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LETTER TO THE EDITOR

Musical Rhythm and Movement Coordination from the Perspective of Ecocognitive Neuroscience

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In order to study the relationship between music rhythm and movement coordination based on Ecocognitive Neuroscience, four groups of experiments are performed to test the time of the button neural response and movement coordination. Through the above experiments, it can be seen that musicians have better hands coordination, which shows that music rhythm training based on Ecocognitive Neuroscience can effectively improve the coordination of movements.

I Introduction

In the previous related research, the coordination of hands is given great attention. In this field, foreign comparative studies of single - handed and hands movements are most concentrated, which are often implemented through the repetitive hand movements (Liao et al. 2017). Music ability is the oldest and most basic cognitive ability of human beings. The study of music cognition and brain mechanism has always attracted scholars. As a complex skill, musicians perform with high precision in time and space, including cognitive structure and motor skills. Therefore, musicians are not only good objects for studying the musical rhythm and movement coordination based on Ecocognitive Neuroscience, it can also be used to study changes in long-term rhythm training for motor skills and brain structure as well as neural mechanisms (Zhang et al. 2016).

The trained musicians will present the visual image and will be connected to the image of the sound. This positive activity is most obvious when there is an auditory image. When the musician performs the stable audiovisual image, the positive spatial pattern of the brain is the result of numerous cortical activities. The training of music rhythm image can make the processing more effective in the auditory cortex (Li 2019). Therefore, according to the theory of music rhythm and Ecocognitive Neuroscience, four experiments are designed to study the musical rhythm and movement coordination based on Ecocognitive Neuroscience (Zhou et al. 2017, Xu 2019).

II Methods

Eighty undergraduates from the normal university are divided into four groups, namely non-music group, piano group, vocal group and violin group. The subjects of the three music groups are from the piano, vocal and violin majors of the conservatory of music. The non-music group subjects are from different majors in the school and did not receive any professional music training other than the basic music education. Each subject needs to record relevant information, including name, gender, age, starting age and learning period of the relevant instrument.

The types of button neural responses studied include: pressing the F button with left hand, pressing the J button with right hand and pressing the FJ button with both hands. Each category is repeated three times, with a total of 9 blocks, which are randomly distributed and blocks of the same category do not appear consecutively. Each block includes 36 trials, and each category has one block, so there is a total of 432 button responses.

Before the analysis began, the response data with time greater than 450 ms and less than 100 ms had to be removed first, and the average time of button neural response under the three categories is calculated (Humpston 2015). In the two-hand response category, the absolute difference in coordination between the left and right hands needs to be calculated as the measure of the coordination of the hands. The larger the value is, the worse the coordination of the hands is.

The types of button neural responses studied include: pressing the F button with left hand, pressing the J button with right hand and pressing the FJ button with both hands. Each category is repeated three times, with a total of 9 blocks, which are randomly distributed and blocks of the same category do not appear consecutively. Each block includes 45 trials, and each category has one block, so there is a total of 540 button responses. In every 45 trials, cognitive nerve stimulation occurred 20 times on the left or right side of the screen, and the other 5 target stimuli did not appear. At this time, the experimenter did not need to react. This setting is to avoid mechanical reactions to maximize the Simon effect of Ecocognitive Neuroscience (Butler et al. 2017).

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The experiment includes two types of button neural response, which are the left-handed F-key while the right-hand high-frequency interference and the right-handed J-key while the left-hand high-frequency interference. Each category is repeated three times, with a total of 6 blocks, two categories appear at intervals. Each block includes 36 trials, and each category has one block, so there is a total of 288 button responses.

Before the analysis began, the response data with time greater than 450ms and less than 100ms had to be removed first. Subsequently, the average response time of the hands, the left hand reaction time, and the right hand reaction time are separately calculated to compare with the relevant data of Experiment one. The greater the contrast difference is, the greater the interference between the hands is, and that is, the worse the coordination of the hands is.

Sixty undergraduates from the normal university are divided into three groups, namely non-music group, piano group and sports group. The piano team is from the piano school of the conservatory of music. The sports team members are from non-music and hand-related majors in the sports academy. The non-music group members come from other majors in the school. Except for the piano group, the rest of the staff did not have any instruments, nor did they receive any professional music training other than the basic music education. Each participant is required to record relevant information, including name, gender, age, starting age and length of study of the relevant instrument, or the starting age and length of study for professional sports training.

According to the Seashore Music Proficiency Test, the experiment consists of three categories: pitch, tone memory and voice recognition. Each category is repeated twice, so there are 6 blocks in total. According to the difficulty, each participant receives the pitch test first, then the tone memory, and finally the voice recognition. The three categories will repeat once. There are 15 trials per block, and there are 5 trials per class to familiarize you with the experiment, so there are 15*6+5*3=105 button responses. In the pitch category, which of the two

tones is higher needs to be discerned; in the tone memory category, which tone has changed needs to be identified.

In the discriminating category, La in the C major is used as the reference sound to determine which of the C majors is the latter.

The audio properties are Channels 2, Samples 44k Hz, and Bits per Sample 16 bits.

The average time of button neural response, correct rate and related data under the three categories are calculated separately. The shorter the time of the button neural response is, and the higher the correct rate is, the better the musical rhythm is.

III Results

The 4*2*2 variance analyses of three factors is used to analyze the experimental results, mainly to compare the time of button nerve responses of the four groups and the absolute difference of the movement coordination of the hands. There are two other situations, one with one hand and both hands, and the left and right hands.

