

# The Application of Music in Opera Stage and Virtual Art Training Based on Multiple Regression and Utility Function

Zhiyong Huang

School of arts, Sichuan University of Science and Engineering, Zigong, China

h\_uang\_zhiyong@126.com

**Keywords:** music, marginal utility decline law, expert assessment method, opera, virtual art training

**Abstract.** Music plays an important role in operas and virtual art training and this article explains the music applications in different aspects. Music and performing are the two cornerstones in opera coordinated development. Through analyzing the utility function and marginal utility function of the audience attraction to the performance, the utility function of the audience to the music will be got, which states that the music application in opera stage differs in different periods. The music has improved the virtual art training. This article regards learning time, actual operation capacity, teaching interaction and timeliness of teaching, which are the 4 concerned aspects of virtual art training, as the study objects. Multiple linear regression function and expert assessment methods are employed to analyze the effects of the music on the four aspects; taking the animation training as an example, the musical application analysis to the virtual art training is ultimately got.

## The impact of music on the operatic stage

### A. Introduction

Opera<sup>[1]</sup> is originated from Italy with over 400 years' history. Initially its aim was to satisfy the nobles' needs, which was focusing on entertainment and sociality. After the disclosure to the public, the opera began to think highly of the development. The content and plots, music and performance, makeup, finery and stage light, and the scenery have made this art fashionable all over the world.

The main factors which make the opera fascinating the audience include the musical integrity, independence, ideological contents, performing accuracy, cooperation and popularity. Therefore, in order to continuously improve the status of the director and conductor, the coordination of music and performance<sup>[2]</sup> is required.

### B. Set up utility function and marginal utility function

#### 1) The utility function and marginal utility of the attractiveness of music for the audience

Suppose the attractiveness of music for the audience  $y_1$  is the dependent variable and the perfection (the integrity, independence and ideological content) of the music  $x_1$  is independent variable; establish utility function<sup>[3]</sup>

$$y_1 = f(x_1) \quad (1)$$

In the opera, if any of the music integrity, independence and ideological content increases, the attractiveness will be increased, which (1) is increasing function. When the perfection of the music continuously increases, the attractiveness of the music for the audience will be increased constantly; when the perfection reaches a certain level, audience will increasingly look forward to the perfection of the performance.

For example, a hungry person will feel very effective when he eats the first steamed dumpling. With the number of the steamed dumplings eaten increasing, he will feel more enough, but actually the marginal utility that each one he eats is declining. When he is full, the total utility is reaching maximum, but the marginal utility is declining to zero. If he continues to eat, he will feel uncomfortable. That means the marginal utility declines to negative value and the total utility is therefore declining. Similarly, when the perfection of the music continues to increase, the marginal attractiveness of the music for the audience

$$y_1' = \frac{dy_1}{dx_1} \quad (2)$$

will decline, which is the expression of the marginal utility decline law in economics.

2) *The utility function and marginal utility of the attractiveness of performance for the audience*

Suppose the attractiveness of performance for the audience  $y_2$  is the dependent variable and the appropriate performance (the accuracy, cooperation and popularity) of the performance  $x_2$  is the independent variable; establish utility function

$$y_2 = f(x_2) \quad (3)$$

The marginal utility function of the attractiveness of performance for the audience is

$$y_2' = \frac{dy_2}{dx_2} \quad (4)$$

Similarly, the better the actors play, the bigger the attractiveness for the audience  $y_2$  is. When  $y_2$  reaches a certain level, the need for the perfection of the music required by the audience will be intensified and the marginal utility value will decline.

C. *Searching for the perfect coordination between the music and performance*

In order to make the opera more attractive, we should coordinate the music and performance, which means that the total utility of attractiveness of music for the audience and that of the attractiveness of performance for the audience should unanimously reach to the maximum. Due to the marginal utility decline law, the same total utility may correspond to different investment and marginal utility value.

