Preliminary Results of Prosodic Effects on Domain-initial Segments in Hamkyeong Korean

Sung-A Kim

Department of English Language and Literature
Dong-A University
sakim@donga.ac.kr

Abstract

This paper investigates the domain-initial strengthening in English and Hamkyeong Korean, a pitch accent dialect spoken in the northern part of North Korea. Domain-initial strengthening, which refers to the phonetic prominence of the initial positions, has been assumed to be cross-linguistically universal phenomenon due to the contrast preservation of the domain-initial syllables in phonology. The question addressed in the present study is whether the domain-initial strengthening effect is observed at the domain-initial vowels as well as domain-initial consonants. In the experiment, durations of initial-syllable vowels in various prosodic domains were compared with those of second vowels in real-word tokens for both languages. Hamkyeong Korean, like English, tuned out to strengthen the domain-initial consonants. With regard to vowel durations, we found no significant prosodic effect in English. On the other hand, Hamkyeong Korean showed significant differences between durations of initial and non-initial vowels in the higher prosodic domains. The findings in the study are theoretically important as they show that the potentially-universal phenomenon of initial strengthening is subject to language specific variations in its implementation.

1. Introduction

There has been an increasing consensus that one of the most crucial elements in understanding spoken language on a segmental level lies in understanding how prosody affects the physical realization of individual segments. Equally, it is also important to study prosodically conditioned segmental variations because they are likely to serve as cues for higher-level linguistic structure. A large body of recent experimental work has shown that such prosodically conditioned segmental alternations come primarily from segment strengthening in domain-initial positions, an effect known as domain-initial strengthening (Fujimura 1990, Pierrehumbert and Talkin 1992, Jun 1995) In the similar line, a series of electropalatographic studies showed that the consonants are produced in general with greater articultory magnitude in domain-initial positions at each level than in domain-medial positions (Fougeron and Keating 1996, 1997, Fougeron 1999, Keating, Cho, Fougeon, and Hsu 1999). There is also some evidence that the duration of word-initial vowels is longer than that of word-internal vowels in French, English (Fougeron 1999, Turk and Shattuck-Hufnagel 2000, Byrd 2000). A number of experiments cited above show that both consonants and onsetless word-initial vowels are regularly subject to this strengthening, but it is less clear whether initial-syllable vowels with onset consonants undergo it as well.

Fougeron and Keating (1996) clearly demonstrating initial strengthening of consonants and onsetless word-initial vowel in English, found little evidence of lengthening of initial-syllable vowels with onsets. Byrd (2000) obtained similar results. The results of these studies are furthermore puzzling in light of the typological frequency of vowel-quality neutralizations in non-initial syllables, suggesting that initial position bears some type of positional prominence. Cross linguistically, vowels of initial syllables tend to retain contrasts even when they are not actually domain initial. Progressive vowel harmony is one of such examples. From a slightly different angle, domain-initial syllables are known to be more important for lexical access and thus it is crucial that all contrasts be maintained there. If this is the case, why are only domain-initial consonants and onsetless vowels subject to domain-initial strengthening? This paper attempts to answer this question by presenting the result of an experimental study of initial syllables in Hamkyeong Korean, a pitch accent dialect spoken in the northern part of North Korea. The data were collected from two native speakers of Hamkyeong Korean who defected from North Korea.

2. Behaviors of initial syllables in Hamkyeong Korean

Before proceeding to discussion of the prosody and the behaviors of domain-initial syllables in Hamkyeong Korean, let us begin with a brief sketch of its tone patterns. Five basic observations should be noted. First, the pitch accent bearing unit in Hamkyeong Korean is a syllable rather than a mora. Second, it has two lexical tones and there is an asymmetry between high and low tones. It is always the high tone that undergoes tone alternations. Nothing occurs if two low toned syllables are juxtaposed. Presence and absence of low tones does not make any contribution in defining tone classes. Third, three classes of verbal stems are recognized with regard to the distribution of high tones. They are not our concern and will not be discussed here (refer Kim, 1997, 1998a, 1998b, 1999 for more detailed descriptions along with Optimality theoretic analysis of tone patterns). What is more interesting is the tonal alternations, which lead us to the fourth observation: Compounds are also subject to the Obligatory Contour Principle (Ramsey 1978). The generalizations of tone patterns are summarized in (1).

(1) The generalizations of the tone patterns in Hamkyeong Korean

a. One and only one syllable is high-toned in a compound.

b. If high tone-bearing syllables are adjacent, then leftmost one is high toned.
c. If high tone-bearing syllables are not adjacent, the rightmost one is high toned.

