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Effects of different types of music on spatial memory in mice

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Abstract. A preliminary investigation was conducted to find out whether different types of music have an effect on spatial memory in adult mice. Thirty mice were divided into six groups, each half male and half female, namely, female pop group, male pop group, female classical group, male classical group, female control group, male control group, and kept in cages and fed freely. There was a reduction in latency time in the musical group compared to the control group. There was a significant difference between the classical group and the control group ($P<0.05$), while there was no significant difference between the pop group and the control group ($P>0.05$). There was an enhancement of spatial memory in mice by classical music and no statistically significant enhancement of spatial memory in mice by popular music.

Keywords: Music, spatial memory, Morris water maze.

1. Introduction

The history of music can be traced back to the early days of human civilisation. The music of different periods has different artistic characteristics, but also conveys the emotions and ideas of people in different periods. After discovering that music has an effect on emotions, people often use music for therapeutic purposes. In 1995, scientists Rauscher and Shaw GL found that temporary listening to Mozart's music can improve spatial cognitive ability, and put forward the famous "Mozart effect" [1]; Hu Jingjing and other experimental research found that TchE and MAO in the brains of mice in the Liangzhu music group were significantly reduced compared to the control group, which signified that the mice's brain was not as strong as that of the control group. In 2013, Chan, Alice S. and Helen Tager-Flusberg concluded that music has a positive effect on brain function and can promote children's language ability and cognitive development [3]; the types of music that have been developed so far have been very diverse, so we decided to select two of the most well-known and popular genres for this study. In this study, we decided to choose the two most familiar and popular types of music, pop music and classical music, to investigate the effects of these two types of music on the spatial memory and activities of mice, in order to lay a theoretical foundation for the future guidance of students' education and patients' rehabilitation and other practices.

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2. Materials and methods

2.1. Materials

Thirty healthy adult Kunming rats, weighing 35-55 g, half male and half female, were purchased from the Animal Experiment Centre of Qiqihar Medical College.

Morris water maze; Morris Animal Behavioural Experiment Software; sound-proof box; classical music (Piano Sonata No. 14 in ascending c minor, Moonlight op. 27.2); pop music (Parade), and the intensity of the background music was controlled to be 60~70dB.

2.2. Methods

2.2.1. Clusters

The experimental animals were randomly divided by sex into female control group (n=5), male control group (n=5), female classical music group (n=5), male classical music group (n=5), female popular music group (n=5), male popular music group (n=5)

2.2.2. Intervention

The small speakers were placed in the soundproof box, and the sound volume meter measured 60~70 dB in each cage box when the speakers were turned off, and 30 dB outside the cage box, and 60~70 dB in the cage box when the music was played, and the mice in each group did not interfere with each other when they received the music stimulation. Every day from 9:00 am to 11:30 am and from 15:00 pm to 17:30 pm, the speakers in the cages of each music group played the corresponding music, and the blank group placed the same speakers but kept them turned off, and the water maze test was conducted at the end of each 6-day cycle. A total of three tests were performed, during which the mice were fed and watered freely. The musical frequencies of the two pieces of music are shown in Figure 1.