From the questionnaire of one opera in the situation of constant improvement of accuracy, cooperation and popularity, the original data is shown in table 1 below

TABLE I. THE TOTAL UTILITY AND MARGINAL UTILITY IN DIFFERENT LEVELS OF PERFORMANCE

Level of Performance	Total Utility	Marginal Utility
0	0	
1	10	10
2	18	8
3	24	6
4	28	4
5	30	2
6	30	0
7	28	-2

Taking the level of performance as the horizontal axis and the total utility as the vertical axis, Figure 1 of total utility is got.

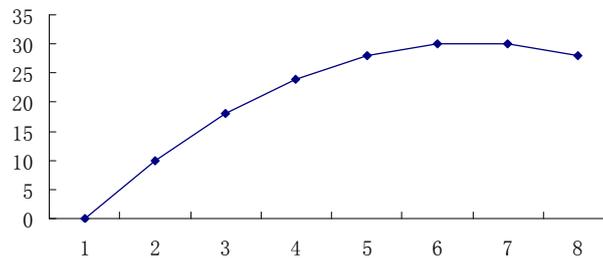


Figure 1. The Graph of Total Utility in Different Level of Performance

From this figure, when the total utility is 28 or 30, we have two levels of performance, which means the performance should coordinate with other factors of the opera. If you just pay much attention to one aspect, you may work fruitlessly and even influence the overall performance of the opera.

Taking the level of performance as the horizontal axis and the marginal utility amount as the vertical axis, figure 2 of marginal utility is got.

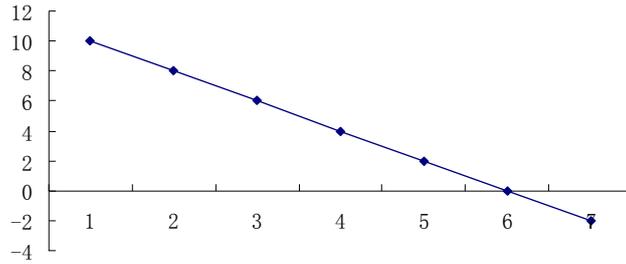


Figure 2. The Graph of Marginal Utility in Different Level of Performance

Using Matlab to have data difference fitting in Fig. 1, the utility function of attractiveness of performance for the audience can be got as below.

$$y = -x^2 + 12x$$

And the marginal utility function is as below

$$y = -2x + 12$$

To sum up, we should coordinate the music and performance perfectly, which means that when the total utility of attractiveness of music for the audience and that of the attractiveness of performance for the audience unanimously reach to the maximum, the perfection spot is located in the curves when the corresponding marginal utility value is more or equal to zero.

#### D. Conclusion

The main factors opera attracting audiences are integrity, independence and ideological content of the music and the accuracy, cooperation and popularity of the performance. Only by coordinating the music and performance, can the opera stage develop. The different social background and actors can influence the acting, makeup, finery, light, scenery and even the significance of the music on the opera stage. That is to say, the music is inevitable in the opera and the style of it is changeable in different periods.

### The music application in virtual art training

Virtual art <sup>[4]</sup> refers to the creation in the virtual world by using computer technology. Its works exist in the virtual forms and its main object is the exchanges among the artists, audience and software. The virtual technology <sup>[6]</sup> in the digital art <sup>[5]</sup> is using the computer as the creation platform. Through the imitation, students can see and hear many things, such as the stars, atoms or particles.

Taking the design art for example, widely spread and accepted is the representation of the vitality of the design art. Like many other artworks, the virtual art should be realized by carriers or tools, such as paintings, music and dramas, etc. Therefore, music plays an essential role in the virtual art training.

In macroscopic view, training is the important part of human resource. In microscopic view, the object of training is to improve people's working ability. Compared with virtual art education, virtual art training should pay more attention to the following four aspects:

- (1) The short learning time;
- (2) Improving the practical operation ability;
- (3) Paying attentions to teaching interaction;
- (4) Paying attentions to the timeliness of teaching.

