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11 Laryngeal Timing in Karen Obstruents

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BACKGROUND

While doing fieldwork at The University of Connecticut with students of mine on two dialects of Karen, one in 1987 and the other in 1992, I found that among the obstruents the systems of plosive consonants of both of them are largely characterized by a three-way contrast at each place of articulation, while the affricates of one and the sibilants of the other have a two-way contrast. A search of the scant literature revealed one comprehensive source of information on the major dialects and subdialects of this Southeast Asian language (Jones, 1961). Jones' description of the obstruents in terms of voicing and aspiration, together with our own auditory impressions, suggested that this three-way distinction for the stops and a two-way distinction for affricates in one dialect and for sibilants in the other, could well be explained by a mechanism of laryngeal timing (Abramson, 1977).

Although such a model has been widely accepted and used, a brief review may be in order. In a series of publications, starting 30 years ago, with supporting data from acoustic (Lisker & Abramson, 1964) and physiological (e.g., Sawashima, Abramson, Cooper, & Lisker, 1970) studies of production and the

results of experiments in perception (e.g., Lisker & Abramson, 1970), Leigh Lisker and I presented data in support of the proposal that the timing of glottal pulsing relative to supraglottal articulation will account for the great majority of homorganic consonantal distinctions traditionally said to depend on voicing, aspiration, "tensity," and the like. Because in the early days we concentrated on stop consonants, for which such distinctions are more plentifully found in word-initial position in a great many languages, we measured the onset of glottal pulsing relative to stop-release and called that measurement voice onset time (VOT). In general, this model of laryngeal timing stands up well, although its efficacy is low or nil in some contrasts, as in plain vs. glottalized stops and voiced aspirated vs. voiceless aspirated stops.

Karen is a tone language. It belongs to the Sino-Tibetan family, within which it is commonly assigned to the Tibeto-Burman branch, although some argue for a separate Karennic branch (Jones, 1961). It is spoken by a sizable minority of people on both sides of much of the border between Myanmar (Burma) and Thailand and in parts of northern Thailand. Two of its major dialects, Pho and Sgaw, each of which has a number of subdialects, are of concern to us here.

The Pho variety treated here is spoken in the village of Paa Sangngaam in the province of Chiangrai, northern Thailand. The single native speaker available to me was a woman in her twenties with a secondary-school education and some training in a vocational school. Although her first language was Karen, she also spoke Northern Thai and Standard Thai and was studying English at The University of Connecticut, while her American husband worked on a Master's degree. Her dialect has the following obstruents that seemed amenable to the proposed approach:

Voiced unaspirated:	b	d		
Voiceless unaspirated:	p	t	c	k
Voiceless aspirated:	ph	th	ch	kh

My hypothesis for these stops and affricates was simply that the distinctions of voicing and aspiration would lie along the VOT dimension, although an articulatory complication with regard to the affricates /c ch/ will have to be discussed.

Our Sgaw variety is spoken in Taunggyi, Southern Shan States, Myanmar (Burma). My one native informant was a woman in her thirties doing graduate work toward a Master's degree at The University of Connecticut. She also spoke Burmese and English. Her dialect is the one mentioned earlier as having a two-way distinction for sibilants along with a three-way distinction for stops:

Voiced unaspirated:	b	d		
Voiceless unaspirated:	p	t	s	k
Voiceless aspirated:	ph	th	sh	kh

The stop systems, including the lack of a dorsovelar voiced stop, are the same in both dialects. Indeed, they are the same as in neighboring Thai and Shan. A striking trait of the Sgaw variety is the pair of sibilants /s sh/ distinguished by aspiration. This is rare in the languages of the world. Again, my hypothesis was that in speech production the distinctions of voicing and aspiration would lie along the VOT dimension.

PROCEDURE

The eliciting of utterances was done in the same way for both dialects, one in one semester of the graduate course Field Methods in Linguistics and the other in another semester five years later. We worked with each informant for three or four hours a week over a period of four months or so. All sessions were recorded on tape. A few hundred isolated words were elicited from the informant with a view toward obtaining a basic vocabulary and determining the system of tonal, consonantal, and vocalic contrasts. Usually three utterances of each word were recorded. Many of these lexical items were then used to form phrases and sentences for syntactic analysis. In addition, narrative passages were recorded and later analyzed linguistically with the help of the informant.

