Temporal Summation for Tones at Threshold

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listeners ($N=12$) produced individual absolute loudness scales from ratio (doubling and halving) and equisection (five points over each of three ranges) judgments. These scales have been interrelated using Garner's [J. Acoust. Soc. Amer. **26**, 73–88 (1954)] method of corrected ratios. Estimates of the second and third aural harmonics of a 500-Hz pure tone were made from tone-on-tone masking measurements. A comparison of the doubling and halving ratios will be discussed together with the shunting hypothesis: i.e., energy shunted into harmonic production is subtracted from that available for conversion into the magnitude of the loudness sensation.

L8. Differential Reinforcement of High Responding Rate with Changes in Sound Intensity as the Reinforcer. J. A. Molino, *Institute for Basic Standards, National Bureau of Standards, Washington, D. C. 20234.*—Subjects (19 high school students) worked on a modified DRH schedule by tapping on a telegraph key to reduce the intensity of a continuous acoustic stimulus. The stimuli were three pure tones (125, 1000, 8000 Hz) and a white noise presented diotically through earphones. Every 20 responses falling within 200 msec of each other produced a 1-dB decrement in stimulus intensity. Failure to respond produced an intensity increase of 1 dB every 4 sec. One of the stimuli was chosen at random for each 10-min session until four sessions had been completed with each stimulus. The starting intensity level was always 70–74 dB(A). The average intensity curve as a function of time stabilized after about 4 min. The asymptotic levels achieved after 7 min were taken as a measure of equal averseness for the stimuli. Equal averseness levels were compared with other subjective weighting contours: equal loudness level, dB(A), and perceived noise level. The equal aversiveness levels fell between dB(A) and the other contours.

L9. Loudness Evaluations of the Sound from an Electric Clock. W. M. Viebrock[*] and M. J. Crocker, *Ray W. Herrick Laboratories, School of Mechanical Engineering, Purdue University, West Lafayette, Indiana 47907.*—The noise from a consumer electric clock was studied to evaluate loudness estimating procedures. Eight different clock noises were tape recorded for presentation to a panel of people for loudness judgments. An electronic switch enabled the recorded clock noise and a 1000-Hz tone to be presented alternately via earphones for $\frac{1}{2}$-sec durations with $\frac{1}{2}$-sec silences in between signals. The person adjusted the 1000-Hz tone to match the loudness of the clock noise providing a correlation to the phon loudness scale. It was determined that Steven's method generally underestimates the loudness but is usually less than 10 dB in error. If ranking on a relative loudness scale is all that is desired, dB(A) measurements will suffice. [This work was supported by Westclox Division, General Time Corporation, LaSalle, Illinois.]

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L10. Temporal Summation for Tones at Threshold. H. N. Wright, *Department of Otolaryngology, State University of New York, Upstate Medical Center, Syracuse, New York 13210.*—The threshold for tones as a function of their duration (500, 200, 100, 50, 20, and 10 msec) was investigated with the tracking method in a population of 50 normal-hearing listeners (25 male, 25 female; 25 right ears, 25 left ears) at nine frequencies from 125 through 8000 Hz under test-retest conditions. The results indicate that temporal auditory summation, at least as measured with the tracking method, conforms with theoretical expectations. There was no variation in the function with frequency, sex, or ear. When the thresholds for individual listeners are normalized to the threshold for 20-msec tones, the variability both among and within subjects is about the same at all frequencies for all duration tones (standard deviation of 2 dB). These results permit further investigation on the effect of other variables (e.g., hearing impairment) on the threshold for tones as a function of their duration. [Supported by a PHS Research Grant from NINDS.]

L11. Equal Loudness Pressures and the Normal Ear. John A. Victoreen, *Victoreen Laboratory, Maitland, Florida 32751.*—Measurements are presented to show equal-loudness sound-pressure values for a number of ears. Observations are given as average values for a number of ears that are useful in defining how a "perfect average" ear would be expected to perform. Equal-loudness sound-pressure observations are also given for several individual ears showing how supposedly "normal" ears deviate from a "perfect average" normal ear. Measurements were made by means of damped wavetrain signals having a decrement of 0.90. Signals were applied to the ear by means of a Sointrex HA10 circumaural earphone, which was calibrated on a flat-plate coupler. A number of conclusions are suggested which relate this type of measurement to the behavior of the average normal ear as a standard of general comparison without attempting to define specific numerical values.

L12. Measurement of Loudness Adaptation with a Monaural Procedure. T. L. Wiley, *Department of Communicative Disorders, The University of Wisconsin, Madison, Wisconsin 53706,* and A. M. Small and D. J. Lilly, *Department of Speech Pathology and Audiology, The University of Iowa, Iowa City, Iowa 52240.*—Monaural loudness-adaptation measurements were made at several suprathreshold levels for 500 and 4000 Hz with normal-hearing subjects. A unique procedure used the subject as a null device and adaptively varied the signal level over time until no change in loudness was indicated. Constant-loudness functions (SPL with time) were derived for each condition over a 30-sec interval. The results indicated no monaural loudness adaptation. This generalization held for all experimental conditions. These findings support similar data obtained by other investigators using delayed-balance procedures. It was concluded that the adaptation effects observed in experiments using some type of simultaneous binaural stimulation apparently are due to binaural interaction and may reflect central as well as peripheral influences.

L13. A Timing Model for the Intensity and Frequency Discrimination Functions. R. Duncan Luce, *School of Social Sciences, University of California, Irvine, California 92664,* and David M. Green, *University of California, San Diego, La Jolla, California 92037.*—For a pure-tone signal of intensity I and frequency $f \leq 1000$ Hz, we attempt to arrive at the dependence of ΔI and Δf on I and f. Single fiber neural data for low frequency tones suggest that the pulse trains are approximately renewal process with interarrival times of the form $\mathbf{IAT}=I/f+\mathbf{X}$, where $\mathbf{I}$ is a geometrically distributed random variable with parameter p and $\mathbf{X}$ is a bounded random variable with $E(\mathbf{X})=0$ and $V(\mathbf{X})$ proportional to $1/f^2$. Because the distribution of IATs is almost perfectly multimodal, if the sample is reasonably large, it is usually possible to determine the value of $\mathbf{I}$ for each IAT. Since $E(\mathbf{IAT})=1/pf$ and $E(\mathbf{IAT}/\mathbf{I})=1/f$, p and f can be estimated from the sample in the obvious way. Using a d' argument, we derive ΔP and Δf as functions of p and f. Assumptions are made relating p and the sample size to I and f, and from these assumptions are derived formulas relating ΔI and Δf to I and f. These predictions are compared with the existing data. Various theoretical problems are pointed out. [This research was supported by a grant from National Science Foundation.]