (and usually deleted) in NKK rather than being modified by downstep or upstep.

2. Background: Phonological and phonetic approaches to tone patterns in NKK

In this section, we briefly outline the competing explanations for the NKK tone patterns, namely phonological high tone deletion based on the intuitions of native speakers (§2.1), and phonetic up- and down-step based on instrumental measurements of pitch (§2.2).

2.1 Phonological accounts

Various previous researchers (e.g. N.-J. Kim (1997), S.-H. Kim (1999)) have proposed phonological accounts of the NKK tonal patterns. Though the details of their accounts differ, they agree that there is a phonological calculation involving high tone, such that only one of the words in an accentual phrase will bear high tone. Thus, high tone disappears from all but one of the elements of a simple compound (section 2.1.1) or phrase (section 2.1.2).

2.1.1 Tone Patterns of Compounds

NKK speakers have the intuition that in two-word compounds only one word retains its high tone at the surface. There are two types of compounds in NKK: phrase-like compounds and lexical compounds. In this article, we consider only the phrase-like compounds. The tonal pattern of a compound is predictable from the tonal types of its constituent elements, based principally on the first word of the compound. When the first word of a compound is an A-type, C-type, or D-type stem, the first word retains its high tone, and the second word loses its high tone, as in (2).

(2) a. [A-type + ...]: [... HL + ...] → [...HL + ...]
nápi 'butterfly' + nekthái 'necktie' → nápi-nekthai 'bow tie'
b. [C-type + ...]: [HH ... + ...] → [HH... + ...]
kúlim 'picture' + chék 'book' → kúlim-chek 'picture book'
c. [D-type + ...]: [H... + ...] → [H... + ...]
tóksuli 'eagle' + páp 'boiled rice' → tóksuli-pap 'victim'

In contrast with the tonal pattern of these compounds, when the first word is a B-type stem there are two different tone patterns in phrase-like compounds, according to the tonal type of the *second* word. When the second word is a C-type stem, the first word retains its tone, as in (3a), similar to the cases in (2). When the second word is any other type, the second word retains its high tone, and the *first* word loses its high tone, as in (3b).

(3) a. [B-type + C-type]: [...**H** + HH...] → [...**H** + ...]
polí 'barley' + múntingi 'leper' → polí-muntingi 'nickname for NKK people'
b. [B-type + A-, B-, or D-type]: [...H + ...H...] → [...+ ...**H**...]
pusán 'Pusan' + ácime 'aunt' → pusan-ácime 'native woman of Pusan'

Thus, the intuitions of NKK speakers as to the tonal patterns of compounds can be succinctly captured by the deletion of the high tone from one of the elements of the compound, based on the tonal types of the constituent words in their isolation forms.

2.1.2. Tone Patterns of Phrases

NKK speakers have the intuition that the tone patterns of two-word phrases are identical to those of phrase-like compounds. When the first member of two-word phrases is an A-, C-, or D-type stems, the first member retains its high tone, and the second member loses its high tone, as shown in (4).

(4) Two-word Phrases: [[A, C, or D-type] [...]]
a [[alungtáun]$_{ADJ}$ [mucike]$_{N}$]$_{NP}$ b [[ménuli]$_{N}$ [kapang]$_{N}$]$_{NP}$
'beautiful' 'rainbow' 'daughter-in-law' 'bag'
'beautiful rainbow' 'a daughter-in-law's bag'

On the other hand, when the first member of a two-word phrase is a B-type stem, the *second* member of this phrase retains its high tone unless the second member is a C-type stem, as in (5).

(5) Two-word phrases: [[B] [A, B, or D-type]]
a. [[ppalkan]$_{ADJ}$ [cekóli]$_{N}$]$_{NP}$ b [[nemu]$_{ADV}$ [ppalkán]$_{ADJ}$]$_{ADJP}$
'red' 'jacket' 'too' 'red'
'a red jacket' 'too red'

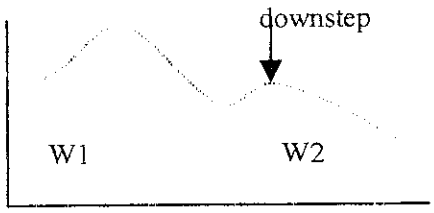
When the second member is a C-type word, however, the B-type first member keeps a high tone, and the second member loses its high tone, as shown in (6).

