

**inter.noise 2000**

*The 29th International Congress and Exhibition on Noise Control Engineering  
27-30 August 2000, Nice, FRANCE*

---

I-INCE Classification: 6.6

## COMPARISON OF COMMUNITY RESPONSE TO ROAD TRAFFIC NOISE IN JAPAN AND SWEDEN, PART I: OUTLINE OF SURVEYS AND DOSE-RESPONSE RELATIONSHIPS

T. Sato\*, T. Yano\*\*, M. Bjorkman\*\*\*, R. Rylander\*\*\*

\* Hokkai Gakuen University, Minami 26, Nishi 11, Chuo-ku, 064-0926, Sapporo, Japan

\*\* Kumamoto University, Kurokami 2-39-1, 860-8555, Kumamoto, Japan

\*\*\* University of Gothenburg, Box 414, 405 30, Gothenburg, Sweden

Tel.: +81-11-841-1161 / Fax: +81-11-551-2951 / Email: sato@arc.hokkai-s-u.ac.jp

**Keywords:**

CROSS-CULTURAL COMPARISON, ROAD TRAFFIC NOISE, DOSE-RESPONSE RELATIONSHIPS, ANNOYANCE

**ABSTRACT**

To investigate cross-cultural differences in the community response to road traffic noise, social surveys were conducted in Gothenburg, Sweden, and Kumamoto and Sapporo, Japan. Community responses were compared on the basis of dose-response relationships. The main results are summarized as follows: 1) There are no systematic differences between community responses in Sapporo and Kumamoto, which have the same culture; 2) people living in detached houses in Gothenburg are more annoyed by the same road traffic noise than are people living in Japanese cities; and 3) there are no systematic differences among the three cities with regard to activity disturbances indoors, but there is significant disturbance to activities and resting in gardens or on balconies in Gothenburg due to the differences between life-styles in the two countries.

**1 - INTRODUCTION**

Social surveys on road traffic noise have been conducted all over the world. The importance of the effects of non-acoustical factors on annoyance in a uniform cultural background has been pointed out in some reports. However, community responses to noise may have been affected by cultural and climatic differences in the areas surveyed. Of particular interest is how to utilize the results of annoyance studies in many countries for the establishment of a general noise evaluation system. To shed light on this problem, Jonsson *et al.* [1] conducted a joint study in Sweden and Italy in 1969 using a unified method. They concluded that the differences in annoyance reactions seemed to be dependent on differences in living conditions, on different requirements and on different evaluations of motor traffic as a part of the physical environment. The present authors [2, 3] have also found differences in community responses in preliminary joint studies conducted in Japan, Sweden and Thailand. On the other hand, several studies on the annoyance responses to environmental noise among residents of different types of housing have also been conducted. Fields [4] reviewed 14 surveys and concluded that annoyance is not affected by the type of dwelling. However, there are discrepancies in the noise sources, housing types and results of the surveys. In a recent study, the authors [5] found differences in annoyance responses to road traffic noise among people living in detached, row and apartment houses. The authors conducted a series of social surveys to examine how and why the community responses to road traffic noise are different between residents of detached houses and apartments and between people living in Japan and in Sweden using the same questionnaire and noise measurement method. The purpose of the present study was to clarify cross-cultural differences in community responses to road traffic noise in Gothenburg, Sweden, and Kumamoto and Sapporo, Japan.

