MADRID
inter.noise 2019
June 16 - 19
NOISE CONTROL FOR A BETTER ENVIRONMENT

A cross-cultural comparison in sound perception between Chinese and Russian students in urban open spaces in China

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ABSTRACT

In recent years, soundscape studies have been a topical issue in urban sound environment. However, there are only few cross-cultural researches in present studies, since cross-cultural characteristics may lead to the different soundscape design. Therefore, the main goal of this study is to find out if there is any significant difference in the perception of sound characteristics according to different cultural experiences, how big is this difference, and how to take it into account in design stage. This study examines the effects cultural factors on the perception of sound environment in Harbin city, China, based on sound sources and the level of sound pressure. Semantic sound characteristics, such as calm-vibrant, pleasant-unpleasant, natural-artificial, have been assessed in this study, which involved 15 Russian and 15 Chinese participants. The results showed that Chinese felt less satisfied Harbin's soundscape than Russians. The strongest Correlation was seen between Interesting-Boring rate and Natural-Artificial rate. These findings provide empirical evidence of socio-cultural differences in soundscape perception and reveal the importance of considering cultural factors in urban and architecture design.

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Keywords: Cross-cultural, soundscape, sound perception, urban open spaces, acoustic comfort
I-INCE Classification of Subject Number: 66

1. INTRODUCTION

Despite the fact that sound environment and acoustic comfort are not visually tangible, they are still significant components of the overall physical comfort [1]. A person living in the city is affected by several environmental factors, such as quality of air and water, climate, sound environment, and so on. All these parameters directly or indirectly affect the mental and physical health of the person, and therefore they are very significant. Sound pollution has a negative impact on human well-being, along with air, water and waste pollutions. Thus finding ways to reduce it is very important. The significance of noise pollution environment has also been demonstrated by other researchers [2, 3, 4].

Cross-cultural research takes into account non-acoustic factors in soundscape evaluation. Social and demographic factors, as well as sound sensitivity of individuals and acoustic characteristics, may also play a substantial role in soundscape assessment [5, 6].

Soundscape has already been investigated from different points of view and kinds of open space [7–10]. There are few ways to measure soundscape. It can be done by acoustic parameters; another way is to evaluate semantic sound characteristics according to personal feelings. Such evaluation can be affected by the range of factors, including personal, socio-cultural backgrounds, and previous experiences. Thus the sound environment is rather a complex system that depends on physical, psychological, social, cultural factors, and it is important to understand key determinants which define the soundscape [11].

Some cross-cultural studies have already been conducted [2, 12]. This research includes comparison between Russia and China. Chinese soundscape is distinctive and has peculiar sound sources, such as sounds coming from shops, different human activities, and loud traffic. For this assessment, we chose urban parks and streets as sound environments. These two sites are different because of their assignment and sound sources. In this research this difference is also analysed.

Along with previous cross-cultural studies, the main goal of this research is to investigate the difference in soundscape perception between Russian and Chinese participants.

2. METHODOLOGY

2.1 Case sites

The study was conducted in Harbin, a big city in the North of China that has many exchange students, especially of Russian descent. One meaningful fact about Harbin is that it was established by Russians, so it had been be under the influence of Russian culture, and this influence is especially evident in old architecture. Thus there is a significant cluster of Russians still residing in the city. Figure 1 presents the location of Harbin.

In this research, soundscape walk was used. It allowed participants to experience sonic environment, so they could listen carefully and notice the subtle sounds [13]. Soundscape is not an isolated environment and is connected to a list of factors, such as temperature, season, time of the day, wind, illumination level, etc [14]. During the soundscape walk, the participants were able to experience them all, and sound evalua-

tion become more precise. Participants took part in experiment individually or in small groups, because big groups could be a source of sound themselves. It is worth mentioning that research took place during winter time, when an average temperature was -13 Celsius degrees, with a strong wind. Every soundscape walk on average took around three hours, so participants might have felt cold. That is an important factor, which may affect the results of the experiment.

Fig. 1. Harbin's location on the map of China.