(6) Two-word phrases: [[B] [C]]
[[ppalkán]$_{ADJ}$ [kokuma]$_{N}$]$_{NP}$
'red' 'sweet potato'
'a red sweet potato'

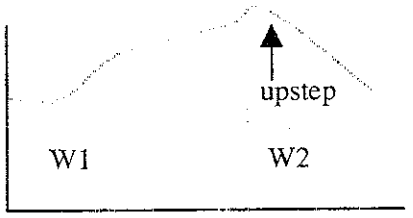
2.2 A phonetic analysis

So far, we have shown that the intuitions of native speakers of NKK are that two word compounds and phrases are alike in their tonal patterns in that the high tone of only one word survives due to the deletion of the high tone in the other word. Kenstowicz and Sohn (1997) propose a different analysis for phrases, based on phonetic measurements of pitch. They claim that the realization of high tones in a phrasal context is not due to deletion of high tones, but rather to processes of downstep and upstep affecting the relative pitch of the high tones. They found a basic distinction between B-type stems and A-type stems in terms of their tone behaviors: A-type stems induce downstep, whereas B-type stems induce upstep. For example, when the first word (W1) is an A-type stem, they found that the peak of the second word (W2) is significantly reduced (by about 60Hz) compared to W1, suggesting that the peak of W2 is downstepped rather than deleted. That is, they claim that the final low tone in W1 (...HL) triggers a downstep of the high tone in W2, as shown schematically in (7). In contrast, if W1 is a B-type stem, they found a plateau that starts from the final syllable in W1 and extends up to the high tone of W2. The high tone of W2 is upstepped about 10-20Hz higher than the plateau, as shown schematically in (8).

(7)



(8)



Therefore, based on these observations, Kenstowicz and Sohn claim that the fact that there is a single prominent high tone per phonological phrase is due to processes of downstep and upstep which change the prominence of one of the tones rather than the actual deletion of a high tone.

3. Experiment

The purpose of the experiment reported in this section is to try and replicate Kenstowicz and Sohn's findings of downstep and upstep in phrasal contexts.

3.1. Method

Five native speakers from Taegu (three male and two female) participated in the experiment. Compounds and phrases involving A-, B- and C-type stems were constructed; the stimulus list is included as an appendix to this article. Words were chosen to minimize the number of obstruents in the items, so as to provide better automatic extraction of pitch values. Each speaker read the whole list of compounds and phrases two times in conversational style. The test words were digitized at a sampling rate of 11 Khz with 16 bit quantization, and the fundamental frequency (F0) was tracked automatically with Speech Analyzer 1.5.

3.2 Results

The general findings are that there is one clearly prominent high tone per phrase and that there is a clear utterance-final low boundary tone (L%).

3.2.1 Strong versus Weak Tone Patterns

When two words are combined into a compound or phrase, the tone of one of the two words is significantly reduced compared to its isolation form. That is, one of the two words keeps a prominent high tone, whereas the other becomes significantly weaker. As a result, there is a clear distinction between a strong tone and a weak tone.

A Compounds: *iut* 'neighborhood' + *ŭla* 'village'

In order to understand the tone patterns of compounds we will first examine the isolation forms. The pitch tracks for the isolation forms of the words, *iut* 'neighborhood' (A-type) and *ŭla* 'village' (B-type) are shown in Figures 1 and 2 respectively.

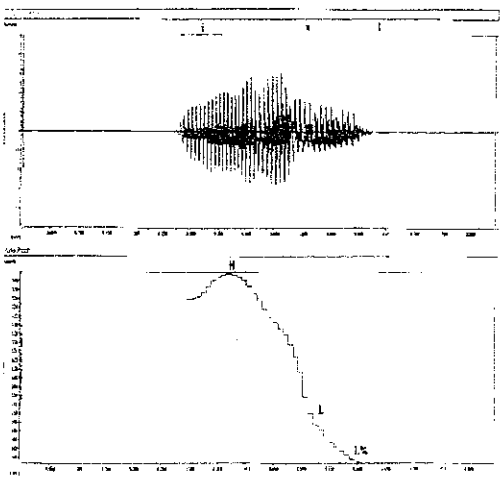


Figure 1. *iut* 'neighborhood' (isolation)

