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Effect of dynamic visual form on sound preference of waterscape

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ABSTRACT

Waterscape has a positive impact on the preference of public space. This study investigated three fountains in Harbin, China, to explore whether their dynamic visual form and corresponding sound rhythm change would affect the sound preference evaluation of the waterscapes. In total, 150 visitors were selected to answer a questionnaire on site, on how they perceived the fountain, including its visual and acoustic environment. It was found from the field experiment that people had different preferences for the sound of waterscape. The waterscape was then classified and subjectively evaluated in laboratory from visual and auditory aspects. The results show that, the evaluation of the rhythm of several kinds of water had little difference when there was no visual stimuli, but participants preferred dynamic visual form to steady-state continuous form, in which the significant rhythm change was more acceptant. The higher the score of visual form was, the better the evaluation of waterscape was. In general, in this study a significant positive correlation was observed between the dynamic visual form of fountain and the preference of waterscape.

1. INTRODUCTION

Many studies have been conducted on the waterscape in urban public space. According to previous field survey study in the city square, 75% of the respondents responded very well to the sound of waterscape [1]. Among the selected natural soundscape elements, waterscape sound becomes the second most popular soundscape element that is second only to wind sound [1]. In a laboratory study, combining the sound of streams and lakes with traffic noise and building noise, the evaluations were significantly better than other natural soundscape elements [2]. However, compared with steady-state waterscape sounds, people prefer waterscape sounds with higher frequency conversion, such as fountains. Among them, the water velocity, flow rate, drop height, spray frequency and impact

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interface are the main factors that affect its sound effect [3]. By studying the sounds of waterscapes in different forms, it is found that the sounds of waterscapes near fountains in parks can improve the environmental quality more effectively [4.5]. Many studies focus on acoustic while ignore the influence of visual factors on the evaluation of urban acoustic environment. Some experimental studies on audiovisual effects have shown that acoustic evaluation is greatly affected by the visual scene [6]. Due to the impact of geographical location and climate, there are few natural water landscapes in northern cities. The water feature in most urban open spaces is dominated by fountains. The research on the water feature of the fountain is worth of exploring.

In this paper, three representative fountains are selected as the research objects in Harbin, aiming at studying whether the dynamic visual form and the corresponding acoustic rhythm change will affect the sound preference of waterscape from visual and auditory aspects.

2. METHOD

2.1. Site selection and field survey

The locations of the site selection are the Sophia Church Square, Qunli Music Fountain Square and Flood Control Memorial Tower in Harbin, China. From the plan view, the three squares have their own representativeness. Sofia Church Square is surrounded by the main traffic arteries and enclosed by buildings, mainly affected by traffic noise and other noise from surrounding areas. The Flood Control Memorial Square is close to the Songhua River in Harbin, on one side next to the water, on one side next to the commercial area and main roads. However, there is a certain distance between the building complex and Fountain Square, so it is mainly affected by traffic noise. Qunli Music Fountain Plaza is located in a dense residential area. Although there are traffic roads around it, due to the large area of the square and the dense green planting, it is almost not affected by the surrounding traffic noise.

In order to collect different videos, 4-8 different measuring points were selected at each location to record the waterscape sound and images, and measured the water sound by using a sound level meter. According to the water flow form of the fountain, it is divided into two groups of steady-state continuous form and dynamic form. While recording at each test point, we conducted a questionnaire survey. There are 50 questionnaires in each location, a total of 150.

2.2. Participants

Children, adults and the elderly were selected as respondents in the on-site questionnaire survey. When the sound pressure level (SPL) is the same, people of different age groups have almost the same score on the sound comfort evaluation of the current SPL, as shown in Table 1.

Table 1: The evaluation of sound comfort

		Site 1 (Qunli)	Site 2 (Sophia Church)	Site 3 (Memorial Tower)
SPL(dBA)		78.58	77.17	80.56
Average score	Children	3.87	3.72	4.10
	Adults	3.66	3.78	3.80
	Elderly	3.73	3.81	3.96

Therefore, the subjects studied in the laboratory are young people with high hearing sensitivity. The sample size was 30, and all subjects were the randomly selected students from Harbin Institute of Technology.

