A Preliminary Study on the Effect of Chinese Instrument Guzheng Music on Heart Rate and Mood

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ABSTRACT. This paper mainly studies the apparent effects of the music played by Chinese traditional instrument Guzheng on biological functions, especially on heart rate and mood. Today, many scholars are seeking other active interventions, such as psychology, to reduce the psychological factors caused by the disease. Among them, more and more use music therapy. The author preliminarily evaluates the effect of the music played by Guzheng on people's physical and mental improvement. The evidence mainly comes from heart-rate measurement and questionnaires. The study finds that for Chinese people aged 15-17, Chinese Guzheng music has a postive effect on heart rate and mood.

Keywords: music therapy, Guzheng, heart rate, moods

1 INTRODUCTION

Today, in a rapidly developing society in all aspects, people's demand for health is gradually increasing, not only the survival needs on the material level, but also the safety needs on a higher level of Maslow's theoretical system. Therefore, many scholars, such as M Gómez Gallego, J Gómez García, are seeking other positive interventions, such as psychological methods, to reduce the trouble of disease, and one of them is music therapy. More and more scholars like Mayra Alves Soares are studying music, and more and more doctors have used music therapy. This paper focuses on the traditional Chinese instrument Guzheng (Guzheng) to study the effect of music on people's heart rate and moods.

2 LITERATURE REVIEW

Up to now, many researchers have been engaged in the related researches on the influence of music on human physiology. For example, some studies have explored the effects of music on the control of systolic and diastolic blood pressure around the heart, while others have assessed the effects of music on the human body by recording subjects' emotional changes. The conclusions drawn from these studies are basically the same: music has a direct impact on physiological indicators, such as heart rate, or psychological indicators, such as moods.

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Kolsch & Jäncke et al. found that both heart rate and respiratory rate change with the fluctuation of music, and exciting and pleasant music increases these two indicators. Second, music can also affect regional activity in the heart. In clinical conditions, music can reduce distress, anxiety, and soothe people's moods. It follows that music is a adjuvant therapy cheap and safe1.

There is also research pointing out that concerts have a certain impact on sports. “It is reasonable to conclude that music has the capacity to provide significant positive effects for exercisers and athletes, particularly in the areas of enhanced affective responses and improved physical performance”2. The study speculates that this positive effect is mediated by heart rate, so part of this study was examining the effect of music on heart rate, and it suggests that heart rate increases accordingly.

Other scholars have not only studied the control of music on heart disease but have also studied the effect of music on hypertension. Amaral in the paper of “The Effect of Music Therapy on Blood Pressure of Individuals with Hypertension” concludes that music can also positively relieve high blood pressure. Clinically, it is a low-cost therapeutic intervention with few side effects. Amaral uses a few study comparison methods to assess the significance of the reduction in systolic blood pressure, including hypothesis testing for statistical significance, and the I2 statistic, which are worthy of continued use in further research3.

For music, Amaral uses Turkish classical music and Bach's Air, Pachelbel's Canon, Bach's Flute concerto andante and Tchaikovsky's Andante cantabile to cite two types of music styles and conduct experiments. It is also predicted that concerts in different cultural contexts would have different effects on different groups of people. Moreover, data show that Asians (Taiwan) tend to choose the sound of harp in several Western music (other than jazz, piano, and orchestra)4

From these previous studies, listening to music does have a certain impact on the dynamic performance of the human body. How are these effects generated step by step? Some scholars have explored the biological scientific basis of music therapy before. Hajime Fukui believes that listening to music promotes neurogenesis by regulating the secretion of steroid hormones, promotes the regeneration and repair of cranial nerves, and ultimately leads to the plasticity of the brain. Music affects the levels of steroid hormones such as cortisol (C), testosterone (T), and estrogen (E), and it is believed that music also affects receptor genes and related proteins5 associated with these substances. This study mainly focuses on the source of sound generation and the final reflection effect of human body mechanism. For intermediate receptor genes, associated with protein and hormone synthesis, it directly tests the connection between the production of music and the final changes in human heart rate and mood.