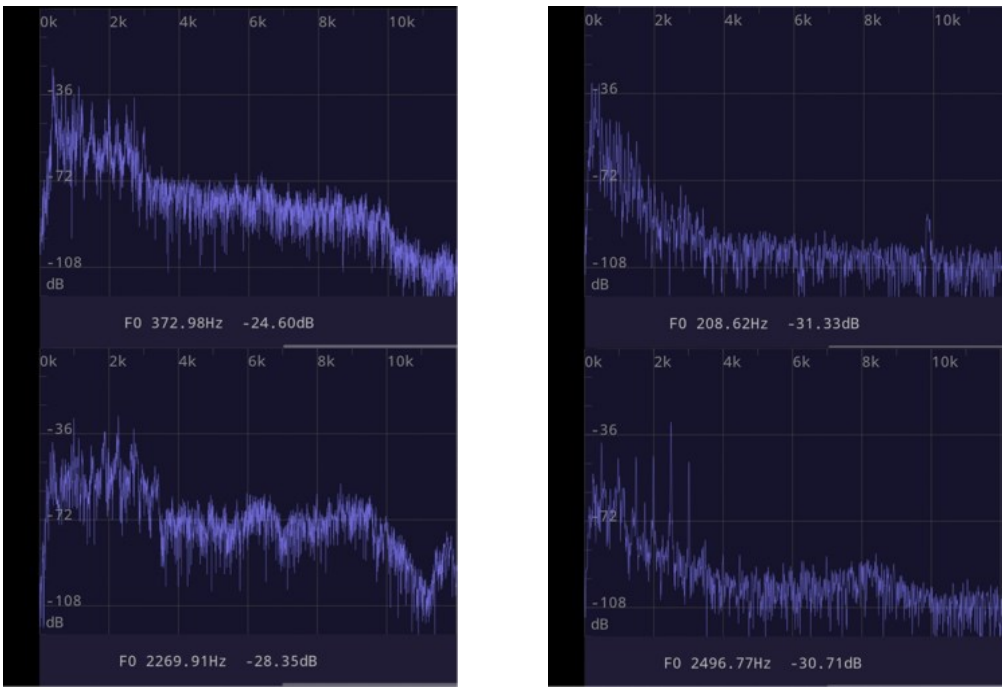

Figure 1. The musical frequencies of the two pieces of music. (Photo credit: Original)

2.2.3. Morris Water Maze Test

The musical stimuli were kept constant during the test. Fresh water was added to the labyrinth, and the water temperature was controlled to be between 18℃ and 22℃, with the water surface about 1 cm above

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the platform so that the platform could not be seen by the naked eye. The maximum latency of the automatic recorder was set to 90 s. The localisation navigation experiment was conducted at 9:00 am on the 7th day of each cycle after 6 d of intervention. Mice were placed into the pool with their backs facing the platform from four entry points in the east, south, west and north of the pool, and the time taken for the mice to locate and climb up to the platform, i.e. the latency to escape, was observed and recorded. mice that could not locate the platform within 90 s were guided to the platform and remained there for 10 s. The test was conducted four times consecutively.

2.3. Statistical analysis

The experimental data of each group were expressed as mean ± standard deviation($\bar{x}\pm s$), and the data were analysed using repeated measures analysis of variance (ANOVA), a statistical software, and the difference was considered significant at $P < 0.05$. The results are shown in Table 1

Table 1. Average latency of water maze ($\bar{x}\pm s$,n=10,s)

Group	1st day	2st day	3st day
Control group	51.21±15.18	50.33±17.55	51.17±16.37
Classical group	50.93±23.35	41.17±21.74	29.11±15.42
POP group	44.09±21.96	46.32±17.59	44.54±21.48

3. Result

In the positioning navigation experiment, the latency time was shorter in the music group compared to the control group and became shorter in the classical group as the training time increased. There was a significant difference between the classical group compared to the control group ($p<0.05$), while there was no significant difference between the popular group compared to the control group ($p>0.05$).

4. Conclusion

Learning and memory are complex processes, and it has been shown that the establishment of short-term memory is associated with an increase in synapses, with serotonin leading to an increase in presynaptic cAMP, which activates the pka and leads to synaptic enhancement through the release of augmentative transmitters generated by the connectivity mechanism; long-term memory persists through the growth of new synaptic connections, a structural change that parallels the duration of behavioural memory. As memories fade, these connections contract over time [4].

Music, as an integral part of our daily lives and studies, has not only been limited to the role of appreciation and enrichment, but also has therapeutic effects. It has been found that music plays a therapeutic role in psychosomatic and physiological diseases, and has an important role in assisting in the treatment of adverse emotions such as tension anxiety depression and pain [5]. Not only that in the experiment also found that music stimulation can improve the spatial memory ability of rats ,enhance the hippocampal neuron NMDA receptor and encoding NMDA receptor mRNA expression [6].

The results of this experiment showed that the spatial memory ability of mice in the classical group was significantly improved compared with that of the control group, which indicated that classical music promoted the development of related areas in the brain to a certain extent, confirming the enhancement effect of classical music on spatial memory. There was no significant difference between the pop group and the control group, and this result does not confirm that pop music can enhance spatial memory. The music tracks chosen in this study are few, and only a preliminary exploration of different music genres was made, which has certain limitations, and the subsequent experimental study can be conducted by increasing the music tracks of various genres.

Authors contribution

Binying Fu, Jiale Zheng made the same contribution. Binying Fu: Introduction. Jiale Zheng: Conclusion.

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