SINGLE H AND DOUBLY-LINKED H IN SOUTH KYUNGSANG KOREAN

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ABSTRACT

This experiment examined the distinction between single H and doubly-linked H of monomorphemic words (HL, HH) and bimorphemic words (H+L, H+H) in South Kyungsang Korean. The acoustic data in this study verify the previous transcriptions for the monomorphemic HL and HH contrast in this language. It was seen that the F0 peak realizing a high tone occurs only in the first syllable for HL, but occurs both in the first and the second syllables for HH in monomorphemic words. However, the results do not confirm the transcription of bimorphemic H+H, that is, F0 timing of doubly-linked H was different depending on the morpheme type, in contrast to previous research. The peak plateau is significantly longer in monomorphemic HH than in bimorphemic H+H. This suggests that the tone spreading analysis in bimorphemic H+H is not plausible and that phonetic realization, such as F0 timing, might reflect the different morphological structure.

Keywords: high tone spreading, peak delay, South Kyungsang Korean, morphological structure, F0 timing

1. INTRODUCTION

South Kyungsang Korean, spoken in the south-eastern part of Korea, has lexical tones and tone minimal pairs, such as *kaǹ* (H) 'taste', *kaǎn* (R) 'liver', while standard Korean does not [4,7]. Transcription-based studies have suggested that there are two high tone types, depending on the tone alternation patterns in suffixed words [4,7]. I arbitrarily refer to the two high tones as *non-spreading H* and *spreading H,* respectively. According to these descriptions, when *non-spreading H* is followed by a toneless suffix, the high tone occurs in the root, as in (1b,c). Otherwise, the high tone occurs in the suffix (1d). In contrast, when *spreading H* is followed by a suffix, the high tone occurs both in the root and in the initial syllable of the suffix, regardless of suffix, as in (2) (the suffixes are underlined). When followed by a monosyllabic suffix, as in (1b) and (2b), each high tone type can be transcribed as H+L and H+H.

(1) non-spreading H

a. súl			'alcohol'
b. súl	+ i	→ súl-i	'alcohol (nom.)'
c. súl	+ esə	→ súl-esə	'in alcohol'
d. súl	+ cócha	→ sul-cócha	'even alcohol'

(2) spreading H

a. múl			'water'
b. múl	+ i	→ múl -ǐ	'water (nom.)
c. múl	+ esə	→ múl-ésə	'in water'
d. múl	+ cócha	→ múl-cócha	'even water'

This experiment was concerned with two high tone types, with a monosyllabic suffix in particular, i.e., bimorphemic H+L and H+H, in comparison with monomorphemic HH and HL. Although H+H and H+L have been unanimously transcribed with the same representation as have HH and HL, their phonetic realization has not been examined. Additionally, the pilot study by this author cast doubt on the claim that the high tone is associated with two syllables in bimorphemic H+H, but this issue was not properly investigated in the study [1].

One goal of this study, therefore, is to verify whether there is any reliable acoustic difference between single H and doubly-linked H (an underlying H associated with two syllables) and between different morpheme types. It is assumed that the F0 peak realizing a high tone lays upon the two syllables for doubly-linked H, while the peak occurs in one syllable for single H. This difference can be measured with the timing of F0 fall [1,5]. The F0 fall would come later in doubly-linked H than in single H, and thus *F0 fall delay* (F0 peak offset-the first syllable onset) and *peak plateau* (F0 peak offset-F0 peak onset) would be greater in doubly-linked H than in single H. Another concern was to examine the possibility of the morpheme effect on F0 timing. Although there has been research on morpheme effects on segments [2], few

studies have addressed the effects on suprasegmentals such as tones. It will be shown that the F0 peak stretch onto two syllables is observed in monomorphemic HH, but not in bimorphemic H+H, and thus the phonetic realization of F0 timing is distinct in different morpheme structures.