## 2 - OUTLINE OF THE SURVEY

Fig. 1 shows the climatic conditions of the three cities. Sapporo is located in the northern part of Japan, which has a comfortable summer temperature and cold winters, while Kumamoto, in the southern part of Japan, has a very hot and humid summer. Gothenburg is located in the western part of Sweden, which has almost the same temperature as Sapporo but is more humid in winter. The cultures of the two countries are very different. Eleven to fifteen typical residential areas with both detached houses and apartment houses were selected as the target areas in each city. All of the houses surveyed faced roads. The questionnaire consisted of 40 questions related to environmental, housing and personal factors. The key questions concerned annoyance caused by road traffic noise. The answers were given on a five-point category scale, as shown in Table 1. The respondents, from 18 to 75 years of age in Gothenburg and from 20 to 75 years of age in Kumamoto and Sapporo, were randomly selected on a one-person-per-family basis. The postal method was used in Gothenburg, while the distribute-collect method was used in Kumamoto and Sapporo. In our previous study [3], there were no significant differences in community responses obtained by these two methods. The total numbers of respondents were 1,142 in Gothenburg, 837 in Kumamoto and 780 in Sapporo, and the response rates were 68.8%, 69.3% and 57.5%, respectively.

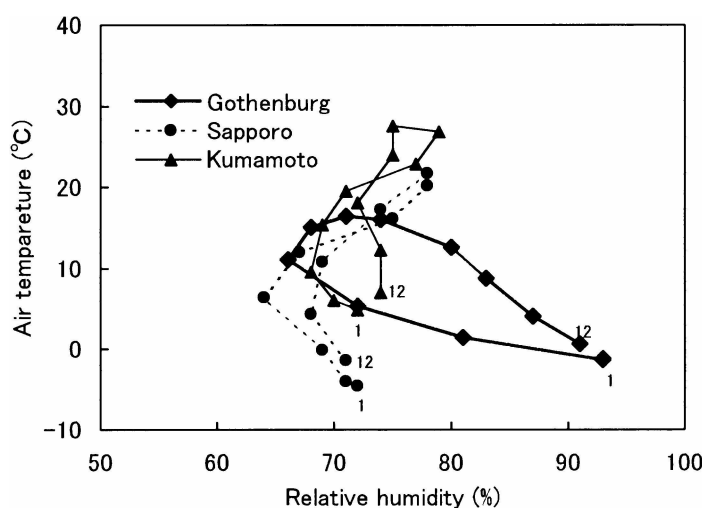


Figure 1: Climatic conditions of Gothenburg, Sapporo and Kumamoto.

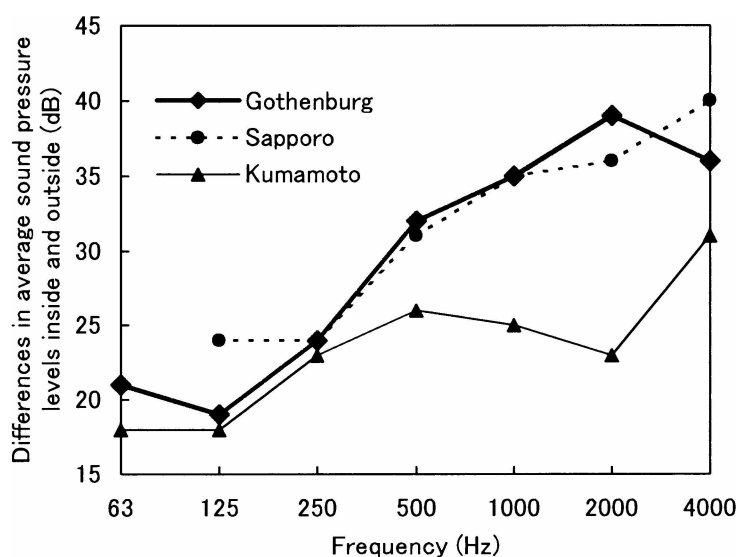


Figure 2: Comparison of sound insulation of external wall with window.

