Reaction to Road Traffic and Aircraft Noises in Hanoi and Ho Chi Minh City

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To formulate Vietnamese and global noise policies, community response to transportation noise has been investigated in Vietnam. Two large-scale socio-acoustic surveys on community response to road traffic noise were conducted in Hanoi 2005 and in Ho Chi Minh 2007 and then two other surveys on the impact of aircraft noise in Ho Chi Minh City 2008 and in Hanoi 2009. In total, 2974 and 2959 responses were obtained in road traffic and aircraft noise surveys, respectively. The dose-response curve for road traffic noise almost coincided with the EU's curve, while the curve for aircraft noise was slightly higher than EU's. For the same noise exposure, the noise annoyance in Hanoi was higher than that in Ho Chi Minh City because of the lower background noise level in Hanoi.

Keywords: Aircraft Noise, Road Traffic Noise, Dose-response Relationship

1. INTRODUCTION

Noise effects in developing countries are continuing to grow because of rapid urbanization in addition to bad planning and poor social infrastructure. However, environmental noise in these countries is insufficiently controlled because of the unavailability of adequate data. The data are insufficient to propose dose-response relationships and this therefore leads to the establishment of inappropriate criteria. Therefore, there is an urgent need to accumulate a reliable dataset to establish the relationship between noise and community annoyance in developing countries for both national and global noise management. To formulate Vietnamese and global noise policies, community response to transportation noise has been investigated in Vietnam since 2004. Hanoi and Ho Chi Minh City, the cities chosen for the surveys are the busiest major metropolitan areas in Vietnam with a concentration of more than a third of the urban population in Vietnam. Two large-scale socio-acoustic surveys on community response to road traffic noise were conducted first and then two other surveys on the impact of aircraft noise in 2005, 2007, 2008 and 2009, respectively. The objectives of this study are (i) to propose representative dose-response relationships for road traffic and aircraft noise annoyance in Vietnam and (ii) to discuss the difference in annoyance between cities.

2. METHODS

Survey sites

Eight sites were selected for each of road traffic noise surveys in Hanoi and Ho Chi

Minh City. The sites were selected to reflect not only the road traffic noise covering various traffic volumes but also the characteristics of streets such as road width or the residential identify and so on. All selected sites were streets having residential houses located densely along the road with busy commercial activities.

Ten residential areas were selected around Tan Son Nhat Airport in Ho Chi Minh City including eight sites under the landing and takeoff paths of aircraft and two other sites laying to the north and south of the runway. Nine sites were selected around Noi Bai airport in Hanoi including seven sites under the landing and takeoff paths of aircraft and two sites to the south of the runway. The sites were selected to reflect the aircraft noise exposure covering locations at various distances from and directions relative to the airport. At each site, the houses facing the roads were selected for combined noise survey and those apart from the road were for single aircraft noise survey.

Social surveys

Outlines of the social surveys on road traffic and aircraft noise annoyance in Hanoi and Ho Chi Minh City are presented in Table 1. The surveys on road traffic noise annoyance were conducted in Hanoi in September 2005 and Ho Chi Minh City in August and September 2007. The sample sizes were 1,503 and 1471 people in road traffic noise survey in Hanoi and Ho Chi Minh City, respectively. Social surveys on community response to aircraft noise and combined noise from aircraft and road traffic were carried out in Ho Chi Minh City from August to September 2008 and in Hanoi from August to September 2009. In total, 1562 and 1397 responses were obtained in Ho Chi Minh City and Hanoi, respectively.

All surveys were principally conducted in weekends when family members were at home and were carried out by using face-to-face interviews with the same questionnaires. In the questionnaire, two scales—5-point verbal and 11-point numeric—constructed according to the ICBEN (International Commission on Biological Effects of Noise) method were used to evaluate the respondents' noise annoyance [1].

Noise measurements

Road traffic noise was measured in Hanoi in September 2005 and in Ho Chi Minh City in September 2007, including the 24-hour noise measurement, short-term horizontal and vertical reduction measurements. Aircraft noise measurements were performed in Ho Chi Minh City from September 22 to 29, 2008, and in Hanoi from September 10 to 17, 2009. Combined noise of aircraft and road traffic was measured every 1 s for 24 h on the road shoulder. Aircraft noise exposure was measured every 1 s for seven successive days by using sound level meters (RION NL-21 and NL-22) at the same site but for the areas rather separate from the road which is supposed to be exposed mainly by aircraft noise.

