Perceptual fusion of tonal and noisy sounds

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MM11. Post-discharge recovery effects in gerbil auditory-nerve period and PST histograms. Walter R. Bosch (Institute for Biomedical Computing, Washington University, St. Louis, MO 63110)

Excitation-function (EF) and recovery-function (RF) parameters of a self-exciting point process (SEPP) model for auditory nerve discharges were estimated [M. I. Miller, J. Acoust. Soc. Am. **77**, 1452–1464 (1985)] for neural discharges recorded in gerbil in response to continuous-tone and tone-burst stimuli. The mean discharge intensity (MDI) of the SEPP model (expected value of the PST or period histogram) was computed from the EF and RF estimates by solving an integral equation [K. Jones *et al.*, J. Acoust. Soc. Am. **78**, 90–94 (1985)]. Period histograms computed from neural discharges in response to continuous-tone stimuli were found to agree almost exactly with the corresponding MDI over a range of stimulus sound-pressure levels from 0 to 50 dB above threshold, indicating that the SEPP model accounts well for post-discharge recovery effects in period histograms under these stimulus conditions. PST histograms computed from the neural response to tone-burst stimulation also agreed quite well with the computed MDI for the conditions tested. [Work supported by NIH grants NS21592 and RR01379.]

MM12. Neurophysiological observations on the auditory cortex in the FM bat, *Eptesicus fuscus*. Cynthia F. Moss (Department of Psychology, Harvard University, Cambridge, MA 02138), Jonathan Fritz, Michael Ferragamo, and James A. Simmons (Department of Psychology and Section of Neurobiology, Brown University, Providence, RI 02912)

The echolocating FM bat, *Eptesicus fuscus*, integrates target range and shape (range profile) into unified images along a synthetic target-range axis. The response properties contained in single- and multi-unit recordings from the auditory cortex of *Eptesicus* in relation to the process of image formation revealed in psychophysical data were examined. A tonotopic map was found in primary auditory cortex similar to what has been described previously, but also a much larger auditory cortical representation than hitherto reported. Echo delay-tuned neurons are interspersed with frequency-tuned neurons, showing no apparent topographic organization. The response profiles of some echo-delay-tuned and delay-tracking neurons are dependent on the harmonic structure of the FM stimuli, as required for representing the unusual dual time- and frequency-domain images that the bat perceives. Strong suppression effects may sharpen perceived target range and be the basis for encoding the depth structure of sonar targets in *Eptesicus*.

MM13. ABER latencies are prolonged in rat pups fed a biotin deficient diet. L. P. Rybak, C. Whitworth, V. Scott, and B. Bhardwaj (Department of Surgery, SIU School of Medicine, Springfield, IL 62794-9230)

The effects of biotin deprivation on ABER were studied in rat pups fed a diet that lacked this compound. Pregnant rats were either fed a normal rat diet (controls) or a special diet without biotin (Teklad, Harlan Sprague Dawley, Madison, WI). After weaning, the respective diets were continued in pups from each group. ABER was tested under chloral hydrate anesthesia (380 mg/kg) using clicks (100 μs, 5/s) and tone bursts (3-ms duration, 1.5-ms rise–fall time at 2, 8, 16, and 32 kHz) presented free field with a driver suspended 8 cm above the vertex in the median plane. Responses were obtained using an active lead from the vertex with a reference electrode in the nose. Blood levels of biotin were measured using a microbiological assay. Animals on the biotin-free diet showed alopecia and dry, scaly skin. There was no significant difference in ABER threshold in control versus experimental animals. However, there was a significantly longer brain-stem transmission time (interpeak latencies from waves I to IV) in biotin-deficient animals. The lowering of serum biotin in experimentals was confirmed by microbiologic assay. These findings suggest that biotin deficiency in the developing rat adversely affects auditory-nerve and/or brain-stem development. These effects could be mediated by a delayed myelination of these structures. [Work supported by Deafness Research Foundation.]

MM14. Auditory-nerve discharge characteristics that distinguish between basilar papilla neurons and amphibian papilla neurons in the leopard frog, *Rana pipiens*. Don A. Ronken (Institute for Biomedical Computing, Washington University, St. Louis, MO 63110)

The frog's inner ear has two sensory organs for auditory reception. One organ, the amphibian papilla (ap), has many of the complexities of mammalian ears. The other organ, the basilar papilla (bp), is much simpler and offers special opportunities for comparison to the mammalian inner hair cell configuration. These anatomical differences make it important to identify the site of the receptor cell when recording from individual afferent neurons in the main trunk of the auditory nerve. In routine experiments, this can be a difficult problem, since the characteristic frequency (cf) of the highest-frequency (ap) neurons overlaps the cf of bp neurons in many species. To approach this problem, a statistical data base was created using responses to tone bursts and clicks, tuning curve characteristics, and spontaneous rates. A standard statistical method, discriminant analysis, produced reliable classification of neurons without using cf estimates and offers the possibility of a fully automated decision procedure. [Work supported by NIH grants NS21592 and RR01379.]

MM15. Cochlear mechanical model stability. John W. Matthews and Charles E. Molnar (Institute for Biomedical Computing, Washington University, St. Louis, MO 63110)

The introduction of nonlinear damping into computational simulations of stable active cochlear mechanical models has introduced instability in computational simulations of models used here. Nonlinear dynamical systems theory provides tools that give insight into the possible sources of such instability. Analysis of differential equations for a simplified cochlear mechanical model with a computer program ("AUTO" by Eusebius Doedel) suggests that the unstable behavior of earlier simulations is an artifact of the computations rather than an inherent feature of the differential equation model. [Work supported by NIH grants NS21592 and RR01379.]

MM16. Perceptual fusion of tonal and noisy sounds. Dik J. Hermes (Institute for Perception Research/IPO, P.O. Box 513, NL 5600 MB Eindhoven, The Netherlands)

If stationary noise is added to a tonal, periodic sound, the noise is, to a large extent, perceived as a separate sound coming from a source other than the periodic sound. Perceptual fusion of noise with a periodic sound requires specific conditions. Results will be presented that indicate that the temporal envelope of the noise plays an important role in this matter. In experiments in which this envelope had the same peridocity as the tonal stimulus, perceptual fusion did occur. Furthermore, the energy content of the noise within successive periods of the envelope was made more or less constant. These results were obtained in an experimental setup in which a quantitative measure was obtained for the extent to which the noise integrated with the periodic sound. It will be argued that perceptual fusion as reported here cannot be explained by a peripheral mechanism such as adaptation, but must be the result of a central process which groups components from a wide range of frequency bands into one or more sound images.

MM17. Vowel formant frequencies produced with and without auditory feedback. Emily A. Tobey and Christy Murchison (Department of Communication Disorders, Louisiana State University Medical Center, New Orleans, LA 70112)

Several authors have hypothesized that auditory feedback is used to refine articulatory gestures in children developing speech. In order to examine the role of auditory feedback in children, vowel production was examined in 12 children ranging in age from 3–13 years who received a multichannel cochlear implant. Data were collected 1 year after using the implant. Speech samples consisted of ten repetitions of the word, "head," spoken under four conditions: implant on, immediately after the implant