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EXPERIMENTS INTO THE EFFECTS OF LOW FREQUENCY NOISE UPON HUMAN BEHAVIOUR : A PILOT STUDY

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INTRODUCTION

The results of a survey, which covered a period of two years, contributed to the design of conditions used in an investigation into the effects of low frequency noise. Each condition required the subject to perform a primary and secondary task, while exposed to noise for 30 minutes. There were 5 experimental conditions, including the control, consisting of 4 different types of noise. The noise conditions were: pure tones of 40Hz and 100Hz (both modulated at 1Hz), narrow band (f_c=70Hz, bandwidth=31.0Hz), and traffic noise (90dB lin). Subjects' physiological responses were monitored continuously.

BACKGROUND

It has been argued that annoyance is only one form of response derived from the processing activity of the auditory system, Benton & Leventhall (1983). It is likely that differential subjective effects reflect processing characteristics of audition. A key feature of this process is that of attention, the active selection of stimuli to which the individual should attend. The main characteristics of this process is its role in assessing uncertainty, relevant to the individual, Moray (1969). It is therefore required to constantly monitor and assess environmental stimuli and to attenuate those inputs which are less relevant (at that time) to the individual's requirements. It is this process which results in the subjective phenomenon of concentration. The system is primed so that input stimuli cannot simply be disregarded, that is, the channel cannot be turned off. The individual must be prepared to cope with environmental change.

If low frequency noise does present processing difficulties to the auditory system, it should be revealed in a context comprising of attentional tasks and information processing change, which involves uncertainty.

CASE STUDY

Anumber of complainants were invited to Chelsea College, in order to undergo tests. The aim being to provide both the subject and relevant agencies with a detailed account of two major factors. Firstly, the subjects' hearing sensitivity, and secondly, the SPL, frequency and character of the problem noise. Subjects' hearing M.A.P. thresholds were tested using a Peters audiometer and low frequency M.A.F. thresholds were determined (30Hz-125Hz), using steps of 10Hz intervals. Those subjects who were audiometrically normal served as the data group. The results of particular relevance here are those outlining the SPL/Hz/character associated with noise disturbance, see Fig 1. The high SPL is probably the result of the individual's "tuning" into the original noise. A number of field studies were carried out, and provided further support and guidance for the experimental conditions selected.

EXPERIMENTAL CONDITIONS

An important parameter to be considered in these tests concerned the SPL to be used. After viewing case study data and field measurements, a SPL of 25dB above the individual's threshold at 100Hz was selected. This level being likely to cause problems for traditional noise assessment procedures, and subsequently assigned annoyance values. Loudness matching procedures were carried out, with experimental conditions, pure tone mod (1Hz) 40Hz and narrow band noise being matched to 100Hz reference, after M.A.F. measurements.

TASK

The task made use of a screen (32 cm x 44 cm) with a circle marked at the centre (diameter 5 cm). In addition, a joystick control is positioned below a 4x3 rectangle of button lights (8 cm x 11 cm), placed on an angle ramp leading down from the base of the screen.

During a period of 30 minutes, the subject would be confronted with a randomly moving white dot on the screen (generated by random deflection voltages). The task being to restrict the movement of the dot by use of the joystick control. The further from the centre, the higher the error score. This served as the primary task.

Meanwhile, the 4x3 array of buttons could be triggered to illuminate randomly in fours. The buttons would illuminate for 1 second, followed by an interval of the same period, after which a response light would come on (2 second period), during which time the subject had to depress each of the 4 buttons presented sequentially.

Deviations from this schedule resulted in error scores. The presentation rate was 2 per minute.

PHYSIOLOGICAL MONITORING

The subjects' physiological responses to the experimental conditions were monitored throughout the experiment. Measures of heart rate (ECG), skin resistance (GSR), skin temperature and ambient room temperature were taken and logged on punch tape for analysis. These physiological measures indicate the level of activity which through the autonomic nervous system (A.N.S.) are responsive to the individual's needs and environment. If coping strategies are inadequate (for the task performance), the system would then respond as to a physical stressor. The system is primed to change from one state of activity to another, when the first is shown to be inappropriate.

RESULTS

These would be displayed in terms of physiological activity, error scores and subjective scaling on such constructs as 'annoyance' and 'disturbing'. An example of pilot study results may be seen in Fig 2. The GSR starting point has been zeroed for each condition. Detailed results of a complete experimental group will be presented at the conference.

REFERENCE

(1) S. Benton and H.G. Leventhall, "The role of complex auditory phenomena in noise assessment", Journal of Low Frequency Noise and Vibration, 1983 (in press).

(2) N. Moray, "Attention : selective processes in vision and Hearing", Hutchinson Educational Ltd., 1969.

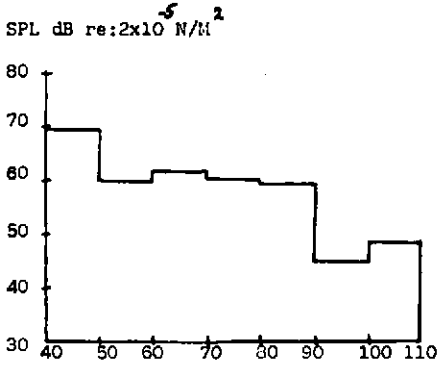

Figure 1

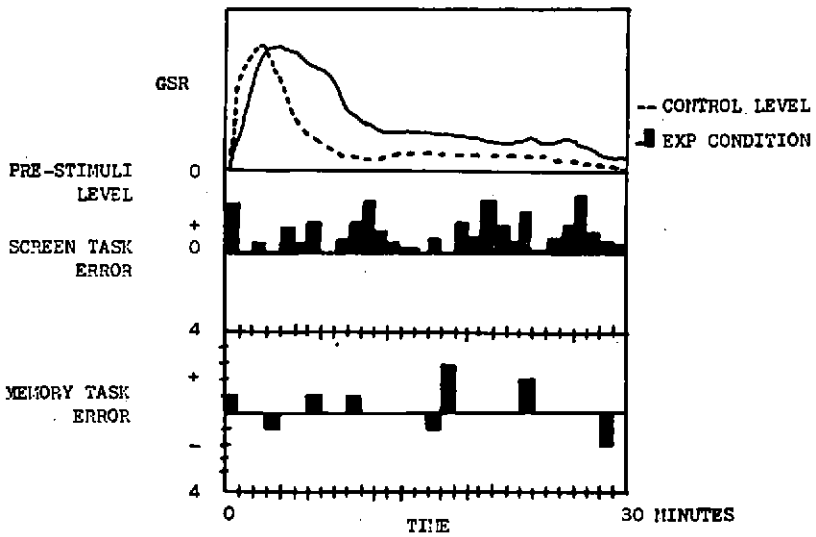

Figure 2. SUBJECT'S PHYSIOLOGICAL AND RESPONSES DURING A CONTROL AND EXPERIMENTAL CONDITION (100Hz MOD 1Hz AT 25dB ABOVE THRESHOLD)