

Evaluation of urban soundscape using soundwalking

Joo Young Hong (1), Pyoung Jik Lee (1) and Jin Yong Jeon (1)

(1) Department of Architectural Engineering, Hanyang University, Seoul 133-791, Korea

PACS: 43.50.Qp , 43.50.Rq , 43.50.Sr

ABSTRACT

In this study, urban soundscapes was evaluated through soundwalking. Soundwalking was conducted during ISO meeting in Seoul, thus international as well as domestic experts in the soundscape studies were participated. Subjects were asked to walk along a route with different characteristics of urban soundscape, and to concentrate on what they could hear as they walked and observed the urban environments. At each site, the subjects evaluated the overall impression and preference to context of soundscape. During the soundwalking, audio-visual recordings were carried out by using binaural microphone and video camera. From the results, the factors affecting the perception of urban soundscape were extracted, and the responses from domestic and international experts were compared.

INTRODUCTION

Perception of acoustic environment in urban spaces are not only affected by sound sources such as traffic noise, construction noise and people's speech but also closely related to various contexts of urban space. However the procedure for assessing acoustic environment has not been standardized yet and needed to discuss more. Recently, ISO TC 43 SC 1 WG 54 was established to standardize the evaluation method of soundscape and has started the discussion on definition process.

Evaluations of urban soundscape have been carried out mainly by field survey [1-5], and most of them adopted soundwalking methodology [6-8]. Soundwalking is one of the methods for evaluating perception of soundscape. During soundwalking, subjects were asked to concentrate on what they could hear and see. Thus, it was possible to evaluate the visual image as well as sound source in urban spaces through soundwalking. In this study, soundwalking was carried out during ISO meeting in Seoul, and not only domestic experts but also international researchers in the soundscape studies took part in soundwalk. From the soundwalking, the factors influencing the perception of urban soundscape and the difference between domestic and foreign subjects' responses were investigated.

PERCEPTION OF SOUNDSCAPE

Figure 1 describes a simple box diagram (blocks and definition), proposed by blocks group of ISO TC43 SC1 WG54 in 2009, about various elements of the individual's soundscape perception process. In this process, it was assumed that context, physical soundscape and coping behaviors affected person's perception of soundscape independently. Physical soundscape was defined as the physical exposure at a point or area and coping behaviors indicated the behaviors involved in contexts such as displacement and desire to return to area.

Contexts were classified into sources, characteristics of society and individual and physical condition such as landscape, natural brightness, etc. In this study, perception of urban soundscape has been investigated by considering various factors discussed in blocks group's perception model.

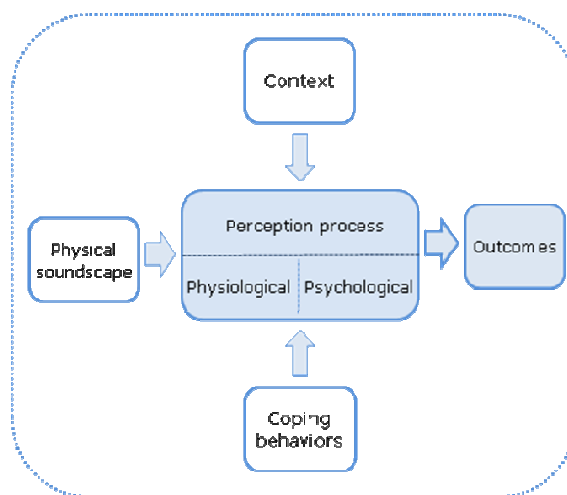


Figure 1. Blocks and definition ver. 2.1

SOUNDWALKING

Site selection

Four sites were selected on the consideration of various elements which consists of urban environments such as buildings, traffic roads, squares and water features. Table 1 shows main functions and sound sources at each site and Figure 2 shows the pictures at each site. Site 1 is a shopping district where is crowded with people and heavy traffic. Offices and commercial buildings are located along the either side of street. Site 2 located in front of Seoul city hall where surrounded by traffic roads is an urban square with grass and

fountains. Site 3, located in downtown of Seoul, is an office district with relaxation place near city stream. Site 4 is a city stream, Cheongyecheon, with pedestrian road.

