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Article

Application of Music Education in Brain Cognition

Qi Zhang
Hebei Agricultural University

Abstract

Neuroscience studies have revealed that music education may have a catalytic effect on brain cognition and development. Intensive music training will also intrigue educates' interests in other disciplines for comprehensive quality development. This paper analyzes the findings of domestic and foreign scholars on how music education will be correlated to cranial nerves and finally bears out that music education contributes much to brain cognition and cranial nerve development. More than that, music education plays a more powerful role in several special sensitive periods of human development process. What's the relationship between cranial nerves and bermorgen training is also analyzed herein. In a word, the unique music training mode can develop the human brain potential, activate the cerebral nerve functions to lay a foundation for the development of other skills, thus providing the clue to the reform of education in the new era.

Keywords

Brain Cognitive Mechanism • Music Pedagogy • Development Potential

Correspondence to: Qi Zhang, College of Arts, Hebei Agricultural University. Email: xxqq1982@163.com

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As an elegant art, music offers an access to human emotion experience. It emerges in the social life of humans in the countries and regions, regardless of race disparity. It also acts as an integral part to constitute the human art life. In this art experience, cerebral phronetal functions of human are infected by the music melody to unconsciously influence and change people's lifestyles and thinking habits with it (Moreno, 2009). This phenomenon occurs because concerts activate dopamine in the cerebral cortex system in the brain, which will regulate and awaken people's attention, emotion, learning, memory, and decision, even all aspects (Chlan, Engeland & Savik, 2013). Among multiple individuals, the simultaneous activation of these brain systems may be synchronized with the music structure and tune. Music also benefits human learning and other behaviors, and can improve human adaptability to environmental transitions, accelerate the evolution of living things.

The study of brain neuroscience has fully revealed such a fact that complex psychology activities are involved in human learning process. The purpose of education is to far more than just learn some available knowledge or skills. It is not limited to textbook teaching in universities, but involves the psychological and neurocognitive processes of the entire life cycle (Jones, 2009). If learners' emotional and psychological activities get a full stimulus during the learning, anyone can adapt to the challenges arising from economic turmoil, environmental degradation or population aging. Educational neurology based on brain cognition strongly advocates the cognitive control and perceptibility during students' learning process. It is believed that social experience and emotional experience should be advanced using several methods in the learning process. As a complex learning and practice activity, music involves many aspects of human psychology and neurology, so that it may play a greatly catalytic effect on learners' learning since it can stimulate multiple neural modules in the brain by functions, fully mobilize the fluctuated emotion of learners and influence their learning effect. What's more, it can change specific functions of these brain neural networks or repair neuron systems in impaired brain systems. Many studies show that the music training covers a series of sensory organs which may participate in the process, and allows a variety of motor skills to be developed, so as to play a significant effect on emotions, memory and higher-order cognition (Spilka, Steele & Penhune, 2010). The cognitive activation under music is reflected from the fact that it can activate the brain's emotions and neural networks, integrate multiple brain system modules into the music training and appreciation. Up to now, there are more than 100 neuroimaging studies, which all suggest that multiple neuron systems will be activated in people's brain while they listen to music and recall music performances. Hence in this sense, scholars discover that those people who have been exposed to the intensive music training have great difference from those people who have never access to music in brain size, shape, density, and connectivity (Hyde *et al*., 2009). Music provides a "brain motivation" for new education model based on brain cognition in the future, broadly improving the learning skills and happiness exponent of our individuals and communities. On this basis, this paper explores the relationship between music learning and brain-cognition-based education, analyzes the unique role of music in cognitive education. Beyond that, reasonable advice is also given herein.