In this research soundscape walk was used. It allows participants to experience sonic environment, so they can listen carefully and notice the subtle sounds [13]. Soundscape is not isolated environment, it is also connected with a list of factors, such as temperature, season, time of the day, wind, illumination level, etc [14]. So through soundscape walking participants can experience them all, and sound evaluation become more pure. Participants took part in experiment individually or in small groups, because big groups could be a source of sound themselves.

The study was conducted through 20 sites, 10 urban parks, and 10 streets in Harbin. The route is illustrated in Figure 2. The walk started from a square in front of Harbin Institute of Technology Library. Every site has different quietness level and different sound sources. The panoramic photographs of the sites are illustrated in Fig. 3.
Sites were chosen according to different significantly predominating sound sources, such as human voices and steps, traffic, equipment sounds, music, shop agitating sound, and wind and bird sounds. Since the participants took part in the walk individually or in small groups, experiment for every participant was conducted in different time (in the morning, during the day, or in the evening). It is important to remember that soundscape changes according to the time in the day. For instance, parks tend to be relatively quiet during the day, but in the evening, elder people arrange for different kinds of activities, including music, singing, loud voices, so the sonic environment significantly changes. Thus weather conditions, time of the day, temperature were taken into account every time the experiment was conducted.

2.2 Objective measurements

During experiment in every site, participants were asked to fill the questionnaire, and at the same time, audio readout (2 minutes) was recorded using Sound and Vibration analyser (BSWA 801, microphone type MPA231T, sensitivity 41.2 mV/Pa). The microphone was placed in the height of 1.2 meters from the ground, facing the source of predominant sound [15]. In total, 280 audio-recordings were conducted (14 recordings

for every site). Every recording is equal or longer than 2 minutes. Since the research took place in cold winter time and every participant supposed to wait no less than 2 minutes in every site, the recording time could not be longer, because of the long soundscape walk. It means that for every site, the total recording time was not less than 28 minutes, which was enough.

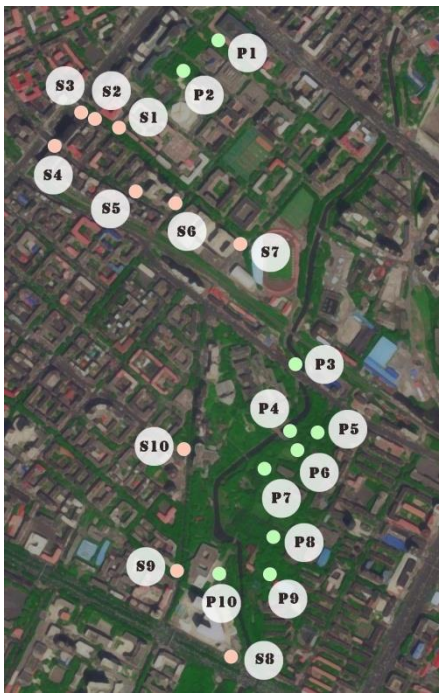
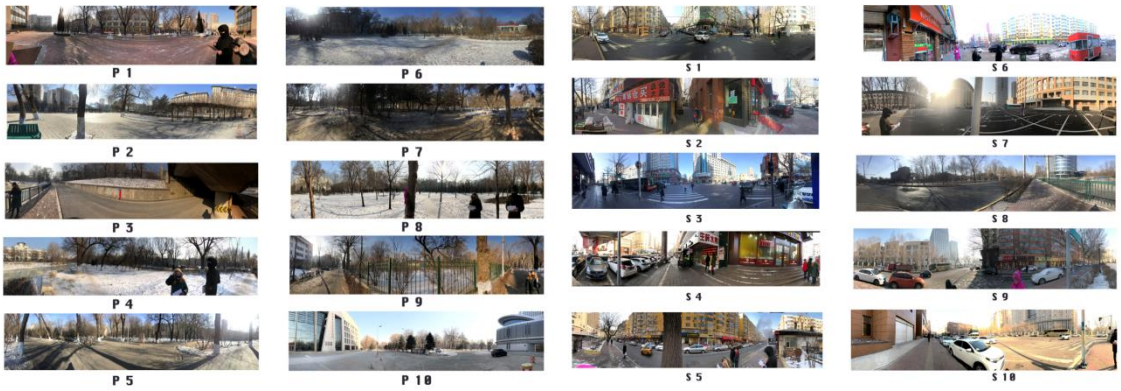


Fig. 2. Soundscape walking route.



a) ***b)***

Fig. 3. Panoramic photographs of sites. a) Urban Park sites; b) Street sites.

