Annoyance Response to Traffic Noise of Population in Different Settings in Hong Kong

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ABSTRACT

Hong Kong is a small city with over 7 million people living in 1,100 sq km in which 85% of land is hilly area and about 40% of area is countryside. Although the majority of residents live in high-rise buildings in the city, a portion of the population stays in the countryside, giving rise to different settings. To support the economic growth, many roads were built within the city and traffic noise is inevitably the major component of the background noise in the city. A recently completed study looks into the relationship in annoyance response of the Hong Kong population to road traffic noise. Making use of the social survey data and noise level data generated through city-wide noise mapping exercise, this study examines the annoyance response of population to traffic noise in different settings (urban, low density residential, rural/village, and new development areas) in Hong Kong and explores the possible causes of different annoyance responses including background noise levels and urban morphology.

INTRODUCTION

The urban landscape of Hong Kong is rather unique due to the high urban density and complicated land use patterns, with over 7 million people living in 1,100 sq km in which 85% of land is hilly area and about 40% of area is countryside. Figure 1 shows the countryside areas of Hong Kong and the high urban density area. The majority of residents live in high-rise buildings in the city. A small portion of population stays in countryside giving rise to different settings.

Figure 1: Countryside and urban areas of Hong Kong

Economy growth during the 80s and 90s in Hong Kong brought more developments including transportation infrastructures. However, due to deficiencies in city planning coupling neglects in environmental concerns in the past, cramped development resulted in thorny problems such as highways running just outside people's living rooms. As such, similar to other major metropolises around the world, traffic noise is the major component of the background noise in Hong Kong.

A large scale territory-wide noise mapping and household survey was completed looking into the relationship annoyance response of population in Hong Kong to traffic noise. To further investigate the annoyance response of population, this study examines the annoyance response of the population to road traffic noise in different settings, such as urban, low density residential, rural/village, and new development areas and explores the possible causes of different annoyance responses including background noise and urban morphology.

METHODOLOGY

This study uses the data collected in a large scale territory-wide noise mapping and household survey (Environmental Protection Department, Hong Kong SAR 2012). A total of 10,077 households were successfully interviewed. Each household was assigned to one of the four types of settings identified in this paper.

From noise mapping, L_{DEN} was calculated for each selected household using noise prediction method with French GBTT as the emission model and ISO 9613 as the propagation model. Using data such as topography, gradient of roads, heights of buildings, traffic flow, percent heavy vehicles and traffic speed, road traffic noise levels were calculated at 1 metre from the façade of the most exposed side of the selected dwellings. In additional to the calculated road traffic noise, information about the noise sources, as identified by the respondents in the households as annoying, was also obtained through the survey.

For each household, the type of surrounding area in which the dwelling was located was also identified on maps and zoning plans. Four types of settings were defined in accordance with the Technical Memorandum for the Assessment of Noise from Places Other Than Domestic Premises, Public Places or Construction Sites (TM-IND) (Environmental Protection Department, Hong Kong SAR 1997) of Noise Control Ordinance in Hong Kong. Such a classification scheme was used to set the noise limits for noise control in various types of settings in Hong Kong. The four types of settings include (1) Urban area; (2) Low density residential area consisting of low-rise or isolated high-rise developments; (3) Rural area, including country parks or village type developments, and (4) Area other than those above. An Urban area is characterized by high density and diverse developments including a mixture of industrial activities, trade and commercial activities and residential premises. Areas other than those above are New developed areas (NDA) with major proportion of high-rise residential developments.

RESULTS

The percentage of inhabitants reporting “highly annoyed” in each of these four types of settings is shown in Table 1. In the Urban area category, there is no reported data in the traffic noise range from 40dB - 45dB(A) L_{DEN}; whereas in Rural area, there is no reported data in upper traffic noise level range of 75 – 80 dB(A) L_{DEN}. This reflects the general situation in Hong Kong that higher traffic noise levels are more commonly found in Urban area than in Rural area.

For the traffic noise level range 70-75 dB(A) L_{DEN}, the percentage of highly annoyed people in the Rural area was 25.0%. The corresponding figure for NDA was 24.1%. The percentages of highly annoyed in these two types of settings are higher than the other two types of settings (Urban area and Low Density area) by as much as 10%, indicating significant difference among four types of settings.

