Comparison of community response to road traffic noise in five cities of Vietnam

K. Shimoyama[1], T. Yano[1], T. Morihara[2], T. L. Nguyen[1] and H. Q. Nguyen[1]

[1] Graduate School of Science and Technology, Kumamoto University, Kurokami 2-39-1, Chuo-ku, Kumamoto 860-8555, JAPAN, crucify_my_heart_if_xxxxx@yahoo.co.jp, yano@gpo.kumamoto-u.ac.jp, linh2lan@gmail.com, nhuyquang@yahoo.com

[2] Department of Architecture, Ishikawa National College of Technology, Kitachujo, Tubata, Kahoku, Ishikawa 929-0392,JAPAN, morihara@ishikawa-nct.ac.jp

ABSTRACT

Social surveys on community response to road traffic noise has been performed since 2005 in five major cities of Vietnam: Hanoi, Ho Chi Minh City, Da Nang, Hue and Thai Nguyen. The sample sizes (response rates) were 1502 (50%), 1471 (61%), 492 (82%), 688 (98%) and 813 (81%), respectively. The noise exposures ranged from 61 to 83 dB in L_{den}. The exposure-response relationship was drawn with logistic regression curve based on all the socio-acoustic survey data, which can be proposed as the representative exposure-response relationship for road traffic noise in Vietnam. This curve showed that Vietnamese respondents were about 5 to 10 dB less annoyed by road traffic noise than those of EU and Japan. Exposure-response curves for general annoyance, awaking, falling asleep, conversation, telephone-listening, TV/Radio listening, reading/thinking, and rest disturbances were also drawn. Annoyance in the two largest cities, Hanoi and Ho Chi Minh City, were higher than those in the other three cities. Sleep disturbance were severer than listening and the other activity disturbances in all the cities. The distribution pattern of annoyance was consistent with those of environmental factors such as residential satisfaction. This finding suggests that noise annoyance is strongly affected by or interacted with the evaluation of residential environment.

1. INTRODUCTION

Developing countries including Vietnam are facing serious noise problems caused by the expansion of transportation and the increase of traffic volume. Noise annoyance is not only influenced by noise exposure but also by cultural backgrounds. Hence it is necessary to accumulate social survey data in each country to formulate the effective noise policy. Since enough number of social surveys have not been conducted in South East Asian countries, this research project has been performed in Vietnam since 2005 to contribute to noise policies in developing countries. The traffic condition in Vietnam is quite different from those in developed countries in that the main traffic is numerous motor bikes with frequent horn sounds.

In this paper, the results of social surveys for inhabitants along the roads in five major cities of Vietnam are reported and compared among the cities: Hanoi, Ho Chi Minh City, Da Nang, Hue and Thai Nguyen. The exposure-response relationship was drawn with logistic regression curve based on all the socio-acoustic survey data, which can be proposed as the representative exposure-response relationship for road traffic noise in Vietnam and compared with European and Japanese ones. The exposure-response curves for awaking, falling asleep, conversation, telephone-listening, TV/Radio listening, reading/thinking, and rest disturbances were drawn and compared in the same way.

2. METHODS

2.1 Social survey

Social surveys have been performed with face-to-face interview in Vietnam as shown in Table 1: five road traffic, three aircraft and two railway noise surveys. Table 2 shows the basic information of these cities at the time when the surveys were performed: the number of survey sites, the sample size and response rate. The response rates of two biggest cities, Hanoi and Ho Chi Minh, are smaller than the other three cities. Main questionnaire items were housing, residential, and personal factors.

The questions on noise annoyance followed the ICBEN method with a five-point verbal scale and an 11 point-numeric scale. The question wordings with a five-point verbal scale was as followed "Within 12 months, how much does road traffic noise annoy/disturb you when you are at home, not at all, slightly, moderately, very, or extremely?" The question wordings with an 11 point-numeric sale was as followed,**"**Thinking about the last 12 months or so, what number from 0 to 10 best shows how much you are bothered, disturbed or annoyed by road traffic noise?**"**, and the answer was chosen between 0 and 10, 0 means "Not at all" and 10 means "Extremely annoyed".