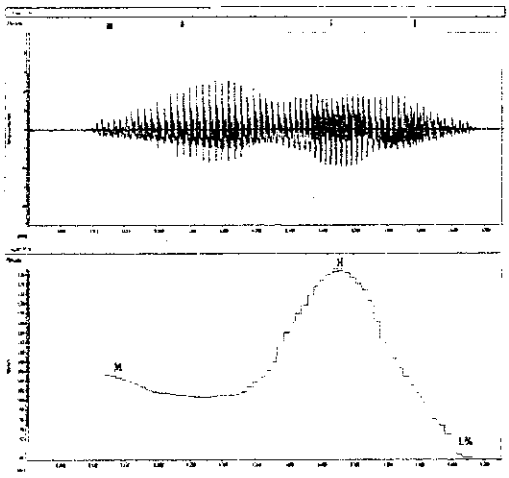


Figure 2. *măl* 'village' (isolation)

We can clearly see the initial high tone in Figure 1, as well as the final low boundary tone. In contrast, in Figure 2, the word *ŭla* begins with a mid tone, rising to a high tone on the second syllable, and falling to the final low boundary tone.

Now, let us examine the tone pattern of the compound *iut* +*ŭla* 'neighborhood village'.

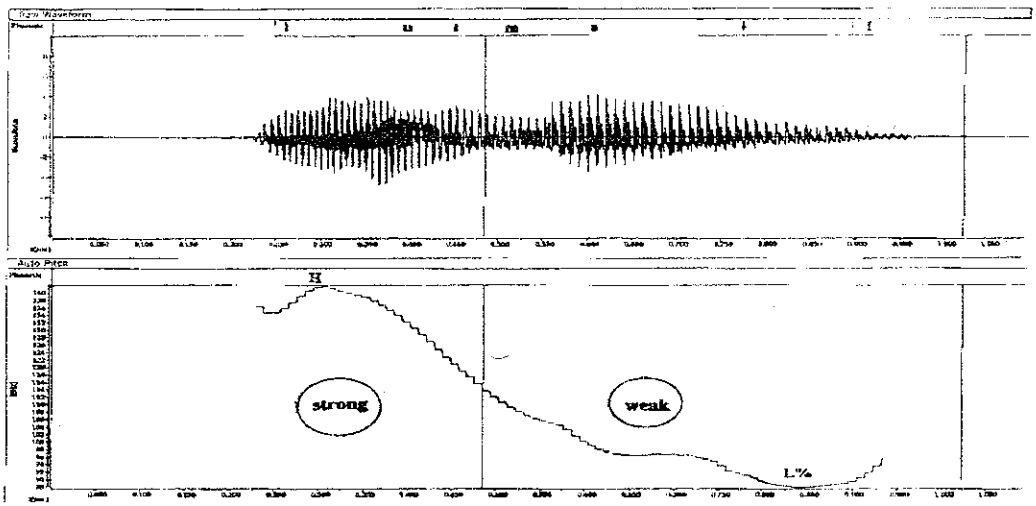


Figure 3. The tone pattern of the compound *iut* + *ŭla* neighborhood village

In Figure 3, the pitch peak occurs on the first syllable of the first word, and the boundary low tone is at the end of the entire compound. Furthermore, no additional tones can be found between the H and the L%. Instead, pitch appears to be simply interpolated between the two targets. The tone of the first word in Figure 3 is as strong as its isolation form (Figure 1). However, the tone of the second word is significantly weakened compared with its isolation form (Figure 2). In fact, no high tone is readily apparent in the second word.

B. Phrases: *ŏlin* + *namu* 'young tree'

As with the compound case, we will begin with an examination of the isolation forms. The words *ŏlin* 'young' (A-type) and *namu* 'tree' (B-type), are shown in Figures 4 and 5 respectively. Figure 4 shows that the word *ŏlin* begins with a high tone and ends with the low boundary tone. Figure 5 shows that *namu* has a high tone on its final syllable, followed by the low boundary tone.

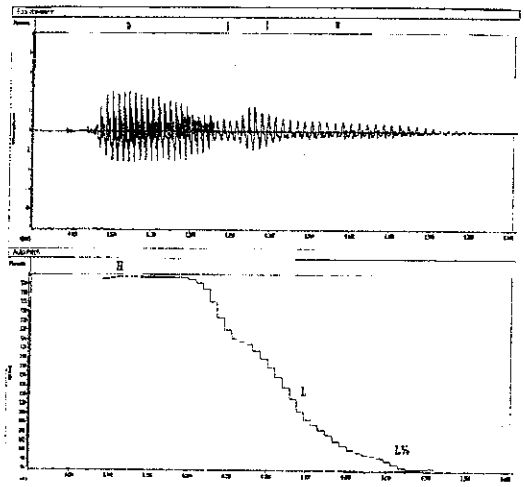


Figure 4. *ŏlin* 'young' (isolation)

