Factors influencing the sound preference in urban open spaces

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ABSTRACT

In this paper, based on a large scale survey in Europe and China as well as corresponding laboratory studies, the influencing factors on the sound preference evaluation, considering social, demographical, physical, behavioural and psychological facets, have been systematically examined based on statistical analyses for each of the 19 case study sites. Various sound types have been considered, including natural, human, mechanical and instrumental sounds. In terms of social/demographical factors, the results suggest that age and education level are two factors which universally influence the sound preference significantly, although the influence may vary with different types of urban open spaces and sounds. With increasing age or education level, people tend to prefer natural sounds and are more annoyed by mechanical sounds in general. It has also been found that gender, occupation and residence status generally would not influence the sound preference evaluation significantly, although gender has a rather strong influence for certain sound types such as bird sounds, especially at certain case study sites. In terms of physical factors (season, time of day), behavioural factors (frequency of coming to the site, reason for coming to the site), and psychological factors (site preference), generally speaking, their influence on the sound preference evaluation is insignificant, except for limited case study sites and certain sound types. The influence of home sound environment, in terms of sounds heard at home, on the sound preference has been found to be generally insignificant, except for certain sounds. It is noted that there are some correlations between social/demographical factors and the studied physical/behavioural/psychological factors, which should be taken into account when considering the influence of individual factors on sound preference.

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1. Introduction

With the renaissance of city centres, urban open spaces are re-conceptualised with the new 'urbanity' [1]. In order to create a friendly environment, rethinking the urban open spaces from an ecological viewpoint is important [2]. Sound quality is considered as a key part of ecological/sustainable development of urban open spaces [3,4]. Soundscape, also called acoustic landscape, is simultaneously a physical and a social environment when one perceives the environment with his/her hearing, where a sound is a basic element in the 'scape' [5]. This 'scape' physically consists of the sounds, the energy waves, the listeners, and the listener's social circumstances, dictating who gets to hear what [6–11]. Subjective effects of soundscape rely on the perceptions to acoustic phenomena through a cognitive process in which two concepts are used: sounds and noises [12]; it is essential to determine aesthetic satisfaction of an aural 'scape' [13,14]. In many soundscape-related studies, the general evaluation of a soundscape is usually considered as sound level evaluation, namely subjective evaluation of

loudness, normally for background noise [15–20], and as sound preference evaluation, namely the evaluation of foreground sounds [10–12,21,22]. As basic components, individual sounds are important in the whole soundscape [23]. The evaluation of the sound preference is therefore crucial to determine soundscape quality in a specific space.

With ever increasing community noise since industrial revolution, a large number of studies in examining noise annoyance and noise effects on health have been carried out [15–17]. Recently, accounting for meaningful acoustic environments, issues of sound identification and its effects on aural perceptions have been brought forward with a cognitive or ecological approach [12]. However, the study on the sound preference, especially in urban open spaces, has been rather limited, although it has been suggested that the sound preference is affected by various factors from both physical and social aspects [24–26]. In our previous study [13,14], the sound preference was investigated in some typical urban squares, as a part of an overall soundscape research. In the investigation presented in this paper, however, a more systematic analysis has been made based on case studies in nineteen urban open spaces in Europe and China as well as on laboratory experiments.

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Environmental psychologists pointed out that the implicit attributes of social/cultural factors and the explicit attributes of physical surroundings are interrelated to affect people's perception of a physical sound [27,28]. Therefore, the study of the sound preference evaluation is mainly to explore the relationships between the preference of a sound and the implicit and explicit attributes. Unlike the preferences of musical listening which focus on the sound itself, the judgement of everyday sound listening is to gather relevant information about our surrounding environment [11]. In this study, the influencing factors on the sound preference evaluation, considering social, demographical, physical, behavioural and psychological facets, have thus been systematically examined based on a series of large scale field surveys. The influences of those factors on the sound level evaluation have also been examined in a parallel paper [29]. It is expected that the results are useful for soundscape design in urban open spaces, and also helpful for formulating input variables for a soundscape prediction model based on artificial neural networks [30–33].

