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THE ASSESSMENT OF NOISE ANNOYANCE IN SCHOOLCHILDREN AND THEIR MOTHERS

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ABSTRACT

Children and young persons differ substantially in their environmental needs and behavior (development, learning, playing). Nevertheless, the assessment of the effects on this population segment of a noisy environment is based on results from adult surveys. Currently, no dose-response curve is available for noise annoyance of children. Only recently (Bullinger 1995, Evans et al 1995, Evans et al 1998) a standardised methodology was developed to survey schoolchildren about their perception of the environment. In June 1998 we surveyed one thousand two hundred and eighty children in grades 3 - 4 (M=9.44 years) from 26 local schools in their classrooms. Furthermore, the mothers of these children completed a standardised questionnaire. The response rate was 79.5%. Noise exposure (dB, A, Ldn) was assessed by modeling and calibration through measurements from 31 sites. Data were linked via GIS. The extensive data base allowed the assessment of various dose-response curves for road and rail noise. Moreover a comparison is made with the mother's responses to the same noise sources. In addition the differences in the perception of the soundscape and the environmental, situational and personal modifying factors are reported.

1 - INTRODUCTION

The physical environment is known to influence the behaviour, the development and the health of children. Research of the last decade has confirmed that noisy environments can exhibit various effects on the behaviour, motivation, cognition, memory, physiology, hormone release and intellectual achievement of children [1, 2, 3]. Surprisingly though field data on children's annoyance response to noise are not available yet. Partly this may have been due to the unavailability of a standardised methodology to survey schoolchildren about their perception of the environment. Only recently researchers involved in the prospective Munich airport study have developed a 'environmental list' to supplement lab ratings of annoyance to provided acoustic stimuli [4, 5, 6]. The aim of our field studies conducted in the framework of an environmental health impact assessment (EHIA) was to supplement typical adult survey information on annoyance with similar information provided by children and their mothers. The focus of the current work is to establish dose-response curves also for schoolchildren, to compare them with the one obtained by their mothers and to lay out the factors that modify their reaction to noise exposure.

2 - BACKGROUND AND METHODS

In June 1998 we surveyed one thousand two hundred and eighty children in grades 3 - 4 (M=9.44 years) from 26 local schools in their classrooms.

The survey area - the Inn valley (east of Innsbruck, Austria) - consists of small towns and villages with a mix of industrial, small business and agricultural activities. The primary noise sources are road and rail traffic, most of it through-traffic with a high impact also during night. Over the last decade a slight increase of rail traffic occurred due to a shift of truck cargo to the railway. Part of the population lives on the scenic slopes of the valley with direct exposure to both the highway and the rail track.

A main local road connects the villages and the highway.

The children's questionnaire consisted of several parts. Quality of life was assessed by two subscales ('psychological', 'daily life') of the KINDL, a self-rating instrument for children's principal domains of quality of life [7]. Perception of the environment was assessed with a slightly adapted version (19 items) of the 'environmental list' (Meis 1998).

Various qualities of the living environment were assessed by a four-graded response scale: 'completely disagree – disagree – agree – completely agree'.

The structure and layout of the questions were as follows: 'In my living area'

- 'I can hear many cars'
- 'The noise of the cars disturbs me'
- 'I can hear the railway'
- 'The noise of the railway disturbs me'
- 'I like to live here'
- 'Children can make noise and have fun here'
- 'There is a lot of space to play'
- 'There are nice houses'

Children filled in the questionnaire in the classroom under standardised guidance of two trained supervisors.

Additionally, each child's teacher was asked to fill out a behavioural conduct scale (11 items) developed by Needleman [8].

Information on socio-demographic data, housing, children's activities and health were obtained from the mother's questionnaire. The response rate of the mothers was 79.5 %. This questionnaire contained also a standardised section on annoyance and interference due to noise which was identical with the questions in the larger representative survey.

The annoyance of the mothers was assessed likewise by a four-graded response scale with the following 'standard' verbal descriptors: 'Not at all – a little – moderately – very much'.

For this analysis, the highest scale response from the mothers (very much) and children (completely agree) was used equivalent and formed the percentage 'highly annoyed'.

Noise exposure (dB,A,Ldn) was assessed by modelling (Soundplan) and calibration through measurements from 31 sites according to Austrian guidelines (OAL Nr 28+30, ONORM S 5011). Based on both data sources approximate day-night levels (Ldn) were calculated for each respondent for each noise source to ease comparison with typical dose-response data. Exposure and survey data were then linked via GIS.

