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NOISE DISTURBANCE AT NIGHT NEAR HEATHROW AND GATWICK AIRPORTS

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INTRODUCTION

This paper presents the main results of a "check study" into noise disturbance at night near Heathrow and Gatwick. The check study [1] follows on from a major research programme into the relationship between aircraft noise and sleep disturbance [2] carried out in 1979.

The objectives of the original research programme were:

(a) to establish the nature and scale of sleep disturbance from all causes around Heathrow and Gatwick airports,
(b) to assess the significance of aircraft noise in causing sleep disturbance,
(c) to investigate the relationship between exposure to aircraft noise and the degree of sleep disturbance.

The results of the research programme were used in the considerations of the Department of Trade - the relevant responsibilities are now with the Department of Transport - into restrictions on night flights at Heathrow and Gatwick. Details of the Government's decision and its night restrictions policy are given in a Department of Trade Press Notice [3].

The movement quota system divides aircraft types into two groups - "Noisier" and "Quieter". The intention when these groupings were proposed was to distinguish the new technology aircraft, which incorporate the improvements in acoustic design which have led to significant reductions in engine noise, from older types. Over the period of the movement quota system, the number of aircraft permitted in the "noisier" group has been progressively reduced year by year.

This process of progressive reduction of the "Noisier" subquota has, obviously, an impact on the night-time aircraft noise exposure experienced by residents near Heathrow and Gatwick. The Government promised to undertake a further review of the restrictions on "Quieter" flights when most of the "Noisier" movements have been phased out [3]. The present study is a contribution to that review.

In the earlier research programme the major element was a number of social surveys in selected areas around the airports, with associated noise measurements. The check study followed very nearly the same methodology as the original exercise. However, instead of a large number of geographically widespread areas (22 areas around Heathrow and Gatwick were used in the original study) a small number of these same areas - those worst affected by aircraft noise - were used.

This approach - almost a 'longitudinal' study - sought to determine whether changes had occurred, and if so what they were. Apart from reductions in noise exposure at night and possible changes from other sources, people's reactions may have changed and there may have been demographic shifts in the population.

This check study is therefore intended as a comparison with the earlier work. The aim is to focus on the most relevant aspects and the measures of disturbance at night, and not to repeat the full and extensive analysis of the original study. These measures include: difficulty in getting to sleep, wakings, and tiredness.

PLANNING AND CONDUCT OF THE CHECK STUDY

The approach in the study is to investigate reported sleep disturbance in small communities, within each of which the exposure to aircraft noise is approximately the same for all its members - so-called "common noise areas". A social survey is used to assess sleep disturbance. Two sorts of questionnaire - postal and interview - are used, the postal being chosen so as to obtain a large sample comparatively inexpensively, and the interview to pursue a more detailed examination of disturbance responses at a selection of the postal survey areas. The postal questionnaire is framed in such a way that aircraft noise is only one of several possible causes for disturbance: the respondent is not "led". The questionnaire employed for the interviews asks specifically about noise disturbance from aircraft and views on night movement restrictions, but only after general questions on the degree of, and interviewee-reported causes of, sleep disturbance.

Five areas were surveyed using the postal questionnaire, three near Heathrow and two near Gatwick: of these, two were also surveyed using the interview questionnaire. The areas at Heathrow were Hounslow, Hounslow Barracks and Stanwell Moor. In the original study these areas were subject to the highest aircraft noise exposure, and there were indications that people at these locations were markedly more disturbed than residents in other areas near Heathrow. In addition Hounslow was chosen for survey by the Interviewer method, as it had also been used in the main study. Of the Gatwick areas South Horley and Lingfield were chosen: South Horley had been the noisest area at Gatwick in the main study, Lingfield had the second highest number of recorded aircraft movements at Gatwick and had been surveyed by interviewer - it was again interview-surveyed in the check study.

The social survey fieldwork was carried out by an independent organisation, Social and Community Planning Research (SCPR) [4]. The same sample sizes (200 for each postal site, 150 for each interview site) were used as in the main study. The overall postal response rate was 59%, almost the same as that in the main study, but with minor variations from area to area.

