Journal of Sound and Vibration (2002) **249**(4), 828–831
doi:10.1006/jsvi.2001.3745, available online at http://www.idealibrary.com on IDEAL®

ROAD TRAFFIC NOISE ANNOYANCE AND WINDOW ORIENTATION IN DWELLINGS

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(*Received* 8 *July* 1998, *and in final form* 4 *June* 2001)

1. BACKGROUND

Disturbance by noise is the most important consequence of the transportation apparatus. Increased knowledge of the risks involved and the nature of the major acoustical determinants for noise effects on humans is a prerequisite for valid noise-control strategies.

Previous research on the effects of environmental noise has demonstrated that the most common effects are sleep disturbance and interference with activities, rest and recreation [1]. The ensuing summarized experience of annoyance is often used to estimate the exposure effects in a given population [2–4].

In most studies, there is a relatively large variation in the degree of annoyance reported between different persons living in the area, even if the exposure as measured as a representative place is the same. This variation could be dependent on individual factors such as sensitivity to noise. Another possibility is that the noise dose is imprecise. In a recent study, it was shown that corrections of the individual noise dose, taking into consideration the distance to the street and the floor level, markedly improved the dose–response relationship between exposure to road traffic noise and the extent of annoyance, comparing areas with different exposure levels [4].

An important factor determining the individual's exposure to road traffic noise is the layout of the living quarters. In a previous study, we found that persons living in flats that had one window facing the quiet side of the building reported less annoyance than those living in flats where all the windows faced the street with traffic (unpublished). Similar findings have been presented by Lercher [3]. To further explore this phenomenon, we formulated the hypothesis that groups of persons living in flats with windows facing the street only would report a larger extent of annoyance than persons living in flats that also had windows facing a quiet side of the building. A study was undertaken to compare the extent of annoyance among residents along streets with road traffic who had or did not have windows against a quiet side of the building.

2. MATERIAL AND METHODS

2.1. AREAS STUDIED

For the study, we used eight areas in Gothenburg, Sweden, selected for a variation in the distribution of the road traffic over the day, the type of traffic and the number of vehicles.

2.2. NOISE MEASUREMENTS

Noise measurements were made in each area for 3 days using a mobile van. A microphone (Brüel and Kjaer 4165) was placed directly against the facade of the building one story above the street level, and the measurements were corrected with (-6 dB) in order to obtain the freefield value. Maximum levels emitted by individual vehicle passages were registered in a measurement computer together with indications of the time they appeared during the three measurement days.

For each area, the L_{Aeq} level was calculated as well as the maximum noise level (MAX3) defined as the mean value of the highest noise level measured on each of the 3 days.

2.3. POPULATION SAMPLE

A random selection of 100 individuals was made from each area. The selection basis was residence in the area for more than 1 year and 18–65 years of age. The selected persons received an information letter and a questionnaire similar to the one used in previous studies [2, 4]. It contained questions on general sources of annoyance in the area, family status, occupation, general satisfaction with the environment and specific questions on annoyance caused by different environmental noise sources, including road traffic noise. The respondents were asked whether they noticed a particular noise source and, if so, if they were annoyed (a little annoyed, rather annoyed, very annoyed). A reminder letter was sent if the persons selected had not answered within a fortnight. An additional reminder, this time with another copy of the questionnaire, was mailed after another fortnight.

2.4. TREATMENT OF DATA

The respondents were classified into those living in flats with rooms facing the street only (SO) and those living in flats that also had rooms facing the quiet side of the building (QS). The percentage of persons reporting that they were "very annoyed" by traffic noise was calculated for each area. These data were compared to the different acoustical parameters measured in the different areas.

3. RESULTS

Table 1 reports noise exposure in different areas, the extent of annoyance among persons living in flats with SO and QS. The extent of annoyance was generally higher among persons living in SO dwellings. The average difference between the two types of dwellings within the same area was 13.6%, with a range from 3 to 26%.

Figure 1 shows the relation between the noise exposure expressed as L_{Aeq} and the differences in the extent of annoyance between SO and QS dwellings. It can be seen that the difference in the extent of annoyance between SO and QS locations were not related to the exposure level. The same was found when the difference was related to the MAX3 value or other ways of expressing noise exposure (data not shown).

4. COMMENTS

The material in the investigation is based on a rather limited number of areas. In spite of this, the results were consistent with the hypothesis. There were important differences in the

Table 1

Road traffic noise exposure and annoyance characteristics for different areas

	Noise exposure	Street only		Quiet side	
	L_{Aeq}	n	%	n	%
Area		Very annoyed		Very annoyed	
1	71	19	42	58	16
2	65	16	31	47	19
3	64	24	13	30	10
4	62	5	40	44	25
5	60	28	14	54	4
6	60	26	31	45	7
7	67	35	28	13	23
8	71	55	35	40	20

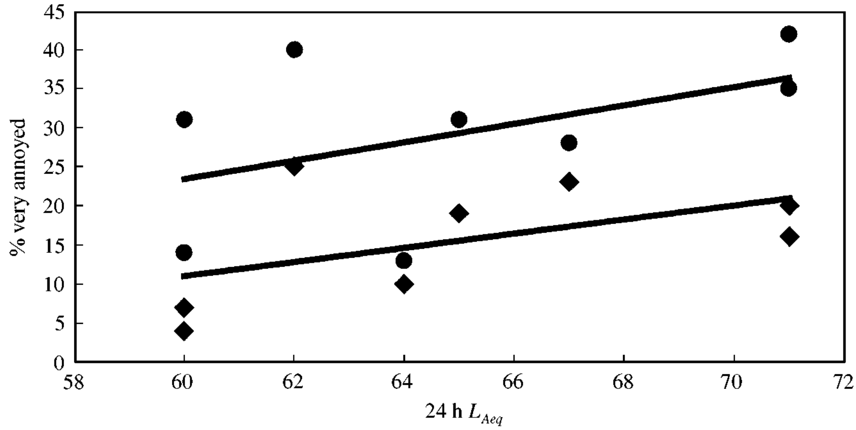

Figure 1. Difference in extent of annoyance (very annoyed) in different areas for persons with a dwelling with windows facing the street only (●) and with windows also facing the quiet side of the building (◆) in relation to L_{Aeq} 24 h.

extent of annoyance in flats with windows facing the street only and those also having windows towards the quiet side. This agrees with previously published data [3]. The difference in the extent of annoyance between the different types of flats found in that study was 20%, which is relatively close to the average of 13% found in the present study.

The differences in the average extent of annoyance among persons living in SO or QS may be dependent on differences among the populations. Socio-economic conditions, number of persons in the household or habits regarding off-work activities may play a role. A more probable explanation is the ability to retire to a quiet part of the dwelling for sleep or rest. These possibilities should be explained in future studies.

Whatever the reason for the differences found in this and previous studies, the results imply that, in any study on traffic noise annoyance, a variation in the proportion of respondents living in flats could introduce an error when relating the extent of annoyance to the noise exposure. The difference between SO and SQ may thus explain part of the difference seen in a previous study comparing detached and apartment house residents [5].

The findings from the study imply that noise-abatement programs in built-up areas must include control of the planning of the dwellings and not only actions to reduce noise levels.

In summary, the results of this study suggest that the planning of dwelling layouts is important for minimizing the extent of annoyance caused by road traffic noise. Road traffic noise control should thus include a requirement that dwellings have windows facing the quiet side of the house.

ACKNOWLEDGMENTS

This study was supported by the Swedish Transportation Research Establishment (contract 95-453-24).

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