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Explorations of laryngeal function in speech sound production have generated a new model of how the pharyngeal/epiglottal articulator works, focusing on the compression of the epilaryngeal tube, massing of vibrating elements through the tube, and the sphinctering of the aryepiglottic folds. The interaction of laryngeal constriction, larynx height, and pitch control has implications for how contrasting tones are produced in the languages of the world, since pitch is not the sole parameter that can be called on within the larynx to generate contrast. Complex articulatory parameters are also present, and these have a relationship to articulations in the oral vocal tract. This presentation is an exploration of the relationship between the mechanism of laryngeal constriction and changes in laryngeal height that may have a bearing on the production and the perception of tone.

Over the years, laryngoscopy has allowed phoneticians to visualize the complex phonatory and articulatory actions of the larynx with only a limited impression of vertical movement. Changes in larynx height contribute to laryngeal configurations influencing voice quality, pitch, and segmental articulations (Catford 1977, Laver 1980, Honda et al. 1999, Honda 2004, Esling & Harris 2005). Laryngoscopy has been used to visualize qualitatively how laryngeal height and constriction interact in instances of pharyngeal articulation and of tonal register in various languages (Esling 1996, Esling 2005, Edmondson & Esling 2006). In order to investigate how the larynx height parameter correlates with laryngeal constriction, laryngoscopic imaging of the larynx is compared with evidence from videofluoroscopy and, independently, laryngoscopy performed simultaneously with laryngeal ultrasound. These data have been used to identify quantitative relationships between vertical larynx height and laryngeal constriction and serve as a basis for examining how these mechanisms produce auditory qualities that interact with pitch production.

Videofluoroscopy of careful phonetic productions of [ɑʔɑ], [ɑʕɑ], and [ɑʜɑ] are shown and used as an opportunity to analyze and compare changes in the volumes of the pharynx and of the epilaryngeal tube. Changes in larynx height and in the vertical separation between the vocal folds and the aryepiglottic folds during stop and trill productions have also been measured. Comparing laryngoscopic images of the same articulatory productions, the data provide a way of correlating images from the horizontal plane with quantifiable areas in the sagittal plane. Simultaneous laryngoscopy and laryngeal ultrasound video data generate an image of numerous laryngeal structures in which changes in laryngeal height can be tracked using an automated optic flow analysis algorithm (Moisik, Esling, Bird, & Lin 2011). Changes in laryngeal height relative to the ultrasound probe are quantified, as is the velocity with which changes occur. The velocity data are then numerically integrated to determine the change in height of the larynx. Movements of structures in the laryngoscopic data are then compared with the laryngeal ultrasound data to provide a more robust picture of how the larynx is displaced during the production of sounds with laryngeal constriction, as can occur in tonal register systems. This novel combination of three instrumental methods of laryngeal tracking together with new data provides an enriched understanding of the vertical dimension of the laryngeal articulator in sounds that have long resisted image analysis.

Larynx raising has also been examined in relation to vowel quality; and aryepiglottic (AE) trilling has been examined as a secondary voicing source to vocal fold vibration. Careful phonetic productions of [i u a ɑ] were performed in normal, raised, and lowered larynx states while maintaining constant F0. Change in larynx height was observed using laryngeal ultrasound and quantified using the optic flow algorithm, and F1, F2 and F3 were measured using LPC. The results show that larynx raising has a more pronounced effect on formant structure than lowering, and the relation between larynx height and formant frequency is not a strictly positive correlation. Particularly interesting is the lowering behaviour of F3 with raised larynx, for all vowels. The larynx-lowering data mostly conform with prior accounts (Sundberg & Nordström 1976), in which formant drops occur linearly with vocal tract expansion and lengthening. However, the non-linear effects on formant structure in the raised larynx case are attributed to activation of the laryngeal constrictor, which reshapes the epilaryngeal tube within the pharyngeal tube, also accounting for changes in phonation that accompany larynx raising.

Aryepiglottic trilling in Iraqi Arabic voiced and voiceless pharyngeals has been analyzed qualitatively and quantitatively using high-speed laryngoscopy (Hassan et al. 2011), and acoustic, EGG, kymographic, and aperture estimation techniques. Evaluation of trilling frequency and duration shows a greater degree of laryngeal constriction at the superior AE-fold borders of the epilaryngeal tube for voiced trills. AE vibration acts as a secondary phonation source that ‘bleeds’ into neighbouring vowel sounds as a coarticulatory effect. Epilaryngeal stricture is argued to play the unique articulatory role of being a link between posterior lingual and vocal fold structures, simultaneously capable of manipulating vowel quality and phonation while interacting with pitch. It is also posited that the resonance and vibratory-source functions of the epilaryngeal tube are a means of salient enhancement in certain prosodic and vocalic environments.

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