Several acoustic indicators, such as the A-weighted equivalent continuous sound pressure level ($L_{Aeq,\ 2min}$), statistical levels (L_{A90}, L_{A50}, L_{A10}), and temporal variability (L_{A10}–L_{A90}), were calculated of the 20 audio experts. Table 1 presents the arithmetic mean values for the 28 audio excerpts. The overall sound pressure levels

($L_{Aeq,\ 2min}$) represent a large variability, ranging from 50.6 to 67.2 dBA in urban parks, and from 59.1 to 83.0 dB(A) in the streets [16]. The difference between the largest and the smallest temporal variability L_{A10}–L_{A90} in park was equal 17.3 dB, in the streets was equal to 10.9 dB, which is larger than 10 dB. This indicates that the range of soundscape in urban parks and streets of Harbin was sufficiently wide.

Table 1. Acoustic parameters of 20 acoustic stimuli used in laboratory experiments [dB].

Site	LAeq, 2 min	L_{A90}	L_{A50}	L_{A10}	L_{A10}-L_{A90}
P1	58.0	53.5	56.4	66.7	13.2
P2	50.6	48.3	51.0	52.5	4.2
P3	67.2	61.3	67.1	75.1	13.8
P4	55.7	52.4	56.0	58.0	5.6
P5	54.7	52.1	53.0	59.9	7.8
P6	54.1	50.9	53.9	57.4	6.5
P7	56.1	51.3	53.6	61.0	9.7
P8	54.1	48.9	55.8	58.8	9.9
P9	53.9	50.4	51.7	55.8	5.4
P10	61.5	49.5	58.3	71.0	21.5
S1	68.4	66.4	67.7	71.1	4.7
S2	68.5	63.9	68.2	70.7	6.8
S3	74.4	73.1	74.4	76.2	3.1
S4	83.0	77.2	84.0	90.2	13.0
S5	64.2	57.3	64.0	69.0	11.7
S6	61.8	55.8	60.5	67.5	11.7
S7	59.1	51.9	59.8	65.9	14.0
S8	77.6	73.7	78.8	80.0	6.3
S9	64.1	60.6	64.2	67.3	6.7
S10	65.6	62.3	66.0	71.0	8.7

2.3 Subjective measurements

2.3.1 Data collection instrument

During soundscape walking in every site, participants were asked to fill the form to evaluate sonic environment. It consisted of two parts; In the first part, the participants were asked to mark different sound sources they heard and put them in order, from the least to the most insignificant. In the second part they were required to evaluate sound-

scape according to their personal feelings, using the list of semantic sound characteristics, such as pleasant-unpleasant, comfortable-uncomfortable, quiet-noisy, calm-vibrant, interesting-boring, liked-disliked, natural-artificial, safe-unsafe, directional-everywhere, far-close which could be assessed by the 7 points scale, from '3' (meaning very pleasant, very comforting, etc.) to '-3' (very unpleasant, very uncomfortable, etc.). Questionnaire was made using three languages: English, Russian, and Chinese, so every participant would feel comfortable using his/her native language. As previous studies concluded, incorrect translation could be a reason for some inaccuracy in research results. As noted above, all participants were students, so most of them could speak at least two languages, so that inaccuracy could be reduced using all three languages at the same time, which allowed participants to better understand the meaning of assessed characteristics.

2.4 Participants

A total of 30 participants aged from 17 to 31 (M age = 22.7; SD age = 2.99 years) took a part in experiment. Demographic information is presented in Table 2. In order to maintain warranted research, all participants were university students or recently graduates. There were 15 Chinese (4 male, 11 female) and 15 Russian (7 male, 8 female) participants, all audiologically normal. The research took a place in China, so for the Chinese participants, the investigated environment was native, but for the Russian participants, it was new cultural experience. Nevertheless all Russian students spent in China at least half a year, and at the moment of research, none of them reported cultural shock, so we can ignore this factor.