Subjective cultural differences in music have been explored by many scholars. Music is often given an abstract definition because it is varied and subjectively emotional. Baoqiang Han, director of the Music Technology Department of the China Conservatory of Music, points out in a discussion on the nature of "sound" that the standard of timbre varies from person to person. Han also emphasizes that the four elements of musical tone are a "psychological attribute rather than a "physical attribute"6. Therefore, the evaluation of tone should consider the differences between people, environments, and moods.

There are also numerous documents in ancient China discussing the relationship between music, the human body, and the environment. The traditional Chinese scale is pentatonic, and the order of the five scales is Gong, Shang, Jue, Zhi, and Yu. Chinese medicine believes that the five tones are related to the five elements in China--that is, the orientation and analogy of all things, and that the five elements can connect the five internal organs, namely the heart, lungs, spleen, liver and kidney. An ancient Chinese saying once said that Zhi is the sound of fire, which communicates with the heart, and Shang is the sound of gold, which communicates with the lungs7. This means that music in the Zhi mode or Shangmode is very likely to cause a psychological state to the heart and lungs. Influence stimulates the nervous system, thereby adjusting the cardiopulmonary function.

3 PROPOSAL

Based on the previous researches, the experiment in this paper selects the traditional Guzheng music. As a Chinese musical instrument with a long history of 2,000 years, the musical expressiveness and appeal of Chinese Guzheng has a special influence on the Chinese people. In this experiment, the Chinese Guzheng music “Spring to Xiangjiang” was selected as the test track. By measuring and recording heart rate and gauging mood changes of the testers before and after listening to the music, the influence of music, especially Chinese classical music, on the human body has been investigated. Through a control experiment on Chinese teenagers of 15 to 17 years old, let them listen to a piece music played by Guzheng, record heart rate and mood changes, test whether Guzheng music can affect people's heart rate and mood, and determine whether the impact is positive.

4 METHOD

4.1 Subjects

The subjects selected for the experiment are 10 Chinese teenagers (5 females) with the average age of 16.9 (±0.57std) years old.

4.2 Experiment Preparation

Use Chinese Instrument Guzheng (see Figure 1).

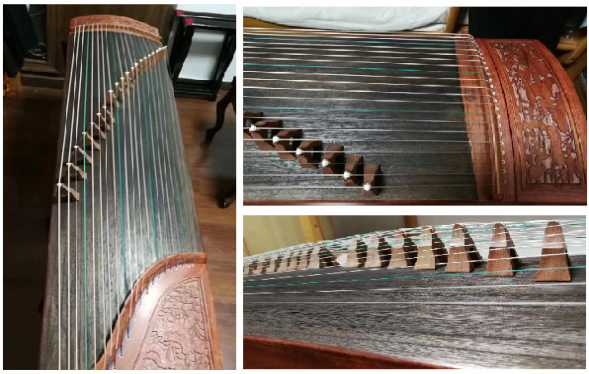
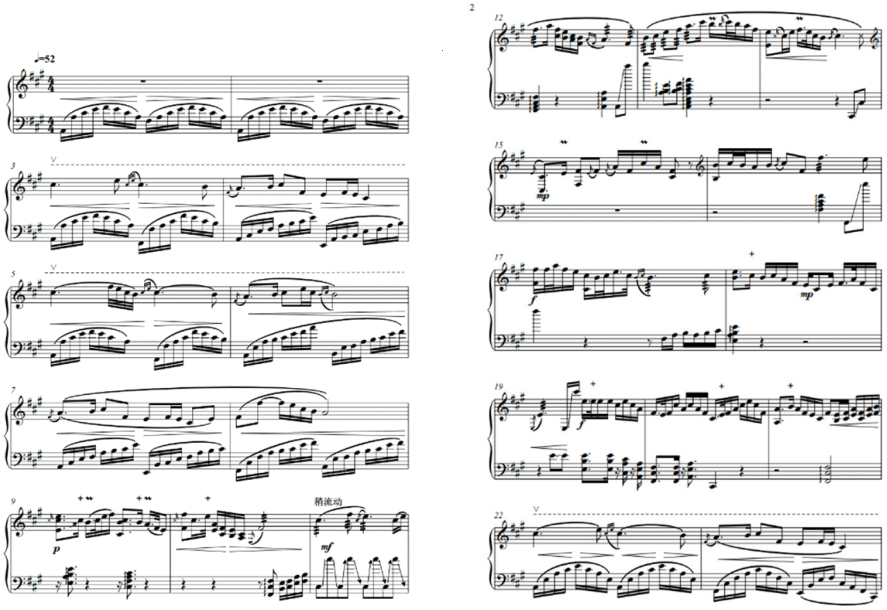


