Hmong Complex Initials

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White Hmong, which belongs to the West Hmongic subgroup of the Hmong-Mien family of southern China and northern Southeast Asia, is a basically monosyllabic language with a rich system of fifty seven consonants/consonant clusters that occur at the beginning of a syllable.[1] These will be referred to as the complex initials of the language (see Table 1). Consider the coronal [-continuant] initials exemplified in (1) below.

(1) (a) Coronal [+anterior] initials

t	[t]	*tub*	'son'
th	[t^{h}]	*them*	'to pay'
nt		*ntub*	'wet'
nth		*nthuav*	'to open out, unfold'
d	?[d]	*dawb*	'white'
dh	?[d^{h}]	*dhia*	'to jump'
tx	[ts]	*txob*	'pepper'
txh	[ts^{h}]	*txhuv*	'hulled, rice'
ntx		*ntxuav*	'to wash (hands, body)'
ntxh		*ntxhua*	'to wash (clothes), scrub'

(b) Coronal [-anterior] initials

r	[ʈ]	*roob*	'mountain'
rh	[ʈ^{h}]	*rhiab*	'to tickle'
nr		*nres*	'to stop'
nrh		*nrhiav*	'to look for'
c	[t^{j}]	*cub*	'to steam rice'
ch	[t$^{j\,h}$]	*cheb*	'to sweep'
nc		*nco*	'to remember'
nch		*nch*	'to pour out'
ts	[ʧ]	*tsev*	'house'
tsh	[ʧ^{h}]	*tsheb*	'vehicle'
nts		*ntsuab*	'green, greenish blue'
ntsh		*ntshai*	'to fear'

	bilabial	lab/lat rel	lab/dent	[dental	fric rel	palatalized]	[alveolar	lamino-	post-alv]	palatal	velar	uvular	glottal
V-LESS UNASP STOPS	*p* p	*pl* pl̪		*t* t̪	*tx* t̪s̪	*c* ţ	*d* d:	*ts* tʃ	*r* tṛ		*k* k	*q* q	ʔ
V-LESS ASP STOPS	*ph* pʰ	*plh* pḷ		*th* t̪ʰ	*txh* t̪s̪ʰ	*ch* ţʰ	*dh* d:ʰ	*tsh* tʃʰ	*rh* tṛʰ		*kh* kʰ	*qh* qʰ	
PRE-NASAL STOPS	*np* mb	*npl* mbl̪		*nt* n̪d̪	*ntx* n̪d̪z̪	*nc* ɲd̡		*nts* ndʒ	*nr* ɳtṛ		*nk* ŋg	*nq* NG	
PRE-NASAL ASP STOPS	*nph* mpʰ	*nplh* mpḷ		*nth* n̪t̪ʰ	*ntxh* n̪t̪s̪ʰ	*nch* ɲţʰ		*ntsh* ntʃʰ	*nrh* ɳtṛʰ		*nkh* ŋkʰ	*nqh* ɴqʰ	
VOICED FRICS			*v* v					*z* ʒ					
V-LESS FRICS			*f* f	*x* s̪				*s* ʃ		*xy* ç			*h* h
VOICED NASALS	*m* m	*ml* ml̪		*n* n̪						*ny* ɲ	*g.* ŋ		
V-LESS NASALS	*hm* ʰṃ	*hml* ʰṃḷ		*hn* ʰṇ						*hny* ʰɲ̣			
VOICED LIQUID				*l* l̪									
V-LESS LIQUID				*hl* hḷ									
GLIDE										*y* j			

Table 1: White Hmong Consonantal Phonemes (cf. Strecker 1987; Ratliff 1992)

The coronals in (1) are similar in that all have a noncontinuant obstruent as a component, singly or in combination. The [+anterior] initials are dentalized; the grapheme *x* represents a coronal fricative [s]. The [-anterior] initials are a three-way series of a retroflexed [ʈ] (represented as *r*) set, a palatalized [tʲ] set (represented as *c*), and a palato-alveolar affricate set (represented as *ts*). In terms of features, each [anterior] set contrasts (i) unaspirated ([-spread glottis]) with aspirated consonants ([+spread glottis]), (ii) plain with affricated release, and (iii) with one exception, a plain consonantal onset series to a nasal onset series. Of importance is the asymmetry in the [+anterior] series. Here, the orthographic ***d*** - ***dh*** lack corresponding prenasalized consonants in White Hmong (**nd* and **ndh*) and are unusual in that they would appear to be the only noncontinuant obstruents that are voiced. Note too that the corresponding [-anterior] set (*c*, *ch*, *nc*, *nch*) contrasts not [voice] but [spread glottis] and is distinguished from its other [-anterior] consonant sets in a release feature (palatalized, as opposed to retroflexed or affricated), but not in a laryngeal feature.

