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Research on the Characteristics and Functions of Brain Activity in Musical Performance

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ABSTRACT. *Music has a long history, and its production and development are closely related to human brain activity. Music performance is an advanced cognitive activity to express music art, and it is also an important model to study brain music interaction and brain plasticity. In recent years, it has received widespread attention from musicians, psychologists, and neuroscientists. In order to explore the effect of brain activity in musical performance, this paper conducted a questionnaire survey among volunteers of different ages through a simple coping style questionnaire, and drew the conclusion that musical performance significantly improved brain activity ability. From the test results, college students' emotional and motor coordination abilities have been significantly improved, but the improvement of communication skills and cognitive ability is not as good as the improvement of emotional response and motor coordination abilities, which have been increased by 12% and 15% respectively.*

KEYWORDS: *Musical Performance, Brain Activity, MRI Technology, Questionnaire Survey*

1. Introduction

Music occurs simultaneously with human activities and gradually forms a sound sequence with certain rules and systems. Based on the basic physical properties and communication needs, it gives these ordered sounds more emotional and aesthetic significance, and becomes an art form that synchronizes with human history to produce and develop. In the relationship between music and the brain, perhaps the most striking thing is that the neural signals of brain functional activity are also music. With the development of neuroscience and information science, the study of musical brain mechanism has gradually become one of the research contents of neuroscience, and gradually evolved into a new discipline of neuromusicology.

With the maturity of science and technology, people have become more and more curious about the characteristics and functions of music as brain activity, and

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many teams have studied it. Some research teams believe that the regions of the human brain that recognize pitch are located in the dorsolateral prefrontal cortex and the right temporal auditory cortex, which are distinctly right-sided. The sense of rhythm is mainly distributed in the left prefrontal gyrus, bilateral superior temporal region, left inferior parietal lobe and right frontal cortex [2]. George W have studied the brain and music teams analyzed how the right brain perceives the contours of a melody and how the left brain perceives the intervals of a melody. In addition, the superior temporal gyrus is involved in melody recognition. The perception of timbre was concentrated in the right temporal lobe. The timbre characteristics of music are only related to specific areas of brain response in the cognitive process, while tonality and rhythm characteristics are related to cognitive, emotional, and motor areas [3]. Artificial neural network (Ann) is considered as a highly complex nonlinear dynamic system. Although the structure and function of each neuron in the neural network is relatively simple, the behavior of the system composed of a large number of networks is colorful and very complex. Artificial neural networks have common characteristics of general nonlinear systems. For example, neural networks have high dimensions and neurons have extensive continuity, adaptability, and self-organization [4]. "The therapeutic process of musical performance is more like a systematic intervention process," Liu wrote in his book. In this process, musicians use various forms of musical experience and therapeutic relationships developed during therapy as therapeutic driving forces to help them achieve their health goals [5]. Although music performance has a rich impact on brain activity, there is still no clear explanation, and there are still some deficiencies in which part of the brain is most affected. In order to study and find brain activity in the characteristics and functions of music performance, this paper, a series of experiments, using comparative analysis method, theoretical analysis method and other experimental methods, concluded that brain activity is very active in music performance, and to some extent, explain the music itself effect on plasticity of the brain structure or function.

2. Method

2.1 Music Performance

Musical performance is a complex and technically operable discipline. Music learners need a long period of hard practice to master it. This practice runs not only through the growth process from beginner to musician, but also through the entire artistic career of every musician. As a result, "practice" has become a nightmare for every musician, but it cannot be avoided. In practice, with the guidance and help of professionals, musicians will spend a lot of time and energy to overcome all kinds of technical difficulties. Of course, musicians sometimes get frustrated because they can't overcome the technical difficulties of a piece. In order to achieve the ideal performance effect, music learners often wander on the edge of tension and frustration. In such a long-term state, repeated cycles will make learners feel bored and lost [6]. The player's psychological state plays an important role in musical

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performance. Players should consciously adopt corresponding strategies to coordinate and control their own psychological state in order to achieve success in the practice of musical performance. In the practice of the specific music playing, players by sense perception and action coordination and cooperation consciousness, pass the incoming information to the optic nerve and the auditory nerve (including music, music acoustics, etc.), direct feedback to the cerebral cortex of the players, and imagination, synesthesia, thinking activities, so this is through the movement function to pick out the thinking activity results. Therefore, while training performance skills, players must understand the psychological operation mechanism and related factors in music performance, so as to carry out psychological training through scientific and effective playing strategies and improve the psychological self-control ability.