Table 1: Traffic noise highly annoyance percentage in various types of settings

	Traffic Noise Exposure Level, dB(A)L_{DEN}							
Types of Areas	**40-45**	**45-50**	**50-55**	**55-60**	**60-65**	**65-70**	**70-75**	**75-80**
Rural area	3.0	4.9	9.0	2.4	5.8	12.7	25.0	
Low Density area		0.0	0.0	9.3	3.5	8.5	15.8	
Urban area		7.9	7.4	5.2	9.5	14.0	15.2	20.2
NDA	3.6	2.5	11.2	5.4	6.3	11.9	24.1	28.9

The annoyance response with respect to traffic noise exposure in various types of settings are shown in Figure 2 and they are compared with the Miedema curve (European Environment Agency 2010) in Figure 3.

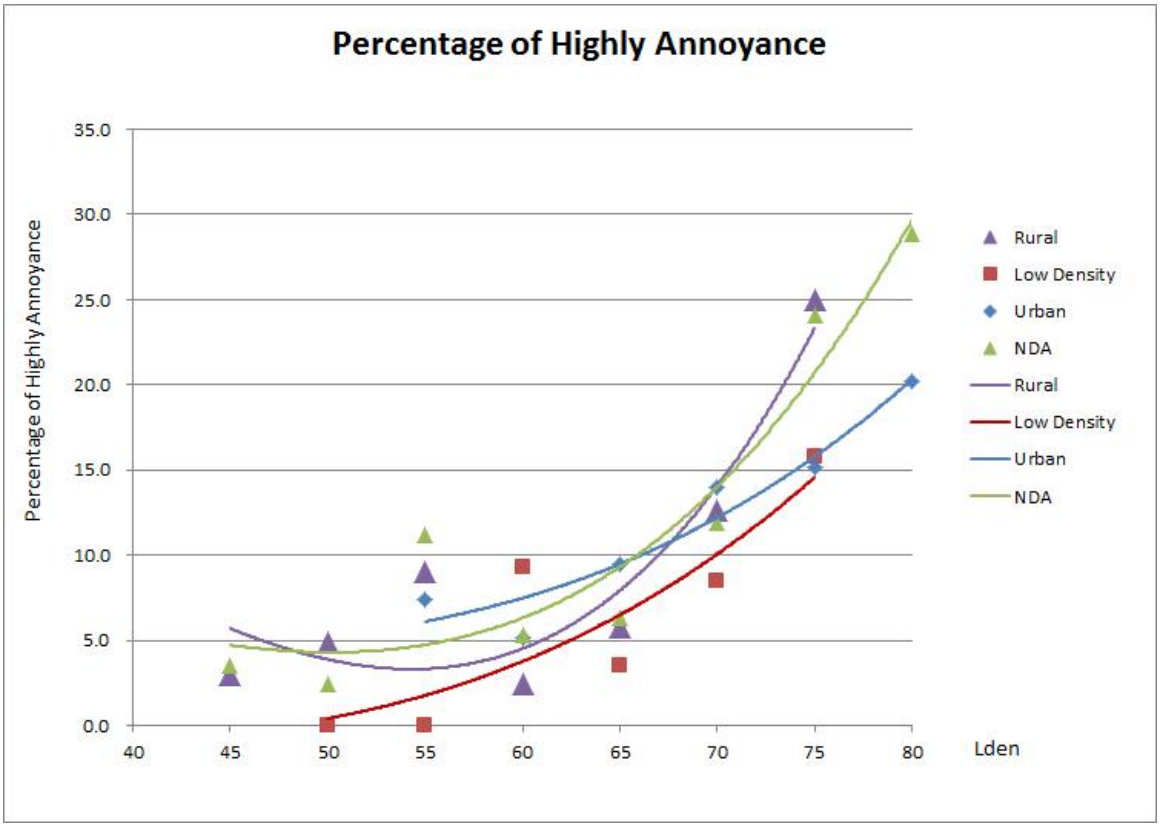

Figure 2: Percentage of dwellings reporting High Annoyance in various types of areas