Finally the vowel durations in Hamkyeong Korean are positively correlated with degree of opening in isolation and thus low vowel /a/ is much longer than a high vowel /i/. In citation forms, presence of pitch accent does not affect the vowel duration if all other conditions being equal. Put differently, pitch accent in Hamkyeong Korean is not cued by vowel duration and low-tone bearing vowels do not undergo reduction. It is cued by fundamental frequency (Kim, 1999).Researchers in previous studies provide an interesting and recurring description about the behavior of the utterance initial syllables in connection with absence of vowel reduction of low-toned vowels and its duration in Hamkyeong Korean (Ramsey 1978, Cheong 1988, Cheon 1993). One of such descriptions is shown in (2).

> Utterance-initial syllables appear to be louder and prominent than the other syllables regardless of their pitch accents.
>
> (Cheong Y-H 1988: 175).

Some scholars working on Hamkyeong Korean have a tendency to link this observation to the presence of intonational variations or speech style unique to Hamkyeong Korean speakers, which turns out to be misleading. A question that arises from the description is what the physical correlates of prominence mentioned in (2) are. It should be noted that pitch accent or high tone is not cued by vowel duration even in citation forms and the observation as in (2) is concerned with utterance-initial syllables.

The experimental analysis in the following sections suggests a totally different understanding of facts previously described as an intonational variation. We argue that the phenomenon is in fact a consequence of domain-initial strengthening.

3. Experimental method

The purpose of this experiment is to examine the effect of domain-initial strengthening. Previous phonetic works on strengthening of domain–initial vowels all demonstrated the lack of strengthening for initial-syllable vowels in English and it was verified in Kim (2001) as well. Due to the space limitations, I will not present my result from three native speakers of North American English here. At this point, we can say with great confidence initial-syllable vowels are exempted from the domain-initial strengthening in English. The major work presented in the paper is concerned with the experimental results for Hamkyeong Korean.

The data reported here are from two native speakers of Hamkyeong Korean speakers, a female and one male in the fifties. Speakers read the test sentences from a randomized list. Sentences were uncovered one at a time by the author to insert a short pause after each sentence. To induce a broad range of vowel duration, the speakers were asked to vary loudness and speech rate. There were two conditions with respect to loudness as used in Liberman et al. (1993): loud (as if shouting to a person in the hall), normal (as if speaking to a person next to you). With respect to speech rate, the conditions were normal and fast. In the normal condition, they were asked to speak at a normal conversation rate. In the fast condition they were asked to speak as quickly as possible while still speaking clearly. The utterances were all recorded on digital tape and they were digitized at a sampling rate of 22.5 KHz., and vowel durations were measured from spectrograms and waveforms display created using the PCquirer (Scicon) as shown in (3).

(3) s**a**nn**a**mul-i mome cota

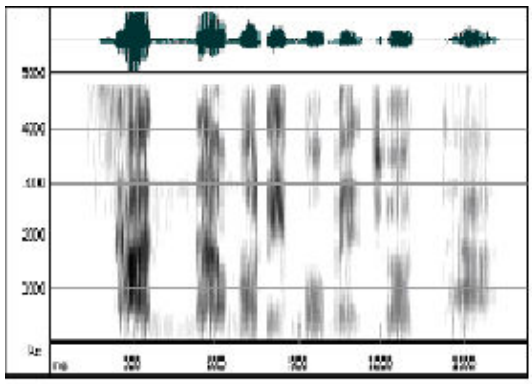

Figure 1: *A sample spectrogram of speech production*

The stimuli all were composed of words with more than three syllables. No onsetless syllables were included in the stimuli. VOT of stops in the onsets of the first and second syllables were measured. Among the 22 words, 15 words have identical vowels in the first and second syllables and their durations were measured. The target vowels are indicated in boldface. Codas of the target vowels were controlled and they were all either nasals or liquids. Each token was placed in three different frame sentences selected to place the target word in initial position in a variety of prosodic domains as in Fougeron and Keating (1996) and Jun (1995). Although a comprehensive study remained to be done, we assumed accentual phrase in Hamkyeong Korean. For present purposes, it does not matter whether Hamkyeong Korean has accentual phrases or phonological phrases. What is crucial is that it has several domains organized hierarchically. The relevant domains were Utterance, Accentual Phrase, and Phonological Word.

The first measurement was VOT of stops in the first and second syllables (Syllable 1 and Syllable 2 henceforth). Another measurement was durations of the two identical vowels in Syllable 1 and Syllable 2.

4. Results and concluding remarks

Experimental results are summarized in Figure 2 and 3. First, the line chart in Figure 2 shows that VOT values of stops vary as a function of prosodic position (the higher the prosodic positions, the longer the VOT).

