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L_{Aeq} AND SUBJECTIVE REACTION TO DIFFERENT NOISE SOURCES: A REVIEW OF RESEARCH

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INTRODUCTION

Published literature on relative subjective reaction to noise at a given level from different sources has been reviewed. Reaction to road traffic noise - as the most widespread source - was systematically compared with that to aircraft, railway and industrial/construction noise. Laboratory experiments and social surveys were included in the review.

ROAD TRAFFIC AND AIRCRAFT NOISE

Figure 1 compares results of experiments by Rice (1977), Powell (1979) and Large (1981) in which subjects in simulated domestic living rooms were asked to judge road traffic and aircraft noise. The same category scale (0-9) with ends labelled "Not annoying at all/ Extremely annoying" was used in all cases. Both Rice and Large used traffic noise, which was more variable in level at high values of L_{Aeq} than at low, whilst Powell used a traffic noise of low variability. The results of Rice and Powell conflict. Large's results are more similar to Rice's but there is less evidence of a source-difference at low levels.

The synthesis of social surveys published by Schultz in 1978 implied a source-independent relationship between percentage of persons highly annoyed and L_{dn}. In a later paper (1980), the question of source-differences was more explicitly addressed. Fig.2 shows the average result from four road traffic noise surveys compared to that for six aircraft noise surveys. Also shown are the contrasting results from the 1978 Toronto survey in which an identical questionnaire and the same survey respondents were used for both sources. An indication of problems involved in comparing surveys can be obtained from analysing the 1972 Building Research Establishment (BRE) traffic noise survey and the 2nd Heathrow survey. For the BRE 1972 survey the percentage

highly annoyed was taken as those scoring 6 or 7 on the 7 point scale of dissatisfaction or those scoring 7. For the Heathrow survey two definitions of percentage highly annoyed were considered. Firstly the definition used by Schultz based on those scoring 5 or 6 on the 0-6 scale known as N/1, built up from two questions; Q.15 on activity interference and Q.12(a) "Tell me how much the noise of the aircraft bothers or annoys you - very much/moderately/a little/not at all/don't know?" The second definition uses the direct interpretation of those responding "very much" to Q.12(a). The results of analysing the two surveys, each with two possible definitions of percentage highly annoyed and with noise exposure in $L_{Aeq,24h}$, are shown in Fig.3. If the Schultz definition is used one would infer that road traffic noise is more annoying than aircraft noise. If the more direct definition is used then the question of source differences depends on the choice of cut-off point defining percentage highly annoyed for the BRE 1972 survey.

ROAD TRAFFIC AND RAILWAY NOISE

Experiments by Flindell (1982) in which annoyance responses were obtained to 5-minute exposures of railway noise (2 events) and road traffic noise over the range of L_{Aeq} from 44 to 65 dB (indoor) indicated less annoyance from railway noise. The opposite result was obtained by Ohrstrom (1980) who used 25 minute sessions with an L_{Aeq} value of 55 dB due to five pass-bys of either a lorry or a train.

The ISVR railway noise survey (1980) was designed to facilitate comparative analysis and such analyses were performed. Recently the effect on such analyses of including another UK survey of traffic noise - the 1975 Salford survey - which was itself designed to be comparable to the BRE 1972 survey - was studied. Fig. 4 shows regression lines of mean annoyance on $L_{Aeq,24h}$ for the Salford and BRE surveys (free flow traffic only) and the ISVR railway survey. This analysis suggests that railway noise is not always less annoying than road traffic noise and, more significantly that large differences can be obtained between surveys on the same source, in the same country, with similar techniques.

ROAD TRAFFIC AND INDUSTRIAL/CONSTRUCTION NOISE

In a joint, EEC-funded study of impulsive sound compared to traffic noise (Rice 1981), involving four laboratories, 5-minute exposures to a low-variability traffic noise and pile driving, at a range of L_{Aeq} values, were judged for annoyance using the 0-9 category scale discussed earlier. Diametrically opposing results were obtained by two laboratories. The results from the remaining two laboratories were similar, showing traffic noise to be less annoying than pile driving at low levels but more annoying at high levels

The majority of social surveys have involved transportation noise. Only two surveys were found in which traffic noise effects could be

compared to those of industrial/construction noise. In both cases traffic noise was generally the less annoying but non-acoustical factors greatly influenced results.

