Phrase-final lengthening and its interaction with lexical pitch accent in Japanese

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Phrase-final lengthening is known to affect segments before prosodic boundaries in many languages. However, the scope of the effect, i.e., the stretch of speech that undergoes lengthening, is unclear. Previous work on the scope of boundary lengthening is minimal and mainly focused on stress languages such as Greek and English, where it has been shown that phrase-final lengthening interacts with the position of lexical stress [1, 2, 6]. Evidence for the scope of phrase-final lengthening in a language with no lexical stress comes from [4, 5], who conducted an acoustic study of phrase-final lengthening in disyllabic words with and without lexical pitch accent (initially accented vs. unaccented) in Japanese. Their results showed lengthening in all segments except the first consonant in all accent conditions, but there was less lengthening on the final rime in words with initial accent. The work presented here is part of a larger Electromagnetic Articulography (EMA) study that examines the interaction between lexical pitch accent and boundary-related events in Tokyo Japanese. Here, we report results on the scope of phrase-final lengthening in disyllabic words that have pitch accent on either the first or second syllable or are unaccented.

The test words for this analysis were a minimal set differing only in pitch accent: unaccented (P0), initial-accented (P1) and final-accented (P2). These were elicited in two boundary conditions, i.e., either in phrase-medial (PhM) or phrase-final (PhF) positions. The stimuli are shown in Table 1. For each speaker, 9 repetitions of the stimuli were collected. To date, data from two participants in their 20s (1 female) have been analyzed, and analysis is ongoing. The kinematic measures of duration were made using a semi-automatic procedure that detects constriction gestures (Mark Tiede, Haskins Laboratories). Separate linear mixed effects models were fitted using the lmerTest package [3] in R for each test consonant constriction (C1 and C2 for the first and second consonant of the test word, respectively), with formation (F) gesture duration or release (R) gesture duration as response variables. Random effects of speaker and fixed effects of boundary and pitch accent were included. The relevel function in R was used to derive pairwise comparisons from the lmer output. The second evaluation of the factor pitch accent was compensated for using a Bonferroni correction.

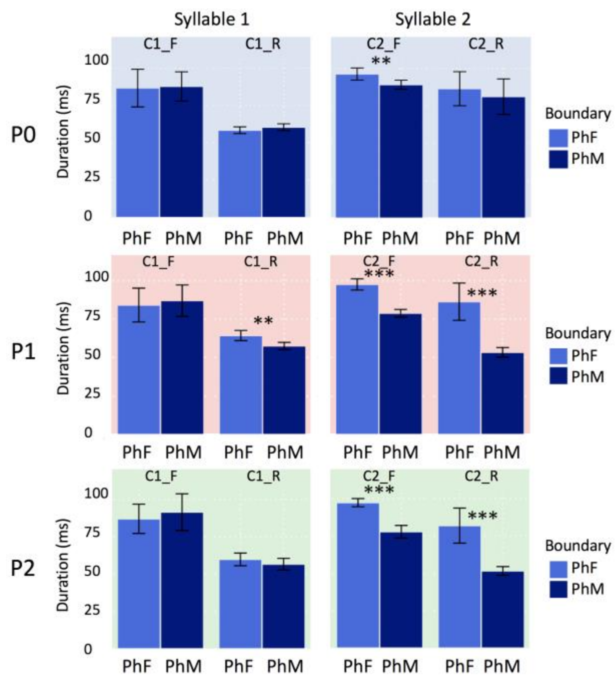
The results of boundary and its interaction with pitch accent for formation (F) and release (R) durations for both consonants (C1 and C2) are summarized in Figure 1. The release gesture of the first consonant (C1_R) is significantly longer only when the first syllable is accented (β_{P0}= -5.78, SE=2.76, β_{P2}=-4.38, SE=3.06, $\chi^2(2)=8.32$, $p<0.05$). In the second consonant, both the formation and release gesture durations undergo boundary lengthening (C2_F: $\chi^2(1)=81.99$, $p<0.0001$; C2_R: $\chi^2(1)=51.11$, $p<0.0001$). Interestingly, both gestures show a smaller difference between phrase-medial (PhM) and phrase-final (PhF) conditions when unaccented (P0), mainly due to shortening in the phrase-medial condition (C2_F: β_{P0}=-12.02, SE=3.12, β_{P2}=-12.25, SE=2.99, $\chi^2(2)=19.32$, $p<0.0001$; C2_R: β_{P0}=-30.32, SE=6.64, β_{P2}=-24.3, SE=6.35, $\chi^2(2)=22.61$, $p<0.0001$).

In sum, our results suggest that presence and position of lexical pitch accent affect both the scope and amount of lengthening in Japanese, partially agreeing with [4, 5]. We are in the process of including ongoing participant data and conducting simultaneous articulatory and acoustic analysis of both consonants and vowels, which should provide us with a clearer picture of the profile of phrase-final lengthening in Japanese. We discuss the implications of our findings for the role of interactions between prosodic functions, such as prominence and boundaries, in prosodic structure. We also draw cross-linguistic comparisons in order to highlight important dimensions of typological variation.

Table 1: Experimental Stimuli organized by experimental factor, i.e., Accent (unaccented (P0), initial-accented (P1), final-accented (P2)) and Boundary (phrase-medial (PhM), phrase-final (PhF)).

Accent	Boundary	Stimulus sentences
P0	PhM	[hoNto: ni **nami** nakusita?] “Really lost the medium?”
	PhF	[hoNto: ni **nami**?] [nakusita?] “Really the medium? Lost it?”
P1	PhM	[hoNto: ni **nami** makasita?] “Really defeated Nami?”
	PhF	[hoNto: ni **nami**?] [makasita?] “Really Nami? Defeated?”
P2	PhM	[hoNto: ni **nami** makasita?] “Really defeated the waves?”
	PhF	[hoNto: ni **nami**?] [makasita?] “Really the waves? Defeated?”

Figure 1: Mean and standard error of each consonant’s (C1 and C2) formation (F) and release (R) duration (in ms) by Boundary (PhM, PhF) and Accent (P0, P1, P2). P-value significance codes: ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05.



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