2.2 Brain Activity

The human brain, with thousands or even hundreds of millions of synapses, is the most complex system known in the universe. Generally speaking, the adult brain is very light, accounting for only a small part of the body weight, but its oxygen consumption accounts for a high proportion of the whole body, carrying all the human intelligence about feeling, behavior, memory, emotion, and thinking [7]. The human brain is one of the most important organs in the human body. It is the most complex and perfect dynamic information processing system known in the existing scientific system. The study of brain structure and function is indeed a strategic scientific subject of great scientific and philosophical significance. In recent years, cognitive neuroscience has become an important branch of neuroscience. It studies how the human brain performs a range of mental activities. Early studies of the brain were based on observations of changes in brain function following local brain tissue damage. The results showed that the thickness of the superior temporal gyrus and dorsolateral frontal cortex was thicker in musicians than in non-musicians. Researchers have studied the gray matter volume of musicians and non-musicians, and found that compared with non-musicians, musicians have differences in the motor area, auditory area, and visual space area. In terms of brain function research, researchers have found that music can enhance the brain's auditory and motor interaction function, as well as affect working memory. These studies go some way to explaining the effects of music itself on brain structure or functional plasticity.

2.3 MRI

Magnetic resonance imaging (MRI) is one of the most mature imaging techniques and is widely used in medical image processing. This technique has no ionizing radiation damage to the brain during the imaging process, and can achieve multi-angle THREE-DIMENSIONAL tomography, with a relatively clear resolution for brain soft tissue structures, such as white matter, gray matter, cerebrospinal fluid, etc. [8].

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There are mainly four different imaging patterns or sequences in MRI. Each MR imaging sequence (also known as a mode) has a different effect on brain image segmentation, and one of the sequences includes three imaging positions: cross-sectional azimuth, sagittal azimuth, and coronal azimuth. MR brain image in cross-section [9].

2.4 Extraction of Rhythm Characteristics of Music Performance

According to the analysis of western music and the interpretation of experts, it is found that the melody of music is composed of a series of notes that can reflect the theme of the music, which can fully show the content characteristics of the music. According to the characteristics of rhythm, subsequent notes have a certain dependence on the length of the preceding note. It can also be understood that if the previous note is not properly handled, the following note will follow the error. To judge the degree of rhythmic grasp, different weights should be given to different notes. Calculate the difference between the pronunciation point of each note and the standard value, and multiply by the weight of the note to get the degree of this section to grasp the rhythm of the music. Si represents the node of music, Bi represents the ups and downs of music, EI represents the length of music, di represents the beat of music, and Qi represents the weight of music Its formula is expressed as[10]:

$$f(x) = \sum abs(Si - Bi) + abs(Ei - Di)Qi$$

According to the characteristics of the chord, its pitch has the greatest influence on the sound performance of the chord, so the weight of pitch is used to calculate the volume value of all synthesis. Its formula is expressed as:

$$f(x) = \sum abs(Ai - Bi)Qi$$

Net is used to represent the cumulative effect of the input signal obtained by the neuron, and its formula is expressed as:

$$net = \sum_{i=1}^{n} x_i n_i$$

3. Experience

3.1 Music Player Experiment

This article will use the simplified coping style questionnaire. The simple coping Style questionnaire is compiled based on the coping style scale of foreign countries, according to the practical application needs, and combined with the characteristics

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of the Chinese population. The questionnaire is a self-rating scale, which adopts multi-level scoring. After each coping style item, there are 3 choices (the corresponding score is 1, 2, 3), which are not adopted, occasionally adopted, sometimes adopted, and often adopted. The research subjects choose one response according to their actual situation. The subjects included a range of ages. All the subjects passed the composition level test organized by the Conservatory, whose score was the average score of their compositions scored by 15 professors from the composition department of the Sichuan Conservatory of Music.

3.2 Magnetic Resonance Experiment

The whole magnetic resonance experiment was carried out in the magnetic resonance imaging research center. The experiment was carried out in the composer group and the control group respectively. All subjects, including the composer group and the control group, signed a consent form before the experiment.

4. Discussion

4.1 Variance Analysis of Brain's Negative Coping Dimension in Coping Style during Music Playing

With music playing professional college students' brain negative coping style score as the dependent variable, in gender, professional, grade, for the independent variables, including gender points and two levels of male and female, professional distribution line, nation and vocal music three- level, freshman and sophomore and junior grade three levels, do 2 x 3 x 3 multi-factor analysis of variance, difference test and variance analysis

Table 1 Variance analysis of self-efficacy of college students majoring in music performance

The dependent variable	Sources of variation	DF	MS	F	P
Self-Efficacy					
	gender	2	968	80	1
	professional	3	115	9.9	1
	grade	3	1576	156	1
	Gender*Major	3	50	5.009	0.08
	Gender*Grade	3	70.98	0.987	0.07
	Major * Grade	1	7.8	0.789	0.73
	Gender*Major * grade	1	52.65	5.234	0.333

Multi-factor analysis of variance results by above knowable, music playing professional college students' brain on self-efficacy scores, gender differences significant main effect, major and grade interactions have not reached a significant

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level, the significant difference of gender and professional interaction and interaction of gender and grade professional and significant difference, thus further do effect test, the results show that self-efficacy induction is more intense.