The total number of respondents was 4966, and the average response rate was 64%. Table 3 shows the socio-demographic data, whose distribution was almost the same among the five cities. There were slightly more female respondents than males. Most of the respondents were in their 20s, and the older they were, the smaller the sample sizes were.

Table 1: Social survey of transportation noise in Vietnam

Year	City	Noise source
2005	Hanoi	Road traffic
2007	Ho Chi Minh	Road traffic
2008	Ho Chi Minh	Aircraft
2009	Hanoi	Aircraft
2010	Hanoi	Railway
2011	Da Nang	Aircraft, Road traffic
2012	Hue	Railway, Road traffic
2013	Thai Nguyen	Road traffic

Table 2: Basic information on five cities

City	Population (thousnad)	Area (m^2)	Number of survey locations	Number of respondents	Response rate (%)
Hanoi	3,230	1000	8	1502	50
Ho Chi Minh	6,650	2095	8	1471	61
Da Nang	950	1255	6	492	82
Hue	330	83	7	688	98
Thai Nguyen	330	190	10	813	81

Table 3: Demographic variables

City	Gender		Age					
	Male	Female	20s	30s	40s	50s	60s	70s+
Hanoi	718 (49.1%)	745 (50.9%)	443 (29.7%)	349 (23.4%)	306 (20.5%)	214 (14.3%)	121 (8.1%)	60 (4.0%)
Ho Chi Minh	723 (49.5%)	737 (50.5%)	406 (27.7%)	388 (26.5%)	324 (22.1%)	197 (13.5%)	99 (6.8%)	50 (3.4%)
Da Nang	237 (49.6%)	241 (50.4%)	141 (29.2%)	91 (18.8%)	99 (20.5%)	79 (16.4%)	39 (8.1%)	34 (7.0%)
Hue	321 (47.5%)	355 (52.5%)	161 (23.7%)	117 (17.2%)	122 (17.9%)	128 (18.8%)	87 (12.8%)	65 (9.6%)
Thai Nguyen	388 (48.7%)	409 (51.3%)	181 (22.5%)	203 (25.3%)	146 (18.2%)	144 (17.9%)	87 (10.8%)	42 (5.2%)
Total	2387 (49.0%)	2487 (51.0%)	1332 (27.1%)	1148 (23.3%)	997 (20.3%)	762 (15.5%)	433 (8.8%)	251 (5.1%)

2.2 Noise measurement

Twenty-four-hours noise measurements were performed at the survey sites in the five cities as follows. A microphone with omni-weather screen was placed at a point 1.2m high and 2m away from the house facade. This was connected to a sound level meter (RION NL-21, NL-22), and $L_{Aeq,1s}$, equivalent continuous A-weighted sound pressure level per second, was recorded every second. Table 4 shows the results of noise measurements. They were from 61 to 83 dB in L_{den}, and from 50 to 73 dB in $L_{Aeq,\ 22\text{-}07}$.

Table 4: Noise exposure levels

City	Survey site ID									
	RT1	RT2	RT3	RT4	RT5	RT6	RT7	RT8	RT9	RT10
$L_{Aeq,\ night}$										
Hanoi	73	67	71	69	65	72	73			
Ho Chi Minh	69	71	75	70	72	71	74	76		
Da Nang	60	60	57	66	63	61				
Hue	58	59	65	50	62	70	66			
Thai Nguyen	64	69	64	67	65	51	55	66	70	67
$L_{Aeq,24h}$										
Hanoi	77	72	75	72	68	69	73			
Ho Chi Minh	73	76	79	70	75	76	76	77		
Da Nang	67	65	63	72	72	67				
Hue	67	69	70	58	69	76	71			
Thai Nguyen	70	73	70	71	71	58	61	70	74	71
L_{den}										
Hanoi	81	76	79	77	73	74	79			
Ho Chi Minh	77	80	83	78	79	80	82	83		
Da Nang	70	69	66	76	76	71				
Hue	70	71	74	61	72	80	75			
Thai Nguyen	73	77	73	75	74	61	64	74	78	75

2.3 Statistical analysis

A logistic regression analysis was applied to investigate the relationships between road traffic noise exposure and community response. Highly annoyed or not and highly disturbed or not, were used as the dependent variables in the exposure-response relationships. People who responded to any of the top three categories from 11-point numeric scale were counted as %highly annoyed, and those for the top two categories from five-point verbal scale were counted as %very disturbed. Noise exposure levels in $L_{Aeq,22\text{-}07}$ were used as the independent variables for sleep disturbance, those in L_{den} were used for other disturbances and annoyance.

