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# AN INSTRUMENTAL ANALYSIS OF SHARCHHOP OBSTRUENTS

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## 1.0. INTRODUCTION*

A great many of the world's languages have never received serious phonetic study. This report concerns itself with one language, colloquially known as Sharchhop, on which no instrumental phonetic investigation has been conducted in the past. Sharchhop-kha, as it is also known, is spoken by about 140,000 citizens of Bhutan (Andvik 1993), a small nation in the Himalayas north of India. Its main variety is called Tshangla, a term which also refers to the central ethnic group of Sharchhop speakers. Tshangla is considered by some sources (e.g., "Bodish Languages" 1991-92) to be a distinct language rather than a dialect of Sharchhop. Either way, both are members of the Tshangla group as classified by Shafer (1955). The Tshangla group is a major division of the Bodish languages, all of which are grouped with the East Himalayan languages to form the Bodic sub-branch within the Himalayish branch of the Tibeto-Burman family.

## 2.0. PHONOLOGY

### *2.1. Consonants*

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **fortis** | p | t | ts | tʃ | ʈ | | k | |
| **lenis** | b | d | dz | ʒ | ɖ | | g | |
| **aspirated** | pʰ | tʰ | tsʰ | tʃʰ | ʈʰ | | kʰ | |
| **fricatives** | | s | | ʃ | | | | h |
| | | z | | ʒ | | | | |
| **nasals** | m | n | | | | ɲ | ŋ | |
| **liquids** | | l | | | r | | | |
| **glides** | w | | | | | j | | |

*Table 1. Consonants of Sharchhop*

* Language material for this paper was gathered under a STEP grant to the University of Calgary, during the summer of 1994, under the direction of M. Dobrovolsky.

Sharchhop has a rich system of obstruents, with plosives in four places of articulation for each of three manners of articulation, and two different affricates exhibiting the three manners. The plosive manners will be called *fortis*, *lenis*, and *aspirated*. This terminology is used because varying degrees of tension seem to be involved in the production of fortis and lenis stops, while Voice Onset Time is not a reliable indicator of stop manner beyond distinguishing the aspirated stops from the other two series. Plosives can be bilabial, dental, retroflex, or velar. The dental stops may be better described by resurrecting the older term *gingival*, as they seem to be produced with the tongue tip against the base of the gums. The retroflex plosives are in free variation with corresponding retroflex clusters [ʈɹ, ʈʰɹ, ɖɹ].

The fricatives are also distinguished along a fortis/lenis dimension; voicing is unimportant in the [s/z, ʃ/ʒ] oppositions provided the articulation is lax. The phoneme /r/ is a retroflex trill, which is pronounced as a flap intervocalically. All consonants are possible as initials, and most were found to occur intervocalically. In final position, however, the only obstruents that occur are the fortis [p, k]. This restricted array of final consonants is a common feature of Sino-Tibetan languages.

### *2.2. Vowels*

Tshangla has essentially five full vowel phonemes (Andvik 1993):

| | | |
|---|---|---|
| i | | u |
| ɪ | | |
| | | o |
| | a | |

The high front vowels are quite similar in quality; the back vowel /o/ is often pronounced as [ɔ], while the front vowel /ɪ/ is a lax vowel whose quality may range down to [ɛ]. There is one diphthong, /aj/.

## 3.0. ACOUSTIC STUDY OF FORTIS AND LENIS OBSTRUENTS

It was mentioned above that the two obstruent classes called here fortis and lenis do not have VOT (in plosives) or voicing (in fricatives) as a reliable distinguishing feature. This is not to say that the lenis segments are never phonetically voiced; one of our informants voiced these segments quite consistently, while the other showed voicing only sporadically. One feature that does distinguish these two obstruent classes is the voice quality of the following vowel. In general, lenis obstruents are followed by vowels with lax

or slack voicing (not to be confused with lax vowels), while fortis obstruents are linked to a tenser voice quality. We speculate that these voice qualities, or *registers*, are produced largely by variation in tension of the glottal source. Laver (1980:145-46) writes: "The two muscular parameters that are most exploited in the laryngeal contributions to tense voice and lax voice are adductive tension and medial compression.[1] In tense voice, the values of both parameters are boosted." In lax voice, on the other hand, "the values of the laryngeal parameters of adductive tension and medial compression are lower than in the neutral state of modal voice." Lax voice is frequently accompanied by varying degrees of breathiness.