In contrast, in Green Hmong (the second major dialect of Hmong) as shown in (2) below, the corresponding [+anterior] set is not asymmetric: we find in this dialect *dl*, *dlh*, *ndl*, *ndlh*; while these segments are thought to be voiced, there is no gap in the prenasalised series and the set contrasts to other [+anterior] sets in a release feature (lateralized as opposed to plain or fricated).

(2) Green Hmong

(a)	*dl*	corresponds to *d* in White Hmong	
	dlh	corresponds to *dh* in White Hmong	
	ndl	*ndluav*	'to throw out (liquid)'
	ndlh	*ndlhij ndlhuaj*	'sound of walking through mud'
(b)	lacks the White Hmong voiceless sonorant series.		

These coronals and the other initials present several interesting issues regarding the nature of the underlying feature system and the representational question of whether these initials are underlyingly one complex segment or a sequence of two or more consonant segments. As can be seen in Table 1 and the data in (1), the language contrasts [spread glottis] throughout the phonological inventory, but the feature [voice] appears to be underlying in *d* - *dh* (and possibly in *z*) and perhaps in the prenasalized series where there is either phonological voicing /mb, mbl, nd, ndz, nd^{y} ,ndʒ, NG/ (e.g. Strecker 1987, Ratliff 1992; see Table 1) or phonetic post-nasal voicing of underlyingly voiceless obstruents.

These asymmetries are puzzling for several reasons and in this paper, we focus on three questions: (i) What is the phonological structure and phonetic content of the laryngeal feature system in Hmong? (ii) What feature is contrastive in the obstruent series? (iii) What is the structure of the prenasalized series where, if [voice] is redundant in sonorants in Green Hmong, we find an inert feature triggering voicing? Evidence will include data from an acoustic phonetic study of White Hmong complex initials (section 3, below).

Before turning to these questions in Hmong, we must first look at a difference between two types of features, contrastive and redundant feaures (section 1), and second at a relevant typology, *NT, that has been proposed to account for voicing in nasal+obstruent clusters (section 2).

1.0 Contrastive and redundant features

There is a basic difference in two types of features: contrastive features operate in phonological rules while predictable, redundant features overwhelmingly do not. The phonological inertness of voicing in sonorants is classic evidence for underspecification of redundant features in rule-based theories (Kiparsky 1981; Steriade 1987, 1995). For example, in most languages sonorants do not contrast in voicing and do not participate in rules that operate on the features [voice]. This is the case in Russian where sonorants are noncontrastive for [voice] and fail to trigger or block voicing assimilation (Kiparsky 1985). Similarly, Japanese sonorants are not subject to the voicing constraint of Lyman's Law (3, below) and also fail to block voicing dissimilation in 'sequential voicing' of Rendaku (4, below), both of which hold in the Yamato--or native Japanese--part of the language (Ito and Mester 1986).

(3) Lyman's Law: /futa/ 'lid', /fu**d**a/ 'sign', */**b**u**d**a/
(Ito and Mester 1986)

(4) Rendaku
/ori+kami/ -> ori-**g**ami 'paper folding',
/yama+tera/ -> yama-**d**era 'mountain temple'
/kami-ka**z**e/ -> kami-ka**z**e 'divine wind',
*kami-**gaz**e
(Ito and Mester 1986)

In classic derivational theory, redundant phonological features are taken to be unspecified. Since phonological rules and constraints can only make reference to specified features, the redundant feature of [voice] in sonorants in Russian and Japanese is predictably inert. Under the locality condition, sonorants in Japanese do not block Rendaku in (4) because they are [0 voice] at the point in the derivation where the rule operates.[2] Many interesting results of the past several decades have centered on this difference between the contrastivity or redundancy of phonological features, and underspecification has accordingly played a major role in the explanation of these generalizations.