The noise measurements [5] closely followed the method of the main study [2]. Because of the concept of a common noise area the measurements made at a central site within each community could be regarded as typical for the area. Noise measurements were made on a number of nights so that a reliable measure of the "General Experience" climate (corresponding to the three months prior to the social survey), and the "Designated Night" (corresponding to the night

immediately before the social survey) results could be determined.

INTERVIEW QUESTIONNAIRE RESULTS

General Impression of the Area

In the two areas considered in the 1984 check survey the general satisfaction with the areas was much the same as before. In Hounslow in 1984 86% of respondents rated the area as "fair", "good", or "excellent", in comparison with the 1979 figure of 87%. The corresponding figures for Lingfield are 100% and 97% respectively. Noise from aircraft remains the single most cited factor for disliking the area, 40% of respondents at Lingfield and 34% at Hounslow quoting it. These proportions are not much different from the response in the 1979 survey (47% and 37% respectively).

Sleep Problems: Getting to Sleep

In both areas 60% of people experience no difficulty in getting to sleep, which is very close to the results of the previous survey. At Hounslow 14% of all respondents now cite aircraft noise as a reason for their inability to get to sleep. Whilst this is a smaller percentage than that shown by the 1979 survey (20%) it is not statistically significant at the 5% level. However, at Lingfield only 7% of all respondents now report difficulty getting to sleep because of aircraft noise. In 1979 the figure was 21%, and so the new figure is outside the range expected from random fluctuations. In both these areas, the aircraft noise exposure between 10.00pm and midnight was less than in 1979 and noise in general is cited as a reason for difficulty getting to sleep slightly less than before in both places, although the proportions contributed by the various noise sources have altered.

Sleep Problems: Awakening

Once asleep, respondents at Lingfield are far less likely to be woken than before for any reason (58% now are woken compared with 75% in 1979), whilst the proportion of people at Hounslow who report being woken is 65% which is very similar to the 1979 figure. In both areas the aircraft noise exposure between 11.00pm and 7.00am is lower and being awoken by noise from any source is reported less frequently than before. However, while there has been a large drop in reported wakings due to aircraft noise (from 36% to 19% of all respondents at Hounslow, and from 40% to 17% at Lingfield), this still remains a major reported cause of waking at both places. At Lingfield road traffic noise is now cited as frequently as aircraft noise, and at Hounslow noisy neighbours are a very close second.

At Lingfield although about three fifths of respondents report difficulty in getting back to sleep having woken (on both surveys), only 3 individuals now say the difficulty is caused by aircraft compared with 29 in 1979. Noise from any source is cited by 17 people. At Hounslow 66% of respondents have difficulty getting to sleep again once awake (up from 45% in 1979), with 2 respondents blaming aircraft out of a total of 16 blaming noise. In 1979 17 respondents blamed noises, 9 of the cases being aircraft noise.

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General Causes of Bother at Night

Aircraft noise remains the main cause of bother at night. In both areas the the percentages of respondents citing aircraft noise have increased: from 65% to 76% at Lingfield, and from 78% to 97% at Hounslow. The increase in the latter areas is outside the expected range for random fluctuations. Responses at Hounslow also show increases in disturbance from lights and tradesmen, while at Lingfield there has been a reported increase in disturbance caused by neighbours from 17% to 37% of respondents.

Factors Affecting Disturbance

The percentage of respondents usually sleeping with some or all of their windows open is 55% in Lingfield and 38% in Hounslow - close to the 1979 figures of 53% and 34% respectively. The number of people quoting the various reasons for shutting windows are very similar in the two surveys and at both places, with the exception of those quoting aircraft noise. At both Hounslow and Lingfield few people quote aircraft noise as a reason to sleep with shut windows. At Lingfield in 1984, 4 out of 120 respondents would shut windows at night compared with 15 out of 125 in 1979. The corresponding numbers at Hounslow are 7 out of 103 and 20 out of 123.

