AUDITORY-NERVE AND ENERGY-DETECTION MODELS OF TEMPORAL SUMMATION IN HEARING: A THEORETICAL AND EXPERIMENTAL INVESTIGATION

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ABSTRACT

Experimental extensions and theoretical explanations of a psychoacoustic experiment concerning temporal summation of human hearing are investigated. The experiment has the well-established result that, ceteris paribus, a brief tone burst is more readily detected than a brief gap in a tone. Two models, one based on the neuroelectrical activity of the auditory nerve and one on energy-detection theory, are presented and developed in detail: both are shown capable of predicting the result of the bursts and gaps experiment. Seven experiments are reported. Experiment 1 found the reaction time to the start of a faint tone embedded in noise generally shorter than that to its end. Experiment 2 examined the effect of rise/decay time on the detectability of brief bursts of, or gaps in, broadband noise: when the energy change was constant, there was no effect except at long (100 msec) rise/decay times. Experiments 3 and 4 assessed the detectability of bursts of, and gaps in, a tone embedded in noise where energy change to noise power per cycle was constant but duration varied. The data demonstrate that the effect of duration on detectability was different for burst than gap events, a result predicted by both models. Experiment 5 showed that, when the energy in and duration of a tone burst in noise were constant but the temporal distribution of the burst energy varied, detectability remained unchanged. The repetition rate of noise bursts and gaps in continuous noise was varied without effect on detectability in Experiment 6. Bursts, however, were consistently more detectable than gaps.

Experiment 7 compared the detectability of increments and decrements of a continuous tone embedded in noise. The quantitative predictions of the two models are compared with the data resulting from Experiments 3, 5, and 7. The qualitative results of these and the other experiments are also discussed in terms of their theoretical implications. Taken all together, the experiments do not definitely favour either model over the other.