

Effects of cultural factors on the evaluation of acoustic quality in residential areas

Chia Jen YU (1), Jian KANG (2)

(1) Department of Interior Design, Nan Jeon Institute of Technology, Tainan, Taiwan.

(2) School of Architecture, University of Sheffield, Sheffield S10 2TN, UK

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ABSTRACT

To examine the effects of cultural factors in sound evaluation, a comparative study was carried out between the UK and Taiwan, with six case study sites, three in Sheffield and three in Taipei, representing typical urban texture of residential areas. The study included a series of questionnaire surveys as well as noise measurements and simulation of the case study sites using noise-mapping software. The results reveal significant differences between the two cultures in a number of aspects, including choosing and evaluating living environment, noise noticeability, annoyance and sleep disturbance, activities, and sound preference, although it has been demonstrated that both in the UK and Taiwan, acoustic quality is an important consideration of the overall urban environment.

INTRODUCTION

Urban areas are usually densely populated, increasing various environmental loads and pollutions. It is therefore of great significance to create a sustainable living environment. Acoustic environment is an important part of the overall urban environment. In most cities there are various kinds of mechanical and artificial noise including traffic noise, construction noise and activity noise, but there are also many positive sounds such as bird songs and water sounds. Certain environmental pollutions may not be stopped immediately, but they could be dealt with in a more sustainable way. There has been increasing attention on the creation of good soundscape as part of the sustainable living environment.

The environment in residential areas is important for sustainable urban living. On the other hand, choosing a living environment is influenced by many factors such as transportation, recreation, and various social and economic issues. In addition to various objective measures, it is vital to consider people's perception and preferences.

The aim of this paper is to study the role of soundscape in the sustainable living environment. A particular aim is to examine the effect of cultural background [1]. The research has been carried out in three stages, based on samples in six typical residential areas in Sheffield and Taipei, random samples in Sheffield and Taipei, and random samples in the UK and Taiwan, respectively. While the results of stage one and two have been reported in previous papers [2-4], this paper concentrates on the results of the stage-three study.

METHODOLOGY

Based on the questionnaire survey in stages one and two, a relatively simplified questionnaire was designed, in both English and Chinese, with identical content. The questions included social and demographic data, evaluation and preference of various sound sources, and perception of general living environment. A five-point linear scale was generally

used in the questionnaire, for example, from -2, very comfortable, to 2, very uncomfortable.

The questionnaire was put on the internet, and in both the UK and Taiwan 300 valid responses were received. The statistic analysis using software SPSS [5] shows that the distribution of various social and demographic factors such as occupation, education, gender, and age was generally rather representative. In the analysis below, if the number of people in any group is less than 10, this group will be treated as missing data when comparing differences between groups.

RESULTS

Choosing a Living Environment

Questions were asked about the importance of various factors when people choose a living environment, with 1 as yes (selected) and 2 as no. The results in the UK and Taiwan are compared in Table 1, through the Independent Samples Test. From the Table it can be seen that there are significant differences between the UK and Taiwan for nearly all the factors. Whilst the average evaluation score in the UK and Taiwan are very close, in the UK the standard deviations (std.) are 0.04 higher than that in Taiwan.

In terms of the ranking of various factors, there are significant differences between the UK and Taiwan ($p < 0.01$). The correlation coefficient between the two rankings is $R^2 = 0.2052$, as shown in Figure 1, and this correlation fails to achieve a significant level ($p < 0.01$).

It is interesting to note that the 'quietness' is ranked as the 8th important factor in the UK, and 5th in Taiwan. The mean value is 1.91 in the UK, considerably higher than that in Taiwan, 1.64. This ranking order is relatively lower than those in the stage one and two results, especially in the UK, possibly because the previous results are based on Sheffield, where there are many low density areas and people might be more concerned with quietness.

Table 1. Importance of various factors when choosing a living environment, comparing the UK and Taiwan, where the significance level $p < 0.01$ is marked with ** and $p < 0.05$ is marked with *.

