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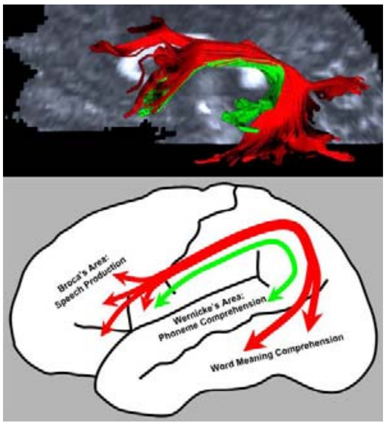

Well connected.
The arcuate fasciculus (red and green in MRI image above and schematic below) links key language areas in the human brain.

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Wired for Language

By Michael Balter
*Science*NOW Daily News
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We humans can do all sorts of things other animals can't. Take language, for example--an ability researchers have long chalked up to our big and specialized brains. But size isn't everything, according to a new study, which suggests that important changes in the brain's wiring played a key role in language evolution.

Back in the 19th century, neuroanatomists identified small regions of the human brain--such as Broca's area in the frontal cortex and Wernicke's area in the temporal cortex--and linked them to language. (Other, smaller-brained primates have regions that roughly correspond to these areas, but they appear to serve other functions.) More recently, scientists have found that language ability is not just isolated in discrete brain areas but requires close communication between them. For example, patients with damage to the brain's arcuate fasciculus, which consists of multiple bundles of nerve fibers that connect Broca's and Wernicke's areas, have severe difficulty speaking and understanding others. And a number of recent studies suggest that the brains of humans are wired somewhat differently than those of other primates (*Science*, 2 March 2007, p. 1208).

To see whether the arcuate fasciculus had been rewired over the course of human evolution, a team led by anthropologist James Rilling of Emory University in Atlanta, Georgia, turned to a relatively new technique called diffusion tensor imaging. This type of MRI visualizes tissues by detecting the flow of water within them, allowing scientists to trace the long nerve fibers that connect parts of the brain. The researchers scanned the brains of 10 live human subjects as well as three deceased chimpanzees and two deceased macaque monkeys. They also looked at one live chimpanzee and one live macaque, to be sure that any differences they saw were not due to the chemicals used to preserve the dead brains.

The scans showed dramatic differences between humans and the other primates. Although the arcuate fasciculus in all three species was hooked up to the frontal cortex--including with Broca's area in humans--only in humans did the arcuate fasciculus extend deeply into language-associated areas of the temporal cortex, such as Wernicke's area. In chimps, the arcuate fasciculus made only very limited connections with temporal cortex regions homologous to Wernicke's area, and there was little evidence of such connections in macaques, the team reports online this week in *Nature Neuroscience*.

The authors conclude that the evolution of specialized language areas in the human brain was accompanied by the addition of major new wiring via the arcuate fasciculus. The net effect was that Wernicke's area, which is associated with understanding word meaning, became strongly connected with Broca's area, which plays an important role in the construction and understanding of sentences.

The findings demonstrate "the uniqueness of the human brain, because it has been widely assumed that the basic brain structures are essentially similar between humans and apes," says Kuniyoshi Sakai, a language researcher at the University of Tokyo in Japan. Thomas Schoenemann, an anthropologist at James Madison University in Harrisonburg, Virginia, says diffusion tensor imaging is a promising approach to understanding how our brains are wired, but he cautions that the approach should be repeated with more samples before drawing firm conclusions.

Related sites

- Visualizing the arcuate fasciculus
- Language and the brain, with more on Broca's and Wernicke's area