WORD-INITIAL CONSONANT LENGTH IN PATTANI MALAY

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ABSTRACT

Pattani Malay has distinctive length in all word-initial consonants. Earlier work showed that variations in closure-duration yield perceptual shifts between "short" and "long" phonemes for all sentence-medial intervocalic consonants but only for sentence-initial consonants with acoustic excitation before the release. For words, however, with initial voiceless closures but no pre-release excitation, which are identified well in isolation, where are the cues to the "length" distinction? In the belief that the underlying mechanism is the temporal control of closure, two hypotheses are tested here acoustically: (1) For all consonants, the closure-durations differentiate the short and long categories. (2) The ratio of the amplitude of the first syllable to the second syllable is greater in disyllabic words with long plosives than in those with short plosives.

BACKGROUND

The use of time and timing [1, 2] for phonological distinctions is still an important topic for research. This study tries to shed further light on the acoustic bases of length contrasts in which the relative durations of vocalic and consonantal gestures seem to have a distinctive function. Insofar as it might be a phonetic matter rather than an abstract phonological one, the question of whether to treat long segments as "geminates" will not be handled here.

Treatments of phonemic consonant length usually discuss intervocalic consonants, as in Estonian and Italian, where it is easy to show the physical reliability and perceptual relevance of durational differences in closures and constrictions. A language with this distinction in word-initial, and thus potentially, utterance-initial position, is rare.

The Language

Pattani Malay, spoken by some 600,000 ethnic Malays in southeastern Thailand, has a length-distinction for all consonants in word-initial position [3]. (The language was first called to my attention by Christopher Court and Jimmy G. Harris.) Here are some word-pairs with the contrast:

/makɛ/ 'to eat'	/mːakɛ/ 'to be eaten'
/lamaʔ/ 'late'	/lːamaʔ/ 'to make late'
/siku/ 'elbow'	/sːiku/ 'hand-tool'
/dʑalɛ/ 'way'	/dʑːalɛ/ 'to walk'
/butɔ/ 'blind'	/bːutɔ/ 'a kind of tree'

All of the foregoing examples have acoustic excitation during their closures or constrictions, but there is none in the voiceless unaspirated plosives, as in these examples:

/tɕuɣi/ 'to rob'	/tɕːuɣi/ 'robber'
/tawa/ 'bland'	/tːawa/ 'to show wares'

Recent work [4] has shown the power of closure-duration as an acoustic cue to the short-long distinction. Incremental shortening of acoustically excited closures yields perceptual shifts from long to short consonants. Voiceless plosives with their silent closures can be tested only in utterance-medial intervocalic slots; there, shortening or lengthening a silent gap induces shifts.

Goals

The justification for the perceptual experiments [4] was impressionistic observations of length and a small body of instrumental measurements. The first goal here was to determine the statistical reliability of closure-duration as a differentiator of the categories. The second goal was to explore the possible role of overall amplitude in the distinction. That is, for utterance-initial voiceless plosives, something other than audible differences in closure durations must convey the distinction. Although other acoustic features, such as fundamental-frequency shifts and formant-transition rates, are not ruled out, the hypothesis considered here was that the aerodynamic consequences of the apparent articulatory mechanism would cause a higher amplitude upon the release of a long plosive.

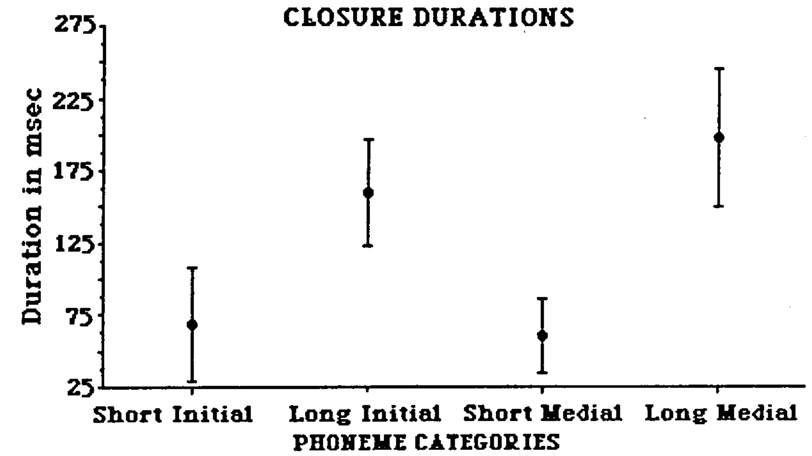

Fig. 1. Means and one-standard-deviation error bars for Speaker PCM. Initial: C, n = 28; C:, n = 28. Medial: C, n = 44; C:, n = 44.

Data

Recordings were made of several native speakers, but only those of one man, PMC, were analyzed for this report. Minimal pairs of disyllabic words, two tokens of each, were elicited in isolation and in a carrier sentence. These utterances were digitized for measurement in a waveform editing program and for spectral analysis.