Factors	UK			Taiwan			Sig.
	Mean	Std.	Rank	Mean	Std.	Rank	
Convenience to work	1.57	0.50	2	1.60	0.49	2	0.07
Convenient transport	1.64	0.48	3	1.24	0.43	1	0.00**
Convenient school, shopping	1.71	0.45	6	1.61	0.49	3	0.00**
Recreational space	1.85	0.35	7	1.98	0.13	10	0.00**
Social with neighbors/friends	1.70	0.46	5	1.98	0.13	10	0.00**
Safety	1.66	0.47	4	1.62	0.49	4	0.02*
Property price	1.46	0.50	1	1.71	0.45	6	0.00**
Quietness	1.91	0.29	8	1.64	0.48	5	0.00**
Views	1.91	0.29	8	1.81	0.40	7	0.00**
Size of the house	1.66	0.47	4	1.87	0.33	8	0.00**
Interior decoration	1.91	0.28	8	1.95	0.23	9	0.00**
Mean	1.73	0.41		1.73	0.37		

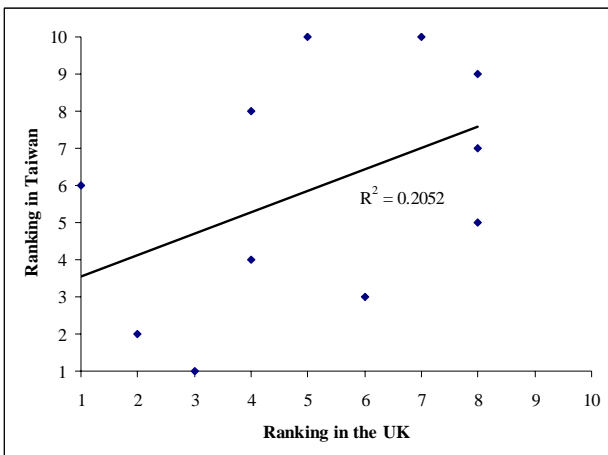


Figure 1. Correlation between the factor rankings in the UK and Taiwan when choosing a living environment.

Effect of Social and Demographic Factors When Choosing a Living Environment

In Table 2 the differences between various occupations (student, working person, pensioner, housekeeper, others), education levels (O level, A level, university), age groups (11-17, 18-24, 25-34, 35-44, 45-54, 55-64, >65) and current living condition/environment (very well, well, neither well nor bad, bad, very bad) are examined, using the one-way ANOVA analysis of variance. It is interesting to note that in the UK the effects of social and demographic factors on choosing a living environment are considerably less than that in Taiwan.

In terms of the importance of ‘quietness’ when choosing a living environment, in Table 2 it is interesting to note that between different occupations and education levels there are significant differences both in the UK and Taiwan, whereas the age effect is only significant in Taiwan. The effect of the current living condition/environment seems to be insignificant.

Table 2. Effects of occupation, education level, age, and current living environment/conditions when choosing a living environment, where the significance levels of one-way ANOVA analysis of variance are shown. The significance levels $p < 0.01$ are marked with ** and $p < 0.05$ marked with *.

Factors	Occupation		Education		Age		Living condition	
	UK	TW	UK	TW	UK	TW	UK	TW
	Convenient to work	0.27	0.00**	0.66	0.00**	0.44	0.00**	0.97
Convenient transport	0.58	0.01**	0.28	0.44	0.00**	0.18	0.25	0.49
Convenient school shopping	0.70	0.01**	0.03*	0.62	0.18	0.20	0.57	0.00**
Recreational space	0.82	0.03*	0.24	0.39	0.40	0.00**	0.08	0.38
Social with neighborhoods/friends	0.72	0.00**	0.57	0.00**	0.19	0.00**	0.09	0.14
Safety	0.32	0.00**	0.20	0.01**	0.09	0.00**	0.50	0.31
Property price	0.00**	0.00**	0.58	0.04*	0.00**	0.13	0.15	0.03*
Quietness	0.00**	0.00**	0.00**	0.00**	0.14	0.00**	0.09	0.30
Views	0.00**	0.00**	0.44	0.00**	0.03*	0.00**	0.24	0.00**
Size of the house	0.32	0.00**	0.32	0.59	0.06	0.35	0.53	0.00**
Interior decoration	0.49	0.26	0.45	0.00**	0.22	0.17	0.67	0.00**

To further examine the effects of social and demographic factors when choosing a living environment in terms of quietness, Figure 2 shows the differences between various social and demographic groups. In terms of occupation, as shown in Figure 2a, both in the UK and Taiwan there are notable differences between students and working people. The results of pensioners and housekeepers are not presented due to the low sample number.