	Gothenburg	Kumamoto	Sapporo
Survey Period	January – June, 1996	May – November, 1996	October, 1997 – October, 1998
Number of Respondents	Detached: 436	Detached: 378	Detached: 411
	Apartment: 706	Apartment: 459	Apartment: 369
Response Rate [%]	Detached: 73.3	Detached: 76.1	Detached: 63.5
	Apartment: 66.4	Apartment: 64.6	Apartment: 52.0
Noise Exposure Level LAeq(24) [dBA]	Detached: 46.2 – 73.6	Detached: 49.0 – 73.5	Detached: 53.3 – 75.7
	Apartment: 48.5 – 82.3	Apartment: 51.1 – 73.5	Apartment: 52.1 – 75.8
Rating Scale for Key Questions			
1. Not noticed 2. Not annoyed 3. A little annoyed 4. Rather annoyed 5. Very annoyed			

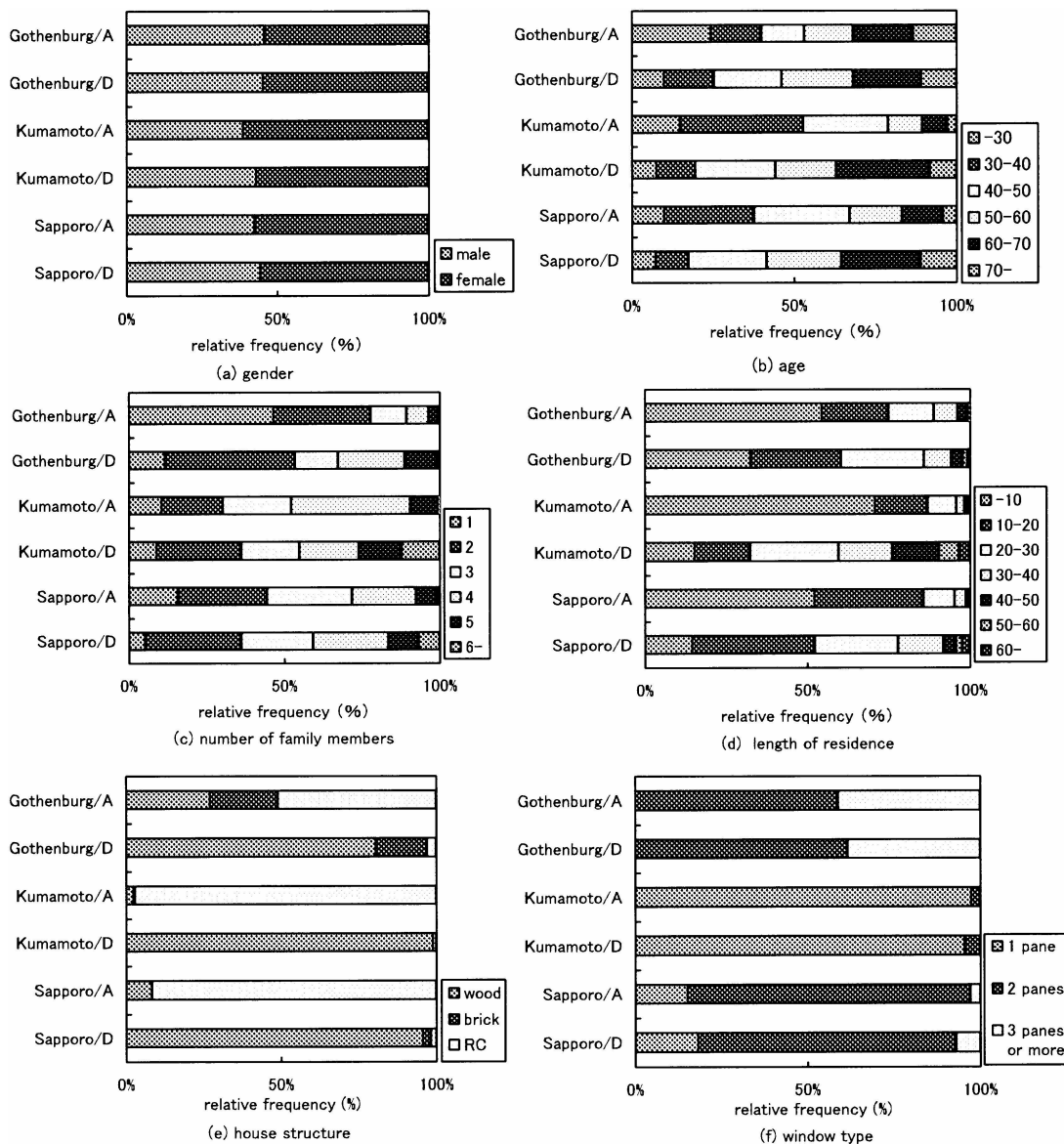
**Table 1:** Outline of the survey.

