Aircraft Noise Annoyance at Different Times of Day

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Introduction

There exists some evidence that the time of day plays an important role when subjects judge their noise annoyance. [1] showed that at same noise levels, night-time annoyance is above day-time annoyance. However, this is only true for aircraft noise; in the case of road traffic noise, [1] found no difference in annoyance between day and night. For railway traffic, subjects were less annoyed during the night than during the day. Furthermore, [2] and [3] showed that there exists a noise annoyance profile during the day, with different annoyance-peaks, being partly independent from the noise level. The Swiss Noise Study 2000 demonstrated that subjects feel highly annoyed especially in the morning, around noon and in the evening [4]. Not the shape of this profile, but the height of the percentage of highly annoyed persons (%HA) per hour was influenced by moderator variables.

On the basis of the Swiss Noise Study 2000, some more questions about noise annoyance at different day periods shall be approached. This study was carried out in 2001 around the airport Zurich. 1826 people filled out a noise annoyance questionnaire. In this presentation, the following questions are of interest:

1. Is night time annoyance above day time annoyance?
2. Is the annoyance profile during the day corresponding with the profile of the Leq?
3. Which factors influence the variation of the tolerability judgment of aircraft noise during the day?

1. Difference between day time and night time annoyance

The results show that at same noise levels, subjects are more annoyed in the night time than in the day time (see fig. 1).

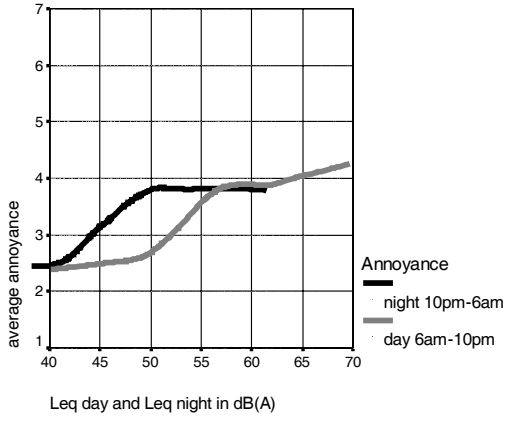

Figure 1: Dose-response relationship for day and night. N=1298.

2. Annoyance profile during the day

In [4], it was shown that there exists an annoyance profile during night and day with distinct annoyance peaks from 6-9 h, 12-14 h and 20-23 h. How much does this profile correspond with the real aircraft noise? Figure 2 shows the %HA per hour and the Leq per hour (averaged over all 1298 subjects with civil aircraft noise). The annoyance profile corresponds only partly with the Leq. From 12 to 13 h and from 22 to 23 h, subjects are more annoyed than one would expect on the basis of the Leq. However, in the late morning and in the afternoon, they are much less annoyed even if the Leq is on a local maximum at these periods.

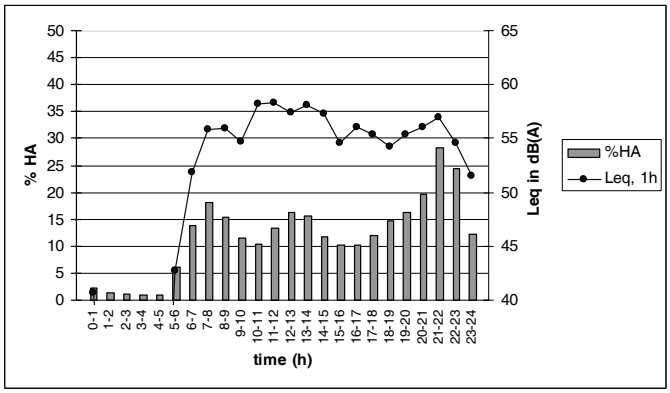

Figure 2: Percentage of %HA per hour and Leq per hour. N=1298.

With Hofstätter's Q (a correlation coefficient between two profiles; see [5]), the two profiles can be compared. In this case, Q is with 0.77 quite high. When asked about times of day of high annoyance, subjects are able to judge the changes of the aircraft noise during the day in a differentiated way. Nevertheless, independently from the real aircraft noise, there seem to be noise-sensitive periods over the day.

