LARYNGOSCOPIC ANALYSIS OF TIBETAN CHANTING MODES
AND THEIR RELATIONSHIP TO REGISTER IN SINO-TIBETAN

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1. TIBETAN CHANTING

To investigate how the articulatory structures of the larynx and pharynx behave in Tibetan chanting, we obtained laryngoscopic video sequences of several phonemic contrasts in Tibetan and of two principal chant modes: a “high” chant which adopts raised-larynx posture with the tongue and epiglottis retracted, and a “deep” chant which adopts lowered-larynx posture with an open pharyngeal area but constricted ventricular ring immediately above the glottis and ventricular/mucosal channeling of airflow. The two chants reflect different modes of the laryngeal sphincter mechanism: one with aryepiglottic approximation but without trilling; the other with only the ventricular component. Aspects of phonemic patterns found in the three Sino-Tibetan languages we have observed laryngoscopically (Yi, Bai, and Tibetan) can be seen in the way the two chant modes are produced in Tibetan. The high chant resembles “tense” register in Yi, while the deep chant resembles “tense/harsh/low-tone” register in Bai.

2. PROCEDURE

Gedun Jungney, whose family originates in western Sichuan (Dege) and extreme northwest Yunnan, China, is the 33-year-old chant master of the Ganden Jangtse Norling Monastery in Madras, India. At the time of filming in 1999, he had been learning and perfecting chanting techniques for over 15 years.

Laryngoscopic video images of the pharyngeal/laryngeal area were obtained by means of a Kay 9100 RLS light source and Olympus ENF-P3 fiberoptic nasendoscope fitted with a 28mm lens. An analog S-VHS videotape master was produced at 30 frames/sec, and video images were exported to a PC PHIL-450 for processing using MediaStudio Pro 6.0 and synchronous waveform and spectrographic analysis using MultiSpeech and WaveSurfer. The video images show the behavior of the lower pharynx including vocal folds, ventricular folds, aryepiglottic folds (laryngeal sphincter), epiglottis and tongue root.

Two principal forms of chanting were elicited in repetitive sequences. A third type of chant was produced in an attempt to emulate a form used in a different monastery but which appears not to differ substantially from the deep chant mode familiar to the chant master. Video sequences were also obtained of several phonemic contrasts in Tibetan, focusing on the high/low tonal register distinction in twelve minimal pairs. Vowels /i, a, o, e, u/ were sampled, but were not the main focus of study. /i, u/ environments produce the clearest view of the larynx, while /a/ often obscures the view of the larynx in an essentially pharyngeal manoeuvre. /i, u/ examples are illustrated here. All examples are available in audio format only in the UVPD [1].

First, laryngoscopic videos of the two chanting modes are reviewed to assess lower pharynx posture. Then laryngoscopic images of minimal pairs in Tibetan and in other Sino-Tibetan languages are reviewed to evaluate the similarity of chanting postures to the postures found in contrasting phonemic forms.

3. OBSERVATIONS

The two chanting modes observed include a “high” chant and a “deep” chant, differing substantially in articulatory production. Figure 1 illustrates four pharyngeal/laryngeal postures during the high chant, and Figure 2 illustrates four postures at different points during the deep chant.

The views are taken with the tip of the nasally inserted laryngoscope positioned in the velo-pharynx just behind and at about the height of the uvula, looking down directly onto the glottis and pyriform recesses beneath. The glottis is central, between the arytenoid cartilages, and the opening to the oesophagus would be exactly behind (above) the arytenoids at the base of the posterior pharyngeal wall.

The high chant adopts a raised-larynx posture with the tongue and epiglottis retracted, while the deep chant adopts a lowered-larynx posture with an open pharyngeal area but constricted ventricular ring immediately above the glottis. The ventricular folds form a tube that channels airflow through a circular mucosal wall, but apparently without aryepiglottic trilling. The two chants can be regarded as different modes of the laryngeal sphincter mechanism. Judged auditorily, the high chant is not as constricted at the level of the vocal/ventricular folds, but is achieved by what could be called superior constriction of the laryngeal sphincter. The deep chant could be called an inferior constriction of the laryngeal sphincter.
Figure 1: Laryngoscopic view of pharynx for the high chant (藏語). U-shaped epiglottis and tongue retract as the larynx rises. The effect on spectral quality of reduced pharyngeal volume resulting from this adjustment has been called “muted”, “covered” or “raised larynx”.

Figure 2: Laryngoscopic view of the pharynx shows the open lower pharyngeal space (with advanced tongue root and lowered larynx) during the production of the deep chant (藏語). Arytenoids, vocal folds, ventricular folds and lower muscular components of the laryngeal sphincter mechanism are tightly adducted to form a channel of substantial height with a distinct ring of mucus at its upper border.

The musculature we hypothesize to be responsible for the high chant setting are the external (lateral) fibres of the thyroarytenoid muscles and, for the deep ventricular sphincteric manoeuvre, the more medial internal fibres of the thyroarytenoids.

The auditory difference in the minimal pairs ‘die/four’, ‘ten/grasp’, ‘water/coral’ (Figures 3-5) is one of pitch and of phonation type. This study does not exhaust the combinatorial tone-class paradigm of Dege Tibetan but only touches on one broad distinction. The first item in each pair is high in pitch and modal in phonation type, and the second is lower pitched and breathier, but lower pharynx shape is substantially similar. We are unable to determine if the apparent larynx height difference (descending for low tone) is due to laryngeal tilt (cricothyroid adjustment) or to the vertical raising and lowering of the larynx.
Figure 3: Spectrograms and laryngoscopic images (at point A in each vowel) of the Tibetan contrast between the “high” and “low” syllables /cí/ ‘to die’ vs. /cí/ ‘four’.