DURATION

The durations of all closures and constrictions were measured for all utterance-initial consonants--except, of course, for the voiceless ones--and all utterance-medial consonants. This was done by examining the waveforms for acoustic signs of forming and releasing obstructions in the supraglottal vocal tract; these were mainly release bursts and sudden changes in amplitude. Occasional difficult cases were checked against spectrograms. The data are summarized in Figure 1.

An analysis of variance showed duration to be highly significant for initial consonants [F (1, 26) = 49.40, $p < 0.0001$] and medial consonants [F (1, 42) =185.19, $p < 0.0001$]. To measure durations of initial voiceless closures would require either a direct look at articulation or, perhaps, measurements of buccal air pressure. The robustness of the difference for medial voiceless plosives, in conformity with the graphs for the medials in Figure 1, and the data in both positions for all other consonants, suggest the high probability of a closure-duration difference for initial voiceless plosives too.

AMPLITUDE

Since the major concern was with initial voiceless plosives, measurements of amplitude were limited to isolated words. Pilot work with rise time, peak value, and average amplitude of the first syllable relative to the second gave useful results only with the third method.

A program with variable window-settings, designed by Richard S. McGowan, was used to derive the average root-mean-square (RMS) amplitude of each syllable in the disyllabic words recorded. (Apparently, monosyllabic words are rare.) The results are given in Table 1.

As expected, the most promising set of data in Table 1 is for the voiceless plosives (stops and affricates). In the analysis of variance of the underlying data, the interaction between consonant length and syllable approached significance: F (1, 14) = 4.36, p = 0.056. Indeed, post-hoc simple-effects tests showed that the difference between the short and long consonants with respect to amplitude-ratio is strongly significant: F (1, 14) = 11.037, p = 0.005. Although the continuants (nasals, laterals, and fricatives) showed a slight tendency in the same direction, the effect was not statistically significant. Compared with the continuants, the voiced plosives present a stronger case in the simple-effects test: F (1, 24) = 4.24, p = 0.05. With its greater number of degrees of freedom, however, this category underwent a more powerful test than the voiceless plosives and yielded a weaker although significant effect.

TABLE 1

Means and Standard Deviations for RMS Amplitudes in dB

		Short Consonants			Long Consonants		
Type	Syl. No.	n	M	SD	n	M	SD
Plosives							
Voiceless	1	16	**47.5**	3.0	16	**51.0**	2.2
	2	16	**45.0**	2.8	16	**45.0**	2.3
Voiced	1	14	**46.8**	3.9	14	**49.5**	3.5
	2	14	**43.3**	3.4	14	**44.4**	2.9
Continuants	1	14	**45.1**	3.9	14	**48.1**	2.8
	2	14	**46.1**	3.4	14	**46.9**	3.4

CONCLUSION

That the phonemic distinction between "short" and "long" Pattani Malay consonants is based on the quantitative feature of articulatory timing is abundantly clear from the data of Figure 1. Indeed, the perceptual efficacy of closure-durations has been demonstrated for medial position and for initial consonants with audible excitation [4]. (Of course, the value of this cue has been demonstrated for at least medial position in some other languages [e.g.,5].)

Even if, as seems likely, the underlying mechanism for this length distinction is articulatory timing, there may nevertheless be more than one acoustic cue involved. That is, temporal control of closures and constriction, intersecting with states of the glottis, may engender not only varying spans of silence or appropriate sound but also, perhaps, variations in air flow and pressure with certain acoustic consequences. The data in Table 1 show that for long voiceless initial plosives the average RMS amplitude is significantly higher in the first syllable than the second. There is also a significant but somewhat smaller effect for voiced plosives. We may speculate that although both categories involve complete momentary obstruction of the oral air flow, the presumed greater impedance at the larynx for the voiced plosives lessens the effect. For the continuants, however, which always have a by-pass for the air, there is no effect.

The amplitudes of PMC's embedded words remain to be measured. In the meantime, a cursory look at the productions of three other native speakers of the language seems to support the findings. Their utterances, too, will have to be measured. Finally, to round out the first experiments on perception [4], the plan is to produce stimuli with controlled variations in amplitude on disyllables.

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REFERENCES

[1] I. Lehiste, *Suprasegmentals*. Cambridge, MA: MIT Press, 1970.

[2] L. Lisker, On time and timing in speech. In T.A. Sebeok *et al.* (eds.), *Current Trends in Linguistics*, **12** (pp. 2387-2418). The Hague: Mouton, 1974.

[3] P. Masmintra Chaiyanara, *Dialek Melayu Patani dan Bahasa Malaysia: Satu Kajian Perbandingan dari segi Fonologi, Morfologi dan Syntaksis*. Master's thesis, University of Malaya, 1983.

[4] A.S. Abramson, Distinctive length in initial consonants: Pattani Malay. *J. acoust. Soc. Am.*, **79**, S27 (abstract), 1986.

[5] A. Lahiri and J. Hankamer, Acoustic properties of geminate consonants. *J. acoust. Soc. Am.*, **80**, S62 (abstract), 1986.