Statistical analysis was conducted with S+ 4.5 including F Harrell's HMISC- and DESIGN-libraries. Multiple linear and logistic regression techniques were used.

3 - RESULTS

| Item | Children | | Mothers | |
|-----------------------------------|------------------|--------|-------------------|-------|
| | Completely agree | | Very much annoyed | |
| | n | % | n | % |
| Must take care of car traffic | 188 | 14.7 % | n.a. | n.a. |
| Disturbance by road traffic noise | 149 | 11.6 % | 74 | 5.8 % |
| Disturbance by truck noise | 109 | 8.5 % | n.a. | n.a. |
| Disturbance by railway noise | 69 | 5.4 % | 40 | 3.1 % |
| Disturbance by car exhaust | 65 | 5.1 % | 31 | 2.4 % |

Table 1: Transportation: perception and annoyance by children and their mothers.

Overall children report higher prevalences of the various annoyances than their mothers (Table 1), although the ranking and the relative size between the source annoyances remain roughly the same. Noticeable is that the most prevalent annoyance mentioned by children is the perceived danger of car traffic.

The dose-response for traffic noise (Figure 1) shows a pretty flat curve for the children across the noise spectrum. The response of the mothers stays low until 50 dB,A, then shows an increase between 50 and 60 dB,A and eventually passes the responses of their kids beyond 60 dB,A of road traffic noise exposure.

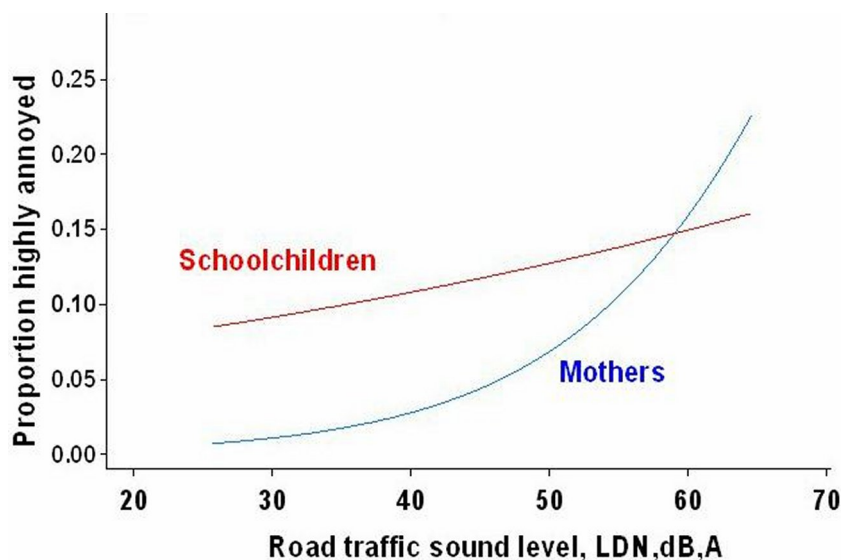


Figure 1: Road noise-annoyance: children-mothers.

The dose-response curve for railway noise (Figure 2) provides a more distinct picture.

Until 50 dB,A children and mothers indicate lower annoyance than by road noise and furthermore they do not differ in their response. Above 50 dB,A the response of the mothers triggers off and at 60 dB,A we are already confronted with a three fold higher annoyance expression than that of the children.

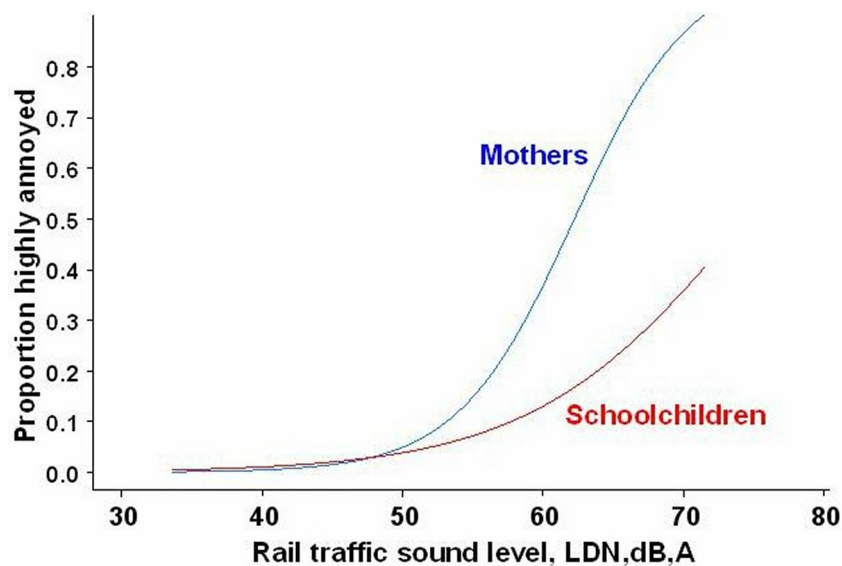


Figure 2: Rail noise-annoyance: children-mothers.