2.3. Experimental Sounds

Stereo headphones were used for sound signal playback, and the TV screen was used to play different silent films of fountain. When playing sound signals, ensure that the sound pressure level is the same as the data at the time of measurement [7].

The procedure of the methods is shown in Figure 1. The experimental content was divided into the auditory group, the visual group and audiovisual group; the date was divided into steady-state continuous form, dynamic form of orderly change and dynamic form with changes consistent with background music. First, turned off the image, played three groups of different waterscape sounds, and then scored; turned off the sound, played three silent films of different fountains, and then scored; finally, played the videos of the three fountains simultaneously and scored separately.

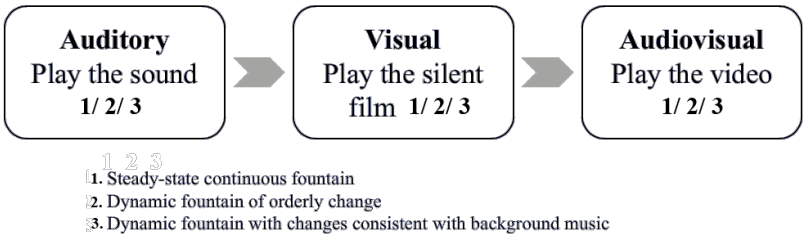

Figure 1: Procedure of the methods

3. RESULTS

3.1. Comparison of Mean Values

Through the statistics and analysis of the questionnaire, it was found that people have a certain difference in the evaluation of the waterscape sound under different visual environments. Therefore, laboratory research analyzed sound of waterscape from both visual and auditory aspects.

In the absence of visual stimulation, the rhythm of several types of water sound was evaluated, and the average score difference was not significant, as shown in Figure 2.

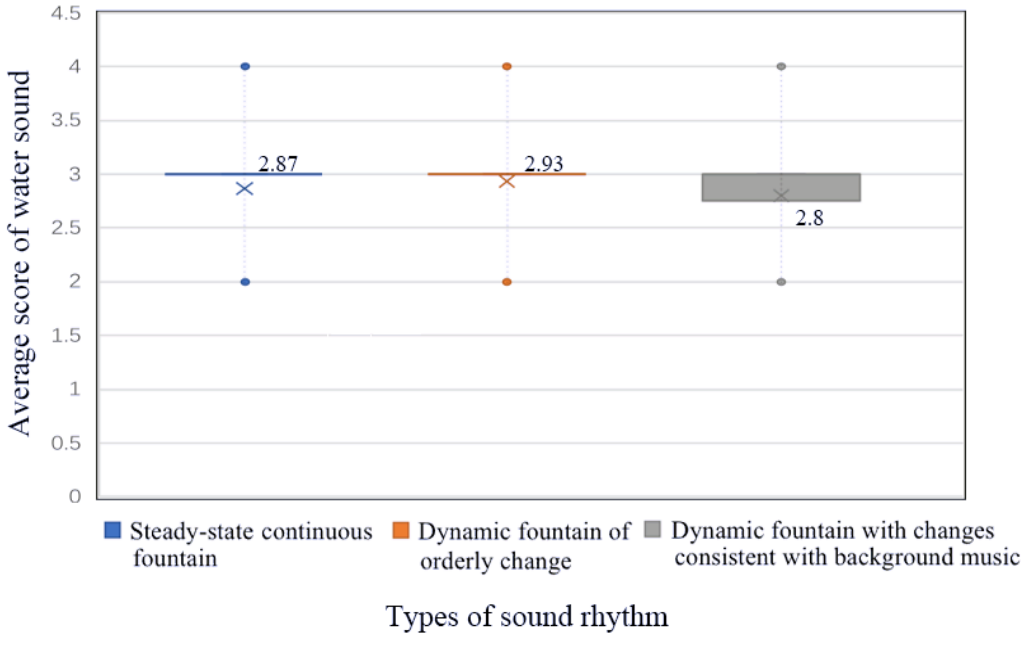

Figure 2: The average score of auditory factors on the preferences of water sound

When there is no auditory stimuli, Figure 3 shows that the dynamic waterscape is obviously more popular, and the visual preference of the waterscape consistent with background music is more prominent.