2. METHODOLOGY

2.1. **Stimuli.** To test these hypotheses, the following factors were considered: (i) *tone type*: non-spreading H and spreading H, and (ii) *morpheme type:* monomorpheme and bimorpheme. There were 4 conditions (2 tone types * 2 morpheme types) and 10 repetitions for each condition, yielding a total of 40 tokens per speaker. Factors that are known to affect the F0, such as segments, phrase-position, adjacent tones, and syllable structure, were controlled. The intrinsic vowel height also should be controlled, but due to the difficulty of finding words whose vowel height is same across all four types, the condition was controlled within the same morpheme type. The test materials used in this experiment are presented in Table 1.

Table 1: Test Materials

Single H	Doubly-linked H
a. HL	c. HH
ije **móɾe** boínda	ije **móɾé** moínda
'Now sand is seen.'	*'We gather the day after tomorrow.'*
b. H+L	d. H+H
ije **náni** boínda	ije **námí** boínda
'Now an orchid is seen'	*'Now other people are seen'*

2.2. **Subjects.** Six adult native speakers (ages 21-43, three females and three males) of South Kyungsang Korean produced the materials. All speakers were linguistically naïve and were born and grew up in Pusan, the capital of the South Kyungsang province. Three lived only in Pusan before coming to the U.S., and three had lived in Pusan over 20 years and in Seoul for 7 to 10 years.

2.3. **Procedure.** The stimuli were provided in Korean on a laptop, in a timed PowerPoint presentation, and the speakers read aloud the syllables. Recordings were made in a sound-treated room in the Phonetics Lab of the Linguistics Department, University of Texas at Austin. The recordings then were digitized and analyzed using the Macquirer software package from SciConRD. For each sentence, synchronized displays of the sound waveform, a wide-band spectrogram, and an F0 track were produced. Four time points (the first syllable onset, the first syllable offset, F0 peak onset, and F0 peak offset) were measured.

3. RESULTS

3.1. The timing of F0 fall

We first tested the hypothesis that the *fall delay* would be greater in doubly-linked H than in single H. The results indicated that F0 fall came later in doubly-linked H than in single H. Fig. 1 presents typical F0 tracks for the four tone types. Fig. (1a) shows HL, (1b) H+L, (1c) HH, and (1d) H+H. The first vertical line marks the onset of the first syllable, the second one marks the offset of the first syllable, and the third one marks the offset of the second syllable. The first arrow indicates the onset of F0 peak (the first point at the end of the F0 rise), and the second one indicates the offset of F0 peak.

Figure 1: Typical effects of four tone types on the timing of F0

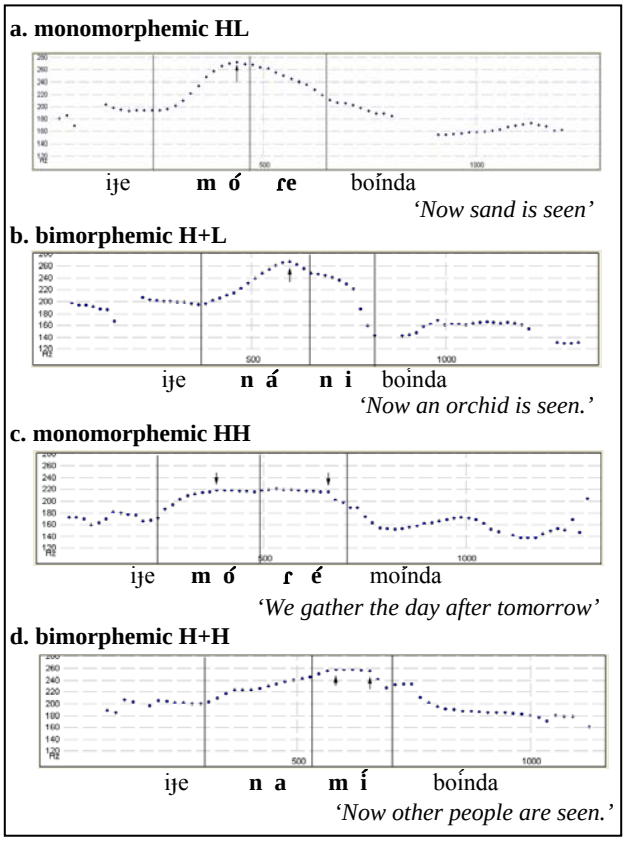

Fig. 1 shows that the F0 fall begins *in* the first syllable in HL and H+L, while it begins *after* the first syllable in HH and H+H.