The experiment did not find coordination differences of single-hand and both hands and group interactions. In fact, all 2D and 3D interactions did not occur. Significant differences are not found in the left and right hand coordination analysis. There are also no significant differences in the four groups of button neural response times.

The absolute difference in the coordination of the hands is very significant. By comparison between the non-music group and the other three vocal groups, the value of the significance test parameter p is less than 0.001, all reaching very significant degree of difference. By comparing the three music groups, there is no significant difference in the coordination between the piano group and the vocal group, $p = 0.676$. The difference between the violin group and the piano group is significant, $p = 0.018$, and the difference between the violin group and the vocal group is also very significantly, $p = 0.006$.

Therefore, the relationship between the four groups of coordination differences is: violin group <piano group $\approx$ vocal group <non-music group.

Experiment two focuses on the changes in the absolute difference values of the four groups of hands under the influence of the Simon effect of Ecocognitive Neuroscience. The absolute difference in coordination between the four groups is calculated to be 5.15 ms for the non-music group, 2.68 ms for the piano group, 2.72 ms for the vocal group, and 1.46 ms for the violin group.

The experiment focused on the speed change of the button nerve response under the influence of the action of the unilateral hand.

The average reaction time of the hands in Experiment 3 is compared with the data of Experiment 1. The results of the test show that there is the very significant time difference in the non-music group; the comparison results of the piano group do not show significant differences; the comparison results of the vocal group are significantly different; the comparison results of the violin group are not significantly different.

The left-hand and right-hand reaction times of Experiment 3 are compared with those of Experiment 1. The results of the test show very significant difference in the left-hand reaction time of the non-music group. There is no significant difference in the left hand reaction time comparison between the piano group.

It can be seen from Table 4 that as the difficulty of the task increases, the piano group does not show the difference, but the correct rate of the non-music group and the sports group gradually decreases. In the overall trend of correct rate (ACC) and button nerve response time (RT), the correct rate: piano > non-music group > sports group, the time of button nerve response: non-music group > sports group > piano group.

The overall correct rate comparison shows piano > non-music $\approx$ sports, and the overall response time inequality

is non-music > sports > piano, that is, the musical rhythm of piano students can be very good. They not only have the high correct rate, but also have the fast response and good movement coordination. However, compared with the students of non-music majors, the physical response time of sports majors is shorter than that of non-music students.

IV Discussions

Studies have shown that training of music rhythm not only has the long-term impact on cognitive ability, but also has the positive effect on the flexibility and coordination of hands. Even in the structure of the brain, musicians have undergone certain structural changes and functional reorganization. In foreign countries, single and two-hand button tasks are used to study the musician's motor skills. These studies show that musicians have faster button presses and more precise melody performance, which is greater flexibility and independence. But there is no study about the better coordination of the hands of musicians. Therefore, in this paper, the influence of music rhythm based on Ecocognitive Neuroscience on movement coordination is studied by comparing the neural response time and the hands coordination.

Four experiments are conducted to explore the interaction of different musical rhythm training and hands coordination. With the simple time of the button nerve response as the observation index, the difference in the reaction speed and coordination between the musician and the non-musician in the hands is initially explored in the experiment one.

In Experiment two, the Simon effect of Ecocognitive Neuroscience is adopted to study the differences in hands coordination.

In the experiment three, the difference between the time of the button nerve responses and the hands coordination is further explored through the button tasks of different rhythms.

In Experiment four, the difference between musical ability and hands coordination is obtained by comparing musicians, sports specialties and non-musicians.

V Conclusions

According to the four experiments in this paper, the following conclusions can be drawn: Musicians have better performance in the flexibility and coordination of their hands. Among them, the violinist performed best, followed by the pianist, then the vocalist, and the non-musician's flexibility and coordination are poor. This shows that the training of music rhythm can effectively improve the movement coordination.

The hands coordination of musicians is not affected by the Simon effect of Ecocognitive Neuroscience. Among them, violinists are almost unaffected, followed by pianists and vocalists, and non-musicians are seriously affected. It shows that the musician's hands are more stable and not easily interfered by the outside world.

The musician's hands are more coordinated. Among them, the violinist is the best, and the pianist is not significantly different. The performance of vocalists is not good enough, and it is interfered by the coordination task. Although this kind of interference is not as strong as that of non-musicians, it also shows that the training of music rhythm promotes the improvement of the hands coordination.

References

Butler MJR, Butler MJR, Butler MJR (2017) Organizational Ecocognitive Neuroscience – potential (non-) implications for practice. Leadership & Organization Development Journal 38 (4): 564-575.

Humpston CS (2015) The measure of madness: philosophy of mind, Ecocognitive Neuroscience, and delusional

thought. American Journal of Psychiatry 172 (3): 297-8.

Li X (2019) Research on Preschool Music Education from the Perspective of Ecology. Ekoloji 28 (UNSP e107335107): 2989-2996.

Liao Z, Zhu Z M, Wang Y, et al. (2017) Brain double simulation indncing method based on light music and music beats way. Computer Engineering 43 (11): 27-31.

Xu Y (2019) Ecological Research on the Cognitive and Visual Features of Regional Culture in Landscape Design. Ekoloji 28 (UNSP e107172107): 1487-1493.

Zhang H, Zhu XF (2016) Progress of children's developmental coordination disorder and physical training interference. Chinese General Practice 19 (33): 4142-4146.

Zhou LS, Zhao HY, Jiang CM (2017) Neural plasticity to musical performance training: A meta-analysis study. Advances in Psychological Science 25 (11): 1877-1887.