

Medical Neuroscience | Tutorial Notes

Associational Cortex of the Frontal Lobe

MAP TO NEUROSCIENCE CORE CONCEPTS¹

- NCC5. Intelligence arises as the brain reasons, plans, and solves problems.
- NCC7. The human brain endows us with a natural curiosity to understand how the world works.

LEARNING OBJECTIVES

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

1. Discuss the major functions that are localized to the associational cortex of the frontal lobe.

TUTORIAL OUTLINE

- I. Frontal associational cortex: the prefrontal cortex
 - A. two major cortical territories in the frontal lobe
 1. posterior motor cortex (premotor cortex and primary motor cortex)
 2. **prefrontal cortex**: cortex anterior and medial to the motor cortex (“pre”-frontal because it is “before”—anterior to—the motor cortex)
 - B. two divisions of the prefrontal cortex: dorsal-lateral and ventral (orbital)-medial
 1. **dorsal-lateral prefrontal cortex**: executive functions
 - a. involved in planning behavior based on integration of sensory information together with other sources of input (e.g., memory, interoception, emotion) that inform cognition
 - b. exemplified by **working memory**
 - information must be held “on-line” for the execution of an appropriate behavioral response (e.g., looking for a lost set of keys or a familiar face in a crowd)
 - neurons in the prefrontal cortex respond during the delay phase of a working memory task (when information must be held “on-line” in order to guide behavior) (see **Figure 26.17**²)

¹ Visit [BrainFacts.org](https://www.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](#)]

- c. dorsal-lateral prefrontal networks are among the last cortical networks to develop, at least in terms of myelination and stability in the integrity of functional connections
 - d. once mature, dorsal-lateral prefrontal networks play an important role in making use of prior experience to guide subsequent behavior
 - i. this is key for moderating or suppressing inappropriate behaviors
 - ii. especially important in complex, real-world situations where the “rules” that guide social behavior are dynamic
 - e. damage to dorsal-lateral prefrontal networks can lead to deficits in working memory, but also to perseveration (a continuation of prior behavior, even after reinforcement contingencies have changed) (see **Box 26B**)
 - i. people with dorsal-lateral prefrontal injury are impaired in planning appropriate behavior in complex, dynamic scenarios
 - ii. disruption of executive functions
2. **orbital-medial (ventral-medial) prefrontal cortex**
- a. involved in emotional processing, reason, interpretation of social cues, planning appropriate social behavior, and formation of advantageous decisions in real-life circumstances
 - b. Phineas Gage: an illustration of the disruption of social behavior following damage to the orbital-medial prefrontal cortex: “A Wonderful Journey Through Skull and Brains” (Vermont Mercury, October 13, 1848)

STUDY QUESTION

A patient developed a meningioma in the anterior 2-3 cm of the **falx cerebri**. What behavioral problems would you expect with this patient?

- A. profound inability to produce fluent speech
- B. difficulty walking
- C. diminished capacity to formulate advantageous, real-life decisions
- D. perseveration of action
- E. profound difficulty recalling recent events