If we assume as has been claimed in the literature that the post-nasal obstruents in (1) (and in Table 1) are phonetically voiced in both White Hmong and Green Hmong, we find the anomalous situation in Green Hmong (which lacks contrastive [voice] in sonorants) where voicing is trigged by the redundant, noncontrastive feature. We will return to this issue in section 5.

2.0 Nasal + obstruent clusters

Cross-linguistically, obstruent consonant clusters agree in voicing, a general phonotactic constraint that in languages like Russian often gives rise to a phonological rule that assimilates in one way or another the voicing of obstruents that come together at morpheme boundaries. The unmarked case for nasal + obstruent clusters is similarly [+voice], which we will represent as "ND" clusters. The marked case then would be for the nasal to combine with a voiceless obstruent, which we will represent as "NT" clusters. Pater 1999 argues that languages resolve violations of the unmarked contraint, *NT, in a small number of ways: (1) deletion of the nasal before a voiceless obstruent (Kelantan Malay); (2) nasal substitution where the voiceless stop deletes after nasal assimilation (Indonesian); (3) post-nasal voicing of the obstruent (Puyu Pungo Quechua); (4) denasalization (Austronesian languages like Mandar, Toba Batak, and Kaingang). (There are no known cases of a logically possible fifth means, vowel epenthesis.) In the typological survey of Pater 1999, there are Austronesian languages that exemplify (1-2) and (4) but none for (3). For (2), Pater cites the well-known case of the *meng-/peng-* prefixation in Indonesian, illustrated in (5).

(5) Nasal substitution — Indonesian

(a) NT clusters

[-son, -voi]->0 / [+nas] ___

/məN-pilih/ ->	[məmilih]	'to choose, to vote'
/məN-tulis/ ->	[mənulis]	'to write'

(b) ND clusters

/məN-bəli/ ->	[məmbəli]	'to buy'
/məN-dapat/ ->	[məndapat]	'to get, to receive'

In (5a), the *NT violation is removed by deletion of the voiceless obstruent. However, there are additional facts in Indonesian that are not noted in Pater 1999. First, there are nasal + obstruent clusters that are found morpheme internally (6, below). These clusters, as shown in (6b) below do not undergo the deletion rule in (5a).

(6) (a) *lambat* 'slow' (b) *lompat* 'to jump', *jemput* 'to fetch'
undang 'to invite' *ganti* 'to change', *tante* 'aunt'

In addition, nasal + voiceless obstruent clusters that arise at the stem-suffix boundary also do not undergo the (5a) deletion rule, as shown in (7).

(7) *mengomongkan* 'to talk about someone or something'
meng - *omong* *-kan*
active prefix- 'to chat' - transitivizing suffix

Clearly, Indonesian permits NT clusters. Moreover, the rules affecting the *meng-/peng-* prefixes maintain the underlying [voice] contrasts of the stem initial consonants by differentially operating on voiced versus voiceless phonemes. The languages that Pater cites (and many others like them) as showing resolution type (3), post-nasal voicing, in contrast are languages in which there is *no* underlying phonological contrast of [voice] in obstruents, and it is the *contrastivity* of [voice] in obstruents that likely accounts for the absence of post-nasal voicing in languages Austronesian languages like Indonesian, Toba Batak, etc. (Macken 2000b). Let us now return to Hmong.

3.0 Acoustic evidence

Assuming that, as has just been argued, languages preserve contrast *ceteris paribus* and that lexical minimality (the principle of underspecification) requires a minimal set of phonemically contrasting features, then there is unexpected duplication in the Hmong system, which appears to employ both [spread glottis] and [voice] in its inventory of phonemic contrasts, and there is a contradictory role for [voice] in nasal+obstruent complex initials.

