inter·noise 96
25th Anniversary Congress - Liverpool

INCE: 66

ANNOYANCE AFTER CHANGES IN AIRPORT NOISE ENVIRONMENT

M Vallet

INRETS-LEN, France

1 INTRODUCTION

The extension of existing airports or the building of a new airport are today very difficult, because of the problem of noise. Residents in airports areas are opposed to the building of new runways or even to an extension of the operating periods at night. The population in general shows at least in Europe a violent opposition when the projects are announced.

We could distinguish two psychosociological phenomena about noise :

- the first one concerns the difficulty for people living around airports to perceive decreasing noise levels, due to the gradual suppression of the noisiest aircrafts and despite the increasing daily number of events.

This appears too in the case of significant and sudden changes, like the suspension of night flights or the temporary closure of a runway. The first question is opened since the very beginning : what acoustic index is to be used to characterise the noise around airports, not to be sensitive to these changes,

- the second aspect is that the population is afraid of increasing noise levels in the future. Consequently people today are expressing a higher annoyance towards the existing noise levels in order to stop any further evolution, assuming that the noise situation would be more unberable in the future.

2 LITERATURE SURVEY

There are several studies about noise changes. Usually the authors study reactions after changes in the noise level and compare the new

annoyance with the memory of the disturbance before the noise variation.

A more exhaustive method consists of carrying out two surveys, one before and one after the noise exposure change. When the social surveys are done in the same area, this is called a longitudinal survey. I f the control group, which is subjected to constant exposure noise, lives in another area this is a cross-sectional comparison. The most effective studies compare the post-change reaction to steady state reactions at the same noise level. They adopt the hypothesis that a new noise exposure will change the annoyance more than would be predicted from a steady state noise level, preferably in the same site. Indeed it is difficult to consider as a reference data from others surveys carried out elsewhere, in previous time, and synthesised in one curve, like that proposed by Schultz (1978). Bradley (1994) demonstrates that, in several aircraft noise surveys, the results indicate a much greater percentage of people highly annoyed than the Schultz synthesis curve suggests, although exactly the same questionnaire and survey techniques were used in aircraft and road noise surveys. Moreover a minimum of 6 dB Leq of the noise exposure is necessary to get a change in the annoyance level. After a noise exposure change of 2 or 3 dB for instance, people clearly perceive that the noise varies, whilst the degree of annoyance does not (Vallet 1979).

The best synthesis has been done by J. Fields (1992) : 19 surveys are listed, with 8 concerned with aircraft noise. The changes in noise exposure are due to the gradual increase of aircraft numbers, the opening of a new airport, modified departure procedures, airport maintenance and the close of a runway, and the quasi total elimination of night flights. Globally, the detailed analysis of the author shows that residents experience a change in noise exposure in their area (decrease, increase) : "it does appear that substantial changes in noise levels are followed by substantial changes in annoyance".

Experimental data are not easy to analyse in order "to provide a conclusion about whether residents are overreacting to change" in noise levels.

Considering the 2467 interviews from surveys after an increase of noise, and after a strict selection of the studies by Fields, 57 % show no important difference : 43 % overreact to change, none under-react.

In the case of a noise decrease, 67 % of the 6189 interviews over-react by a higher than expected decreasing annoyance, 18 % express no important difference, and 15 % under-react, ie they show a lower than expected decreasing of annoyance in relation to the noise exposure variation.

The general conclusion is that "a changed noise environment may be an important factor in mobilising public action against noise".

Other longitudinal studies have been carried out in Japan, around Nagasaki Airport (Miyahara 1985) over a 7 years period ; 3 waves of surveys, in an area at 4 km of the airport, consequently with a moderate noise exposure show, 2 years after the airport opening, a noticeable decrease of annoyance, even though the noise gradually increased from 9 events a day in 1976 to 15 in 1981. The surveys led by Katska (1995) at Dusseldorf Airport are the most instructive. Around this airport the noise levels have decreased by 0,5 dB Leq per year, since 1985 ; concurrently the mean peak levels have decreased withdrawal of the noisest aircrafts. Nevertheless the percentage of highly annoyed residents has increased from 29 % in 1987 to 45 % in 1993. This could be due to the progressive increasing number of events from 84 000 per year to 161 000.

Generally speaking it is necessary to take into account the delay between the actual change in noise level and the survey ; today it is usual to launch a first survey just after the exposure change and a second 6 months later. Immediately after the variation of noise, the reactions of the residents are substantial, then moderate. The subjective rating of annoyance seems to show a certain inertness to follow the physical changes : this observation is confirmed by two groups of researchs, each of which includes a psychosociological survey by use of questionnaires and a physiological study of sleep disturbance, assessed at home by classical laboratory methods.

In 1973 Fidell and Jones observed the evolution of the degree of annoyance among residents around the Los Angeles airport, after an almost a complete suppression of night time flights. This cessation provoked a serious decrease in noise levels.

Despite this important change in noise exposure, only 2 % of the population experienced a change in the overall or nightime annoyance (1400 interviews).

At the same time Globus and Friedmann recorded the sleep signal parameters of some residents, in order to compare the sleep quality before and after the cessation of the late night flights. The differences, based on 80 recorded nights of a sample population (average age 45), are moderate. Some important parameters of the sleep quality, for example the duration of the slow waves sleep (stage III and IV), show a spectacular improvement : the duration of 47 minutes for the whole night with outdoor noise (Leq 23h-6h = 71 dB(A) increases to 68 minutes one

week after the cessation (Leq = 51 dB(A) and to 61 minutes after one month.

In France, one year after the opening of Paris-Roissy airport, Vallet and François carried out another couple of studies.