In Figure 2b it can be seen that both in the UK and Taiwan there are considerable differences between various education levels, but it seems that there is no clear tendency in evaluation score with increasing/decreasing education level.

Figure 2c seems to suggest a tendency that with increasing age, people are more concerned about the quietness, especially in Taiwan. It is noted, however, further examination is still needed since the results of age group 55-64 and >64 are not presented due to the low sample number.

In terms of current living condition/environment, as shown in Figure 2d, in Taiwan there seems to be a very slight tendency that with a better current living condition/environment, people tend to think ‘quietness’ is more important, although this does not reach a significant level, as shown in Table 2, whereas in the UK there is no such a tendency.

The comparison between genders shows that in the UK there is no significant difference between males and females, and the mean evaluation scores are both 1.9. In Taiwan, conversely, it seems that males are more concerned with quietness, with a significantly ($p < 0.01$) higher score than that of females, by about 0.15.

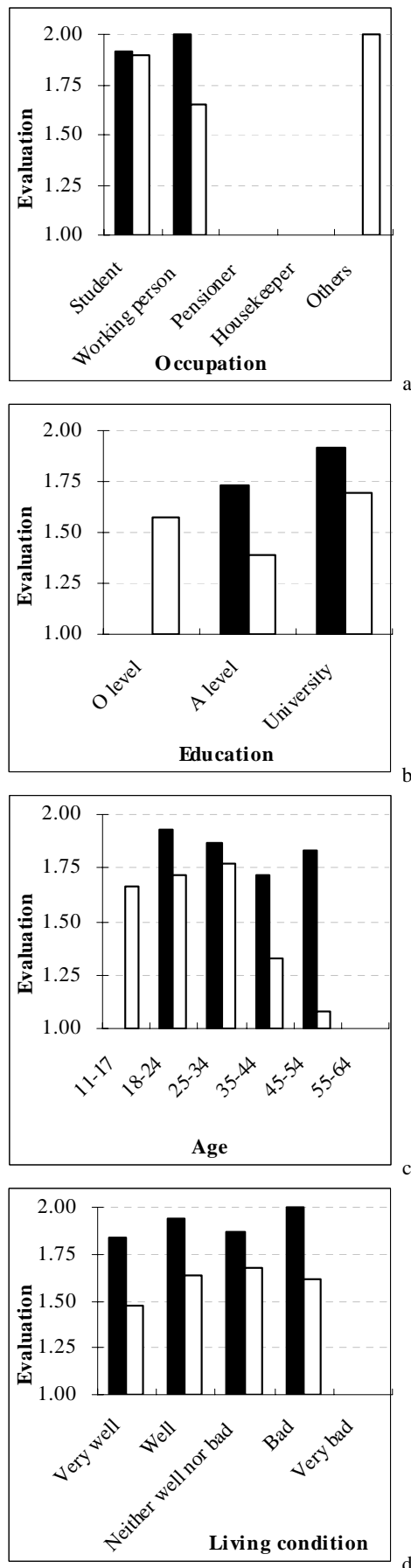


Figure 2. Effects of social and demographic factors when choosing a living environment, in terms of ‘quietness’ [evaluation 1: yes (selected); 2: no (not selected)]. Black bars: UK; white bars: Taiwan.

Current Living Environment

Table 3 compares the evaluation of current general living condition/environment, sound quality of the living area and the sound quality at home between the UK and Taiwan, where the five-point linear scale was: 1, very comfortable; 2, comfortable; 3, neither comfortable nor uncomfortable; 4, uncomfortable; 5, very uncomfortable. It is interesting to note that the scores in Taiwan are all significantly higher than those in the UK, by about 0.4 to 0.7, indicating that the general living condition/environment and the acoustic environments are less comfortable in terms of people’s perception.

