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Influence of Virtual Reality Technology on Audience's Performance Behavior of Stage Music Performance Art

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Keywords: Virtual Reality Technology, Stage Performance, Watch the Performance, Relationship between Watching and Performing

Abstract: Stage performance art has a long calendar, its cultural heritage is deep, and its strong infection form is loved by the audience. Under the new stage of micro media, however, the impact of the new stage is increasing. With the gradual loss of customer groups, the emergence of virtual reality technology has brought new life to this field. At the same time, the traditional relationship between watching and performing is also changing. However, the research on virtual reality technology and audience behavior of stage performance is almost blank. In view of this situation, this paper puts forward the research on the impact of virtual reality technology on audience performance behavior of stage music performance art. This paper is divided into three parts; the first part is theoretical research. Through the research, this paper believes that the traditional stage performance art has great market potential, but its development needs to combine with the latest science and technology, and the emergence of virtual reality technology makes the audience have a new experience. The second part is the model design of stage performance based on virtual reality technology, which optimizes the shortcomings of existing 3D display performance. In this paper, through the optimization of stage model making, motion simulation and control design, the comprehensive performance of the model is improved, and the display effect is greatly improved. The third part is the comparative test, which further verifies the actual effect of the model in this paper through the way of comparative experiment. The experimental analysis mainly focuses on the following, fluidity, diversity, collectivity and independence in the performance observation. Through the analysis of experimental data, we can see that the stage performance using virtual reality technology can bring a new immersive experience to the audience, which is more popular than the traditional performance form.

1. Introduction

Throughout the history of stage music performance art, its progress is closely related to technology. Since the prosperity of ancient Greek drama, in the mature stage of music performance

art in the 6th century B.C., theater architecture, stage machinery, lighting system and modern mechanical recording technology have brought profound changes in the form of expression and even the concept of stage music performance. The development of theatrical architecture and stage machinery technology provides the material basis for the imitation and illusion of drama. The use of lighting on the stage in the 1880s marks the emergence of various schools of anti-naturalism and realism in the early 20th century. The film art produced by mechanical recording technology is the cousin of drama art, which arouses people's memory of the essential characteristics of drama. It can be said that the history of the emergence and development of music on the stage, the emergence of each special stage performance form. Every important stage performance style transformation and every important evolution stage directly or indirectly affects the development of science and technology, which is particularly prominent in modern times. In recent decades, information technology has provided great impetus for the innovation of traditional stage music performance.

Virtual reality is a kind of special computer information technology. Since the concept of virtual reality was put forward, it has set off a research upsurge in the field of information science and industry. People's enduring enthusiasm for this emerging technology is due to the fact that virtual reality itself has a set of new features, which adds great attraction to its applications. Virtual reality provides people with a computer-generated world, giving them multiple sensory feedbacks, immersing them in it and interacting with it in a natural way. He can make human experience and experience the events that have happened or have not happened in the world, and can observe and study the occurrence and development process of the same event under various assumptions. It can be explored and studied in macro and micro fields that human physiological conditions cannot reach, and provides new methods and means for human beings to understand and transform the world. The mature application of this technology will create a highly realistic and immersive virtual space for human beings. The audience can directly enter the virtual world and interact with it.

There is a delicate and complex relationship between the performance of traditional stage art and the audience. It flows in the three stages before, during and after the performance, and is cultivated in the field community formed by theater, audience and stage. It develops between audience and audience, audience and actor, actor and actor. With the wide application of virtual reality technology, the traditional relationship between watching and performing has also been greatly changed. At present, there is almost no research on the performance behavior of stage performance based on virtual reality technology at home and abroad. In view of this situation, this paper puts forward the research on the influence of virtual reality technology on audience's performance behavior of stage music performance art.

