VOICE QUALITY IN THE YI AND BAI LANGUAGES: THE ROLE OF THE ARYEPIGLOTTIC FOLDS

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1. Introduction. What is voice quality? The linguistic use of sound qualities created through settings of muscle tension in various structures. The names given to voice qualities in actual languages include: *tense*, *breathy*, *creaky*, *whisper*, and *harsh*. These often accompany *tone* or *register* in building a contrast in the phonological system.

How widespread is it? Voice quality contrasts are found throughout the Pan Asiatic realm.1 Voice quality is very common in Mon-Khmer languages. For instance, Vietnamese tones in northern pronunciation are said by Thompson (1965:40-1) to show both pitch and voice quality features in :

(1) *Sắc* tone "a pitch high and rising (perhaps nearly level at the high point in rapid speech) and tense."

(2) *Ngã* tone "also high and rising..., but it is accompanied by the rasping voice quality occasioned by tense glottal stricture."

(3) *Huyền* tone "is often accompanied by a kind of breathy voicing, reminiscent of a sigh."

(4) Nặng tone "also tense; it starts somewhat lower than *hỏi*. With syllables ending in a stop [p t ch k] it drops only a little more sharply than *huyền* tone, but it is never accompanied by the breathy quality of that tone."

Among Tibeto-Burman languages tense or lax voice quality is a contrastive feature in Bai, Hani, Yi, Lahu, Lisu, and others (more on this later). Burmese is said to have a creaky closure at the end of Tone 3. In Wu Chinese low tones are accompanied by a breathy quality and Zhenhai Wu has harsh voice quality in Lower Level tone (Yangping) (Rose, 1989). Pa-hng of Bắc Quang (Hà Giang Province, Vietnam), Chiêm Hoa District (Tuyên Quang, Vietnam), and Sanjiang County in Guangxi Province, China has breathy voice in . I believe that there are many other examples from South and Central Asia in languages of Indo-European and Altaic families in which voice qualities figure.

How do speakers produce voice qualities? In general it is believed that voice quality results from different settings of muscle groups to produce sound waves with special properties, including settings that produce pharyngealization and nasalization. Languages such as English, French, German do not demonstrate voice quality except for special settings such as singing. In other languages too, singing will show some properties also found in tense and lax voice.

In this paper I will present data and analysis from direct observation with the laryngoscope of the larynx and supralaryngeal area of speakers of two languages known to show tense and other voice qualities. While only two languages were examined, I believe that the mechanisms are likely also found in other languages.

General phonetics has studied for more than 70 years the possibilities of voice qualities by human speakers. Nevertheless, there has been little detail about which anatomical structures actually function in the production of real speech sounds in native speakers. The most important work to mention in this connection is Laver 1980.

This paper will discuss the voice quality properties of the Yi and Bai langugaes of SW China. We were able to study the speech sounds of Mr. Lama Ziwo of Sichuan Province, and Mr. Li Shaoni of Jianchuan, Yunnan Province by means of the laryngoscope. Our finding is that both Yi and Bai speakers have persuasive similarity (there were also some differences) in producing tense voice quality. Of special importance in the process are the aryepiglottic folds at the top of *aditus laryngis*, a triangular-shaped opening between the larynx and the pharynx. These folds can be sphinctered and sometimes even trilled constricing the opening into the pharynx to produce tense and harsh voice quality. We would note, though, that Bai exhibits voice qualities other than tense voice contrast and therefore can be said to have finer phonetic distinctions than Yi. Thus, it has beside tense voice contrast a kind of harsh voice and breathy voice and for some syllables even sequences of voice qualities harsh-modal and breathy-tense.

2. The Yi and Bai languages of Southwest China.

2.1. Yi. The Yi or Lolo language is one of the largest in China and is spoken in many areas, including southwestern Sichuan, many areas of Yunnan, western Guizhou, and the northwestern tip of Guangxi. The total population in China amounts to 7 million.2

The first systematic study of Yi phonology is attributed to Chen 1963 and Chen et al. 1984, although there have been scattered reports by others. He describes three tones with values 55, 33, and 21. (A fourth tone exists in sandhi position according to Lama Ziwo 1998.) He states that for the lax vowels the vocal fold muscles are tensed to produce an approximation of the glottal lips; for the tense vowels, the muscles of the articulators are much tighter, but the tightness is not prolonged throughout the syllable. Li and Ma 1983 suggest that some of the vowels are "tight throat" or "glottally tense". As these accounts show, "tense" and "lax" are regarded as endpoints on a scale in Yi, whereby "lax" usually means modal, non-tense voice without special stricture whereas "tense" entails some form of added tension. The extact nature of this tension and other related voice qualities is what this paper intends to examine.3

2.2. Bai. Bai is also a Tibeto-Burman language 1.6 million speakers as determined by the census of 1996. It is divided into three vernacular areas that center on Dali, Jianchuan, and Bijiang Counties of Yunnan Province. Mr. Li originates from Jianchuan, but comes from a mountain village and not the county seat.4

In Edmondson and Li (1988, 1994, 1997) we noted that Jianchuan Bai possesses not only a distinctive set of pitch contrasts: 55, 33, 35, 31, and 21, but also four different kinds of voice quality contrasts: (a) modal voice, (b) tense voice, (c) breathy voice, and (d) harsh voice.