3. RESULTS

3.1 Exposure-response relationships for noise annoyance

Figure 1 shows the exposure-response curves for road traffic noise in the five cities with plots at survey sites which are widely spread. The noise exposures ranged from 61 to 83 dB in L_{den}. Annoyance in the two largest cities, Hanoi and Ho Chi Minh City, were higher than those in other three cities.

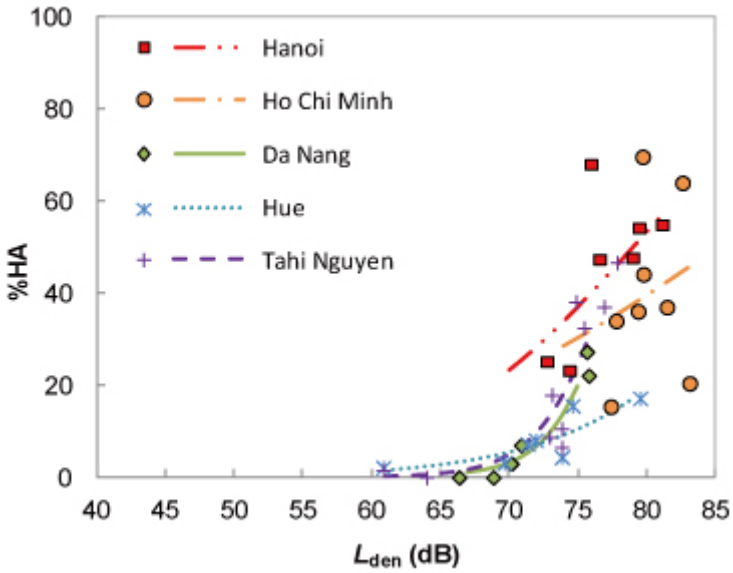


Figure 1: Comparison of exposure-response relationships among cities

The exposure-response curve based on all the socio-acoustic survey data is shown in Figure 2, which can be proposed as the representative one for road traffic noise in Vietnam. In addition, exposure-response curves for road traffic noise annoyance in EU and Japan are drawn in Figure 2. This figure shows that Vietnamese respondents were about 5 to 10 dB less annoyed by road traffic noise than those of EU and Japan.

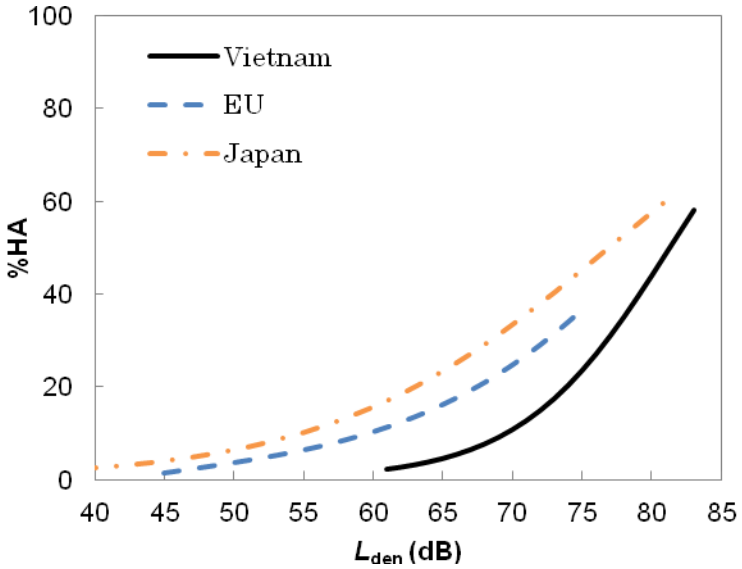


Figure 2: Comparison of exposure-response relationships among countries

3.2 Exposure-response relationships for activity disturbance

Exposure-response relationships for awaking, falling asleep, conversation, telephone-listening, TV/Radio listening, reading/thinking, and rest disturbances are shown in Figure 3. It shows that sleep disturbance were severer than listening and the other activity disturbances. Only curves which based on all the data are shown because almost the same trend was obtained in all cities.

