Research Article

Sound and Shape in Chorus Performance Based on Behavioural and Cognitive Perspectives

Zhengwei Zhao[1]

Anyang Normal University

Abstract

In view of multiple attributes in chorus art, chorus performance must pay close attention to the audience's cognitive origin and aesthetic demand, while fully displaying the voices of harmony and beauty. Through timely auditory stimuli and visual perception, it can excite and stimulate the audience's cognitive and emotional experience, which creates conditions for listening to the music, understanding the works, and improve aesthetic feeling. For chorus performance, sound and shape should be well combined, which must be based on the style and theme of the work. In this paper, the related study was conducted in three aspects: the basic attributes of chorus art, audience's appreciation and cognition process, and the implementation principle of the sound-shape combination. Finally, the experiments were conducted to show the analysis results of the sound and shape in chorus performance based on behavioural and cognitive perspectives.

Keywords

Behavioural and Cognitive Perspectives • Chorus Performance • Analysis of Sound and Shape

[1]**Correspondence to:** Zhengwei Zhao (MA), School of Music, Anyang Normal University, Anyang 455000, China. Email: wewe@aynu.edu.cn

Since the earlier 1980s, following the rapid development of China's economy, China's chorus industry has been developing fast. In particular, the chorus of the masses has been taken on a delightful situation both in terms of the popularity and singing level (Bregman, Patel & Gentner, 2016; Lavranos, Kostagiolas, Martzoukou & Papadatos, 2015; Huang & Bilal, 2017). It's well known that that the form of chorus art originated from Europe has a history of 500 or 600 years in the west. While China 's chorus industry has developed considerably in less than one hundred years (Teshome & Oseikofi, 2012). Fig.1 shows the analysis framework of sound and shape in chorus performance.
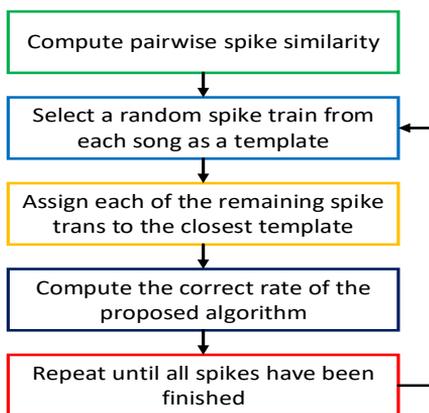
Figure 1. Analytical framework of sound and shape in chorus performances.

There is still a long way before catching up with the international advanced level. So, it's necessary to face up to this reality, otherwise the development and improvement of our country's chorus shall be negatively influenced. In addition, it's believed that in terms of the vocal training and application, there exist some different opinions due to the inconsistent understanding, resulting in the problems such as limited choral skills and styles. This should be taken seriously (Doyle, Loveridge & Faamanatu-Eteuati, 2016). The chorus, based on the art of vocal multi-voice performance, is known as the "vocal symphony". Therefore, the basic pursuit of the chorus art is to purposefully and consciously exhibit the structure and level of the musical works to the audience and embody the harmonious beauty of the human voice (Powell, 2017; Bleicher & Lindgren, 2005). However, from the perspective of audience appreciation psychology, cognitive processing and artistic achievement, chorus performance can not only focus on the performance of "sound" but ignore or despise the function of "shape". Chorus art should be based on the sound-shape combination.

The basic concept of Chorus Performance Art

Multiple attributes are the basis for the combination of chorus performances

In the art of chorus, its all forms such as mixed chorus, male chorus, female chorus or a cappella, or accompaniment chorus are performed on the basis of different combinations of human voices (Broomhead,

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Skidmore, Eggett & Mills, 2012). In this paper, the chorus is seen as a combination of multiple musical compositions, as shown below.