To obtain more complete phonetic evidence, an acoustic study was carried out, using randomized word sets with the coronal initials exemplified in (1) above as stimuli. Words were produced twice in isolation and in a sentence frame. Subjects were four adult native White Hmong speakers, 25-45 years of age. Each speaker was recorded in a low noise phonetics lab. Stimuli were recorded digitally and analyzed using CSpeech acoustic software. Speakers were bilingual, with Hmong as their dominant language and the language of the home. Given the topic and the space limitations here, the discussion below focuses on the data as evidence for phonological categories, rather than on the full range and details of the phonetic data (to be published separately). Data are presented here from one (female) speaker, and, of the acoustic measurements made, only voice onset time will be discussed. Voice onset time (VOT) was measured from the stop burst release to the onset of regular striations corresponding to the onset of vocal fold vibration.

For voiceless, unaspirated coronals, VOT values fell within an expected short lag region of zero to +20 ms, with values for [t] and retroflexed [ʈ] generally somewhat shorter than those for [tʲ], as exemplified in Figures 1 through 3.[3]

Figure 1. [t] — *tub* 'son'

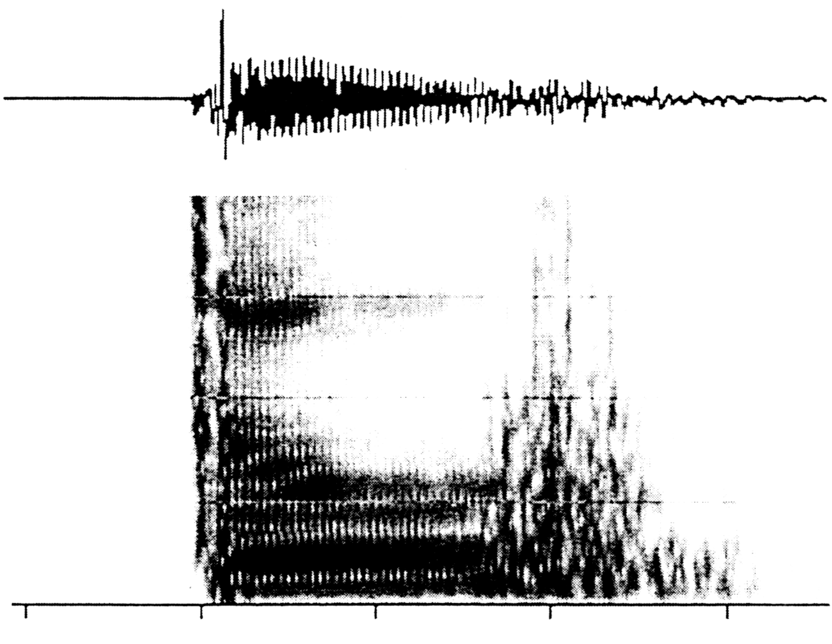


Figure 2. [ʈ] — *roob* ‘mountain’

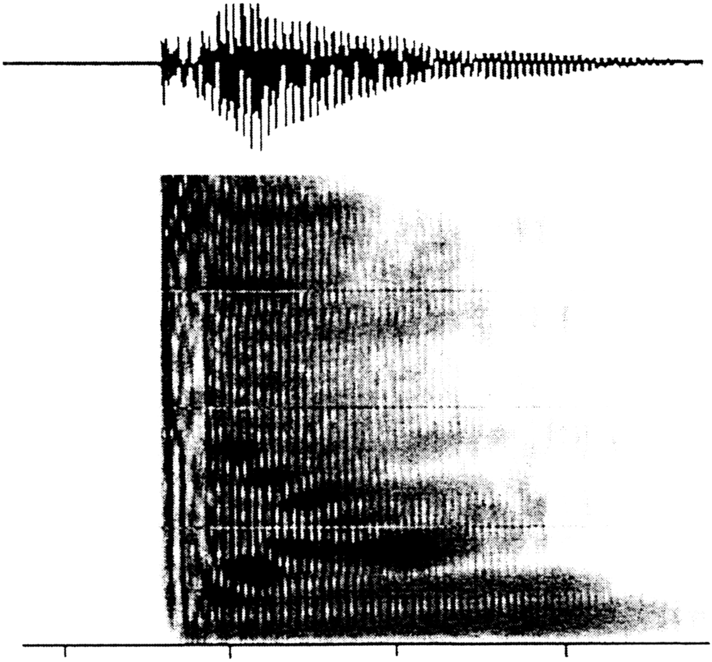
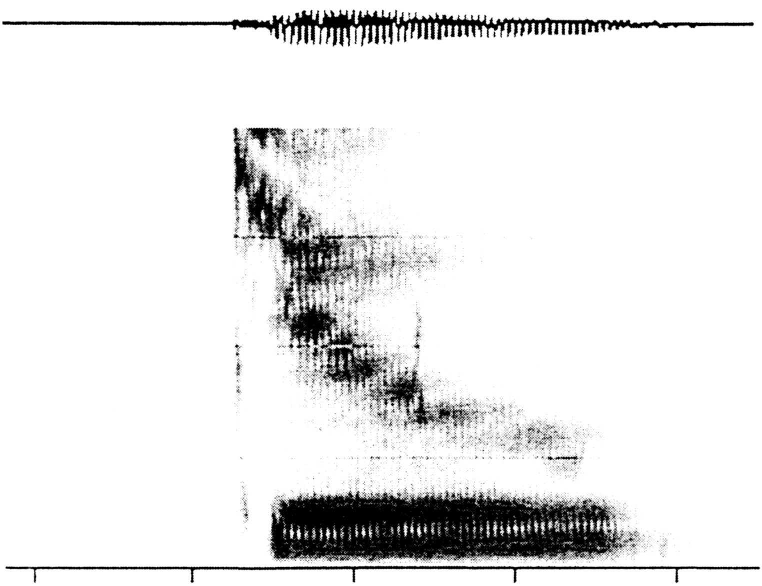