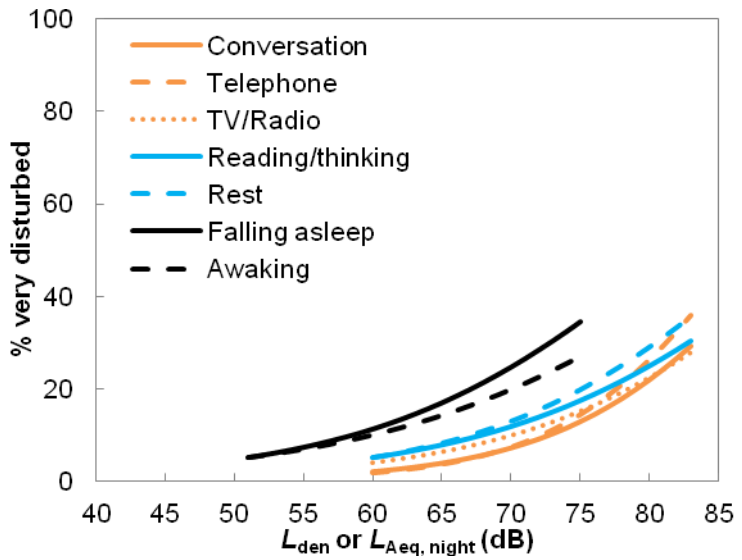
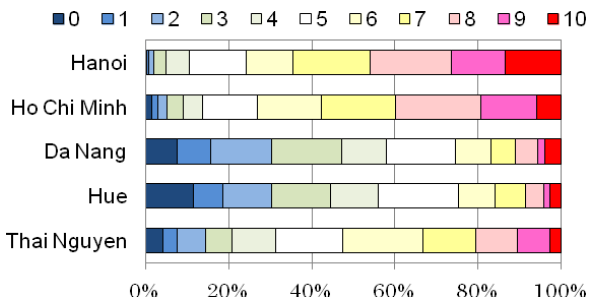


Figure 3: Comparison of exposure-response relationships for each activity disturbance

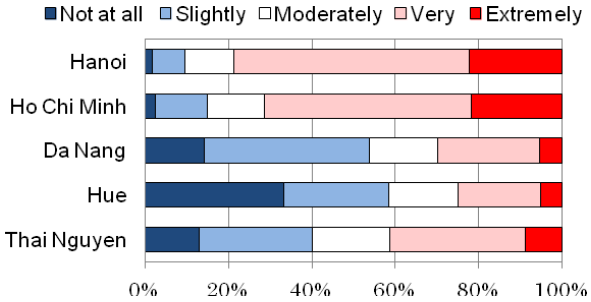
3.3 Effects of environmental factors on noise annoyance

Whether environmental factors affect the noise annoyance or not was investigated. They are townscape, natural environment such as green, view from the house, quietness around the house, and residential satisfaction. Figure 4 and Table 5 show the distribution of noise annoyance and environmental factors and the correlation coefficients among the variables, respectively. The distribution patterns of noise annoyance are similar to those of environmental factors. Of correlations between

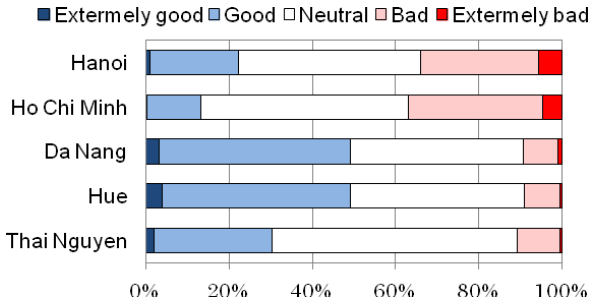
annoyance and environmental factors, the highest one was found for quietness around the house, followed by townscape and natural environment in Table 5. Though the correlations between view from the house and townscape or natural environment were high, those between view from the house and annoyance were low. These findings suggest that noise annoyance was strongly affected by or interacted with the environmental factors.



