

Evaluation Method of Music Psychological Intervention Effect based on Deep Convolution Neural Network

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Abstract—In order to improve the accuracy of the evaluation of the effect of music psychological intervention and ensure the application effect of music psychological intervention, a method of evaluation of the effect of music psychological intervention based on deep convolution neural network is proposed. Based on the research of the theoretical basis of music therapy, according to the characteristics of music psychology, the psychological intervention of music is carried out by using music, and the information of music psychological intervention is obtained by using deep convolution neural network. The ability of preparation for music psychological intervention is determined by setting the intensity of music psychological interference, the behavioral intervention coefficient and the evaluation index of utility. The emotional relief ability coefficient of patients was set up to obtain the tracking results of psychological intervention effect, and the evaluation of music psychological intervention effect was realized. The experimental results show that the evaluation results of the method based on the deep convolution neural network are in line with the actual situation, the accuracy of the evaluation is high and the application effect is good.

Keywords: deep convolution neural network; music psychology; intervention effect; intervention information; intervention preparation; impact assessment;

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Music psychology is a science that uses psychological methods and theories to study the relationship between music and people's various psychological phenomena and find out their laws [1-2]. It is a branch of psychology, which is based on psychological theory, draws on physiology, physics, genetics, anthropology, aesthetics and other related theories, and adopts the method of experimental psychology to study and explain people's music experience and music behavior from primitive (newborn) to advanced. Music psychology is a science that takes empirical research as the basic method to study psychological phenomena and problems related to music [3-4]. Its research objects are widely related to the basic characteristics of human auditory perception, the psychological basis of the aesthetic characteristics of music sound structure, the psychological mechanism of music performance, the psychological characteristics of music creation, performance, acceptance and aesthetic value judgment activities, music learning, education and psychological problems related to music ability. The basic problems of its research are not only of basic significance to the study of music aesthetics and history, but also of application value to a wide range of music practice. Compared with other academic fields, the present situation of music

psychology is particularly prominent. However, the research data in the field of music psychology is expanding, and more research is needed in this field, because only in this way can people's deeper understanding of the phenomenon of music behavior be guaranteed.

MUSIC PSYCHOLOGICAL INTERVENTION MODEL BASED ON DEEP CONVOLUTION NEURAL NETWORK

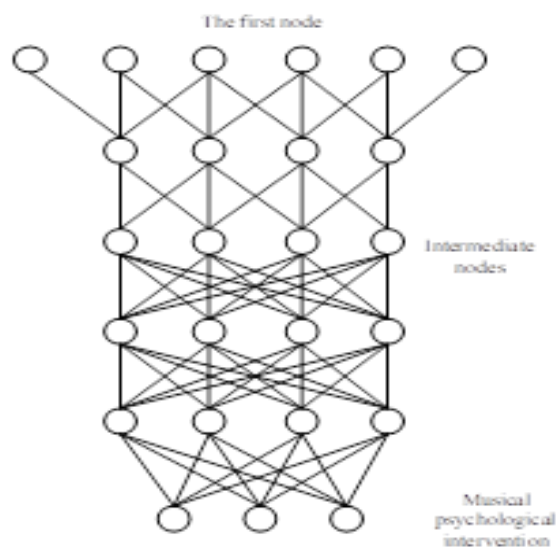
The Relationship between Man and Music

Human beings have certain musical characteristics, and have a response by perceiving and touching the sound effect. In the process of feeling music, rhythm, beat, melody, harmony and other aspects have some resonance. Through the rhythm of music, the dynamic changes of psychology can arouse the body's instinctive response. From this point, the relationship between human psychology and music can be deduced, which is also the basis and starting point of music therapy [5-6]. Music therapy is a kind of sound effect organized by human, that is, music type. Usually, regular rhythms, such as the single roar of the engine, are not appreciated as music and will not be moved for. Some soothing and

vigorous sounds can affect people's psychological changes, such as the performance of musical instruments. Therefore, human musical instinct will respond differently to different timbre [7-8]. As far as music itself is concerned, it is impossible to separate from the main body control behavior of human being, whether it is in the process of organizing sound or feeling music. There are several kinds of musical behaviors of human beings: one is the body behavior. When contacting with the instrument or singing, the posture of the body, the placement of fingers on the instrument and the singing behavior between the muscles and vocal cords can be transformed. The sound effect needs some physical behavior to be transformed; the second is the social behavior, including the human being in the social life. The third is the behavior of learning, which is musicality, but it also needs to be learned and perfected after tomorrow, so as to improve the musical ability.