Figure 3. [t^j] — *cub* ‘to steam rice’



Voiceless aspirates show VOT values in the expected long lag region of +45 to +90 ms. The resulting VOT contrast is maintained when prenasalized, e.g. *nt* and *nth* (Figures 4 and 5).

Figure 4. [nt] — *ntub* 'wet'

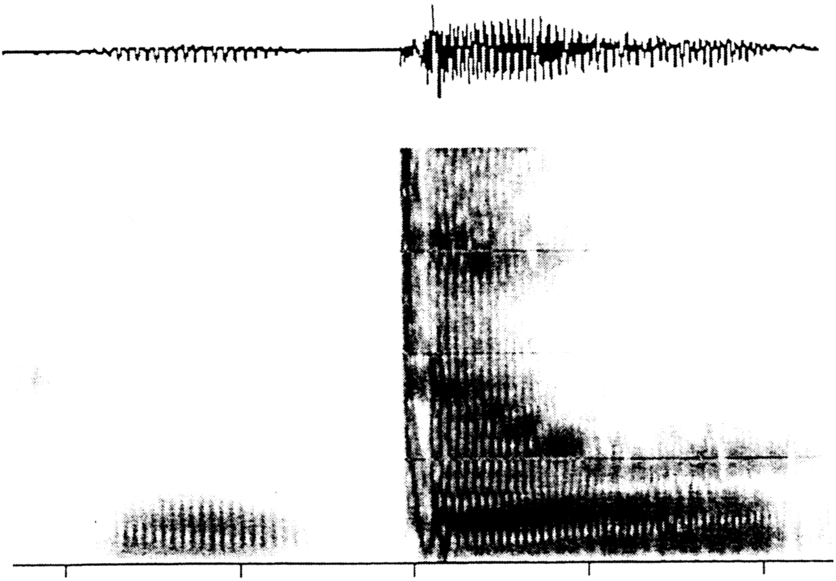
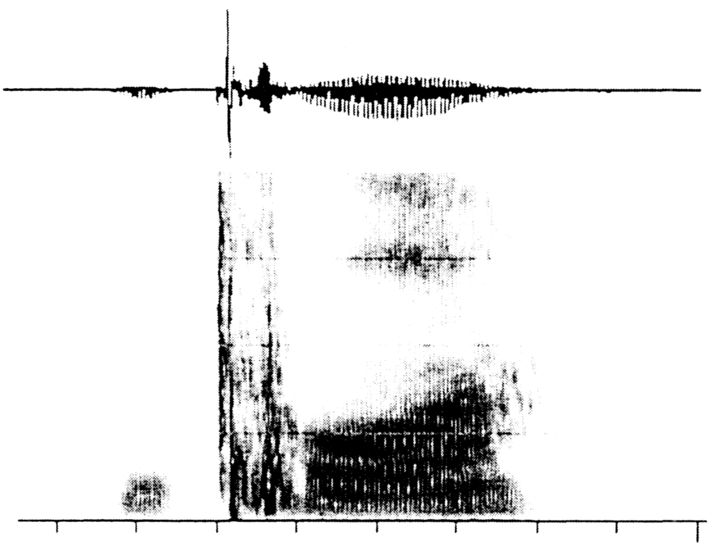


