Medical Neuroscience | Tutorial Notes

Upper Motor Neuronal Control—Emotional Motor System

Map to Neuroscience Core Concepts[1]

NCC1. The brain is the body's most complex organ.

NCC3. Genetically determined circuits are the foundation of the nervous system.

NCC4. Life experiences change the nervous system.

Learning Objectives

After study of the assigned learning materials, the student will:

1. Discuss the evidence for an "emotional motor system".

Tutorial Outline

I. Emotional Motor System (see **Figure 29.2**[2])

- A. originates mainly within neural centers of the 'limbic' forebrain that coordinate emotional integration; these include the **cingulate gyrus**, **orbital and medial prefrontal cortex**, the **amygdala** and the **hypothalamus**
- B. this (largely) non-volitional motor system is for:
  1. the expression and experience of emotional, motivated or appetitive behavior
  2. preparations for and the execution of emergency ("fight or flight") behaviors
- C. these forebrain structures give rise to medial and lateral descending projections
  1. medial component (e.g., during stressful or threatening circumstances, preparation for maximal motor activity with neglect of painful stimuli)
     - a. terminates in the medial reticular formation, which in turn gives rise to projections that modulate lower motor circuits (and sensory neurons)
     - b. mediates widespread influence on the excitability of lower motor neurons and the local interneurons that organize their output
  2. lateral component (e.g., regulation of cardiovascular and respiratory function, salivation, vocalization (non-speech), facial expression, micturition, vomiting)
     - a. terminates in the lateral reticular formation and cranial nerve nuclei that govern somatic and visceral motor aspects of emotional expression

[1] Visit **BrainFacts.org** for *Neuroscience Core Concepts* (©2012 Society for Neuroscience) that offer fundamental principles about the brain and nervous system, the most complex living structure known in the universe.

[2] Figure references to Purves et al., *Neuroscience, 5th Ed.*, Sinauer Assoc., Inc., 2012. [click here]

D. examples of integrated activity of the emotional motor system

1. facial expressions (see Chapter 29, **Box 17A** and **Box 29A**): illustrates parallel pathways that govern certain muscles

2. speech: illustrates the coordinated contributions of volitional motor and emotional motor systems in the expression of an integrated behavior

STUDY QUESTION

You are trying your best to smile for a camera, but you are not all that happy about having your picture taken. Which part of the motor cortex is likely governing that forced smile?

A. the paracentral lobule
B. the inferior segment of the precentral gyrus, just inferior to where the "S-shaped" bend is typically found in the central sulcus
C. the central portion of the precentral gyrus where the "S-shaped" bend is typically found in the central sulcus
D. the cingulate motor area, which is a division of the medial premotor cortex in the banks of the cingulate sulcus