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

\*\*\*

A thesis submitted to the University of Auckland  
in partial fulfillment of the requirements for the  
degree of Doctor of Philosophy.

\*\*

Simon Kemp  
Auckland, October, 1979.

\*

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## CONTENTS

	Page No.
Abstract	
Chapter One : Introduction	1
Chapter Two : Experimental Review	7
Temporal summation at threshold	7
Temporal summation of loudness	11
The decay of auditory sensation	12
Gap detection	16
Temporal properties of masking	21
Chapter Three : Theory	29
Temporal summation models - the convolution integral	29
Zwislocki's theory and its extension by Irwin and Kemp	30
Electrical activity in the auditory nerve	38
Modification of the auditory-nerve model	44
Some applications of the auditory-nerve theory	50
Alternative theories - the energy detection model	60
Variance in the energy detection model	65
Chapter Four : Some Methodological Issues	71
Apparatus - sound production and measurement	71
Apparatus - other equipment	74
Subjects	74
Experimental procedures	75
Practice and session design	76
Techniques of analysis	77

Chapter Five : Reaction Time to the Start and End of a Tone	82
Experiments on reaction time	82
Experiment 1	87
Method	87
Results	88
Discussion	95
Chapter Six : The Effect of Rise/Decay Time	99
Previous psychophysical findings	104
Experiment 2	106
Method	106
Results	107
Discussion	110
Chapter Seven : The Detection of Bursts and Gaps with	
Constant $E/N_0$	113
Experiment 3	114
Method	114
Results	115
Discussion: The auditory-nerve model	118
Experiment 4	132
Method	132
Results	132
Discussion of Experiment 4	134
Energy-detection models	135
General discussion	146

Chapter Eight : A 'Stepped-Burst' Experiment	148
Experiment 5	157
Method	157
Results	157
Discussion	159
Chapter Nine : The Effect of Repetition Rate	163
Experiment 6	170
Method	170
Results	172
Discussion	174
Chapter Ten : Increment and Decrement Detection	180
Experiment 7	195
Method	195
Results	197
Discussion	205
Chapter Eleven : Conclusions	216
Summary of Experimental results	216
Evaluation of the auditory-nerve model	218
Evaluation of the energy-detection model	222
Theoretical conclusions	225
References	229
Appendix	240

## LIST OF FIGURES

	Page No.
Figure 2•1. Just-noticeable gap as a function of the sensation level of the second noise burst. (From Plomp, 1964).	17
Figure 2•2. Percentage of correct responses as a function of event duration averaged over four subjects from Irwin and Kemp (1976).	20
Figure 3•1. Illustration of the auditory-nerve model of Irwin and Kemp (1976), showing the responses $x(t)$ and $y(t)$ to burst and gap events.	32
Figure 3•2. Scheme of the auditory-nerve model up to the decision.	36
Figure 3•3. Approximation of the neuroelectrical firing rate of the auditory nerve in response to three varieties of tone stimulation. (After Smith, 1979).	42
Figure 3•4. Noise intensity and the $x(t)$ and $y(t)$ responses postulated by the auditory-nerve model, for Plomp's (1964) experiment.	55
Figure 3•5. Intensity of the second noise burst as a function of $-\log_{10}(1-e^{-5D})$ , where $D$ is the minimum detectable gap in Plomp's (1964) experiment.	58



Figure 5.1. Mean reaction time for each subject of Experiment 1 to each $P/N_0$ and event type.	89
Figure 5.2. $d'$ for each $P/N_0$ , event type, and subject in Experiment 1.	90
Figures 6.1 and 6.2. Percentage correct as a function of rise/decay time for S21 and S22 for each event type.	108
Figures 6.3 and 6.4. Percentage correct as a function of rise/decay time for S23 and the average of three subjects for each event type.	109
Figures 7.1 and 7.2. Percentage correct as a function of event duration for each subject, event type, and $E/N_0$ in Experiment 3.	116
Figure 7.3. Percentage correct, averaged over subjects, as a function of event duration for each event type and $E/N_0$ in Experiment 3.	117
Figure 7.4. Relation between percentage correct from Experiment 3 and $z(D)$ from equations 3.7 and 3.8 with $\gamma = 20\text{sec}^{-1}$ , $B=2$ , and $K = 0.74$ .	121
Figure 7.5. Relation between percentage correct from Experiment 3 and $z(D)$ from equations 3.7 and 3.8 with $\gamma = 5.17\text{sec}^{-1}$ , $B=1.40$ , and $K = 0.78$ .	124