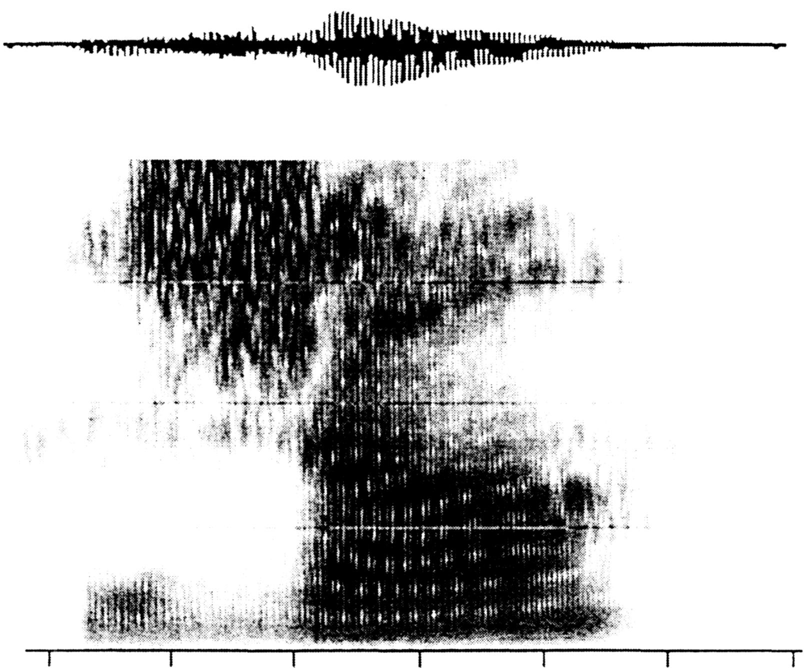
Figure 5. [nt^h] — *nthuav* 'to open, unfold'



As can be seen in Figure 4 (and, not surprisingly, in Figure 5), there is no post-nasal voicing. This phonetic evidence indicates that both phonologically and phonetically the post-nasal consonants that have variously been analyzed as "voiced" in words like *ntub/ndub* 'wet' or *nco/njo* 'to remember' are voiceless, unaspirated stops.

Before turning to the White Hmong *d* and *dh*, we can verify that the fricative *z* is indeed voiced, as can be seen in Figure 6. Due to space limitations, a spectrogram for *s*, as in *sub* 'to warm something over a fire', is not included here, but tokens of all *s*-words show a acoustic characteristics typical of a voiceless strident fricative and, as expected, no voicing.

Figure 6. [ʒ] — *zob* 'to sharpen (an arrow)'



Of particular interest finally are the White Hmong *d* and *dh*, variously described, respectively, as "d comme dans *doight*" and "d aspiré" (Mottin 1978) , as [d:] and [d:h] (Ratliff 1992) or as glottalized [?d] and [?th] ('a slight catch in the throat', Smalley

1990). Consider the spectrograms in Figures 7 and 8.

Figure 7. *d* — *dub* 'black'

