# Improving Cochlear Implants

*A young researcher aims to make the technology responsive to pitch and widen deaf people's perceptions of complex sound environments.*

Experiencing the limitations of his own cochlear implant inspired Chad Ruffin to better the device.

COCHLEAR IMPLANTS HAVE HELPED BRING PROFOUNDLY DEAF INDIVIDUALS into the hearing world, but one HHMI fellow says the technology needs improvement. Chad Ruffin says users have a tough time understanding speech in noisy environments, largely because today's implants transmit almost no information about pitch—the tone that allows the hearer to distinguish one sound from another, as in picking one voice out of the din. Ruffin knows firsthand; he received an implant 6 years ago.

He hopes to correct the limitations of cochlear implants through his research. An HHMI medical research training fellow at the Virginia Merrill Bloedel Hearing Research Center at the University of Washington in Seattle, Ruffin is studying how cochlear implants can be programmed to transmit more information on frequency, thereby enabling the user to discriminate between the pitch of different voices.

Each implant contains a tiny computer that receives sound information from the environment and then uses speech-processing programs to relay this information—or at least some of it—to the brain. Current speech processors rely almost entirely on the intensity of sounds within a few frequency bands; that is, they are sensitive mainly to the changes in amplitude in a series of spoken syllables or words. Although this feature gives "good speech perception in the quiet," Ruffin says, "if you start to add complex sounds, such as music or noise, the perception goes down dramatically."

For cochlear implants to give users a better level of pitch perception, they must deliver information on the fine structure of the sound—the tiny and rapid changes in frequency. Ruffin is working with Jay Rubinstein, director of the Bloedel Center, to test a speech-processing algorithm designed to do just that. Studies in animals show that this algorithm conveys a sound's fine structure to the brain, Rubinstein says. And some people whose implants were reprogrammed with the new algorithm report improved speech perception. Ruffin is developing psychophysical tests to prove that the algorithm is in fact allowing fine structure information to reach the brain.

For the congenitally deaf, says Rubinstein, the earlier they receive an implant, the better. Older children and adults show a great deal of variability in how well they perform with implants. Ruffin still requires assistive listening devices at the movies and to hear lectures in a classroom environment, but he marvels at the changes he's experienced since his implant. "My social circle expanded exponentially after the implant," and, he says, "Now I can converse in the dark with a friend; I don't have to read lips."

Ruffin began working in the field of implant research in 2004 after completing his first year of medical school at Louisiana State University in Shreveport. His investigations took him to the University of Iowa in Iowa City, where he met Rubinstein. When Rubinstein moved to the University of Washington, Ruffin applied for the HHMI fellowship to join him. Although he plans to become a surgeon, Ruffin would also like to do long-term research. "And I decided that if I was going to do research," he says, "it'd be something that I'm interested in." –**Melissa Lee Phillips**

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Brian Smale