This report presents preliminary results of a small utterance corpus elicited from two Sharchhop speakers. The data will be examined for evidence that the voice quality of vowels is in fact affected by the fortis or lenis nature of a preceding obstruent. The effect of obstruents on the voice quality of following vowels has been observed in previous studies of other languages (e.g., Fulop 1994 on Zürich German and Korean; Hardcastle 1973 on Korean).

### *3.1. Procedures*

Two Sharchhop speakers were recorded; only one of these spoke the Tshangla dialect. There are, however, very few substantive lexical, semantic, or phonological differences between the two speakers' dialects with the exception that the non-Tsangla speaker's vowel inventory included infrequent examples of the front rounded vowels [y] and [ø]. The speakers were recorded on a Panasonic Digital Audio Tape machine with a Shure 57 dynamic cardioid microphone and a Peavey 16 channel mixing board. They were asked to give three repetitions of each word in the corpus. The items of interest were subsequently digitized at 8 bit quantization using Soundscope from GW Instruments on a Macintosh Quadra 660AV. Tokens demonstrating the fricatives in word-initial position were also digitized at 16 bit quantization using Computer Speech Lab from Kay Elemetrics. The entire corpus used in this study is reproduced in the appendix.

### *3.2. Methods*

There are several ways to measure the relative voice quality of vowels. One successful method was employed by Maddieson and Ladefoged (1985:437). In this procedure, the difference in amplitude between the fundamental frequency and the second harmonic is measured:

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[1] These terms refer to tension at the meeting point of the arytenoid cartilages and the pressing together of the ligamental glottis, respectively.

> It has been shown by various authors that in a breathy voice there is comparatively more energy in the fundamental and less in the higher harmonics, whereas in a vowel pronounced with a more constricted glottis the reverse is true (Ladefoged 1981, Bickley 1982, Ladefoged 1983, Kirk et al. 1984). Moreover, variation in this parameter, measured by the relative amplitudes of the fundamental and either the second harmonic or the first formant, correlates very closely with listeners' judgments on degrees of breathiness (Ladefoged and Antoñanzas-Barroso 1985), and reflect differences in "spectral tilt" generated in models of the voice source by varying the rate of vocal cord closure in the glottal pulse (Fant 1983).

We have chosen to measure the harmonic amplitudes, as they are more consistent than the formant amplitudes.

Speakers vary in which harmonic amplitude best reflects their voice quality (Peter Ladefoged, pers. comm.), so both the second and third harmonics will be employed in the measure here. Let us call the fundamental frequency's amplitude $A_1$, and the amplitudes of the second and third harmonics $A_2$ and $A_3$. Then the difference $A_n - A_1$ (n = 2 or 3, depending on the speaker) will be a measure of the glottal tension. We thus expect $A_n - A_1$ to be larger the more tense is the voice quality, and smaller (or negative) the more lax is the voice quality, for one of $A_2$ or $A_3$.

The corpus of data to be measured consists of one word illustrating each obstruent in initial position. In each case the obstruent is followed by the vowel [a], except for the [ʃ / ʒ] examples, which are followed by the vowel [u]. There are three tokens of each word for each speaker. Initial VOTs and intervocal closure durations were measured (for the plosives and affricates), as well as intervocal fricative durations. The intervocalic measurements were performed on an additional corpus exemplifying obstruents in this position.

The primary results obtained, however, are from measurements of the fundamental frequency and harmonic amplitudes of the vowels following initial fortis and lenis obstruents (the aspirated plosives and affricates are not included in this part of the study). To accomplish this, a narrow band FFT was generated using a 512 point Hamming window beginning at some point in the initial portion of the vowel, usually 20–40 ms following the start of the vowel. This position for the power spectrum was chosen because it best reflects the influence of the preceding obstruent on the voice quality; further into the vowel, its own inherent voice quality may take over, possibly obscuring any influence of the preceding obstruent. From this spectrum, the frequencies and amplitudes of the fundamental and first two harmonics were measured. The difference