

Music and the Brain

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Commentary

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From our very first moments in life when our mother gently whispers some lullaby to help us sleep or calm us down, to the overwhelming walls of sound that surround us in our first rock concert, when we aggressively affirm our independence and individuality, music plays an important role in our everyday life.

The relationship between each individual and the music playing at landmark events throughout their lives constitutes the “soundtrack of their life” and each is unique. Some individuals are very passionate about music while others seem to be indifferent towards it.

Some people reacts with deep and uncontrolled emotions to the well-combined sounds of a melody while others are left completely unmoved by them, but everybody, absolutely every person perceives and responds to music in their own individual way.

Even in the absence of musical training, almost everybody knows whether a piece of music feels right, based on his or her individual sense and definition of right and wrong and the nature of the emotional response that music triggers.

Why can a particular piece of music make one individual smile but leave another cold?

Why does a particular chord resonate within our emotional and affective networks while another elicits no such sensation?

Why does a popular musical piece that is almost universally loved trigger disdain and even rejection in others?

Why no piece of music, despite of being hugely popular and almost universally loved, is liked by absolutely everybody and, surprisingly, some people hates it?

While birds and whales utilize music as a means of communication, humans are uniquely fanatical about musical creation and consumption for pleasure. In fact, there is a growing corpus of evidence of deep connections between music and our own nervous system as evidenced by several neurological clinical conditions and syndromes, including but not limited to, Amusia in which patients can no longer produce or appreciate musical sounds following a traumatic event. Musicogenic Epilepsy, a rare disorder in which hearing certain songs can produce epileptic seizures. Williams Syndrome, a rare genetic condition that is associated with intense musical interest, but diminished abilities in other cognitive domains.

Musical appreciation is an indispensable trait for those in the musical field, from professionals of any type (composers, performers, critics), to the dilettante or the simple fan, and includes perceiving the sounds, recognizing music and experiencing emotions. Perceiving the sounds is a purely neurological process involving the sensory division of the body’s nervous system and requiring a functional auditory pathway from ears to nerve connections to cortical final destination.

Recognizing Music is a much more complex activity requiring different structures, at different levels, to combine perfectly to result in musical recognition.

Musical recognition occurs in the frontal and temporal lobes, an evolutionarily newer part of the brain that varies substantially between individuals. The frontal lobes are

particularly involved in pattern recognition, which is required to recognize different chords, rhythms, and musical themes. Imaging studies have shown that when listening to music, the left hemisphere of the brain becomes more involved in musicians than in non-musicians, suggesting a more technical appraisal of music in more highly trained listeners.

The emotions provoked by music are what keep most of us coming back for more or never coming back.

The frontal lobes can help identify and perceive different aspects of music but there is certainly more to music than intellectual analysis as obviously demonstrated by the different types of music used in a movie soundtrack as different situations in the script call for different emotional reactions in the viewer.

The type of music used, mostly in the background, successfully creates the right mood that supports what the eyes directly perceive in the screen but perhaps more important is the music that, due to its nature and the associations already established in our brain, announces the type of actions coming (sad, scary, happy) getting us emotionally ready for the coming images.

As children get older, the ability to correlate major keys and faster tempos with happiness and minor keys and slow paces with sorrow becomes more consistent. This aspect of musical appreciation has been tied to activity in the left frontal lobe and bilateral posterior cingulate cortex.

One of music's complexities is that the character of the music does not completely correlate with our own emotional experience; we can listen to a tragic aria and feel a degree of sorrow, while simultaneously enjoying the experience enormously and that is extremely important and can perfectly explain why we listen frequently to music that makes us very sad or angry or brings back painful experiences and difficult times in our life.

We feel the power of some music with our entire body. Pleasurable music activates the brain's Ventral Tegmental Area (VTA), a reward center that is also activated by romantic love and addictive drugs.

The Ventral Tegmental area (VTA), the Nucleus Accumbens and the bundle of dopamine-containing fibers

that are connecting them, are an essential part of what is known as the Mesolimbic Dopaminergic System, a specific portion of the Limbic Circuit hypothesized to play an important role in translation of motivation to motor behavior and reward-related learning in particular.

This system is commonly implicated in the seeking out and consumption of rewarding stimuli or events, such as sweet-tasting foods or sexual interaction, that result in an elevated level of dopamine in the Nucleus Accumbens, stimulating their dopamine receptor cells activity, which translate into an intense sensation of pleasure. This is the mechanism believed to be instrumental in the pleasurable experience provided by music. Furthermore, the Ventral Tegmental Area is closely associated with the Hypothalamus, a brain center linked to the body's autonomic nervous system that can increase heart rate, alter breathing patterns and even provide the sensation of "chills."

An obligatory brainstem way-station for auditory processing, the Inferior Colliculus, is where our mother's voice may leave its first affective imprints. This brain region clearly mediates affective processes and is richly populated with opiate receptors, which may mediate the attachments we develop to certain sounds, including but not limited to, the voices of those we love and certain types of music.

Auditory processing of musical information could easily access the higher reaches of various emotional systems through temporal lobe inputs into the amygdala; frontal and parietal cortical inputs into other basal ganglia such as the Nucleus Accumbens, as well as more direct inputs to limbic areas such as the cingulate and medial frontal cortices.

In reality, there may be no specific or restricted brain module, nucleus or system that is devoted solely to musical appreciation. It is more likely that our appreciation of music comes from the interplay of many brain areas, much like most of our higher intellectual functions and capacities.

It is possible that, after all, the popular expression used to characterize musical geniuses like Mozart, Beethoven, Bach and many more, "music is in their genes" is a really accurate one, not far from reality.