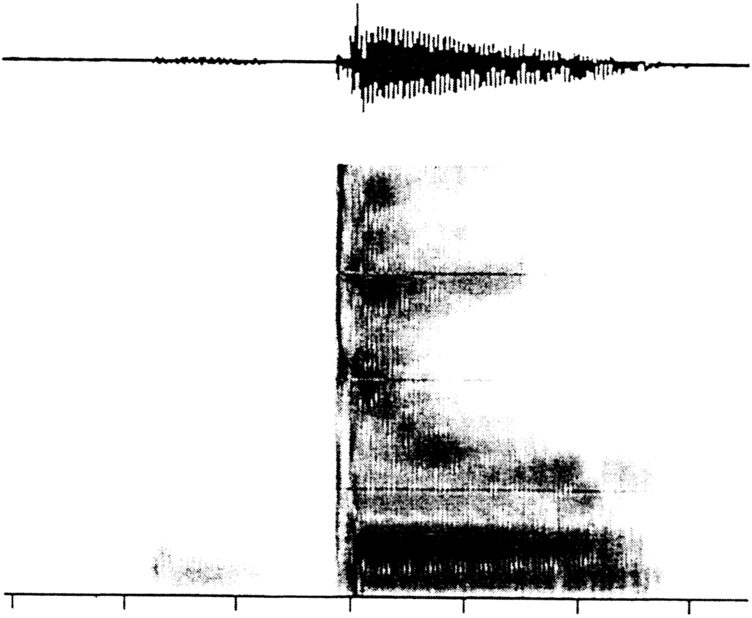
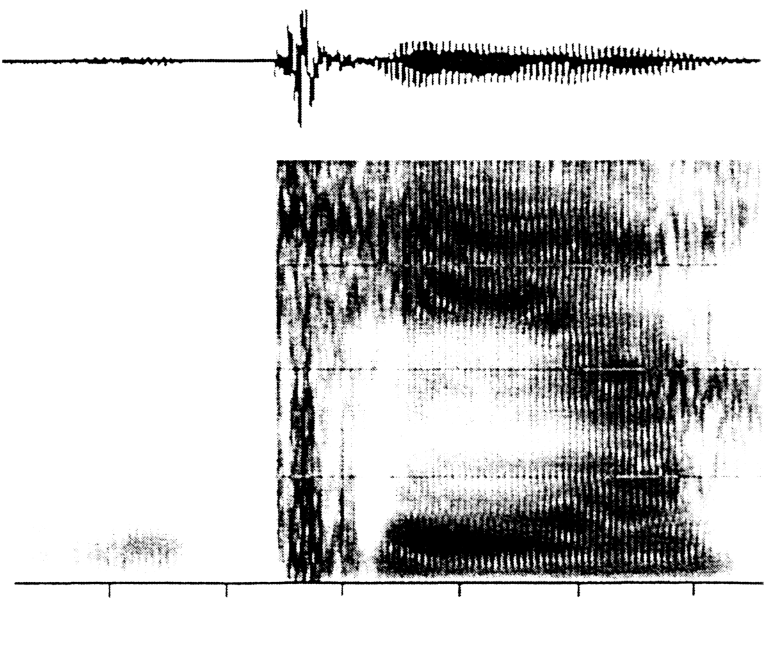
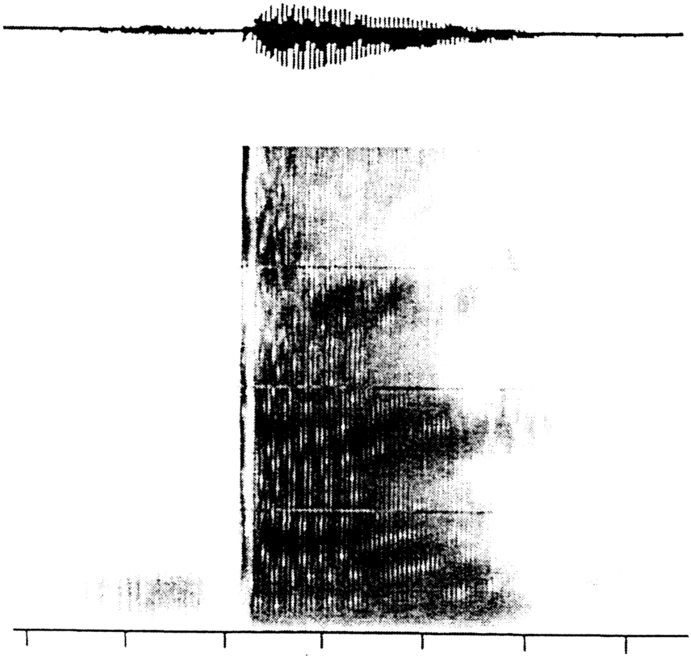


Figure 8. *dh* — *dhia* 'jump'



As can be seen in Figures 7-8, *d* and *dh* are complex segments produced with a period of prevoicing (similar in duration to that of the nasal in pre-nasalized consonants) followed by *voicelessness* during the closure and a release that is voiceless unaspirated in *d* and aspirated in *dh*. These sounds are not the typical voiced, long lead stop that is found in the voiced stop series in languages like Spanish, where voicing continues throughout the closure.[4] While there is no increase in amplitude of voicing toward the closure in these stops of the kind that is typical of glottalization, occasional tokens show some irregularity in the timing of vocal fold vibration at the onset of voicing and resonance around 2000 Hz. See Figure 9 below.