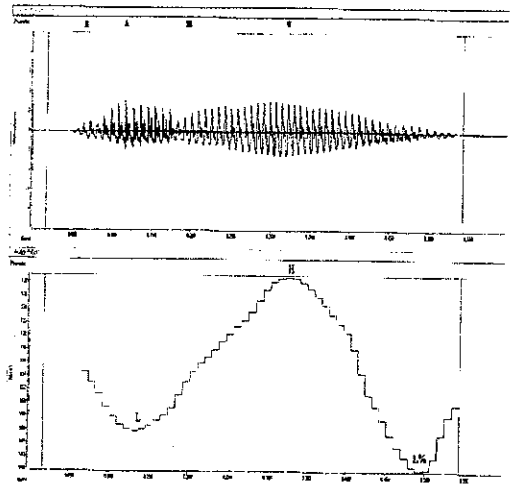


Figure 5. *namu* 'tree' (isolation)

The tone pattern of the phrase, *ŏlin+namu* 'young tree', is shown in Figure 6.

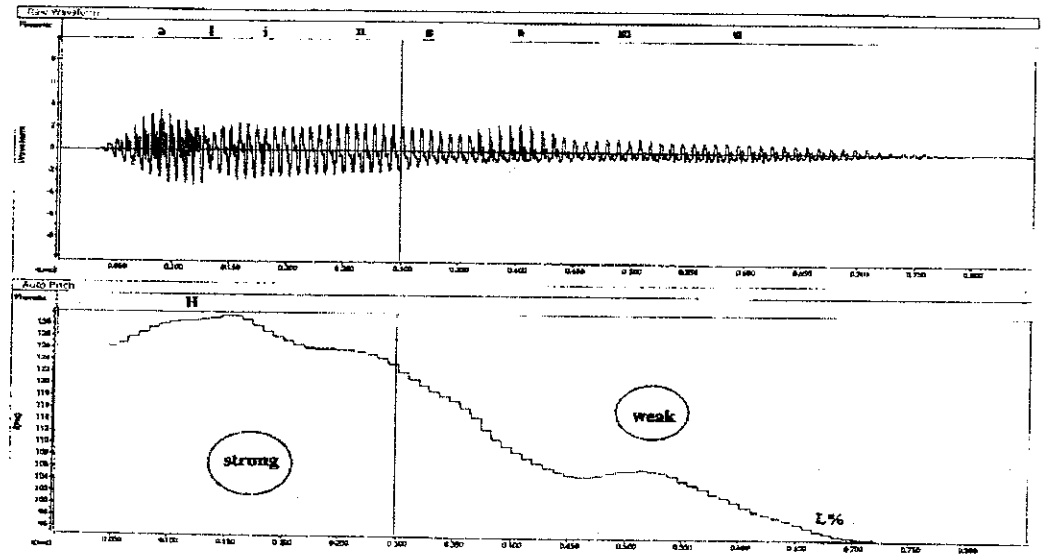


Figure 6 The tone pattern of the phrase. *ŏlin* + *namu* 'young tree'

In Figure 6 a high tone appears on the first syllable of the first word, and the boundary low tone is found at the end of the entire phrase. While the tone of the first word is as strong as its isolation form, the tone of the second word is significantly weakened. It is not immediately clear that the tone has been deleted, however. There is an interruption in the interpolation of F0 between the H and L% which may be the remnant of the high tone of the second word.

3.2.2 Reduction vs. Deletion

Because NKK shows different tonal patterns according to the tonal types of the stems involved, in our discussion we will group the tone patterns as in (9).

(9) a. A-type + A-, B- or C-type
b. C-type + A-, B- or C-type
c. B-type + A- or B-type

The [B + C] type was excluded from our study because it shows a different tone pattern, a plateau which starts on the final syllable of the first word and extends into the second word. This pattern is difficult to classify under all accounts, and so we will leave the investigation of this combination for future research.

A. A-type + A-, B- or C-type

In the phonological accounts, it is claimed that in [A ....] cases, the first word will retain its high tone, and the second word loses its high tone. Alternatively, according to Kenstowicz and Sohn, the high tone of the second member is downstepped. In this experiment, both extreme reduction and deletion were found in this type of combination. However, the majority of cases show deletion rather than reduction. Moreover, even when reduction occurs, the high tone of the second member is reduced dramatically, by about 100 Hz. Figure 7 illustrates a case where the high tone of the second word is completely deleted.

