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Dreams of Purple and Blue**

**It's Only Rock 'n' Roll (Jazz, Funk,  
Opera, etc.), but I Like It**

**Breaking Out in Nashville**

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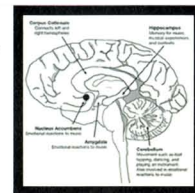
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# It's Only Rock 'n' Roll (Jazz, Funk, Opera, etc.), but I like It

*A new book by musician and neuroscientist Daniel Levitin '80 sheds light on the connections between human brain structure and function and our passion for music.*

by Mark Small

Mick Jagger's lyrics to "It's Only Rock 'n' Roll (But I Like It)" touch on a subject that has kept neuroscientist Daniel Levitin '80 busy. Levitin, an associate professor at the Levitin Laboratory for Musical Perception and Cognition at McGill University in Montreal helps answer the question. Why do we have a strong emotional reaction to some styles of music and artists and not others? Further, is it innate talent or hard work that enables some musicians to become world-renowned masters? In his new book, *This Is Your Brain on Music: The Science of a Human Obsession*, Levitin presents his findings on how the brain processes music, the physical reactions of the brain to music, connections between music and deep-seated memories, theories about perfect pitch, tune recognition, attaining musical expectations, and much more. The following article focuses on research Levitin and others have conducted on the acquisition of musical expertise and why we are passionate about the music we love the most.

Levitin, a former A&R staffer for Columbia Records, session musician, record producer, and recording engineer who earned his Ph.D. in neuroscience in 1996, describes the story of your brain on music as, "The story of how brains and music coevolved—what music can teach us about

the brain, what the brain can teach us about music, and what both can teach us about ourselves." Levitin maintains that gaining a better understanding of how our brains process music may help us to better understand our motives, fears, desires, memories, and communication in a broad sense.

The effect of music on the brain, Levitin writes, is "an exquisite orchestration of brain regions, involving both the oldest and newest parts of the human brain, and regions as far apart as the cerebellum in the back of the head and the frontal lobes just behind your eyes. It involves a precision choreography of neurochemical release and uptake between logical prediction systems and emotional reward systems. When we love a piece of music, it reminds us of other music we have heard, and it activates memory traces of emotional times in our lives." Whenever a piece of music moves us, a series of complex and fascinating connections between physical sound, past experiences, and memories are made in the brain.

## Development of Musical Preferences

All music lovers have their favorites. For some that means only the works of classical or jazz greats. To others, it's hip-hop, ethnic drumming, classic rock, funk, folk, country, metal, and so forth. A number of factors contribute to the shaping of our personal musical tastes. Levitin reveals that some of these influences date to prenatal listening experiences we had in the womb. The auditory system of the fetus is fully functional about 20 weeks after conception and the fetus can process musical as well as environmental sounds. Experiments were conducted in England on infants whose mothers played a single piece of music repeatedly during the final months of gestation, and then did not play it again until one year after the birth. The pieces used in the research included classical, top-40, reggae, and world beat selections. Elaborate tests developed to monitor the babies' reactions to music after their first birthday indicated that they exhibited a preference for the type of music they had been exposed to in utero. A control group of one-year-olds who hadn't heard any of the selections before showed no preference, confirming that there was nothing in the music itself that caused these results.

The culture we grow up in has a lot to do with shaping our musical preferences. "Certain sequences of pitches evoke calm; others, excitement. The brain basis for this is primarily based on learning, just as we learn that a rising intonation [in a speaker's voice] indicates a question. All of us have the innate capacity to learn the linguistic and musical distinctions of whatever culture we are born into, and experience with the music of that culture shapes our neural pathways so that we ultimately internalize a set of rules common to that musical tradition.

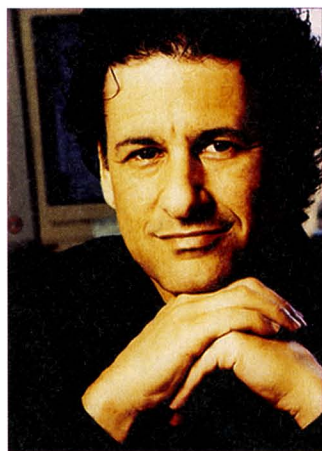
"For reasons that are largely cultural, we tend to associate major scales with happy or triumphant emotions, and minor scales with sad or defeated emotions. Some studies have suggested that the associations might be innate, but the fact that these are not culturally universal indicates that, at very least, any innate tendency can be overcome by exposure to specific cultural associations."