Table 1. Function and sound sources of Selected sites

no	Location	Main function	Sound sources
1	Department store	Commerce Offices	Traffic footsteps Music Speech
2	Seoul square	Square Offices	Traffic Fountain Children
3	Cheongye Plaza	Office Relaxation	Traffic Footsteps, Speech Stream
4	Cheongyecheon	Relaxation	Traffic Footsteps Speech, Stream



Figure 2. Pictures of selected sites

Procedure

Soundwalking was conducted in Seoul on November in 2009. Fifteen subjects comprised of seven domestic and eight foreign experts in the soundscape studies evaluated urban soundscape through questionnaires during the walk for around one hour. As shown in Figure 3, the soundwalk was began at the department store and finished at Cheongyecheon. During the soundwalking, audio-visual recording were conducted by using field recoder (Fostex, FR-2) with a binaural microphone (B&K, Type 4101) and a video camera (Sony HDV V-1). A steady camera, stabilizing mount for motion pictures, was also used in order to minimize a shake so that it could offer smooth shots although operator was moving quickly.



Figure 3. Route of sound walk

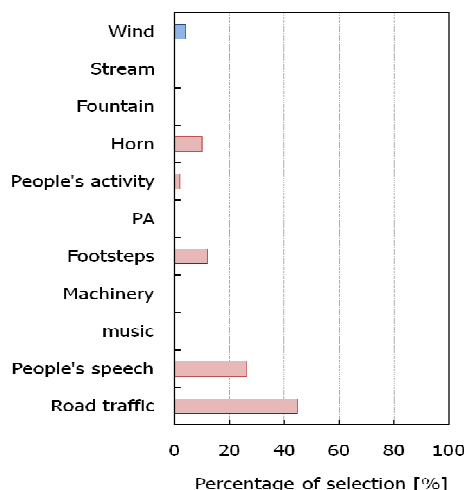
QUESTIONNAIRE

Questionnaire was constructed on the basis of the context of the soundscape in blocks group. The questionnaire consists of four sections. In the first section, it was asked to describe recognized sounds at each site. The second section sought to obtain the preference to physical conditions of urban soundscape such as visual images, natural brightness, fragrances and odors and reverberance. All of the questions in second section were evaluated by using an 11-point numerical scale (with 0 as 'not at all' and 10 as 'extremely'). In the third section, the preferences of overall soundscape and acoustic comfort at each site were assessed. The last fourth section dealt with demographic data (age, gender). Frequency of visiting to urban spaces and noise sensitivity were also evaluated by using 11-point numerical scale.

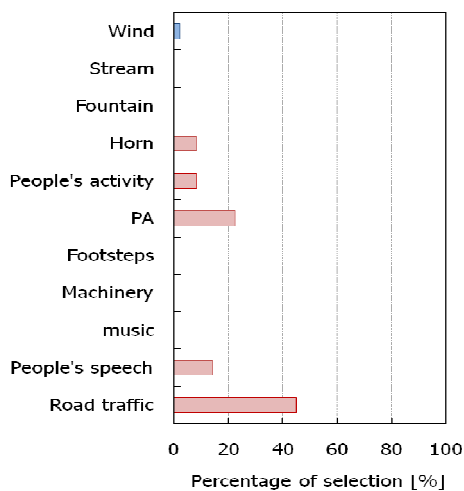
RESULTS

Percieved sound

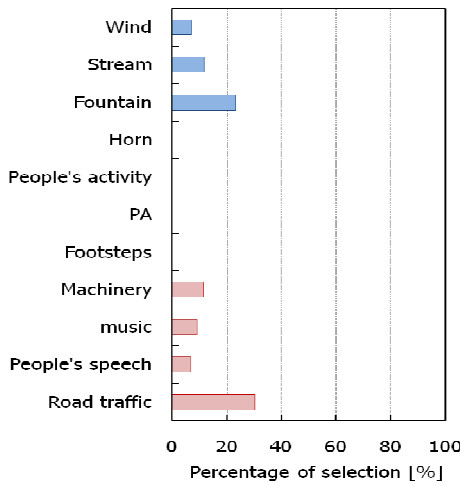
The percentages of sound sources recognized at each site were shown in Figure 4. It was found that road traffic noise was the most common sound source in urban space. However, the selected sound sources were significantly different between sites 1 and 2 without water feature and sites 3 and 4 near the city stream. The percentages of natural and artificial sounds were similar at the sites 3 and 4, whereas artificial sounds such as road traffic noise were dominant at sites 1 and 2.