A quantitative measure of the fall delay is the *relative fall delay* (the fall delay divided by the test syllable duration); it provides the percentage of the syllable duration at which the F0 fall is first attained. Fig. 2 shows the variation in relative fall delay in a box plot graph, with tone type compared, pooled across 6 speakers. The relative fall delay "1" indicates that the peak begins to fall precisely at the onset of the first syllable, the "less than 1" indicates that the peak begins to fall *before* the end of the first syllable (*in* the first syllable), and "greater than 1" indicates that the peak begins to fall *after* the first syllable. This figure shows that the F0 fall came *in* the first syllable in H+L and HL, whereas it came *after* the first syllable in H+H and HH.

The mean relative F0 fall delay for each speaker is presented in Table 2. The data are generally consistent with the trend in Fig. 2, i.e., each speaker has "less than 1" relative fall delay in single H, i.e., HL and H+L, whereas each speaker has "more than 1" relative fall delay in doubly-linked H, i.e., HH and H+H.

Figure 2: *Relative fall delay* (6 subjects pooled)

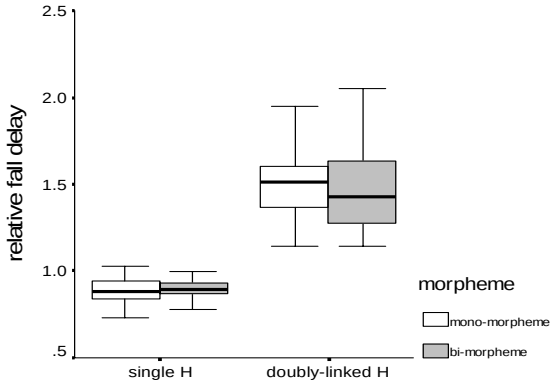

Table 2: Means of *relative fall delay* for each subject

Speaker	Single H		Doubly-linked H	
	(HL)	(H+L)	(HH)	(H+H)
1	0.83	0.96	1.56	1.62
2	0.85	0.93	1.66	1.50
3	0.87	0.88	1.29	1.32
4	0.84	0.90	1.50	1.42
5	0.90	0.95	1.38	1.24
6	0.89	0.91	1.59	1.72

The results of an ANOVA, with a dependent variable of relative fall delay and independent variables of tone type and morpheme type, showed a significant main effect for tone type for all speakers (α =.05). Specifically, the fall delay was significantly greater in doubly-linked H than in single H. A significant morpheme effect was not found in the relative fall delay.

3.2. Peak plateau

Fig. 2 shows the variation in *peak plateau* in a box plot graph with tone type compared, pooled across 6 speakers. As seen in the figure, the peak plateau is greater in HH and H+H than in HL and H+L. However, the peak plateau is also consistently longer in HH than in H+H. The detailed mean peak plateau (ms) for each speaker is presented in Table 3, and the data are generally consistent with the trend presented in Fig. 3.

Figure 3: *Peak plateau* (ms) (6 subjects pooled)

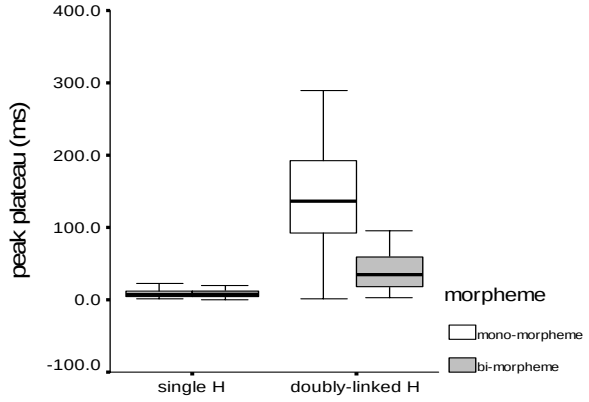

Table 3: Means of *peak plateau* for each subject (ms)