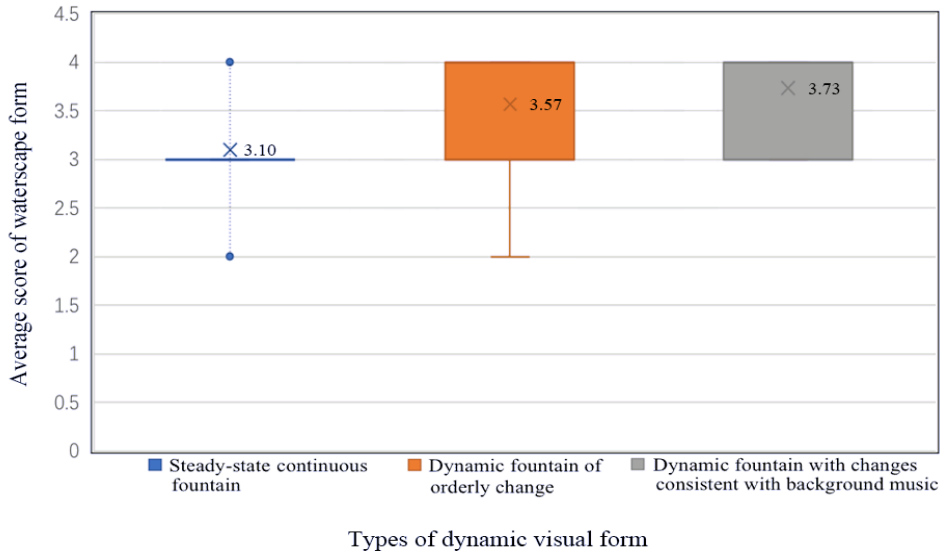

Figure 3: The average score of dynamic visual factors on the preferences of water sound

3.2. Correlations and Regression

The visual factors affected the evaluation of waterscape preference, and the influence of visual factors was higher than that of auditory factors. Figure 4 shows that adding visual factors made the increase of preference score positively correlated with the sound preference of the waterscape, and the correlation coefficients were r1=0.472, r2=0.441, r3=0.772 ($p<0.05$). The higher score of the visual form was, the better the waterscape preference was.