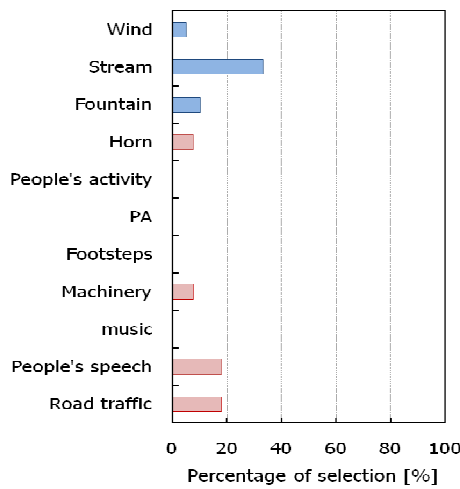
(a) Site 1



(b) Site 2



(c) Site 3



(d) Site 4

Figure 4. Perceived sounds at each site

Evaluation of contexts

Figure 5 shows the evaluation results in terms of contexts at each site. Site 4 with city stream obtained higher subjective rating than others in every context while site 1, department store, showed lower rating than others. It can be seen that the sites with water features such as streams and fountains have rated relatively higher than the site where mainly consists of artificial factors such as buildings and streets. And Site 2, an open urban square in downtown, was evaluated best place in terms of natural brightness.

Correlation coefficients between overall impression and contexts are listed in Table 2. The results show that fragrances and odors as well as acoustic comfort were highly correlated with overall impression of soundscape while visual image, natural brightness and reverberance were not.

Table 2. Correlation coefficients between overall impression and contexts (**p>0.01)

Visual image	Natural brightness	Fragrances and odors	Reverberance	Acoustic comfort
0.24	0.20	0.52**	0.15	0.36**

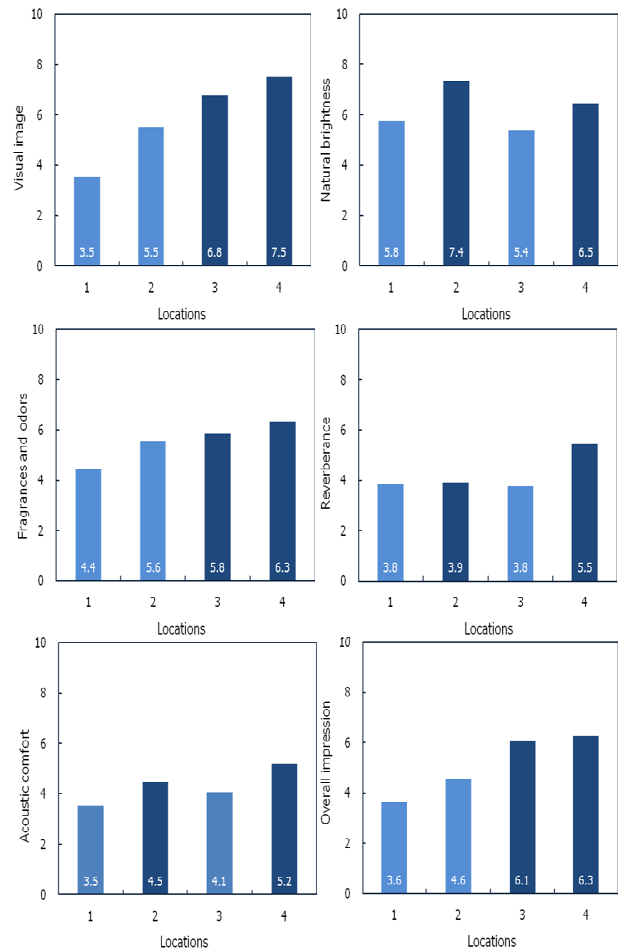
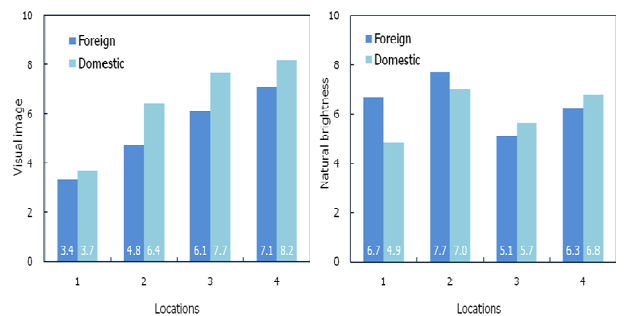


