Survey of cochlear implant work

Carl G. Müller

Citation: The Journal of the Acoustical Society of America **70**, S52 (1981); doi: 10.1121/1.2018916
View online: https://doi.org/10.1121/1.2018916
View Table of Contents: https://asa.scitation.org/toc/jas/70/S1
Published by the Acoustical Society of America

cochlear microphonic generated by the outer hair cells on the IHC synapse and the IHC receptor potential respectively and conclude that IHCs respond to basilar membrane velocity at least up to 500 Hz. Using the Mossbauer technique we have measured basilar membrane vibration at low sound pressures. The measurements were performed on guinea pigs at about the 18-kHz point in a fluid-filled scala tympani. The results show strong nonlinearities and sharp tuning, both of which are very vulnerable. There is a direct relationship between basilar membrane velocity and neural thresholds over a 60-dB range. This suggests that only minor processing takes place between basilar membrane vibration and hair cell stimulation.

WEDNESDAY AFTERNOON, 2 DECEMBER 1981 BANYAN EAST ROOM, 12:30 TO 2:45 P.M.

Session X. Psychological Acoustics III: Single-Subject Studies and Nonacoustic Auditory Stimulation

John H. Mills, Chairman

Medical University of South Carolina, Department of Otolaryngology, 80 Barre Street, Charleston, South Carolina 29401

Contributed Papers

12:30

X1. Vocal pitch production in a patient with expressive dysprosody: A possible right hemisphere role in speech production. John J. Sidtis and Bruce T. Volpe (Department of Neurology, Cornell Medical College, 1300 York Avenue, New York, NY 10021)

Recent evidence obtained from normal listeners, from neurological patients with focal cortical lesions, and from patients who have undergone surgical section of the corpus callosum suggests that the right hemisphere auditory system has an advantage over the left in the perception of complex pitch. A possible production correlate was studied in a patient with right hemisphere tumor in whom speech was monotonic. On binaural testing, both speech and complex pitch discrimination were intact. On dichotic testing, a significant impairment was observed on pitch, but not speech discrimination. Vocal pitch control was assessed by having the patient mimic the pitch of a binaurally presented token frequency. A range of 100 to 240 Hz was tested at 20-Hz intervals. The patient's production was limited to a range of approximately 24 Hz, centered around 140 Hz. The modulation of vocal pitch in the production of intonation contour may be one way in which right hemisphere mechanisms contribute to the production of speech. [Work supported by NIH grants NS03346-19 and RR05396-20.]

12:45

X2. Theoretical basis for the perception of acoustic stimuli by the mammalian brain: CNS-endogenous microwave fields. Philip L. Stocklin (Consulting Physicist, 25 Ledgewood Court, Norwich, CT 06360)

Endogenous microwave fields are those radiated by changes in rotational energy state of proteins integral to neural membranes. Previous electromagnetic analysis [P. L. Stocklin and B. F. Stocklin, T.-I.-T. J. Life Sci. 9, 29–51 (1979)] and data review [P. L. Stocklin and B. F. Stocklin, Physiol. Chem. Phys. 13, 175–177 (1981)] have developed properties of characteristic modes supported by the adult human brain/skull cavity, whose frequencies lie within the protein rotational frequency band. Basic physical theory is reviewed, then applied to acoustic stimulus perception. When neurally stimulated, the primary auditory cortex (AI) acts as a modal source region. Within AI, tonotopicity matches the orderly variation of mode energy partitioning as source location is changed. Elsewhere within the auditory cortex, modal properties support the absence of strict tonotopicity. Transverse electric field modal patterns and rank-ordered modal energy analysis are used to relate modal properties to the following properties of hearing: perceived difference between acoustic tones of different frequency, two-tone consonance/dissonance, and frequency variation of minimum audible signal level.

1:00

X3. Survey of cochlear implant work. Carl G. Müller (Institut für Allgem. Elektrotechnik, Technical University of Vienna, Gusshausstr. 27-29, A-1040 Vienna, Austria)

The cochlear implant has recently seemed useful enough to be considered by some as a clinical procedure. This paper presents a review of the progress made on cochlear implants worldwide. Data are presented which contrast the results obtained in different labs on similar tests: threshold detection, pitch and loudness scaling, chronaxie, and difference limen tests. Models to account for some of these results are given. Four centers (San Francisco, Vienna, Salt Lake City, and Melbourne) have reported surprisingly good speech comprehension scores. We discuss the psychoacoustic characteristics which may relate to these scores and demonstrate that many implant patients show results which are expected quite typically in cochlear dysfunction. Thus the limits on speech processing in the hard-of-hearing may apply as well to implant patients, regardless of the method of speech coding. We also stress the lack of evidence confirming the assumed greater usefulness of multi-channel implants over single channel devices. Finally, a careful look is given to the risks involved in these procedures, specifically those of bone and tumor growth, device replacement, and the psychological effects from device failure.

1:15

X4. The effects of electrode position and stimulus period on the hearing sensations in a multiple-channel cochlear implant patient. Y. C. Tong, P. J. Blamey, R. C. Dowell, and G. M. Clark (Department of Otolaryngology, University of Melbourne, Parkville, Victoria, 3052, Australia)

The first study involved the categorization of sensations produced by decreasing and increasing electrical stimulus period (SP) trajectories as "Questions" or "Statements" (corresponding to rising or falling pitch). Separate studies were conducted with the 300 ms SP trajectories superimposed on: (i) individual electrodes with no variation in electrode position (EP), and (ii) electrode