First of all, this paper studies the basic theory and core concepts of stage performance art and virtual reality technology. Through the research, this paper believes that the traditional stage music performance, with the support of new media technology, has a great change in the relationship between the performance and the performance, and it is of great significance to study the audience behavior under the virtual reality technology. Then, this paper establishes a stage music performance model based on virtual reality technology, which adjusts the form of performance on the basis of traditional performance mode. The method of this paper is 3D display technology based on virtual reality technology. Through the optimization of motion simulation and control, key frame module design and other aspects, it achieves the effect of high simulation and gives the audience immersive experience. In the third chapter, the design principle and improvement method are given in detail. Finally, in order to further verify the actual effect of the model, this paper carries out a comparative test by means of simulation experiment. The test was divided into the experimental group and the control group, the two groups used the same script, the same time, and under the condition of the same level of actors. There were 500 people in each group, and their watching behaviors were recorded. Through the analysis of the statistical data, we can see that the audience's

behavior is more active and active when using virtual reality technology. Among them, conformity and mobility are particularly prominent. Therefore, this paper believes that with the help of virtual reality technology, the traditional relationship between watching and performing has been changed, and the interactivity and interest of performance have been increased, making it more popular with the audience [1-3].

2. Basic Theory and Core Concepts of This Paper

2.1. Summary of Stage Performance Art

Stage art refers to the art of performing on the stage. Performance art is an art that creates images, conveys emotions and emotions to express life through human singing, performing or body movements and expressions. Performing arts include dance, song, drama, quyi, modeling, acrobatics, magic, drama, etc. The representative categories of stage performance are singing and dancing, but acrobatics, crosstalk, magic, modeling and drama are usually included in the performing arts. Stage performance art is a kind of comprehensive art form which takes stage as carrier and performs through actors' secondary creation. With the development of history and culture, traditional and modern performances such as national dance, folk dance, ballet, singing, drama, opera, etc. have become important forms of stage performance art.

Taking drama performance as an example, actors write according to the script, respect and strive to improve the roles in the script. The "respect" here is not a repetition of the rules, but a "recreation" of the author's ideas and his own understanding. An excellent actor is to use this "re-creation" to interpret the characters in the readers' hearts on the stage, so that the characters can jump from the paper to the stage. According to their own cultivation and understanding of the role, the actor dominates the life of the character. The vitality of the role on the stage is also combined with the actor's perception and experience of his own life. Therefore, without the actor's "second creation", no role will be born. To play a role is to immerse you in the play and reflect another self on yourself, just like a thousand Camel Xiangzi in a thousand people's hearts. There is no one with the same personality in the world, and there is no reason to have a role without personality. Performing art is to reproduce human behavior in the environment of art fiction. Actors play roles and create images. This is the purpose of Performing Arts [4-6].

2.2. Noumenon Characteristics of Stage Performance Art

(1) Indivisibility of production and consumption

The intangible property of performance products determines that the audience cannot consume materialized goods, but consume at the same time of art production. Therefore, stage art is inseparable from production and consumption. This puts forward higher requirements for the audience to watch the performance, the decision-making behavior of buying tickets, and the maintenance of "after-sales service" of the audience.

(2) Non replicability

Stage performance art has a strong dependence on the service of people, and there is uncertainty in every art production (performance process). Therefore, each performance is unique and cannot be copied. First of all, different from the general tangible goods pipeline replication, due to different operation time, location and equipment performance, repeat the same performance in different time and space cannot be completely consistent, so it is difficult to ensure the accuracy of each performance. Secondly, different from the visual art exhibition based on tangible works, due to the different audience participation and timely feedback, the emotional transmission and expression rhythm of each performer on the stage is also different, which is unstable and cannot be copied.

(3) The particularity of spiritual products

As a kind of spiritual product, art is difficult to be measured by a unified standard. Stage art has a strong artistic quality. Different audiences will make opposite comments on the same work due to different professional background, age, culture and economic conditions. Therefore, the development, expansion and maintenance of stage art audience are more difficult and essential.

(4) Quasi publicity.

In the face of market failure, public goods need to be solved through budget investment, and cannot pass the market test independently. As a quasi-public product, performing art is difficult to achieve the balance of supply and demand through market regulation. In addition, its externality cannot be fully evaluated in the general market. Therefore, in the supply of quasi-public products such as stage performing arts, the principle of sharing between the government and the market is adopted. Public support and subsidies from the state, enterprises and individuals can help the Performing Arts alleviate the economic pressure and better survive [7-9].

2.3. An Analysis of the Characteristics of Watching Performance

(1) The same time and space

In the theater, the interaction between the audience and the actors is always in a dynamic balance. When a play is staged, the audience and actors are synchronized in time and space. The actors bring the contradictions, conflicts and rich inner activities of different roles into the drama. On the stage, the audience feels the joy of synchronized artistic creation with the actors, which is a special interaction between watching and performing.