Figure 5. Evaluation results of contexts

Responses from domestic and foreign experts

Comparison of responses from domestic and foreign experts was carried out through the T-test in respect of contexts. Figure 6 presents the results of domestic and international subject's responses in terms of contexts. From the result of T-test, the response differences between domestic and international subjects were significant in terms of fragrances and overall impression of soundscape. The results imply that personal and cultural contexts could affect the perception of soundscape. For instance, Koreans might more prefer city stream crossing the downtown due to lack of natural features in city than international participant who mainly live in Europe. Acoustic comfort also could be perceived differently in accordance with cultural properties such as languages and familiarity with locations.



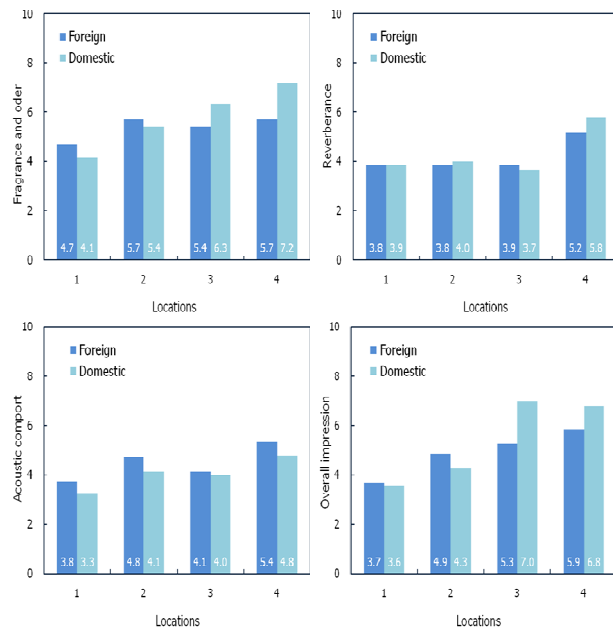


Figure 6. Evaluation results of contexts between domestic and foreign subjects

SUMMARY AND FURTHER STUDIES

In this study, soundwalking was carried out to assess urban soundscape and to investigate the effect of contexts on perception of soundscape. The results showed that fragrances and acoustic comfort were the dominant factors affecting overall impression of soundscape. In addition, it was found that the differences between responses of domestic and foreign subjects were statistically significant in respects of fragrances and overall impression. In the future, laboratory experiments will be conducted to investigate the effects of acoustic environment and visual images on perception of soundscape.

REFERENCES

- 1 Raimbault et al, "Ambient sound assessment of urban environments: field studies in two French cities" *Applied acoustics*. **64**, 1241-1256 (2003)
- 2 Raimbault and Dubois, "Urban soundscapes: Experiences and knowledge" *J. cites*. **22**, 339-350 (2005)
- 3 Mats E. Nilsson and Birgitta Berglund, "Soundscape Quality in Suburban Green Areas and City Parks", *Acta Acustica*. **92**, 903-911 (2006)
- 4 W. Yang, and J. Kang, "Acoustic comfort evaluation in urban open public spaces" *Applied acoustics*. **66**, 211-229 (2005)
- 5 J. Kang and M. Zhang, "Semantic differential analysis of the soundscape in urban open public spaces" *Building and Environment* **45**, 150-157 (2010)
- 6 Jeon J. Y.; Lee P. J.; You J.; Kang J. "Perceptual assessment of quality of urban soundscapes with combined noise sources and water sounds", *J. Acoust. Soc. Am.* **127**, 1357-1366 (2010)
- 7 Semidor, "Listening to a City With the Soundwalk Method", *Acta Acustica*. **92**, 959-964 (2006)
- 8 M Adams and N Bruce, "Soundwalking as methodology for understanding soundscape", *Proceedings of the Institute of Acoustics*. **30**, Pt.2 (2008)