Levitin states that "young children start to show a preference for the music of their culture by age two, around the same time they begin to develop specialized speech processing. At first, children tend to like simple songs, where simple means music that has clearly defined themes (as opposed to, say, four-part counterpoint) and chord progressions that resolve in direct and easily predictable ways. As they mature, children start to tire of easily predictable music and search for music that holds more challenge.

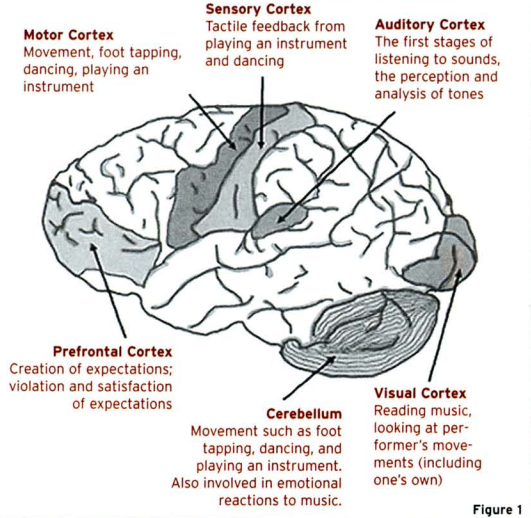
"The developmental trajectory in children, of first preferring simple and then more complex songs, is a generalization, of course; not all children like music in the first place, and some children develop a taste for music that is off the beaten path, oftentimes through pure serendipity." Levitin points to his own exposure to big band and swing music as an eight-year-old after obtaining his grandfather's old record collection. This ultimately became part of his "mental wiring," and jazz took its place among his musical preferences.

## Neural Pruning

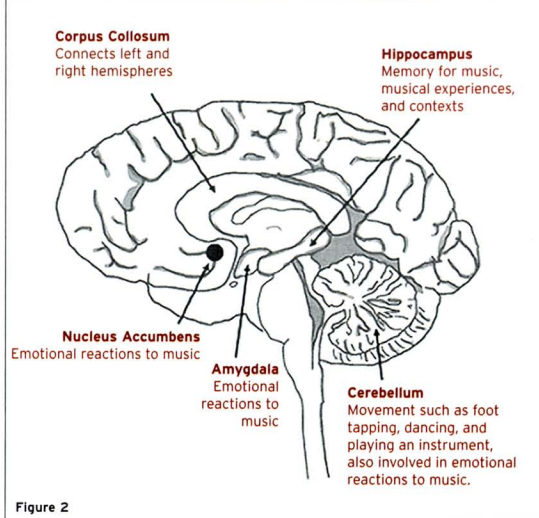
During our midchildhood years, our brain starts to prune connections formed during the period of rapid neural development that begins in the



Neuroscientist Daniel Levitin '80



Music processing is distributed throughout the brain. Figures 1 and 2 show the brain's major computational centers for music. Figure 1 is a view of the brain from the side. The front of the brain is to the left. Figure 2 shows the inside of the brain from the same point of view.



first years of life. The brain retains only the most important and most frequently used neural connections. This forms the basis for our understanding of music, and the development of our musical tastes.

Levitin cites research that indicates the teen years are a turning point for forming musical preferences. Adults find they have an enduring fondness for music that moved them when they were teenagers. Those years are a time of self-discovery and are emotionally charged. Most of us have found our memories stirred by a familiar scent or sight or by a tune that became significant to us at a key point in our lives. Hearing it again, we can become nostalgic and reconnect with feelings we experienced years earlier.

“The music that you have listened to at various times in your life is [neurally] cross-coded with the events of those times. That is, the music is linked to events of the time, and those events are linked to the music.

“We tend to remember things that have an emotional component because our amygdala and neurotransmitters act in concert to ‘tag’ the memories as something important. Part of the reason also has to do with neural maturation and pruning; it is around age 14 that the wiring of our musical brains is approaching adult-like levels of completion.”

