

Effect of single-motor-unit firings on fundamental frequency of phonation

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The role of the intrinsic laryngeal muscles in accomplishing various accent types in Japanese was studied. Specifically, the electromyographic activities of the posterior cricoarytenoid (PCA) and the thyroarytenoid (VOC) were investigated in comparison with that of the cricothyroid (CT). It was revealed that the PCA activity for the voiceless stops or affricates following the first mora with accent kernel was significantly smaller than that for those in the second mora not preceded by accent kernel, regardless of whether or not this second mora has accent kernel. The results were in good agreement with those of fiberoptic observation. The glottal width was always larger for the latter group. The VOC showed activity patterns similar to the CT, generally peaking for the accent kernel. However, the VOC activity tended to decline more rapidly than the CT after the peak. It was also suggested that VOC activity was related not only to the realization of accent but to various segmental features such as glottalization of the word initial vowel or voicelessness of the phonetic segment. [Work supported by NIH NS-13870.]

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II6. Sensorimotor integration just prior to F_0 change. A. Miller, R. J. Hanson, and C. Shulak (Department of Speech, University of California Santa Barbara, CA 93106)

Pitch matching data gathered in a previous experiment [R. J. Hanson, Proc. IX Inter. Congr. Acoust. 1, 519 (1977)] were analyzed for reaction time to step changes in target frequency, for the accuracy and for the variability of pitch matching during reaction time. In the experimental task, subjects attempted to match the F_0 of their own vowel production presented to one ear with a target sinusoid presented to the opposite ear, which changed randomly up or down by 5, 10, or 15 Hz in each trial. Subjects performed 48 trials in each of the two stimulus/ear configurations. Reaction time was determined using a recently developed two-state model of F_0 control [R. J. Hanson, J. Acoust. Soc. Am. S64A]. Accuracy was measured using the percentage difference between the average F_0 during reaction time and the target frequency. Variability was measured using the coefficient of variability of the pitch periods during reaction time. These three indices were used to characterize sensorimotor integration during the dynamic processing period just prior to initiating an F_0 change. The major results of this study are: (1) reaction time was shorter when the target was presented to the right ear and for larger changes in target frequency, but was equal for up and down changes in the target frequency; (2) accuracy and variability were not affected by the stimulus/ear configuration, the magnitude nor the direction of the target change. These findings corroborate and extend those of previous experiments regarding the processing advantage of the right ear/left hemisphere pathway for the target during reaction time.

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II7. Effect of single-motor-unit firings on fundamental frequency of phonation. Thomas Baer (Haskins Laboratories, 270 Crown St., New Haven, CT 06510)

A technique originally used for studying contraction properties of skeletal muscles was applied to study of the musculature controlling fundamental frequency (F_0). Continuous records of electromyographic activity from laryngeal muscles and of voice fundamental frequency were obtained from a subject producing steady, sustained phonation at low F_0 . The fundamental frequency record exhibits small perturbations around a nominally constant value. An average-response computation of fundamental frequency triggered by single firings in the cricothyroid muscle exhibits a systematic pulse in the interval immediately following the firings. The pulse apparently represents the average effect on F_0 of a single twitch in the muscle. This result implicates variability of motor input as a contributing factor in F_0 perturbation. The same technique can be used to investigate the effect of other muscles on F_0 . Using this

technique, muscles whose activity is grossly intercorrelated during ongoing F_0 control can be uncorrelated to examine their individual effects on F_0 . Implications for detailed models of fundamental frequency control will be discussed. [Work supported by NINCDS grant NS 13870.]

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II8. Predicting vocal frequency from selected physiologic measures. Thomas Shipp (VA Hospital, San Francisco, CA 94121) and E. Thomas Doherty (IASCP, University of Florida, Gainesville, FL 32611)

Measures of intrinsic laryngeal muscle activity, subglottal air pressure and vertical laryngeal position were obtained simultaneously on four adult male subjects while they sustained vocalization at frequencies between 100 and 400 Hz. A stepwise multiple regression analysis of the physiologic data showed that the only significant term for any one subject in predicting his vocal frequency was cricothyroid muscle activity. This single term explained over 90% of the variability in the vocal frequency produced. Pooled data from the group showed that three terms contributed significantly to vocal frequency: Cricothyroid activity alone resulted in an R^2 of 67%, while adding subglottal air pressure measures increased R^2 to 71% and adding the final term of cricothyroid times thyroarytenoid muscle activity increased R^2 to 73%. For these subjects, intrinsic laryngeal muscle activity overshadowed any of the other forces thought to influence the frequency of sustained phonation. [Work supported by NIH.]

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II9. Speaking fundamental frequency (SFF) characteristics of children. Patricia A. Hollien, W. S. Brown, Jr., and Harry Hollien (Institute for Advanced Study of the Communication Processes, University of Florida, Gainesville, FL 32611)

While some information is available concerning the SFF characteristics of children, these data are based on relatively small groups of preschool and school-aged (but prepubescent) subjects. Moreover, it has been suggested [AAPS Newsletter 3, 5 (1976)] that prepubescent girls actually may exhibit lower SFF levels than similar groups of boys. Accordingly, a standard reading passage was recorded for four groups of 30 boys and 30 girls each ($N = 240$) for the ages of 7, 8, 9, and 10 years; all subjects were drawn from the Gainesville, Florida public schools. Mean SFF levels were obtained via processing by the IASCP Fundamental Frequency Indicator (FFI-8). The resultant data demonstrate a systematic—and expected—lowering of SFF through the ages 7–10 years. Further, the postulation that average f_0 for girls is lower than that for boys was verified; however, the trend was slight and not statistically significant. Variability within the obtained data will be discussed—as will the findings when contrasted to similar (previous) studies of a like nature. [Research supported by NIH.]

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II10. Observation of vocal fold vibration by x-ray stroboscopy. Shigeji Saito, Hiroyuki Fukuda, Hiroshi Ono, and Yutaka Isogai (Department of O.R.L., School of Medicine, Keio University, Shinjuku-ku, Tokyo, 160 Japan)

Every laryngologist wants to observe the vibratory pattern of the vocal cords from all directions. A pulse generated x-ray equipment has recently been widely used as part of diagnostic procedure especially for cardiovascular lesions. Voice-synchronized x-rays can be obtained by use of a pulse signal from a laryngostroboscope as a trigger to this x-ray equipment. An experimental sound was obtained by use of the resected larynx of a human and a canine. As contrasting mediae, lead particles were inserted into the vocal