Relationship between soundscapes and landscape factors in urban commercial spaces

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ABSTRACT
This study aims to explore the relationship between soundscape and landscape factors in commercial spaces. Commercial pedestrian streets in Seoul, Korea were selected in order to include various sound and visual elements in urban commercial spaces. In site evaluation of soundscape were performed in the case study areas. Perceptual and physical acoustic environments in the commercial area were assessed using both questionnaire surveys and acoustic measurements. In terms of landscape factors, urban morphological indices and event density of street were calculated to analyze the visual environments and behavioral characteristics of pedestrians in commercial area. Based on the field measurement data, the effects of landscape factors on soundscape perception in urban commercial streets were examined.

Keywords: Soundscape, Urban commercial streets, Pedestrian streets, Acoustic quality

I-INCE Classification of Subjects Number(s): 56.3

1. INTRODUCTION
According to the Kevin Lynch’s work, the image of the city, people capture dominant city images in mental representations consisting of five basic elements: paths, edges, districts, nodes, and landmarks (1). Among the five elements, paths such as streets and sidewalks are common urban open space that city dwellers usually experience in their daily lives. In addition, there are various urban activities in commercial pedestrian streets which play important contexts affecting the quality of streetscapes (2). Many studies to enhance the comfort and safety of commercial pedestrian streets (3,4,2). There are a few studies on soundscapes in pedestrian streets although soundscapes are closely related to the perceived commercial pedestrian streets quality (5–7). In addition, non-acoustic factors such as vision, odor, temperature and daylight directly or indirectly affect perceived soundscapes. In particular, landscape factors are significantly associated with soundscape perceptions (8–12). The relationship between landscape and soundscapes should be taken into account for soundscape planning. Thus, the aims of this study are to investigate the soundscape characteristics in urban commercial pedestrian streets and to explore the association between soundscape and landscape factors in commercial spaces.

2. METHOD
2.1 Site selection
Eight commercial pedestrian streets in Seoul, Korea were selected for this study as shown in Figure 1. The case study areas were chosen considering various urban morphologies and main functions. In terms of urban morphology, road width and building height were varied across the selected pedestrian streets. The streets are classified into two group in terms of main functions of spaces: pedestrian streets in 1) office districts and 2) shopping districts to investigate the influence of space functional aspects on soundscapes. The pedestrian streets (JG, TH, SC, and UJ) are located in the office districts, while the pedestrian streets (IS, MD, GN, GR) were classified in to shopping streets.

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2.2 Evaluation of soundscape and landscape

Soundscape at each commercial pedestrian street was evaluated using questionnaire. The questionnaire was designed based on previous studies (8,13,14) to identify perceived sound sources and to access soundscape and landscape quality. Identified sound sources were evaluated regarding four types of sounds: traffic noise, technological sounds, human-made sounds, and natural sounds using 5-point scale (0: “Do not hear at all” and 4: “Dominates completely.”). Soundscape perceptions including pleasantness and eventfulness were assessed using adjective attributes: pleasant and eventful. Regarding landscape factors, perceived crowd density and overall quality of streetscape were evaluated. The soundscape and landscape attributes were evaluated using a 5-point Likert scale. (0: disagree strongly and 4: agree strongly)

2.3 Procedure

Soundwalk evaluations were carried out in May, 2016, to measure the physical and perceptual data of soundscape in the urban commercial streets. The soundwalks were conducted during daytime in weekdays and weekend. Twenty participants took part in soundwalk evaluation at each street. Perception of sound environment were evaluated using smart phones based on the google survey service. During the soundwalks, sound environment were recorded for 5-minutes using binaural microphone (B&K, Type 4101) and a portable field recorder (Zoom, H4n).

3. RESULTS

Mean values of soundscape perceptions including pleasantness and eventfulness are plotted in Figure 2. It was found that the locations including GN, GR and MD obtained high values of both pleasantness and eventfulness, where are mainly shopping streets. The office streets such as TH and SC had lower eventfulness scores. This indicates that there are relatively lower sound events in office districts compared to shopping streets. These finding shows that soundscape characteristics can differ depending on main functions of spaces and human activities in the areas.
Relationships between soundscape and perceived crowd density are illustrated in Figure 3. Weak correlation was found between pleasantness of soundscape as shown Figure 3a, while eventfulness of soundscape showed strong correlation with perceived crowded density as shown Figure 3b. This demonstrates that crowd density in at street significantly influence eventfulness of soundscape. Figure 4 shows the relationship between soundscape and overall quality in pedestrian streets. It was revealed that there was no significant relationship between eventfulness of soundscape and overall quality of environment, whereas pleasantness values were moderately correlated with overall quality of commercial streets. This finding implies that creating pleasant soundscape is critical to improve overall quality of streetscape in urban spaces.

![Relationships between soundscape and perceived crowd density](image1)

![Relationships between soundscape and perceived crowd density](image2)

Figure 3 – Relationships between soundscape and perceived crowd density

Figure 4 – Relationships between soundscape and perceived crowd density

### 4. CONCLUSIONS

Soundscape in commercial streets in urban areas were assessed by conducting soundwalks. The selected urban pedestrian streets showed large variation of soundscape in terms of pleasantness and eventfulness. It was found that eventfulness of soundscape showed significant association with perceived crowd density, while relatively weak correlation was found between pleasantness of soundscape and crowd density in commercial streets. In addition, it was revealed that pleasant sound environment is closely related to overall impression of urban pedestrian streets. This support that acoustic comfort contribute to improve the amenity of commercial pedestrian streets. In the future, in-depth relationship between soundscape and landscape factors in the commercial pedestrian street will be analyze based on the survey and acoustic measurement results.
REFERENCES