Before the soundscape walk, all participants were provided oral information about the study, route, questionnaire, and requirements in their native language.

Table 2. Demographic information for participants.

Nationality	**Gender**		**Age**		
	Male	**Female**	**Mean**	**SD**	**Range**
Russia (15)	7	8	22.93	3.15	17-29
China (15)	4	11	22.47	1.73	18-31
Total (30)	**11**	**19**	**22.7**	**2.99**	**17-31**

2.4 Statistical analyses

Received data consist of filled formers by 30 participants, including evaluated soundscape in 20 sites in urban parks and streets in Harbin city. Data was analysed using IBM SPSS Statistics 23 for Windows. Cross-cultural comparison of semantic sound characteristics was conducted. We found differences in soundscape perception between urban park areas and street sites, as well as varying perception of different sound sources.

3. RESULTS

3.1 Difference of semantic characteristics

Series of experimental designs were assessed using an independent t-test.

3.1.1 Pleasant-unpleasant rate

It was found that Russian participants evaluated soundscape environment in streets and parks in Harbin as significantly more pleasant (M=0.66; SD=1.83) than Chi-

nese counterparts (M=0.22; SD=1.72, t=3.03 > CV=1.645; p<0.01) (Figure 4a). An effect size was 0.25.

3.1.2 Comfort-discomfort rate

There was statistically significant difference found in comfort-discomfort evaluation between Russian (M=0.69; SD=1.87) and Chinese (M=0.37; SD=1.79) participants, as Russian participants found soundscape more comfortable (t= 2.14 > CV= 1.645; p=0.03 < 0.05) (Figure 4b). The effect size was 0.18.

3.1.3 Quiet-noisy rate

There was no significant difference found in quiet-noisy evaluation between Russian (M=0.11; SD=1.98) and Chinese (M=-0.09; SD=2.17) participants (t=1.2 < CV=1.645; p=0.23 > 0.05) (Figure 4c).

3.1.4 Calm-vibrant rate

There was no significant difference found in calm-vibrant evaluation between Russian (M=0.39; SD=1.96) and Chinese (M=0.16; SD=1.87) participants (t=1.49 < CV=1.645; p=0.14>0.05) (Figure 4d).

3.1.5 Interesting-boring rate

There was statistically significant difference found in interesting-boring evaluation between Russian (M=0.1; SD=1.61) and Chinese (M=0.45; SD=1.60) participants. Russian participants found soundscape more interesting (t=4.254 > CV=1.645; p<0.01). This could be due to the new culture experience that foreigners encounter in China (Figure 4e). The effect size was 0.34 and was sufficiently big.

3.1.6 Like-dislike rate

There was statistically significant difference found in like-dislike evaluation between Russian (M=0.38; SD=1.88) and Chinese (M=-0.14; SD=1.72) participants (t=3.56> CV=1.645; p<0.01) (Figure 4f). The effect size was 0.29.

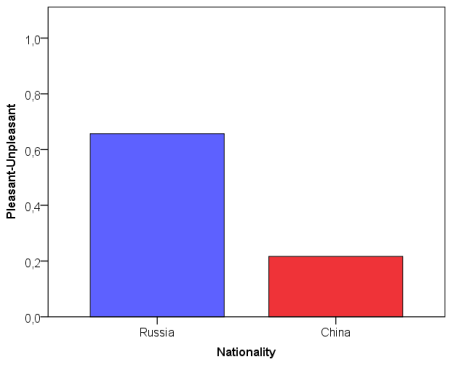
3.1.7 Natural-artificial rate

There is also significant difference in Natural-Artificial evaluation between Russian (M=-0.11; SD=2.10) and Chinese (M=-0.88; SD=2.07) participants (t=4.55>CV=1.645; p<0.01) (Figure 4g). Russian participants found soundscape environment in China more natural than Chinese participants, and that finding was quite surprising. The effect size was 0.37, and was the biggest one.