Table 3. Evaluations of the current living environment, and the sound quality of the living area and at home.

	UK		Taiwan		Sig. (t-test)
	Mean	Std.	Mean	Std.	
General living environment	2.26	0.71	2.65	0.79	0.00**
Sound quality of the living area	2.23	0.88	2.95	0.88	0.00**
Sound quality at home	2.25	0.93	2.74	0.75	0.00**

Main Activities

The main activities when people stay at home were asked and the results are shown in Table 4, where multiple choices were allowed. It can be seen that both in the UK and Taiwan there is a high percentage of activities which could potentially be disturbed by noise, including reading, watching television and listening to music, although in the UK the percentage of listening to music is considerably higher than that in Taiwan, by 23%, and in Taiwan the percentage of watching television is higher than that in the UK, by 30%. It is therefore possible that UK people could be more sensitive in terms of disturbance of activities by noise.

Table 4. Main activities when people stay at home (%), where multiple choices were allowed.

Activities	UK	Taiwan
Reading	47.3	55.3
Watching television	53.0	83.0
Listening to music	61.3	38.0
Others	34.7	60.3

Annoyance Level and Sleep Disturbance of Noise Sources

In the questionnaire the annoyance level and sleep disturbance of typical sound sources in residential areas were examined, and the results are shown in Table 5, where the five-point linear scale was: -2, not very annoyed; -1, occasional; 0, medium; 1, annoyed; 2, very annoyed.

It can be seen that there are generally considerable differences between the UK and Taiwan, with Taiwan having significantly higher scores, namely higher annoyance level. This is reflected in the difference in noise levels in the UK and Taiwan, especially in urban areas [2].

It is interesting to note that in terms of annoyance of various noise sources, people living in the UK have a relatively high annoyance level for nearby transportation stations, followed by events, schools and heavy vehicles, whereas in Taiwan two wheelers, and various vehicles are at the top of the list. For sleep disturbance, the results are similar. The significant differences between the two rankings strongly indicate the importance of considering cultural factors as well as urban structure and building types when evaluating noise. The correlations between the rankings in the UK and Taiwan are shown in Figure 3a and 3b, for annoyance and sleep distur-

bance, respectively. It can be seen that the correlation coefficients are very low. On the other hand, the correlations between annoyance and sleep disturbance are rather high, as illustrated in Figure 4a and 4b, for the UK and Taiwan, respectively.

Table 5. Annoyance and sleep disturbance of various noise sources in the UK and Taiwan.

Noise sources		Annoyance				Sleep				
		UK		Taiwan		UK		Taiwan		
		Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	
Traffic	Light vehicle	Mean	-0.69	-0.23	-0.77	-0.29	8	4	11	4
		Std.	0.68	1.05	0.62	1.13				
	Medium vehicle	Mean	-0.69	-0.11	-0.76	-0.12	9	3	10	2
		Std.	0.72	1.14	0.66	1.23				
	Heavy vehicle	Mean	-0.51	-0.08	-0.47	0.07	4	2	2	1
		Std.	0.96	1.17	0.97	1.32				
	Two wheelers	Mean	-0.73	0.00	-0.77	-0.19	13	1	8	3
		Std.	0.73	1.06	0.71	1.15				
Nearby facilities	School	Mean	-0.49	-0.55	-0.60	-0.62	3	8	5	8
		Std.	0.85	0.77	0.90	0.76				
	Shops	Mean	-0.68	-0.52	-0.76	-0.69	7	7	9	11
		Std.	0.57	0.86	0.54	0.75				
	Recreation/leisure facilities	Mean	-0.70	-0.77	-0.61	-0.72	11	14	6	12
		Std.	0.63	0.62	0.66	0.67				
	Transportation stations	Mean	-0.40	-0.73	-0.51	-0.66	1	13	3	10
		Std.	0.93	0.68	0.94	0.78				
	Events	Mean	-0.46	-0.48	-0.47	-0.43	2	5	1	5
		Std.	0.84	0.93	0.87	0.92				
Neighbors	Talking	Mean	-0.71	-0.51	-0.70	-0.59	12	6	8	6
		Std.	0.63	0.82	0.70	0.72				
	Music, TV	Mean	-0.56	-0.66	-0.51	-0.74	5	10	4	16
		Std.	0.81	0.72	0.86	0.64				
Air-conditioning	Mean	-0.82	-0.69	-0.78	-0.66	15	12	13	9	
	Std.	0.47	0.69	0.52	0.68					
Own home	Talking	Mean	-0.80	-0.69	-0.79	-0.61	14	11	15	7
		Std.	0.49	0.54	0.53	0.78				
	Music, TV	Mean	-0.60	-0.69	-0.68	-0.75	6	11	7	15
		Std.	0.75	0.57	0.69	0.56				
	Air-conditioning	Mean	-0.69	-0.65	-0.79	-0.73	10	9	14	13
Std.		0.73	0.62	0.50	0.55					
Mean			-0.64	-0.49	-0.66				-0.52	

