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Research Article

Study on the Impact of Different Music Education on Emotional Regulation of Adolescents Based on EEG Signals*

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Abstract

Music has a positive effect on psychological adjustment and relieve tension and this view has been supported by clinical evidence. However, there is still no in-depth analysis of whether there are differences in the regulating effect of music with different characteristics on human psychology, which leads to the fact that current therapeutic schemes using the music to relieve tension are not targeted. In this context, this paper uses the method of EEG clinical trials to explore the role of differences in music rhythm and music mode in psychological regulation. By monitoring the variance of brainwaves of the subjects and the synchronic characteristics of brainwaves in different regions, the research proves that there are great differences in the psychological regulation effect of music with different characteristics: Compared to fast-rhythm music, the effect of slow-rhythm music in psychological regulation and relaxation is better. Compared with major music, the effect of minor music in psychological regulation and relaxation is better. The above conclusions can be well applied to the treatment of psychological disorder diseases such as anxiety disorder and depression, providing a reference for the targeted design of music therapeutic schemes.

Keywords

Music • Psychology • EEG Experiment • Rhythm Difference • Mode Difference

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In recent years, human society has entered the urbanized society rapidly and the proportion of urban population has exceeded 55% of the total population. With the growth of the urban population and the leap-forward development of human society, people are confronted with fast-paced life, facing more and more survival and social. It can be considered that the psychological condition of human beings has been greatly challenged. In this situation, psychological pressure leads to the psychological disorder of human beings and further brings mental diseases such as arrogance, autism, fear, depression and anxiety. In some cases, the affliction of mental diseases eventually leads people to the extreme, bringing great trouble to individuals, families and society. Because of this, how to relax people's minds in this fast-paced life and stay away from mental diseases has become a social problem that has to be resolved (Rüssele, Altenmüller, Nager, Kohlmetz & Münte, 2001).

Some researches on music have shown that music can be integrated into our mind and body, which can affect and regulate our psychology, exerting a positive impact on people (Kimura & Takeda, 2016). Further researches have shown that music can make our blood flow smoother and the nerve conduction can also be adjusted (Stoodley, Hill, Stein & Bishop, 2006). The above-mentioned impact of music on human psychology has attracted the attention of many experts and scholars and they have applied music to the treatment of anxiety disorders, manic disorder, autism and depression, achieving good results. In addition, some brain experts use cortical DC EEG, nuclear magnetic resonance and positron emission tomography to study the impact of music on the brain activity of human beings, providing direct and conclusive scientific evidence for the impact of music on human psychology (Cycowicz & Friedman, 1998; Sonnadara, Alain & Trainor, 2006; Zheng & Qiu, 2015; Schröger, Näätänen, & Paavilainen, 1992). However, music has a variety of types and characteristics. The impact of on the psychology of patients is different and music with what characteristics can exert a positive impact on the psychological. These questions have not been well answered. In this context, this paper proceeds from the difference in music rhythm and music mode to study the impact of music with different characteristics on psychology, providing theoretical support for follow-up researches.

Music, Psychology and EEG

The study on the stress relief and psychological relief of music originated from the UK (Kogure, Matsuzaki & Wada, 2010). The British scholar Brown once wrote a book entitled "Music Medicine," which detailed the role of music in medicine. This research achievement was inherited by American scholars. Since then, many scholars believe that music therapy is actually a branch of behavioural science, which focuses on the improvement effect of music on human behaviour and psychology (Koivisto & Revonsuo, 2008; Arikan *et al*., 1999).

From the perspective of physics, music is actually a regular mechanical wave (Chen, Zhou & Luo, 2008). This regular mechanical wave can stimulate the cerebral cortex, leading to the reflex of the nervous system and the behavior and psychological reflection of human beings. Clinical studies have shown that music has a direct impact on the cerebral limbic system and the brainstem and these brain structures are a key part of psychology regulation (Leino, Brattico, Tervaniemi & Vuust, 2007). Other scholars have discovered through the brain

magnetic resonance that when playing the music, the brain activity of mentally stressed patients shows better regularity and the degree of disorder is significantly reduced. Finally, it is reflected in a decrease in the degree of tension and the improvement of psychological state (Bailey, 2005). The above studies actually provide the evidence for the role of music in reducing psychological pressure and regulating psychology from many aspects.