Speaker	Single H		Doubly-linked H	
	(HL)	(H+L)	(HH)	(H+H)
1	11	6	125	50
2	8	13	116	46
3	13	5	88	41
4	10	7	262	34
5	8	6	97	15
6	4	7	189	49

The results of an ANOVA, with a dependent variable of peak plateau and independent variables of tone type and morpheme type, showed a significant main effect for tone type and morpheme type (α =.05) for all speakers. Post-hoc tests, using Fisher's PLSD, showed that the peak plateau was

significantly greater for H+H and HH than for H+L and HL ($p<.001$) for all speakers. In addition, peak plateau was greater for HH than for H+H for all speakers ($p<.001$).

4. DISCUSSION

The results of this study provide physical evidence for the monomorphemic HH and HL contrast in South Kyungsang Korean. That is, a high tone occurs in one syllable for single H, but occurs in two syllables for doubly-linked H. The results substantiate the transcription studies suggesting that this language has HL and HH contrast in disyllabic words [4,7].

However, it also was revealed that the F0 contours of the doubly-linked H were significantly different in two morpheme types, indicating that phonetic realization is distinct in bimorphemic H+H and monomorphemic HH. Evidently, the peak plateau was significantly longer for HH than for H+H, as the peak was not extended into two syllables for H+H, although it clearly was for HH. Instead, the high tone in H+H was realized, with F0 rising through the initial syllable up to a peak near the onset or middle portion of the second syllable, with a relatively long peak plateau. This could easily be heard as tone spread, as both the initial syllable and the second syllable includes regions of high F0. In sum, instrumental data do not confirm the previous description of monomorphemic HH and bimorphemic H+H as represented as the same doubly-linked H [4,7].

One possible reason for these patterns is that the test syllables in the monomorpheme type, móré (HH) and móre (HL), were minimal pairs; however, they were not minimal pairs in bimorphemic words. Speakers tend to make a greater effort to contrast two lexical items than they do with bimorphemic words. Yet, this account cannot explain why the peak was generally realized in the suffix (the second syllable), but not in the root (the first syllable) in bimorphemic H+H.

Another phonetic explanation might be the effect of intrinsic vowel height on F0: high vowels have a higher F_0 than do low vowels [3,6]. The vowel /i/ in the second syllable has higher intrinsic F0 than /a/ in the first syllable of the test syllable, na + mi '*other people, nom.*'. This could make the second H slightly higher than the first H, and thus the peak is realized only in the second syllable. However, preliminary and informal observation by this author showed that the pitch track for bimorphemic H+H, i.e., nu.ni '*eye (nom.)*' also has the peak in the second syllable, although both vowels in each syllable are the high vowels.

Consequently, it is argued in this study that tone spreading analysis is not plausible for *spreading H* with a suffix (H+H). Instead, the H+H can be understood as follows: when the high tone is followed by a toneless suffix, the peak is delayed to the next syllable (to the suffix), rather than associated with both the root and the suffix. This is a widespread pattern, according to which the F0 peak occurs regularly at the onset of the syllable following the high-toned one [8,9,10]. This analysis perturbs the status of the non-spreading H, whose peak was not delayed to the next syllable in suffixed words (H+L). One possibility is that non-spreading H might not be the high tone. Rather, it might be the mid-tone or toneless, whose peak is assumed to be less or slightly delayed, compared to a high tone. Although spreading H and non-spreading H have been transcribed as the same high tone, distinct only in suffixed words, there is no physical evidence for the claim, and thus the suggestion that these two tone types are not the same high tone is worthy of further investigation.

5. REFERENCES

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