$$y = \sum_i S_i, i = 1, 2, \ldots, n \tag{1}$$

So, the chorus signal can be filtered in the following method:

$$f_i = g_i + \varepsilon_i \tag{2}$$

where, g_i is the signal, and ε_i is the noise

For this, the creators and performers of the chorus art not only focus on creating or exhibiting the harmonious beauty of voices, but also attaches basic importance to the entertainment of chorus performances. Fig. 2 shows the multiple attributes of the chorus performance.
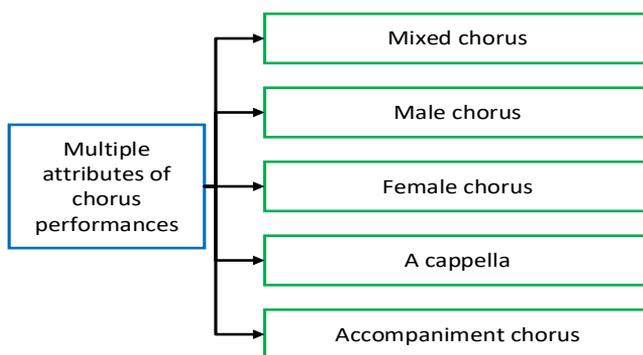
Figure 2. Multiple attributes of chorus performances.

The psychological basis of the combination of vocal performances

Auditory sense is the main organ for the audience to appreciate the musical works, so, more attention has been paid to the sound in the chorus performance. However, the results of cognitive learning show that when individuals perceive external things, the stimuli received by visual channels and auditory channels can not only transform and reinforce each other, but also promote the individual cognitive processing (Steinhart, Kamins, Mazursky & Noy, 2013; Shahvar & Tang, 2015). It realizes the integration of auditory perception and visual perception in the process of audience's appreciation, and then provides audio-visual information for the effective processing of cognitive activities, which helps to promote the selection, organization and integration of information by the audience. Two prerequisite conditions for wavelet domain filtering were proposed.

Smoothness The original signal should have very similar smoothness to the processed signal.

Fitness g is the minimum mean square error estimate.

Based on the first condition, the following conclusion can be drawn: at $N \rightarrow \infty$, if satisfying the following inequality, the case 1 will exist,

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$$\|\hat{g}\|_F \leq C_1 \|g\|_F \tag{3}$$

This wavelet domain means that the following inequality holds.

$$\left|\widehat{\theta_{j,i}}\right| \leq \left|\theta_{j,i}\right| \tag{4}$$

For the promotion of chorus art, the audience's understanding and appreciation of works, it's the basis for the chorus writers (the conductor, performance team, etc.) to spread the common sense of music and carefully create the performance situation.

The basic requirements of the combination of sound and shape for the chorus performance

Call the voice and lay the foundation for understanding

The performing and appreciating process of the chorus art is essentially a process of communication between the performer and the appreciator based on the lines of the songwriter, and its effectiveness is governed by the cognitive structure of both parties (such as music knowledge, and common sense of life) and emotional experience (such as aesthetic experience, and aesthetic standards). In the communication process, "sound" is the necessary condition for improving the performance of chorus performance, but it is not a sufficient condition; "shape" is a stimulus factor for improving the chorus performance, but not the necessary condition. The performance of some works requires the "shape" as the basis, and some works can fully interpret the works and evoke the beauty with the performance of "sound". When a performer can effectively achieve the goal of promoting audience information selection and arousing emotional experience through human "sound", or by using the application of human "sound" expression echnology, it is enough to create a psychological environment for the audience to perceive and appreciate the work; in this way, the cognitive process shall happen. Therefore, the signal estimate and the noise-free signal wavelet coefficient must satisfy the following formula:

$$E\|\hat{g} - g\|^2 \leq \gamma E\left\|\hat{\theta} - \theta\right\|^2 \leq \gamma \sigma N \sqrt{2 \ln N} \tag{5}$$

When it is an orthogonal transform, $\gamma = 1$. Then it can be derived as:

$$\frac{1}{N} E\left\|\hat{\theta} - \theta\right\|_F^2 \leq \sigma \sqrt{2 \ln N} \tag{6}$$

