

TOWARDS GUIDELINES FOR SOUNDSCAPE DESIGN

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Architects and urban planners request guidelines with regards to soundscape design. In 2013 staff and students at the University of Sheffield, UK, were invited to take part in an electronic survey to investigate what kinds of urban open spaces that they prefer, and how these spaces should be designed with regards to soundscape. Respondents were asked to freely name their favourite outdoor place in Sheffield, and to what extent they found a list of 45 social and recreational activities, as well as a list of 40 sound sources appropriate for this place. A total of 935 individuals completed the questionnaire. A hierarchical cluster analysis of the 45 social and recreational activities revealed three main categories of favourite outdoor places: 'Urban Park', 'City Centre', and 'My Space'. For 'Urban Park' natural sounds were appropriate when clearly audible, sounds of individuals when moderately audible, sounds of crowds when slightly audible, and technological sounds when inaudible. For 'City Centre' sounds of individuals were appropriate when moderately audible, whereas natural sounds, and sounds of crowds were appropriate when slightly audible. Technological sounds were appropriate when inaudible. For 'My Space' natural sounds and sounds of individuals were appropriate when moderately audible, whereas sounds of crowds and technological sounds were appropriate when inaudible. This kinds of profiles may serve as design guidelines for urban outdoor spaces with regards to soundscape, based on their social and recreational purposes.

Keywords: soundscape, urban design, guidelines

1. Introduction

In 2010 I organised the international conference *Designing Soundscape for Sustainable Urban Development* in Stockholm, Sweden (Axelsson, 2011). The purpose was to introduce soundscape to architects and urban planners, and to discuss how soundscape may be implemented in these creative disciplines. A number of internationally renowned architects and planners were invited to present their thoughts on soundscape. Still, in the final panel discussion and in the evaluation of the conference, participants requested further information on how to approach soundscape in practice. To bring this work forward, I organised a special session on soundscape at the annual conference of the Association of European Schools of Planning (AESOP) in Ankara, Turkey, 2012. Also here, participants in the session requested further practical guidance on how to approach soundscape. A specific request concerned soundscape design guidelines. The present paper is an attempt to meet this need.

The environmental planner Lex Brown, Griffith University, Brisbane, Australia, has argued that soundscape quality is a matter of the match between the soundscape and a place, and particularly whether the soundscape enables desired activities (e.g., Brown & Muhar, 2004). This notion was one of my inspirations when I, in collaboration with the Noise Abatement Society, tried to map the soundscape of urban outdoor areas in Brighton & Hove, UK, in 2011, in order to develop an applied soundscape strategy for the city (Lavia, Axelsson & Dixon, 2012). Another source of inspiration was the Sociotope Mapping that the City of Stockholm developed in the early 2000s in order to better understand the human scale of urban outdoor space (Ståhle, 2002, 2003, 2006). Sociotope Mapping involves investigating what social and recreational values the citizens associate with specific places. This knowledge is used to avoid goal conflicts in the planning process.

In order to map the soundscape of urban outdoor areas in Brighton & Hove, I and the Noise Abatement Society developed an on-line questionnaire. It was circulated to local interest groups with support from the Brighton & Hove City Council. Among other things the questionnaire asked the respondents to name their favourite outdoor place in Brighton & Hove, and to assess to what extent a list of 27 social and recreational activities would be appropriate for this place. The respondents were also asked to assess to what extent a list of 29 sound sources would be appropriate in their favourite place (Lavia, Axelsson & Dixon, 2012). This is a similar approach as used when Sociotope Mapping was introduced in Stockholm.

In total, 354 individuals, 15 years or older, completed the soundscape questionnaire in Brighton & Hove. Using hierarchical cluster analysis, 5 categories of favourite outdoor places, as well as 5 categories of soundscapes, were identified. A Chi Square analysis showed that there was a statistically significant and meaningful relationship between the 5 categories of favourite outdoor places and the 5 categories of soundscapes.

A similar approach as used in Brighton & Hove would be useful for creating soundscape design guidelines, by focusing on categories of favourite outdoor places and what sounds would be appropriate there. In the present paper I present a study conducted in Sheffield, UK, in 2013, in which I used an improved version of the questionnaire used in Brighton & Hove.