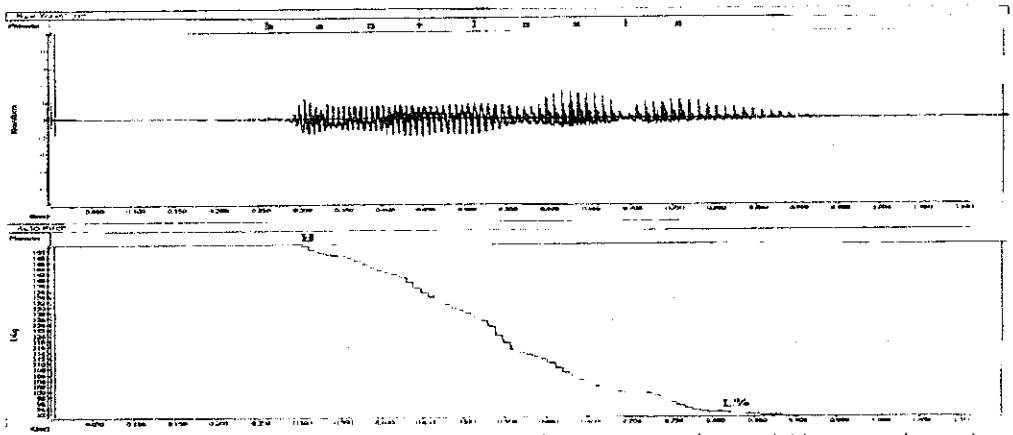


Figure 7. The tone pattern of the compound *hánu nara* 'heaven' (A-type + A-type)

In Figure 7, a high tone appears on the first syllable of the first word, and a boundary low tone falls at the end of the compound. There is no trace of a second high tone, only a smooth interpolation of pitch between the H and the L%. Thus, the high tone of the second word was completely deleted.

In contrast, let us examine a case where the high tone of the second word was not completely deleted, as in Figure 8. In Figure 8, a high tone appears on the first member of the compound. The dotted line represents the hypothetical continuation of the apparent start of the pitch interpolation between the H and L%. In this case, the high tone of the second word does not seem to be deleted completely. If, as in Figure 7, the high tone of the second word had been completely deleted, then we would not find the shaded area in Figure 8, which indicates the gap between the deletion of a high tone and the reduction of a high tone. Thus, Figure 8 shows that the high tone of the second member may be reduced, instead of being deleted, showing up as an interruption of the interpolation between H and L%. However, we note that the high tone of the second word has been significantly lowered here, by about 100 Hz.

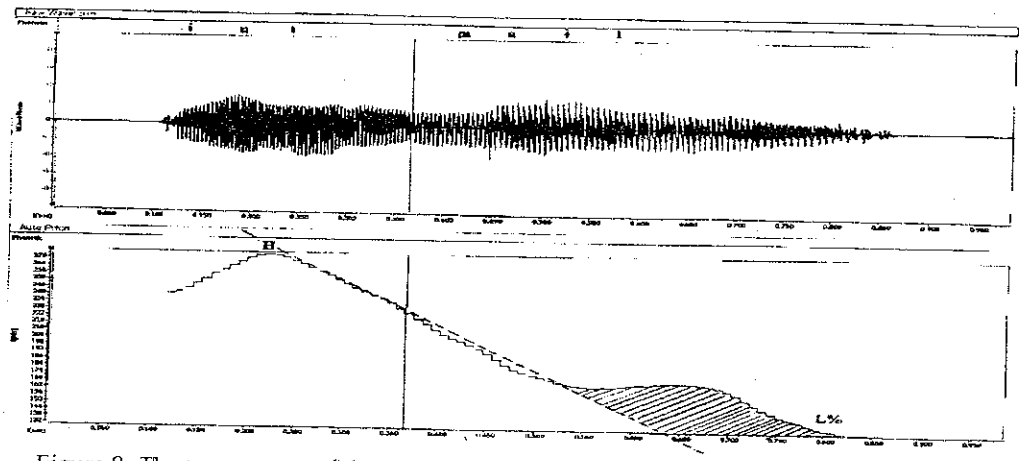


Figure 8 The tone pattern of the compound *iut +ŭla* 'neighborhood village' (A-type + B-type)

The overall rates for deletion and reduction are shown in (10), which shows that in the majority of cases we found deletion rather than reduction.

