CHAPTER 6

Temporocingulate Interactions in the Monkey

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Chapter contents

The cingulate gyrus has long been considered to be part of the limbic lobe (Broca, 1878) and was later incorporated into a medial circuit that formed the substrate for emotion (Papez, 1937). With the advent of modern tract-tracing methods, MacLean (1990) developed the concept of the limbic system, incorporating the amygdala and septum along with the cingulate gyrus. The circuitry of this system expanded greatly with subsequent connection studies.

Based on cytoarchitecture, connections, and functional analyses, the cingulate gyrus is comprised of four regions: anterior cingulate cortex (ACC), midcingulate cortex (MCC), posterior cingulate cortex (PCC), and retrosplenial cortex (RSC). Although all a part of the cingulate gyrus, these regions are not uniform and can be further subdivided, for example, into dorsal and ventral parts of the PCC (Shibata and Yukie, 2003). In functional terms, the cingulate cortex plays key roles not only in emotional and motivational processes but also in autonomic responses (Kaada *et al.*, 1949; Nishijo *et al.*, 1997) and higher cognitive processes, such as attention, error detection, motor activity, social behavior, conflict, and different types of memory (Smith, 1945: Mirsky *et al.*, 1957; Gemba *et al.*,1986; Valenstein *et al.*, 1987; Posner *et al.*, 1988; Grasby *et al.*, 1993b).

The temporal lobe transmits information from all sensory association cortical areas and has robust interactions with many limbic structures, including the amygdala and hippocampus. As such, the temporal lobe is involved in emotion, motivation, memory, and learning and the cingulate cortex has been implicated in aspects of these particular functions including auditory-verbal memory and memory of visual episodic events. Clinical studies have demonstrated that damage to the left RSC and the adjacent PCC or splenial tumors