The annoyance survey shows that 60 % of residents are disturbed by aircraft noise in the evening, and 40 % at night, with an exposure of 52-60 dBA in Leq 22h-6h in facade. Physiological experiments, carried out during exactly the same period, show a moderate sleep disturbance : the EEG reaction (awakenings and stage shifts) varies between 12 and 19 % of the total number of flights, which could reach 35 events per night, depending of the nature of the sleep stages. The reaction rate varies from 10 to 25 % following the peak level of the aircraft noises.

These two study methods, even though not exactly similar because of the different ways of data analysis, both stress that the psychophysiological method is able to better assess a quick variation in sleep quality. The psychosociological surveys need both, more time to recognize a decrease of annoyance (at Los Angeles) and a clear over-reaction to new aircraft noise (in Paris).

3 DISCUSSION

Adopting a theoretical model to forecast the degree of annoyance due to noise, whatever efforts made to refine the way to take into account the noise levels, the global acoustical energy explains only 33 % of the variance in the annoyance scores. (Levine, Lambert)

By simple deduction, numerous other variables, acoustical and non acoustical, modulate the annoyance scores. Bertoni and Franchini (1993) stress that the noise dose received at the work place increases the annoyance expressed by the noise at home. Bradley (1979) insists on the variable -size of the communities- and there is evidence that residents in small towns are less disturbed than those living in large urban communities, with the same noise exposure. Similarly Vallet (1983) considers the concept of environmental load : at the same noise exposure (day Leq) the annoyance is higher in towns than in rural areas.

The main relevant factors to explain the different annoyance rating are the socio-demographic variables, including many aspects of housing and the attitudes towards noise (Job 1993).

This second category includes numerous and influent attitudes :

- fear of danger (aircraft crash)

- belief that the noise could be prevented
- feeling that the noise could not be controlled
- general noise sensitivity and other environmental impacts of noise sources.

Fields (1992) quotes the impact of the fear of possible aircraft crash danger.

The results vary from one survey to another : there is a negative effect corresponding to 3 dB, in Switzerland and to 15 dB in Australia, demonstrating that fear increases noise annoyance. Some other surveys show no impact.

Belief that authorities could prevent or reduce the noise "here and now" provides a higher rate of annoyance corresponding to 8 dB Leq.

The very sensitive groups expressed an annoyance equivalent to a noise level of 10 dB. Nevertheless all these variables are not simply additive.

However it is easy to consider that an action on the purely physical aspect of the noise would have a limited impact on annoyance, and may explain why a decrease of 6 dB Leq is necessary to begin to observe a lower annoyance.

The public authorities are not able to modify the socio-demographic variables which have an influence on annoyance but it is possible to decrease the annoyance level, by influencing attitudes through advertisement.

Katska (1980) stresses that in German towns (3400 interviews) the noise levels were reduced by 1 dBA (Leq) but the reduction of the annoyance was equivalent to a reduction of 6-14 dBA. This spectacular impact seems to due both to more regular traffic and to a very efficient advertising campaign among residents.

To return then to aircraft noise, we can conclude that it is compulsory to reduce the noise levels to act on the annoyance, but it is necessary to minimise the synergetic aspects of some attitudes too, among them the fear of mor noise exposure in the future.

References

(1) Bertoni D., Franchini A et al : Reactions of people to urban traffic noise in Modena, Italy. 1993. Proceedings of the 6th Congress : Noise as a public health problem, Inrets Lyon vol 2, 593-596.

(2) Bradley J., Jonah H. : The effects of site selected variables on human response to traffic noise 1979 J.S.V 66. 589-604

(3) Bradley J.S : On dose response curves of annoyance to aircraft noise. InterNoise 1994 Proceedings 235-238.

(4) Fidell S., Jones G. : Effects of cessation of late night landing noise on sleep electrophysiology in the home. NASA report CR 132543 Dec 1974.

(5) Fields J. : Effect of personal and situational variables on noise annoyance with special reference to implications for en route noise. report US DOT/FAA/EE/92-03, 234 p, 1992.

(6) Friedmann J., Globus G. : Effects of cessation of late night landing noise on sleep electrophysiology in the home. Nasa Report 132543, 1974.

(7) Job S. Psychological factors of community reaction to noise 1993. Proceeding of the 6th Congress : Noise as a public health problem vol 3, 48-70 INRETS Lyon.

(8) Katska J. : Noise annoyance reduction in residential areas by traffic control technics. 1980 10th ICA proceeding Sydney.

(9) Katska J. et al : Longitudinal study on aircraft noise effects at Dusseldorf Airport 1981-1995 ; 15th ICA Proceedings, Troudheim vol IV 5p.

(10) Lambert J., Simonnet F., Vallet M. : Patterns of behaviour in duvellings exposed to road traffic noise. J. Sound Vibrations 1984, 92, 2, 159-172.

(11) Levine N. : The development of an annoyance scale for community noise assessment J. Sound Vibration 1981, 74, 2, 265-279.

(12) Miyahara Kazuaki : An investigation of secular change of social response to aircraft noise. 1985.

(13) Schultz T. JASA, 64, 2, 377-405 (1978).

(14) Vallet M., Abramowitch J.M., Lambert J. : The subjective effect of a road side noise barrier : a case study at l'Hay les Roses InterNoise 1979 Proceedings 865-868.

(15) Vallet M., Carrere C., Lacoste P. : La gêne due au bruit des liaisons interurbaines en rase campagne. 11th ICA Proceedings Paris 1983, 407-410.

(16) Vallet M., François J. : Evaluation physiologique et psychosociologique de l'effet du bruit d'avion sur le sommeil. Le travail humain. 1982, 1, 45, 155-168.