Table 1: Outline of surveys

	Road traffic noise	**Aircraft noise**
Area	Hanoi	Ho Chi Minh City
Housing type	Row houses and apartments	Detached and row houses
Survey site	Eight sites along streets in Hanoi	Ten sites around Tan Son Nhat
Method	Face-to-face interview	Face-to-face interview
Survey term	Sep 2005, Sep 2006	Aug-Sep 2008
Measurement	24h, Sep 2005	1 week, Sep 22-29, 2008
Sample size	1503	1562
Response rate (%)	50	87
L_{den} *(dB)*	75-83	53-71

Area	Ho Chi Minh City	Hanoi
Housing type	Row houses and apartments	Detached and row houses
Survey site	Eight sites along streets in Ho Chi Minh City	Nine sites around Noi Bai Airport
Method	Face-to-face interview	Face-to-face interview
Survey term	Aug 2007	Aug-Sep 2009
Measurement	24h, Sep 2007	1 week, Sep 10-17, 2009
Sample size	1471	1397
Response rate (%)	61	54
L_{den} *(dB)*	78-83	48-61

4. RESULTS AND DISCUSSIONS

A logistic regression function was applied to plot the dose-response curves for aircraft and road traffic noise annoyance. This was evaluated by the percentage of people highly annoyed as dependent variable and the day-evening-night average sound level (L_{den}) as independent variable. Following the European Union (EU) position paper [2], in which the cut-off point for the highly annoyed was defined as the top 28%, the authors defined the top three categories of the 11-point numeric scale (top 27%) as highly annoyed.

Figure 1 shows the relationships for aircraft and road traffic annoyance in Ho Chi Minh City and Hanoi using synthesized data from the single and combined noise surveys. Hanoi's curves are higher than Ho Chi Minh City's in both term of aircraft and road traffic noise. In other words, respondents in Hanoi were more annoyed than those in Ho Chi Minh City at the same noise level. The background noise level, in this study, is defined as the 95^{th} percentile (L_{95}). The results of noise measurements show that the background noise levels at almost all sites of Ho Chi Minh City are higher than at those of Hanoi. The outstandingly larger traffic volume in Ho Chi Minh City might yield the higher background noise level there. Correlation coefficients were calculated to measure the relationship between aircraft annoyance and background noise levels. The results showed that L_{95} was statistically significantly correlated at the 0.01 level with individual annoyance score evaluated by the respondents of all surveys in both Hanoi and Ho Chi Minh City. It can be speculated that the road traffic and aircraft noise in Hanoi might be generally more noticeable since the background noise levels are lower than in Ho Chi Minh City. This finding emphasized the role of background noise level on the annoyance of respondents in Ho Chi Minh City and Hanoi.

In Figure 2, the synthesized curves of Hanoi and Ho Chi Minh City were superimposed and fitted on to the EU data curves. The dose-response curve for road traffic noise almost coincided in the position of the EU's data curve. This could be considered as a supplement to the serial data of the EU for the noise level above 75 dB. Meanwhile, the curve for aircraft noise was slightly higher than EU's. It could be argued that, at the same noise exposure level, despite having the same degree of annoyance to road noise, Vietnamese were more disturbed by aircraft noise than European people. However, this result shows the correctness and the applicability accompanied by the amendment given by a thorough study of European standards with Vietnam in particular and other developing countries in general.

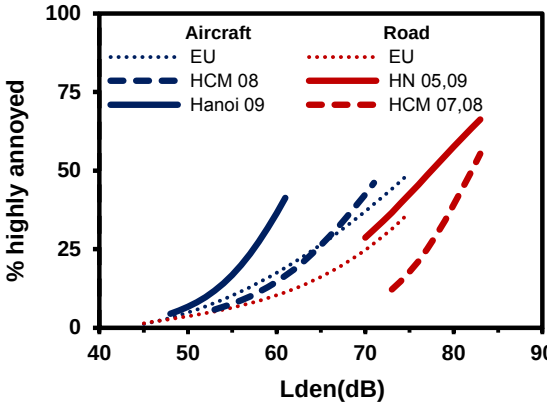

Figure 1. Dose-response relationships for road traffic and aircraft noise annoyance using synthesized data from surveys in Hanoi and Ho Chi Minh City

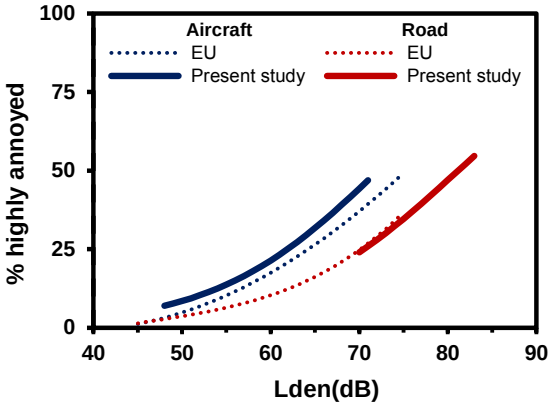

Figure 2. The synthesized curve of road traffic and aircraft noise surveys in comparison with the EU's curve

5. CONCLUSIONS

The first dose–response relationship between L_{den} and % highly annoyed was established for road traffic and aircraft noise in Vietnam and fitted onto the curve for the EU. It has been found that the dose-response curve for road traffic noise almost coincided in the position of the EU's data curve and the curve for aircraft noise was 2 to 3 dB lower than that for the EU at the same percentage of high annoyance. Finally, for the same noise exposure, the noise annoyance in Hanoi was higher than that in Ho Chi Minh City because of the lower background noise level in Hanoi.

6. REFERENCES

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