4.2 Effect of Musical Performance on Brain Tissue Segmentation

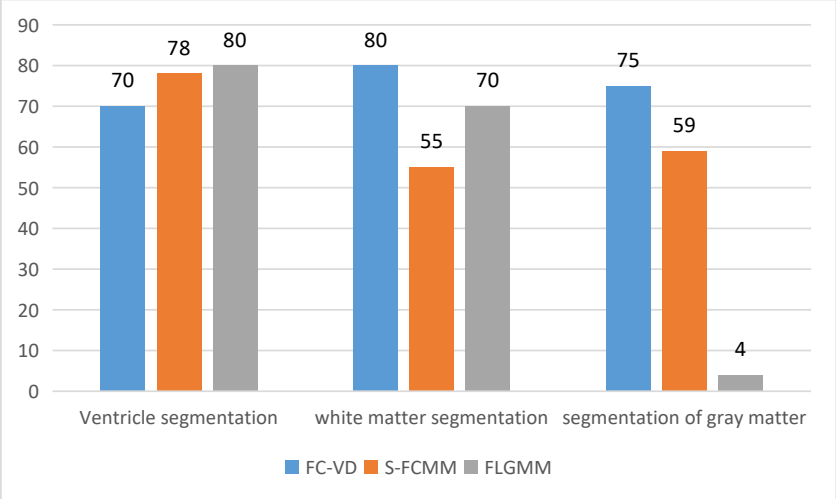

Figure. 1 Effect Diagram of Brain Tissue Segmentation by Different Musical Performance Methods

It can be seen from Figure 1 that, on the one hand, the gray value of pixels in the ventricle area in the image data concentration of the brain is low, the gray distribution in the cluster is dense, and the variance is small. Therefore, several methods have strong applicability. It is worth noting that the algorithm only USES the grayscale and part of the spatial information of the image, and it has some limitations on other features of the image. Therefore, how to integrate image gradient, texture, and other information into the algorithm in this chapter to enhance the repeatability and robustness of the algorithm so as to further improve the segmentation accuracy is one of the directions worth exploring. In addition, the performance of the algorithm also needs to be improved.

4.3 Evaluation of Brainwave Music in Both States

Brain wave music of the two states was analyzed from the perspective of the emotions expressed by the music. The evaluation score of each item was 1-10, with 1 representing the weakest and 10 representing the strongest. There are statistical results of the evaluation of brain wave music in terms of emotional arousal and

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pleasure of volunteers in the two states. It was found through a calculation that brain wave music in music creation state had a higher arousal degree of emotion compared with music in resting state, while there was no statistically significant difference between the two in terms of emotional pleasure degree. This shows that brainwave music can provide more evidence for the study of the brain mechanism of music creation from a new perspective.

Table 2 Evaluation Statistics of Eeg- F Mri Brain Wave Music in The Two States in Terms of Emotional Arousal and Pleasure

	arousal (mean± standard deviation)	valence (mean ± standard deviation)
The resting state	4.50±6.40	3.70±2.89
The music played in a pose	7.10±2.45	5.40±1.84

See Table 2, we can see that EEG and FMRI signals are collected synchronously to produce brainwave music, further enriching the theory of scale-free brainwave music. The pitch and pitch intensity of the newly generated EEG-FMRI brain wave music conform to the non-scale property and are independent of each other, and are closer to the musical characteristics created by composers. After that, EEG-FMRI brain wave music generation method was used to produce the composer's brain wave music in resting state and music creation state respectively. The results showed that the arousal degree of emotion caused by the two different states was obviously different. This shows that brainwave music can provide more evidence for the study of the brain mechanism of music creation from a new perspective

4.4 Comparison of Emotional and Behavioral Performance before and After Playing Music

Table 3 Test results of emotional and behavioral performance ability before and after playing music

	Emotional response	coordination	cognitive	communication	Total level
Before playing	29%	26%	50%	28%	30%
After the play	69%	68%	65%	40%	59%