Music learning and brain cognitive mechanism

Analysis of cognitive relationship between music and cranial nerves

Music as a human activity with high degree of participation requires participants to have certain perceptual

skills, including pitch recognition, auditory memory, selective attention, and perception of the music time and structure, all of which constitute a distributed brain neural network (Peretz & Zatorre, 2005). Unlike many other human activities, the music performance requires precise time arrangement, as well as hierarchical actions and control over pitch intervals. When exposing to the music, the auditory cognition system must depend on human memory mechanism to allow the received stimuli to be stored in the brain neural network, thereby to associate one element in a sequence with another element that occurs later on. Music recognition process must access to and choose potential temperament elements and memory modules in the sense memory system. Studies involving the neuroimaging show that the emotions that music can induce usually involve extremely similar brain regions associated to unmusical and basic emotions, including the brain nucleus, amygdala, and hippocampus (Salimpoor *et al*., 2011). Music can produce strong touch on the emotions of the audiences, making people have a high engagement without performance anxiety. In a variety of social activities, if exposed to the music, the teams can enhance communication and assistance between each other, thereby facilitating mutual learning and development. As shown in Fig. 1, a simplified model is given for music process in the human brain system. We can learn that there is a close correlation between music and brain cognition. Under exposure to the music, people can awaken a wide range of activities in the cerebral cortex and subcortex tissues, which in turn changes human cognition of society and itself. That is to say, an "impartment silently" teaching model is available to allow people to learn knowledge imperceptibly. This knowledge is crucial for its future development.

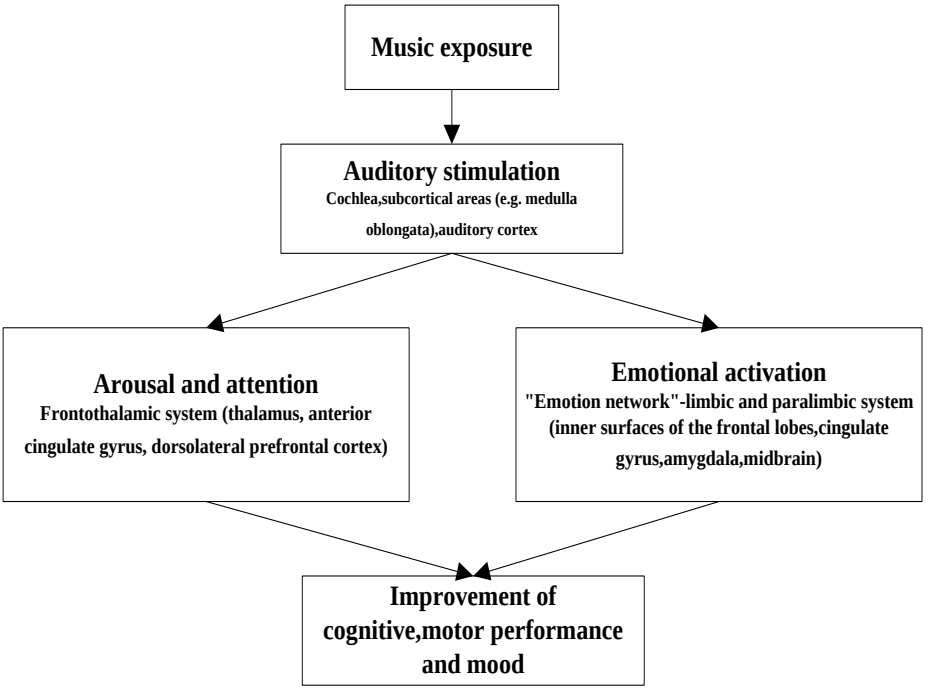

Figure 1. Simplified model for the potential effect of music on brain structure

Music training is a multi-sensory exercise experience that often requires a lot of tips, including reading

complex coincidence systems and transforming them into continuous temperament rhythm which also depend on multi-sensory feedback. Music reading must process a huge mass of information in parallel in a short time so that these can be used immediately. To accomplish these tasks, it is required to accurately master the pitch and time of the notes at least. Therefore, intensive music training can enhance learner's attention and executive function. Since music activities often require the engagement of multiple cognition functions, especially in the brain neural networks of highly disciplined musicians, the potential role of these functions tends to perform extremely strong plasticity. It is suggested that this plasticity occur in the brain regions via the music training, while these regions either control the major music skills or transfer to other skills as a multi-modal integration of music skills. For example, the survey has found that musicians have significantly improved function connectivity in the motor and multisensory regions in relation to non-musicians (Luo *et al*., 2012). The study shows that long-term music training may play an effect on the function connectivity of the brain's nerves and enhance the cognition degree of the cranial nerves.