For both Karen dialects all occurrences of words containing the consonants of interest were digitized at a sampling rate of 22, 254 Hz and analyzed acoustically by means of the Signalyze™ program on Macintosh computers. Data for citation forms and for words embedded in running speech were recorded separately.

Both wave forms and wideband spectrograms, time-aligned in the displays, were used for making measurements of the timing of glottal pulsing relative to acoustic indices of articulatory closure and, in the case of sibilants, constriction. For the analysis of stops and affricates, the conventions of voice onset time (VOT) were used (Lisker & Abramson, 1964). That is, with the value of zero assigned to the moment of release, onsets of voicing before the release ("voicing lead") were recorded as negative values in milliseconds, while onsets after the release ("voicing lag") were recorded as positive values. For intervocalic /bdg/ voicing leads were measured only if there was a break in the glottal pulsing between the offset of the vowel formants and voicing onset in the stop closure; if there was no break, the item was described as "unbroken."

For the special case of sibilants in the Sgaw dialect, in order to facilitate comparison between /s/ and /sh/, two measurements were made. One was the duration of the frication noise and the other, VOT from the offset of the frication. Of course, given the spectral nature of turbulence, especially in the transition from frication to aspiration, the best possible estimates were made through inspection of the spectrograms.

RESULTS

Stop Consonants in Citation Forms

The data for the stop consonants of the Pho dialect of Karen in citation forms of words from the speech of one informant are displayed in Table 1. Means, standard deviations, and numbers of tokens are shown on the left for word-initial position and on the right for medial intervocalic position. Unfortunately, statistical tests for levels of significance seemed futile because of the very small numbers of tokens, as few as 1–3 in many of the cells of the five tables. In addition, neither the original informants nor others have been available to me for some time. Speakers of these two languages are hard to find away from their homelands. For the instances of unbroken voicing, of course, the cells for standard deviations are blank.

It is quite clear, even without significance levels, that the separation between categories along the VOT dimension is good. Note that in spite of the absence of a voiced dorso-velar stop in the system,[1] the voiceless unaspirated /k/ stays in the short-lag region, even in intervocalic position.

TABLE 1. *Initial and medial intervocalic Pho Karen stop consonants in isolated words: "Unbr" = unbroken glottal pulsing.*

	VOT in ms					
	Initial			Intervocalic		
	/b/	/p/	/ph/	/b/	/p/	/ph/
M	−64	5	59	Unbr	11	48
SD	−31	4	13	—	5	14
N	12	6	6	2	3	9
	/d/	/t/	/th/	/d/	/t/	/th/
M	−65	9	56	Unbr	13	65
SD	−17	10	18	—	2	6
N	9	3	15	3	3	3
		/k/	/kh/		/k/	/kh/
M		18	64		21	128
SD		6	19		10	45
N		6	8		3	3

[1]The phone [g] may occasionally appear as a variant of the dorso-velar voiced fricative /ɣ/.

The data for the stop consonants of the Sgaw dialect of Karen in citation forms of words from the speech of one informant are displayed in Table 2. Here, too, the categories are well separated along the VOT dimension. Aside from making the same generalizations here as for the Pho stops, I am prevented by the paucity of data from making quantitative comparisons between the two dialects.

Pho Affricates in Citation Forms

If the Pho alveolo-palatal affricates, voiceless unaspirated /c/ and voiceless aspirated /ch/, are to be included in this laryngeal-timing framework, certain conceptual problems have to be faced. Let us consider them with the help of Figure 1.

In Figure 1 note that I have shown the time from the release of the full closure to the onset of glottal pulsing to be, in this particular pair, 41 ms for the syllable /ci/ and 152 ms for the syllable /chi/. In the general sense of this paper, these may be taken to be two spans of voicing lag that, if typical, surely differentiate the two categories much as VOT does for the stops. Looking closely at the spectrograms, however, we are hard put to claim that we have anything substantial other than the local turbulence of the fricative portions of the affricates, with the "aspirated" one showing a considerably longer duration of frication.