Change in Night Restriction Policy

When asked if they would prefer the "quiet" period at the airport to be moved, 15% at Lingfield and 14% at Hounslow said they would like it to start and finish an hour earlier. 12% at Lingfield and 20% at Hounslow favoured the period starting and finishing an hour later than at present. While the new survey shows slightly more people favouring a move to later starting, and fewer people wanting the period brought forward, the results are not significantly different from the 1979 survey. The remainder of respondents favoured no change or had no opinion.

POSTAL QUESTIONNAIRE RESULTS

Designated Night

The designated night does of course refer to a particular night, so the aircraft noise "stimulus" is not necessarily typical of the average noise climate, which is properly estimated by the general experience results. However the postal responses to this question do not involve the elements of "long period remembering" and "mental averaging" that are necessary in the case of such responses in general experience [1]

For all of the areas the Leq is lower in the check study than in 1979, particularly so for Hounslow Barracks, Stanwell Moor and Lingfield. The "all reasons" percentage of difficulty in getting to sleep is about the same as in 1979, although the very high 1979 Hounslow Barracks response is significantly down in 1984. The variation in the "all reasons" response against Leq remains flat at about 25%. Those respondents giving aircraft noise as a reason for difficulty in getting to sleep are down significantly at Hounslow Barracks and Lingfield, but up at South Horley, albeit not significantly. Both the Leq and

number of aircraft at South Horley are very similar for 1979 and 1984. For these areas, which it should be remembered were chosen here for their high aircraft noise exposure, on average 10% of respondents say aircraft noise caused difficulty in getting to sleep. The variation in this percentage with Leq is consistent with the 1979 results - less than 5% at 50 Leq to around 15% approaching 70 Leq.

The 1979 data show a constant percentage (within sampling variations) in awakenings from all causes, and an approximately linear increase with Leq in the awakenings attributed to aircraft noise. The check study results match well with those of 1979. The only individually significant results for the check study are the drop in total awakenings and in those attributed to aircraft at Hounslow Barracks, which in 1979 showed higher figures in both these respects than any other area.

The general experience variable of percentage having difficulty getting to sleep for all reasons and for those giving aircraft noise as a reason showed an approximately linear increase with 10.00 pm to midnight Leq, the "all causes" increasing less strongly than the aircraft-attributed. The check study results are consistent, except that both the Gatwick aircraft-attributed points are around 10% above the fitted line, although these are possible sampling fluctuations.

All the Leq values have gone down since 1979. This is more marked for the Heathrow areas than for those at Gatwick. Some of the reduction at Heathrow is the result of the approximate halving of the number of movements, whereas at Gatwick the numbers have remained much the same. There is a general reduction in the aircraft-attributed percentage, statistically significant for Stanwell Moor and Lingfield. About half of those who say they have difficulty getting to sleep now name aircraft noise as a reason.

General Experience

The general experience awakenings - 'ever' - show a consistent reduction from 1979 to 1984 accompanied by great reductions in the number of aircraft making 90dBA or more. The general experience awakenings - 'more than once a week' - rarely exceed 40% from all causes and 25% from aircraft noise. The trends in general experience awakenings with Leq are consistent with those of 1979 [2] and may be summarized as follows:-

Ever awoken (all reasons)	-	Constant
Ever awoken (aircraft as a reason)	-	strong linear increase, with Gatwick check study points slightly high.
Awoken more than once per week (all reasons)	-	linear increase, although Hounslow Barracks has decreased significantly.

Awoken more than once per week – slightly stronger linear increase than for 'all reasons', although Gatwick points rather high.

There has been a consistent reduction in aircraft-attributed awakenings from 1979 to 1984 for the areas surveyed. The Hounslow and Lingfield reductions showing up as statistically significant. For these five areas the percentage who say they are ever awoken, and give aircraft noise as a reason, now averages to about 40%. The percentage who wake more often than once a week, and give aircraft noise as a reason, is now about 20%. The comparable percentage for all reasons are roughly 80% and 35%.