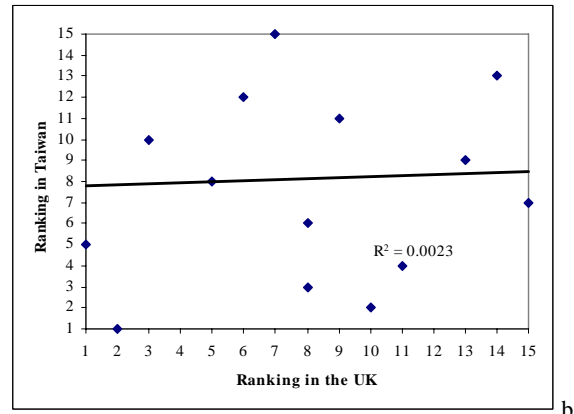
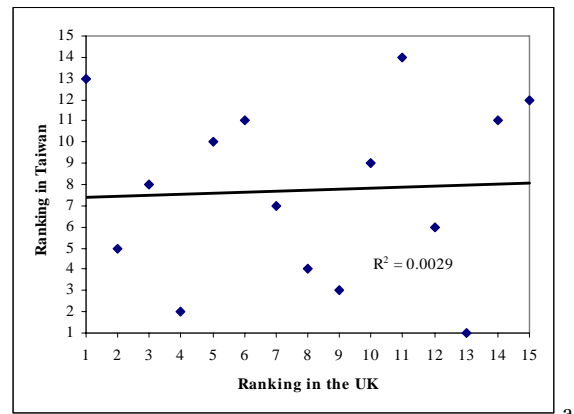


Figure 3. Correlations between the rankings of noise sources in the UK and Taiwan. (a) Annoyance; (b) sleep.

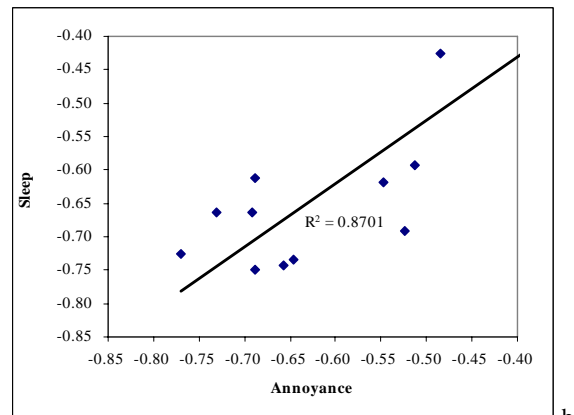
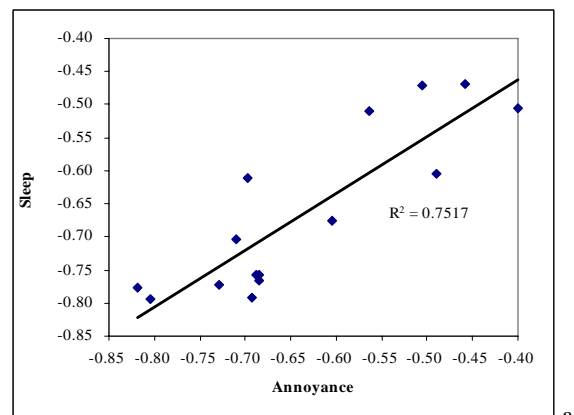


Figure 4. Correlations between the noise annoyance and sleep disturbance rankings. (a) UK; (b) Taiwan.