By formula conversion, the following results can be obtained:

$$\left|\widehat{\theta_{j,i}}\right| \leq \sigma \sqrt{2 \ln N} \tag{7}$$

Herein, the threshold is defined as:

$$t = \sigma \sqrt{2 \ln N} \tag{8}$$

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Achieve cognitive orientation by means of shape

The basic implication of this requirement is that chorus performances should be motivated by factors other than melody. The conscious, purposeful and well-designed formations, costumes, dance moves, limb rhythms, stage backgrounds and lighting changes, etc., all can evoke the audience's original cognitive and emotional experiences related to the theme of the work, and then make the proper psychological reaction when enjoying the performance. The chorus art has the natural conditions of sound-shape combined performance, which is the premise of "Evoking cognition by shapes". In many cases, the command is also the charm of chorus art, and audiences will watch how they vividly express music with aura and vitality. According to the specific points of sound and shape in the chorus performance, in this paper the following algorithm was designed to make analysis from the behaviour and cognitive perspective. Fig.3 shows the specific flow chart.
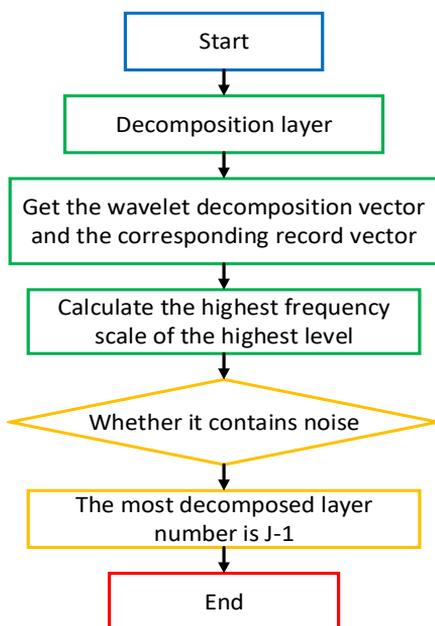
Figure 3. Flow chart of analysis method of sound and shape in chorus performance based on behavioral and cognitive perspective.

Shape auxiliary sound, sound shape knot suitability

"Sound" is the life of chorus art, and "shape" is the fine costume of chorus performance. Without the fine costumes, the vitality of the chorus can continue, but it may be difficult to acquire the audience's understanding, recognition and appreciation. Similarly, the costumes that loses vitality has no value, although it may be dazzling and amazing. The true expressive power of chorus is achieved through singing, but not performance. Some suggested that in the chorus, it should have no movement or not suitable for moving. Even if it is moving, the children's choir and the youth choir can only be moved slightly, and the purpose of the movement is to

increase the fun of the chorus performance. This thinking of the anatomical judgment for the complete chorus performance is not conducive to the healthy development and popularization of the chorus art.

Experimental Simulation

On the Matlab20lOb platform, any audio signal is read by the waveread function, and the noise is randomly generated by WlqOise. The simulation diagram is shown in Fig. 2: The return value of the audio read by the waveread function was a column matrix with a large length value. Thus, only the first 2,000 values of the column matrix were extracted for analysis. Comparing the algorithm proposed in this paper with the traditional algorithm, the results are shown in Table 1.

Table 1
Chorus Performance Prediction Accuracy

Index	Level 1	Level 2	Level 3	Level 4	Level 5
Compared algorithm 1	0.501	0.404	0.051	0.092	0.133
Compared algorithm 2	0.867	0.907	0.938	0.12	0.303
Compared algorithm 3	0.976	0.891	0.950	0.940	0.980
Proposed algorithm	0.909	0.934	0.950	0.950	0.984

It can be seen from Fig. 1 that the improved algorithm proposed in this paper is better than the traditional algorithm in predicting the accuracy of the chorus, mainly because the sound and shape analysis algorithms in the chorus performance based on behavioural and cognitive perspectives can better analyse the quality of the chorus performance.

Experiment 2: 3%, 6%, 9%, 10%, 15%, 20%, 26% of the data information were arbitrarily selected from the source data set represented by p, and then by deleting some attribute values in the chorus performance data information, the incomplete data set o was simulated. Table 2 lists the simulation results under different parameters.