3. Judgment of tolerability at different times of day

In the questionnaire, subjects were asked to rate the aircraft noise of the past 12 months as tolerable or untolerable at different times of the day (5-6 h; 6-7 h; 7-18 h; 18-22 h; 22-0:30 h) (In the night from 0:30 till 5:30, there was no air traffic at the airport Zurich). Figure 3 shows that at the same Leq, the percentage of subjects judging aircraft noise as untolerable differs a lot at different periods of the day. Especially in the early morning and in the late evening, the percentage of subjects rating aircraft noise as untolerable is quite high. Most interesting is the fact that from 5-6 h, only a minority of the subjects (15%) had aircraft noise, since air traffic began at 5:30 in the morning: Aircrafts began to land

at 5:30 on only one runway, and were only allowed to take off from 6 h on. Some of the 17% of the persons judging aircraft noise as untolerable from 5 to 6 judged something else, but not the aircraft noise they had heard during the past year from 5 to 6.

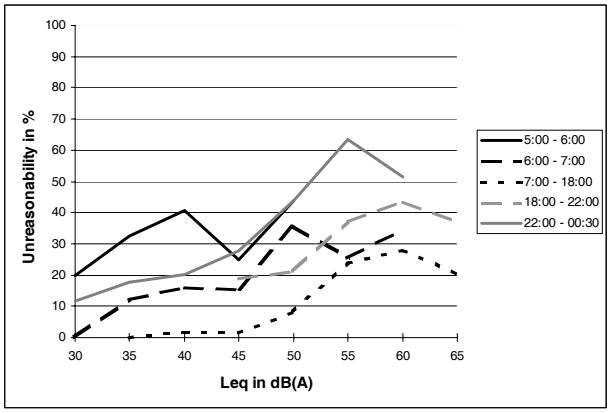

Figure 3: Percentage of subjects rating aircraft noise as untolerable in the past 12 months, on the basis of the Leq of the respective time of day.

	5-6	**6-7**	**7-18**	**18-22**	**22-0.30**	**overall**
general symptoms	↑	0	0	0	↑	0
health problems because of aircraft noise	↑	↑	↑	0	0	↑
satisfaction with acoustical aspects of dwelling	↓	↓	↓	↓	↓	↓
satisfaction with non-acoustical aspects of dwelling	0	0	0	↓	0	0
environmental-political attitude : for environment protection	↑	↑	↑	0	↑	↑
coping strategies	0	↑	0	↑	0	0
health status	0	↓	0	0	0	0
fear of more annoyance in the future	0	↑	↑	↑	↑	↑
(positive) attitude towards air traffic	0	0	↓	↓	0	↓
region	0	0	+	0	0	+
trust in organizations involved with air traffic	0	0	0	↓	↓	↓
windows closed in winter	0	0	0	↑	0	0
number of hours of work outwards	0	0	0	0	↑	0
Leq 5-6	0	0	↑	0	0	0
Leq 6-7	0	0	0	0	0	0
Leq 7-18	0	↑	↑	0	0	0
Leq 18-22	0	↑	↑	0	0	0
Leq 22-0.30	0	0	0	0	0	0
Leq 0-24	0	0	0	0	0	0
Nagelkerke's R^2	**.29**	**.37**	**.46**	**.38**	**.36**	**.59**

Table 1: Binary logistic regressions (dependent variables: untolerability of aircraft noise overall and at different times of day) with all significant predictors. N=939. 0 = not sign., + = neutral sign. relationship, ↑ = positive sign. relationship, ↓ = negative sign. relationship to dependent variable.

In order to find out what factors influenced the tolerability judgement at different times of the day, binary logistic regression analysis were carried out (dependent variable: aircraft noise was tolerable / untolerable; predictors: Leq and several non-acoustical variables). Table 1 shows the significant predictors for every tolerability judgement. The explained variance (Nagelkerke's R^2) is quite low in the early morning and in the evening. Other factors that were not collected in this survey seem to influence the tolerability judgment especially in the morning and in the evening.

Summary and Discussion

It could be shown that the annoyance effect of aircraft noise is changing during the day. In the night, subjects are more annoyed than in daytime at same noise levels. In course of the day, they are especially annoyed in the morning, around noon and in the evening and less annoyed in the late morning and in the afternoon. These judgements can not be explained simply by the aircraft noise. Moreover, the judgments about the tolerability of aircraft noise in the past 12 months at different day periods depend only partly on the noise level of the respective day period. Especially in the morning and in the evening, non-acoustical moderator variables play an important role.

One factor that was not surveyed in this study is probably important: the need of silence that is varying during the day. Probably, there exists a "noise tolerance" that is changing during the day, depending on the individual need of silence and on intended activities (that are often time-specific, such as eating, napping, working). Other environmental noise, that is changing over the day, too, probably influences this "noise tolerance" as well.

In the past, noise effect research has mostly focused on noise as a negative aspect and has neglected the value of silence. Silence is, however, not only the absence of noise, but has a quality per se that should be taken into consideration in future research.

References

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