Convolutional neural network is a kind of feedforward neural network with convolution calculation and depth structure, which is one of the representative algorithms of deep learning. Convolutional neural network has the ability of representation learning, and it can classify the input information according to its hierarchical structure, so it is also called "translation invariant artificial neural network". The input layer of convolutional neural network can process multi-dimensional data. Generally, the input layer of one-dimensional convolutional neural network receives one-dimensional or two-dimensional array, in which one-dimensional array is usually time or spectrum sampling; two-dimensional array may contain multiple channels; the input layer of two-dimensional convolutional neural network receives two-dimensional or three-dimensional array; the input layer of three-dimensional convolutional neural network receives four-dimensional array. Similar to other neural network algorithms, the input features of convolutional neural network need to be standardized because of the gradient descent algorithm. The structure of deep convolution neural network is shown in Figure 1.

Fig. 1 Structure of deep convolution neural network



The Characteristics of Music Psychology

Music therapy as a multi-disciplinary integration of comprehensive disciplines, the principles of medicine and musicology and psychology are applied to the psychological and physiological treatment of patients. As music therapy involves a wide range of disciplines, complex application fields and rich schools of thought, there is no unified discipline definition standard for the development of music therapy. In short, music therapy is the use of all forms of music activities, including listening, singing, playing, rhythm and other means to stimulate and hypnotize people, and sound to stimulate physical reactions, so that people can achieve the purpose of health. Music therapy mainly looks at the effect on patients from the perspective of physiology and psychology. In the eyes of medical experts, music is regarded as a tool to reduce stress and make people relaxed [9-10]. From the perspective of physiology, music itself has three basic elements, namely pitch, timbre, sound strength, and other elements such as rhythm, interval, and chord mode. By listening to music, it can stimulate brain cells, regulate the functions of limbic system and brain stem network structure, and make human viscera and internal system get neural structure group. This stimulation can increase the endorphin and norepinephrine in the body, effectively inhibit the pain perception controlled by the central system of the human body, significantly reduce the pain of patients, achieve sedation, adjust the heart rate, blood pressure and blood flow, so as to relieve mental tension and improve digestive function. The influence of different music volume on the effect of music psychological intervention is shown in Table 1.

Table 1 Effect of music volume on music psychological intervention

Classification n	Volume (decibels)	Effect of psychological intervention
Other volume	80	Sympathetic nerves become excited and blood pressure begins to be affected
	90	That is, they begin to be agitated, their blood pressure rises, their endocrine disorders and their digestive functions are inhibited
	More than 100	The human body can not bear it, until the hunt into varying degrees of deafness
Efficient Healing Audio	50 the following	People began to breathe deeply, blood pressure is stable, the heart is slow and powerful, the metabolism is reduced, and the digestive function is enhanced, to a healthy development
	10-50	In the range of parasympathetic excitation, the human body will get a good feeling

Access to Intervention Information

With the advent of the era of big data, trainable music psychological information has become very large and complex. Because deep convolution neural network is essentially a shallow network model, it lacks effective modeling ability on such data sets, and can not fully describe the state space distribution of music psychological information characteristics. In addition, the deep convolution neural network will assume that its covariance matrix is a diagonal matrix, so as to reduce the amount of calculation in the whole model training process, which makes it have many restrictions in selecting input features, and it must ensure that the internal dimensions of music psychological information features are not related^[11-12]. In this way, the deep convolution neural network can not effectively integrate the structural data in the characteristics of music psychological information, which is obviously inconsistent with the time series information of psychological intervention effect.