- Figure 7.6. Relation between percentage correct from Irwin and Kemp (1976) and  $z(D)$  from equations 3.7 and 3.8 with  $\gamma = 5.17\text{sec}^{-1}$ ,  $B=1.40$ , and  $K = 0.78$  . 127
- Figure 7.7.  $z(D)$  predicted from equations 3.7 and 3.8, with  $\gamma = 5.17\text{sec}^{-1}$ ,  $B=1.40$ , and  $K = 0.78$  , as a function of event duration. 131
- Figure 7.8.  $z(D)$  predicted from equations 3.13 and 3.14, with  $\lambda = 5\text{sec}^{-1}$  and  $G = 2.56$  , as a function of event duration. 138
- Figure 7.9. Relation between percentage correct from Experiment 3 and  $z(D)$  from equations 7.1 and 7.2 with  $\lambda = 6.80\text{sec}^{-1}$ ,  $K = 0.62$ , and  $G = 2.35$  . 143
- Figure 7.10. Relation between percentage correct from Irwin and Kemp (1976) and  $z(D)$  from equations 7.1 and 7.2 with  $\lambda = 6.80\text{sec}^{-1}$ ,  $K = 0.62$ , and  $G = 2.35$  . 144
- Figure 7.11.  $z(D)$  predicted from equations 7.1 and 7.2, with  $\lambda = 6.80\text{sec}^{-1}$ ,  $K = 0.62$ , and  $G = 2.35$ , as a function of event duration. 145
- Figure 8.1. Stimulus envelopes and hypothesised  $x(t)$  functions for a 'stepped-burst' experiment. 149

Figure 8•2. Stimulus conditions for Experiment 5: voltage of the stimulus envelope as a function of time.	156
Figure 9•1. Stimulus conditions for Experiment 6: envelope intensity of white noise as a function of time.	171
Figure 10•1. Percentage correct as a function of 'pedestal level' for method A of Experiment 7.	201
Figure 10•2. Percentage correct as a function of pedestal level for method B of Experiment 7.	203
Figure 10•3. Percentage correct as a function of pedestal level for method C of Experiment 7.	204
Figure 10•4. Relation between percentage correct from Experiment 7 and $z(D)$ from equations 10•4 and 10•5 with $\lambda = 6.80\text{sec}^{-1}$ , $K = 0.62$ , $G = -1.45$ , and $h = 1.77 \times 10^{-5}$ .	208
Figure 10•5. Relation between percentage correct from Experiment 7 and $z(D)$ from equations 10•8 and 10•9 with $\gamma = 5.17\text{sec}^{-1}$ , $B=1.40$ , $K = 0.55$ , and $t = 7.55 \times 10^{-4}$ .	209
Figure 10•6. Percentage correct predicted by the energy-detection model for each pedestal level, for method B of Experiment 7.	211

Figure 10•7. Percentage correct predicted by the auditory-nerve model for each pedestal level, for method B of Experiment 7.

## LIST OF TABLES

	Page No.
Table 4•1. Expected binomial standard error and average obtained standard error for four experiments reported in this thesis.	80
Table 5•1. Mean reaction time for correct and incorrect responses in Experiment 1.	94
Table 7•1. Percentage correct for each subject and experimental condition in Experiment 4.	133
Table 7•2. Terms in equations 3•13 and 3•14 as a function of event duration and $E/N_0$ with $\lambda = 5\text{sec}^{-1}$ .	136
Table 8•1. Results of Experiment 5. Percentage correct for each signal waveform condition and subject.	158
Table 8•2. Average results of Experiment 5 compared with the predictions of the auditory-nerve and energy-detection models.	160
Table 9•1. Results, as percentages correct for each condition and subject, of Experiment 6.	173
Table 10•1. Guide to the stimulus conditions of Experiment 7.	196

Table 10•2a. Percentages correct obtained by S71 in Experiment 7.	198
Table 10•2b. Percentages correct obtained by S72 in Experiment 7.	199
Table A1. Average reaction time for each subject and session number in Experiment 1.	240

## 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.