Figure 4: Tibetan contrast between /tɕi/ ‘ten’ vs. /tɕi/ ‘to grasp’. The “low” series is breathier, lower in pitch, longer in duration; but not different in lower pharynx shape. The glottal opening itself becomes wider for /tɕi/.

Figure 5: Tibetan /tʰu/ ‘water’ vs. /tʰu/ ‘coral’. Breathiness in the “low” series is reflected in the opening at the glottis and the noisy spectrum throughout.

(adjustment of the hyoid musculature to facilitate modal voice in the higher position and breathier airflow in the lower position). This phonemic contrast is not very large phonetically and could be adequately achieved either through pitch or phonation alone. The contrast nevertheless contains two distinct auditory qualities which can be supposed to have two different physiological origins. The sphinctered raised-larynx setting of the high chant resembles the retracted posture of an [a] vowel, but is even more larynx raised and tongue retracted than an open back vowel and could be called a cardinal example of a raised-larynx voice quality setting [2]. It also resembles the singing styles that have been found to use a raised-larynx (sphinctered) setting [3].

The lowered laryngeal posture for low tone words is not the same setting as for the deep chant. Low tone has open, breathy phonation, while the deep chant has extreme ventricular constriction and lowered larynx and open pharynx apparently to enhance the extremely low pitch. Physiologically, a sphinctered setting such as this might be expected to cause the larynx to rise [4, 2]. Here, however, the larynx is pulled lower, perhaps to increase the size of the entire pharyngeal cavity for enhanced low-pitch resonance in synchrony with the source characteristics generated by the reinforced inferior channel.

Because pharyngeal postures do not differ greatly between phonemic contrasts in this dialect of Tibetan, it will be useful to compare Tibetan chanting postures with configurations of the lower pharynx found in other Sino-Tibetan languages.

4. LAX/TENSE AND PHONATORY REGISTER IN SINO-TIBETAN

The three Sino-Tibetan languages which we have observed laryngoscopically (Yi, Bai, and Tibetan) use the phonetics of the larynx and pharynx in different ways. Yi (Tibeto-Burman) has a phonological contrast between “lax” and “tense” syllables which is realized articulatorily as a neutral mode of voicing with neutral positioning of the epilaryngeal structures in the case of lax vowels and as a raised-larynx, retracted-tongue, laryngeally sphinctered posture of the epilaryngeal structures in the case of tense vowels [5, 6]. Both postures occur commonly at mid tone (see Figure 6), but tense syllables are phonetically predisposed at high tone, and lax syllables at low tone; a result of the compatibility of raised-larynx quality (tense mode) with high pitch and of modal quality (lax mode) with low pitch. As in Tibetan, Yi low tone has an opener quality, but this may be typical of a two-way contrast. Distinctions of further complexity (as in Bai, below) may group low pitch (and creaky and harsh modes of phonation) together with the ventricular type of constriction as opposed to the raised-larynx type.

Bai (variably categorized as Sinitic, para-Sinitic or Tibeto-Burman) does not use the lower pharynx as in Yi. In Bai, modal syllables at 55 and 33 tone have an open epilarynx in lax mode but ventricular stricture in tense mode [7, 8, 6]. The tongue does not retract for tense mode as in Yi, and the epiglottis does not approximate the back wall of the pharynx, except of course when the vowel is open and back. Only ventricular and inferior aryepiglottic structures appear to be involved. At 31 tone in Bai, this type of ventricular sphinctering becomes even more pronounced for the tense series, inciting aryepiglottic trilling at the lowest 21 tone. These articulatory relationships have been outlined in cardinal terms [9], and correspond to the behaviour of pharyngeals in many languages [9, 10, 11] and tonal and register features of phonation in others [12, 13, 14, 15].
The lax /i/ vowel of Yi (as in /piŋ/ ‘to exclaim’) with open lower pharynx, and tense /a/ (as in /paŋ/ ‘to exchange’) with sphinctered lower pharynx.

Figure 6: The lax /i/ vowel of Yi (as in /piŋ/ ‘to exclaim’) with open lower pharynx, and tense /a/ (as in /paŋ/ ‘to exchange’) with sphinctered lower pharynx.

The tense /a/ counterpart (as in /paŋ/ ‘to chase’) with ventricular sphinctering.

Figure 7: At 31 tone, the lax /i/ vowel of Bai (hči ‘field, soil’) with open lower pharynx, and its tense counterpart (hči ‘to chase’) with ventricular sphinctering.

5. IMPLICATIONS

The three Sino-Tibetan languages which we have observed laryngoscopically (Yi, Bai, and Tibetan) use the phonetics of the larynx and pharynx in different ways. Aspects of the phonemic patterns found in each language can be seen in the way the two chant modes are produced in Tibetan. The high chant resembles “tense” register in Yi, while the deep chant resembles “tense/harsh/low-tone” register in Bai.

The contrasts that commonly occur in Sino-Tibetan languages maximally exploit the fine articulatory adjustments available in the lower pharynx, epilarynx and glottis. Elements of these configurations account for laxness/tenseness, register, and tone in the phonology. Similarly, these same elements, to a more refined and professionally nurtured degree, account for the exceptional sound quality of formal styles such as Tibetan chanting. It remains to research the musculature responsible for the two main postures of the laryngeal sphincter identified here, and to explain the aerodynamic relationship between the channelled/mucosal source of the deep chant and the chamber resonance of the pharynx.

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7. WEB-SITE VIEWING

The laryngoscopic video images illustrated in this paper can be viewed in full-motion video/audio format at the University of Victoria Phonetics Laboratory web site:

http://web.uvic.ca/ling/research/

8. REFERENCES