(Baldo et al., 2011; Dronkers, 1996) identified a critical location for control of speech articulation: the left precentral gyrus of the insula. The insular cortex is located on the lateral wall of the cerebral hemisphere behind the anterior temporal lobe. Normally, this region is hidden and can be seen only when the temporal lobe is dissected away. (See Figure 14.9.) Dronkers discovered the apparent role of this region by plotting the lesions of patients with and without apraxia of speech who had strokes that damaged the same general area of the brain. (**Apraxia of speech** is an impairment in the ability to program movements of the tongue, lips, and throat that are required to produce the proper sequence of speech sounds.)

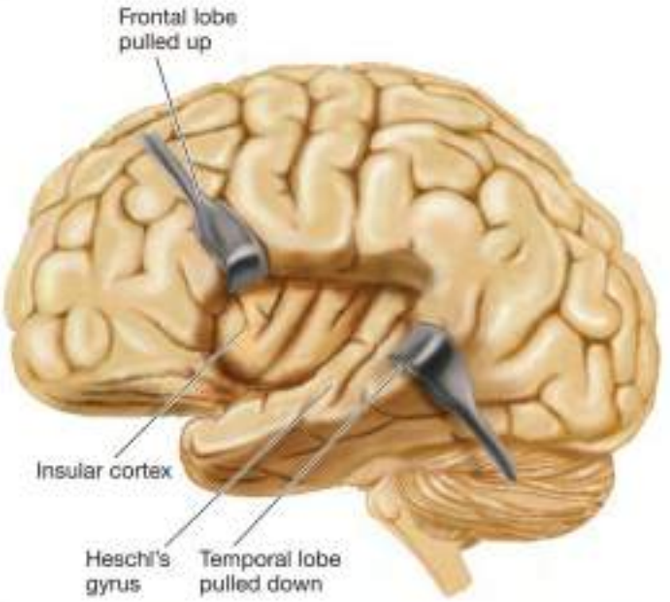
At least two functional-imaging studies support Dronkers's conclusion. Kuriki and colleagues (1999) and Wise and colleagues (1999) found that pronunciation of words caused activation of the left anterior insula. However, other studies suggest that Broca's area is also involved in articulation (Hillis et al., 2004; Nestor et al., 2003). Stewart and colleagues (2001) used TMS to interfere with the activity of neurons in Broca's area or the adjacent area of primary motor cortex, which controls the muscles used for speech. The participants reported that stimulation of the motor cortex made them feel as though they had lost control of their facial muscles. In contrast, stimulation of Broca's area made them feel as if they were unable to "get the word out."

Most of us have, at one time or other, had difficulty getting a word out even though the word was one that we knew well. This phenomenon has been called the "tip of the tongue phenomenon," or TOT. Shafto and colleagues (2007) found that people who often had difficulty thinking of the correct word to say but were sure that they knew it (that is, often had a TOT experience) showed loss of gray matter in the left insular cortex.

In a study of older adults, fMRI was used to determine brain regions involved in TOT experiences while attempting to identify famous faces. Regions of the prefrontal cortex and insular cortex were activated in TOT (Huijbers et al., 2017). (See Figure 14.10.)

Figure 14.9 The Insular Cortex and Its Involvement in Speech

The cortex is normally hidden behind the rostral temporal lobe. Evidence for involvement is shown by the percentage overlap in the lesions of 25 patients.



Disorders of Language Comprehension: Wernicke's Aphasia

LO 14.7 Describe the symptoms and biological basis of Wernicke's aphasia.

Speech comprehension begins in the auditory system, which detects and analyzes sounds. But recognizing words is one thing; comprehending them—understanding their meaning—is another. Recognizing a spoken word is a complex perceptual task that relies on memories of sequences of sounds. This task appears to be accomplished by neural circuits in the superior temporal gyrus of the left hemisphere, a region that has come to be known as **Wernicke's area**. (Refer back to Figure 14.3.)

Figure 14.10 Brain regions involved in TOT

Whole brain maps of functional MRI activity related to TOT. Brain activity is projected onto the cortical surface. On the right, a coronal slice is shown to visualize lack of activity in the hippocampal formation.