One of the most interesting measures of disturbance examined in 1979 was 'Tiredness', defined as the percentage of respondents who reported they were 'tired' or 'very tired' after a typical night's sleep. There was evidence that this percentage did not vary over the Leq range until a level of around 65 Leq was reached, at which point there was a significant increase. The highest Leq point in the check study (66 dBA at Hounslow Barracks) does not show such a marked increase with this measure of disturbance but it is still consistent with the onset of an increasing trend at around the 65 Leq point.

Two further variables give indications from different aspects of the degree to which aircraft noise is perceived as a problem. The percentage giving aircraft noise as a reason for closing windows for all the areas show a drop and this is very significant for Hounslow Barracks. However this improvement is probably quite compatible with that expected from the reduction in Leq.

Three of the areas show a significant reduction in the percentage of people who report that aircraft noise is a cause of bother at night. Only for South Horley is there no indication of improvement in this regard. The average percentage for the 5 areas has decreased from around 70% in 1979 to around 60% in 1984.

Respondents to the Interview questionnaire were asked about the night restriction period: given its present length, should it begin later or earlier. The results of the 1979 study, with the majority (about two-thirds of respondents) not wanting a shift, were confirmed. The proportions wanting either an earlier or a later start were about the same.

DISCUSSION AND CONCLUSIONS

In a fully "longitudinal" study the same people as in the original exercise would be interviewed in the check study. Here representative samples of the population have been interviewed, so the area results tell us about the change in the situation but not about the effects of habituation/age etc for a particular group of individuals. In the original study it was found that the "aircraft noise energy" measure Leq correlated well with the degree of reported disturbance - however measured - as being due to aircraft. The 1984 data points lie on approximately the same lines of disturbance versus Leq thus there is no evidence in the check study which would overthrow Leq as a good measure of aircraft noise exposure at night.

One of the most interesting aspects of the 1979 study, which is confirmed by the 1984 results is that in general the disturbance attributed by respondents to aircraft noise tends to show a greater increase with aircraft noise exposure (as measured by Leq) than does the total (ie "all reasons") amount of disturbance reported. A possible explanation is that an increase in the aircraft noise exposure does, to some extent, provide a "label" to which respondents can attribute their disturbance. Thus in areas with higher aircraft noise exposure individuals waking for any reason are more likely to hear an aircraft, and thus tend to nominate aircraft noise as the cause of their awakening or disturbance. In particular, no strong evidence for an increase in total disturbance of sleep which could be attributable to aircraft noise, however measured, was found in 1979 or 1984, except that in the original study an increase was detected at 65 Leq plus. However the reduction in Leq values since 1979 means that the marked increase in total disturbance at night then observed for Leq values above 65 Leq is not detectable given the data range here (noise variables within the range of the 1979 study).

One of the most significant results of the check study is the reduction in disturbance for the 5 areas. While the trends of noise exposure and disturbance have shown little change, the individual data points for the check study areas have "moved down the curve". Thus, the reduced noise exposure has decreased disturbance between 1979 and 1984.

Leq is, as noted before, a measurement of aircraft noise energy. The same Leq value could be produced by one noisy aircraft or several quiet aircraft. [2] discusses this point with respect to night restrictions. If it can be assumed that the relationships between Leq and sleep disturbance attributed to aircraft continue to hold over a wide range of number of aircraft overflights, then disturbance would remain the same for the same value of Leq no matter how it was produced. This is not improbable for a "small" extrapolation of number ("25%?" was quoted in [2], because no marked dependence on number - other that that implicit in the use of Leq - was found in the 1979 data. For example, the "general experience" number of aircraft [2] varied from 245 to 3926 (a factor of more than 15) and this did not reveal itself in an increased disturbance response beyond that expected from the comparable Leq values.

Confirmation for the use of Leq is found, but, no additional evidence is produced for the use of Leq for markedly larger numbers of aircraft.

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