Proceedings of the Institute of Acoustics

A STUDY OF ANNOYANCE DUE TO GENERAL AND BUSINESS AVIATION NOISE

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INTRODUCTION

In recent years there has been considerable concern about the application of conventional airport planning guidelines in areas affected by noise from General Aviation (GA)[1] aerodromes. The use of standard guidelines (which in the UK [1] are based on the Noise and Number Index) has been questioned because of suggestions (by the Airfield Environment Federation) that in terms of aircraft noise level (ANL) the annoyance thresholds may be lower due to the multiplicity of different operational patterns, lower background noise levels and different hours of operation. It has been suggested, for example [2], that the repetitive nature of training flights might cause a greater level of annoyance than normal itinerant flights.

Studies of the problem have been carried out in several other countries (see for example [2-5]). The findings tend to indicate that although annoyance due to GA noise is only weakly related to ANL it is relatively higher, for a particular ANL, than air transport (AT)[1] operations.

In the UK a study was carried out in 1981 [6] to determine the adequacy of existing noise indices, in particular NNI and L_{eq}, for describing disturbance due to GA operations. This included a combined noise and social survey in communities around five GA aerodromes. However, the ANLs were rather low and at only one aerodrome (Leavesden, N. London) was a reasonable spread of noise exposure observed. At this aerodrome, annoyance (as measured by a Guttman Annoyance Scale (GAS)) was correlated with NNI and was not significantly different to that found in 1967 at similar NNI values near London's main airport at Heathrow [7]. Considerable debate concerning the policy implications of this work led to the call for a further study with a wider set of objectives. This paper summarises the results of that new investigation.

THE 1986 GENERAL AND BUSINESS AVIATION SURVEY

This study had the following specific aims: (1) to investigate whether the relationship between noise and annoyance is the same for GA and AT operations; (ii) to ascertain whether non-acoustical factors such as attitudes to the aerodrome or to particular modes or types of flying predicted an individual's annoyance; (iii) to consider the extent to which annoyance is related to variations in traffic, particularly between times of day, week or season, or whether disturbance is 'integrated' over some time period and related to average air traffic levels.

The basic approach was similar to that of the 1981 study [6] in that it involved integrated noise and social surveys at, in this case, six sites around five aerodromes [Elstree, Wycombe, Shoreham,

[1]Air transport (AT) defines the aviation sector concerned with the carriage, mainly in large aircraft, of fare-paying passengers. General Aviation (GA) encompasses all other forms of civil aviation mainly of small aircraft operating from small aerodromes. Business aviation is that component of GA concerned with business and commercial flying.

Southampton and Biggin Hill (Biggin Hill Village and New Addington)] chosen so as to reflect a wide variety of noise levels and types of GA. However, the questionnaire was rather more comprehensive and featured numerous questions aimed specifically at objectives (ii) and (iii) above. The questionnaire was broadly divided into five sections to ascertain:

(1) General opinions about local living conditions to identify specific favourable and unfavourable points.

(2) Perceptions of aircraft noise in relation to those concerning other local noise sources considering different times and the incidence of activity disturbance.

(3) Awareness of and annoyance caused by different types of aircraft and modes of flying.

(4) Knowledge and opinions about the local aerodrome and the activities there, and the general importance of various branches of aviation.

(5) Socio-economic characteristics.

The samples were chosen using a two stage procedure. First, households were selected from all those within a particular area and then an individual was sampled from within each household using a Kish Grid [8]. The aim was to obtain 120 interviews at each site. This was achieved at all survey areas except Shoreham where a combination of a rather aged population together with the timing of the survey (July) led to a rather lower response rate. The interviews were carried out over a short time period to minimise risks of giving prior warning about the nature of the survey.

Careful records were kept of the aircraft movements to and from the aerodrome during the period of the social survey. Noise measurements were made in the vicinity of the survey area afterwards, again to avoid revealing the nature of the study beforehand to those interviewed. The relevant noise exposures were calculated from noise and flight track information. The optimisation of noise indices of GA operations was outside the scope of the study. Instead ANLs were defined by the widely accepted SEL/L_{Aeq} scales. Noise exposures were determined for two time periods: day (0700-1900) and evening (1900-2300). There was little or no aircraft traffic at night at any of the aerodromes.