Figure 1. Music therapy.

In addition to the physical perspective, it can also be considered that music and brainwaves have similarities and belong to one type of signal. When music enters the brain, it becomes the result of brain activities, so there is a certain specific rule between brainwaves and music. Because of this, in recent years, many scholars have used brain waves to study the impact of music on the brain. The commonly used methods include cortical DC EEG, positron emission tomography, time-related sites and functional nuclear magnetic resonance. The above researches provide a theoretical basis for us to study the impact of music on human psychology through brainwaves.

Experimental Design

The main research purpose of this paper is to study the music with different characteristics, specifically the impact of music with different rhythm and modes to human psychology. The main research method is the EEG experiment. The experimental design is as follows.

Selection of experimental subjects

The subjects of this experiment are mainly from patients with abnormal psychological fluctuation in a key hospital in Beijing. A total of 47 subjects are recruited, including 23 males and 24 females, all aged 45 to 55 years old. During the experiment, all patients are divided into two groups and four sub-groups. Among them, patients in the first group are mainly used to study the impact of differences in music rhythm on psychology, which can be divided into sub-group A and sub-group B; patients in the first group are mainly used to study the impact of differences in music mode on psychology, which can be divided into sub-group A and sub-group B.

The statistical analysis of the basic information of the control group and the experimental group shows that there is no significant difference between the groups, conforming to the experimental condition.

Table 1
Comparison of Experimental 2 Groups

	GROUP 1			GROUP 2		
	Group A	**Group B**	**P-Value**	**Group A**	**Group B**	**P-Value**
Age	51.4±2.1	50.8±2.9	0.081	50.6±3.5	52.1±1.7	0.071
Stature(cm)	169.2±8.7	170.1±9.5	0.221	171.4±5.5	170.9±6.8	0.189
Weight(kg)	72.3±5.1	73.8±4.4	0.156	70.4±6.1	71.1±3.5	0.212

Experimental preparation

The preliminary preparation of this experiment mainly includes the following aspects:

(1) Before the brainwave experiment, it is necessary to determine the on-demand collection position. According to previous studies, the brainwave collection positions determined in this paper are the black spots in the Figure below. Before conducting the brainwave test, subjects are required to wash their hair and are not allowed to apply any hair spray or conditioner, avoiding the interference for EEG signals.

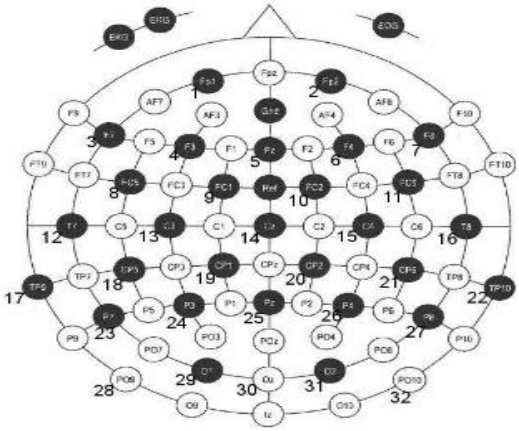


Figure 2. Brainwave collection point.

(2) The EEG collection experiment needs to be performed within 2 hours after eating, avoiding the interference of hypoglycemia of subjects for EEG signals.

(3) Prior to the start of the experiment, all subjects are informed that there is no risk in the experiment and no direct or indirect injury will be caused to the brain, avoiding the distortion of EEG signals caused by nervousness and anxiety.

Experimental procedures

For the first group of patients, the music selected for the experiment is the piano C major adagio and C major allegro. For the second group of patients, the music selected is the “Nocturne” and “Dante Symphony”.

It is necessary to keep the experimental environment quiet when conducting the experiment and subjects are required to keep relaxed. Before playing the music, subjects have 15 minutes of relaxation time. After listening to the music, subjects will be asked to sit still for 5 minutes in and the experimental instruments will record the EEG simultaneously. After collecting the EEG, the MATLAB software is used for data processing and EEG analysis.

Experimental Results and Discussion

The main EEG index collected in the experiment is the EEG variance and the EEG synchronism in different regions. Among them, the EEG variance can monitor the brain activity intensity of subjects. In general, the more nervous, the greater the EEG variance of brain. The more relaxed, the smaller the EEG variance (Grossberg, 1980). The EEG synchronism in different regions can monitor whether there is a psychological disorder. If the synchrony is poor, it indicates that there are disorders; if not, it indicates that there is no disorder (Viinikainen, Kätsyri & Sams, 2012).

