Lost in translation: Scientist studies the neural origins of speech disorders

April 20 2011, By Heather Wuebker

"The act of speech involves coordination between auditory and motor functions in the brain," says Greg Hickok, director of UCI's Center for Cognitive Neuroscience. "Depending on exactly how the process misfires, the result can be speech errors, stuttering or auditory hallucinations." Credit: Steve Zylius / University Communications

It can be heart-wrenching to watch a loved one try to verbally express him- or herself after suffering stroke-induced brain damage known as conduction aphasia.

The disorder produces lesions that interfere with the neurological process of translating thought into speech, says UC Irvine cognitive neuroscientist Greg Hickok, and the interference is believed to occur in the Sylvian fissure dividing the brain's parietal and temporal lobes.

The same region, he says, could help explain why some people stutter and how schizophrenics can misinterpret their internal thoughts as external voices.

In December, Hickok received a five-year, $3.2 million renewal grant from the National Institutes of Health to support his continued research on how neural abnormalities affect speech and language in stroke victims. The award supplements the $6.1 million he has already gotten to advance understanding of the brain's role in speech and how abnormalities can inhibit this process.

"The act of speech involves coordination between auditory and motor functions in the brain," Hickok says. "This is obvious in visuomotor tasks like reaching for a cup, where we use visual information about its shape and location to guide our reach. It's less obvious in language, but studies have shown that in the same way, a word's sound guides our speech."

The director of UCI's Center for Cognitive Neuroscience, Hickok first began seeing this in action at a neural level 10 years ago when utilizing fMRI to study brain processes related to speech production. He noticed that, in addition to the expected motor regions, auditory areas of the brain "lit up," or activated, when people named pictures – even if they thought about but didn't actually vocalize the words for them.

"Stroke-based research found that these activations reflected the critical involvement of auditory areas in speaking. When these regions are damaged, patients tend to struggle to come up with words, and when they do speak, they make a lot of errors," says Hickok, professor of cognitive sciences.

He has since been using fMRI and stroke-based methods to zero in on the Sylvian parietal-temporal region of the brain, in which he believes

the regulation of auditory and motor processes occurs.

“In people with schizophrenia or aphasia and those who stutter, the coordination between perception and production is dysfunctional, and it appears to be happening in the SPT region,” Hickok says. “Depending on exactly how the process misfires, the result can be speech errors, stuttering or auditory hallucinations.”

With his renewed funding, he’ll further study both SPT mechanics and speech perception as a whole. While it’s generally accepted in the cognitive neuroscience community that auditory and motor functions work together, Hickok explains, the details are not well understood.

Continued NIH support has been helping him close this knowledge gap. In a paper published Feb. 10 in *Neuron*, Hickok presented a new model of how these two processes operate, illustrating the SPT zone’s role in translating auditory perception into motor output.

He has also created a multi-university consortium for aphasia research. Hickok’s hope is that by conducting studies and sharing findings, he and others will contribute to better therapies for people with brain damage, lesions or neural abnormalities.

Provided by University of California, Irvine