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ON THE NOTICEABILITY OF SMALL AND GRADUAL DECLINES IN AIRCRAFT NOISE EXPOSURE LEVELS

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INTRODUCTION

This paper describes a social survey undertaken to collect empirical evidence of the noticeability of reductions in aircraft noise exposure in the vicinity of Seattle-Tacoma International Airport. The Port of Seattle has reported that the mean value of measured Day-Night Average Sound levels (DNL) in the vicinity of the airport declined from 1991 to 1994 by 2.9 dB, due primarily to replacement of older and noisier jet transports by similar numbers of newer and quieter aircraft. In the two years prior to the current study, the shrinkage of cumulative aircraft noise exposure contours at Seattle-Tacoma International Airport was on the order of 1.5 dB. Fidell, Silvati, and Pearsons (1995) provide further details of this survey.

METHOD

A structured questionnaire containing twelve items inquiring about neighborhood conditions provided a context for questions about the salience and consequences of changes in aircraft noise exposure. The first explicit mention of noise occurred in Item 5 ("Would you say that your neighborhood was quiet or noisy?"), following preliminary questions about duration of residence, about the most and least favored aspects of neighborhood living conditions, and about annoyance with traffic congestion. The next two items ("Have you noticed any more or any less aircraft noise in your neighborhood over the past year?" and "past two years") solicited opinions about the issue of central concern. The remaining questions focused on specifics of short- and long-term annoyance with neighborhood street traffic and aircraft noise.

Telephone interviews were conducted in five neighborhoods to the north and south of Seattle-Tacoma International Airport that differed in aircraft noise exposure by roughly 12 dB, as indicated by the airport's noise

contours. Unattended, A-weighted measurements of aircraft and other outdoor community noise were made at locations within each interviewing area during the week prior to interviewing.

RESULTS

Overall, 1,236 interviews were completed. The percentage of completed interviews was 53%, with only minor variation from site to site. Failure to complete an interview was due in most cases to refusals and non-contacts after seven attempts. Forty-six percent of the respondents were male, while 54% were female. The bulk of respondents in all interviewing areas had lived at their current addresses at least two years. Sixty percent of all respondents had lived at their current addresses for five or more years; 27% for two to five years; 8% for one to two years; and 5% for less than one year.

Noise measurements made during the week prior to interviewing revealed Day-Night Average Sound Levels between 63 and 74 dB. Noise exposure attributable to aircraft overflights in interviewing areas was distinguished from that attributable to street traffic noise by the level and duration of individual noise events in excess of site-specific thresholds. Aircraft noise was responsible for 6-14 dB of the total noise exposure observed at the five sites.

No more than 10% of the respondents in any interviewing area reported noticing less aircraft noise in their neighborhoods during the year prior to interviewing. Large majorities of respondents at all sites either reported noticing *no* changes in aircraft noise, or noticing *increases* in aircraft noise in their neighborhoods in the year prior to interviewing.

Respondents who (1) had noticed any change (either an increase or a decrease) in aircraft noise during the prior year, and (2) had resided at their current addresses for two or more years, also were asked whether they had noticed an increase or a decrease in aircraft noise during the *two* years prior to interviewing. Large majorities of these respondents in all interviewing areas reported noticing increases in aircraft noise during the two years prior to interviewing. A comparison of the opinions of respondents who had noticed increases in aircraft noise in the prior year and the prior two years indicates that greater percentages of the latter than of the former respondents reported "considerably" more aircraft noise annoyance.

No more than 14% of the respondents in any interviewing area were annoyed in any degree by street traffic noise in the week prior to interviewing. Relatively small minorities of respondents (7% or less) in each interviewing area had been bothered or annoyed to a consequential degree by street traffic noise in the week preceding interviewing.

A greater percentage of respondents (38%-60%) at all sites had been annoyed in any degree during the prior week by aircraft noise than by street traffic noise. Further, the percentage of respondents describing themselves as highly annoyed by aircraft noise during the past week ranged from 9% to 26% in the various interviewing areas.

Even greater percentages of respondents (56%-77%) had been annoyed in some degree during the prior year by aircraft noise than by either aircraft or street traffic noise during the prior week. The percentage of respondents reporting high annoyance due to aircraft noise during the prior year ranged from 16% to 31% across all sites.

A majority of respondents reported that their annoyance attributable to aircraft noise had not changed over the prior two years. About a third reported that their annoyance had increased, and small numbers of respondents reported that their annoyance attributable to aircraft noise had decreased.

DISCUSSION

Noticeability of Changes in Aircraft Noise

The pattern of findings with respect to the notice of changes in aircraft noise among respondents who had lived at their present addresses for at least a year was similar in each interviewing area. No more than 10% of the respondents in any interviewing area noticed a *decrease* in aircraft noise during the prior year, while as many as 60% of respondents in one area reported no change in aircraft noise in the same time period.

