R&R

Music Under the Microscope

A Montreal scientist explores the ways your brain is wired to enjoy music

BY EVAN SERPICK

THIS IS YOUR BRAIN ON James Brown, according to Dr. Daniel Levitin, a cognitive scientist at Montreal's McGill University: As "Papa's Got a Brand New Bag" plays, the primary auditory cortices are activated, as is your cerebellum – the part of the brain that controls motor functions and keeps time. Your visual cortex lights up, too, perhaps because an image of the Godfather of Soul doing splits at the Apollo has entered your mind.

At the moment, Levitin happens to be looking at my brain, on monitors attached to an MRI machine. I'm just one of a dozen people the forty-nine-year-old scientist has scanned with MRIs as part of his groundbreaking research into why music is so important to us – work that has established him as one of the world's leading authorities on music and the brain. "I got into this field because I had so many questions," says Levitin, sitting among the pianos, guitars and mixing boards that make his Laboratory for Music Perception, Cognition and Expertise look like a recording studio. "Where does creativity come from? Why are some people creative and others aren't? What is really going on when you hear music?"

Levitin is uniquely qualified for his area of research: Before he got his doctorate in 1996, he helped produce albums for Chris Isaak and Blue Öyster Cult, and played in punk bands. In his recent book, the *New York Times* best seller *This Is Your Brain on Music*, Levitin suggests that the human brain is hard-wired to understand music, perhaps because it preceded language as a mode of communication. "When we hear music, not speech, it stimulates these very ancient, primitive parts of the brain that are below the level of conscious thought," he says.

Levitin came to his conclusion by looking at people's brain function as they listened to real music, from AC/DC and Ludacris to Joni Mitchell and Beethoven. "Earlier experiments would either use a sine-tone generator or the experimenter would write some melody and see how well people could remember it," says Levitin, whose subjects showed a much stronger reaction to music than in previous studies, with several different areas of the brain activated, including those connected to motor skills, emotion, visual stimuli and pleasure.

Levitin's journey began in the late 1970s, when he dropped out of college to play bass in the San Francisco punk band the Mortals. He went on to become a producer, developing a masterful ear. In 1992, Levitin noticed that third-generation copies had been used to reissue seven Steely Dan albums, causing the band's label to recall them. Later, Levitin was hired to help produce a Steely Dan compilation and worked on hits collections from Santana and Stevie Wonder. (A Stevie Wonder gold record hangs above his desk.) Fifteen years ago, Levitin's fascination with the science of sound led him to Stanford, where he began to study the deep connections between music and memory.

In one early study, he asked people to sing their favorite pop songs off the tops of their heads. "It was astonishing," he says. "Most people – nonmusicians – were able to sing the song at or very near its actual pitch, and at or very near its actual tempo." In his lab, Levitin replicates another study by playing the first half-second of a song, which I immediately identify as "Eleanor Rigby." He does the same with several well-known pieces of music, including obscure cover versions and a take on Beethoven's 5th Symphony played entirely using power tools. Like most people, I was able to identify nearly all of them instantly. "Your brain has to extract the features of pitch and rhythm, ignoring timbre and the sound of the musical instruments," he says. "To give you an idea of how complicated this is, there's no computer in the world that can do this."

"I got into this field because I had so many questions," says Levitin.

Levitin's conclusions are at odds with some of his contemporaries, including eminent Harvard neurolinguist Steven Pinker, who has described music as "auditory cheesecake," enjoyable but not essential to human development. But scientists with a music background have found a haven in Levitin's lab. In the 1980s, Susan Rogers was a top recording engineer, working on classic albums including Prince's *Purple Rain* and *Sign O' the Times*. She is now a doctoral candidate in his program. "At first, if you love music, this seems like the antithesis of the sort of involvement you want to have with it," she says. "It's like, 'Oh, no, don't take away the beauty.' Then I started reading Dan Levitin's papers, and I realized that of everybody out there, he's the only person who would understand."

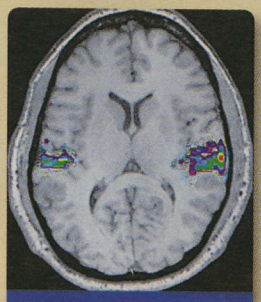
Rogers' research includes a study that focuses on the brain's reaction to consonant and dissonant chords. "I was interested in the evolution of the music faculty," she says. "What is the origin of our appreciation for consonance? Is it because we're innately prewired to favor some type of interval over another, or is it just a function of what we've learned, that we just happen to hear more consonant music than we hear dissonant?"

Rogers' theories, like Levitin's, point to an evolutionary need for human brains to understand music, which has left us with a deep connection to it. But what drove that need is among the many unanswered questions. "Brain science is the study of the most complex thing in the known universe," she says. "There is nothing more complex in terms of the possibilities of connections – even stars and galaxies are sort of a repeating pattern of very few elements. This is the equivalent of exploring uncharted territory."

Levitin in his McGill lab in February

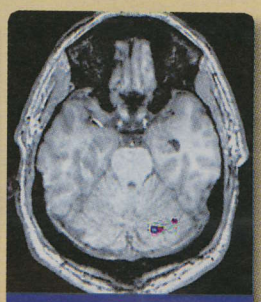
What Eminem and Mozart Do to Your Brain

Using a Magnetic Resonance Imaging machine, Levitin can detect which areas of the brain are responding to music by tracking blood flow (the more blood in a particular region, the more activity). In this study, Levitin played me three pieces of music through headphones while I was in the MRI: Mozart's Symphony No. 41, James Brown's "Papa's Got a Brand New Bag" and Eminem's "The Real Slim Shady." Of course, many areas of the brain are active at any given time, so in order to produce meaningful results, one scan must be compared with another. The first scan shows the areas of my brain that were activated when listening to Mozart, as compared to silence. The second shows the areas activated by Brown, as compared to Mozart, and the third shows the brain activity initiated by Eminem, as compared to Brown. E.S.



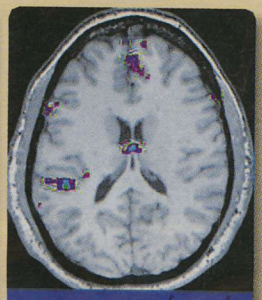
MOZART

As with all the music here, Mozart activated the primary auditory cortex in the left and right hemispheres, where the brain interprets pitch, timbre and rhythm. The activity is more active in the right hemisphere, as it is for most right-handed people.



JAMES BROWN

In addition to the auditory cortex activity Mozart triggered, JB activates the cerebellum – the part of the brain that controls basic motor skills and is the gateway to emotion. The visual cortex is also activated, indicating a mental image of James Brown performing.



EMINEM

Eminem sparks regions responsible for accessing language. Also activated were areas involved in pitch and rhythm processing and the medial prefrontal cortex, which indicates I personally related to the message, as people often do when songs have lyrics with "I" and "you."

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