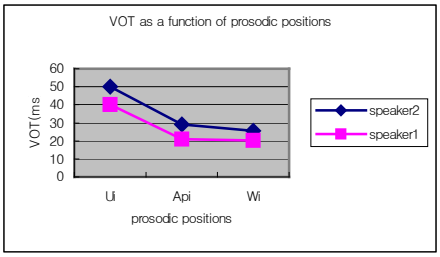

Figure 2: *Variations of VOT values as a function of prosodic positions.*

Second, the bars in Figure 3 illustrate the VOT values pooled across the prosodic positions. Ui and Api refer to utterance initial and accentual phrase initial respectively. The left bars indicate the VOT values of Syllable 1, while the right bars represent those of Syllable 2. In short, VOT of stops in Syllable 1 is significantly longer than that of Syllable 2. This finding was supported by the results of paired t-tests ($p< 0.05$).

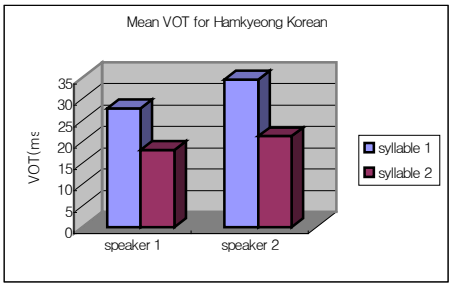

Figure 3:*Mean VOT for Hamkyeong Korean*

So far, we have shown that stops in the initial positions of prosodic domains are strengthened, which arguably serves as significant cue marking different levels of prosodic boundaries in Hamkyeong Korean.

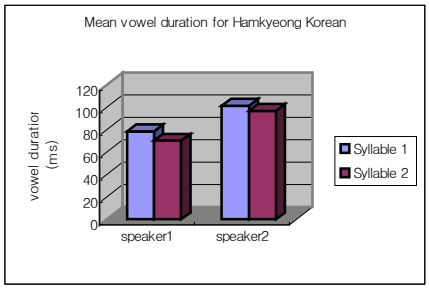

Figure 4: *Mean vowel duration for Hamkyeong Korean*

Now, let us move on the most important part of the experimental results: durations of the domain-initial vowels with onsets. It should be reminded that 15 words with identical vowels in the first and second syllables (e.g. *sannamul*, 'wild edible greens' *k'amaki* 'a crow') were selected for this purpose for Hamkyeong Korean data, and that utterance-initial vowels with onsets did not show any significant lengthening in English in the experiment.

Figure 4 corresponds to mean vowel durations for Syllable 1 and 2 of the target vowels. For both speakers, mean durations of initial-syllable vowels are significantly longer than those of the vowels of second syllables as verified by paired t-test ($p<0.01$).

Putting all of these results together, we can conclude that both English and Hamkyeong Korean have the strengthening of domain-initial consonants. On the other hand, only Hamkyeong Korean exhibits a pattern of domain-initial vowel (i.e., initial-syllable vowels with onset consonants) strengthening in the higher prosodic domains. Presence of domain-initial vowels lengthening in Hamkyeong Korean is important since it provides evidence that domain-initial strengthening may vary depending on its language-specific phonetic implementation rules. The potentially universal phenomenon of initial strengthening is shown to be subject to language specific variations in its implementation. The results of the present study support a specific model of phonology regarding the relationship of phonetics and phonology: Phonetic realization of a given phonological rule varies across languages.

Traditional position forwarded by Pierrehumbert and her colleagues are in the same line with this view. From this perspective, phonetics and phonology are distinct and the phonology-phonetics interface consists of the translation of a static representation into a dynamic one realized in both time and space. This view, however, has been called into question in some work (Kirchiner 1997 among others) in which researchers challenge the presence of language-specific phonetics. The present results show that at least part of phonetic component is no universal and belongs to the language-specific grammar. Thus, they indicate the traditional model of distinct phonetics and phonology is better equipped to account for the Hamkyeong Korean facts.

Any close reader may ask why Hamkyeong Korean displays domain-initial vowel lengthening unlike English. The answer to this question can be found in Keating, Cho, Fougeron and Hsu (1999) where the different boundary signals were revealed in English, as opposed to French and Korean. One of the primary cues for stress placement in English is vowel duration. It is no wonder that English avoids simultaneously implementation of other prosody-determined vowel-lengthening patterns. Otherwise, it would seriously confuse the accurate perception of the placement of stress. Hamkyeong Korean pitch accent is cued only by fundamental frequency (Kim 1999). It is not related to vowel durations, which may allow prosodically determined vowel durations to serve as a source of phonetic cue.

In short, English stress is cued in large by vowels durations and additional positional complication of the feature could interfere with the perception of stress, which leaves no room for positional perturbations of vowel duration. The pitch accent in Hamkyeong Korean, however, is cued only by fundamental frequency and thus vowel duration is free to vary as a boundary signal if necessary. More extensive work will be necessary for us to make any further claims regarding this matter.

5. References

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