

Rhythm, melody, life ; Human hearts have always warmed to the rhythm of music

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Abstract

The power of music for infants may arise from its social nature and its link to positive emotions, Sandra E. Trehub, a University of Toronto psychologist, reported in Nature. Trehub has shown that infants as young as 4 months who have been exposed to little music, nevertheless have a similar appreciation of pitch and rhythm as do trained musicians. By 16 weeks they fuss, cry and turn away from dissonant chords, and smile and turn toward harmonious chords.

Full Text

A popular melody reels around in the brain against our will. Music sets the toe to tapping and the blood to racing. It marks our happiest and most solemn occasions. It forges bonds. It reflects all of our moods. We remember far more songs than we do speeches.

Music, it turns out, has more of a grip on our mind and body than we realize. When couples smile at each other and murmur "They're playing our song," for instance, they may be repeating a universal behavior that goes back to the dawn of humankind.

It is becoming more evident in scientific circles that music was an early form of communication, especially for attracting sexual partners, and that it may predate language. No one knows for sure whether language or music came first, but there is growing evidence, as well as debate, that music is as much of a part of our genetic inheritance as language is. How else can you explain observations such as music being an integral component of every culture in the world, past and present; that primitive musical instruments appeared long before any other form of artistic expression; and that infants know rhythm and pitch almost from the first time they hear music?

Some studies even suggest that children are born with perfect pitch but lose it through disuse.

Unlike language, which has grown into an indispensable tool for conveying knowledge and ideas, music may be a once-dominant capacity that has become grossly underdeveloped.

Music is primal and more basic than language, say researchers, who say there are many more musical similarities across cultures than there are lingual similarities.

Almost everybody enjoys a beautiful melody. It takes root in the brain, priming the imagination, arousing passions, sedating anxieties and inspiring the body to move in rhythm. A person who is born deaf and never has heard a note still can learn to dance by feeling the vibrations music makes.

Much still unknown

But music really is a mystery, like sleep. Science does not know the full biological purposes of either, although it is clear that a person deprived of enough slumber will die.

A life without music may not kill, but it could warp a brain. Researchers are finding that lullabies, which are similar throughout the world, and the sing-song talk of mothers are essential for bonding.

The dance between child and caregiver--eye tracking, laughter and the imitation of sounds and movements--facilitates the sharing of emotional states.

"It's very clear that if you don't have language abilities you're going to have a very hard time functioning in society, whereas if you have no musical abilities it might be awkward at times but you're still going to do just fine," said Petr Janata, a Dartmouth College cognitive neuroscientist who is tracing music's paths through the brain and how they differ from the paths taken by language.

"People look at that and say language is clearly evolutionarily important and music isn't," he said. "I personally believe that if you completely remove music from human cultures around the world it would definitely have a devastating impact on society."

Although language was thought to occur in the brain's logical left hemisphere and music in the creative right hemisphere, Janata found considerable overlap between the two hemispheres for both language and music. Both work through the forefront of the brain, where emotions and higher thinking reign.

"The overall picture that emerges is that music really engages the whole brain," Janata said.

"Music has a certain degree of complexity to it that makes it interesting to our brain. So our brains don't get bored with it, they're always finding something interesting in it."

When some of the brain's musical circuits become blocked, as they can because of brain damage caused by stroke or congenital defects, music disappears in the first case and never appears in the second, according to findings by Isabelle Peretz of the University of Montreal.

"The evidence points to the existence of at least two distinct processing modules: one for music and one for speech," she said. "Music works through different functions like emotions, attachments and social cohesion. That's really the idea behind music."

Why does music exist?

Did music evolve to help us communicate? To express emotions? To organize the brain for learning, as proponents of the "Mozart effect" contend?

Albert Einstein said: "I often think in music. I live my daydreams in music. I see my life in terms of music. ... I get most joy in life out of music."

When the world's most famous scientist was asked whether music influenced his research he said: "No. Both are nourished by the same sort of longing, and they complement each other in the release they offer."

Music is mathematical. The ancient Greek mathematician Pythagoras discovered that the most pleasant sounds occur in exact proportions. Notes are sound waves created by vibrations.

A vibration that is twice as high as another is an octave. Other notes that are pleasant together are those whose vibrations are a fifth or fourth higher. Music expressed mathematically is 1:2:3:4, as Pythagoras said. Those often are the same proportions used in designing beautiful buildings, which is why architecture has been called "frozen music."

Einstein may have hit the nail on the head as far as how music makes a person feel, but to find out why, scientists need answers, and they are beginning to search for them.

Charles Darwin thought that before early humans learned enough words to say, "I love you," they attracted mates with some form of music, not unlike the way birds use song to get together. Elephants, monkeys and many other animals sing songs with patterns that are amazingly close to those of humans' songs. Whale songs have been made into records. How humans became musical is much debated. Theories range an evolutionary hand-me-down from animals to an attribute that is uniquely human to a fortunate accident of nature, a byproduct of language that is not essential for survival.

Steven Pinker of the Massachusetts Institute of Technology dismisses musicality as a frill, a bit of "auditory cheesecake" that may be pleasant but has no survival purpose.

Most scientists disagree with that explanation, though, and say music played an essential role in the development of the modern human mind.

Inside the brain

Today's scientists use imaging technology to look inside the brain when it processes music. They have developed sophisticated techniques to learn how a fetus responds to music while in the womb and how music exists as a distinct entity in the brains of stroke victims who have lost their speech but still can sing.