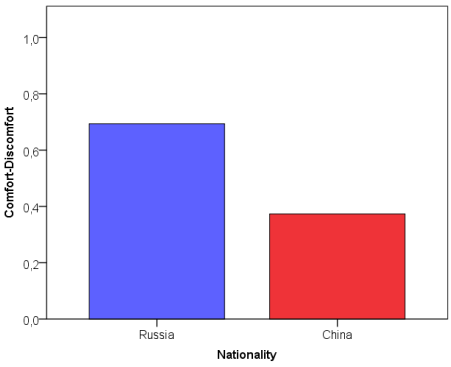
3.1.8 Safe-unsafe rate

There was a statistically significant difference found in safety evaluation between Russian (M=0.77; SD=1.78) and Chinese (M=0.28; SD=1.95) participants (t=3.17 > CV=1.645; p<0.01) (Figure 4h). The effect size was 0.26.

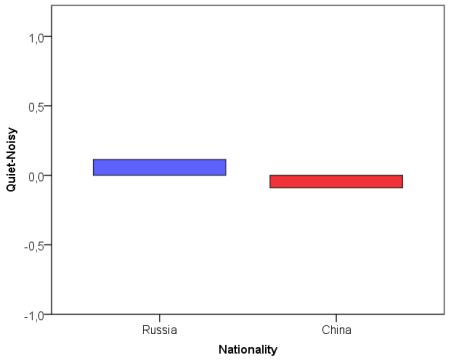
According to independent t-test results, there was a statistically significant difference found between Russian and Chinese participants in the perception of sound environment in streets and parks in Harbin. Chinese participants were slightly less satisfied soundscape.


Pleasant-Unpleasant
1,0
0,8
0,6
0,4
0,2
0,0
Russia
China
Nationality

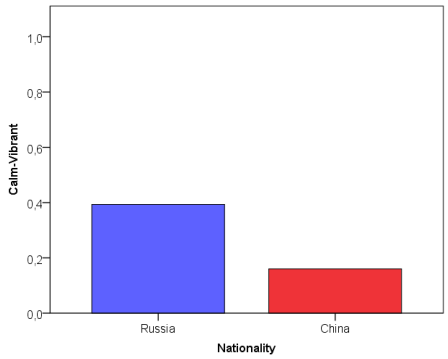
a)


Comfort-Discomfort
1,0
0,8
0,6
0,4
0,2
0,0
Russia
China
Nationality

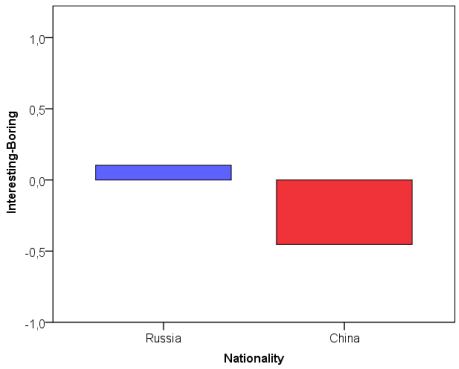
b)


Quiet-Noisy
1,0
0,5
0,0
-0,5
-1,0
Russia
China
Nationality

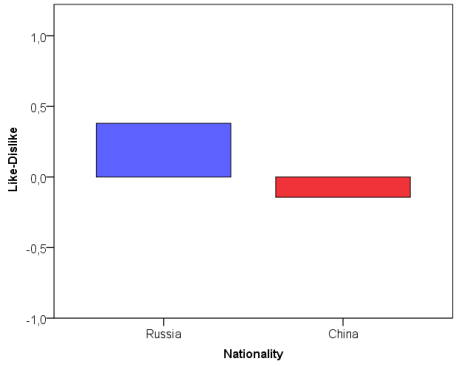
c)


