The role of prominence in phrase-final lengthening: a cross-linguistic comparison

Karen Tsai*, Jiyoung Jang*, Argyro Katsika
University of California, Santa Barbara
karentsai@ucsb.edu; jiyoung@ucsb.edu; argyro@ucsb.edu

Phrase-final lengthening, namely longer acoustic and articulatory durations at the end of phrases, is a well-established phenomenon. However, the stretch of speech that undergoes lengthening, i.e., the scope of effect, is unclear. Previous studies have revealed prominence as a determining factor. For instance, in languages such as Greek and English, it has been shown that phrase-final lengthening interacts with the last stress and/or phrasal pitch accent in the phrase (e.g., Greek: Katsika, 2016; English: Turk & Shattuck-Hufnagel, 2007; Kim *et al.*, 2017). However, this evidence mainly comes from stress languages, and little is known about languages with other prosodic characteristics. Acoustic evidence from Japanese, a lexical pitch accent language, suggests that pitch accent affects the amount, but not scope, of lengthening. Here, we use electromagnetic articulography (EMA) to conduct parallel examination of the interaction of prominence with phrase-final lengthening in two prosodically different languages: Japanese, a pitch accent language (Japanese) and Korean, a language with no lexical prominence. Specifically, we assess the amount and scope of phrase-final lengthening as a function of presence and position of lexical pitch accent in Japanese, and presence and position of focus, the latter as controlled by Accentual Phrase (AP) length, in Korean.

Four native Tokyo Japanese speakers (3F, 1M) and five native Seoul Korean speakers (4F, 1M) participated in the respective experiment. The target words for Japanese were a near-minimal set of three-syllable words varying in pitch accent: unaccented (P0), initial-accented (P1), medial-accented (P2), and final-accented (P3). Stimuli were embedded in frame sentences and elicited in two phrasal positions: phrase-medial (PhM) or phrase-final (PhF). 9 repetitions were collected. For Korean, the test word /nɛ.maŋ.mi.nam/ (the nasals of which prevented any tsegment-related tonal effects) was also elicited in PhM or PhF positions. Test sentences consisted of two APs, either 4 or 7 syllables long: [4-σ-AP1+7-σ-AP2] vs. [7-σ-AP1+4- σ-AP2]. Focus location was also varied, being on either AP1 or AP2. Focus on AP1 led to dephrasing, presumably increasing the distance of the IP boundary from focus to 11 syllables. 8 repetitions were collected. In total, 312 Japanese utterances and 296 Korean utterances were included in the analyses reported here. The consonant (C) gestures of test words were semi-automatically labeled for kinematic landmarks based on velocity criteria using custom software (Tiede, Haskins Laboratories). The duration of the formation (F) and release (R) phase of each C gesture was calculated on the basis of these kinematic landmarks. Separate linear mixed effects models were fitted in R for each test constriction and pairwise comparisons were assessed by the relevel function.

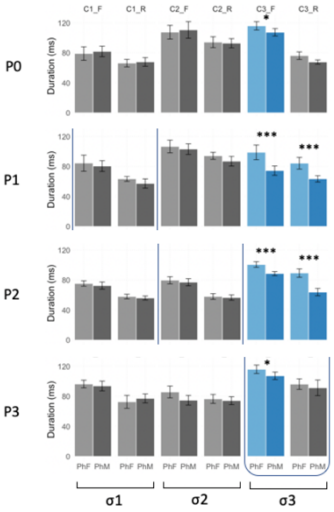

*Figure 1 Duration of F and R of each C gesture per pitch accent and phrasal position in Japanese. Blue bars indicate phrase-final lengthening. Syllables with pitch accent are boxed. *** $p<0.001$, ** $p<0.01$, * $p<0.05$.*

In Japanese (Fig. 1), significant main effects of boundary (C3F: $\chi^2(1)=62.61$, $p<0.001$; C3R: $\chi^2(1)=67.99$, $p<0.001$) and a significant interaction between boundary and pitch accent (C3F: $\chi^2(3)=7.72$, $p=0.05$; C3R: $\chi^2(3)=21.53$, $p<0.001$) were found in the final syllable. Pairwise comparisons revealed that the scope of phrase-final lengthening began on C3F of the final syllable, which was longer in PhF than in PhM by 13.6ms ($p<0.001$). In initial- (P1) and medial-accented

* These authors contributed equally to this work.