(2) Long time performance

A performance or concert can be as short as one hour, or as long as two or three hours. In addition to "the same time and space", performance watching behavior also has the characteristics of "long-term" continuous performance watching. Throughout the performance, the audience needs to stay in the audience and stay focused for a long time. People in a long-term stable psychological environment, lack of certain stimulation, will feel psychological fatigue. And will be too much stimulation, people cannot concentrate, so in the performance space, the audience needs moderate psychological stimulation.

(3) Interaction between audience and actors

Based on the characteristics of interaction between audience and actor, the behavior development of "watching" and "acting" is not linear, closed and single, but has the characteristics of "common characteristics", which is one of the most critical feedback behaviors in interaction.

(4) Interaction between actors and actors

The psychological transmission between actors is "direct communication", which is inevitable after the creation of characters. No matter which actor is the scene of the play, he exerts influence on other actors and accepts and feels their influence. The interaction between participants and participants is very important. Any interaction between actors and actresses on the stage must be supported and responded by the collaborators. This interaction can be captured from the conversation of the other party, and the change of expression can be detected. In theatrical performance, there are many kinds of dramas in which couples are used. The tacit understanding and cooperation between the two sides determine the success or failure of the performance, which is also an important interactive link in drama activities.

(5) Interaction between audience and audience

The interaction between the audience and the audience is more reflected in the mutual infection and influence between the audiences. It is found that the interesting part of the drama is always found and amused by the audience first. Their laughter startles their neighbors and makes more

people laugh. In group psychology, it is an emotional contagion. Although the age, identity, education level and even race of the audience sitting together in the theater space are very complex, in the theater, they are collective. In group psychology, this group is divided into loose groups. The appeal of this group will produce stronger magnetic field in the whole space, infect the emotion between groups, and deepen the understanding of drama [10-12].

2.4. Virtual Reality Technology and Stage Performance

Virtual reality is a technology concerned by the scientific and engineering circles in the 1990s. Its rise has opened up a new research field for the development of human-computer interaction interface. It provides a new interface tool for the application of Intelligent Engineering: a new description method for large-scale data visualization of various projects. In 1993, some experts put forward the triangle of virtual reality technology, which can be divided into the following three parts.

(1) Immersion

It refers to the extent to which the audience can feel the existence of the protagonist in the virtual environment. The most challenging task is not only to attract people's eyes to produce visual shock, but also to attract other senses. It can activate all kinds of sensory organs to mobilize all memories and generate the sense of being in the scene.

(2) Interactivity

It refers to the degree to which the audience operates objects in a virtual environment and gets real-time feedback from the environment. After the audience enters the virtual environment, they interact with the multi-dimensional information environment through various sensors and carry out necessary operations. The response in the virtual environment is the same as that in the real environment.

(3) Imaginative

It is emphasized that virtual reality technology should have a wide space of imagination, which can broaden the scope of human cognition. It can not only reproduce the real environment, but also conceive the objective environment that does not exist or even cannot exist. Immersed in the virtual reality system, users can get perceptual and rational knowledge from the qualitative and quantitative integrated environment, so as to deepen the concept, germinate new ideas and realize the leap of cognition.

The virtual stage virtual reality system can realize the dynamic simulation of 1000 people rehearsal, which also paves the way for the director to achieve creative arrangement. Using artificial intelligence and human-computer interaction technology to assist the director in the creation, modification and adjustment of the opening and closing ceremonies. Secondly, virtual reality technology can help the director to adjust the scheme and panoramic display 3D dynamic performance scheme at any time, and provide reference for the pre-trial and director. Finally, wireless communication and multimedia technology can be used to realize the audio and video communication between the director and the live director, so as to help the editor understand the director's intention at the first time. The use of information management technology can also achieve performance process management, performance personnel management, clothing and props management, schedule management, team scheduling, etc. [13-15].

3. Stage Music Performance Design Based on Virtual Reality Technology

3.1. Stage Model Making

Model design is the first step of 3D technology display. As long as the 3D model of the object is

made, the subsequent model rendering and display can be carried out. The level of 3D display technology is reflected by the quality of model design, so we must pay attention to it. In the process of model design, design as few faces as possible to facilitate the post-processing of the model. At present, all the details in the process of representation are realized by model mapping in the later stage. The fewer faces the model uses in the design process, the faster the computer processes the model and improves the output speed of subsequent models. Model design is the first and key step of 3D technology. Reasonable and indirect design results can effectively improve the output quality of the model, thus affecting the effect of the model in the stage rendering.

