A cross-cultural semantic differential analysis of the soundscape in urban open public spaces

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Abstract: A series of comparative field surveys were carried out in four urban open public spaces, two in Sheffield, UK and two in Beijing, China. The semantic differential method was applied to determine key factors that characterise the soundscape. It has been shown that whilst the soundscape evaluation in urban open public spaces is rather complicated, it is still possible to identify several major factors, including relaxation, communication, spatiality and dynamics, and these factors are common for both UK and Chinese situations, although in terms of the order of factors and the indices included in each factor there are differences between the two countries. It is interesting that these four factors cover the main facets of designing the acoustics of an urban open public space: function (relaxation and communication), space, and time, although the typical coverage of the total variance is only about 50-60%, indicating the complicated features of soundscapes of urban open public spaces. Analyses based on individual seasonal periods and individual case study sites show that the above four factors can still be identified. The general soundscape evaluation shows that both in the UK and China, although people may feel the sound environment is noisy/loud, they could still find it acoustically comfortable, unless a site is dominated by high level unpleasant sounds such as traffic.

Key words: soundscape; urban; open public space; semantic differential analysis; culture

城市公共开敞空间中的声景语义细分法分析的跨文化研究

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摘要: 本文通过一系列问卷调查,运用语义细分法,对两个在英国谢菲尔德、两个在中国北京的四个城市公共开敞空间进行了比较研究,旨在找出城市公共开敞空间中声景的决定因子。研究发现,尽管城市公共开敞空间中的声景评价很复杂,但仍有四个主要的决定性因子:放松、交流、空间性和动态性。这四个因子在中英的案例中很相似,不过就因子的顺序及各因子所包含的评价指标而言,两国之间尚有一定差异。有趣的是,这些因子涵盖了设计城市公共开敞空间声学的主要层面:功能(放松和交流)、空间和时间。不过,这四个因子仅覆盖了总变量的约 50-60%,由此显示了城市公共开敞空间中声景的复杂特点。对不同季节及不同广场的数据进行的分析表明,上述四个决定因子仍然明显。另外,从对英国和中国广场的声景评价中均可看出,即使人们在公共开敞空间中感到很吵闹,而声舒适程度仍然可能较高,除非广场由高声级的、令人不快的声音所主导,例如交通噪声。 关键词: 声景;城市;公共开敞空间;语义细分法;文化

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1 INTRODUCTION

Soundscape and acoustic comfort is an important part of the overall physical comfort in urban open public spaces, which are vital components of modern cities[1-3]. Being different from conventional noise reduction, research in soundscape and acoustic comfort concentrates on the way that people consciously perceive their environment[4], namely the interactions between people and sounds. Recent research shows that reducing noise level does not necessarily lead to a better acoustic comfort in urban areas[5]. Whilst most existing soundscape investigations have dealt with relatively large urban or rural areas, studies relating to urban open public spaces have been limited[6]. Since the soundscape in urban open public spaces is a rather complex system, relating to physical, psychological, social, and cultural aspects, it is important to identify key factors which characterise the soundscape[7].

The semantic differential technique, developed by Osgood et al[8] in order to identify emotional meaning of words, has been extended to a variety of concepts. It has also been proved to be a useful method to identify the most important factors in evaluating sounds. For product sound quality, three main factors, powerful, metallic and pleasant, have been suggested[9]. For general urban environment sounds, the technique has been used to analyse connotative and denotative meanings, and it has been suggested that evaluation, timber, power and temporal change are four essential factors[10]. For residential areas, the soundscape can be characterised in four dimensions-adverse, reposing, affective and expressionless[11].

The effects of cultural aspects on the evaluation of sound have been demonstarted through a number of cross-cultural studies[12-14]. A study on the key factors of evaluating environmental sound quality in Japan, Germany, USA and China, using semantic differential analysis, has demonstrated notable differences between the four countries[12].

The main objective of this study is to identify factors that characterise the soundscape in urban open public spaces through semantic differential analysis, especially consiodering the cultural context. This paper first describes the methodology of a series of field surveys in the UK and China. After a brief analysis of the general soundscape evaluation, the paper then concentrates on the semantic differential analysis.

