SLEEP DISTURBANCE DUE TO INTRODUCED AIRCRAFT NOISE

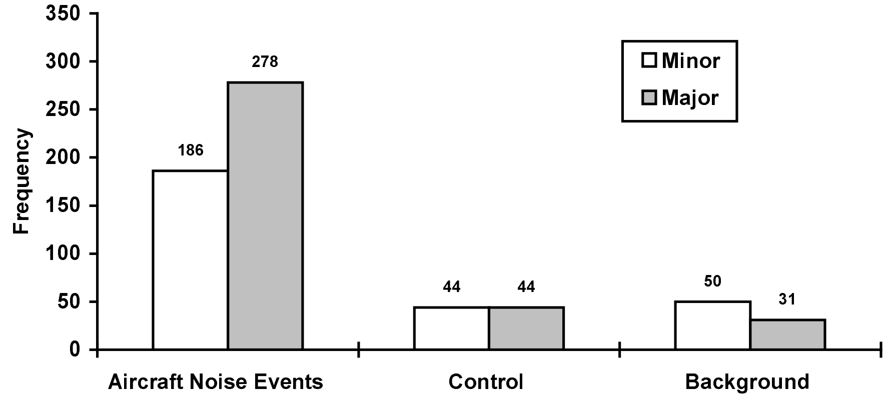
K.I. Hume, C. Whitehead
Department of Biological Sciences, Manchester Metropolitan University, UK

Introduction The worldwide growth of aviation has led to an unfair burden of environmental disturbance, particularly aircraft noise, on the communities living close to major airports. However, research efforts designed to assess the extent of this disruption are faced with a dilemma – should studies be carried out in the laboratory with increased control or - in the field with increased realism? Striking differences exist in the results with much less disturbance measured in field studies than that predicted from laboratory studies[1]. The aim of the present study was to investigate the effect of pre-recorded aircraft noise on subjects sleeping at home in a community that is not habitually subjected to environmental noise. That is, a field-experiment, which investigates the influence of habituation and should help to explain the discrepancy between lab and field data.

Methods Twenty-one paid subjects (11 men) aged 22-37 were recorded (EEG, EOG, EMG, ECG) by conventional methods, at home, in a community that is not habitually subjected to environmental noise, for three consecutive nights in which normal habits were retained. After retiring, pre-recorded aircraft noise events (ANE) were delivered (quasi-randomly every 20-40 minutes) so that a total of 16 would be delivered in an 8h period. The ANE were delivered at 4 peak noise levels (50, 55, 60 and 65 LaMax dBA), so that 4 ANE at each of these levels were presented in random order each night. The electrophysiological sleep data was analyzed in 80sec fragments associated with an ANE, plus two other fragments for each ANE; a background fragment (randomly chosen 3,4 or 5 minutes before the ANE) and a control fragment (chosen mid-way between two consecutive ANE, ie. randomly between 10-20 minutes after an ANE). All these fragments were scored visually and analyzed blind for sleep stage (16 sec epochs) and evidence of arousals that were categorized into major (shifts to epochs of stage 1, MT or W'ness) and minor arousals. The experiment produced 753, 720 & 676 fragments for ANE, background and control conditions respectively.

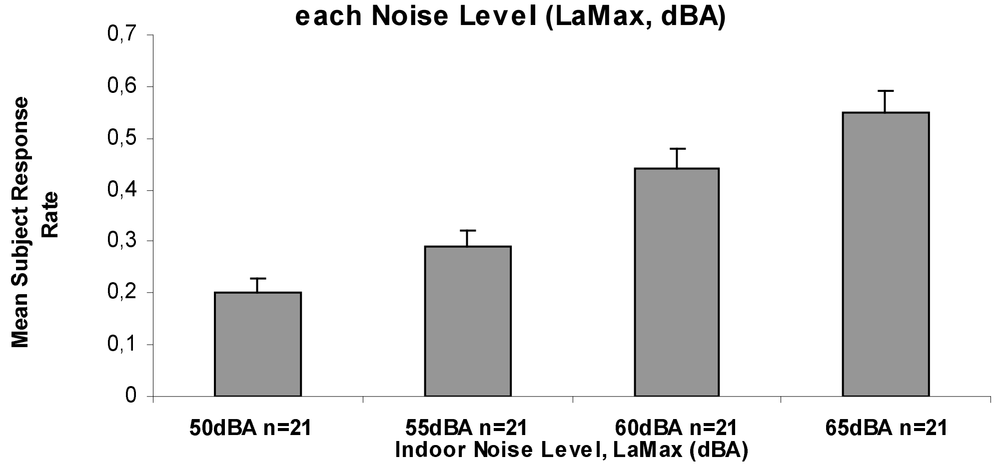
Results The results show clear evidence of disturbance due to aircraft noise. 20.8% of all ANE induced a shift to Wakefulness (>10sec) that compares to 4.2% and 2.1% for control and background fragments respectively. Fig 1 shows the frequency of responses; 62% of ANE induced an EEG response while only 12% of both background and control showed such events.

Figure 1. Frequency of EEG Responses For Aircraft Noise, and EEG Events in Control and Background Fragments



There was a clear significant progressive increase in disturbance as the noise level increased particularly for major responses (Figure 2) and especially shifts to wakefulness with 4.5, 14.1, 18.0 and 25.4% of subjects awoken by ANE at 50, 55, 60 and 65 LaMax dBA respectively. There was evidence of habituation to the ANE with a moderate but significant reduction across the three nights in mean subject response rates particularly for major responses with 24.2, 21.6 and 16.6% for the successive nights of the experiment.

Figure 2. Mean (&SEM) Subject Major Response Rates for each Noise Level (LaMax, dBA)



Discussion There was clear evidence of sleep disturbance when aircraft noise was introduced to subjects sleeping in their homes. Comparison of these findings with previous data (1) showed, as was predicted, that this field-experiment produced disturbance levels intermediate between the laboratory and field data for this noise range. A plausible explanation for the discrepancy between laboratory and field could be, habituation, as subjects in the field have usually "lived with" the environmental noise for a number of years while subjects recruited to laboratory studies would tend to find both, the noise and sleeping in a sleep laboratory, novel experiences. In this field-experiment we have removed the novelty of the environment and just introduced aircraft noise.

There was a very clear and highly significant positive 'dose-response' relationship between the mean subject response rate and the noise level between 50 and 65 dBA. The clarity of this relationship was possibly due to the subjects' sleep being fully habituated within their own homes and the precision and control of delivery of the noise stimulus in the bedroom.

Keywords: Aircraft noise, sleep disturbance, sleep-stages, EEG arousals, home recording

References

1. Pearsons KS et al, Analyses of the predictability of noise-induced sleep disturbance, US Air Force Report HSD-TR-89-029, 1990.