Fig. 1. Chinese Instrument Guzheng

The piece "Spring to Xiangjiang" is selected from music anthology of the Guzheng.



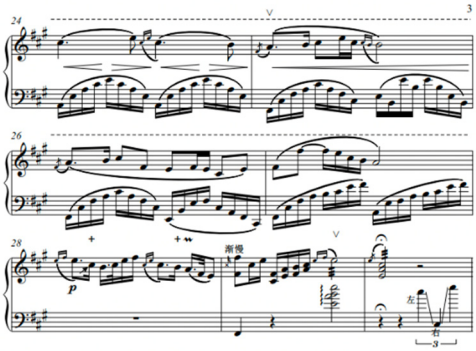


Fig. 2. The piece "Spring to Xiangjiang"

Figure 2 is a piece of folk music transplanted from the flute to Guzheng, which describes the beautiful scenery of spring coming to the riverside. The adagio speed selected for the experiment is around BPM=80, the music is soothing and relaxing, the melody is light and beautiful, and the Chinese pentatonic style runs through it, which is very suitable as a piece of music to adjust moods.

The Xiaomi Mi Band 6NFC (Figure 3) version is used as the experimental instrument for measuring heart rate. Each time the bracelet is clicked, the heart rate is continuously measured for about 30 seconds, and 4 readings are displayed. 20 data readings are taken within a continuous interval of 150 seconds:

Fig. 3. MI Band for Testing Heart Rate

Play in mp3 audio mode and select the slow stage from the 1 minute 54 seconds to the 4 minutes 12 seconds in the original song as the track for music playback for experiments. The decibel of the music will be measured by the decibel meter at a certain

position, and then the equipment and position are determined to control the uniformity of the volume.

4.3 Experimental Procedure

General Information: The start time for all the tests is within the range of 2pm to 5pm to ensure the test-site conditions of each subject are the same. The general steps of the experiment show as followed:

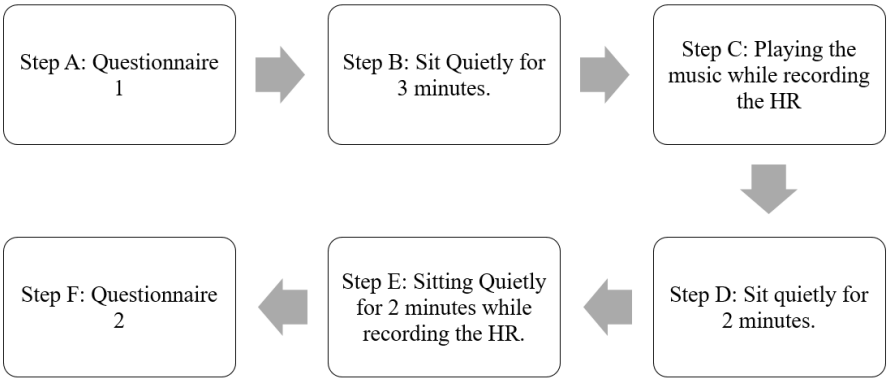


Fig. 4. Flow Chart of the Experiment

Each subjects takes the experiment for 14 minutes in total, including steps as following.
Step A: Pre-test questionnaire phase (3 minutes)
Step B: Preparation phase (2 minutes)
Step C: Music Time (2.5 minutes-5 times)
Step D: Rest time (2 minutes)
Step E: Blank Time (2.5 minutes-5 times)
Step F: Post-test questionnaire (2 minutes)

4.4 Specific Implementations

Step A: Pre-test questionnaire phase (3 minutes)
The purpose of the questionnaire is to compare the subjective level difference of the subjects' mood before and after listening to music, and to see whether the difference is statistically significant through statistical analysis.

