More Science news

Singing in the brain

Neuroscience takes mental note of our affinity for music

By Scott LaFee
UNION-TRIBUNE STAFF WRITER

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Quick! Recite the alphabet.

Odds are, you recalled your ABCs in the form of a song, specifically that tuneful mnemonic most of us learned as children. That's not to say you couldn't recite the alphabet without humming it, but music makes it easier.

And that makes neuroscientists like Dan Levitin wonder:

What is it about music and the mind? Why do we have such an affinity for music, what Levitin even describes as an obsession?

Is music hard-wired into our brains? Is it some sort of fundamental evolutionary adaptation? Is musical talent genetic? Why do we remember some songs so well? Why can't we get others out of our heads?

JAMES BAIRD / Union-Tribune
Dan Levitin was an award-winning music producer before he switched to neuroscience to study how the brain perceives music.

"Music is found in every human culture, dating back thousands of years,"

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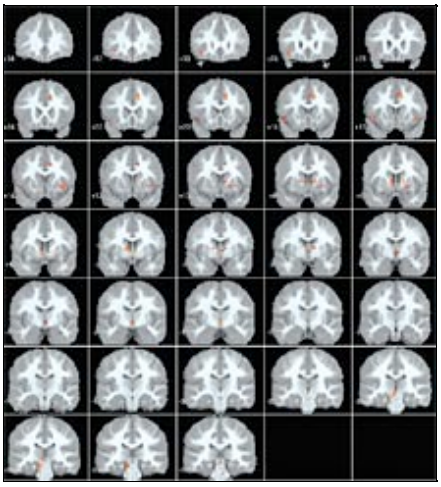
says Levitin, an associate professor at McGill University in Montreal and director of the Laboratory for Music Perception, Cognition and Expertise.

"An infant can recognize music first heard in the womb. By five months, we all recognize specific songs and can tell when a note or chord is wrong. Most of us are capable of recalling a favorite song and singing it with near-perfect pitch and tempo. No other species does anything like this.

"Humans use music, collectively and individually, in ways that we are just now beginning to scientifically understand."

Levitin seems particularly well-suited to seeking that understanding.


The New York Times
Brain scans of people listening to tunes.

He grew up in Southern California enraptured by music, from classical to jazz to rock. He learned to play the saxophone and guitar. At age 4, he got a 7-inch 3M open-reel tape recorder as a gift, and he used it to record first other people's music, later his own compositions.

After high school, Levitin enrolled at the Massachusetts Institute of Technology. He wanted to become a sound engineer, but he quit school to pursue a music career, playing in a string of bands (country, punk, rock) before switching to producing music.

Over the next 13 years, he collaborated with a glittering list of musical artists, from Santana and Steely Dan to Stevie Wonder and k.d. lang. He garnered nine gold and platinum albums, which he keeps scattered around his lab at McGill.

In 1990, disenchanted with what he saw as the music industry's preference for profit over artistry, Levitin returned to school. He had always been curious about music and the brain. As a session musician, he wondered why some artists seemed innately gifted, yet almost everyone had some sort of mental connection to music.

Earning degrees in cognitive psychology and cognitive science, Levitin set out to explain music's hold on the human mind. Last year, he published a popular book on the subject: "This Is Your Brain on Music."

Song and dance

Ask Levitin, now 50, how and why humans invented music, and he shrugs.

"That's probably unknowable."

But the question underlies one of the biggest debates among neuroscientists interested in the subject: Is music a primary evolutionary adaptation, or something less?

Levitin favors the first notion. He cites music's universality in human culture and its early functionality in

A song in your heart is good, but a song in your head can be trouble

At one time or another, most of us have gotten a song stuck in our heads. It plays over and over again,

infants.

Other researchers have suggested music was a key to sexual selection among early humans, "especially our capacities for rhythm, dance and singing," said Geoffrey Miller, an assistant professor of psychology at the University of New Mexico. Early humans who were "musical" were perceived to be healthier, more creative and thus better choices as reproductive mates.