Music has influenced the four aspects differently and the more impacts have more benefits to the virtual art training, which leads to the effectiveness improvement of the music to the virtual art <sup>[7]</sup> training. We suppose the effectiveness of music to virtual art training  $z$ , learning time  $t_1$ , practical operation ability  $t_2$ , teaching interaction  $t_3$ , and timeliness of teaching  $t_4$  are independent variables and establish a four in one linear regression function, which is as follows,

$$z = \omega_1 t_1 + \omega_2 t_2 + \omega_3 t_3 + \omega_4 t_4 \quad (5)$$

$\omega_1$ ,  $\omega_2$ ,  $\omega_3$  and  $\omega_4$  are respectively the weights and should satisfy (6) which is

$$\omega_1 + \omega_2 + \omega_3 + \omega_4 = 1 \quad (6)$$

The virtual art training [8] requires the time, practical operation ability, teaching interaction and the timeliness of teaching differently, which leads to the different contribution rate of music to the four aspects. We use our expert assessment method to assure the weights  $\omega_1$ ,  $\omega_2$ ,  $\omega_3$  and  $\omega_4$ .

In order to analyze the music application in virtual art training, in this article we assess the significance of music in animation training for the college students. The data is shown in Table 2.

TABLE II. THE SIGNIFICANCE OF MUSIC IN ANIMATION TRAINING

Learning Time	Practical Operation Ability	Teaching Interaction	Timeliness of Teaching
25%	34%	82%	68%

Then we invite 3 experts to assess 4 indications as following steps:

Step 1: Inviting each expert to score 4 indications and assuring the total score of the 4 indication is 100;

Step 2: Calculating the average of each indication and the result showing in Table 3;

TABLE III. THE ASSESSMENT RESULT FROM EXPERTS

Indication	Expert A	Expert B	Expert C	The Average Value
Learning Time	40	10	20	23.33
Practical Operation Ability	10	30	20	20
Teaching Interaction	20	40	35	31.67
Timeliness of Teaching	30	20	25	25

Step 3: Calculating the weight of each indication

The weight of Learning time is  $\omega_1 = \frac{23.33}{100} \approx 0.23$

The weight of practical operation ability is  $\omega_2 = \frac{20}{100} \approx 0.20$

The weight of teaching interaction is  $\omega_3 = \frac{31.67}{100} \approx 0.32$

The weight of timeliness of teaching is  $\omega_4 = \frac{25}{100} \approx 0.25$

And the weighted relation we got should satisfy (6).

Put the data in Table 2 and Table 3 into formula 5, then the music application effectiveness in animation training can be got as below,

$$z = 0.23 \times 25\% + 0.20 \times 34\% + 0.32 \times 82\% + 0.25 \times 68\% = 0.5579$$

This indicates that music plays a comparatively important role in animation training and further shows that the virtual stage art training and the music are inseparable. The music application differs in different virtual stage trainings.

## Acknowledgements

The work is funded by Sichuan Humanities and Social Sciences Key Research Base and Yi Culture Research Center Project (project number: YZWH0916).

## References

- [1] Qian Yuan, Outline of Opera written by Lin Hua, Shanghai Music Press, 2003
- [2] Zhou Zhengzhong, The Opera Stage Arts and Development [D], Shanghai Conservatory of Music, 2010: 6-10
- [3] Gao Hongye, Western Economics [M], Beijing: Renmin University of China Press, 2007
- [4] Hu Xiaoqiang, Virtual Reality Technology [M], Beijing: Beijing University of Posts and Telecommunications Press, 2005
- [5] Chen Wangheng, The Aesthetics of Art and Design [M], Wuhan, Wuhan University Press, 2000
- [6] Lin Hua, Art and Design of Computer Graphics [M], Beijing, Tsinghua University Press, 2005
- [7] Zhang Yi, Lipu Quanmin, Chen Jingquan, Virtual Epistemology [M], Shanghai, Academia Press, 2003
- [8] Liu Hongbo, Contemporary Aesthetic Dimension of Digital Virtual Art [J], 2008