Sound Preference

In the survey people were asked to select the sounds they would prefer, both in the living area and at home, from a given list, including both natural sounds and artificial sounds. Table 6 shows the results, where if a sound was selected, value 1 is assigned, otherwise value 2 is assigned. Through the Independent Samples Test, it can be seen that there are significant differences between the UK and Taiwan for nearly all sounds listed.

Table 6. Preference of various natural sounds and artificial sounds, with 1 as yes (selected) and 2 as no.

		Area					Home					
		UK	Rank	TW	Rank	Sig.	UK	Rank	TW	Rank	Sig.	
Natural sounds	Bird songs	Mean	1.59	2	1.49	2	0.00**	1.76	2	1.69	2	0.00**
		Std.	0.49		0.50		0.43	0.46				
	Water	Mean	1.71	3	1.83	4	0.00**	1.78	3	1.91	4	0.00**
		Std.	0.45		0.37		0.41	0.29				
	Insect sounds	Mean	1.95	4	1.71	3	0.00**	1.98	5	1.78	3	0.00**
		Std.	0.23		0.45		0.15	0.42				
	Quiet	Mean	1.51	1	1.41	1	0.00**	1.44	1	1.40	1	0.04*
		Std.	0.5		0.49		0.50	0.49				
	Others	Mean	1.97	5	2	5	0.00**	1.97	4	2	5	0.00**
		Std.	0.17		0		0.16	0				
Artificial sounds	Bells of church	Mean	1.77	2	1.95	2	0.00**	1.93	2	1.99	2	0.00**
		Std.	0.42		0.22		0.26	0.08				
	Music	Mean	1.52	1	1.83	1	0.00**	1.31	1	1.41	1	0.00**
		Std.	0.5		0.37		0.46	0.49				
	Traffic sound	Mean	1.95	3	1.98	3	0.00**	1.99	4	2	3	0.25
		Std.	0.22		0.14		0.08	0.06				
	Others	Mean	1.98	4	2	4	0.00**	1.97	3	2	3	0.00**
		Std.	0.13		0		0.18	0				

In terms of the ranking of preferred sounds the differences between the UK and Taiwan are generally insignificant. The correlations between the UK and Taiwan rankings are shown in Figure 5, for natural sounds and artificial sounds, in the living area and at home, respectively. It can be seen that the correlation correlations are rather high, with R²=0.5-1.

It is interesting to note that both in the UK and Taiwan, 'quiet' is highly preferred both in the living area and at home. This is followed by bird songs and water sounds, although it is interesting to note that these two sounds are less preferred at home compared to the living area, both in the UK and Taiwan. Insect sounds are less preferred in the UK compared to Taiwan, similar to the results obtained in the stage-two study [4].

Church bells are less preferred in Taiwan compared to the UK, likely caused by cultural differences. Music is generally preferred both in the living area and at home, although the

preference level is higher at home. It is interesting that the preference level of music is higher in the UK than that in Taiwan, which corresponds to people's activities, as shown in Table 4.

As expected, traffic sounds are generally least preferred [6]. Moreover, it is important to note that the standard deviation for traffic sounds is much less than that for other more preferred sounds.

CONCLUSIONS

Both in the UK and Taiwan, it has been demonstrated that acoustic environment and soundscape is an important aspect of the sustainable urban living environment.

The comparative study in the UK and Taiwan reveals the importance of considering cultural factors. This is reflected by the significant differences between the two cultures in a number of aspects, including choosing the living environment, effects of social and demographic factors, perception/evaluation of current living environment, main activities, noise annoyance and sleep disturbance, and sound preferences. Generally speaking, these cultural differences correspond to the differences found in stages one and two of this overall research.

It is interesting to note that in both cultures quiet environment is highly preferred, followed by some positive/natural sounds. Conversely, traffic sounds are least preferred, as expected.

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