Yet some scientists scoff. In his 1997 book "How the Mind Works," Harvard University cognitive scientist Steven Pinker famously dismissed music as "acoustic cheesecake," arguing it was a happy but inadvertent byproduct of real evolutionary adaptations, like language and walking upright.

Pinker observed that human song mimics the natural cadences of speech and that dance is just another form of rhythmic body movement, like running.

Aniruddh Patel, the Esther J. Burnham senior fellow at The Neurosciences Institute in La Jolla, says it's a false dichotomy to declare music is one or the other, either evolutionarily hard-wired or accidental "cheesecake."

"Clearly music is something that humans invented," Patel said. "It's not the target of natural selection that, say, language is. But equally clearly music is deeply meaningful to people.

"It's an invention that has profoundly changed human culture and society. Human lives are deeply different because it was invented. And there's evidence that music changes the brain."

Cerebral ensemble

In 1933, the famed French composer Maurice Ravel began exhibiting strange neurological symptoms. He could recall his old compositions and play scales, but he could not put anything new to paper.

[illegible]

as if on an endless loop. Usually it's a snatch of song we can't stand. Think "It's a Small World."

Oops, sorry.

The term for it is "earworm," though there are others: "sticky tune," "cognitive itch." In 2003, researchers at Dartmouth University linked the phenomenon to a part of the brain called the rostromedial prefrontal cortex, whose duties include processing and remembering music and, apparently, playing it back, sometimes unbidden and unending.

Scientists don't know why earworms occur. Nor do they have a sure-fire cure. Anecdotal evidence suggests repeatedly playing the offending tune at a very loud volume – a kind of musical aversion therapy – can help. Another alleged remedy is to think of a different, equally offensive tune, replacing one earworm with another.

Think Chili's "Baby Back Ribs" jingle.

– SCOTT LAFEE

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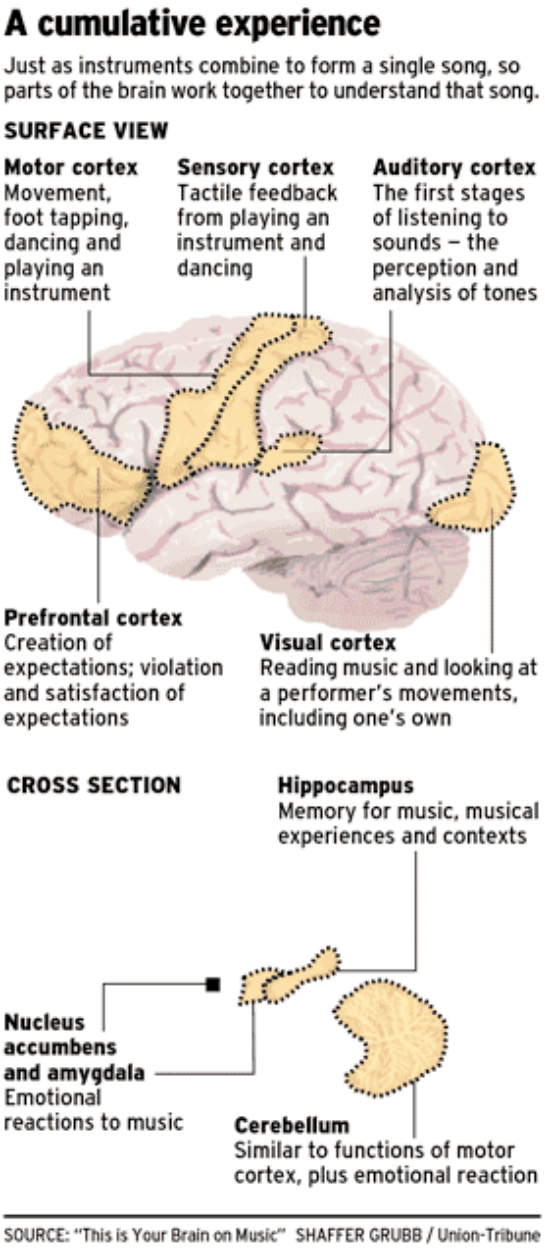
Speaking to a friend about an imagined project, the distraught Ravel cried, “This opera is here, in my head. I can hear it, but I will never write it.”