(10) [A ...] phrases: deletion and reduction of high tone

Deletion	107 (cases)	89 %
Reduction	13 (cases)	11%
Total	120 (cases)	100%

B. C-type + A-, B- or C-type

Let us now turn to the [C ...] combinations. As in the [A ...] combinations, two kinds of surface tonal patterns (deletion and reduction) were found. First, let us examine the case where the high tone of the second member is completely deleted, as in Figure 9.

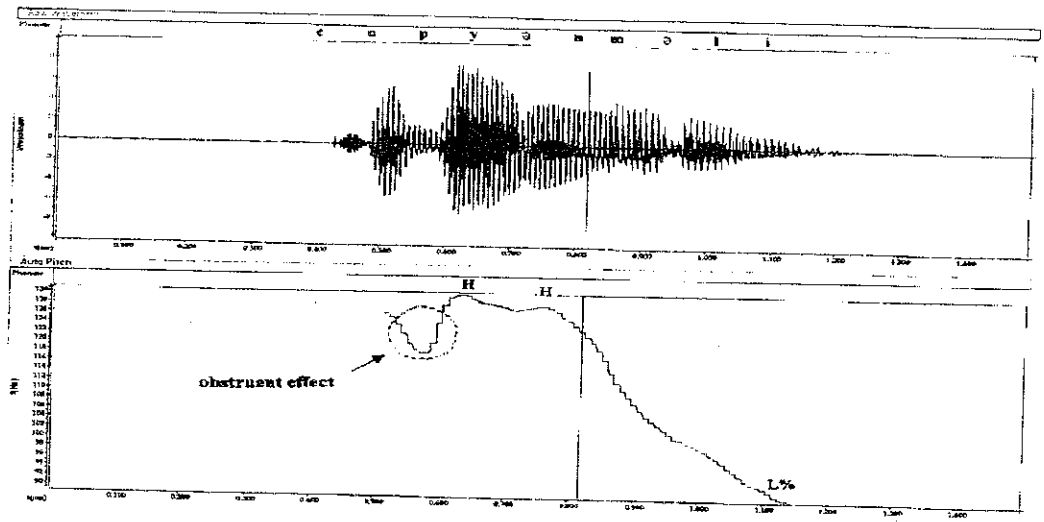


Figure 9. The tone pattern of the compound, *ŏupý ňrɪ* 'versatility' (C-type + A-type)

We can see two high tones on the first word in Figure 9, as well as a low boundary tone at the end of the compound, and a smooth interpolation into L%. Therefore, no trace of a high tone on the second word remains. Thus, the high tone of the second word was completely de-

leted. Furthermore, we note that the slightly lowered area at the onset of the second syllable is probably due to a small perturbation effect from the contextually voiced obstruent [b].

Second, let us consider the case where the high tone of the second member was not completely deleted, as in Figure 10.

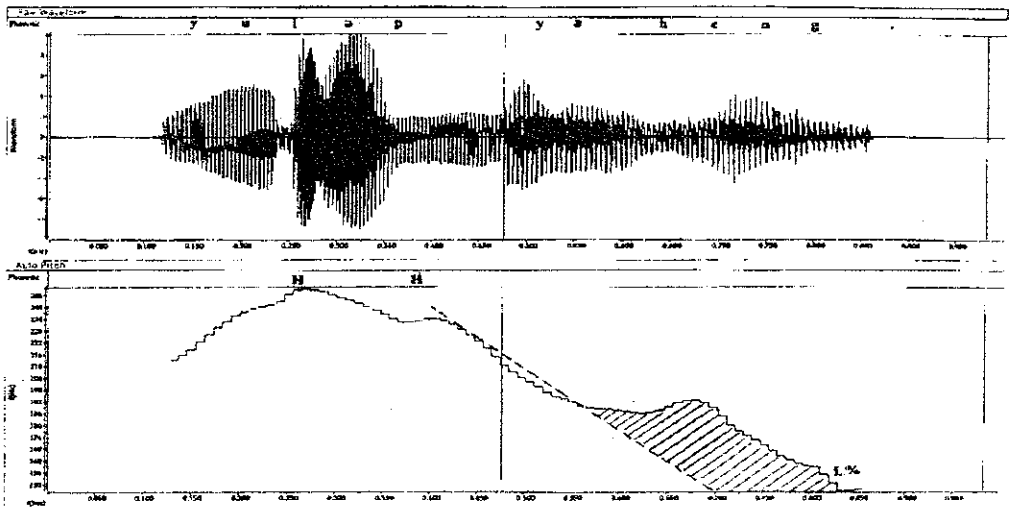


Figure 10 The tone pattern of the compound, *ǒpl+ yeheng* 'Traveling Europe' (C-type + C-type)

As seen in Figure 10, the first word has two high tones. The dotted line again indicates the continuation of the apparent interpolation line. The existence of the shaded area indicates that in this case the high tone of the second word is reduced rather than deleted. As with the [A ...] cases, there is a preponderance of deletion over reduction, summarized in (11).