After the questionnaires were completed, two types of physical measurements were made in each area. One was a 24-hour continuous noise measurement at a reference point close to the roadside. The other was a noise reduction measurement at 5, 10, 20 and 40-meter points on the ground level from the reference point and at each floor level of apartment houses. The noise exposure for each house was determined using these data. The numbers and kinds of vehicles passing in front of the reference point were manually counted during the 24-hour measurement period.

### 3 - RESULTS AND DISCUSSION

Fig. 3 shows the relative frequencies of responses to questions concerning personal and housing factors. There was a wide distribution of responses regarding personal factors. Although the structures of detached and apartment houses were different, the windows of the two housing types were similar in each city, indicating that the degrees of sound insulation in the two housing types in each area are almost the same. Differences in average sound pressure levels inside and outside of external walls with windows were measured in the three cities using the method recommended by the Architectural Institute of Japan. The degree of sound insulation was found to be high in Gothenburg and Sapporo but much lower in Kumamoto, as shown in Fig. 2.

Community responses were compared on the basis of dose-response relationships, as shown in Fig. 4, in relation to "% very annoyed" among the cities and the housing types. It was found that people living in detached houses are more annoyed by the same road traffic noise than those living in apartment houses in Gothenburg, while no significant difference in annoyance response was found between people living in different housing types in Kumamoto and Sapporo. On the other hand, there were no systematic differences in disturbances to indoor activities, such as disturbance to listening to the TV or radio and disturbance to sleep, among the three cities, but there were significant disturbances to activities and resting in gardens or on balconies in Gothenburg. Considering the differences in sound insulation of houses in the three cities, it seems that sound insulation does not have a significant effect on annoyance responses. That probably has to do with differences in customs between the two countries, such as spending time enjoying outdoor life in gardens or on balconies in Gothenburg. With regards to non-acoustical factors, it was found that people living in detached houses are more annoyed by house vibration caused by road traffic than people living in apartment houses. This difference may be explained by difference in house structures. It was also found that people are annoyed by exhaust from road traffic to the same degree as they are annoyed by noise. Exhaust fumes are one of the most serious sources of annoyance in the living environment.



**Figure 3:** Relative frequencies of responses to questions concerning personal and housing factors (A: Apartment house; D: Detached house).

(a) Road traffic noise annoyance

LAeq	KD×GD	KA×GA	KD×KA	GD×GA	SD×SA	SD×KD	SD×GD	SA×KA	SA×GA
50-55dB	-	-	-	-	-	-	-	-	-
55-60dB	-	-	-	**	-	-	*	*	-
60-65dB	-	-	-	**	-	-	**	-	**
65-70dB	**	**	-	**	-	-	*	-	-
70-75dB	-	-	-	*	-	-	-	-	-