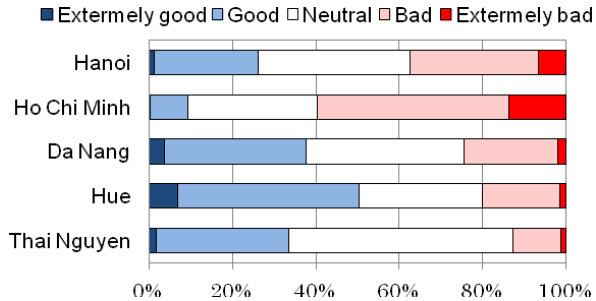
(a) Noise annoyance (11-numerical scale)



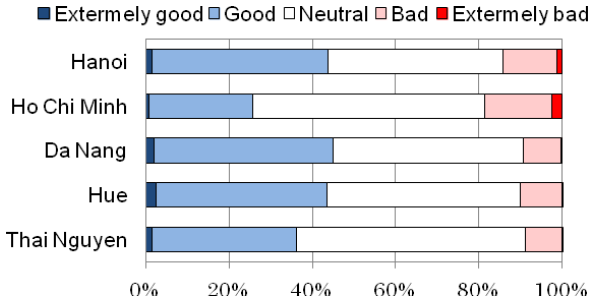
(b) Noise annoyance (5-point verbal scale)



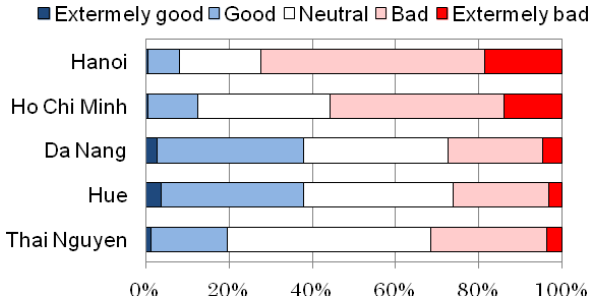
(c) Townscape



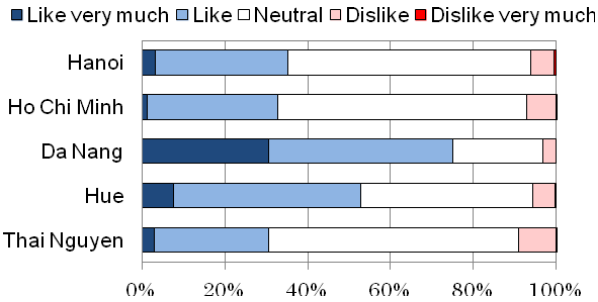
(d) Natural environment



(e) View from your house



(f) Quietness around the house



(g) Residential satisfaction

Figure 4: Distribution of noise annoyance and environmental factors

Table 5: Correlation coefficient of each factors

	(a)	(b)	(c)	(d)	(e)	(f)	(g)
(a) Noise annoyance (11-numerical scale)	1	0.67	0.34	0.32	0.13	0.51	0.22
(b) Noise annoyance (5-point verbal scale)		1	0.37	0.36	0.14	0.58	0.24
(c) Townscape			1	0.59	0.42	0.45	0.27
(d) Natural environment				1	0.33	0.42	0.24
(e) View from your house					1	0.24	0.18
(f) Quietness around the house						1	0.26
(g) Residential satisfaction							1

4. CONCLUSIONS

This paper summarizes the results of social surveys in five major cities of Vietnam as follows:

1) The exposure-response relationships for road traffic noise in two largest cities, Hanoi and Ho Chi Minh, were higher than those in the other three cities.
2) Vietnamese people were about 5 to 10 dB less annoyed by road traffic noise than those of EU and Japan.
3) Sleep disturbance were severer than listening and the other activity disturbances in all the cities.
4) The pattern of annoyance was consistent with those of environmental factors such as townscape and natural environment. This finding suggests that noise annoyance is strongly affected by or interacts with environmental factors.

ACKNOWLEDGMENTS

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