Ravel may have been suffering from focal cerebral degeneration, a disorder in which discrete areas of the brain begin to atrophy. His particular symptoms were an early clue that music is a whole-brain activity.

Modern imaging techniques have proved it. When humans listen, watch or perform music, multiple areas of the brain become engaged. The auditory cortex (hearing) processes the sounds. The visual cortex kicks in if you're reading music or watching a performance. The sensory cortex handles tactile feedback from playing an instrument or dancing; likewise with the motor cortex, which coordinates movement.

But music involves other, perhaps more surprising, regions of the brain as well. Neurons fire in the prefrontal cortex, the part of your brain responsible for rational thinking. It is here, Levitin says, that humans learn very early what constitutes music.



“The brain is set up to learn. That's what it does,” he said. “As infants, we are like little statistical calculators looking for dependencies and patterns. It's how we learn language and how we learn music. Very quickly, we learn the rules of what makes music music.”

But clearly the power of music isn't only a matter of statistics, dependencies and patterns. Indeed, it's more about emotion. When you listen to music, it can elevate you with joy or plunge you into grief. It can summon forth deep, unbidden memories.

Researchers believe this is because the brain processes music in regions also associated with emotion and memory: the hippocampus, the amygdala, the nucleus accumbens and the cerebellum.

“Music ties into memory systems in ways that language alone does not,” said Patel, who has also written a new scholarly treatise called “Music, Language and the Brain.”

“Think about all of those great ancient epics by

Homer and others. They were stories that were sung. Music powerfully articulates emotions – triumph, despair, happiness, angst – and emotion is central to forming strong, long-term memories. That's why Alzheimer's patients can remember old songs, but not faces they saw yesterday."

Or why your favorite music is likely to be something from your teens, said Levitin.

"This is a time when everything is emotional and hormonal. You're listening to music and it's a huge part of your life. It defines you, your friends, your social group. Your brain is still growing and developing, so you're wide open to the experience.

"Later in adulthood, after your brain synapses have been pruned back, this music will tend to be your favorite because you created all of these strong neural circuits and memories. You can learn to like other forms of music, but they won't have the same emotional impact, and it will take a more conscious effort."

Beyond Mozart

Some people seem to be born musical geniuses. Wolfgang Amadeus Mozart, for example, began playing the piano at age 3 and composed his first musical score at 5.

Music was in Mozart's blood. His father was a respected composer and music teacher. But scientists say that genetics only takes musical talent so far. Michael Jordan boasted prodigious physical abilities, but his athletic exploits also required years of practice and refinement.

It's the same with musical talent, said Levitin. Mozart may have been genetically predisposed to musical genius, but he still labored at his art every day of his life.

Music does appear to improve brain function, according to scientists. "Early exposure to and learning of music and instruments seems to have clear benefits," Levitin said. "Such children often have improved visual perception, analytical thinking skills and physical coordination. Music helps them focus their attention."

Whether music actually makes you smarter is debatable. The so-called "Mozart effect," which posits that listening to classical music improves long-term mental performance, has been largely undermined by serious scientific scrutiny.

In any event, the real importance of music to humans seems far larger, more complicated and more profound. Music may not be the essential evolutionary adaptation that language is, but it's clearly a form of communication all humans understand.

"We all still use oohs and ahs and moans and groans to communicate our deepest and most intense emotions," said Mark Jude Tramo, a neurologist and director of the Institute for Music and Brain Science at Harvard

University.

"Which do you think came first: chanting/whistling/humming/beating or speech and language as we presently know it in *Homo sapiens sapiens?*"

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all questions I really could care less about.

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