The analysis of the larger set of modifiers (Figures 3, 4, 5, 6) indicate that the 'typical' response is subject to a substantial deviation depending on the underlying enviro-, psych- and soundscape. Noticeable is that the variations due to the context are more pronounced among the children. Nevertheless, there is good agreement regarding the effect of the modifiers between children and mothers and also across

sources. For instance, experience of density (persons/room) has only an impact on reported road noise but not on rail noise annoyance.

Additional factors that played a significant role in modifying children's responses were: Mental and physical health of the kid, a nice environment (beautiful houses, friendly adults) and sleeping room exposed to either rail track or local road.

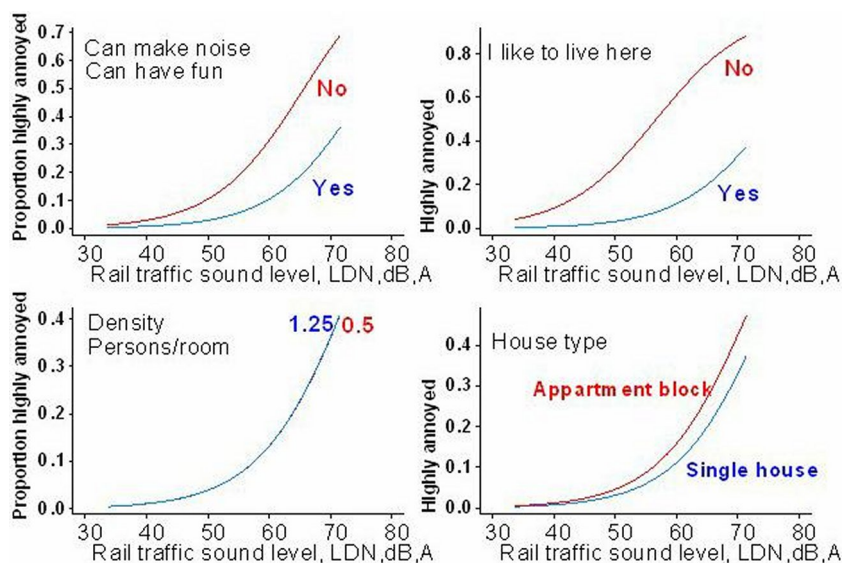


Figure 3: Rail noise-enviroscape-annoyance: children.

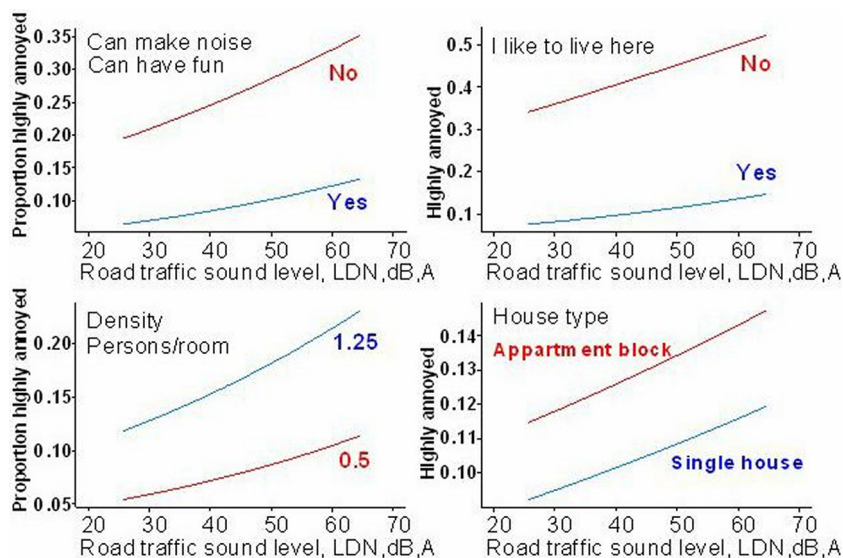


Figure 4: Road noise-enviroscape-annoyance: children.