2. Method

2.1 Participants

Staff and students at the University of Sheffield were invited to take part in the study through the established email lists for staff and student volunteers. A total of 1,437 persons began the questionnaire, while 935 (65 %) completed it. Among the 935 persons who completed the questionnaire 598 were females and 337 were males; 529 were aged 15–34 yrs, 389 aged 35–64 yrs, and the remaining 17 were 65 yrs or older. With regards to occupation, 530 were employed or self-employed, 379 were students, the remaining 26 were retired, unemployed, long-term sick, or on leave. Although the participants virtually lived all across Sheffield, areas close to the University of Sheffield were clearly over represented.

2.2 Questionnaire

The online questionnaire was an improved version of the questionnaire used in Brighton & Hove in 2011. It consisted of four sections. Section 1 concerned demographic data, such as the postcode of the area where the respondents lived, gender, age, as well as occupation. To allow respondents the opportunity to register complaints about noise, Section 2 concerned noise annoyance. It was based on the ISO/TS 15666 question with verbal rating scale (ISO, 2003), with the amendment that the response category 'Not at all' was divided into the two response categories 'Not at all (don't hear it)' and 'Not at all (hear it but not bothered by it)'. Section 2 also included a few questions on sensitivity to sound. In Section 3 the respondents were asked to name their favourite outdoor place in Sheffield, and to indicate to what degree a list of 45 social and recreational activities would be suitable in this place (5-point category scale: 'Not at all/not applicable', 'Slightly', 'Moderately', 'Very', 'Perfectly'). In Section 4 the respondents were asked to indicate to what degree a list of 40 sound sources would be appropriate in the favourite place (5-point category scale: 'Not audible', 'Slightly audible', 'Moderately audible', 'Clearly audible', 'Completely dominant'). The two lists of social and recreational activities, and sound sources were extended based on open-ended responses obtained in Brighton & Hove in 2011.

3. Results

3.1 Favourite outdoor places

The 45 variables of social and recreational activities were subjected to a hierarchical cluster analysis, using Squared Euclidean Distances and the Furthest Neighbour (Complete Linkage) algorithm (SPSS 22 for Windows). The improvement of the agglomeration coefficients suggested that it would be reasonable to select 3, 5 or 7 clusters of favourite outdoor places in Sheffield. Cross Tabulation of the three different cluster solutions against the name of the favourite outdoor places showed that the 3-clusters solution provided enough detailed information.

Cluster 1 was named ‘Urban Park’. This is the sort of place where people go to enjoy the surroundings, to hang out with friends and family, go for a walk, let the children play, or to play informal games, like Frisbee or Rounders, or to have a picnic or a barbeque.

Cluster 2 was named ‘City Centre’. This is where people go to enjoy active street-life together with their friend. The 5 and 7-clusters solutions suggested that Cluster 2 in the 3-clusters solution could be split into two sub-clusters: one representing areas for outdoor dining, like a sitting out area of a restaurant or a pub, and one representing enjoying active street life and shopping. However, these two potential sub-clusters were only a matter of the degree to which certain city centre activities were given priority. In the first of the two potential sub-clusters, people gave priority to having something to eat or drink together with their friends, whereas in the other people gave priority to experiencing active street life. Thus, Cluster 2 in the 3-clusters solution represents a combination of these two potential sub-clusters.

Table 1. The five sound-source variables most strongly associated with each of the four variamax rotated components.

Technological Sounds	Natural Sounds	Sounds of Individuals	Sounds of Crowds
Construction	Rustling leaves	People talking	Buskers
Industry	Insects	People enjoying themselves	Outdoor events
Waste collection	Birdsong	People calling out	Non amplified music
Sirens/alarms	Wind	Children at paly	Amplified music/ announcements
Ventilation	Wildlife	People walking	Sporting events

