

Vocal fold contact area

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(e.g., the presence or absence of frication in the "y" in "had your"). An analysis is presented of transcribed data from 630 speakers reading two sample sentences as well as data from four speakers reading the same two sentences 24 times each, separated by filler material, in three separate sessions. The analysis quantifies the relative usefulness of competing models of variation in information theoretic terms. The results indicate that

(1) speakers can be clustered into low variation groups such that the variation within a group is significantly less than the population variation, and (2) individual speakers show greater consistency than comparable clustered subsets of the population. Finally, it is suggested how this structure may be used to guide rapid, automatic adaptation in speech recognition. [Work supported by NSE.]

10:23-10:33

Break

10:33

P10. Motor-motor adaptation. Linda I. Shuster (Department of Speech Pathology and Audiology, West Virginia University, Morgantown, WV 26506-6122)

Perceptuomotor adaptation experiments have demonstrated that a purely perceptual task can have a significant effect upon a subsequent production task. Cooper has argued that these perceptual effects upon production reflect a link between the cognitive systems underlying perception and production. This argument might be stronger if it could be demonstrated that the effect that a repetitive perceptual task (such as selective adaptation) has on production is the same as that obtained using a repetitive production task. An experimental technique was developed called motor-motor adaptation. In this task, subjects produced a monosyllabic CV repeatedly (the adaptor). After 20-40 repetitions, the subject produced a second CV syllable once (the test syllable). There were two adaptors ([bi] and [p^hi]) and two test syllables ([di] and [t^hi]). Each test syllable was produced in each adaptor condition. Subjects produced only a single adaptor and a single test syllable within each of the four blocked conditions. Analysis of the obtained voice onset times indicated that for the voiceless test syllable, VOT was significantly shorter after adaptation to [p^hi] than to [bi]. However, for the voiced test syllable, there was no significant difference obtained between the two adaptor conditions. These findings are similar to those Cooper obtained using perceptuomotor adaptation and will be discussed with regard to possible links between speech perception and speech production.

10:45

P11. Articulator movement in anticipatory coarticulation. Gina M. Lee (Department of Linguistics, Ohio State University, 1841 Millikin Road, Columbus, OH 43210)

The results of previous studies examining EMG activity (and, to a smaller extent, articulator movement) in anticipatory gestures have not been consistent. In some studies, the onset of activity for a given feature was *time locked*, in that it began at a fixed interval prior to the acoustic onset of the corresponding segment. This suggests that timing plays an intrinsic role in the organization of speech production, and that segmental targets are dynamic. Other studies have shown evidence for *feature spreading*, where the onset of activity begins within the earliest preceding segment which makes no contradictory demands on the articulators, regardless of the length between the onset of activity and the acoustic onset of the relevant segment. This suggests that time is extrinsic to segmental specification, and that targets are represented as static. However, Gelfer, Bell-Berti, and Harris (1985) and Perkell (1986) argue that the different findings may be due to experimental design: /s/ and /t/, the consonants used in such studies, may not be unspecified with regard to lip protrusion, as previously assumed. In the current study, the issue of feature specification for presumed neutral segments is considered. Pellet traces from selected bases of x-ray microbeam data were examined. The point of onset of lip protrusion with respect to the acoustic onset of the rounded vowel in VC_nu utterances was measured. Velocity patterns of articulator movement were also considered.

10:57

P12. Interarticulatory timing and single articulator velocity-displacement relationships in English stress pairs. Kenneth deJong (Department of Linguistics, Ohio State University, Columbus, OH 43210)

Evidence has been brought forward that there exists a direct timing relationship between the articulator movements associated with vowel production and those associated with consonant production. Tuller and others have interpreted such results as evidence for a model of speech production that posits a metrical relationship between vowels and their coproduced consonantal neighbors [cf. Harris *et al.*, in *Invariance and Invariability in Speech Production*, edited by J. Perkell and D. Klatt (Erlbaum, Hillsdale, NJ, 1986); and Tuller *et al.*, *J. Exp. Psychol.* 9, 829-833 (1983)]. A more strictly segmental ordering of speech events could be posited to handle such data. The difference between these models can be brought to light by making reference to statistical correlations between the timing latencies of various articulatory events [cf. K. Munhall, *J. Acoust. Soc. Am.* 78, 1548-1553 (1985)]. This study investigates the effects of stress pattern and syllable structure on articulator timing, using x-ray microbeam traces of jaw, tongue blade, and lip movement. Unlike in earlier studies, real English words were used. Each token was placed in two contexts, natural sentences and short, frame sentences. The effects of these two environments are also to be noted. The traces will also be used to replicate the velocity-displacement relationship in the movement of the jaw, found in earlier studies of reiterant speech [Kelso *et al.*, *J. Acoust. Soc. Am.* 77, 266-280 (1985)].

11:09

P13. Vocal fold contact area. Ingo R. Titze (Department of Speech Pathology and Audiology, The University of Iowa, Iowa City, IA, 52242 and the Recording and Research Center, Denver Center for the Performing Arts, 1245 Champa Street, Denver, CO 80204), David Druker, and Paul Durham (Department of Speech Pathology and Audiology, The University of Iowa, Iowa City, IA 52242)

Vocal fold contact area is generally inferred from the electroglottographic (EGG) signal. To our knowledge, only one attempt has been reported to measure contact area directly [Scherer, Druker, and Titze, *Vocal Fold Physiology Conference*, Tokyo, Japan (1987)]. This direct measurement is needed to identify artifacts and ambiguities in the EGG signal that may lead to questionable interpretations of vocal fold movement. In particular, the spatial distributions of contact area (anterior-posterior and vertical) is not always clear by simple inspection of the EGG signal. In this study, excised dog larynges were prepared and mounted such that one vocal fold could vibrate against a sheet of electroconductive glass. The area of contact was then extracted by videostroboscopy and image processing techniques. Comparisons are made between three-parameter and four-parameter simulation models of EGG and the experimentally determined contact area. [Work supported by NINCDs.]