In the stage model design process, the software provided by the standard model, such as sphere, cuboid and cylinder should use 3DMAX to design projection model. Then draw, rotate, loft and scan commands provide software that should be used to complete the modeling of planar graphics. Generally speaking, the above two methods can complete the modeling and processing of common models in stage design, and 3DMAX software is used to complete the design of three-dimensional models such as stage surface, lifting platform, platform opening and boom [16-17].

3.2. Motion Simulation and Control

In the subsystem, the group parameters, environment parameters and motion constraints of each group of virtual human need to be set. The interpreter interprets these different parameters and calls different motion simulation algorithms according to the parameter settings. Interpreter needs to explain the content of driver formation, which is actually called motion simulation algorithm, including path construction algorithm, collision avoidance algorithm and lead tracking algorithm.

The driving mechanism is that users provide event parameters to the simulation algorithm library to call one or more group behaviors. The control parameters of the algorithm are used to control the behavior of each virtual human grouping. Each virtual human can be organized as a whole, and the movement of each virtual human can be controlled in real time by using multiple control parameters. The ultimate goal of this process is to enable users to drive the entire simulation process by controlling a few advanced event parameters (rather than hundreds of individual parameters) [18].

3.3. Design of Key Frame Module

Key frame is the performance formation state formed by the standing position of virtual human at a certain time in performance scheme design. It is an important part of this research and an important part of intelligent information system. In this paper, the virtual human in the key framework has two logical organization modes: the organization mode based on graph unit and the organization mode based on grouping unit. From the logical point of view of graph, virtual human can belong to a graph in the key frame, and all virtual human belonging to the graph can be managed uniformly through the graph. From the perspective of logical grouping, each virtual human must belong to a group in the key frame, and all virtual people in the group can be managed uniformly through logical grouping [19-20].

Based on the above two organizational forms, the key framework design model should meet the following consistency requirements:

(1) The same virtual human may belong to two different organizational forms, which can be retrieved and managed by meta entity or logical grouping entity.

(2) If an organizational unit modifies the attributes of virtual personnel, the attributes of virtual personnel in another organizational unit should also be updated in time.

(3) No matter how to delete the virtual person, it is necessary to check and update the two organizational forms in the keyframe to ensure that no objects are deleted.

In order to meet the above three unified requirements, the key frame is used to store all the

virtual human information independently, and the logical grouping and graphic elements are stored by the index ID of the performance key frame of the virtual human model. This can not only reduce the storage space, but also effectively achieve the requirements of unified management.

3.4. RGBA Color Mode

Color is essential for creating realistic graphics. The color of an object depends not only on the object itself, but also on the light source, the color of the surrounding environment and the visual system of the observer. Color model is a subset of visible light in three-dimensional color space. Using RGB color model in openGL, add alpha component (or a) to become RGBA color model.

In RGBA mode, the hardware allocates a certain number of bit planes for R (red), G (green), B (blue) and a (alpha) components, but the number of bit planes for each component is not always the same. In general, the values of R, G, and B are stored as integers rather than floating-point numbers. Access to these values is proportional to the number of bytes available. R, G, and B must be between 0.0 (minimum strength) and 1.0 (maximum strength). When r = 0.0, g = 0.0, B = 0.0, the color is black. When r = 1.0, g = 0.0, B = 0.0, the color is red. When r = 1.0, g = 1.0, B = 1.0, the color is white. The mixture of green and blue produces cyan, while the mixture of blue and red produces magenta. openGL uses the glcolor * () command in RGBA mode to select the current color.

3.5. Virtual Preview Shooting System Architecture

When a large number of virtual reality technologies are applied to simulate scenes and character animation, virtual environment can perfectly combine various objects and images for real actor performance. This kind of pre synthesized image effect can be displayed on the monitor, which is convenient for each department to directly control the scene.