2 METHODOLOGY

A series of semantic differential indices were compiled based on previous research relating to urban soundscape as well as product sound qua-lity[10,15-16], and also considering the actual situations to be studied, such as close-far, social-unsocial, safe-unsafe, friendly-unfriendly, happy-sad and like-dislike. A 7-point bipolar rating scale was used. The indices are shown in Table 1, where both connotative meanings of urban environment sounds, such as calming-agitating, interesting-boring and like-dislike, and denotative meanings such as quiet-noisy, sharp-flat and smooth-rough, were included. The indices also covered various aspects of soundscape, for example, satisfaction: comfort-discomfort, quiet-noisy, pleasant-unpleasant, interesting-boring, like-dislike, calming-agitating, happy-sad and beautiful-ugly; strength: gentle-harsh, high-low, hard-soft, light-heavy and strong-weak; fluctuation: sharp-flat, directional-everywhere, varied-simple, fast-slow, echoed-deadly, far-close, smooth-rough, pure-impure and steady-unsteady; and social aspects: meaningful-meaningless, bright-dark, friendly-unfriendly, safe-unsafe and social-unsocial.

Soundscape walks are frequently used in environmental acoustics research. The general purpose is to encourage the participants to listen carefully and make judgments about the sonic environment and sounds they are experiencing. As a pilot study, a soundscape walk with 48 university students was

Table 1 Soundscape evaluation form, where unboldfaced indices were only used in the pilot study

	Extremely	Very	Little	Neutral	Little	Very	Extremely	
Calming	3	2	1	0	-1	-2	-3	Agitating
Comfor	3	2	1	0	-1	-2	-3	Discomfort
Directional	3	2	1	0	-1	-2	-3	Everywhere
Echoed	3	2	1	0	-1	-2	-3	Deadly
Far	3	2	1	0	-1	-2	-3	Close
Fast	3	2	1	0	-1	-2	-3	Slow
Gentle	3	2	1	0	-1	-2	-3	Harsh
Hard	3	2	1	0	-1	-2	-3	Soft
Interesting	3	2	1	0	-1	-2	-3	Boring
Like	3	2	1	0	-1	-2	-3	Dislike
Meaningful	3	2	1	0	-1	-2	-3	Meaningless
Natural	3	2	1	0	-1	-2	-3	Artificial
Pleasant	3	2	1	0	-1	-2	-3	Unpleasant
Quiet	3	2	1	0	-1	-2	-3	Noisy
Smooth	3	2	1	0	-1	-2	-3	Rough
Sharp	3	2	1	0	-1	-2	-3	Flat
Social	3	2	1	0	-1	-2	-3	Unsocial
Varied	3	2	1	0	-1	-2	-3	Simple
Beautiful	3	2	1	0	-1	-2	-3	Ugly
Bright	3	2	1	0	-1	-2	-3	Dark
Friendly	3	2	1	0	-1	-2	-3	Unfriendly
Happy	3	2	1	0	-1	-2	-3	Sad
High	3	2	1	0	-1	-2	-3	Low
Impure	3	2	1	0	-1	-2	-3	Pure
Light	3	2	1	0	-1	-2	-3	Heavy
Safe	3	2	1	0	-1	-2	-3	Unsafe
Steady	3	2	1	0	-1	-2	-3	Unsteady
Strong	3	2	1	0	-1	-2	-3	Weak

conducted in four representative urban open public spaces in Sheffield, including a square in front of the Sheffield University Student Union, which was semi-enclosed and near a busy road; the Devonshire Green, a large green space surrounded by low buildings and small roads; the Barkers Pool, and the Peace Gardens, both located in the city centre.

By analysing the soundscape walk results, it was found that some indices were seldom selected/evaluated, or not well-understood, so that in the next stage of the study only 18 indices were selected, as boldfaced in Table 1. With these selected semantic differential indices, soundscape evaluation was carried out in four sites, two in Sheffield, UK and two in Beijing, China.