TABLE 2. *Initial and medial intervocalic Sgaw Karen stop consonants in isolated words: "Unbr" = unbroken glottal pulsing.*

	VOT in ms					
	Initial			Intervocalic		
	/b/	/p/	/ph/	/b/	/p/	/ph/
M	−102	9	92	Unbr	16	80
SD	−19	6	13	—	6	13
N	6	17	9	2	3	9
	/d/	/t/	/th/	/d/	/t/	/th/
M	−121	13	94	Unbr	13	98
SD	−11	11	12	—	6	—
N	3	16	16	7	5	1
		/k/	/kh/		/k/	/kh/
M		10	96		14	109
SD		5	11		8	18
N		8	9		5	16

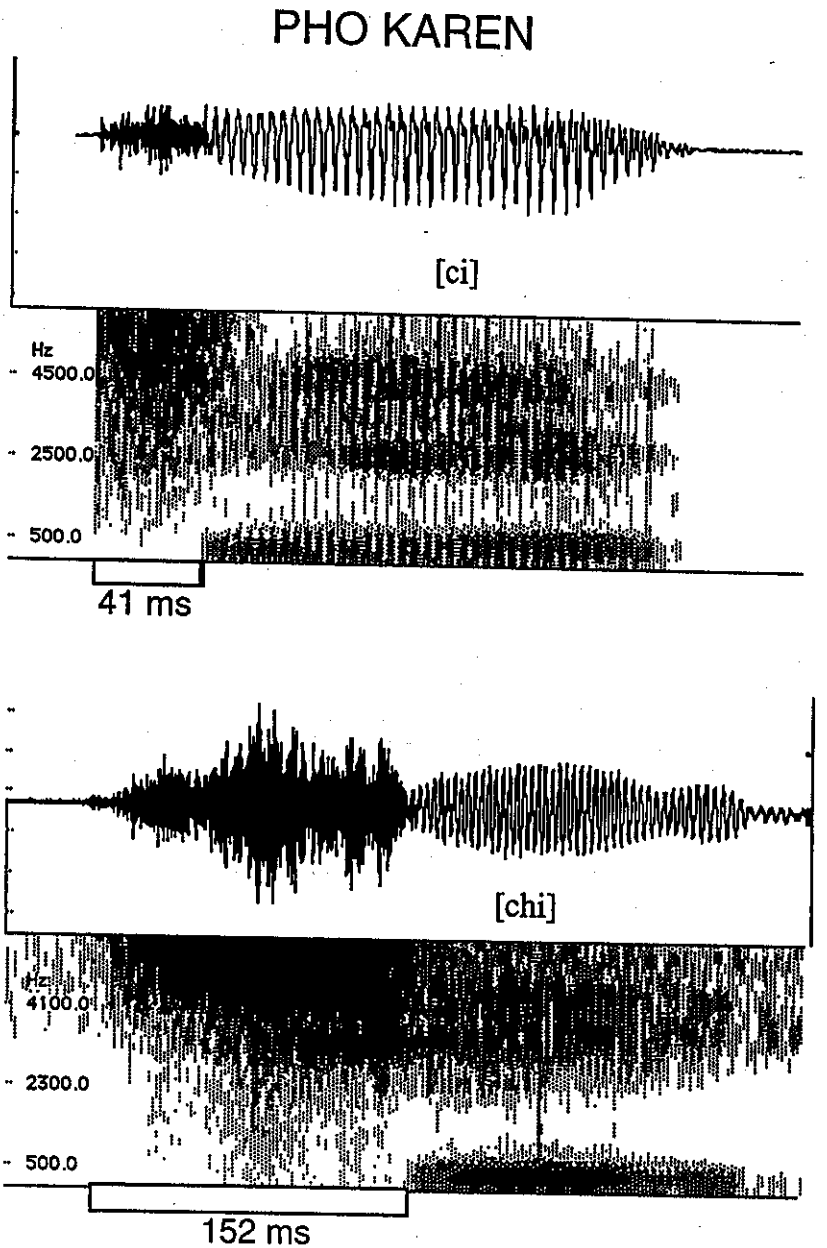

FIGURE 1. Wave forms and wideband spectrograms of the Pho Karen affricates. Top: voiceless unaspirated /c/. Bottom: voiceless aspirated /ch/.