Compared with other modeling methods, deep convolution neural network is a deep model, which can fit arbitrary data distribution well by adjusting its own parameters, without assuming that music psychological information data obey Gaussian distribution like other methods. Moreover, the deep convolution neural network has good feature learning ability, which can extract useful information from the massive original music psychological data, and transform the space through multiple hidden layers, and finally output to the state space from the softmax layer. By setting w_i and w_r to represent two different original music psychological data, i and r to represent two different information node limiting coefficients, and combining the above physical quantities, the results of music psychological intervention information acquisition based on deep convolution neural network can be expressed as follows:

$$P = \frac{e_1^{e_i^p}}{\sum_{i=1}^n e_i^{e_i^p}} \quad (1)$$

In formula (1), e_1 and e_2 represent two different intervention modeling conditions, t_0 represents the minimum data information evaluation time, p and p' represent two

different intervention coefficient indexes.

APPLICATION OF MUSIC PSYCHOLOGICAL INTERVENTION EFFECT EVALUATION METHOD

Psychological Intervention Preparation

The selection of music psychotherapy repertoire is mainly based on the patient's physical and mental status and the observation of the patient's behavior, language and symptoms, and combined with the yin-yang theory of music five tones, five elements and five zang organs. For example, patients with irritable mood and hyperactivity try to choose more negative music; patients with depressive mood and depression try to choose positive music. The choice of music depends on the situation. Different people may have different choices. Usually in the face of patients who need shallow intervention and adjustment, they usually choose music with slow rhythm. However, like medical treatment, music psychological intervention pays attention to the right medicine, so the effect of general shallow intervention is short-term^[13-14]. The selection of music therapy repertoire is based on the patient's mood, for patients who want to relax, choose fine-tuning music; for patients who need to calm down, choose quotient music. Of course, the choice of rhythm depends on the patient's mood and the corresponding function according to the five tones. In addition, the volume control is also necessary. According to scientific research, the most suitable volume for music appreciation and health preservation is 34 DB^[15]. If it exceeds 80 decibels, music will turn into noise, which is not conducive to health preservation, but makes people feel irritable. The treatment place is suitable for the room full of sunshine, clean and clean, and air circulation, and there are appropriate curtains to block, which can make the indoor light soft and not dazzling. It is better to be equipped with a soft leather chair that can be semi reclined. According to the nature of the patient's work and family situation, the treatment site can be selected. By setting $\hat{\lambda}$ as the intensity of music psychological interference, f as the behavioral intervention coefficient, and γ as the

utility evaluation index, we can define the treatment preparation ability of music psychological intervention as follows:

$$d = \chi^2 \frac{n+1}{n} \varepsilon \quad (2)$$

In formula (2), n and ε represent two different emotional measurement coefficients of patients.

Exploration of Psychological Intervention

In order Music therapy as a multi-disciplinary integration of comprehensive disciplines, the principles of medicine and musicology and psychology are applied to the psychological and physiological treatment of patients. As music therapy involves a wide range of disciplines, complex application fields and rich schools of thought, there is no unified discipline definition standard for the development of music therapy. In short, music therapy is to stimulate and hypnotize people by means of all kinds of music activities, including listening, singing, playing, and rhythmic movements, and have sound to stimulate the body response, so as to achieve the health purpose of people [16-17]. Music therapy mainly from the perspective of physiology and psychology to see the role of patients, music in the eyes of medical experts, as a relief of stress, make people relaxed tools. From the perspective of physiology, music itself has three basic elements, namely pitch, timbre, sound strength, and other elements such as rhythm, interval, and chord mode. By listening to music, it can stimulate brain cells, regulate the functions of limbic system and brain stem network structure, and make human viscera and internal system get neural structure group The adjustment of the fabric can increase endorphin and noradrenaline in vivo, effectively inhibit the pain perception controlled by the central system of the human body, and the pain sense of the patients is significantly reduced, and the effect of calming, adjusting the rhythm, blood pressure and blood flow can be achieved, thus relieving the tension of the mind and improving the digestive function [18-19]. Therefore, for patients with arrhythmia, panic and blood pressure instability, music therapy can be carried out, and it can play a certain auxiliary role in the patients' condition.