The first Sheffield site was the Barkers Pool, located in the city centre. The rectangular square was shaped by the Sheffield City Hall and the four-story John Lewis building, one of the largest and highest quality department stores in Sheffield. The Barkers Pool itself was a pedestrian area, but on two sides of the square there were two small roads. The large steps in front of the City Hall were a popular sitting place. Main sound sources during the survey periods were light traffic, conversations, footsteps, skateboarding, wind, and more distinguishingly, street singers as well as music from surrounding buildings. Music gave a special atmosphere in the square. During 35% of the interview time, classical music from the City Hall, jazz music from a music store, or street music could be heard.

The second Sheffield site, the Peace Gardens, was surrounded by multi-story buildings and on one side there was a fairly busy road. It was one of the most popular squares in Sheffield, attracting hundreds of visitors and locals on a fine day to relax near the dramatic water features, intricate stone carvings and colourful flowers. As the most important design features in the Peace Gardens, the fountains helped to create a unique soundscape, together with the Holberry Cascades. Main sounds in this square during the survey periods included water from the fountains and cascades, traffic in distance, chatting and children's shouting. Another noticeable sound source was the noise from demolishing the Sheffield Town Hall extension on one side of the square, mainly diggers' rumbling, which occurred in certain survey periods, causing a considerable change in soundscape.

The first site in Beijing was the Changchuenyuan Culture Square, located on the west side of the city, near the Summer Palace. This public square was surrounded by many residential flats with convenient amusement facilities and local shops. Main sounds in this square during the survey periods included traffic in distance, footsteps, chatting, children's shouting, and user activities such as group dancing.

The second Beijing site, Xidan Cultural Square, was located just beside the famous Changan Street, within walking distance to Tiananmen Square. Adjacent to it there were several large shopping centres, banks and buildings for government organisations and international companies. Main sounds in this square during the survey periods included heavy traffic, conversations and footsteps.

The characteristics of sound sources are vital for soundscape evaluation. The Sheffield and Beijing sites were representative of typical soundscape in urban open public spaces, including continuous and intermittent sounds, man-made and natural sounds, meaningful and meaningless sounds, and pitched and varied sounds. There were also activity-related sounds as well as soundmarks.

The interviewees were the users, not passers-by, of the squares, and were selected randomly. To examine the possible seasonal effects, the survey in Sheffield was made in two seasonal periods, autumn winter and spring summer, whereas in Beijing only spring/summer period was considered. The numbers of interviewees are shown in Table 2. Demographic factors are also important for soundscape evaluation, and it has been shown that those are comparable between various sites in terms of gender, education and occupation profiles.

Table 2 Number of interviewees in the four case study sites

Site	Season	Sample	Sum
Barkers Pool	Autumn/winter	95	240
	Spring/summer	145	
Peace Gardens	Autumn/winter	105	251
	Spring/summer	146	
Changchunyuan	Spring/summer		307
Xidan	Spring/summer		304

Each interviewee was asked to fill in a questionnaire. The first part of the questionnaire included demographic factors, evaluations of sound level and acoustic comfort, and preferences of various sound types by classifying a sound as favourite, neither favourite nor annoying, or annoying. The second part of the questionnaire was an evaluation form, as shown in Table 1, for the semantic differential analysis. Finally, the location of the interviewees on the site and some additional information were recorded by the interviewer. The soundscape questionnaire was introduced as a part of the overall survey of general environmental conditions including thermal, lighting, wind, humid and visual environment, to avoid any possibility of bias in the acoustic aspect.

Immediately before/after an interview or when the interviewee filled the questionnaire quietly, the sound pressure level (SPL) was measured in terms of one-minute Leq. In Table 3 the measurement results are shown, with L_{90}, L_{50} and L_{10}, to give approximate indications of the background, median and intrusive sound levels of the survey period, respectively. In addition to the SPL measurements, typical sounds were recorded and then some psychoacoustic magnitudes including loudness, sharpness and roughness[17], were analysed. The results suggested that the sounds on the sites represented a fairly wide range of psychoacoustic magnitudes.

The data analysis was carried out using SPSS[18].