RESULTS

Of noise sources heard in the local area, aircraft were the sources most frequently mentioned in the three noisiest areas. At the three quietest areas, however, other sources were mentioned more frequently, in particular road traffic and 'people'. The relationship between annoyance and ANL is illustrated in Figures 1(a), (b) and (c). These compare the present results with those of the 1981 GA study [6]. In broad terms it appears that below ANLs of about 50dB(A) L_{Aeq} there is little annoyance and no variation with noise level. At higher noise levels, annoyance increases with noise. Questions about annoyance at different times of day or week indicated that the majority of respondents find noise worse at the weekends; indeed it appears that weekend annoyance is 'driving' the overall annoyance reactions.

Figure 2 compares the noise annoyance relationships due to GA and AT. The percentage of respondents "very much annoyed" by aircraft noise at the eleven GA sites (combining the results of the present study and the 1981 study) is plotted together with data from the 1984 Aircraft Noise Index Study which was confined to noise from AT operations at airports [9]. To determine whether the two relationships (for GA and AT operations) between annoyance and ANL are different, a logistic regression was carried out. The best fit curves have common slopes but separate intercepts as follows:

Air Transport	$\ln(p/1-p) = -10.12 + 0.14$ ANL
General Aviation	$\ln(p/1-p) = -9.44 + 0.14$ ANL

where p is the proportion of respondents "very much annoyed".

Thus although the relationships between annoyance and ANL are similar for both types of air traffic, GA noise appears to be more annoying. For example, in similar areas experiencing one-week L_{Aeq}s of 55dB(A), near a GA aerodrome one would expect 15% of the population to be very much annoyed. Near an AT airport one would expect 8%. However, this finding must be viewed with some caution because the GA regression is based on very few points.

In general, ANL alone appears to account for little of the variation in annoyance. To investigate the possible influence of non-acoustical variables, stepwise regressions were undertaken using a 10-point annoyance scale. Two annoyance prediction models were developed. These are presented in Table 1. The "associative" model is based upon the characteristics most associated with annoyance while the "descriptive" model includes the different types and kinds of flying found annoying.

As has been found in numerous previous studies, non-acoustic factors appear to play an important role in determining annoyance due to aircraft noise. In this case, higher annoyance was found to be associated with feelings that aerodromes are bad with respect to low flying, community relations and in handling complaints, feelings that the aircraft may crash and opinions that leisure flying is unimportant. In addition, respondents who are annoyed tend to be older and more likely to be owner occupiers than their less annoyed counterparts.

The descriptive model relates annoyance to types and modes of flying. Aircraft noise annoyance is particularly closely associated with flying school activities and leisure flying. These results reinforce the need for caution when predicting annoyance from aircraft noise levels alone. Neglect of other non-acoustics factors may give rise to significant errors.

CONCLUSIONS

In general, any reduction in aircraft noise emissions around GA aerodromes may be expected to lead to reduced annoyance but the two major conclusions from this study are first, that the fall in annoyance will be small (and there is no threshold below which annoyance will disappear) and second, that noise annoyance is strongly related to attitudes towards the aerodromes and to their flying activities.

Another conclusion from this study is that civil aviation categories are clearly ranked in importance in people's minds, with air transport being rated most important followed by business aviation and finally general aviation. As predictors of noise annoyance, no distinction can be drawn between air transport, business aviation and the flying school segment of general aviation. However, leisure flying is associated with higher annoyance levels.

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Table 1 Regression Coefficients for Models to Predict Annoyance Due to Aircraft Noise

i. Associative model

Variable	Coefficient	Standard Error
Noise level	0.065	0.01
Importance of leisure flying	-0.34	0.07
Aerodrome bad with respect to		
low flying	2.14	0.20
complaints	1.38	0.33
community relations	0.74	0.20
Fear of crashing	0.86	0.14
Age	0.01	0.01
Owner occupier	0.61	0.22
Constant	-1.26	0.76
	$R^2 = 0.48$	

ii. Descriptive model

Annoyed by		
airlines	1.63	0.25
business jets	1.27	0.24
flying schools	2.19	0.25
leisure flying	2.91	0.23
taking off	1.33	0.37
arriving	1.13	0.39
Constant	2.55	0.39
	$R^2 = 0.50$	