Table 1. Questionnaire 1

Please give your degree of agreement to the following points: "1" means strongly disagree; "2" means disagree; "3" means no obvious feeling; "4" means agree; "5" means strongly agree.
1. I feel discomfort in some parts of my body (example: headache, stomach pain, etc.):

2. I feel good physically and mentally:
3. I feel emotionally anxious or nervous:
4. I feel angry and impulsive:
5. I feel relaxed:

Other questions in the questionnaire in the table aim to exclude other conditions that interfere with mood, and questions above aim to measure the initial state of mood.

Step B: Wearing the wristband

Before the preparation phase(2 minutes), the test watch is worn, and the subject is in a quiet environment and relaxes for 2 minutes.

Step C: Music (2.5 minutes and record heart rate for five times)

During the music playing, record subject's heart rate for five times during 2.5 minutes.

Step D: Rest time. During this 2 minute of resting, the participants are allowed to take a short break without leaving their sitting position. The participants are free to move their limbs, but no fast movement is allowed for the purpose of keeping their heart rate at a normal level.

Step E: Blank (2.5 minutes and record heart rate for five times)

Controlled experiment:

Then rest and sit for 2 minutes and record subject's heart rate for five times in another 2.5 minutes.

Step F: Post-test questionnaire (2 minutes).

Table 2. Questionnaire 2

Answer the questions. Still use a number from 1 to 5 to rate how much you agree with the following statement:
1. I feel more relief from the pain areas during and after listening to music:
2. I feel good physically and mentally:
3. I feel emotionally anxious or nervous:
4. I feel angry and impulsive:
5. I feel relaxed:

5 RESULTS

Through the analysis of heart rate (quantitative) and mood (qualitative), the results of the study will be presented in terms of heart rate and moods, respectively. Individual and group analyses are performed in each aspect to facilitate more rigorous, multi-level conclusions. In this research, aiming at the influence of music on people's heart rate and

moods, a piece of music from the repertoire "Spring to Xiangjiang" played by the Chinese instrument Guzheng has been selected to conduct a controlled experiment. The macro range of results shows that music influences heart rate and mood. Specifically, in terms of heart rate, the effect was significant (p=0.042). In terms of mood, the effect was significant (p=0.00422). Moreover, the fifth subject gave some open-ended answers, he said that he had a relatively obvious feeling of relaxation after listening to the music.

5.1 Heart rate

Heart Rate Population Results.
In the quantitative part of the population, each subject is a group and has two population data: the mean of heart rates of listening to music and of blank sitting (average of 20 data). The two-part population mean (average the average data for each subject) presented by ten subjects is shown in the following table:

Table 3. Mean Heart Rates for Different Music Treatments Across Populations

Mean Heart Rate of Hearing Music	77.4
Mean Heart Rate of Blank Treatment	72.4

Using Wilkerson's signed two-sided rank test, the resulting p-value was approximately $0.042 < 0.05$, demonstrating that there was a statistically significant difference in mean heart rate between listening to music and sitting in a group sense.