CONCLUSIONS AND RESEARCH NEEDS

The review has shown that the problem of source differences is complex with contradictions between the results of similar studies. Whilst some of these could be explained there is still a need for more detailed analyses of existing information and for new studies, particularly in the area of industrial/construction noise. There is scope for re-analysis of existing survey data to investigate alternative forms of noise indices based on L_{Aeq} which might account for the effects of differences in the variability of different noise environments over a daily period. In all the surveys examined in the review, the noise source had been in the study area for some time. The important question of whether new sources or changes in noise environments have source-dependent effects should be investigated. The lack of a clear-cut answer on the question of source-differences raises doubts about recently proposed models of reaction to combined sources which use numerical source-difference corrections.

References. A complete list of papers and reports analysed for this review is available from the author.

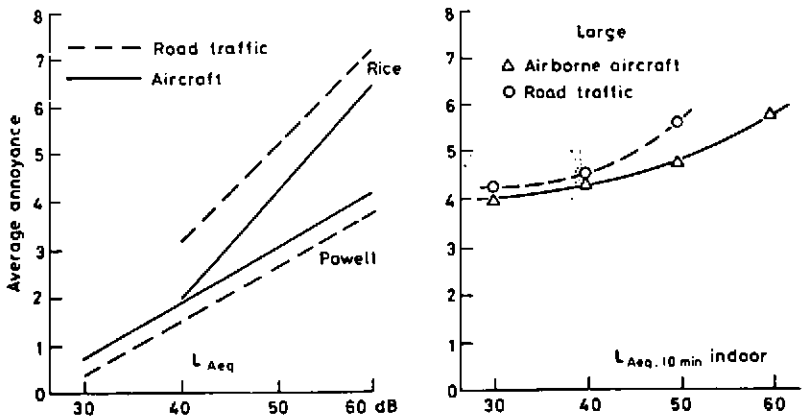

Figure 1. Annoyance rating and L_{Aeq} for aircraft and road traffic noise: Rice 1977, Powell 1979, Large 1981.

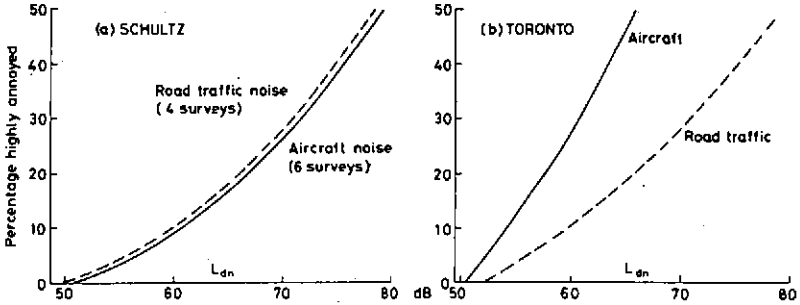

Figure 2. Percentage highly annoyed and L_{dn} for aircraft and road traffic noise: a) Schultz 1980 b) Toronto 1978.

Figure 3.

Percentage highly annoyed and $L_{Aeq,24h}$ for BRE 1972 and Heathrow 1967 survey

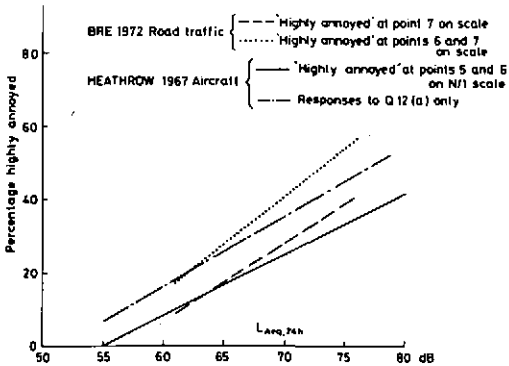

Figure 4.

Annoyance and $L_{Aeq,24h}$ for three surveys