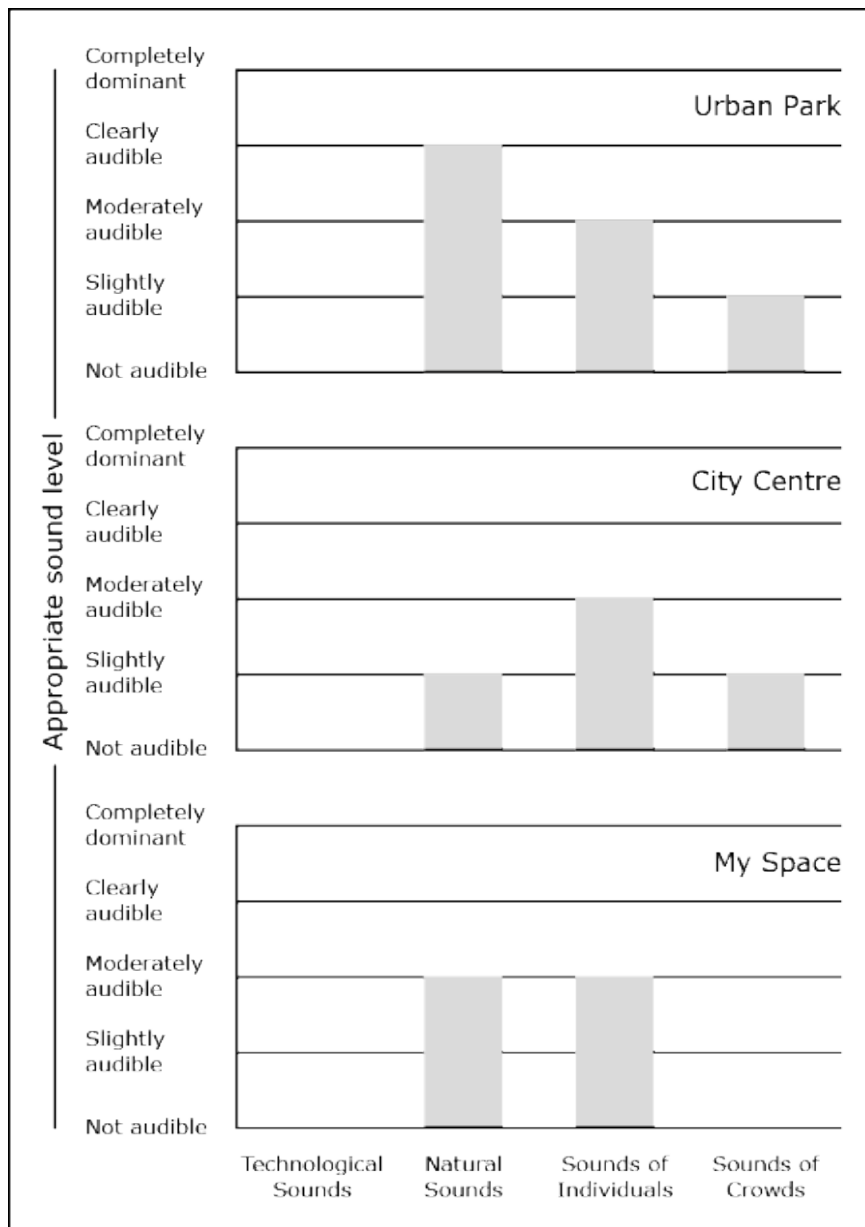


Figure 1. Soundscape profiles of 'Urban Park', 'City Centre' and 'My Space'.

Cluster 3 was named 'My Space'. This is where people go to withdraw from crowded areas and to escape the city stress. A typical place in this category was 'My own garden' or 'My allotment'. In Sheffield 'My Space' could also be found in one of the city's many parks or green areas, or the Peak District National Park.

3.2 Sound source components

Because it was impractical to work with 40 variables of sound sources, it was decided to reduce them by the aid of a Principal Components Analysis. Using the matrix of Pearson correlation coefficients, and Eigenvalues larger than 1.0 as criteria, it turned out that there was a small number of deviant

sound-source variables in the set of data, creating a rather indistinct set of principal components. After removing five such sound-source variables, the analysis resulted in four clear varimax rotated components. They explained 26.4, 17.2, 6.2 and 4.1 % of the variance (53.9 % in total). The four varimax rotated component were named ‘Technological Sounds’, ‘Natural Sounds’, ‘Sounds of Individuals’, and ‘Sounds of Crowds’ (see Table 1).