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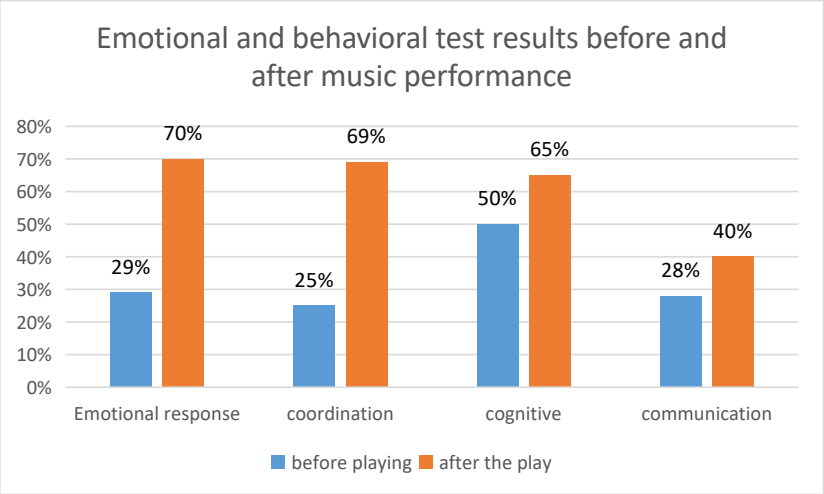

Figure. 2 Emotional and behavioral performance test results before and after playing music

Music playing brain ability of emotion and behavior before and after contrast from table 1 and figure 2 we can see that music played on the brain activity ability has obvious increase, from the test results can be inside out, college students in the aspect of emotion and action coordination got significantly improved, increased by 40% and 42% respectively, but the interaction and cognitive improvement discharge and no emotional response and action coordination gains, only increased by 12% and 15% respectively.

5. Conclusion

As an advanced cognitive activity to express music art, music performance is also an important model to study brain music interaction and brain plasticity. In recent years, musical performance has attracted a lot of attention from musicians, psychologists and neuroscientists. The current research achievements on music playing relatively scattered, understanding of the brain mechanisms of music playing activities is limited, one of the important reasons is likely to be in the past the study of music playing more is given priority to with music player, such as a pianist, and playing music and music creation is two different stages, to create the home for the object to study the brain mechanism of music creation composer of less as the research object.

With the development of society and modern people's understanding and acceptance of art therapy (including music performance therapy), music performance therapy has become the first choice of psychological therapy for many

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groups. The positive effects of music performance therapy on brain activity have been repeatedly proved by scholars at home and abroad. This research is completed on the basis of previous theoretical and practical research. In this study, the intervention of music performance therapy on mood disorders was completed within one year. The results show that music therapy improves the brain's mood and reduces bad behavior by improving mood, thereby promoting the development of interpersonal skills.

References

[1] Rottondi C, Chafe C, Allocchio C, et al. An Overview on Networked Music Performance Technologies [J]. IEEE Access, 2017, 4: 8823-8843.
[2] Robson K E, Kenny DT. Music performance anxiety in ensemble rehearsals and concerts: A comparison of music and non-music major undergraduate musicians [J]. Psychology of Music, 2017: 1-18.
[3] Tahiro.Lu K, Vasquez J C, Kildal J. Facilitating the Musician's Engagement with New Musical Interfaces: Counteractions in Music Performance [J]. Computer Music Journal, 2017, 41 (2): 69-82.
[4] George W, Aaron W. Eye of the Beholder: Stage Entrance Behavior and Facial Expression Affect Continuous Quality Ratings in Music Performance [J]. Frontiers in Psychology, 2017, 8.
[5] Breakspear, Michael. Dynamic models of large-scale brain activity [J]. Nature Neuroence, 2017, 20 (3): 340.
[6] Debbané, Martin, BadoudD, SanderD, etal. Brainactivityunderlying negative self-and other-perception in adolescents: The role of attachment-derived self-representations [J]. Cognitive Affective & Behavioral Neuroence, 2017, 17 (3): 554-576.
[7] Kustubayeva A, Zholdassova M, Borbasova G, et al. T80. Executive Control and Brain Activity in People With High and Low Levels of Depressive Symptoms [J]. Biological Psychiatry, 2019, 85 (10): S159-S160.
[8] Based on magnetic resonance imaging (MRI) technology to investigate the TCM syndrome types and clinical features of AS in different inflammation period [J]. 2019, 023 (001): 69-71.
[9] FengN, GengX, QinL. Study on MRI Medical Image Segmentation Technology Based on CNN-CRF Model [J]. IEEE Access, 2020, 8: 60505-60514.
[10] Hamad W, Sanayeh M B, Hamad M M, et al. Impedance Characteristics and Chip-Parasitics Extraction of High-Performance VCSELs [J]. IEEE Journal of Quantum Electronics, 2020, 56 (1): 1-11.