Table 3 Measured SPL (dBA) in the four case study sites

Site	Mean L_{eq}	STD L_{eq}	L_{90}	L_{50}	L_{10}
Barkers Pool	60.2	3.4	56.5	59.9	63.6
Peace Gardens	67.4	6.3	57.9	68.5	74.5
Changchunyuan	59.2	3.4	55.0	59.0	63.0
Xidan	67.4	3.9	63.0	67.0	73.0

3 SOUNDSCAPE EVALUATION

In Fig.1 the subjective evaluation of sound level as well as acoustic comfort is shown, both at a 5-point scale, namely, for sound level: 1, very quiet; 2, quiet; 3, neither quiet nor noisy; 4, noisy; 5, very noisy; and for acoustic comfort: 1, very comfortable; 2, comfortable; 3, neither comfortable nor uncomfortable; 4, uncomfortable; 5, very uncomfortable. It is interesting to note that, except in Xidan Square where the soundscape was dominated by high level traffic sounds, the scores for acoustic comfort are significantly lower than those for sound level ($p<0.05$), indicating that although people may feel the sound environment is noisy/loud, they could still find it acoustically comfortable. Further analysis shows that there is a strong positive correlation between the measured sound level Leq and the subjective evaluation of sound level ($p<0.01$), whereas the correlation coefficient between Leq and the acoustic comfort evaluation is much lower [19-20]. The difference between the evaluation of sound level and acoustic comfort shows people's tolerance, and also reveals the effect of sound source type, in a wide range of SPL in the studied sites (see Table 3). In addition to the expected reason that introducing a pleasant sound like music or water can considerably improve the acoustic comfort, even when its sound level is rather high, another important reason for the satisfaction in term of acoustic comfort is that users can choose locations in a square according to their preferences and activities. In the Peace Gardens, for example, teenagers and parents of young children were mostly near the fountains, whereas older people were halfway between the fountains and traffic.

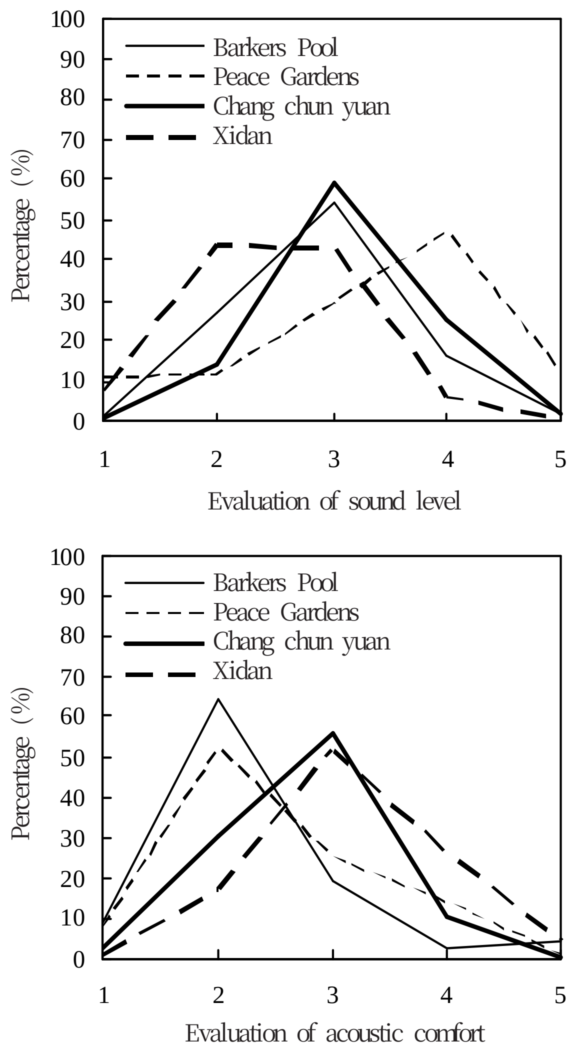

Fig.1 Comparison between the evaluation of sound level and acoustic comfort

As expected, in terms of sound preference, both in the UK and China, people generally shared a common opinion in preferring natural and culture-related sounds rather than artificial sounds. Fig.2 compares the evaluation of bird songs between Peace Gardens and Changchunyuan Square with increasing age, where three scales are 1, favourite; 0, neither favourite nor annoying; and-1, annoying. It is interesting to note that with the increase of age, people are generally more favourable to bird songs, a typical natural sound, and the Chinese interviewees prefer bird songs more.