Tracking the Effect of Psychological Intervention

Music therapy from the perspective of traditional Chinese medicine, music can go deep into the heart of people, ease the mood, make people listen to music, get physical and mental relaxation, in the melody of music, breathing and the internal organs of the body coordinate resonance, stabilize blood pressure, when feeling the vibration of music, thus causing physiological changes, so that rhythm, blood pressure, breathing flat. Traditional Chinese medicine often

says that "all diseases originate from Qi", which refers to the internal five visceral dirty gas. When the dirty gas runs harmoniously, it can be used to adjust the body function by combining with the five sounds of "angle, micro, palace, business and feather", which is the basis for the relief of pressure by sound music [20]. Music therapy is like traditional Chinese medicine treatment needs drug preparation and precipitation. Different prescription should have different proportion. Music needs proper rhythm, strength and beat to cooperate, so that people can feel harmoniously and uniformly. Beautiful music can make people calm, relax breathing and stabilize their emotions. From the medical point of view, the above performance can make the nervous system, digestive system, heart and so on to be regulated. By setting w as the coefficient of the patient's mood relieving ability and e as the intensity of music therapy, the simultaneous formula (2) can express the tracking result of psychological intervention effect as follows:

$$\lambda = \left(\frac{d}{B\sqrt{w} \cdot Q\sqrt{e}} \right)^5 \quad (3)$$

In formula (3), B represents the intensity of patients' mood relief under music psychological intervention, and Q represents the actual treatment duration of music psychological intervention.

PRACTICAL EFFECT ANALYSIS

A patient, female, 45 years old, is an office worker of a power plant Department. She has a daughter, who is in the third grade of high school. Her mother has suffered from coronary heart disease for many years. Patient a is mainly responsible for the relevant financial part in the work unit, the main contents include: timely completion of monthly settlement, bookkeeping, financial processing and other work, need to submit the accurate report to the superior on time every month, and also related tax, banking business, daily expenses and other expenses. In addition, it includes the classification and binding of various financial contents. The patient's monthly income was about 3600 yuan, and her husband's monthly income was about 3000 yuan. The family expenses are: the monthly medical expenses of patient a's mother are about 1600 yuan, and the expenses for her daughter to go to school are about 1000 yuan, including living expenses, transportation expenses and course materials expenses; the expenses of family members for food, clothing, housing and transportation are about 2000 yuan; the monthly mortgage is 1500 yuan, almost no balance. Patient a is currently in menopause, emotional state is easily affected by external factors, tired at work during the day, insomnia and dreaminess at

night, the law of life is seriously disrupted, the body circulation disorder, has been unable to normally complete their work tasks.

In order to enhance the comfort of patients, patients are treated in the environment shown in Figure 2.

Fig. 2 Environment of music psychological intervention therapy



The actual treatment of patients under the evaluation method of music psychological intervention effect based on deep convolution neural network is shown in Table 2. (the lower the value of known emotional indicators, the better the therapeutic effect of the applied therapy.)

Table 2 Patient survey based on the proposed assessment method

Name: Patient X	Date: March 16, 2021	Emotional Indicator Number	
Gender: female	Age: 45	A	20%
Occupation: Office worker	Marital status: Married	B	30%
Family members: mother, husband, daughter		C	25%
Health status: tired and sleepy during the day, insomnia and dreams at night, the work and rest time is reversed day and night. The existing work task is difficult to complete, all day low mood, depressed mood, although they try their best to adjust their life state, adapt to the current reality, but still without any effect. He had not suffered from any previous mental illness.			

The actual treatment of patients under the traditional evaluation method is shown in Table 3.

Table 3 Patient survey based on traditional evaluation method

Name: Patient X	Date: March 16, 2021	Emotional Indicator Number	
Gender: female	Age: 45	A	70%
Occupation: Office worker	Marital status: Married	B	90%
Family members: mother, husband, daughter		C	85%
Health status: tired and sleepy during the day, insomnia and dreams at night, the work and rest time is reversed day and night. The existing work task is difficult to complete, all day low mood, depressed mood, although they try their best to adjust their life state, adapt to the current reality, but still without any effect. He had not suffered from any previous mental illness.			