Among longer term (minimum of two years) residents who noticed any change in aircraft noise exposure in the year prior to interviewing, an even greater percentage of respondents reported noticing increases in aircraft noise in their neighborhoods within the two years prior to interviewing. The pattern of notice of changes in aircraft noise in the past year and past two years suggests that little benefit was perceived by respondents from any reductions in aircraft noise exposure during the years prior to interviewing.

Relative Sensitivities to Noise Exposure of Current Respondents and Those in other Communities

As shown in Figure 1, the observed prevalence of high annoyance with street traffic and aircraft noise among respondents was generally consistent with that predicted by the U.S. Federal Interagency Committee on Noise (FICON, 1992).

A second dosage-response relationship was constructed by the method of Green and Fidell (1991) for the annoyance of aircraft noise during the year prior to interviewing. The value of D^* (a quantity expressing an annoyance criterion in decibel-like units comparable to a DNL value) in the present data set was 75.7 dB, while the average value observed by Green

and Fidell (1991) for aircraft noise annoyance in many other communities was 70.2 dB. Thus, respondents in this survey tolerated nearly 6 dB more aircraft noise exposure than residents of other communities before describing themselves as highly annoyed. In fact, the tolerance for aircraft noise observed in the present study is indistinguishable from that accorded to street traffic noise in other communities (D^{*} = 75.5 dB, as noted by Green and Fidell, 1991).

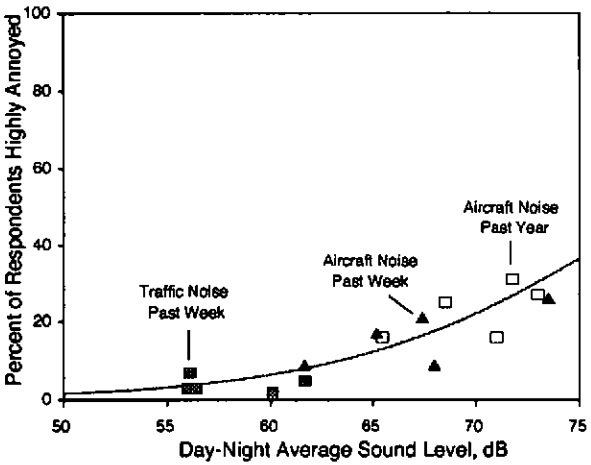

Figure 1 Relationship between the observed prevalence of high annoyance in the interviewing areas and a dosage-response relationship recommended by the U.S. Federal Interagency Committee on Noise (FICON, 1992).

The time course of changes in aircraft noise exposure may also affect the noticeability of a change. It is difficult to argue from current knowledge that a certain change in community noise exposure over a particular time period is more meaningful than another, both because the time constants of arousal and decay of annoyance are not known with any precision (cf. Fidell et al., 1985), and because the time period over which a change is to be considered meaningful may not be well specified. Intuitively, however, it seems reasonable that an abrupt change in circumstances of aircraft noise exposure (say, that resulting from a halving from one day to the next in numbers of flights) is more likely to be noticed than a gradual one (such as

a reduction of 3 dB in average sound exposure levels occurring over a period of years).

The effect of variability in aircraft flight patterns on the meaningfulness of changes in airport noise can be a further complicating factor. In some airport neighborhoods, the distribution of daily cumulative noise exposures is a narrow one relative to the average level. In other airport neighborhoods, the variance of daily noise exposure levels is much greater. The range and standard deviations of daily aircraft noise exposure levels in the last several years in the vicinity of three noise monitoring stations in neighborhoods near the ends of the main runway at Seattle-Tacoma International Airport were examined for such trends. Aircraft noise exposure on the noisier days of the year differed from aircraft noise exposure on the quieter days of the year by more than 15 dB in these neighborhoods. The standard deviations of the distributions of noise exposures in the three neighborhoods were on the order of 3 dB. It would hardly be surprising if the smallest systematic change in aircraft noise exposure likely to be noticed and remembered in a community with such highly variable noise exposure were greater than in a community with much less day-to-day variability in aircraft noise exposure.

Furthermore, the magnitude of a meaningful change in the prevalence of annoyance is clearly level dependent. The rate of change in the prevalence of annoyance predicted by FICON's (1992) dosage-response relationship per 1 dB change in Day-Night Average Sound Level varies (from less than 1% per dB to more than 3% per dB) over the range of noise exposure values of general interest. Because the FICON relationship is not a linear one, a reduction in DNL of a given magnitude is generally "worth" more (in terms of a reduction in the prevalence of annoyance) at higher noise levels than at lower noise levels.

CONCLUSIONS

The following inferences may be drawn from the results of the current study:

(1) Large majorities of respondents in five airport neighborhoods reported noticing either no change at all or increases in aircraft noise in their neighborhoods despite a decrease on the order of 1.5 dB in DNL due to aircraft noise in the two years prior to interviewing.

(2) The overall pattern of findings provides little reason to believe that decreases of 1.5 to 3 dB in aircraft noise exposure levels occurring over an extended period of time are likely to be noticed in airport neighborhoods.

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