The above analysis shows that the soundscape evaluation is a rather complicated system. Other influential aspects include acoustic environment at home, sound sensitivity of individuals, as well as the meaning of sounds to individuals[19-20].

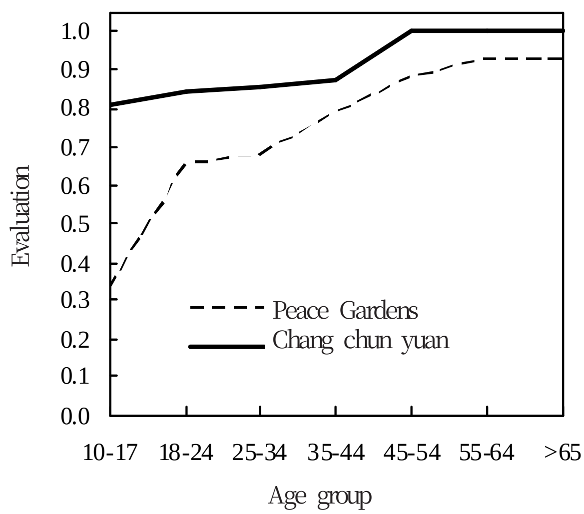

Fig.2 Evaluation of bird songs in the UK and China with increasing age

4 FACTOR ANALYSIS

Factor analysis was first made using all the data in the Barkers Pool and the Peace Gardens, of both autumn/winter and spring summer periods, as shown in Table 4, where Varimax rotated principal component analysis was employed to extract the orthogonal factor underlying the 18 adjective indices. With a criterion factor of eigenvalue>1, four main factors were determined. Factor 1 (26%) is mainly associated with relaxation, including comfort-discomfort, quiet-noisy, pleasant-unpleasant, natural-artificial, like-dislike and gentle-harsh. Factor 2 (12%) is generally associated with communication, including social-unsocial, meaningful-meaningless, calming-agitating and smooth-rough. Factor 3 (8%) is mostly associated with spatiality, including varied-simple, echoed-deadly and far-close. Factor 4 (7%) is principally related to dynamics, including hard-soft and fast-slow.

Correspondingly, factor analysis was carried out based on all the data in Changchunyuan and Xidan squares in China, as shown in Table 5. It can be seen that factor 1, including comfort-discomfort, quiet-noisy, natural-artificial, like-dislike and gentle-harsh, is again mainly related to relaxation, although sharp-flat and far-close are also included in this factor. Whilst the other three factors could be related to communication (factor 2, including pleasant-unpleasant, interesting-boring, social-unsocial and meaningful-meaningless), spatiality and dynamics (factor 4 including echoed-deadly and factor 3 including hard-soft, fast-slow, directional-everywhere, varied-simple and claming-agitating), the factor order and the indices included in each factor are different from the UK situation. In Fig.3 the scatter plot of factor 1 and 2 is shown, for the UK and Chinese case study sites, respectively. Although the two graphs have similar patterns, for the Chinese sites the division between factor 1 and 2 is clearer. Overall, whilst the similarity in Table 4 and 5 is generally dominant, there are also considerable differences, perhaps caused by the cultural differences.

It is noted that the four factors cover only 53% of the total variance in the UK sites, and 56% in the Chinese sites. This is lower than most results in product sound quality studies and general environmental noise evaluation[9-11], perhaps due to the significant variations in urban open public spaces, in terms of the number and type of sound sources, as well as their characteristics. Another possible reason is that some indices, although well evaluated by the students in the pilot study, might not be well understood or evaluated by the interviewees from the general public.