Figure 9. *d* — *dawb* 'white'



The phonetic evidence indicates that these "voiced" alveolar stops are voiceless unaspirated or aspirated stops, with a voiced 'sonorant-type' onset — patterning in part with prenasalized stops at other places of articulation. Further acoustic research on the nature of the sonorant onset is in progress.

4.0 Discussion

The phonetic data with the phonological evidence resolves our puzzles by showing that the inventory is symmetric and lexically minimal, and that there is no inert feature triggering voicing assimilation in NT clusters (in both dialects, assuming Green Hmong has the same structure in this respect). Hmong contrasts [+/- spread glottis] in the complex initials that have a [-continuant] component and, most strikingly, as a component of the so-called 'voiced' stops *d* and *dh*. Given that fricatives can bear [spread glottis] feature values, symmetry in the system results from an analysis in which the voiceless fricatives are also contrastively [+spread glottis], with the voiced fricatives /v/ and /ʒ/ [-spread glottis]. We find compelling supportive evidence for this analysis in which the fricatives /f,s,ʃ,ç,h/ are also [+spread glottis] if we look at the Hmong tonal co-occurrence constraint given in (8).

(8) *[spread glottis] and -g tone constraint: the -g tone cannot co-occur with any aspirated consonant, C^h, *or* with the voiceless fricatives / f, s, ʃ, ç, h /.

$$
\begin{array}{lccc}
 & & \sigma & \\
* & / & | & \backslash \\
 & [+\text{spr gl}] & \text{V} & \text{-g}
\end{array}
$$

In constrast to (8), we find voiced fricatives and voiceless unaspirated stops freely co-occurring with the -g tone, as for example, *zag* classifier for 'story' or 'donkey', *vag* 'one armful (measurement)', and *tuag* 'to die'.

The Hmong complex initials are then indeed singleton segments that differ in phonologized onset and release features and the language syllable structure is phonologically CV. A complex segment like *d* is in effect a phonological factorization and linearization of features that in a language like, say, English are phonologically simultaneous. This results in a sequential structure for *d* and *dh* like that of affricates and prenasalised segments. Evidence from Hmong nativization of words that begin with voiced stops in other languages supports this analysis. In these cases, we find loan words like English *bus* nativized in Hmong as *npav* /mpav/ 'bus'.

Endnotes

1. In addition, there are thirteen vowels (six oral vowels, two nasal vowels and five diphthongs) and seven basic tones. The tones are represented in the orthography by a final consonant: (1) high level 55, *-b* ; (2) high falling 52, *-j* ; (3) mid rising 24, *-v* ; (4) mid level 33, no orthographic symbol; (5) low level 22, *-s* ; (6) low falling with creaky phonation 31?, *-m* ; and (7) falling with breathy phonation 42h, *-g* . There is also a low rising tone (213) variant of the *-m* tone.

2. There are other facts in Japanese that complicate the basic picture, namely an apparent paradox where the sonorant feature for [voice], which is presumably redundant throughout the phonological grammar, is inert in the (a) Lyman's Law/Rendaku cases on the one hand, but is active in (b) voicing assimilation and cluster cooccurrence cases on the other hand. Macken 2000a shows that (a) holds of nasal onsets and (b) of moraic coda nasals and thus is a case of moraic licensing of features.

3. In the figures, a wave form is displayed above the sprectrogram, time increments of 100 ms are marked on the horizontal axis and frequency intervals of 1000 Hz are marked on the vertical axis.

4. These findings contradict the Jarkey 1987 claim that *d* and *dh* are fully voiced and the VOT measurements given in Table 1 of that article (63), though Jarkey does comment that there is an "auditory impression of a slight 'catch' in the voice in some tokens of [...[*d*] that...] can be attributed to a very brief cessation of voicing before the release of the oral stricture (65)."

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