VA Mid-Atlantic Health Care Network

MIRECC
Mental Illness Research, Education and Clinical Center

Post Deployment Mental Health
VISN 6

Windows to the Brain:
Introduction to Circuits

Cortical Association
Prefrontal-Subcortical
Papez
Brainstem

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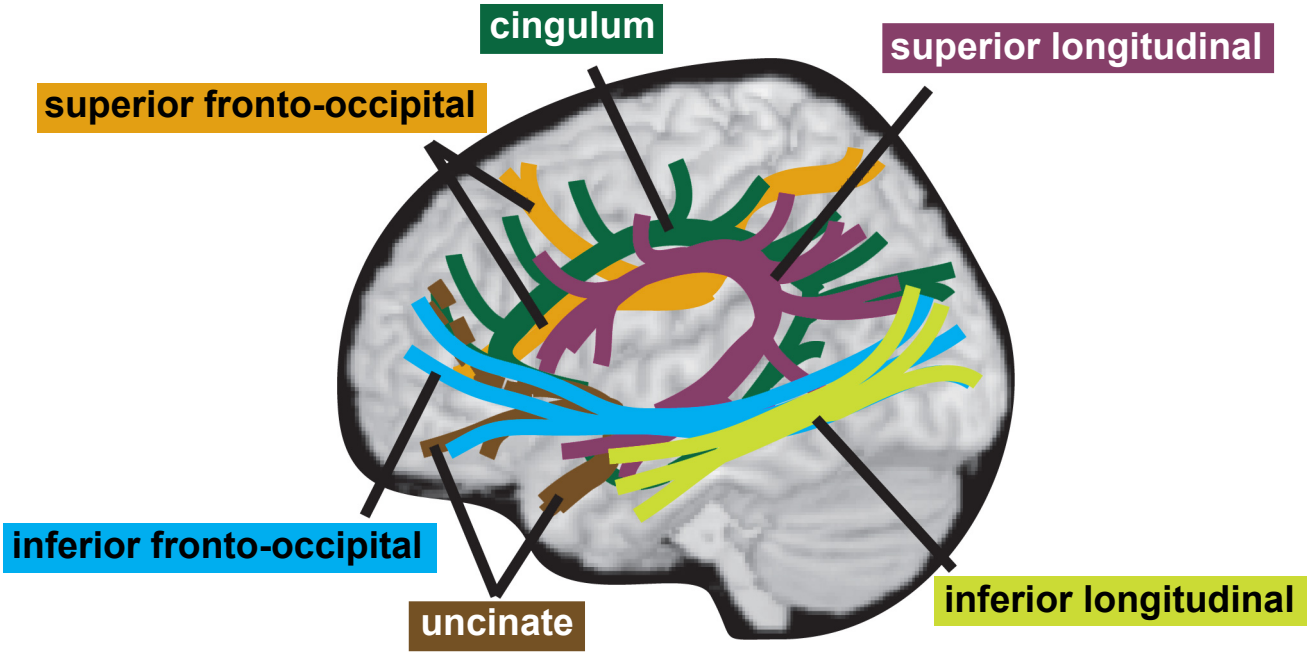
Major Long Cortical Association Tracts



Brief guide to neuropsychiatric symptoms associated with injury to tract.

superior fronto-occipital (subcallosal) fasciculus
orbital & medial prefrontal cortex <-> parietal cortex

akinetic mutism; disordered initiation & preparation of speech movements; transcortical motor aphasia; anomia & reduction of spontaneous speech with normal articulation

cingulum - short fibers
cingulate cortex <-> frontal, parietal, occipital & temporal cortex

cingulum - long fibers
frontal cortex <-> temporal cortex

Anterior - lack of emotional affective response to pain; anxiety; OCD; depression; panic; akinetic mutism **Posterior -** impaired integration of visuospatial & memory processing

superior longitudinal (arcuate) fasciculus
frontal cortex <-> parietal, occipital & temporal cortex

R - left hemispatial neglect; **L** - conduction aphasia (fluent aphasia with impaired repetition, mostly preserved language comprehension); ideational apraxia (can't carry out skilled movements and/or commands); depression; speech arrest; anomia; **Posterior** - transcortical sensory aphasia (impaired auditory comprehension, intact repetition & fluent speech)

uncinate fasciculus
orbital & polar prefrontal cortex <-> anterior temporal cortex

deficits in retrieval of past information: **R -** episodic context-dependent memory, personal experiences, autobiographical; **L -** context-free memory, general knowledge of facts

inferior fronto-occipital fasciculus
ventrolateral & dorsolateral prefrontal cortex <-> posterior temporal & occipital cortex

