The Influence of Prosodic Phrasing on Speech Rhythm

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Ramus et al. (1999) and Grabe and Low (2002) reconfirmed that languages can be classified into different rhythmic classes. They calculate indexes such as the durational variability of consonantal and vocalic intervals, and show that syllable- and stress-timed languages differ on these indexes. These indexes do not take account of the internal prosodic phrasing of an utterance. The success of the indexes therefore begs the question of whether speech rhythm is independent of utterance internal prosodic phrasing. We present evidence to the contrary.

Lehiste (1972) has shown that, in English, stressed vowels shorten when followed by unstressed syllables – the vowel in $\acute{\sigma}_1$ shortens from $\acute{\sigma}_1\sigma_2$ to $\acute{\sigma}_1\breve{\sigma}_2$ to $\acute{\sigma}_1\breve{\sigma}_2\breve{\sigma}_3$. (We call this "compensatory shortening" or CS.) If speech rhythm is independent from prosodic phrasing, CS should apply irrespective of the prosodic relationship between $\acute{\sigma}_1$, and $\breve{\sigma}_2/\breve{\sigma}_3$. However, if the prosodic phrasing plays a role, CS-application could depend on the prosodic relationship between $\acute{\sigma}_1$, and $\breve{\sigma}_2/\breve{\sigma}_3$. We investigated this using South African English data.

We assumed the following about English prosodic phrasing (Selkirk 1995): (i) Each lexical word projects its own PWd, but function words do not. (ii) Function words prosodify with following, not preceding, lexical words. (iii) Function words incorporate into the PPh, not the PWd, headed by the following lexical word. We had four kinds of stimuli on our experiment. We show the prosodification of the stimuli types according to the principles stated above.

(a)	No following $\breve{\sigma}$:	((sp<u>ee</u>d)$_{PWd}$)$_{PPh}$	((kills)$_{PWd}$)$_{PPh}$
		(($\acute{\underline{\sigma}}$)$_{PWd}$)$_{PPh}$	(($\acute{\sigma}$)$_{PWd}$)$_{PPh}$
(b)	$\breve{\sigma}$ follows in same PWd:	((sp<u>ee</u>diness)$_{PWd}$)$_{PPh}$	((matters)$_{PWd}$)$_{PPh}$
		(($\acute{\underline{\sigma}}$ $\breve{\sigma}$ $\breve{\sigma}$)$_{PWd}$)$_{PPh}$	(($\acute{\sigma}$ $\breve{\sigma}$)$_{PWd}$)$_{PPh}$
(c)	$\breve{\sigma}$ follows, but not in same PWd:	((sp<u>ee</u>d)$_{PWd}$)$_{PPh}$	(is the (subject)$_{PWd}$)$_{PPh}$
		(($\acute{\underline{\sigma}}$)$_{PWd}$)$_{PPh}$	($\breve{\sigma}$ $\breve{\sigma}$ ($\acute{\sigma}$ $\breve{\sigma}$)$_{PWd}$)$_{PPh}$
(d)	$\breve{\sigma}$ precedes, but not on same PWd:	(The (sp<u>ee</u>d)$_{PWd}$)$_{PPh}$	((soared)$_{PWd}$)$_{PPh}$
		($\breve{\sigma}$ ($\acute{\underline{\sigma}}$)$_{PWd}$)$_{PPh}$	(($\acute{\sigma}$)$_{PWd}$)$_{PPh}$

We recorded 5 speakers of South African English reading sentences like these, and measured the duration of the stressed vowel corresponding to *ee* in the examples above. This vowel occurs in different prosodic contexts, and therefore allows us to test whether utterance internal prosodic phrasing has an influence on the duration of this vowel. In both (b) and (c) there are two unstressed syllables following stressed *ee*. However, in (b), the unstressed syllables belong to the same PWd as *ee*, but in (c) they do not. Our data confirmed that the duration of *ee* in (b) is shorter than in (a) (p<.001). However, our data showed no evidence of shortening in (c) relative to (a) (p>.70). Unstressed syllables in the same PWd as a stressed vowel trigger CS of that vowel, but unstressed syllables belonging to a different PWd do not.

The unstressed syllables in (c) belong not only a different PWd than *ee* but also to a different PPh. It is therefore not clear whether the unstressed syllables must be in the same PWd or the same PPh as the stressed vowel to trigger CS. Sentences such (d) shed some light on this. In (d), there is an unstressed syllable in the same PPh, but not PWd, as stressed *ee*. If unstressed syllables in the same PPh trigger CS, *ee* in (d) should be shorter than in (a). We found no evidence that the *ee* in (d) was shorter than in (a) (p>.20). This suggests that it is only unstressed syllables in the same PWd that trigger CS. However, since the unstressed syllable in (d) precedes rather than follows the stressed *ee*, other interpretations are possible.

The results of this experiment clearly establish that there is a correlation between the prosodic phrasing and the durational properties of an utterance. If we understood this relationship better, we could use such durational properties as yet another cue to the prosodic phrasing of an utterance.

References

Grabe, Esther and Ee Ling Low. 2002. Durational variability in speech and the rhythm class hypothesis. In Carlos Gussenhoven and Natasha Warner, eds. *Laboratory Phonology VII*. Berlin: Mouton de Gruyter.

Lehiste, I. 1972. The timing of utterances and linguistic boundaries. *Journal of the Acoustical Society of America*, 6(2):2018-2024.

Ramus, Franck, Marina Nespor and Jacques Mehler. 1999. Correlates of linguistic rhythm in the speech signal. *Cognition*, 73:265-292.

Selkirk, Elisabeth. 1995. The prosodic structure of function words. In Jill Beckman, Laura Walsh Dickey, and Suzanne Urbanczyk, eds. *Papers in Optimality Theory*. (*University of Massachusetts Occasional Papers in Linguistics 18.)*. Amherst: GLSA. p. 439-469.