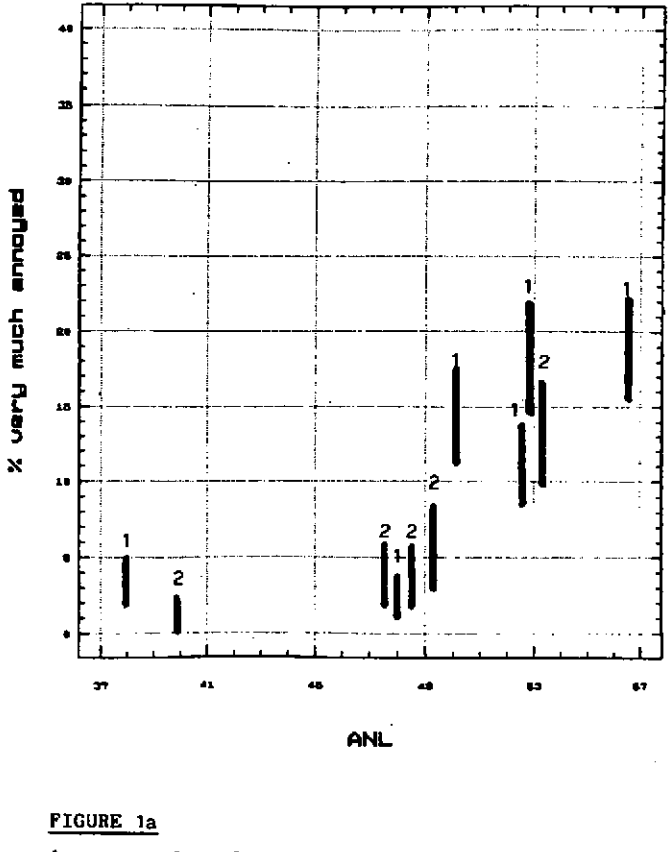

FIGURE 1a

Annoyance from General and Business Aviation in the UK: percent very much annoyed by Aircraft Noise Level (1 week L_{Aeq}).

Key: 1: Current study; 2: 1981 UK study

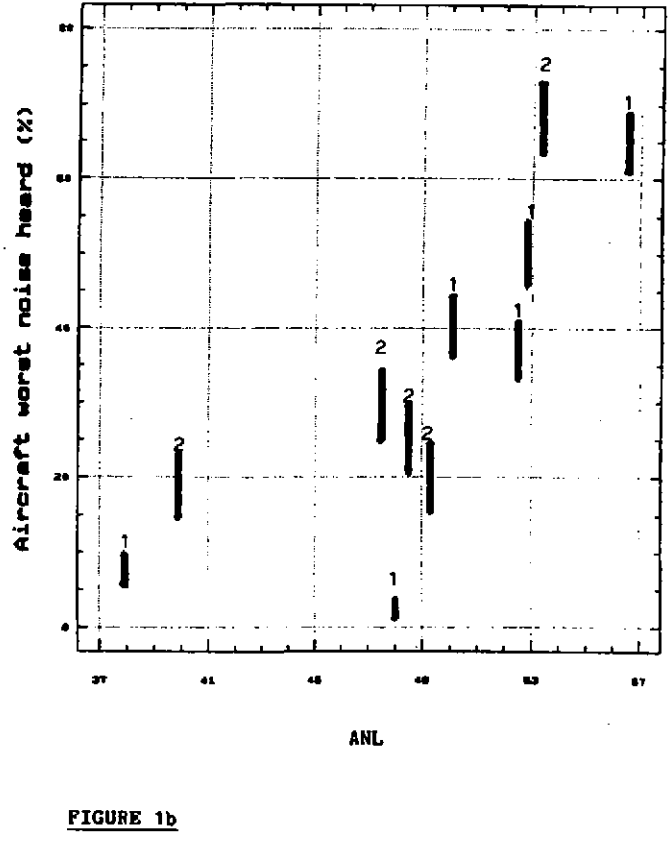

FIGURE 1b

Annoyance from General and Business Aviation in the UK: percent reporting aircraft noise is the worst noise heard by ANL (1 week L_{Aeq}).