Overall, although the soundscape evaluation in urban open public spaces is rather complicated, it is still possible to identify several major factors, for both UK and Chinese situations, and interestingly, these factors cover the main facets of designing the acoustics of an urban open public space: function (relaxation and communication), space, and time.

To examine the difference between the two seasonal periods, factor analysis was carried out based on the autumn/winter and spring/summer data separately for the Barkers Pool, as shown in Table 6 and 7, respectively. It can be seen that in both seasonal periods, relaxation is the main factor, including comfort-discomfort, quiet-noisy, pleasant-unpl-easant, interesting-boring, like-dislike and gentle-harsh, covering 27% and 35% of the total variance, respectively. Whilst the orders of other factors are different between the two seasonal periods, several indices always stay together, for example, calming-agitating and smooth-rough; hard-soft, fast-slow and sharp-flat; and social-unsocial and meaningful-meaningless.

The data of each site were then analysed separately. Table 8 and 9 show the results in the Changchunyuan and Xidan Squares, respectively. It is seen that the two Chinese sites have rather similar patterns, especially for factor 1 and 2, again relating to relaxation and communication respectively. In Fig.4 the scatter plots of the two sites are compared considering factor 1 and 2. For both sites, factor 3 and 4 are associated with spatiality and dynamics, with hard-soft, fast-slow, varied-simple and echoed-deadly commonly included.

The Changchunyuan Square and the Barkers Pool have similar functions and SPL distributions (see Table 3), so that it would be interesting to compare their soundscape evaluation. From Table 6 and Table 8 it can be seen that several groups of indices are always together, including comfort-discomfort, quiet-noisy, like-dislike, gentle-harsh; socialunsocial and meaningful-meaningless; hard-soft and fast-slow; calming-agitating and smooth-rough; and directional-everywhere and varied-simple.

Further analysis shows that whilst the number of factors usually increases with decreasing sample size, a sample size of 100-150 is generally acceptable for evaluating soundscape in urban open public spaces.

It is also noted from the analysis that when there is a special / dominant sound source, the results of factor analysis could be considerably affected. For example, with the high level demolition noise in the Peace Gardens in autumn/winter period, the factor analysis result is rather different from other situations [7], suggesting that attention must be paid to some special sources, especially unpleasant ones.

Table 4 Factor analysis of the soundscape evaluation-overall results of the Barkers Pool and the Peace Gardens in the two seasonal periods. Kaiser-Meyer-Olkin (KMO) measureof sampling adequacy: 0.798; cumulative%: 53.

Indices	Factors			
	1(26%)	2(12%)	3(8%)	4(7%)
Comfort-discomfort	0.701	0.164	0.138	
Quiet-noisy	0.774			
Pleasant-unpleasant	0.784	0.258	0.157	
Interesting-boring	0.435	0.272	0.274	0.103
Natural-artificial	0.532	0.102	0.240	
Like-dislike	0.519	0.575	0.247	0.151
Gentle-harsh	0.502	0.531	0.123	
Hard-soft				0.812
Fast-slow				0.827
Sharp-fla	0.220		0.345	0.488
Directional-everywhere	0.234		0.441	0.267
Varied-simple	0.115		0.674	0.167
Echoed-deadly	0.204		0.531	
Far-close			0.550	
Social-unsocial		0.672	0.462	
Meaningful-meaningless	0.126	0.585	0.469	
Calming-agitating	- 0.143	0.708	0.286	
Rough-Smooth		0.683	0.396	

Table 5 Factor analysis of the soundscape evaluation-overall results of the Xidan Cultural Square and Changchunyuan Culture Square in spring/summer period. KMO: 0.860; cumulative%: 56.