Impact of musical with different rhythms on psychology and EEG

The piano C major adagio belongs to slow-rhythm music and the C major allegro belongs to fast-rhythm music. The subjects in sub-group A in the first group listen to the C major adagio and the subjects in sub-group B in the first group listen to the C major allegro. The EEG variance and the EEG synchronism of subjects in the music environment of different rhythms are as follows.

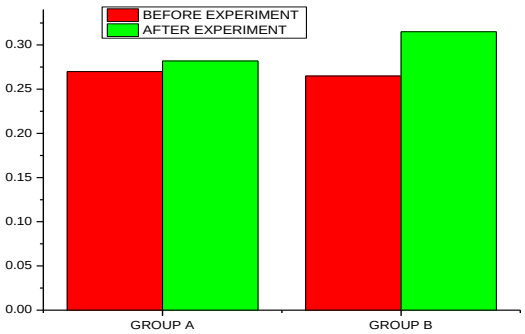


Figure 3. Brainwave variance of group 1.

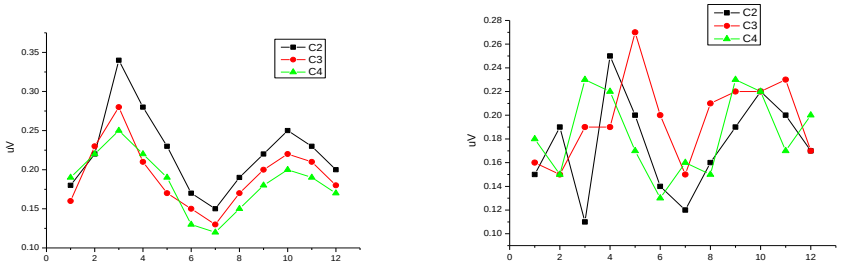
EEG variance

The following Figure shows the EEG variance characteristics of subjects when listening to music with different rhythmic characteristics. In sub-group A in the first group: before the experiment, the EEG variance of subjects in sub-group A in the first group is 0.270 and the value is 0.282 after the experiment. It can be seen

from the results of statistical analysis that there is no significant difference in the EEG variance of subjects before and after the experiment (P>0.05). Since the experimental scene of this experiment requires the subjects to keep relaxed before the experiment, this statistical result can actually show that the C major adagio music still keeps the subjects in a psychologically relaxed state. For sub-group B in the first group, the EEG variance of subjects before the experiment is 0.265. After listening to the fast-rhythm C major allegro music, the mean value of the EEG variance of subjects increases significantly to 0.315 (P<0.05). This experimental result shows that the fast-rhythm music increases the psychological fluctuation of subjects and leads to tension.

EEG synchronism

The following Figure shows the EEG synchronism characteristics in different regions when listening to music with different rhythmic characteristics. To facilitate the explanation, only the EEG synchronism characteristics in three regions, namely C_2, C_3 and C_4 are listed. It is easy to see from the Figure that in the sub-group A, the EEG synchronism in the above three areas is relatively obvious. From the perspective of graphical features, the trend of EEG in these three regions are similar and the EEG basically remains consistent whether in falling or rising without the phenomenon of rising in one group and falling in the other. The statistical results also prove the strong EEG synchronism of subjects in sub-group A. The non-parametric estimation shows that the fluctuation of data in these three groups is not significantly different (P>0.05). For subjects in sub-group B, the variation trend of EEG in these three regions is significantly different. There is a cross region of rising in one group and falling in the other. It can be seen from the Figure that the synchronism is poor and the statistical analysis also supports the above findings. The non-parametric estimation shows that the fluctuation of data in these three groups is significantly different (P<0.05). This result in fact shows that slow-rhythm music can enhance the synchronism of EEG pattern, thus achieving the purpose of relieving and relaxing.



Group A Group B

Figure 4. Brainwave of group 1.

Impact of musical with different modes on psychology and EEG

"Nocturne" is a minor music while "Dante Symphony" is a major music. Subjects in sub-group A in the second group will listen to "Nocturne" and those in sub-group B in the second group will listen to "Dante Symphony". The EEG variance and the EEG synchronism of subjects in the music environment of different modes are as follows.