According to the analysis of Table 2 and table 3, there was no significant difference between the two treatments except for the value of emotional indicators. During the whole experiment, the average level of emotional indicators in Table 2 was always lower than that in Table 3. It can be seen that the evaluation results of music psychological intervention effect of the proposed method are consistent with the actual situation, the evaluation accuracy is higher, and the application of the treatment effect is better. As time goes by, she can't take care of her family and work, but she still can't take care of her life. These problems need to be solved urgently. Otherwise, the longer the time is, the more serious the psychological problems will not be properly adjusted. According to the specific situation of patient A, through preliminary analysis and research, the author thinks that patient A's psychological pressure caused by the pressure of life is increasing, and the pressure silts up, which

affects the normal life, and identifies the patient as slight anxiety.

Through the comprehensive understanding and analysis of patient A's life and psychological situation, we decided to use the psychological empathy therapy in music for psychological intervention. First of all, using SAS self rating Anxiety Scale and SCL-90 self rating symptom scale, the white-collar self-evaluation test was carried out, and the evaluation report was produced after the evaluation; Secondly, the Guqin repertoire suitable for their psychological symptoms is selected, and music therapy methods are used, such as receptive music therapy, music guided imagination, listening music therapy, re creative music therapy, etc.; finally, the treatment cycle is formulated for psychological intervention. The whole course of treatment is tentatively scheduled for once a week, 40 minutes each time, a total of 8 times. At the end of a course of treatment, the former scale was used to test.

Through the change of the index of the scale, the situation improvement after psychological intervention was re evaluated. In the process of music therapy, the treatment plan is usually decided according to the patient's symptoms, some need in-depth treatment, and some only need shallow intervention. In depth treatment cases are generally for patients with depression, insomnia and irritability. Of course, the diagnosis of the above diseases needs to be confirmed by doctors. In the process of treatment, let the patient lie down or half lie on the chair, choose specific music, and use language to guide the patient to a state of mental relaxation. Shallow intervention can make many people sit cross legged on the ground together, get familiar with each other through chatting, create an atmosphere by using music with universal therapeutic effect, and then make positive guidance, adjust the breathing rhythm, relieve the spirit, close the eyes and sing the melody together. The Guqin music psychological intervention program, mainly for personal symptoms, in-depth treatment and improvement, through the evaluation, the treatment effect of tracking records.

In the field of music psychotherapy in China, some people praise the concept of western music therapy, but they don't know enough about the role of traditional Chinese music in music therapy. This requires experts and scholars to use the resources of traditional Chinese music, innovate the contents and methods of music therapy, expand the research vision of music therapy in traditional music, make up for the shortcomings of traditional music in the field of music therapy, and enhance the influence of traditional Chinese culture in the field of music therapy, especially the soothing music. Music plays an important role in medical treatment. Music workers can try to actively innovate on the basis of the original, combining traditional elements with modern theory. On the basis of tradition, not only the repertoire has been innovated and developed, but also the traditional repertoire has been constantly moving forward in the development of the times. Music therapy repertoire should not only follow the requirements of music therapy, but also be full of traditional characteristics to make up for the shortcomings. In music psychological intervention therapy, the lack of works creation.

CONCLUSIONS

Music psychological intervention therapy is a comprehensive and complex subject involving musicology, medicine, psychology and other disciplines. The psychological crisis in people's heart is caused by disasters and events, which will lead the parties into a state of pain and uneasiness, accompanied by the symptoms of despair, anxiety and depression, and lead to functional disorders in all aspects of their emotions. It is necessary to

provide psychological help and treatment programs for patients as soon as possible to help them recover their mental health. The patients often have complex psychological problems, and some are even affected by psychological and physiological problems. Therefore, for patients, it needs a long-term stable treatment process, which requires a detailed music therapy program. If we want to make music psychological intervention occupy a place in the field of music therapy and play a certain role, we should continue to innovate on the basis of inheritance. To apply the connotation of self-cultivation, nature cultivation and heart cultivation of music to music psychological intervention therapy, we should not only combine experience and methods, but also integrate technology and theory, so as to make it an innovative way of inheriting traditional music culture and therapy.