Levitin maintains that there is no cutoff point for developing new musical preferences, but generally, most people have formed their tastes by the age of 18 or so. As infants, we tend to have a preference for consonant sounds. We gain an appreciation for dissonance later in life. Further, developing musical skills is best begun at a young age. Those who don't begin music instruction before age 20 can still learn, but the process is more difficult. “The brain's synapses are programmed to grow for a number of years, making new connections. After that time, there is a shift toward pruning, to get rid of unneeded connections.”

**Structural Variations**

Research has shown that musicians possess differences in brain structure relative to nonmusicians. “The front portion of the corpus collosum—the mass of fibers connecting the two cerebral hemispheres—is significantly larger in musicians . . . particularly for musicians who began their training early.” As well, “musicians

[tend] to have larger cerebellums than nonmusicians.” Levitin sheds light on the factors that contribute to “musical expertise,” most often defined as the mastery of an instrument or compositional skills. A debate on the subject launched by Michael Howe, Jane Davidson, and John Sloboda explored the concept of talent. They assumed that “either high levels of musical achievement are based on innate brain structures (what we refer to as talent) or they are simply the result of training and practice. [Howe, Davidson, and Sloboda] define talent as something (1) that originates in genetic structures, (2) that is identifiable at an early stage by trained people who can recognize it even before exceptional levels of performance have been acquired, (3) that can be used to predict who is likely to excel, and (4) that only a minority can be identified as having it because if everyone were ‘talented,’ the concept would lose meaning.”

The argument for ranking natural talent above practice in the development of an expert musician is the rapid musical development that some people achieve. Evidence that practice is the more important factor comes from observing the regimen of instruction and practice undertaken by experts in any field, not just music. In several studies, conservatory students who achieved the highest performance levels were those who practiced the most. They made greater progress than those who were initially judged to possess greater natural ability.

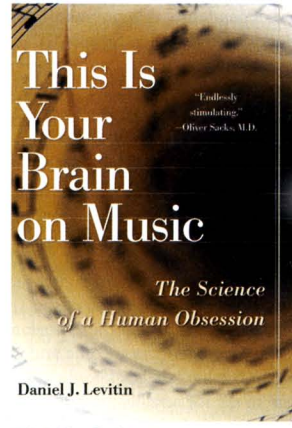
**The 10,000 Hours Theory**

Studies indicate that 10,000 hours of practice are required to reach the level where one could be called a “world-class expert” in any area of endeavor. “In study after study of composers, basketball players, fiction writers, ice skaters, concert pianists, chess players, master criminals, and what have you, this number comes up again and again. Ten thousand hours is equivalent to roughly three hours a day, or 20 hours a week, of practice over 10 years. Of course, this doesn't address why some people don't seem to get anywhere when they practice and why some people get more out of their practice sessions than others. But no one has yet found a case in which true world-class expertise was accomplished in less time. It seems to take the brain this long to assimilate all that it needs to know to achieve true mastery.”

Levitin points out that memory and how much a person cares for the area of endeavor or the instrument he is striving to master also play a critical role in developing expertise.

“Neurochemical tags associated with memories mark them for importance, and we tend to code as important things that carry with them a lot of emotion, either positive or negative. . . . Caring may, in part, account for some of the early differences we see in how quickly people acquire new skills. . . . It is impossible to overestimate the importance of these factors; caring leads to attention, and together they lead to measurable neurochemical changes.”

*This Is Your Brain on Music* gives the reader a guided tour of the brain, stopping to explain brain anatomy in an understandable way, without ever talking down to the reader. “Music is among the most distinctive features of the human race,” Levitin says. “No known culture now, or anytime in the past, lacks music, and some of the oldest artifacts from archeological digs are musical instruments. Why music has held a place of such prominence throughout our shared history is still somewhat of a mystery, but is—along with the mystery of DNA—something that science is beginning to explain. Understanding the neuroscience of music will help us ultimately to better understand the most important musical instrument of all: the human brain.”



*This Is Your Brain on Music*  
Dutton Books, 2006