# Musicians' brain activity jazzes scientists

**Neurology** | How improv lights up an MRI could illuminate human creativity

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WASHINGTON — Scientists inspired by the legendary improv of Miles Davis and John Coltrane are peering inside the brains of today's jazz musicians to learn where creativity comes from. Think dreaming.

This isn't just a curiosity for jazz fans but a bold experiment in the neuroscience of music, a field that's booming as researchers realize that music illuminates how the brain works. How we play and hear music provides a window into most everyday cognitive functions — from attention to emotion to memory — that in turn may help find treatments for brain disorders.

Creativity, though, has long been deemed too elusive to measure. Saxophonist-turned-hearing specialist Dr. Charles Limb thought jazz improvisation provided a perfect tool to do so — by comparing what happens in trained musicians' brains when they play by memory and when they riff.

"It's one thing to come up with a ditty. It's another thing entirely to come up with a masterpiece, an hourlong idea after idea," explains Limb, a Johns Hopkins University otolaryngologist whose ultimate goal is to help the deaf not only hear but hear music.

How do you watch a brain on jazz? Inside an MRI scanner that measures changes in oxygen use by different brain regions as they perform different tasks.

You can't play trumpet or sax inside the giant magnet that is an MRI machine. So Limb and Dr. Allen Braun at the National Institutes of Health hired a company to make a special plastic keyboard that would fit inside the cramped MRI with no metal to bother the magnet.

Then they put six professional jazz pianists inside to measure brain activity while they played straight and when they improvised. They played, right-handed, both a simple C scale and a blues tune that Limb wrote, appropriately titled "Magnetism." Through earphones, they listened to a prerecorded jazz quartet accompaniment, to simulate a real gig.

Getting creative uses the same brain circuitry that Braun has measured during dreaming: First, inhibition switched off. The scientists watched a brain region responsible for that self-monitoring, the dorsolateral prefrontal cortex, shut down.

Then self-expression switched on. A smaller area called the medial prefrontal cortex fired up, a key finding as Braun's earlier research on how language forms linked that region to autobiographical storytelling. And jazz improvisation produces such individual styles that it's often described as telling your own musical story.

More intriguing, the musicians also showed heightened sensory awareness. Regions involved with touch, hearing and sight revved up during improv even though no one touched or saw anything different, and the only new sounds were the ones they created.

That doesn't necessarily mean this is the center of creativity. The brains of highly trained musicians might work differently from an amateur pianist's, or a painter's, or a writer's, something Limb and Braun hope to test next.

The study's biggest significance isn't what it found but that it could be performed at all, opening new avenues of brain research.

"Improvisation always has a sort of magical quality associated with it. People think when you're improvising you have some sort of inspiration that's not measurable," says Dr. Robert Zatorre of the Montreal Neurological Institute, a pioneer in the neuroscience of music and himself a classical organist. "They went forward where everyone else feared to tread."

Neuroscientists call the brain plastic, meaning it has remarkable flexibility to rewire itself. Unraveling how those circuits get modified in turn helps researchers hunt treatments for brain disorders — and the same circuits that process music show strong relationships with other key brain regions. Studies show that patients learning to speak again after a stroke may improve faster if they sing rather than recite, for example. Zatorre's team is finding parallels between tone-deafness and the reading disability dyslexia.

"What we're doing is not necessarily trying to say, 'Well, if we use music it will help Parkinson's patients walk.' It might, yes, and there is some evidence it does so," says Zatorre, whose institute this summer hosts an international conference on music and the brain.

Instead, the quest is to "understand the rules by which the brain changes its organization. That's what we need to know," he adds.