REFERENCES

1. Cui A , Kuang J . The effects of musicality and language background on cue integration in pitch perception[J]. *The Journal of the Acoustical Society of America*, 2019, 146(6):4086-4096.
2. Polat H , Alulu M U , Zerdem M S . Evaluation of potential auras in generalized epilepsy from EEG signals using deep convolutional neural networks and time-frequency representation[J]. *Biomedical Engineering / Biomedizinische Technik*, 2020, 65(4):379-391.
3. Suganuma M , Kobayashi M , Shirakawa S , et al. Evolution of Deep Convolutional Neural Networks Using Cartesian Genetic Programming[J]. *Evolutionary Computation*, 2020, 28(1):141-163.
4. Han T , Liu C , Yang W , et al. A novel adversarial learning framework in deep convolutional neural network for intelligent diagnosis of mechanical faults[J]. *Knowledge-Based Systems*, 2019, 165(FEB.1):474-487.
5. Liu C , Pang M . Extracting Lungs from CT Images via Deep Convolutional Neural Network Based Segmentation and Two-Pass Contour Refinement[J]. *Journal of Digital Imaging*, 2020, 33(6):1465-1478.
6. Burak K C , Baykan M K , Uuz H . A new deep convolutional neural network model for classifying breast cancer histopathological images and the hyperparameter optimisation of the proposed model[J]. *The Journal of Supercomputing*, 2021, 77(3):1-17.
7. Abbas A , Abdelsamea M M , Gaber M M . Classification of COVID-19 in chest X-ray images using DeTraC deep convolutional neural network[J]. *Applied Intelligence*, 2021, 51(2):854-864.
8. Tran M Q , Liu M K , Tran Q V . Milling chatter detection using scalogram and deep convolutional neural network[J]. *The International Journal of Advanced Manufacturing Technology*, 2020, 107(3):1505-1516.
9. AestheticNet: deep convolutional neural network for person identification from visual aesthetic[J]. *The Visual Computer*, 2020, 36(10):2395-2405.
10. Park B , Park H , Sang M L , et al. Lung Segmentation

- on HRCT and Volumetric CT for Diffuse Interstitial Lung Disease Using Deep Convolutional Neural Networks[J]. *Journal of Digital Imaging*, 2019, 32(6):1019-1026.
11. Li Y , Xiao J , Chen Y , et al. Evolving deep convolutional neural networks by quantum behaved particle swarm optimization with binary encoding for image classification[J]. *Neurocomputing*, 2019, 362(Oct.14):156-165.
 12. M, Unterberg, P, et al. In-situ material classification in sheet-metal blanking using deep convolutional neural networks[J]. *Production Engineering*, 2019, 13(6):743-749.
 13. Uddin M Z , Hassan M M . Activity Recognition for Cognitive Assistance Using Body Sensors Data and Deep Convolutional Neural Network[J]. *IEEE sensors journal*, 2019, 19(19):8413-8419.
 14. Giraldo L , Schwartz O . Integrating Flexible Normalization into Midlevel Representations of Deep Convolutional Neural Networks[J]. *Neural Computation*, 2019, 31(11):2138-2176.
 15. Hashimoto F , Ohba H , Ote K , et al. Dynamic PET Image Denoising Using Deep Convolutional Neural Networks Without Prior Training Datasets[J]. *IEEE Access*, 2019, 7(99):96594-96603.
 16. Fahimi F , Zhang Z , Goh W B , et al. Inter-subject transfer learning with an end-to-end deep convolutional neural network for EEG-based BCI[J]. *Journal of neural engineering*, 2019, 16(2):026007.1-026007.12.
 17. Elwekeil M , Jiang S , Wang T , et al. Deep Convolutional Neural Networks for Link Adaptations in MIMO-OFDM Wireless Systems[J]. *IEEE Wireless Communications Letters*, 2019, 8(3):665-668.
 18. Feng C , Zhang H , Wang S , et al. Structural Damage Detection using Deep Convolutional Neural Network and Transfer Learning[J]. *KSCE journal of civil engineering*, 2019, 23(10):4493-4502.
 19. Baldini G , Gentile C , Giuliani R , et al. Comparison of techniques for radiometric identification based on deep convolutional neural networks[J]. *Electronics Letters*, 2019, 55(2):90-92.
 20. Motamedi M , Portillo F A , Fong D , et al. Distill-Net: Application-Specific Distillation of Deep Convolutional Neural Networks for Resource-Constrained IoT Platforms[J]. *ACM Transactions on Embedded Computing Systems*, 2019, 18(5):1-20.