(b) TV/radio listening disturbance									
Laeq	KD×GD	KA×GA	KD×KA	GD×GA	SD×SA	SD×KD	SD×GD	SA×KA	SA×GA
50-55dB	-	-	-	-	-	-	-	-	-
55-60dB	-	-	-	-	-	-	-	-	-
60-65dB	-	-	-	-	-	-	-	-	*
65-70dB	-	-	-	-	*	-	-	-	-
70-75dB	-	-	-	-	-	-	-	-	-
(c) Res/relaxation disturbance in garden/balcony									
Laeq	KD×GD	KA×GA	KD×KA	GD×GA	SD×SA	SD×KD	SD×GD	SA×KA	SA×GA
50-55dB	-	*	-	-	-	-	-	-	*
55-60dB	-	**	-	-	-	*	**	-	*
60-65dB	**	**	-	-	-	-	**	-	*
65-70dB	**	**	-	-	-	-	-	-	-
70-75dB	-	-	-	-	-	-	-	-	-
(d) Awakening									
Laeq	KD×GD	KA×GA	KD×KA	GD×GA	SD×SA	SD×KD	SD×GD	SA×KA	SA×GA
50-55dB	-	-	-	-	-	*	-	-	-
55-60dB	*	-	-	-	-	-	-	-	-
60-65dB	-	-	-	-	-	-	-	-	-
65-70dB	-	-	-	*	-	-	-	-	-
70-75dB	-	-	-	-	-	-	-	-	-
(e) House vibration									
Laeq	KD×GD	KA×GA	KD×KA	GD×GA	SD×SA	SD×KD	SD×GD	SA×KA	SA×GA
50-55dB	-	-	-	*	-	-	-	-	-
55-60dB	-	-	*	**	-	-	-	-	-
60-65dB	-	-	**	**	**	-	-	-	-
65-70dB	-	-	**	**	-	-	*	-	-
70-75dB	-	-	-	**	-	-	-	-	-

(f) Exhaust fumes									
Laeq	KD×GD	KA×GA	KD×KA	GD×GA	SD×SA	SD×KD	SD×GD	SA×KA	SA×GA
50-55dB	-	-	-	-	-	-	-	-	-
55-60dB	-	*	-	-	-	-	**	-	**
60-65dB	**	-	-	-	-	-	**	-	-
65-70dB	**	-	-	**	-	-	-	-	-
70-75dB	-			*					

**Table 2:** Chi-square test (KD: Kumamoto/Detached, KA: Kumamoto/Apartment, GD: Gothenburg/Detached, GA: Gothenburg/Apartment, SD: Sapporo/Detached, SA: Sapporo/Apartment; \*\* significant above 1% level, \* significant above 5% level, - not significant).

#### 4 - SUMMARY

Community responses to road traffic noise in a western Swedish city, and northern and southern Japanese cities were compared cross-culturally on the basis of dose-response relationships. The main results are summarized as follows: 1) There are no systematic differences between community responses in Sapporo and Kumamoto, which have the same culture; 2) people living in detached houses in Gothenburg are more annoyed by the same road traffic noise than are people living in Japanese cities; 3) there are no systematic differences among the three cities with regard to activity disturbances indoors, but there is significant disturbance to activities and resting in gardens or on balconies in Gothenburg due to the differences between life-styles in the two countries; 4) people living in detached houses are more annoyed by house vibration caused by road traffic than are people living in apartments; and 5) people are annoyed by exhaust from road traffic to the same degree as noise.

#### REFERENCES

1. **E. Jonsson et al.**, Annoyance reactions to traffic noise in Italy and Sweden: A comparative study, *Archives of Environmental Health*, Vol. 19, pp. 692-699, 1969
2. **K. Izumi et al.**, Cross-cultural study on community response to traffic noise (1): Surveys in Songkhla, Thailand and Tomakomai, Japan, In *The 1994 International Congress on Noise Control Engineering, Yokohama, Japan*, pp. 1145-1148, 1994
3. **T. Yano et al.**, Cross-cultural study on community response to traffic noise (2): Surveys in Gothenburg, Sweden and Kumamoto, Japan, In *The 1994 International Congress on Noise Control Engineering, Yokohama, Japan*, pp. 1149-1152, 1994
4. **J. M. Fields**, *Effect of personal and situational variables on noise annoyance: With special reference to implications for en route noise*, FAA-AEE-92-03, 1992
5. **T. Sato et al.**, Comparison of community responses to road traffic noise among residents of different types of housing, In *The 1999 International Congress on Noise Control Engineering, Fort Lauderdale, USA*, pp. 1321-1326, 1999