The virtual preview shooting system is mainly composed of camera, optical positioning sensor, track inertial positioning sensor, portable system host, tracking icon (optical positioning mark) position calibration system, etc. In this system, the performance of the camera in front of the blue and green screen is collected in the studio foreground video signal. The camera is installed on the positioning and tracking system to obtain the camera position and posture information, and then transmitted to the real-time image synthesis graphics workstation. The workstation will match the position and posture information of the virtual camera and render the corresponding virtual background in real time. At the same time, the blue and green foreground video screen shots of the background will be delayed. After treatment, the 3d background generated by the rendering graphics workstation will work and synthesize synchronously, and the synthesized video image signal will be generated in real time. The actor's live performance and computer-generated three-dimensional scene can be real-time synthesized, and the real-time composite picture can be timely fed back to the director, photographer and actor to help the photographer adjust the shooting and the actor to adjust the performance action.

3.6. Realization of Virtual Display

The system realizes a kind of immersive virtual reality, that is, it provides a kind of roaming based on Microcomputer Platform. For ordinary microcomputers, the interactive tools of program response are mainly keyboard and mouse. This program realizes the interactive roaming of the mouse, and determines the roaming control of the scene display in openGL through the perspective and observation direction. Specifically, we can use the glulookat() function to realize the roaming effect by setting the corresponding parameters. The program provides two roaming modes, the first

is combined roaming, that is to say, users can first roam the path in the form of a file in a certain format, the system realizes the prefabricated roaming path through reading, of course, the roaming animation realizes the double buffer mechanism provided by openGL. The second way is to walk up and down, to simulate human walking, to walk around, to move around, to move around, to move around, to move around, to move around.

4. Comparison of Experimental Results and Data Analysis

This comparative experiment is divided into the experimental group and the control group. The experimental group uses the method of this paper for stage performance, while the control group uses the traditional stage performance. Among them, each group of 500 people, using the same time, the same script, the level of participants in the case of the same record.

4.1. Conformity Analysis

Conformity is a common behavior characteristic of individuals when they are engaged in activities in the public sphere. It should be manifested in following and imitating the general behavior of a group, whether it is correct or necessary. The psychological theory of "broken window" is that if a broken window cannot be repaired, the next one will be broken quickly.

According to the statistical analysis in Table 1 and Figure 1, the audience responded to the five interactive guidance. Among them, the performance using the virtual reality technology in this paper has got more audience response than the traditional performance, and the five responses have been improved by more than 10%, with obvious differences. It shows that the performance of virtual reality technology and can drive the mood of the audience.

Table 1. Comparative analysis of the number of people responding to interactive guidance

Group	Interaction times	Response number	Response rate (%)
control group	1	153	30.6
experience group		218	43.6
control group	2	165	33
experience group		248	49.6
control group	3	172	34.4
experience group		289	57.8
control group	4	141	28.2
experience group		276	55.2
control group	5	181	36.8
experience group		307	61.4

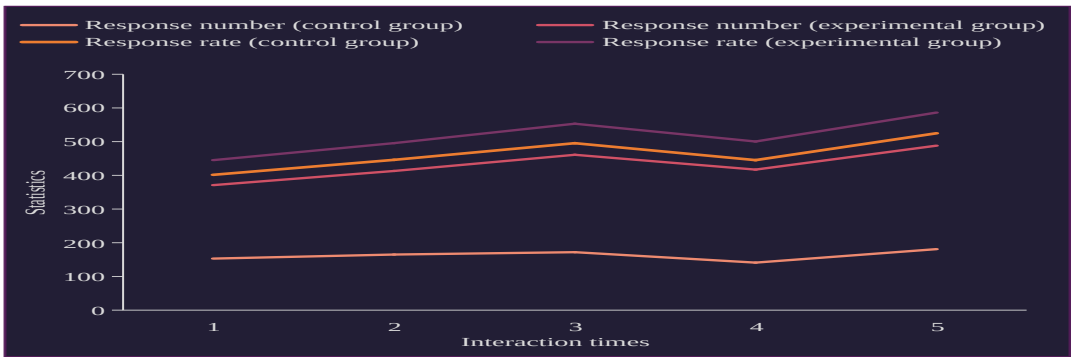

Figure 1. A comparative analysis of the conformity of the two groups of audience

4.2. Diversity Analysis

The diversity of watching behavior includes sitting still, talking, taking pictures, waiting, going to the toilet, shopping, etc. these behaviors of the audience can directly reflect the attraction of the performance to him. This experiment has set up six major items, and the two groups of audience were statistically analyzed.