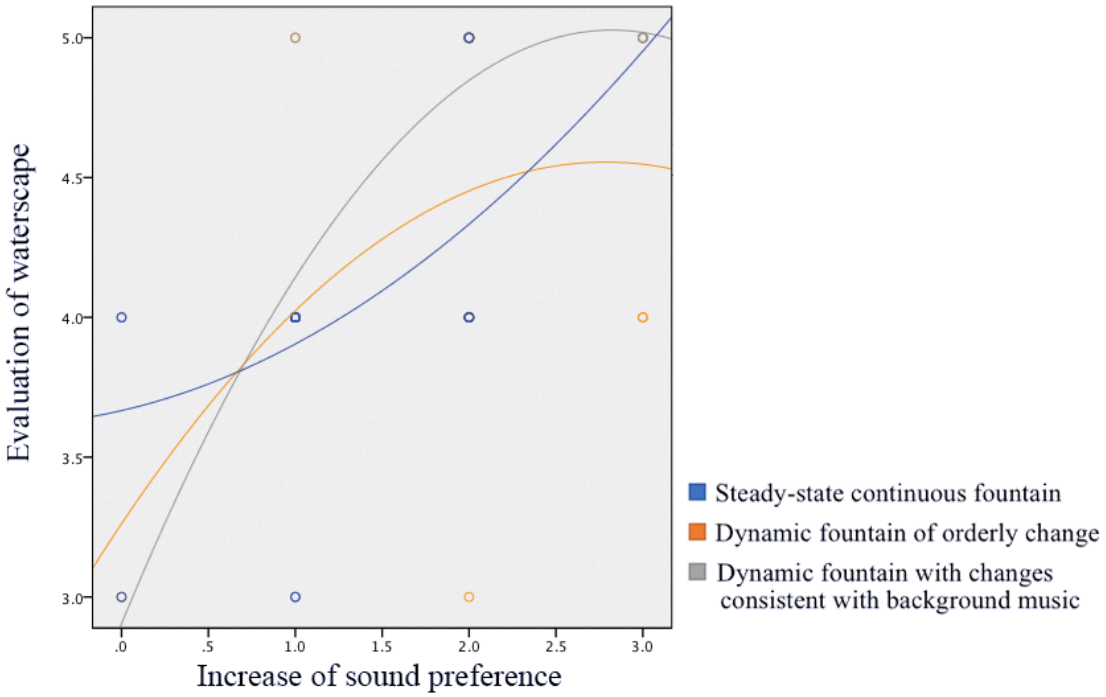

Figure 4: The influence of visual factors on waterscape preference

In the evaluation of waterscape sound preferences, the addition of visual factors increased the score of waterscape preferences more than that of auditory factors. Among them, the influence of dynamic visual form was obviously higher than that of steady-state visual form. Although adding the auditory factors can also increase the score of waterscape preference, but it is not as obvious as the visual form, as shown in Figure 5.

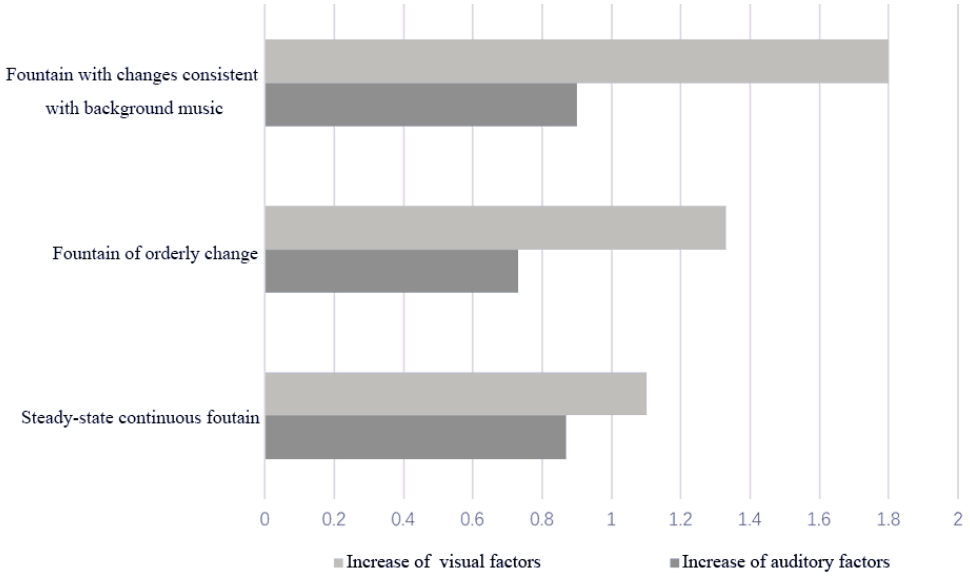

Figure 5: The influence of increasing visual and auditory factors to waterscape preference

4. CONCLUSIONS

The main conclusions of the present study are:

a) Compared with the steady-state continuous form, the dynamic visual form is more popular, especially the visual form with irregular changes and corresponding to the background music.
b) The sound preferences of the waterscape are not affected by the auditory aspects, but by the visual form of the fountain. The preference of dynamic visual form is positively correlated with the preference of waterscape sound.

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