Table 2
Incomplete Data Mining Indicator Data in the Example of Enterprise Performance

Factor	Value	Factor	Value	Factor	Value
g_1	13.6	g_6	23.4	ε_1	0.45
g_2	84.5	g_7	0.87	ε_2	0.34
g_3	43.2	g_8	0.65	ε_3	0.43
g_4	1.9	g_9	Good	ε_4	7.4
g_5	1.6	g_{10}	0.17	ε_5	Good

It can be seen from Table 2 that the sound and shape analysis algorithm in the chorus performance based on behaviour and cognitive perspective proposed in this paper is better than the traditional algorithm in terms of the filling accuracy of the missing big data, because the improved algorithm uses the entropy value in the information theory and use the attribute values of the same type of complete data information to analyse the chorus performance, thereby enhancing the accuracy of the improved algorithm for the chorus performance. Besides, the analysis was made for the relationship between the prediction accuracy and time of the sound and shape analysis algorithm in the chorus performance based on behavioural and cognitive perspectives. Table 3 lists the specific analysis results.

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Table 3
Time Analysis of Acoustic and Shape Analysis Algorithms in Chorus Performance Based on Behavioral and Cognitive Perspectives

Time	Predictive value	95% confidence interval	
2017/6	0.944 9	0.326 1	1.563 8
2017/7	0.955 7	0.336 8	1.574 5
2017/8	1.000 0	0.381 7	1.620 1
2017/9	0.987 9	0.368 4	1.607 3
2017/10	0.973 9	0.341 5	1.606 3

It can be seen from Table 3 that with the increase of usage time, the analysis accuracy of the sound and shape analysis algorithm in the chorus performance presented in this paper shows an overall upward trend, and even can reach 100% accuracy at some time points, fully demonstrating the effectiveness of the proposed algorithm. In order to better analyse the algorithm proposed in this paper, the performance of different algorithms under the specific conditions of different chorus performance factors was compared. The specific results are shown in Table 4.
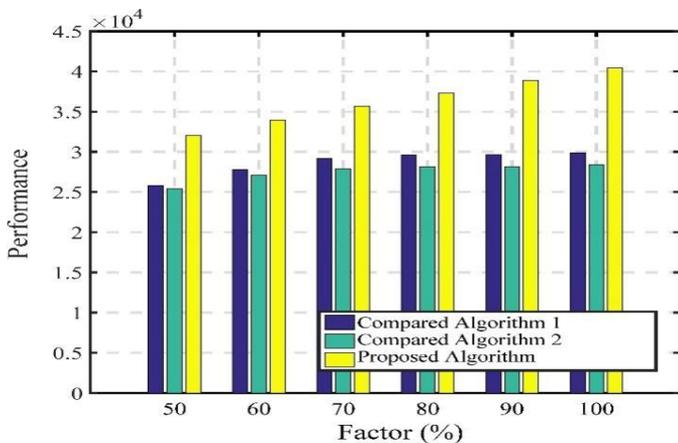
Figure 4. Performance of sound and shape analysis algorithms in chorus performances based on behavioral and cognitive perspectives.

It can be seen from Fig. 4 that the analysis algorithm of sound and shape in the chorus performance in this paper is higher than the comparison method in terms of performance. As the chorus performance factor increases, the method proposed in this paper can effectively improve the performance of the chorus performance.

Conclusion

The combination of sound and shape in the chorus performance is an essential factor that has a significant influence on the performance of the chorus performance. Ignoring or denying its existence will simplify the second creation of the chorus works, and even form an invisible fence between the performer and the viewer.

However, the combination of sound and shape must be meaningful and valuable, and it must be understood well. It is the basic essence of the sound-shape combination in the creation of chorus performances to respect the originality and ensure reasonableness and moderation. In this paper, the experiments were finally made to verify the effectiveness of this sound-shape analysis algorithm in the chorus performance based on behaviour and cognitive perspective.

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