

## MUSIC

# Exploring the relation between thought and sound

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Rock, hip-hop, classical and jazz may not sound alike to your ear, but they do to your brain.

Whether a teenager or a grandparent chooses the music, almost everybody's brain responds the same way. So brain experts are turning to music as a way to illuminate minds.

"If you look at music and use it to explore different aspects of brain functions," said Robert Zatorre of the Montreal Neurological Institute, "you'll learn more not just about music, but about all these other domains that are central to understanding human behavior."

Music plays tunes in the brain that scientists are just beginning to hear. Recent discoveries include how people's emotional reaction to music can alleviate pain, why certain musical intervals sound more pleasing than others, and how musical training alters the growing brains of children.

"People have this real fascination with music -- why music does this thing to our minds that it does," said Petr Janata, a neuroscientist at Dartmouth College in New Hampshire.

## USING TECHNOLOGY

Many of the new insights come from advanced brain imaging, which reveals what parts of people's brains are active during musical tasks.

For instance, Zatorre's studies of perfect pitch -- the ability to identify a note without a reference -- show that the brains of musicians with perfect pitch differ from those of similarly trained musicians without the gift. Work in England has shown that separate areas of the brain process different musical information, such as whether a note is of a particular pitch or within a particular octave. And Janata has taken brain pictures showing that the areas tracking music include the rostromedial prefrontal cortex, which is just behind the forehead and is also involved in processing emotion.

Emotional connections to music are shared across cultures and generations, says Janata. And that observation suggests that neuroscience can be used to unravel music's most basic mysteries.

People's emotional ties to music are among its most puzzling aspects, says Mathieu Roy of the University of Montreal. That's why his research team works to understand the relationship between music and pain.



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The scientists applied heat to the forearms of 12 volunteers who were listening to silence, pleasant music or unpleasant music. The "pleasant" music included classical pieces, such as the William Tell overture, as well as jazz and light pop. The "unpleasant" music was mostly dissonant modern compositions.

## TANGIBLE EFFECTS

When the subjects listened to the pleasant music, they reported feeling less pain from the applied heat than they did during the silence or the unpleasant music, Roy reported at a meeting of the Society for Neuroscience in New Orleans in December. Because pleasant music appears to reduce physical pain, as well as anxiety, doctors and dentists may want to take note, he said.

How pleasant a person finds music in general may be due in part to millennia of human evolution, a study published this summer in *The Journal of Neuroscience* indicates.

Dale Purves of Duke University and colleagues suggest that certain musical intervals -- the difference in pitch between two notes -- sound harmonious because they mimic the natural acoustical properties of speech.

The scientists analyzed the acoustics of specific phrases spoken by more than 500 people in a variety of languages. Breaking apart each sound into its constituent tones, the team found that the most common acoustical frequencies mimicked the frequencies of the most pleasing combination of tones, such as the major third, the fifth and the octave.

The results, says team member David Schwartz, suggest that some musical intervals sound more harmonious than others because they are familiar through everyone's exposure to speech.

"The brain evolved in an environment of very complex sounds," Schwartz says. "If we want to understand why we hear things the way we do, there's no getting around

getting our hands dirty and studying natural sound in all of its messiness."

Researchers led by Dr. Gottfried Schlaug of Beth Israel Deaconess Medical Center in Massachusetts are following the progress of 73 music students, ages 5 to 7, for three years. The students break down into three groups: those learning a musical instrument, those who sing or do other musical tasks without learning an instrument, and those who have only a general music class with no further training.

Still in its early phases, the study so far has shown that there are no major brain differences between children who learn to play an instrument and those who don't, says Schlaug. That suggests that the brains of musicians aren't inherently different from those of nonmusicians, at least when they begin training. Over the course of time, though, differences may arise.

"Ten years ago, if you had said that musicians' brains are different I would have laughed at you," says Schlaug. Now, he thinks that long-term studies can show the effect of musical training on the brain.

### **BREAKING IT DOWN**

One early result from the Harvard study shows that children's brains process rhythm differently than melody. Brain scans from 34 of the children show that melody tends

to be processed in the brain's right hemisphere, while rhythm is processed in the left hemisphere, says Katie Overy, a researcher at Harvard Medical School.

As the children grow older, the researchers will be watching to see whether that difference grows more pronounced. If the training does appear to make kids' brains more active, the scientists will be looking to understand why and how.

Neuroscientists such as Schlaug don't believe in the "Mozart effect," the notion that playing music to children makes them smarter. But musical training itself may create noticeable effects in the brain -- perhaps because of moving fingers to play an instrument, or because of learning to read musical notation.

Still, scientists warn that parents shouldn't rush out to enroll their children in music classes hoping to enrich their brains.

"One of the worst things would be if kids were forced to learn music," said Overy. "The fascination is that something that's so enjoyable has these other cognitive benefits."

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