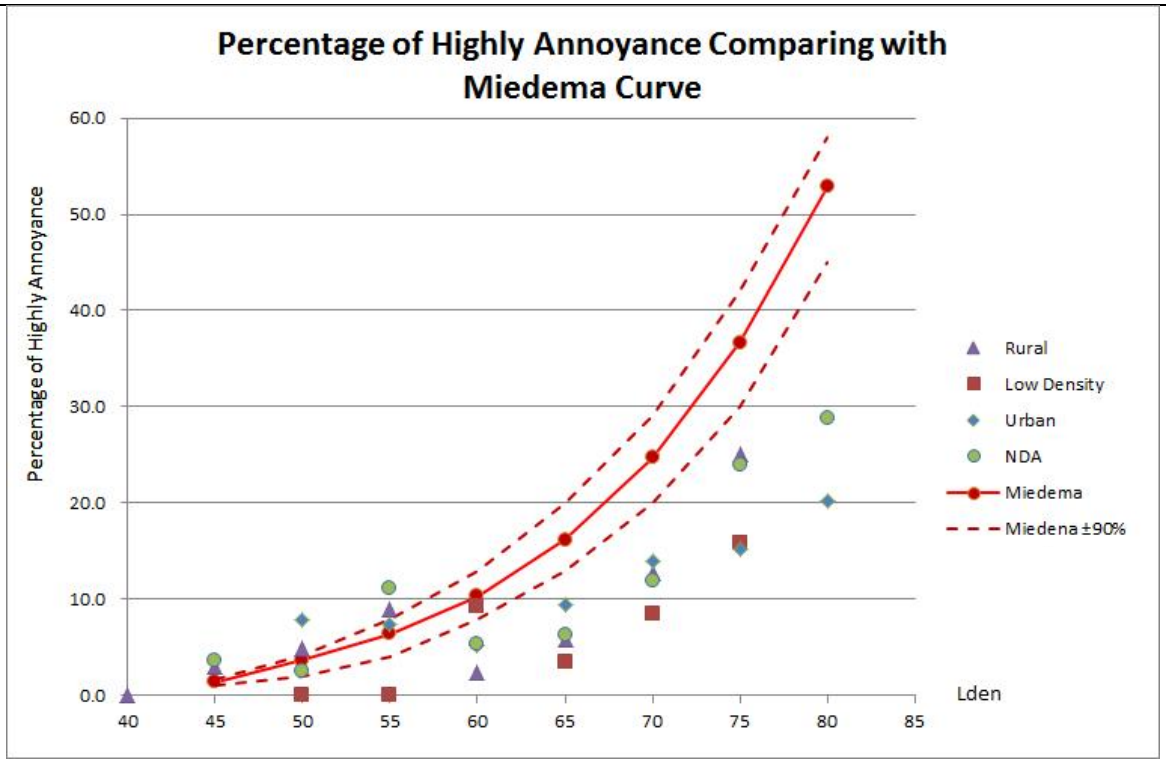

Figure 3: Comparison of percentage High Annoyance between Hong Kong and the Miedema Curve

DISCUSSION

Annoyance response to various noise sources in different urban forms were reported in an earlier paper (Maurice Yeung et al. 2012). It was identified that there were no notable attributial differences between the annoyance levels among those seven common urban forms in Hong Kong, which include public old slab, cruciform, single/ twin tower, trident, small house, private high-rise building with podium and private high-rise building without podium.

Figure 2 suggests that annoyance response to road traffic noise were stronger in Rural area and NDA than other types of settings in the range of 65 to 80 dB(A) L_{DEN}. This can be attributed to the differences in background noise levels different settings types. An earlier study (Kam Sun 2000) shows that the average Leq background noise was lower in Rural area and NDA than in Urban area (Table 2).

Table 2: Background noise levels for different types of settings

	Day and Evening, dB(A)Leq
Urban Area	67.1
New Development Area	61.8
Rural Area	57.1

The background noise levels of Rural area and NDA were lower than 65 dB(A). Therefore, traffic noise levels from 65 to 80 dB(A) L_{DEN} of Rural area and NDA area

could be the dominant noise source in these settings. The difference between traffic noise exposure level and background noise level could be one of the factors to intensify the annoyance response. It is worthy to further investigate the factors in terms of background noise levels or soundscapes affecting the annoyance response.

In Figure 3, it is shown that for the range from 60 to 80 dB(A) L_{DEN}, the traffic noise annoyance responses for all four types of settings were less strong when compared with the Miedema curve. However, in the range from 45 to 60 dB(A) L_{DEN}, except for a few responses from Rural area and NDA, the annoyance response was similar to or less strong than that presented by the Miedema curve.

SUMMARY

The annoyance response of traffic noise to population in different physical settings (Urban area, Low density residential area, Rural area, and NDA) in Hong Kong was discussed by analysing the 10,077 social survey data and noise level data generated through city-wide noise mapping exercise. It is suggested that different annoyance responses could be ascribed to different background noise levels and urban form. In general, the annoyance response to traffic noise in the four types of areas were less strong than that portrayed in the Miedema curve.

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