

A Corpus-based Study on the Layered Duration in Standard Korean

Introduction: The paper uses a large-scale corpus of naturally produced Standard Korean and investigates duration adjustments of vowels observed at the vicinity of word boundary with the word-medial vowel duration serving as reference. Research in spoken language has shown that "a potential set of cues lie in the fact that an individual speech sound can be produced differently in different structural context, even though its abstract lexical representation is presumably the same" (Turk & Shattuck-Hufnagel, 2000). Thus, cues for linguistically organized framework can be found in these contextually determined variant phonetic characteristics. Domain-initial strengthening (Fougeron & Keating, 1997; Cho & Keating, 2001) and domain-final lengthening (Beckman & Edwards, 1990; Edwards, Backman, & Fletcher, 1991; Fletcher, 2010) are perhaps the most well-known cases of lengthening induced by linguistically structured boundaries. Together, these two effects of lengthening conspire to increase the distance between adjacent vowel onsets when they are separated by a boundary. While phrase-final lengthening is well documented, it is more difficult to find convincing evidence for other boundary-related lengthening such as word-final lengthening in non-phrase-final position (S. Kim, 2004; Turk & Shattuck-Hufnagel, 2000) and non-consonantal phrase-initial lengthening. For example, Fougeron (1998) found no evidence of lengthening for the vowel following a phrase-initial consonant in French. Likewise, Byrd (2000) and Cho & Keating (2001) found no consistent evidence of lengthening beyond the phrase-initial consonant in English and Korean. The paper examines boundary-related phenomena from naturally produced large-scale Korean corpus.

Data: The data used for this study was drawn from "A Speech Corpus of Reading-Style Standard Korean," created around 2003 and distributed by the National Institute of the Korean Language (NIKL: <http://korean.go.kr>) in 2007. Speakers are from the Seoul and Gyeonggi area. Ten male speakers in their 20's are selected from the corpus. Each speaker read 930 sentence types from 19 different well-known fairy tales, short stories and essays for more than an hour in a sound-treated booth. Phone and word sequences in the speech files are force-aligned using a custom-made automatic phone alignment system based on Unicode and the Hidden Markov Model (HMM, cf. Young et al. 2010). All instances of /ka/ and /ta/ were visually examined and corrected, if needed, and then extracted from the phone-aligned data. The selection of /ka/ and /ta/ is based on the distribution of these two forms in the corpus and the typical property of Korean has grammatical markers. The tokens of these /ta/ and /ka/ are among the top 5 most frequent syllable types in the corpus (2247 cases of /ta/ and 3011 cases of /ka/ in the 10 male speakers), letting us to examine the phonetic properties from different locations within a phrase, as exemplified in (1), where instances of /ka/ is observed word- and phrase-finally, word- and phrase-initially, and within a word. The decision between phrase-boundary and word-boundary is made based on the presence or absence of silent pause at the vicinity of the target syllable.

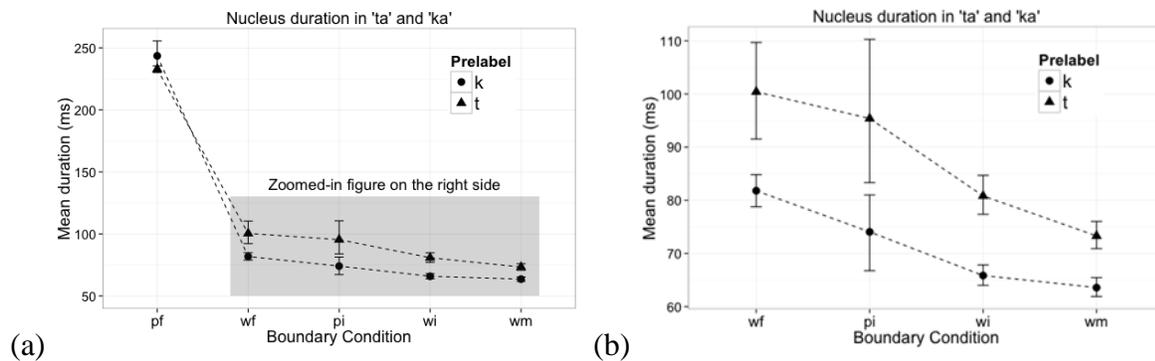
- (1) Chulswu-**ka** hankaunde iss-neun **kagu-lul** sa-ss-ta.
Chulswu-NOM in the middle being-ADN furniture-ACC buy-PAST-DECL
'Chulswu bought a piece of furniture which was located in the middle.'

In addition, as predicate final language, Korean has /ka/ and /ta/ as its grammatical markers. For example, /ka/ and /ta/, respectively, serve as a nominative marker and a declarative sentence ender in (1). Thus, it is possible to examine the phonetic properties of these morphological morphemes of /ka/ and /ta/ in the context of phrase structure. The position which these syllable

occur in a phrase, in turn, correlates with the positions in a prosodic hierarchy. For example, the nominative marker /ka/ may form a left-edge of either AP (Accentual Phrase) if it is followed by a silent pause or IP (Intonational Phrase) if no silent pause follows (Jun, 1993).

Results: Duration measurement is taken at the syllable nucleus of /ta/ and /ka/, respectively and is classified into one of five positions: phrase-final (pf), word final (wf), phrase-initial (pi), word-initial (wi), and word-medial (wm) position. In Figure 1, error-bar graph illustrates the mean and standard error of syllabic nucleus duration at the five different positions. The shaded area in Figure 1(a) is zoomed-in and shown again in Figure 1(b) for clarity. As evident in the figure, positional effects of lengthening are most evident in phrase-final position. In addition, the duration at word-final and phrase-initial is longer than the duration of word-medial tokens.

Figure 1: (a) Vowel Duration of /ka/ and /ta/ as measured at five different positions: (b) vowel duration of /ka/ and /ta/ of the shaded positions in figure 1(a).



Planned contrast test is conducted to test the effect of lengthening of /ka/ and /ta/ in different positions in a phrase. Table 1 illustrates the results of the planned contrast test with word-medial /ta/ as the baseline level. It is evident that the vowel duration in /ta/ is lengthened more when they occur in a position other than the word-medial position. If not shown, similar result is obtained in the case of /ka/.

Table 1: Planned contrasts test: Treatment contrast with word-medial 'ta' as the baseline level.

	<i>Estimate</i>	<i>Std. Error</i>	<i>t value</i>	<i>Pr(> t)</i>
(Intercept)	73.295	2.326	31.509	< 2e-16 ***
pf vs. wm	162.736	2.728	59.652	< 2e-16 ***
pi vs. wm	22.089	8.127	2.718	0.00662 **
wf vs. wm	27.113	5.435	4.989	6.59e-07 ***
wi vs. wm	8.488	3.511	2.418	0.01570 *

Conclusion: Results support that the phonetic manifestation of the utterance boundary is conditioned by the linguistically organized structure, independent of the morphological properties of the language. It also indicates that the failure of earlier studies to find the effect of phrase-initial lengthening may be due to the greater variation in that position. The findings observed in the study may be a reading characteristic observed in the reading style by male speakers, which warrants detailed phonetic analyses for more speakers of different gender and more speaking styles as well as speaker-dependent variations. With the custom-made forced alignment at hand, it is possible to extend the studies to more speakers and more speaking styles.