(11) [C ...] phrases: deletion and reduction of high tone

Deletion	98 (cases)	82 %
Reduction	22 (cases)	18 %
Total	120 (cases)	100%

C B-type + A- or B-type

Now we will consider the combination [B-type + A- or B-type]. We again found evidence for both deletion (Figure 11) and reduction (Figure 12), and it was also again the case that deletion was the more common strategy.

In Figure 11 the pitch peak is on the second word, and the first word appears to be pronounced with a neutral (mid) tone. There is a smooth rise in pitch to the high tone, and the rise begins near the end of the first word. In Figure 12, in contrast, there seems to be some residual effect of the high tone of the first word. The overall pattern is very similar to that in Figure 11, but the pitch begins to rise earlier in Figure 12, beginning at the second syllable of the first word (or perhaps even earlier). This earlier onset of interpolation is consistent with a reduced high tone on the last syllable of the first word. If, instead, these figures are interpreted according to Kenstowicz and Sohn's (1997) proposal, then the second word would have a dramatic upstep of 40 Hz or more, which seems unlikely. Furthermore, it is the high tone of the second word that is comparable to its isolation value, not the first word. Therefore reduction of the first word is a more likely explanation than upstep of the second word.

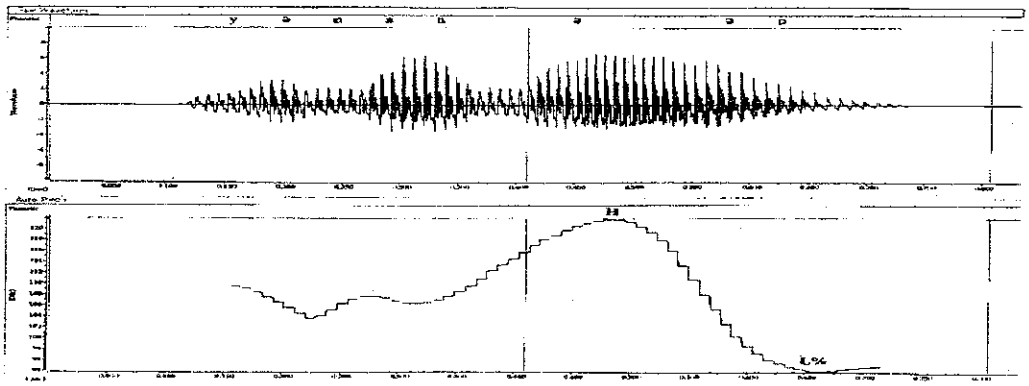


Figure 11. The tone pattern of the compound, *ɣ̌an + ŏŏp* 'inshore fishery' (B-type + A-type)

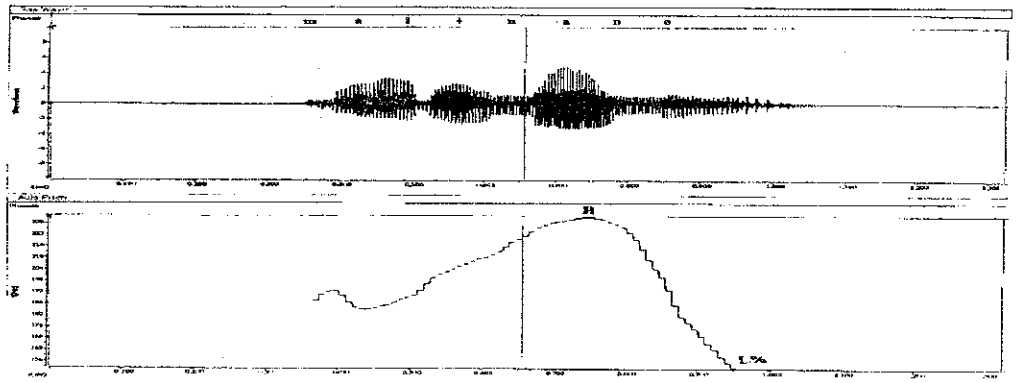


Figure 12. The tone pattern of the phrase *ĭmal+ ane* 'thin wife' (B-type + A-type)

Once again, more cases show deletion than reducation, as summarized in (12). There are only 80 cases in (12) because the [B C] cases were excluded from this study.