4 - DISCUSSION AND CONCLUSIONS

The study results demonstrate the feasibility of obtaining valid information from school-children. Noticeable the discrepancy between the overall prevalence figures of annoyance and the information provided by the dose-response curves. It shows several pieces of information: First, road noise is still the dominant source of annoyance even in the special situation of the Inn-valley, where freight trains during night have created a changing soundscape. Second, children show a stronger response toward road noise at sound levels below 50 dB, A. The higher prevalence of perceived danger of car traffic seem to complement this picture. While the stronger reaction of the mothers towards rail noise at higher sound levels more likely reflects their lower threshold towards noise during night compared with children [9]. Furthermore, the

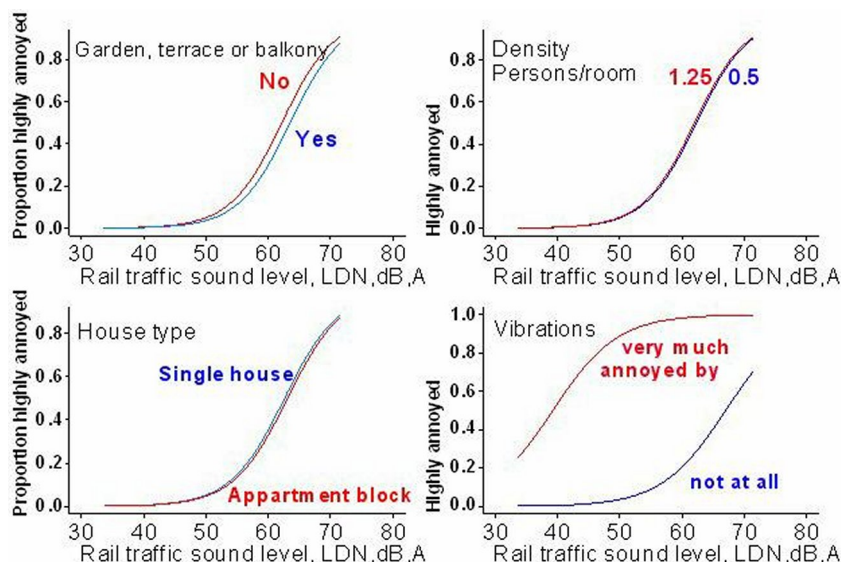


Figure 5: Rail noise-enviroscape-annoyance: mothers.

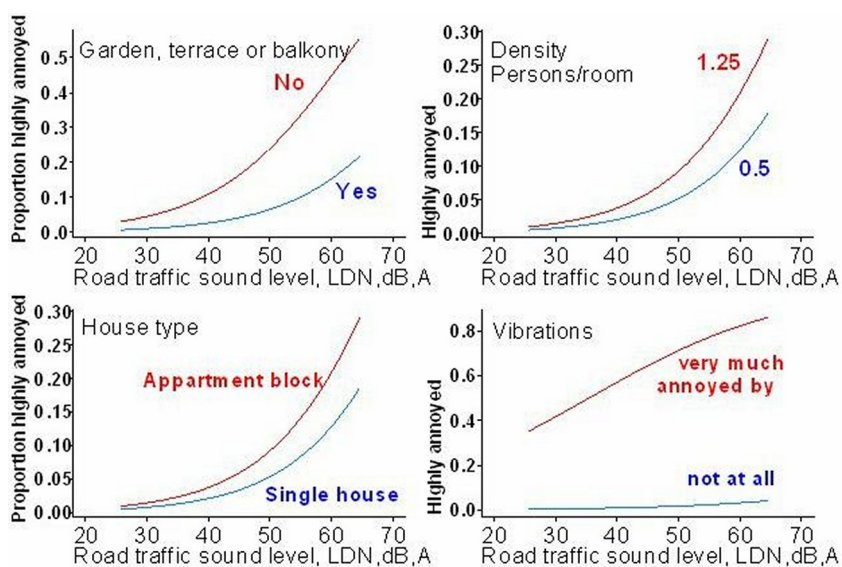


Figure 6: Road noise-enviroscape-annoyance: mothers.

consistent loss of the rail bonus in mothers between 50 and 55 dB, A and in children above 60 dB, A shows the urgent need of abatement measures in modern rail transportation.

Of special importance is the higher variability of the annoyance response in children which depends mainly on the contextual factors. Noteworthy that the factors include such a variety, ranging from physical, psychological, dispositional, social factors to aesthetic values. This clearly reflects the greater dependence of the child on an optimal environment for its development [10, 11].

Annoyance information from children not only complements the results from adult surveys. The surplus is the specific context information that planners and administrators receive. Finally, there remains the need for further development and standardisation of the questionnaires used also for children of different ages.

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