"Just as the ability to understand spoken language emerges effortlessly in infants, the ability to appreciate music likewise requires no explicit training," John Spiro, associate editor of *Nature Neuroscience*, wrote in a recent issue focusing on the emerging research in music.

"Music is fascinating to study, and may offer a unique window onto the brain," he said. "But of course it can also simply be beautiful or just plain fun."

The power of music for infants may arise from its social nature and its link to positive emotions, Sandra E. Trehub, a University of Toronto psychologist, reported in *Nature*. Trehub has shown that infants as young as 4 months who have been exposed to little music, nevertheless have a similar appreciation of pitch and rhythm as do trained musicians. By 16 weeks they fuss, cry and turn away from dissonant chords, and smile and turn toward harmonious chords.

"Music is not communicative in the sense of sharing information," she said. "Instead, it is concerned with sharing feelings and experiences and the regulation of social behavior."

Trehub argues that music appreciation is something people are born with and may be why people like music without knowing why they like it.

"People who have been trained in music are not so different from people who haven't had training, except they don't know the names of things," she said. "In terms of their perception of music, it's really not very different in trained and untrained listeners. Maybe the trained listeners are somewhat more accurate but it's really very similar qualitatively."

Music's ability to strum the emotions may be the reason it has become such a persistent evolutionary hanger-on. Who didn't master the alphabet by memorizing the "A-B-C" song? In ancient times important historical events were recorded in songs that were passed down from generation to generation, a practice still used by Australian aborigines.

Both music and language are highly structured, but notes don't carry the same kind of specific meanings as words do.

What music seems to do is attach emotions not only to words, but to our feelings and experiences, like tags that can be filed away in different parts of the brain for recall.

The clue to music's ability to manipulate emotions is the battery of brain hormones it may affect. Music appears to soothe anxiety by reducing levels of cortisol, the stress hormone.

Trehub discovered that mothers' singing to distressed babies lowers cortisol.

"All you have to do is observe mothers with infants who are fussy or crying and they sing to them and the stress disappears," Trehub said. "Music gets their attention and changes their moods and mothers everywhere know that. Those who care for infants slip into that kind of thing automatically."

Physical reactions

Neuroscientists speculate that music's ability to tame aggression may be because it lowers the male sex hormone testosterone, a phenomenon that some nursing homes use to calm agitated Alzheimer's patients.

Music inspires feelings of love because it may increase oxytocin levels, a hormone that is known to promote bonding in animals and that is suspected of doing the same in humans. Premature babies who are sung to and who listen to background music leave intensive-care units sooner.

Scientists hope to use music as a probe to understand implicit learning, that "Eureka!" moment when you know you know something but you don't know how you know it. Perhaps it's because the brain can retrieve memories that have similar emotional tags and bring them together in new ways, a process that has been called intuition or abstract thinking.

Does music promote learning, as advocates of the "Mozart effect" propose? There is no clear answer yet, but evidence suggests it may help youngsters learn math and reading faster.

Children enrolled in an orchestra, for instance, scored 21 percent higher on vocabulary tests than children of similar socioeconomic backgrounds who did not take music, according to a new study in the journal *Neuropsychology*. The better vocabulary scores persisted when the students were retested a year later, said Agness S. Chan of Chinese University of Hong Kong.

And the potential emotional benefits of music may not be limited to Mozart or classical music. Jazz, pop, gospel, folk and other forms of music may be helpful as well.

"In the past, music was sometimes forbidden because of fears it made people feel good," Trehub said. "Feeling good is a way of promoting all kinds of things, not only well being in general, but it can also be used to promote learning and societal harmony."

Among those who believe music came before language is Dr. Mark Tramo, a Harvard neuroscientist who studies how music travels through the brain.

Pre-lingual communication

Before there was language, emotions were conveyed by vocal sounds such as moans and groans that are still in use today--ahh, ow, mmm, ooh, oh, eeeee, uh-huh, aagh, aieee.

"There is no speech without music, but there can be music without speech," Tramo said.

"Inflection of the voice is the critical element. Humans use voice inflection or melody or intonation for communication as the basic element of language.

"On top of all that modulation of intonation, somehow we were able to put syntax and morphology and come up with the complex constructions that could convey the complex meanings that we are able to share today."

Dale Purves, director of Duke University's Center for Cognitive Neuroscience, says music and language are so intertwined in the brain that they probably developed together. His study of 500 people found that harmony comes from the vocal sounds people were capable of making during evolution.

The points at which sound is concentrated in the speech spectrum predict the chromatic scale--the scale represented by the keys on a piano keyboard, he said. Chords are pleasant when they mimic the human voice and dissonant when they do not.

According to Ian Cross of the University of Cambridge, music promotes the development of metaphorical thinking, the ability to turn everyday experiences into symbols, which become the shorthand for fresh ideas, "the hallmark of our species."

Cross studies ancient musical instruments, including the earliest one found: a bone pipe from Wurttemberg in southern Germany that was played 38,000 years ago.

The flute-like pipe was found in surroundings that link it to use by modern Homo sapiens at the beginning of the time archeologists call the "cultural explosion." During this period, a sudden emergence of visual art occurred, such as cave paintings and symbolic carvings, evidence of the blossoming of modern human cognitive capacities.

Cross says finding a musical instrument that old means early humans were making musical sounds with their voices a lot earlier, probably accompanied by gestures, to communicate feelings.

"One thing we know for certain is that music leaves few traces-- except in the minds of those who engage with it," he said. "It is quite likely that the traces that it left in our ancestors' minds still resonate in our contemporary, everyday world, in the agility of our thought and in the complexity of our social interactions. Without music, it could be that we would never have become human."