According to the statistical analysis chart in Figure 2, in the experimental group of stage performance through virtual reality technology, the audience's watching behavior mainly includes sitting in, talking and taking pictures, while in the traditional performance mode, the probability of going to the toilet and shopping in the control group is significantly increased, which shows that the traditional performance method makes the audience more impatient, and the virtual reality technology in this paper can make up for this There are some deficiencies in this aspect.

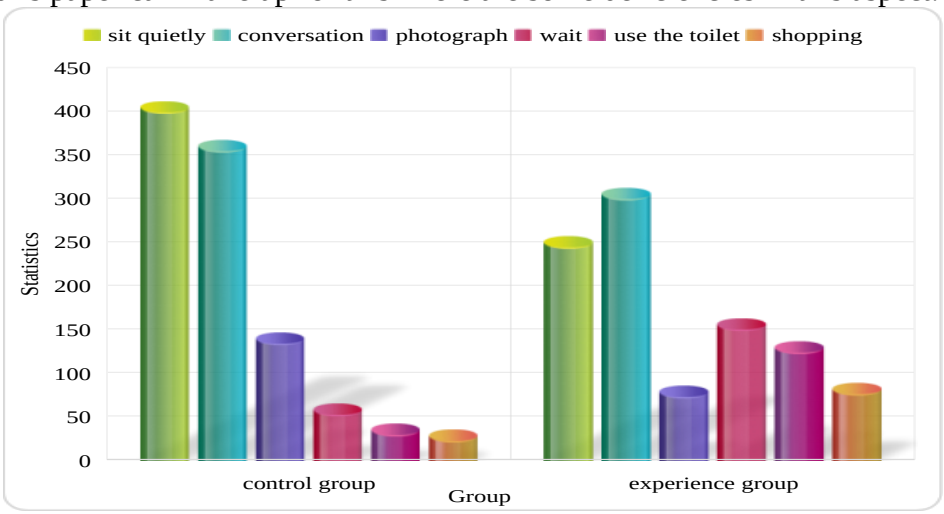

Figure 2. Comparison and analysis of the diversity of audience's performance behavior between the two groups

4.3. Liquidity Analysis

According to the statistical analysis in Table 2 and Figure 3, the audience mobility of the experimental group performing with virtual reality technology is worse than that of the control group with traditional performance mode. There are many reasons for the high mobility, such as communication, shopping, etc., but on the whole, it can be considered that the content of the performance is not attractive to it, so that the spirit is scattered. Through data analysis, this paper believes that the performance using virtual reality technology can better stabilize the audience's emotion and attract attention continuously.

Table 2. Seat movement statistics of different groups

Group	Frequency	Number of mobile people	Movement rate (%)
control group	Less than 5 times	75	15%
experience group		60	12%
control group	5-10 times	40	8%
experience group		25	5%
control group	11-15 times	25	5%
experience group		15	3%
control group	More than 15 times	20	4%
experience group		5	1%