Calm-Vibrant
1,0
0,8
0,6
0,4
0,2
0,0
Russia
China
Nationality

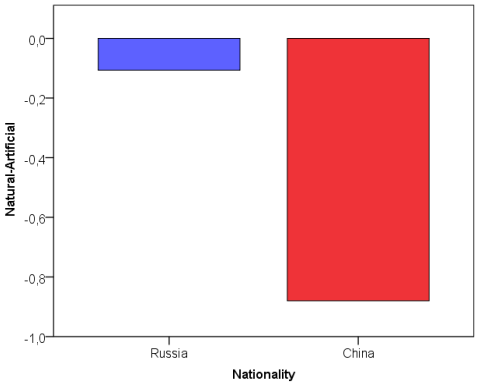
d)


Interesting-Boring
1,0
0,5
0,0
-0,5
-1,0
Russia
China
Nationality

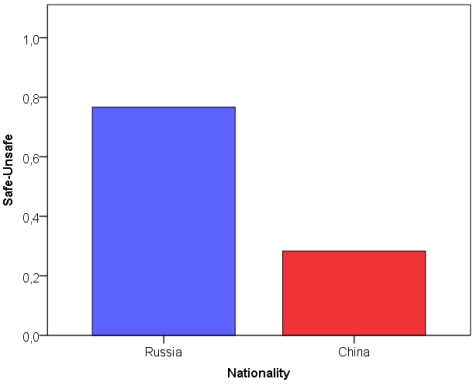
e)


Like-Dislike
1,0
0,5
0,0
-0,5
-1,0
Russia
China
Nationality

f)


Natural-Artificial
0,0
-0,2
-0,4
-0,6
-0,8
-1,0
Russia
China
Nationality

g)


Safe-Unsafe
1,0
0,8
0,6
0,4
0,2
0,0
Russia
China
Nationality

h)

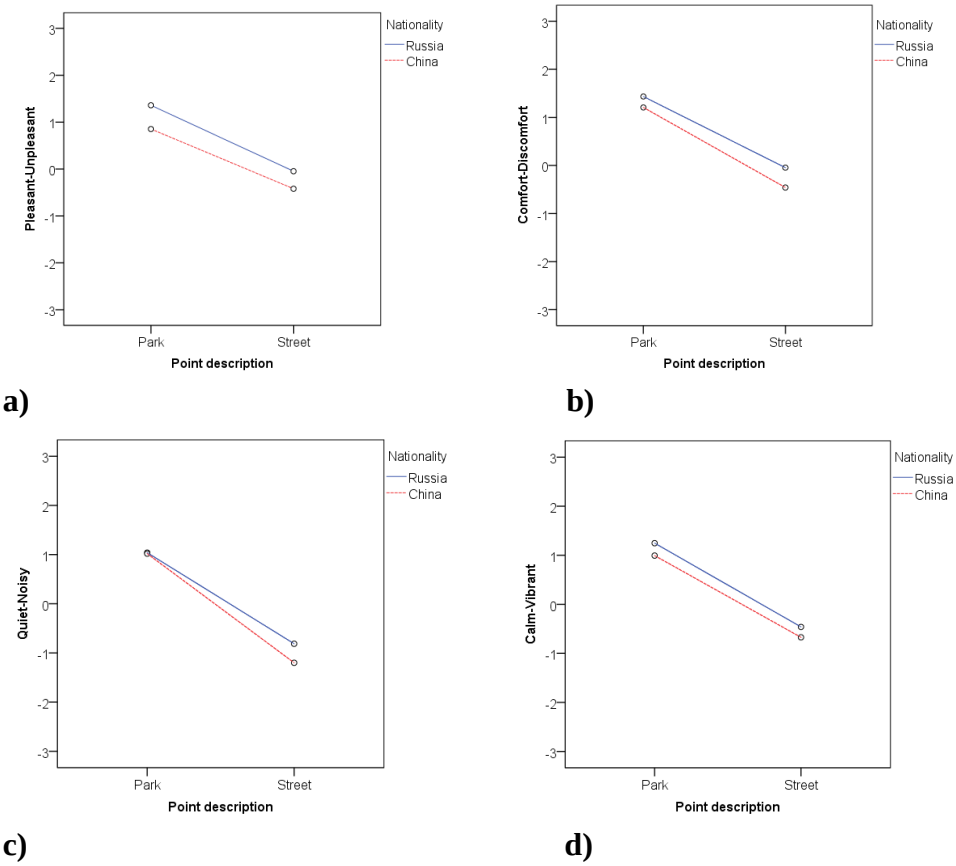
Fig.4. Soundscape rate between Russian and Chinese participants;
a) Pleasant-Unpleasant rate, b) Comfort-Discomfort, c) Quiet-Noisy rate, d) Calm-Vibrant rate e) Interesting-Boring rate, f) Like-Dislike rate, g) Natural-Artificial rate, and, h) Safe-Unsafe rate

