Stop Consonant Voicing and Pharyngeal Cavity Size

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relative to supraglottal events, are the decisive factors by which the various stop consonant types are differentiated. [This research was supported by the National Institute of Dental Research through an NIH grant]

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B8. Stop Consonant Voicing and Pharyngeal Cavity Size. FREDERICKA B. BERTI* AND HAJIME HIROSE,† *Haskins Laboratories, New Haven, Connecticut 06510.*—Aerodynamic forces require a vocal tract volume increase subsequent to oral cavity occlusion if voicing is to proceed through stop consonant closure. Electromyographic recordings of pharyngeal musculature were obtained for three subjects during the production of the six stop consonants of English in controlled phonetic environments. In addition, simultaneous electromyographic recordings and fiberscopic motion pictures were obtained for one subject producing a subset of the total utterance set. Each subject shows differences in the pattern of cavity enlargement for the voiced stops. One subject shows increased levator palatini and sternohyoid activity, and demonstrates greater velar elevation (determined from the motion pictures) for voiced stops as compared with voiceless stops. A second shows decreased activity of the pharyngeal wall musculature along with increased activity of the sternohyoid for the voiced stop cognates. The third subject exhibits a composite of the activity patterns of the first two subjects. The data support earlier suggestions that pharyngeal expansion must be due, at least in part, to positive muscle activity. They also indicate that there may be intersubject variation of actuating mechanisms while the articulations are perceived as equal. [This research was supported by the National Institute of Dental Research, through an NIH grant.]

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B9. A Dynamic Analysis of Two-Dimensional Muscle Force Contributions to Lower Lip Movement. J. H. ABBS, *Speech Research Laboratories, University of Washington, Seattle, Washington 98195,* AND R. NETSELL, *Departments of Communicative Disorders and Rehabilitation Medicine, University of Wisconsin, Madison, Wisconsin 53706.*—Movements of the lower lip in the anterior–posterior and inferior–superior dimensions were recorded along with EMG activity from the orbicularis oris inferior (OOI), depressor labii inferior (DLI), and mentalis (M). Observations of activity in these muscles in relation to simultaneous displacement, velocity, and acceleration of lower lip movement suggest that (1) DLI and OOI act primarily to apply forces in the inferior and superior dimensions, respectively; (2) mentalis is a primary force for protrusion of the lower lip; and (3) the lower lip can be characterized, in a preliminary way, as a simple second-order mechanical system. The implications of the technique and the specific findings will be discussed in relation to development of an analog computer model of the labial–mandibular mechanical system. [Research was supported in part by grant from NIDR.]

B10. Activity of Some Extrinsic and Intrinsic Tongue Muscles in the Articulation of American English Vowels. KATHERINE S. HARRIS* AND LAWRENCE J. RAPHAEL,† *Haskins Laboratories, New Haven, Connecticut 06510.*—Most previous electromyographic studies of tongue muscles have been limited to those extrinsic muscles which are easily accessible: the genioglossus and palatoglossus. Recent experiments have provided access to the styloglossus, among the extrinsic muscles, and to the intrinsic fibers of the tongue. Thus, a fuller picture of muscular synergisms in the positioning and shaping of the tongue is beginning to appear. This study reports findings from three subjects who spoke 10 American English vowels in a labial consonant frame preceded by schwa. All electromyographic activity was recorded from hooked-wire electrodes inserted into the various muscles by means of hypodermic needles. The results reveal as many differences as similarities between the articulatory strategies of the subjects. It appears that the similar articulatory configurations that underlie the linguistically relevant acoustic structures of the vowels can be achieved by a variety of muscular patterning. [This research was supported by the National Institute of Dental Research.]

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B11. Tongue and Lip Activity During Australian Aboriginal (Walbiri) Articulation. W. R. PROFFIT AND R. E. MCGLONE, *University of Kentucky, Lexington, Kentucky 40506,* AND M. J. BARRETT, *University of Adelaide, Australia.*—Recording equipment was transported to Yuendumu, N. T., Australia, to obtain data on tongue and lip activity of aboriginals during speech and swallowing. Strain gauge pressure transducers were fitted into custom constructed plates to be placed in the speaker's mouth to record tongue and lip contact at several locations. Eighteen speakers whose native language is Walbiri acted as subjects. Eight prerecorded Walbiri words and four nonsense words, five repetitions each, were presented to the subjects. These tokens contained three of the Walbiri modifications of the phoneme /t/ situated intervocalically in each word. Distinct articulation patterns of both tongue and lips were found for the three phonemes regardless of whether they were located in meaningful or nonsense words. Furthermore, pressure patterns for the phoneme most like the American language /t/ were very similar to patterns for American speakers. This was true even though tongue and lip movements during swallowing were quite different from Americans. [Kenneth Hale assisted in preparing the speech stimulus. Support from the Fulbright program, NIDR, and Southern Society of Orthodontists is gratefully acknowledged.]

B12. A Two-Dimensional Strain Gauge Transducer System for the Lips and Jaw. J. H. ABBS AND B. N. GILBERT, *Speech Research Laboratories, University of Washington, Seattle, Washington 98195.*—A strain gauge transduction system was designed and constructed for simultaneous observation of the movements of the upper lip, lower lip, and jaw in both inferior–superior and anterior–posterior dimensions. Empirical verification of the system's structural loading factor, frequency response, linearity, and phase response suggests that it provides a favorable alternative to earlier lip and jaw monitoring devices. Some examples of the two-dimensional multistructure movement patterns obtained with this device will be provided and discussed. [Research supported in part by NIDR/grant.]

B13. Intraoral Air Pressure Correlates of Lip Occlusion for Bilabial Stop Consonants. THOMAS SHIPP, *Speech Research Laboratory, Hospital, San Francisco, California 94121.*—The purpose of this procedural study was to determine if a one-to-one correspondence existed between the intraoral pressure curve and complete lip closing and opening for bilabial stop consonants. The faces of two subjects were photographed at high speed (250 fps) in simultaneous anteroposterior and lateral views as they produced a series of words with /p/ and /b/, the midvocalic consonants of interest. A timing signal synchronized the film with the physiologic–acoustic record.