MUS 7220 7001

Dr. Colprit

Reading: The Child Musician's Brain

Author: Donald A. Hodges

Student: Jonathan Oliveira

1. Definitions of terms

Synaptogenesis: the process by which synaptic connections are formed between neurons.

Myelination: the process by which neuronal axons are coated with myelin

Pruning: the process by which unused synaptic connections are eliminated.

Plasticity: the concept that there is some malleability in brain structures. This means that these structures can be influenced by positive or negative experiences, such as learning or injury.

Critical Periods: the periods of brain development at which it must be stimulated for growth to occur.

Optimal Periods: the periods of brain development at which it is easiest to learn. After these periods, learning can still take place, but it becomes increasingly difficult.

Dentrites: portion of the neurons that collect information.

Axon: portion of the neurons that carry information to the outside of the cell.

Synapses: the connections between two neurons.

Synaptic Cleft: the space between neurons

Acetylcholine and Dopamine: chemicals that transfer information across the synaptic cleft.

Gray Matter: unmyelinated axons. Composed mostly of neuron cell bodies.

White Matter: myelinated axons. Composed of feu neuron cell bodies.

Cerebral Cortex: formed by gray matter and white matter.

Cerebelum: the portion of the brain that controls balance and coordination, stores learned movements, and helps detect the position of the limbs in space.

Brainstem: bottom portion of the brain. Transmits information to the rest of the body, controls basic body functions.

Serotonin and Dopamine: the chemicals that transmit information between the cells. They are related to feeling good and activate the reward and pleasure systems in the brain.

Auditory Cortex: the portion of the brain located in the temporal lobe, responsible for processing the location of sounds, volume and pitch.

Corpus callosum: the group of nerves connecting the right and left hemispheres.

Limbic system: located around the brain stem, it is responsible for forming and processing emotions as well as for learning and memory.

Near transfer: tasks that are closely related to each other.

Far transfer: tasks that are unrelated.

2. Chronology of changes

AGE	DEVELOPMENT
16 weeks gestation – 30 years	Myelination begins. Occurs in different brain regions over time.
19-20 weeks gestation	Volume of brain increases from 22 ml to 367 ml. Adult brain is 1350 ml.
Weeks 20-27 gestation	Fetus capable of responding to sound of mother's voice.
1-3 days after birth	Response to music detected with activations in both hemispheres. Between this period, they can also process pitch like adults as well as rhythmic patterns.
Months 3-4 after birth	Burst of synaptic development occurs in the auditory cortex. Adult levels reached between months 4 and 12.
6 months after birth	Development of sound patterns similar to adults
8 months after birth	Infants capable of processing patterns in music like adults.
1- 2 year	Rapid growth, reaching 50% more synapses than an adult.
2 years	Axons in the cortex begin to reach deeper layers of the brain.
2-12 years	Musical training found to increase verbal memory-related skills.
Birth to ages 11.5 and 14.5	Increase in size of the cortex.
5 years	Musical training detected to increase motor control, auditory and bilateral frontal regions of the brain as well as the corpus callosum. Training also found to have near transfer effects.
5years - adulthood	Musical training found to have beneficial effects on brain plasticity. Also increases gamma band responses. Changes retained into adulthood.

6 years	Melody and rhythm activate both hemispheres of the brain, with predominance of the left hemisphere for speech.
From age 7-13	Pruning. Loss of up to 50% of brain tissue. Loss of up to 80% of cortical neurons and synapses.
Adolescence	Musical choice decisions related to social factors. Preference for certain songs related to the activation of the caudate nucleus.
Age 40	White matter begins to decrease.

3. Discussion

This discussion is an overview of the aspects discussed by Hodges that stood out to me. More specifically, I will highlight those that answered pre-existing questions, posed new ones, and prompted contemplation of their effects over my music teaching.

In his chapter on how music affects children's brains, Hodges (2015) describes how the brain develops throughout life, reaching 1.3kg in adulthood. He also describes the concepts of synaptogenesis, myelination, pruning, and plasticity. Hodges states that due to myelination information transfer between neurons can be improved up to 100 times. According to him, this development starts during the fourth month of gestation and continues to the age of thirty, developing specific pathways as information is learned, while at the same time limiting what can be learned.

Hodges also explains that brains are malleable, being influenced by negative as well as by positive experiences and subject to pruning. The concepts of myelination, plasticity, and pruning raise the following question for me: Will children who are exposed to multiple musical styles retain the neurological pathways for these styles or will they be blocked by the self-

specifying/limiting capacity of the brain? Furthermore, Hodges distinguishes between critical and optimal periods. According to him, these are periods at which stimulation is necessary for development to occur and periods when learning is most easily achieved, respectively.

In the second portion of his article, Hodges outlines neuromusical research regarding prenatal infants, children, and adolescents. For the greater portion of this section he discusses research that has shown that humans can detect and react to music from six weeks before birth. One of the concepts described which I found the most interesting was statistical learning. According to Hodges, the brain develops neural representations from frequent exposure to tonal and rhythmic patterns. He mentions that from eight months of age, infants perform as well as adults in detecting culture specific patterns. By way of example, Hodges says that listening to a Chines opera would be difficult for a westerner because the brain will not have developed the pathways to process Chinese music. This made me wonder about how these pathways would develop under frequent exposure to New Music. Would the brain develop pathways to process this type of music as well? Also, how profitable would it be to expose an infant to as wide a genre range as possible? Would it prepare the person for dealing with a wider range of music as an adult or would it inhibit the development of culture-related perceptions of music?

As Hodges describes the neurological development of children, Hodges describes the benefits of musical training for brain development. As a pianist, it was flattering to read that intensive practice increases the plasticity of white matter when it happens during maturation. Before reading this article, I believed in starting musical training with the piano for its usefulness in facilitating the visualization of intervals, chords, and harmonic progression. Now however, I value the use of the piano during childhood for its role in advancing the development of the brain.

According to Hodges, few adolescents have participated in neuromusical research. He does point out, however that musical preference in this age group is highly connected to social life. He describes how, when rating certain songs, the caudate nucleus was activated, indicating pleasing musical experiences.

As I read the articles assigned for the Cognition and the Psychology of Music classes I always try to understand how it applies to New Music, even if it this is not the focus of the articles. This article in particular has helped me reach conclusions regarding the importance of music in the human development and how to use New Music. Hodges shows that music is vital for the development of the human brain, as it induces the formation of neural pathways that increase the speed of information processing as well as cognitive skills related to the development of language skills. I have also been trying to reach a conclusion as to when would be the best time to start introducing New Music to a student's musical experience. From this article, I would conclude that the ideal time would be between the neonatal period and the age of thirteen. According to Hodges, this period encompasses periods of rapid neurological development and precedes the pruning stage. Therefore, infancy seems to me to be the best time to start listening to New Music.

References

Hodges, D. A. (2015). The child musician's brain. In G.E. McPherson (Ed.),*The child as musician: A handbook of musical development* (pp. 52-66). Oxford Scholarship Online. DOI: 10.1093/acprof:oso/9780198744443.001.0001