Indices	Factors			
	1(31%)	2(12%)	3(7%)	4(6%)
Comfort-discomfort	0.770	0.193		-0.146
Quiet-noisy	0.776	0.201		
Pleasant-unpleasant	0.358	0.687		
Interesting-boring	0.299	0.732		
Natural-artificial	0.687	0.136		0.288
Like-dislike	0.744	0.235	0.100	-0.167
Gentle-harsh	0.700	0.306		
Hard-soft		0.129	0.513	0.354
Fast-slow	0.135		0.503	0.271
Sharp-flat	0.636	0.259		
Directional-everywhere	0.380		0.609	-0.284
Varied-simple			0.741	-0.117
Echoed-deadly				0.666
Far-close	0.529	0.127		0.400
Social-unsocial	0.242	0.802		
Meaningful-meaningless	0.196	0.762	0.147	
Calming-agitating	-0.201	-0.439	0.538	0.284
Rough-smooth	-0.109	0.389	0.457	0.387

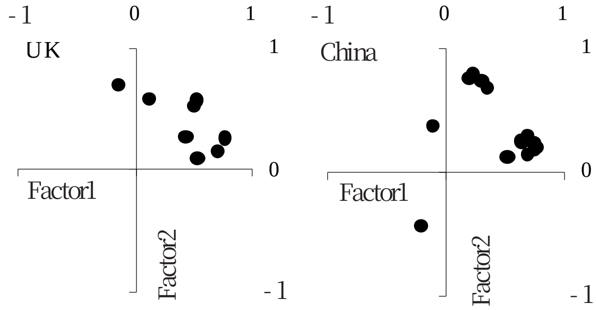

Fig.3 Comparison of scatter plot with factor 1 and 2 between UK and China

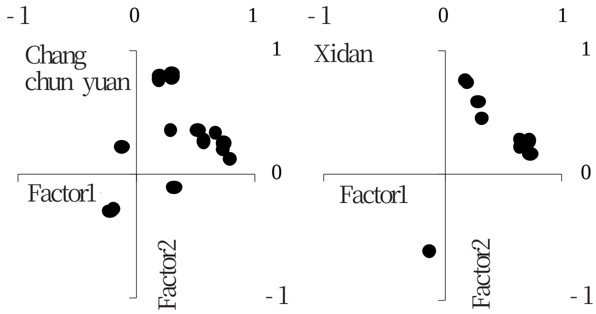

Fig.4 Comparison of scatter plot with factor 1 and 2 between Changchunyuan Culture Square and Xidan Culture Square in Beijing

Table 6 Factor analysis for the Barkers Pool, spring/summer period. KMO: 0.737; Cumulative%: 67.

Indices	Factors					
	1(27%)	2(11%)	3(8%)	4(8%)	5(7%)	6(6%)
Comfort-discomfort	0.607		0.284	-0.178		0.200
Quiet-noisy	0.731	-0.189		0.125		
Pleasant-unpleasant	0.692	0.236	0.279		0.246	
Interesting-boring	0.531	0.103	0.487	-0.178	0.415	
Natural-artificial	0.292			0.222	0.710	
Like-dislike	0.664	0.439	0.219	-0.254		0.188
Gentle-harsh	0.611	0.381	-0.132	-0.136		
Hard-soft	0.105	0.201	0.583	0.136		
Fast-slow	0.172	0.293	0.598	-0.315		
Sharp-flat	0.130	-0.107	0.824			
Directional-everywhere	0.211					0.819
Varied-simple	-0.109	0.280	0.284		0.301	0.695
Echoed-deadly		0.174			0.742	0.290
Far-close	0.267	0.274	0.142	0.545	-0.287	0.297
Social-unsocial		0.854	0.215			
Meaningful-meaningless	0.243	0.810		0.119	0.113	
Calming-agitating			-0.226	0.712		
Rough-smooth	-0.249		0.180	0.770	0.113	-0.102

Table 7 Factor analysis for the Barkers Pool, autumn/winter period. KMO: 0.786; Cumulative%: 70.