EEG variance

The following Figure shows the EEG variance characteristics of subjects when listening to music with different modal characteristics. In sub-group A in the first group: before the experiment, the EEG variance of subjects in sub-group A in the first group is 0.275 and the value is 0.28 after the experiment. The results of statistical analysis are very similar to that in the previous group and there is no significant variation in the EEG variance of subjects before and after the experiment ($P>0.05$). This statistical result can actually show that the minor music can keep the subjects in a psychologically relaxed state. For sub-group B in the first group, the EEG variance of subjects before the experiment is 0.270. After the experiment, the mean value of the EEG variance of subjects increases significantly to 0.326 ($P<0.05$). This experimental result shows that the fast-rhythm music increases the psychological fluctuation of subjects and leads to tension.

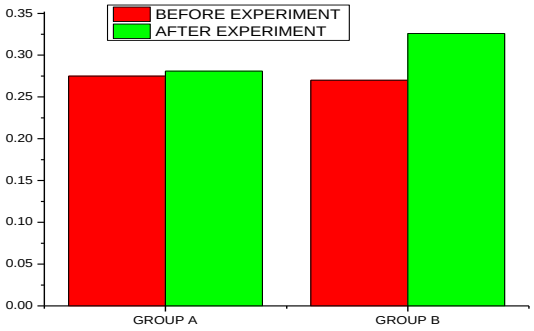
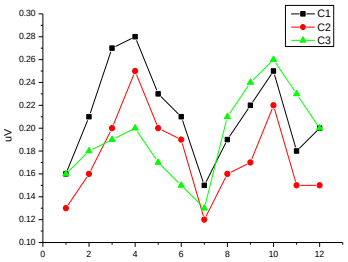


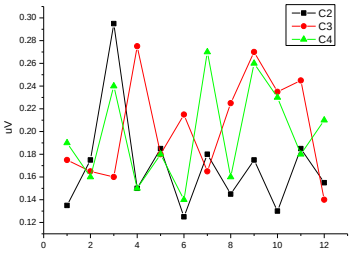
Figure 5. Brainwave variance of group 2.

EEG Synchronism

The following Figure shows the EEG synchronism characteristics in different regions when listening to music with different modal characteristics. In order to maintain the consistency and comparability of the context, only the EEG synchronism characteristics in C_2, C_3 and C_4 are listed. It is easy to see from the Figure that for subjects in sub-group A, the EEG synchronism in the above three areas is relatively obvious. From the perspective of graphical features, the trend of EEG in these three regions are similar, without the phenomenon of rising in one group and falling in the other. The statistical results also prove the strong EEG synchronism of subjects in sub-group A. The non-parametric estimation shows that the trend of EEG in these three regions is similar, namely that there is no significant difference from the perspective of statistics ($P>0.05$). For subjects in sub-group B, the variation trend of EEG in these three regions is significantly different. There is a cross region of rising in one group and falling in the other. It can be seen from the Figure that the synchronism is poor and the statistical analysis also supports the above findings. The non-parametric estimation shows that the trend of EEG in these three regions is not similar and that the trend difference of fluctuation is significant ($P<0.05$). This result in fact shows that minor music can enhance the synchronism of EEG pattern, thus achieving the purpose of relieving and relaxing.



Group A



Group B

Figure 6. Brainwave of group 2.

Conclusion

In this paper, the clinical experiment is used to explore the regulating effect of music with different rhythm and mode on human psychology. The experimental results show that the regulating effect of music with different characteristics on the psychological regulation is very different. Therefore, it is necessary to consciously select music in clinical practice, otherwise it may be difficult to achieve the desired results. The main findings of this paper are as follows:

(1) From the perspective of music with different rhythm, fast-rhythm music significantly increases the EEG variance of subjects and also worsens the EEG synchronism in different regions, causing psychological stress and disorders. In contrast, slow-rhythm music can play a good role in psychological relief.

(2) From the perspective of music with different mode, the major music increases the EEG variance of subjects and destroys the EEG synchronism in different regions, causing psychological stress and disorders. In contrast, minor music can play a good role in psychological relief.

(3) In clinical practice, minor and slow-rhythm music should be selected as the main treatment to maximize the psychological relief for patients.

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