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Evaluation of the role of vowel duration as a perceptual cue in the fortis-lenis distinction in word-final position

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FRIDAY, 8 NOVEMBER 1974 REGENCY ROOM, 9:00 A.M.

Session Z. Speech Communication IV: Perception

S. R. Silverman, Chairman

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Contributed Papers (7 minutes, variable discussion)

9:00

Z1. Evaluation of the role of vowel duration as a perceptual cue in the fortis—lenis distinction in word-final position. J. T. Hogan and A. J. Rozsypal (Department of Linguistics, University of Alberta, Edmonton, Alberta T6G 2H1, Canada)

Heretofore measurements from sonograms have indicated that the durations of vowels before fortis and lenis consonants exhibit a systematic difference, the latter being longer approximately in a 3:2 ratio to the former. Experiments with synthetic speech have shown that vowel duration is at least a sufficient cue for the perception of the fortis—lenis in final position. The role of this cue is evaluated for natural speech signals by the use of digital gating on a PDP-12 digital computer. The stimuli were comprised of English words ending with stops, fricatives, and clusters after tense and lax vowels. Four different durations were gated from the vowel nucleus. The stimuli were gated in four equal intervals at zero crossings to prevent unwanted transients and the stimuli were presented in random order. The method employed was the forced-choice the 50% cross-over points under the different consonant and vowel conditions. In some cases, recognition curves could not be established even after 75% of the vowel was gated. The results of the experiment indicated that vowel duration, voicing, and the duration of silence between the vowel and the final release transient vary in weight as cues under different vowel- and consonant-type conditions.

9:15

Z2. Effect of selective adaptation on the identification of speech sounds. Randy L. Diehl (Department of Psychology, University of Minnesota, Minneapolis, Minnesota 55455)

An experiment was performed to determine the effect of selective adaptation on the identification of synthetic speech sounds which varied along the phonetic dimension *place of articulation*. Adaptation with a stimulus of a particular place value led to a reduction in the number of test stimuli identified as having that place value. An identification shift was obtained even when the acoustic information specifying place value for the adapting stimulus (burst-cued) had little in common with the information specifying place value for any of the test stimuli (transition-cued). Removing the vowel portion of an adapting stimulus eliminated identification shift only when the resulting stimulus was no longer perceived as speechlike. The results indicate that at least part of the adaptation effect occurs at a site of phonetic, nor merely acoustic, feature analysis.

9:30

Z3. Comparison of two diagnostic intelligibility test methods. Caldwell P. Smith (Electronic Systems Division—AFSC, Hanscom AFB, Massachusetts 01730)

Speech processors including analysis/synthesis systems and waveform digitizers were tested with both the six-speaker Diagnostic Rhyme Test (DRT) of Voiers *et al.*, and the Consonant Rhyme Test (CRT) of Preusse. Analysis of response data from two eight-subject listener teams confirmed than mean intelligibility scores obtaines with the DRT and with the CRT were highly correlated ($r = 0.969$, with 9 df). Mean scores were related by the linear regression model: $S(\text{drt}) = 47.07 + 0.582\,S(\text{crt})$, with standard error of regression = 1.87. A diffuse pattern of correlations between the two sets of feature scores was revealed, the extreme cases being for DRT feature sibilation-present, significantly correlated with only one CRT feature score, unvoiced fricatives, while DRT feature graveness-present was significantly correlated with all CRT features: unvoiced stops ($r = 0.675$), unvoiced fricatives ($r = 0.699$), liquids/semivowels ($r = 0.725$), nasals ($r = 0.757^{**}$), voiced fricatives ($r = 0.860^{**}$), and voiced stops ($r = 0.937^{***}$). Findings indicate that, with the appropriate model, mean intelligibility scores obtained with the DRT and with the CRT are equivalent; however, the two tests differ significantly in assessing specific deficiencies of systems.

9:45

Z4. Discrimination of speech sounds by the chinchilla: steady-state /i/ vs /a/. Charles K. Burdick and James D. Miller (Central Institute for the Deaf, St. Louis, Missouri 63110)

Two female and two male talkers recorded two tokens of /a/ and /i/ at each of three pitch levels. Four chinchillas were initially trained to respond differentially to single tokens of one talker's vowels. Intensity was randomly varied over 10 dB throughout. Thereafter variations of tokens, talkers, and pitch levels were singly introduced, and performance exceeding 90% correct was maintained. When the full catalog of 24 /a/'s and 24 /i/'s was used, performance fell to 86% correct. The decrement appeared to be related to testing variables rather than the animals' abilities. The testing procedure was modified and performance rose to 95% correct. Generalization tests showed that the animals could easily transfer to a set of 24 new talkers as well as to synthetic vowels that differed in only formant locations. The chinchilla can correctly classify novel instances of /i/ and /a/ in spite of variations from tokens, talkers, pitch levels, and intensity. [Supported by NIH Grants NS03856 to CID and RR00396 to the Biomedical Computer Laboratory of Washington University.]

10:00

Z5. Discrimination of speech sounds by the chinchilla: /t/ vs /d/ in CV syllables. Patricia K. Kuhl and James. D. Miller (Central Institute for the Deaf, St. Louis, Missouri 63110)

Two female and two male talkers recorded two tokens of /ti, ta, tu, di, da, du/. Voice-onset times ranged from +40 to +128 msec for /t/'s and from −200 to +24 msec for /d/'s. Four chinchillas were trained to respond differentially to single tokens of one talker's /tu/ and /du/. When an animal mastered the discrimination, the task was complicated by adding more items from the catalog of /t/'s and /d/'s. Intensity was varied randomly over a 10-dB range throughout the experiment. In the final sessions, an animal must correctly respond to all 48 CVs. All four animals are currently maintaining 90% correct, or better, in this condition. Chinchillas can learn to