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SUBJECTIVE RESPONSE TO DECREASES IN TRAFFIC NOISE EXPOSURE

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INTRODUCTION

The vast majority of studies of response to the presence of environmental noise have concerned themselves with the psychological effects of long-term exposure to preponderantly steady-state conditions [1,2,3]. A small number of investigators have attempted to assess the effects of a variety of noise control measures (for instance, by-pass roads [4,5,6] or noise barriers [7].

Reanalysis of data from these studies [8] seems to indicate that response to changed noise levels follows significantly different rules from those applicable to the steady-state condition. In particular, these studies appear to show that, while data from a wide range of steady-state studies can be used successfully to predict community response to conditions existing before the opening of by-passes or the construction of noise barriers. The effect of the diversion of traffic is to produce greater levels of satisfaction with the acoustic environment than would seem to be justified by the post-opening noise levels. On the other hand the effect of the construction of the noise barriers is to produce a significantly higher level of dissatisfaction than would be expected on the basis of the sound levels at the dwellings in the post-construction period.

These findings, while surprising and of significance to policy related to environmental planning [9], can only be regarded as indicative, since the data used in the analysis were not collected to test this specific hypothesis. In addition, they raise an important problem in our understanding of the time-course of noise annoyance: it is generally held that there is little or no adaptation or habituation to environmental noise [10]. If that is the case, the suggestion must be that the differences observed between responses to the methods of inducing changes in the noise environment producing similar downward changes in physical noise levels may well be related to permanent rather than temporary subjective assessments.

The Joint Transport Environment Committee of the ESRC and SERC has therefore sponsored a research project at the University of Surrey which is intended to investigate, inter alia, this specific problem. This project has involved parallel acoustic and psychological surveys at roadside sites

subject to upward or downward changes in noise level, carried out before and after such changes. Only some of these data are currently available, and the present paper must therefore be regarded as only a little less tentative than the analysis of data previously gathered by other investigators.

A secondary objective of the study was to replicate the results of earlier studies of the test-retest reliability of measurements of noise annoyance [11] and to investigate the reliability of composite scales produced by repetition of questions within one interview.

STUDY DESIGN

The selection of locations for the study was, of course, strongly influenced by the national road-building programme, and therefore the majority of sites investigated have been locations at which the traffic flow along roads in rural towns has been decreased by the opening of a by-pass. We have investigated 6 such locations in Bedfordshire, Essex, Hertfordshire, Kent and Suffolk. Further studies are in progress or planned at locations in Surrey and Dorset where dwellings will be subject to increased levels of traffic noise.

In all cases the social and physical surveys are limited to households resident in family houses approximately parallel with a major road. At the time of writing we have only completed before-and-after studies and analysis at two towns, in Essex and Kent respectively.

Sample sound level measurements were made by use of an community noise analyser, and the interviews were carried out by an independent fieldwork organization, according to an interview schedule designed by the present authors. The interview contained items related to general satisfaction with the environment, disturbance of activities by noise, health effects, dissatisfaction with the amount of traffic noise heard at home and a self-rating of sensitivity to noise. Sound level measurements were made at points considered to be representative of the houses investigated and where necessary corrections were made to the results of those measurements in terms of distance from the road and measurement point and to achieve facade values. The values of the 18-hr dBA L10 thus measured ranged from 66 to 81 in the 'before by-pass opening' condition.

RESULTS

Regression of the individual dissatisfaction scores at the 6 sites so far completed, in the before condition, yielded a correlation coefficient of 0.397, based on 365 pairs of data. Clustering the data to yield a community-level analysis produced a correlation coefficient of 0.766, based on 6 observations. These are broadly comparable with the scale of correlation encountered in previous studies. The slope of the community regression line (0.120) was extremely similar to the slopes of previous regressions performed on L10 and the 7-point rating scale of dissatisfaction [1,2,3], although the intercepts of these lines show some apparently nonsystematic variation.

Table 1 gives the mean dissatisfaction scores and dBA L10s for the before and after conditions at the two sites so far completed.

It will be noted that the levels of dissatisfaction in the before condition are consonant with the predictions of response to the then-existing noise levels which might be made on the basis of published prediction equations. However, in the case of the after-condition, the mean dissatisfaction scores appear to be lower than might be expected. This would of course be consonant with our major hypothesis, that reductions in noise exposure have greater subjective value than would be predicted from published relationships between exposure and dissatisfaction.

It would, however, be unwise to accept this hypothesis without further statistical test, particularly where only two locations are involved. Table 2 presents the results of the relevant statistical procedure.

The results of the analysis presented in Table 2 are clearly inconsistent with the notion that the 'after' data at these two sites can be predicted from the relationship between the 18hr L10 dBA and dissatisfaction which has been established by the use of steady-state data. Although the t test employed is relatively conservative in this application, the probabilities of occurrence on the hypothesis that differences between observation and expectation are actually zero are extremely low.

It has not so far been possible to replicate the investigation of test-retest reliability for the 7-point rating of noise dissatisfaction. However, since the interview contained a repetition of this question it has been possible to test stability of response over a very short

period of time. The coefficient of this intercorrelation was 0.68, which is highly significant statistically with this size of sample.

Table 1

MEAN DISSATISFACTION SCORES AND NOISE EXPOSURE LEVELS AT TWO SITES, BEFORE AND AFTER THE OPENING OF BY-PASSES

dBA L10		Mean Dissatisfaction	
BEFORE	AFTER	BEFORE	AFTER
81	68	5.99	2.39
77	72	6.41	3.94

Table 2

A TEST OF THE SIGNIFICANCE OF THE DIFFERENCES BETWEEN PREDICTED AND OBSERVED MEAN DISSATISFACTION SCORES AT TWO SITES

X(E) (1)	D (2)	SD (3)	SE(D) (4)	t	N	p (5)
4.43	2.04	1.32	0.25	8.16	51	<0.0005
5.81	3.94	1.46	0.23	8.13	79	<0.0005

Notes:
1 Expected mean = Before mean - 0.12(Before L10 - After L10)
2 Difference between observed (After) mean and Expected mean
3 Standard deviation ofthe observed (After) scores
4 Standard error of the difference
5 Probability of the occurrence of the observed difference on the hypothesis that the real value of D = 0

DISCUSSION AND CONCLUSIONS

The present study is intended to investigate whether the observation, that noise dissatisfaction after changes in ambient levels follows different rules from those of the steady state, can be replicated in the context of a study specifically designed to test this hypothesis.

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There seems to be little room for doubt that downward changes in noise exposure produce greater increments in satisfaction than would have been predicted from the considerable database gathered by the investigation of people living in stable acoustic environments. So far this finding is, of course, restricted to the circumstance in which the reduction has been achieved by an objective change in the noise source. The preliminary analysis of data gathered without the present hypothesis in view [8] indicates that changes brought about by the erection of noise barriers may not have the same effect, and, by analogy, this may also be true of the effectiveness of noise insulation. There is at present no comparable evidence about the effects of upward changes, although the final phases of the present study will include some relevant data-collection.

As far as the stability of measurement of subjective dissatisfaction is concerned, it is evident that the short-term (i.e. within-interview) stability of self-rating is not greatly different from the longer term stability previously studied [3,11], which produced test-retest coefficients of a little over 0.60.

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