(P2) words, the scope extended further rightward to C3R. There was also a greater amount of boundary-related lengthening on C3F and C3R in P1 and P2 conditions (p<0.05). While final-accented (P3) words did not show boundary-related lengthening on C3R, this may have been due to concurrent accent-related lengthening; C3F and C3R in the P3 condition were longer than those in the other pitch accent conditions (P0, P1, and P2), regardless of boundary (all p<0.05).

In Korean (Fig. 2), boundary had a significant main effect on the last five C gestures. Pairwise comparisons revealed that both the F and R phase of C gestures in the final syllable (C4, C5) were longer in the PhF position (C4F: $\chi^2(1)=13.2$; C4R: $\chi^2(1)=38.0$; C5F: $\chi^2(1)=300.9$; C5R: $\chi^2(1)=69.7$; all p<0.001). Lengthening was greatest at the consonant adjacent to the phrase-final boundary (coda of the final rhyme). For C5F, there was a significant interaction between boundary and AP length ($\chi^2(1)=11.1$, p<0.001), which came from greater dispersion between PhF vs. PhM in the [7-σ-AP1+4-σ-AP2] condition (75% increase in PhF) as opposed to its counterpart (52% increase in PhF). C3R, on the other hand, was shorter in PhF position compared to PhM ($\chi2(1)=14.9$, p<0.001). Shortening is frequently observed in the boundary-related research, which may be attributable to the global speech planning process (cf. Byrd *et al*., 2006).

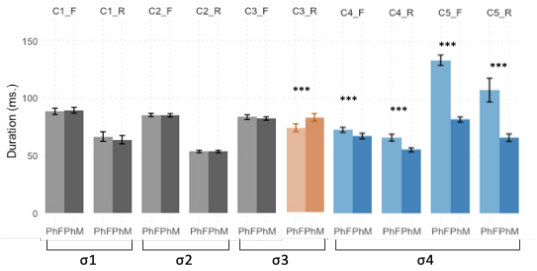

*Figure 2 Duration of F and R for each C gesture of the measured interval in Korean. Blue bars indicate phrase-final lengthening and orange bars indicate phrase-final shortening. ***p<0.001.*

Our results indicate that in both Japanese and Korean, it is the phrase-final syllable that lengthens. This is consistent with previous research detecting phrase-final lengthening on the rhyme of the phrase-final syllable and boundary-adjacent constrictions. However, in both Japanese and Korean, the effect began in the final syllable's onset (consistent with findings in Japanese, cf. Seo *et al*., 2019). In both languages, there was an interaction between prominence and amount of lengthening. It seems that there was no attraction of the lengthening effect in either language towards the prominent linguistic unit (Katsika, 2016), and no lengthening on the prominent syllable as a function of boundary (Turk & Shattuck Hufnagel, 2007). It is possible that prominence affects the scope of lengthening in languages such as English and Greek, in which duration is a primary correlate of prominence.

References

Byrd, D., Krivokapić, J., & Lee, S. (2006). How far, how long: On the temporal scope of prosodic boundary effects, *The Journal of the Acoustical Society of America*, 120(3), 1589-1599.

Katsika, A. (2016). The role of prominence in determining the scope of boundary-related lengthening in Greek. *Journal of phonetics*, 55, 149-181.

Kim, S., Jang, J., Cho, T. (2017). Articulatory characteristics of preboundary lengthening in interaction with prominence on tri- syllabic words in American English. *The Journal of the Acoustical Society of America*, 142(4), EL362-EL368.

Seo, J., Kim, S., Kubozono, H., and Cho, T. (2019). Preboundary lengthening in Japanese: To what extent do lexical pitch accent and moraic structure matter?, *The Journal of the Acoustical Society of America*, 146(3), 1817–1823.

Turk, A. E., & Shattuck-Hufnagel, S. (2007). Multiple targets of phrase-final lengthening in American English words. Journal of Phonetics, 35(4), 445-472.