2. Methodology

2.1. Field survey

From 2001 to 2005, a series of field studies were carried out in 14 European and five Chinese urban squares. The case study sites were selected from nine cities in six countries, namely Bahnhofsplatz, Germany Kassel (site 1); Florentiner, Germany Kassel (site 2); Karaiskaki, Greece Athens (site 3); Seashore, Greece Athens (site 4); Kritis, Greece Thessaloniki (site 5); Makedonomahon, Greece Thessaloniki (site 6); IV Novembre, Italy Milan (site 7); Piazza Petazzi, Italy Milan (site 8); Jardin de Perolles, Switzerland Frobourg (site 9); Place de la Gare, Switzerland Frobourg (site 10); All Saint's Garden, UK Cambridge (site 11); Silver Street, UK Cambridge (site 12); Barkers Pool, UK Sheffield (site 13); Peace Gardens, UK Sheffield (site 14); Chang Chun Yuan Square, China Beijing (site 15); Xi Dan Square, China Beijing (site 16); Century Square, China Shanghai (site 17); Nanjing Road Century Square, China Shanghai (site 18); and Xu Jia Hui Park, China Shanghai (site 19). The case study sites represented a variety of microclimatic and macroclimatic conditions, a diversity of urban square types, and a range of cultural backgrounds. The interviewees were from a range of social groups in terms of their age, gender, occupation, education level and residential status (local or non-local).

Information gathered through the questionnaire surveys and observations included the interviewees' social/cultural background, their activities and behaviours on site, the sounds they identified, and their sound preferences. The acoustic questions were generally introduced as a part of the investigation of the overall physical environment, to avoid possible bias. Objective mea-

surements of the sounds were also made and other physical conditions of the surroundings were recorded during the interviews. A database was consequently established, with variables of social attributes including age (1: <12; 2: 12–17; 3: 18–24; 4: 25–34; 5: 35–44; 6: 45–54; 7: 55–64; 8:>65); gender (male and female); occupation (students, working people and others, such as unemployed and pensioners); education (primary, secondary and higher level); residential status (local and non-local); sounds often heard at home (bird, insect, speaking, music, and traffic), preference of the site (like the site or do not like the site for certain reasons), frequency of coming to the site (first time, per year, per month, per week, per day for EU sites; and first time, occasionally, sometimes, often, daily for Chinese sites); and reason for coming to the site (for the equipment/services of the site, for children playing and private meetings, for business/meeting/break, for attending social events, passing by). Also included in the database were some physical attributes including season and time of day during the interviews, which were found to be related to noise evaluation in previous studies [34,35]. In Table 1 the above factors and their categorisations and scales are summarised. Wherever appropriate, numerical scales were used in the questionnaires along with the categorical scales. The frequency analyses showed that normal distribution was generally followed for the factors studied at each case study site.

In Table 1 it can be seen that three categories are assigned to education. Education is a broad concept, referring to all the experiences in which a person could have learned, and it is an important part of socialisation [36]. While the comparison between people with different education backgrounds is rather complicated, in this study a comparison has simply been made between different education levels. Generally speaking, there are three levels, namely primary, secondary and higher education despite the disparity of adult and alternative education in which no distinct difference exists from low to high level [36]. For occupation, in the surveys a range of categorisations were used. However, considerable differences were found between different cities and countries in terms of the definitions and categorisations of occupations. In order to make comparisons within a common framework, occupations were then re-arranged to form three categories. In terms of the reason for coming to the site, similarly, the survey results were also re-arranged from nine to five categories, given the differences between case study sites, and small sample sizes in certain categories and case study sites.

The questions were initially developed in English, and then translated into other languages. Since the surveys were carried out over five years, in several phases, some slight modifications were made in the questionnaire design. For example, in the surveys in China the question about the sounds often heard at home was added, but the site preference was not asked.

Table 1
Factors studied and their categorisations and scales.

Factors	Categorisation and scale
Season	1 – winter; 2 – autumn; 3 – spring; 4 – summer
Time of day	1 – morning: 9.00 am–11.59 pm; 2 – midday: 12.00–14.59 pm; 3 – afternoon: 15.00–17.59 pm; 4 – evening: 18.00–20.59 pm; 5 – night: 21.00 pm–8.59 am
Frequency of coming to the site	Scales 1–5: 1 = first time; 5 = every day
Reason for coming to the site	1 – equipment/services of the site; 2 – children playing and private meetings; 3 – business/meeting/break; 4 – attending social events; 5 – passing by
Age	1: <12; 2: 12–17; 3: 18–24; 4: 25–34; 5: 35–44; 6: 45–54; 7: 55–64; 8: >65
Gender	1 – male; 2 – female
Occupation	1 – students; 2 – working people; 3 – others (e.g. unemployed and pensioners)
Education level	1 – primary; 2 – secondary; 3 – higher level
Residential status	0 – non-local; 1 – local
Site preference	0 – do not like the site for certain reasons; 1 – like the site
Home sound environment	Bird, insect, speaking, music, traffic