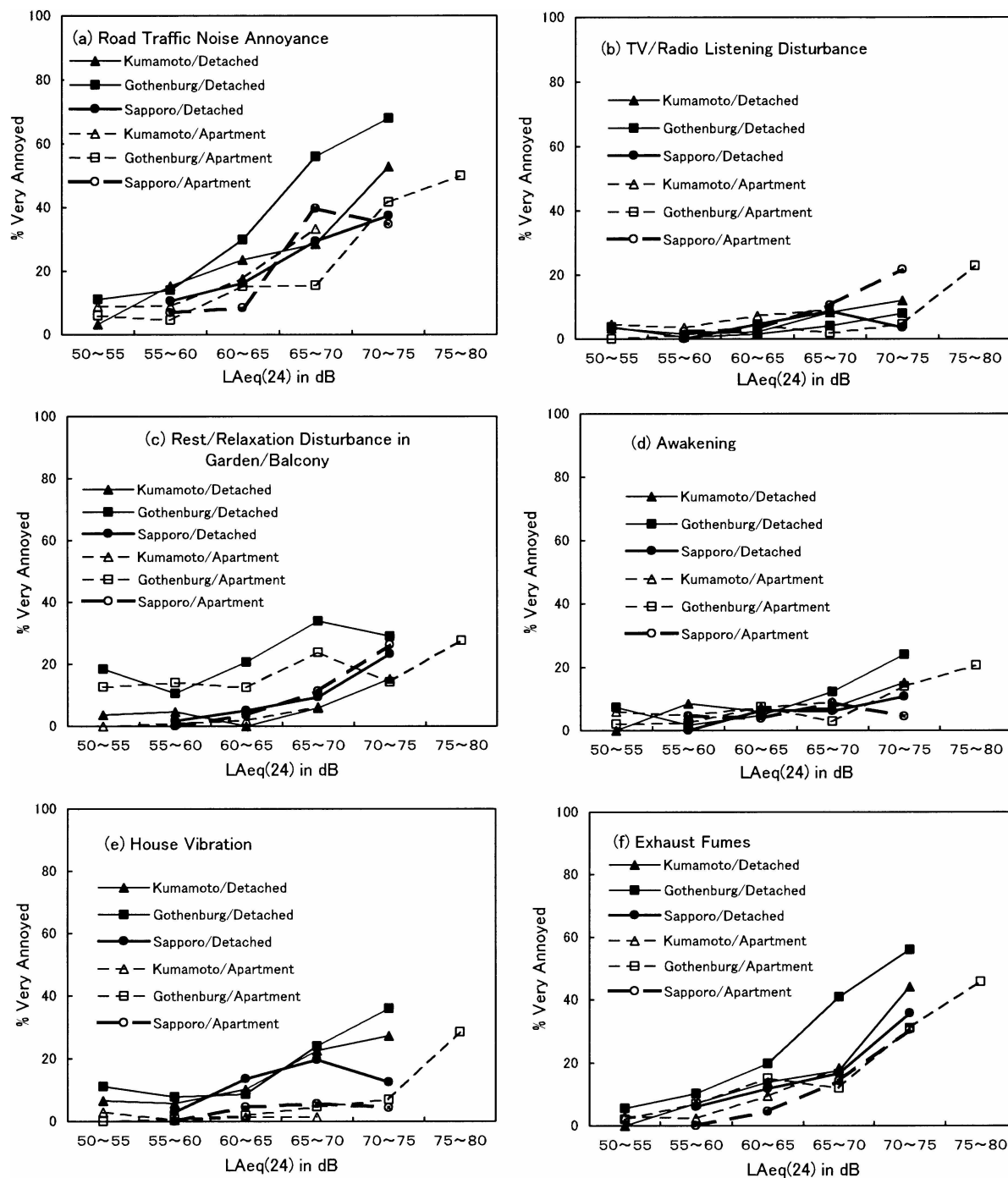


Figure 4: Comparison of community responses to acoustical and non-acoustical factors ("% Very Annoyed" refers to the proportion of people who responded "very annoyed").