Effect of music training on cognitive competence

Cognition based on cranial nerves is a complex information transmission system. Its growth and development are subjected to various processes of neural evolutions. Typical evolutions include synaptic hyperplasia, myelin transmission of nerve fibers, and the development of neurotransmitters, each of which has its own growth trajectory. It is found by studying brain plasticity that many years of music training can make the brain to form an intrinsic reflection in the memory structure, thereby accelerating cognitive development in related regions (Weinberger, 2004).

Music training can significantly improve learners' listening and language skills. Corrigall & Trainor (2009) et al. stated that when compared with people who have accepted the intensive music training, those who have never accepted similar training were found to be far lower competence to handle listening tasks. To be specific, those who have accepted the intensive music training can discern the minor differences between pitches and distinguish between the syllable duration and the start time of the sound (Parbery-Clark, Skoe, Lam, & Kraus, 2009). These findings all show that music training can improve auditory perception and increase listening skills represented by sound discernment. These differences in language processing not only reflect a learning capacity, but also mean that these people can focus on one thing for a long time. All of the above are essential for all kinds of learning. Since the music sound seems like all other sounds to cover most of the information treatment process throughout the auditory system, it can transfer to language-relevant skills. Strait et al found by studying those children who had been trained under the music that their auditory brainstem response could stop the false pronunciation of consonants within three years. It is suggested that the neural differentiation enhancement mechanism for similar sounds of adult musicians could help them transform into better sound discernibility in the future (Parbery-Clark, Strait, & Kraus, 2011). Since music and human language share a common auditory sense basis, some notes will inevitably enable the brain's mechanisms to enhance its sound discernibility in another region and competence to output language. Patel stated in his book that the benefits of musicians in speech coding were caused by five mechanisms. He further pointed out that there was a common brain neural network between language and music. As the music generation needs high precision, these trainings can directly or indirectly affect each other (Patel, 2014).

Executive capacity is a cognitive process controlled by the frontal cortex of the brain, which enables people to focus on and accomplish the means and goals of the event, and deliberately alter behaviors to adapt to the environmental changes (Banich, 2009). Music training stimulates the processes of specific brain regions, increases the processing capacity in the cerebral cortex, so that attention and performance are significantly increased. Attention and memory, as well as coordination skills in different situations, have a direct bearing on the music learning that depends on the integration of top-down and bottom-up processes. Music training integrated like this are the basis of attention and memory. In addition to the executive capacity and attention in the learning process, music training can also improve the learner's intelligence, enhance specific skills, thus resulting in cognitive improvement. Music practice, like extracurricular learning, usually requires focusing attention and memory to have a gradual grasp of the skills. Therefore, the executive capacity, self-control, and continuously focusing attention may render into the learning foundations for other disciplines to improve learning performance, further ultimately leading to changes in IQ. General intelligence tests will run based on Raven's test matrix, where various types of intelligence can be measured in specific columns. These tests require different types of cognitive competence, as a good indicator for intellectual arithmetic and non-verbal reasoning skills. Although various types of intelligence can run in a specific test, these tests require different types of cognitive performance. Since non-verbal reasoning skills are developed during the music practice, music learning can improve the cognitive performance in the tests.