Indices	Factors				
	1(35%)	2(13%)	3(9%)	4(7%)	5(6%)
Comfort-discomfort	0.733	0.221	0.270	- 0.128	- 0.102
Quiet-noisy	0.717	0.134		0.128	0.205
Pleasant-unpleasant	0.771	0.297	0.106	- 0.206	0.232
Interesting-boring	0.679	0.288			0.201
Natural-artificial	0.318	0.707	- 0.336		
Like-dislike	0.684	0.259	- 0.373	0.344	
Gentle-harsh	0.675	0.204	- 0.381		- 0.182
Hard-soft				0.854	
Fast-slow		0.100	0.139	0.754	0.127
Sharp-flat	0.537		0.150	0.567	0.247
Directional-everywhere	0.322		- 0.192	0.276	0.773
Varied-simple	0.141	0.853	0.176	0.108	
Echoed-deadly	0.313	0.698			
Far-close	0.553	0.205	- 0.161	- 0.223	
Social-unsocial	0.588	0.287	- 0.233	0.220	- 0.481
Meaningful-meaningless	0.750		- 0.316	0.213	
Calming-agitating	- 0.160	- 0.124	0.778	0.162	- 0.149
Rough-smooth		0.109	0.856	0.169	

Table 8 Factor analysis for the Changchunyuan Square. KMO: 0.833; cumulative%: 58.

Indices	Factors			
	1(30%)	2(12%)	3(8%)	4(7%)
Comfort-discomfort	0.795	0.130		0.144
Quiet-noisy	0.739	0.247		
Pleasant-unpleasant	0.308	0.794		
Interesting-boring	0.211	0.800		- 0.136
Natural-artificial	0.571	0.276	0.205	- 0.349
Like-dislike	0.732	0.207	- 0.130	0.266
Gentle-harsh	0.670	0.330		
Hard-soft	0.106		0.550	0.149
Fast-slow	0.325	- 0.113	0.573	
Sharp-flat	0.524	0.349		
Directional-everywhere	0.475			0.558
Varied-simple		0.172	0.189	0.764
Echoed-deadly	- 0.123	0.220	0.603	- 0.139
Far-close	0.290	0.352	0.306	- 0.290
Social-unsocial	0.300	0.815		
Meaningful-meaningless	0.185	0.767		0.284
Calming-agitating	- 0.226	- 0.302	0.621	0.407
Rough-smooth	- 0.184	- 0.281	0.632	0.137

Table 9 Factor analysis for the Xidan Cultural Square. KMO: 0.815; cumulative%: 56.

Indices Comfort-discomfort	Factors			
	1(28%)	2(13%)	3(8%)	4(6%)
Quiet-noisy	0.652	0.294		0.305
Pleasant-unpleasant	0.735	0.182		
Interesting-boring	0.333	0.457	0.194	0.378
Natural-artificial	0.290	0.604		0.225
Like-dislike	0.745			
Gentle-harsh	0.679	0.263		0.349
Hard-soft	0.716	0.279		
Fast-slow		0.101	0.718	
Sharp-flat		0.205	0.730	- 0.131
Directional-everywhere	0.643	0.226		0.192
Varied-simple	0.288		0.474	0.266
Echoed-deadly		- 0.156	0.682	0.146
Far-close				0.696
Social-unsocial	0.737		0.176	- 0.234
Meaningful-meaningless	0.203	0.748	0.108	
Calming-agitating	0.170	0.760		0.102
Rough-smooth	- 0.104	- 0.609	0.364	0.256
		- 0.495	0.417	0.355

5 CONCLUSIONS

The semantic differential method has been applied to determine key factors that characterise the soundscape in urban open public spaces. Whilst the soundscape evaluation in urban open public spaces is rather complicated, it is still possible to identify several major factors, including relaxation, communication, spatiality and dynamics, and these factors are common for both UK and Chinese situations, although in terms of the order of factors and the indices included in each factor there are differences between the two countries. It is interesting that these factors cover the main facets of designing the acoustics of an urban open public space: function (relaxation and communication), space, and time, although the typical coverage of the total variance is only about 50-60%, indicating the complicated features of soundscapes of urban open public spaces. Analyses based on individual seasonal periods and individual case study sites show that the above four factors can still be identified, alth-ough there are considerable differences in terms of the order of factors and the indices included in each factor.

The general soundscape evaluation shows that both in the UK and Chinese sites, although people may feel the sound environment is noisy/loud, they could still find it acoustically comfortable, unless a site is dominated by high level unpleasant sounds such as traffic. In both countries people generally shared a common opinion in preferring natural and culture-related sounds, and the preference increases with increasing age.

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