That is, even if, toward the end of the frication, as the articulators open into the vocalic span, there might be a bit of aspiration, (i.e., noise-excitation of the overall supraglottal vocal tract by glottal turbulence), it alone surely could not serve to differentiate the two affricates. Admittedly, then, there is a gestural difference between "aspirates" of this type and aspirated stops. That is, the fricative portion of the "aspirated" affricate is longer than that of the "unaspirated" affricate, so one could argue for a length distinction that is unique in the phonology to this pair of consonants. On the other hand, given the full consonant system, it is tempting to align them with the two voiceless-stop categories. If so, we find that the two sets of values of voicing lag measured from the occlusive release, as seen in Table 3, do indeed separate the two categories, but we must understand that in this case VOT is the output of a gestural complex. The situation is the same in neighboring Thai (Abramson, 1989).

SGAW SIBILANTS IN CITATION FORMS

Although the sibilants /s sh/ of Sgaw Karen are indeed obstruents, they do not figure among the plosives discussed so far, yet they appear to belong to the same subsystem in that they exploit the property of aspiration. Wave forms and wideband spectrograms of such a minimal pair of syllables are illustrated in Figure 2. In the lower spectrogram an estimate is marked of the transition point between the frication ([s]) and the aspiration ([h]) of the token of /sh/. In contrast to the case of the Pho aspirated affricate, here one can not only also see the overall cavity turbulence with vowel formants going through it but can also easily hear the latter as aspiration distinct from the preceding frication.

The data of Table 4 are arranged to show the duration of the [s]-frication for both consonants. It is longer for /s/ than for /sh/. For the latter we see also the duration of the aspiration (labeled [h]) which constitutes true voicing lag, and so, in the conventional sense, distinguishes the two consonants; it is virtually impossible to find measurable aspiration in plain /s/. For /sh/ in the two contexts, the final column gives the total duration, labeled [s^h], of voiceless turbulence.

TABLE 3. *Initial and medial intervocalic Pho Karen affricates in isolated words.*

	VOT in ms			
	Initial		Intervocalic	
	/c/	/ch/	/c/	/ch/
M	35	108	36	85
SD	12	41	4	33
N	8	6	3	5