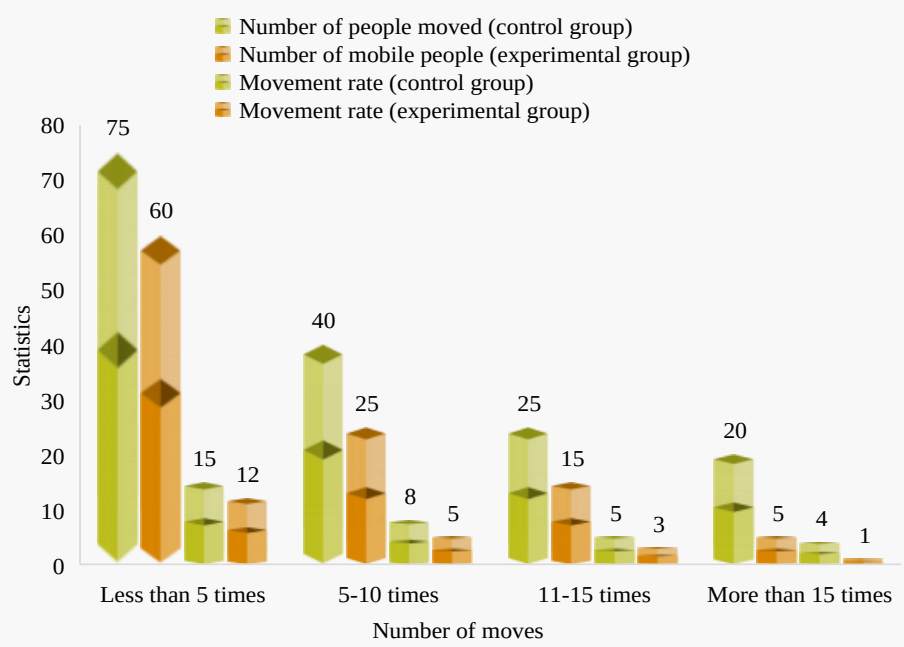

Figure 3. A comparative analysis of the mobility of audience's watching behavior between the two groups

4.4. Analysis of Collectivity and Independence

In the performance space, the related activities are mainly collective, but some private places should also be provided for people to communicate with each other. The collectivity and independence also reflect the enthusiasm of the audience to watch the performance. According to the statistical analysis in Figure 4, compared with the traditional performance, the audience of virtual reality technology has higher collectivity. The analysis thinks that this is mainly due to the immersive experience and the realistic scene restoration effect. In fact, the audience's emotion is high, and in this case, they often have a higher desire to share. Driven by the desire to communicate, the collective performance is more intense, which is obviously different from the traditional performance.

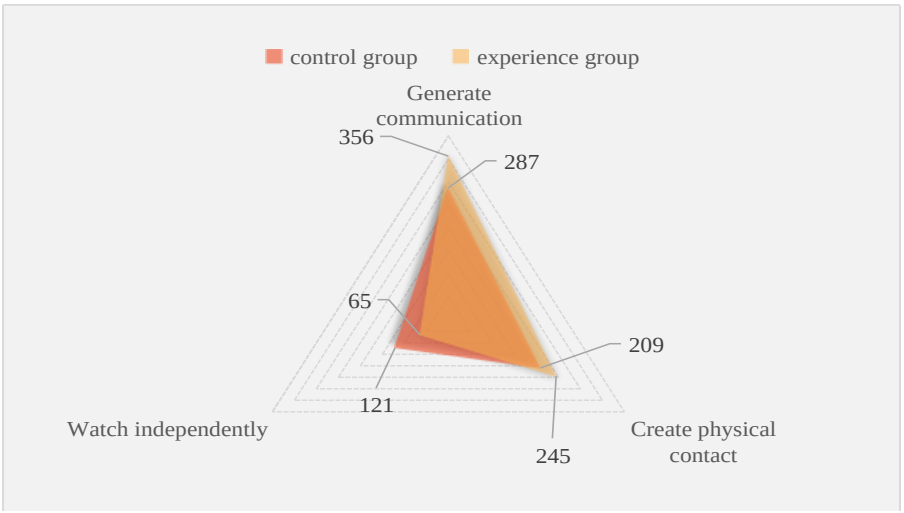

Figure 4. Comparative analysis of collectivity and independence of two groups of audience

5. Conclusion

In recent years, virtual reality technology has developed rapidly, and its unique real simulation and immersive experience have been widely used in many fields. Combined with the existing virtual reality technology, the traditional stage music performance has also been upgraded. Since the successful performance of the opening ceremony of the 2008 Olympic Games, people have seen the charm of virtual reality technology. The combination of new technology and new performance forms has transcended the shackles of physical space and opened up a new aesthetic art. At the same time, the traditional relationship between watching and performing also changed. The research on the impact of virtual reality technology on audience's performance behavior of stage music performance art can provide good guidance for the development of this field. The core of this paper is to optimize the stage performance model of existing virtual reality technology, optimize its structure on the basis of the traditional way, strengthen the display reality of the model, and bring a new experience to the audience. In addition, in order to verify the actual effect of the model in this paper, the actual comparison method is used for comparative analysis. The experiment was divided into the experimental group and the control group. The experimental group adopted the method of this paper, while the control group adopted the traditional way. Each group of 500 audiences performed at the same time and recorded the data. Through the analysis of the data, we can see that the audience in the experimental group is more active and interactive than the control group in the traditional way, which benefits from the immersive experience in virtual reality technology, so that the audience can get a better performance experience.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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