Key: 1: Current study; 2: 1981 UK study

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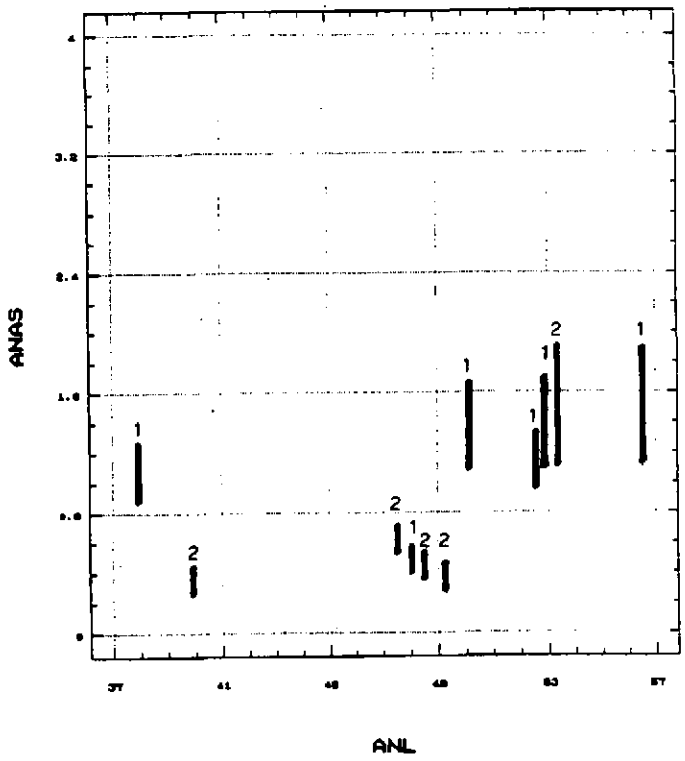

FIGURE 1c

Annoyance from General and Business Aviation in the UK: average ANAS score by ANL (1 week L_{Aeq}).

Key: 1: Current study; 2: 1981 UK study.

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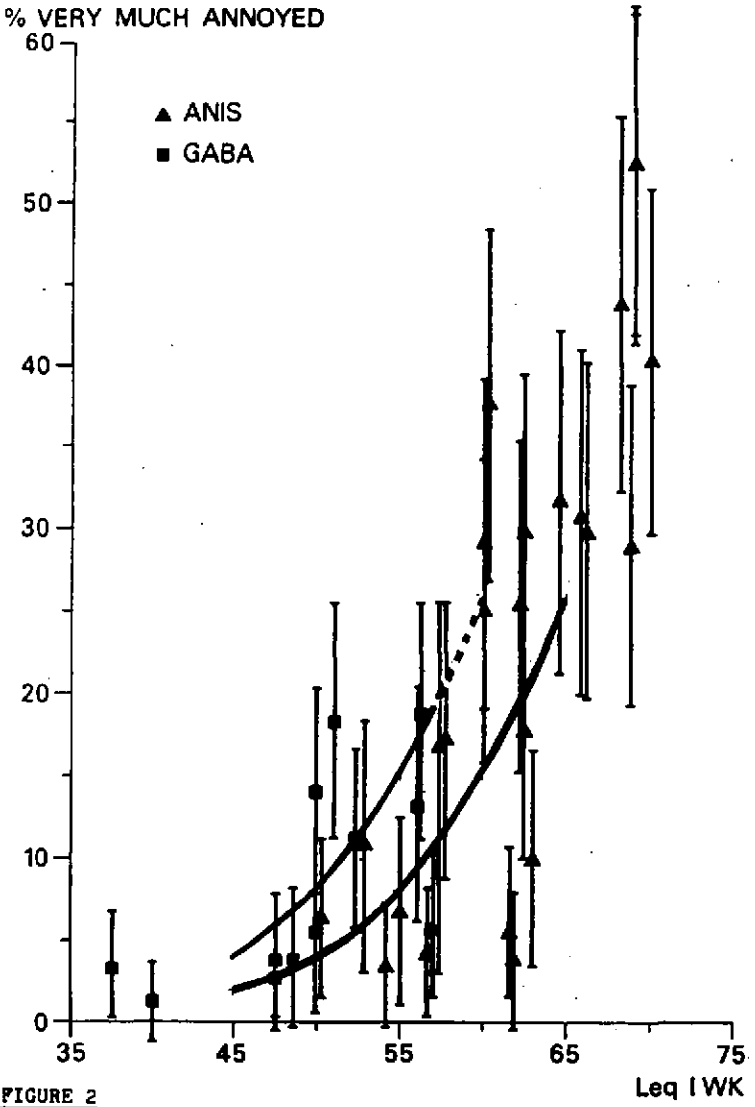

FIGURE 2

Comparison of annoyance from General and Business Aviation with that from scheduled Air Transport.
ANIS refers to observations from the UK Aircraft Noise Index Study
GABA refers to observations from the current study and from the 1981 UK study

[Vertical lines correspond to one standard deviation from observed annoyance].
The Upper super-imposed curve is the best fit curve for GA; the lower curve is the best fit curve for AT.