3.3 Soundscape profiles

Soundscape profiles were created for each of the 3 clusters of favourite outdoor places. For the four varimax rotated components of sound sources, the five sound-source variables with the strongest association with each component were selected to form indices, based on their median values. Table 1 presents these five sound-source variables for each of the four variamax rotated components. Figure 1 presents the soundscape profiles for each of the three clusters of favourite outdoor places. The values on the Y-axes are median values calculated across the five sound-source variables for each of the four variamax rotated components, representing appropriate sound levels.

Figure 1 shows that the appropriateness of natural sounds varied with the type of place. For ‘Urban Park’ natural sounds were appropriate when clearly audible, whereas for ‘My Space’ they were appropriate when moderately audible, and for ‘City Centre’ when slightly audible. The sounds of individuals were appropriate at a moderate level in all three sorts of places, while the sounds of crowds were appropriate when slightly audible, except for ‘My Space’ where the sounds of crowds were unacceptable. Technological sounds were unwelcome in all of the three types of places, also in the city centre of Sheffield.

4. Discussion

Architects and urban planners are requesting guidelines to soundscape design. In the present paper I propose an approach involving defining a place based on its social and recreational values, and identifying what sounds are appropriate in the place and to what extent. In the present case I conducted an electronic survey among staff and students at University of Sheffield in the UK, asking them to name their favourite outdoor place in Sheffield. They were also asked to assess to what extent a list of 45 social and recreational activities, as well as a list of 40 sound sources would be appropriate in their favourite place. Through a cluster analysis of the list of 45 social and recreational activities, I identified three types of places, named ‘Urban Park’, ‘City Centre’, and ‘My Space’. For each of the three types of places I created soundscape profiles based on the list of 40 sound sources.

The three soundscape profiles presented in Figure 1 may serve as soundscape design criteria for these sort of places in Sheffield. For example, the top panel in Figure 1 suggests that if the City of Sheffield would like to create a new urban park, it should aim to create a lush, green space that promotes the sound of nature, including wind in vegetation and singing birds. The park should be located at a safe distance from surrounding roads and industrial areas to avoid technological sounds. The park must allow individual human activities, like walking, jogging, informal games, picnic and barbeque, without forming large crowds of people.

A potential limitation in the present approach to soundscape design is that it is based on human memory and imagination. An alternative would be to invite people to a laboratory where the soundscapes can be reproduced or simulated. The participants could then either assess reproduced soundscapes or create their own ideal soundscapes. Soundscape design guidelines based on such experiments might be more detailed.

In the present study the participants expressed that technological sounds are unacceptable in any place, but what does this actually mean. Would there be a sound level at which, for example, road traffic is acceptable although it may be heard in the background?

In a study in Stockholm it was found that 80 % of the visitors in parks and green areas rated the soundscape as ‘Good’ or ‘Very good’ when the sound levels from road traffic was at or below 50 dB(A) (Nilsson, 2007). Probably such a sound level cannot be considered as equal to ‘Not audible’, but to correspond to ‘Slightly audible’. So, perhaps, in reality, people would accept another sound level than what they would imagine. Possibly the appropriate sound levels could be identified more accurately in a laboratory study. On the other hand, it would be laborious and impractical to survey a whole city with this method.

Another potential limitation in the present approach is that it relates to a general and overall scale, giving the impression that all areas under ‘Urban Park’ should be the same throughout. This is probably not the case. It is more likely that a large urban open space should provide a diversity of social and recreational activities, and corresponding soundscapes. For example, among the 149 participants who mention the Sheffield Botanical Gardens as their favourite place, 76 responses fell in the category ‘My Space’, 60 in ‘Urban Park’ and the remaining 13 in ‘City Centre’. Thus, the present approach to soundscape design provides us with rules of thumb, not detailed roadmaps to every destination.

A specific limitation with the present study is that it only concerns Sheffield in the UK, and mainly involved staff and students at the University of Sheffield. The results must not be generalised to any other city, not even within the UK. More studies of this kind are needed to learn how this approach to soundscape design may be implemented in practice. In particular it would be interesting to conduct a survey with a representative sample of the population in a city.

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