2.3. Aryepiglottic folds. Articulations in the supralaryngeal area have attracted considerable interest in recent years. In studying the Yi language Maddieson and Ladefoged (1985) perceptively suggest that the tense-lax difference in Yi might involve some supralaryngeal strctures. Previous research on the role of the tongue, pharynx and

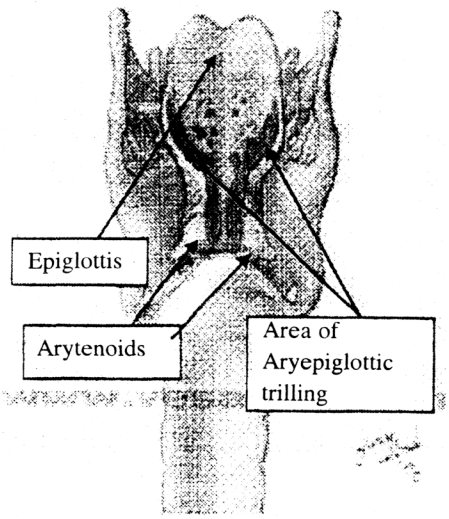
epilaryngeal structures on laryngeal stricture (Esling, 1996) led us to predict that this larger set of articulators must be responsible for *tense* voice quality in Yi and for *tense* and *harsh* voice qualities in Bai.5 Supralaryngeal articulations occur occasionaly and in particular they occur as distinctive phonemes in Pan Asiatic languages such as in Semitic (for example, Arabic) and Caucasian (e.g., Abkhaz) or as a secondary characteristic where a series of sounds is modified by the presence of a supralaryngeal posture as is found in Formosan (e.g., Amis), and Mongolic (e.g., Khalkha) languages. We also feel that Tibeto-Burman, Miao-Yao, Sinitic, and Mon-Khmer languages offer an opportunity to study register systems with contrastive phonation types using direct laryngoscopic observation.

Major research on covert structures of the throat, including supralaryngeal articulations, remained basically in a rudimentary state until late in the 20th century, cf. Zemlin (1998:138). In early radiographic work at University College London, it was found by Stephen Jones that in Somali pharyngeals the larynx not only elevated but that there also appeared to be some sort of vibration around the epiglottis during forceful articulations (1934). Catford (1968, 1977, 1983) described these sounds as *epiglottopharyngeal* and also identified the possibility of what he called *epiglottal trilling*. Documentation of such trilling in certain tense larynx conditions can be found in Traill (1985, 1986) for Khoisan and in Rose (1989) for Zhenhai Chinese. Esling (1996) presents laryngoscopic evidence that it is the laryngeal (aryepiglottic) sphincter which is responsible for the production of both pharyngealized voice and what Laver terms *raised larynx voice* (1980).

Recent work has suggested that the aryepiglottic folds contribute to special qualities in singing. Yanagisawa, Estill, Kmucha and Leder (1989) and Honda, Hirai, Estill and Tohkura (1995) have shown that the epilaryngeal tube is elevated into the pharynx during many singing. But it was not traditional western singing styles that have focus widespread interest on supraglottal structures. There is, for example, the case of *throat singing* or biphonic/overtone singing, which reaches its full flower among the Tuvans of Central Asia, cf. the role of the aryepiglottal folds in throat singing discussed in Levin and Edgerton 1999. Inuits and Tibetans are also known to show special *chant modes*. I observed in the laboratory of John Esling a video tape of a Tibetan monk producing this special chant mode. In the high chant mode our Tibetan subject appeared to demonstrate raised larynx, whereas in the deep chant mode the tube demonstrated a similar to the harsh voice quality of Bai and there was trilling around the whole circumference of the aryepiglottic opening into the phraynx

Figure 1: Aryepiglottic folds and the area where trilling was observed during harsh voice in Bai

In Figure 1 one should note the aryepiglottic folds and their relative position above the arytenoids and above the true and ventricular vocal folds. We also indicate the area where we observed trilling in Bai.



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3. Methods. In this study the production of Yi and Bai syllables were observed with a stroboscopic *laryngoscope*, which is an imaging device with a very flexible fiber optic tip devised by Sawashima and Hirose in 1968, and improved and reduced in size in recent years. In particular, the instrument in this research was the Kay Elemetrics Rhino-Laryngeal Stroboscope 9100 with a package halogen light source, an Olympus ENF-P3 fiber optic laryngoscope, and a Panasonic KS with 152 camera and 28mm wide-angle lens. The procedure for use of the device is to insert the fiber optic bundle through a nostril and then lower it into the nasal-pharyngeal cavity until it is positioned over the glottis just above the level of the apex of the epiglottis. Once the scope is adjusted for optimal viewing, the subjects utter sets of lexical items from a prepared word list that includes voice quality contrasts as determined by our previous research (Edmondson and Li 1994, Chen 1963, Chen et al 1984, Lama Ziwo 1998). During production of the sounds we made S-VHS video recordings for later observation, analysis, and measurement. Mr. Li, the Bai subject, also produced contrastive sets of items using whisper and then voice so that we could determine if aryepiglottic trilling was possible while the true vocal folds were in a voiceless position. For Mr. Lama the recording lasted about 20 minutes in duration and for Mr. Li about 37 minutes.

From our previous experiments with the laryngoscope we knew that front vowels allowed optimal viewing, as test syllables with open vowels, such as [ɑ], tended to result in the tongue moving back and obscuring the view. We, therefore, spent most of our time in recording examples with non-open vowel nuclei.

3.1. Yi data. Data were selected that showed the linkages of voice quality and vowel quality. We divided examples into lax and tense categories on the basic of our previous research.