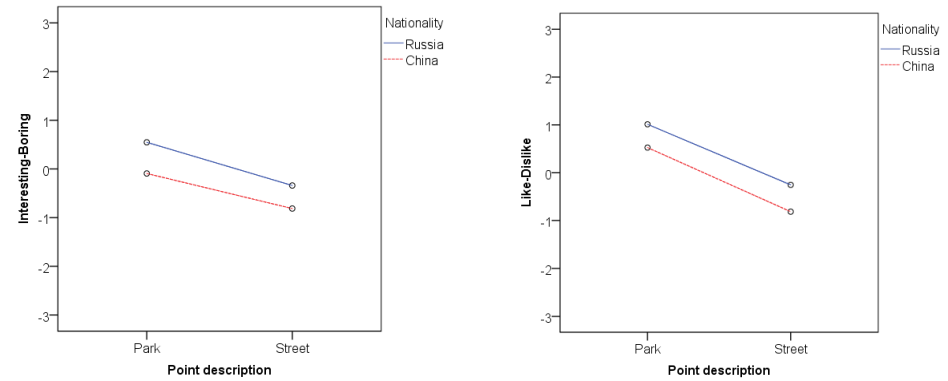
The biggest effect size had 'natural-artificial rate' and 'interesting-boring rate', which could have been caused by different cultural backgrounds. I can suggest that one of the reasons is that all participants are students, so they are young and still do not understand the traditional Chinese soundscape environment, but for Russian students, that kind of soundscape can be an interesting experience, so they see it as an adventure. Also it is likely Russian participants do not understand Chinese advertisement, conversations, and music lyrics, so popular culture does not influence them as much as it influences Chinese participants. As for Natural-artificial rate, I can suggest, that the difference might be connected with time that Russian and Chinese participants spend in the nature. Perhaps Russian participants are more familiar with nature sounds and can evaluate them differently.

We found predictable tendencies for sound pressure level and soundscape perception. The quieter the place, the higher were the levels of pleasantness, comfort, calmness, nature, and safety levels, and the more people like soundscape. This finding confirms previous studies [11].

3.2 Assessment of distinction between urban park area and street sites

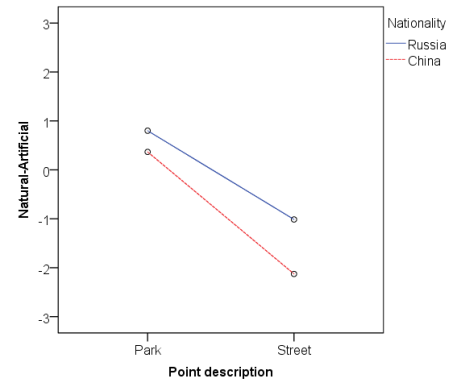
As for different sound environment in urban parks and in the streets, there was strong significant correlation found between sound environment perceptions in these two areas. Regardless of their nationality, participants found urban park soundscape more satisfying than streets. This finding is in line with previous studies (Figure 5).



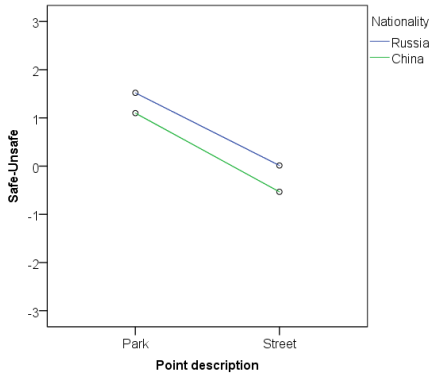


e)

f)



g)



h)