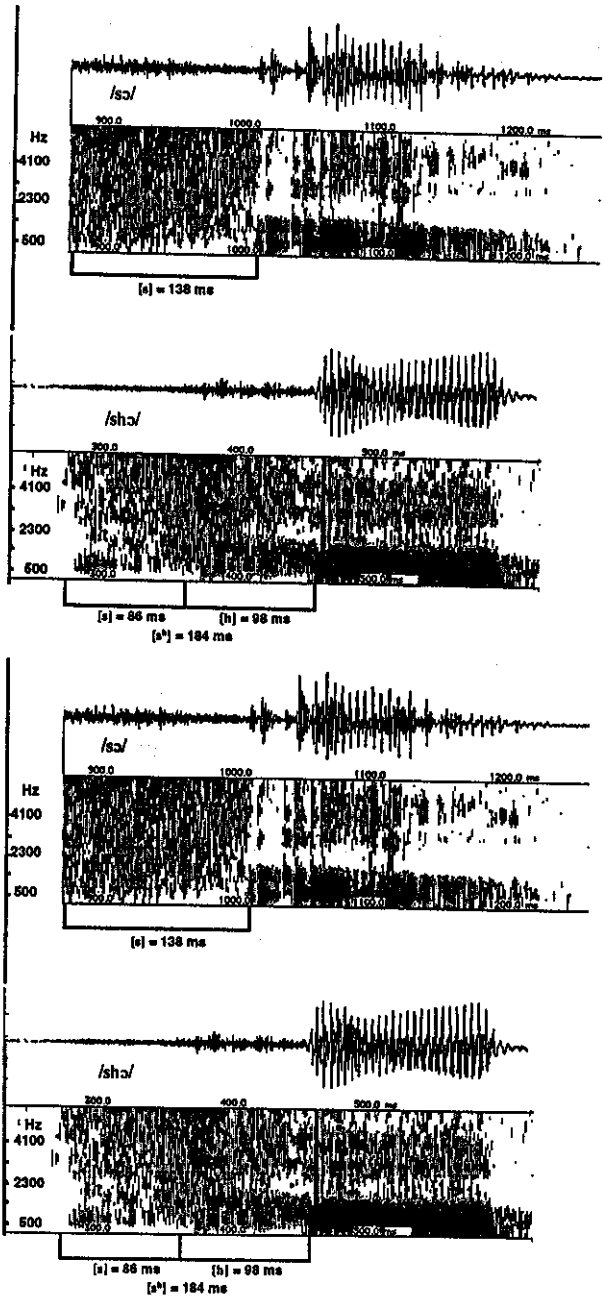

FIGURE 2. Wave forms and wideband spectrograms of the Sgaw Karen sibilants. Top: unaspirated /s/. Bottom: aspirated /sh/.

TABLE 4. *Initial and medial intervocalic Sgaw Karen sibilants in isolated words. [h] = aspiration.*

	Duration of Turbulence and Aspiration in ms							
	Initial				Intervocalic			
	/s/	/sh/			/s/	/sh/		
	[s]	[s]	[h]	[s^h]	[s]	[s]	[h]	[s^h]
M	156	126	69	195	189	148	74	222
SD	8	14	12	23	9	13	14	23
N	3	14	14	14	3	7	7	7

Brief Treatment of Running Speech

Regrettably, failing to look beyond the scope of the Field Methods course to the possibility of an acoustic study, I did not have my two informants record a great deal of running speech. Some of the tokens of relevant consonants in the narrative material could not be used because of low signal level or intrusive noises. I have limited myself in Table 5 to data from the medial intervocalic aspirated consonants of the two dialects. My thought was that they might be the ones most vulnerable to variation in running speech. In addition, there were fewer tokens for most of the rest of the consonants and none for some.

The entries of Table 5 are arranged to show a comparison of the aspirated consonants in running speech with their counterparts in citation forms of words. The latter values are taken from the preceding four tables. Out of eight comparisons, five voicing lags are longer for citation forms than for running speech. (This includes Sgaw /sh/ whether one takes the [h]-portion alone or the total duration of turbulence.) With so few data, however, I cannot as yet attach significance to this finding. In general, the data do allow us to say that the characteristic long voicing lags of the voiceless aspirates are well maintained.

CONCLUSION

The sufficiency of laryngeal timing, with voice onset time as its index, appears to be clear as a differentiating acoustic property for the sets of homorganic consonants of Karen treated here. Extending this criterion to the two voiceless alveolo-palatal affricates of Pho Karen is, in my view, justified by their place in the system of obstruents and, of course, by the data, although one does have to provide for gestural complexity in the account. In the case of the Sgaw Karen sibilants the relevance of this temporal property seems quite firm. This finding is especially interesting, given the rarity of such a distinction in the languages of the world.

It would certainly be desirable to validate the perceptual efficacy of voice timing through experiments with suitable stimuli and a number of native speakers as subjects. Perhaps on a forthcoming visit to Southeast Asia I can do that for at least one of the dialects.

TABLE 5. *Comparison of medial intervocalic voiceless aspirated consonants in words and running speech. [h] = aspiration.*

Intervocalic /ph/

	Pho		Sgaw	
	Words	Running Sp.	Words	Running Sp.
M	48	56	80	94
SD	14	16	13	9
N	9	9	9	3

Intervocalic /th/

	Pho		Sgaw	
	Words	Running Sp.	Words	Running Sp.
M	65	52	98	102
SD	6	19	—	6
N	3	19	1	3

Intervocalic /kh/

	Pho		Sgaw	
	Words	Running Sp.	Words	Running Sp.
M	128	58	109	101
SD	45	23	18	9
N	3	8	16	2

Intervocalic /ch/ and /sh/

	Pho /ch/		Sgaw /sh/					
			Words			Running Sp		
	Words	Run. Speech	[s]	[h]	[s^h]	[s]	[h]	[s^h]
M	108	85	148	74	222	136	62	198
SD	41	33	13	14	23	14	15	6
N	6	5	7	7	7	3	3	3

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Having known Kathy Harris for 39 years, I am very happy to offer this modest contribution in her honor. I first met her in 1955 when she overwhelmed me with a lucid lecture on psychophysics in a Columbia University graduate course taught by Franklin S. Cooper. Not too long thereafter I became her colleague and then, to my delight, her friend.

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