(12) [B ...] phrases: deletion and reduction of high tone

Deletion	68 (cases)	85 %
Reduction	12 (cases)	15 %
Total	80 (cases)	100%

4. Discussion

Our main findings are that the tone pattern of compounds and phrases can be divided into a strong part and a weak part, and that the weak part usually loses its high tone completely. Specifically, when the first word is an A- or C-type stem, the high tone of the second word is overwhelmingly deleted (85% overall). Even when the high tone of the second word is not deleted, it is dramatically reduced (around 60-100 Hz). This reduction is far too extreme to be considered simply a downstep process. When the first word is a B-type stem, its high tone is also overwhelmingly deleted (85%), and in the cases where its high tone is not deleted, it is reduced, rather than the second tone being upstepped. It is the realization of the second word in [B] cases that is most comparable to the isolation form, and therefore the first word is reduced in pitch, the second word does not undergo upstep. Thus, our results do not support Kenstowicz and Sohn's (1997) claim that NKK phrases show processes of downstep and upstep. Rather, our experimental study supports the previous analyses in which the high tone of one of the words in combination is deleted (or very strongly reduced) in NKK.

References

Chung, Kook. 1980. Neutralization in Korean: A functional view. Doctoral Dissertation, University of Texas, Austin.

Chung, Young-Hee. 1991. The lexical tone system of North Kyungsang Korean. Doctoral dissertation, the Ohio State University.

Kenstowicz, M. and Hyang-Sook Sohn. 1997. Phrasing and Focus in North Kyungsang Korean. *MITWPL 30*: 25-48

Kim, Gyung-Ran. 1988. The pitch-accent system of the Taegu dialect of Korean with emphasis on tone sandhi at the phrasal level. Doctoral dissertation. University of Hawaii.

Kim, No-Ju. 1997. Tone, segments, and their interaction in North Kyungsang Korean: a correspondence theoretic account. Doctoral dissertation, the Ohio State University.

Kim, Sun-Hoi. 1999. The metrical computation tone assignment. Doctoral dissertation, University of Delaware

Appendix

Compounds

A + A	ŭhn 'sky'	+ nala 'country'	('heaven')	napi 'butterfly'	+ nekthai 'necktie'	('bow tie')
A + B	iut 'neighborhood'	+ ŭla 'village'		ŏlŭm 'summer'	+ panghak 'vacation'	
A + C	congi 'paper'	+ holangi 'tiger'	('paper tiger')	ŏpng 'agriculture'	+ ŏŋgmy revolution	
B + A	inku 'population'	+ itong 'movement'		ŏnan 'shore'	ŏŏp fishery	
B + B	simcang 'heart'	+ mapi 'paralysis'	('heart attack')	nampi 'pan'	+ utong kind of noodle	(Soup noodle in a pan)
B + C	poli 'barley'	+ muntungi 'leper'	(nickname for NKK people)	inku 'population'	+ milto density	
C + A	ŏupy 'circumference'	+ ŏli 'head'	('versatility')	mutang 'shaman'	+ ŏlle 'insect'	('ladybug')
C + B	manhwa 'cartoon'	+ ŏnghwa 'movie'		techu 'jujube'	+ namu tree	
C + C	yaoi 'outdoor'	+ untong 'exercises'		ŏpi 'Europe'	+ŏheng 'travel'	

Phrases

A + A	meu 'very'	+ ŭlin 'slow'	ŏhublue'	+ ŭhnsky'
A + B		+ cinhan 'deep'	ŏlin 'young'	+ namu 'tree'
A + C		+ ŏlŏun 'dirty'	ŏuns fierce'	+ holangi 'tiger'
B + A	ŏmu 'too'	+ ŭlin 'slow'	ŭmalthin'	+ ane 'wife'
B + B		+ sinkihan 'marvelous'	nolan 'yellow'	+ muoo 'radish'
B + C		+ isanghan 'strange'	uahan elegant'	+ ŏin 'woman'
C + A	ŏnak 'small'	+ apuci father' ('uncle')	isanghan 'strange'	+ ai 'child'
C + B		+ ŭm 'mind'	mianhan 'apologized'	+ ŭm 'mind'
C + C		+ ŏin 'woman'	seloun 'new'	+ iyaki 'story'

Department of Linguistics, University of Delaware
Newark, Delaware, 19716-2551, USA
cwh@udel.edu, idsardi@udel.edu