Fig.5. Perception of sound environment in Urban Parks and in the streets in Harbin. a) Pleasant-Unpleasant rate, b) Comfort-Discomfort, c) Quiet-Noisy rate, d) Calm-Vibrant rate e) Interesting-Boring rate, f) Like-Dislike rate, g) Natural-Artificial rate, and, h) Safe-Unsafe rate

3.3 Sound sources analyses

During the experiment, participants were asked in each point to rate sounds they heard from the most significant to the most insignificant. Points were chosen with different significant sounds so that we could evaluate perception of different kinds of sounds. According to received date, the most irritating sound was shop agitating sound. Regardless of their nationality, participants found this sound the most unpleasant. We noticed that this sound was part of Chinese sound environment and could be heard almost everywhere.

The most pleasant sound was the bird sound, which could be heard in some points in urban parks. That can be connected with natural people want to be closer to nature. Wind, music, footsteps, human voices sounds also received positive evaluation, unlike traffic and equipment's sounds. Also there is a tendency the closer sound, the most unlikely it is.

There were no statistically significant correlations between directionality of sound and sound perception. Maybe the reason is participants don't quite understand the meaning of 'Directional-Everywhere rate'.

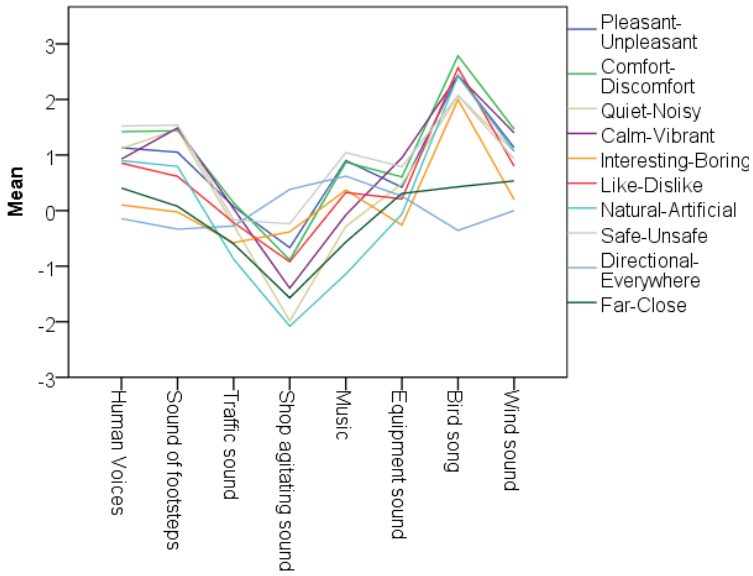


Fig.6. Perception of sound environment according to different sound sources.

4. CONCLUSIONS

This study examined cultural factors' effects on perception of sound environment in Harbin based on sound sources and sound pressure level. The results showed that there was statistically significant correlation found between Russian and Chinese participants in perception sound environment in urban open spaces. According to the data obtained, Chinese participants felt less satisfied with Harbin's soundscape than Russian participants.

Here are the main findings:

1. The strongest correlation was seen between interesting-boring rate ($t=4.254 > CV=1.645$; $p<0.01$, effect size=0.34) and natural-artificial rate ($t=4.55>CV=1.645$; $p<0.01$; Effect size=0.37), and this correlation could have been caused by different cultural backgrounds.
2. Significant correlation between sound pressure level and comfort acoustic level was found. The quieter place, the better sonic environment perceives.
3. Regardless of mentality differences, soundscape in urban parks was assessed more favourably than acoustic environment in the streets.
4. People most prefer nature sounds, such as bird songs, than artificial sounds. Shop agitating sound is the least preferable acoustic source.

Here are some of the limitations of this experiment.

1. Because of small experimental group (just 30 participants), the results can be not as accurate as they should be, so this study requires farther research including more participants.
2. Different research timing (morning, day, evening) resulted in different activities in the streets and in parks, so sound environment could have change every time. So conditions for every participants are different, it also can lead to inaccuracy.

For the farther research these factors should be taken into account.

5. ACKNOWLEDGEMENTS

This study was supported by the National Natural Science Foundation of China (51878210, 51678180)

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