Educational enlightenment based on relationship between brain cognition and music

Grasp the key period of music education

The plasticity of cognitive competence is closely bound up with music training degree and periods. The start and duration of the sensitive period of music learning is not only age-related, but also matters the learner's experience, so that the sensitive period of music knowledge will be prolonged in an intensive training environment. For example, the critical period for auditory cortex plasticity is at ages 13-14, when cranial nervous system prevents normal sensory discrimination and oral learning. While for those who have ever been exposed to it, the second language will be better. However, not all brain nerve regions develop in the same time course, that is to say, each nervous system has peculiarity and persistence at its uniquely key periods. Any of intensive trainings, including instrumental training in childhood, may have different effects on the plasticity and development of brain cognition, but vary according to different ages. In general, the brain cognitive system based on music education mainly consists of two parts, that is, one part based on the evolutionary congenital cranial nervous system, and the other based on the acquired training characterization system. The music learning mode is a process of transition from the innate through the acquired training. In this process, the characterization system based on acquired training continuously provides positive feedback to the congenital cranial nervous system, which promotes its persistent development and perfection. While the evolution based innate cranial nervous system is the basis for the development of the acquired training characterization. Unlike the traditional educational viewpoints that regard music education only as an adult's entertainment and recreation, we should strengthen the exercise and edification in this regard from the early years, and hone the brain's cognitive

function. Therefore, the music learning and education not only depends on the innate conditions of the learners, but more importantly, it also captures the critical periods of brain cognitive development to offer a favorable learning environment for learners, so as to drive them a comprehensive and balanced development based on music.

Abandon the concept of "focus on intellectual education, disdain aesthetic education"

In the concept of the traditional education system, teachers and parents all cling to old educational idea, that is, “focus on the intellectual education, disdain aesthetic education”. They have long stressed the mathematics and some subjects rather than aesthetic and moral education represented by music. The traditional education system is a passively accepted learning model that lays undue stress on the rote memorization and mechanical training and oppresses students' creative power and associative ability. This education model seems to enable students to quickly learn skills and gain high scores. However, in the long run, as it cannot fully develop the brain nerve regions in a balanced manner, students will not be able to respond quickly to changes in the environment and become high-quality talents that the state and society require. Therefore, it is necessary to abandon the traditional and backward education concept, improve the existing learning model, and let students become the learning protagonists. Music teaching should be taken as dominant subject to encourage students to experience learning in a free and comfortable environment. The students' brain cognition potential is fully developed with the music learning, so that their interest in learning will be intrigued for a high participation in learning.

Implement adaptable teaching evaluation mechanism

There is a big gap between the music education and learning model and traditional model. It is required to choose appropriate evaluation mechanisms to enhance the common development of teachers and students. Music cognition involves the development of the cranial nerve, so it is a long and progressive process to develop it in a highly complicated brain structure. Beyond that, students are rather different from each other in the music learning development process since there are many phases, saltatory phenomenon. While in the traditional education system, teachers or students will conduct regular assessments for testing the teaching effect. However, most music teachers have a hard time to let other music teachers make an assessment, because they simply depend more on experience and past teaching effects, rather than taking the exam. However, this personalized teaching style will become more rigid over time and hardly adapt to the music teaching requirement. For this purpose, a self-evaluation mechanism can be implemented in this regard. It includes teaching strategies used in the reflection curriculum and takes account of how students' learning outcomes are influenced by teacher behaviors. When using the self-evaluation model, an effective measure is to develop video recording and course reflection to observe the character traits of different students and the unconscious behavioral disposition of teachers. Via this model, teachers are more easily discover the latent demand of students and their own problems. This intrinsically driven teaching evaluation mechanism well fits to the characteristics of music teaching. Because there is huge gap in the cognitive process of music, an important component of music education assessment is to select reasonable phased evaluation criteria and achieve the teaching model that coincides with the law of brain cognitive science.

Conclusion

The rapid development of information technology has resulted in an explosive growth of knowledge, and now people bath in knowledge pools. In the face of this new situation, how to learn knowledge more effectively has aroused wide concern of people all over the world. The traditional education model only focuses on the development of skills, but lacks the development of learners for their moral and aesthetic potentials, so that cognitive potential of them cannot be intrigued. Many current studies have borne out that music education is closely correlated to brain cognition. How to build a music education model based on brain cognition is highly concerned by scholars engaged in the spheres of cognitive, psychological and educational sciences all over the world. Only when the relationship between music education and the neurological mechanism are actively conquered and applied to the current education practices can we make an education revolution in a true sense and help people achieve true development in an all-round way.

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