Heart Rate Individual Results.
At the level of individual quantitative heart rate analysis, each subject has 40 data, which are 20 Music and 20 Blank. The Music and Blank data of each subject are analyzed as two independent samples, so that the specificity test of independent samples was carried out. The mean heart rate of each subject is as follows:

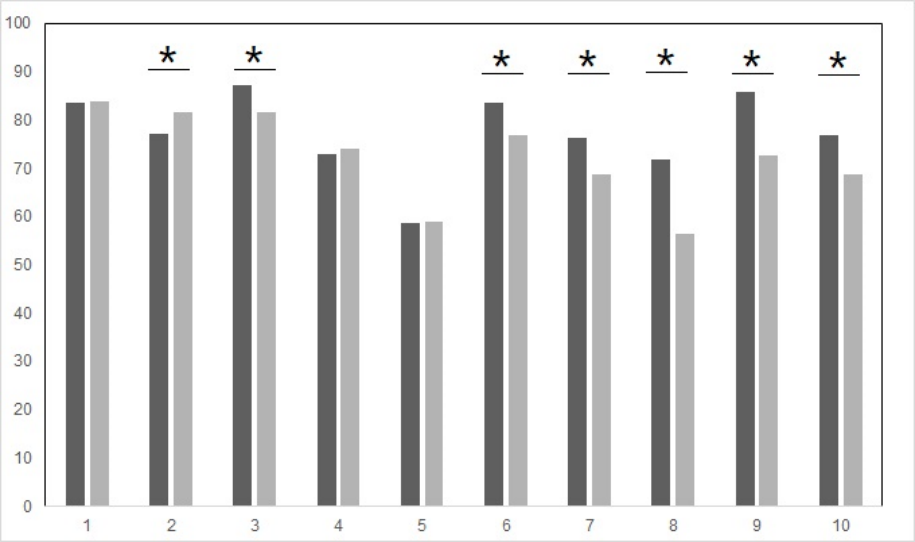


Fig. 5. Mean heart rate (bpm) for Each Subject. The mean hear rate is calculated form the heart rate measurements taken from all 10 subjects during the "Musics Time" (shown in blue) and the "Blank Time" (shown in orange).

The p-values for the two-sided test results for each subject are shown in the table below:

Table 4. Result of Two Sample t Test for Means of Heart Rate from Each Subjects

Subject	1	2	3	4	5	6	7	8	9	10
p-value	0.886	0.042	0.019	0.496	0.59	0.001	0.015	$9.26E^{-10}$	$6.32E^{-10}$	$7.16E^{-7}$

Through the test results, it can be found that among the 10 subjects, the p values of subjects 2, 3, 6, 7, 8, 9, and 10 (marked with stars) are all less than 0.05, and the p values of subjects 8, 9, and 10 are all less than 0.05. Values less than 0.001 (very significant). The experimental results show that at the individual level the heart rate of each person when listening to music is also significantly different from that when sitting.

5.2 Mood

Group results on mood.

In the qualitative part of the group, the study adopts the method of evaluating an index for quantification. There are four main questions about mood in the questionnaire, two positives and two negatives. Index uses the addition of two positive indices and subtracts two negative indices to quantify sentiment changes subjectively. For ten subjects, each person calculated the mood index before and after listening to music by this method, and the results are as follows:

Table 5. Mean Mood Index Before and After Hearing Music

Mood Index Before Hearing Music	3.5
Mood Index After Hearing Music	6.3

There is a big difference in the mood of the subjects before and after listening to music, and the general mood is improved (toward a positive change). The result of the bilateral test is about p=0.00422, indicating that the mood of the subjects also has a significant change before and after listening to music, and there is a significant positive change.

Results on Individual Mood.

The results of the change of individual subjective moods are similar to the analysis made in the group moods. The mood index of each subject is as follows:

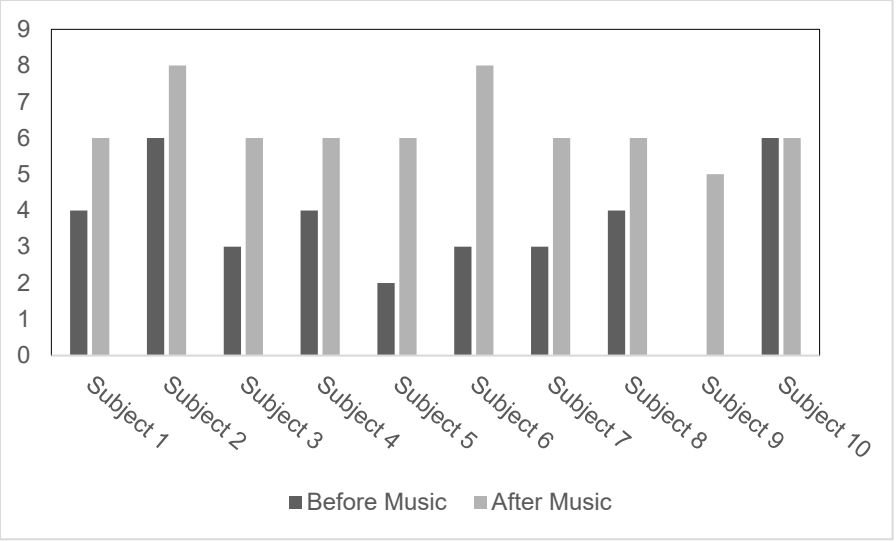


Fig. 6. Index Before Music and After Music for Each Subject

It is not difficult to find that each individual subject will be subjectively affected by music, and the moods of 10 subjects are all improved in a more positive emotional direction.

6 DISCUSSION

From the results, the significant impact results obtained by the study are similar to some previous studies. For example, music affects regional activity in the heart. The conclusion of the Music and Heart paper that music reduces pain and anxiety8 is similar to the findings of this study on mood. Although this study has some limitations in terms of experimental equipment and samples, the results obtained in this study are still statistically significant.

In terms of research methods, most of the previous studies used Western musical instruments, such as harp, piano, violin, etc. In this experiment, Guzheng is selected to make up for the insufficiency of the previous researches. Listen to the traditional folk music to the subjects to observe whether the significance is more obvious. Most previous studies used Western instruments, lacking the types of music familiar to the Chinese. Of course, this experiment only selected the adagio part of "Spring to Xiangjiang". If possible, future research can choose the allegro part and the slow half of "Spring to Xiangjiang" for a comparative experiment to observe different song styles and speeds. Does it affect heart rate differently?

The heart rate test device in this experiment is the Xiaomi Mi Band. The calculation method inside the band is not available. Therefore, there may still be some unknown deviations in the data obtained by the band. More accurate experimental instruments can be used for subsequent research. Another point is the question of test time. Currently, the experiment is conducted at 3:00 pm. Still, some subjects verbally expressed obvious sleepiness when listening to music, such as the sixth subject, while other subjects who did the experiment after 3:00 pm did not respond to a similar situation. In later studies, the sampling time was again considered to reduce the influence of its own physiological response on the experiment.

When it comes to the sample, the current sample size is 10, which is still in the range of the pilot test. Too small a sample size will cause a lot of variation due to individual differences. For example, subject 5 has a perfect physique and is good at exercising, and his heart rate will be low overall, falling in the range of 50-60. For another example, the test result obtained by subject 1 yielded a p-value close to 1: 0.886. Looking back at the questionnaire, it is speculated that the fundamental reason for such a significant difference from the other nine subjects may be that he has just received the rabies vaccine, and his arms will be sore at any time, which reduces his attention to music and affects the result. the result of. Small sample sizes can also cause statistical skewness, that is, the population data distribution of the sample exhibits a non-normal distribution. The non-normally distributed population data also made the analysis of the results of the study abandon the t-test (independent and one-sample) that requires approximately normality, and thus opt for the Wilkerson signed-rank test.

7 CONCLUSION

In the 15-17 age group, people will be influenced by music played by Guzheng to increase their heart rate and have positive changes in mood. Based on previous studies on the influence of Western musical instruments, such as harp, piano, and violin on mood, follow-up research can also use the experimental method of this study to conduct experiments on Western musical instruments and compare the results with those obtained from Guzheng, to observe differences in the effects of Chinese and Western musical instruments on heart rate and mood. The significant results obtained from the study can be used for further research on music therapy-related experiments.

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