R>L - impaired orienting of attention; visual recognition abnormalities; **R+L -** impaired pursuit eye movements; inaccurate reaching under visual guidance; impaired motion perception; **R or R+L -** impaired seeing/selecting in crowds; impaired spatial relations; visual agnosia & poor visual memory; impaired recognition of places & directions to get there; getting lost

inferior longitudinal fasciculus
temporal pole <-> occipital cortex

disorders in recognition (visual agnosia) impaired visual recent memory; **R or R+L -** impaired face recognition (prospagnosia), visual object agnosia, visual hypoemotionality if cue presented visually; **R+L or L>R -** contralateral deficit in color vision (hemiachromatopsia); **L-bilateral** misnaming of objects presented by touch (tactoverbal dysfunction)

*Taber KH, Hurley RA. J Neuropsychiatry Clin Neurosci 2007;19(2):100-104.

Major Prefrontal - Subcortical Circuits

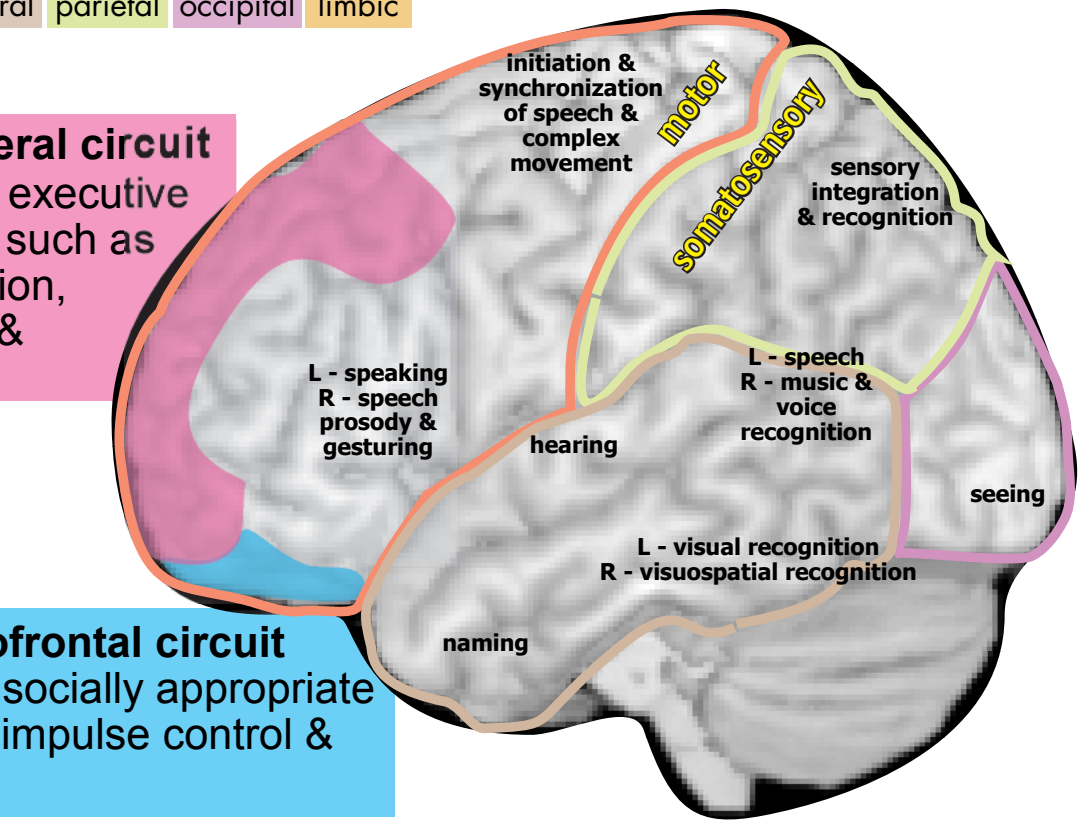
In psychiatry, the prefrontal cortex is generally divided into three principal areas. Each area has reciprocal connections with subcortical structures that form cortico-subcortical circuits.*

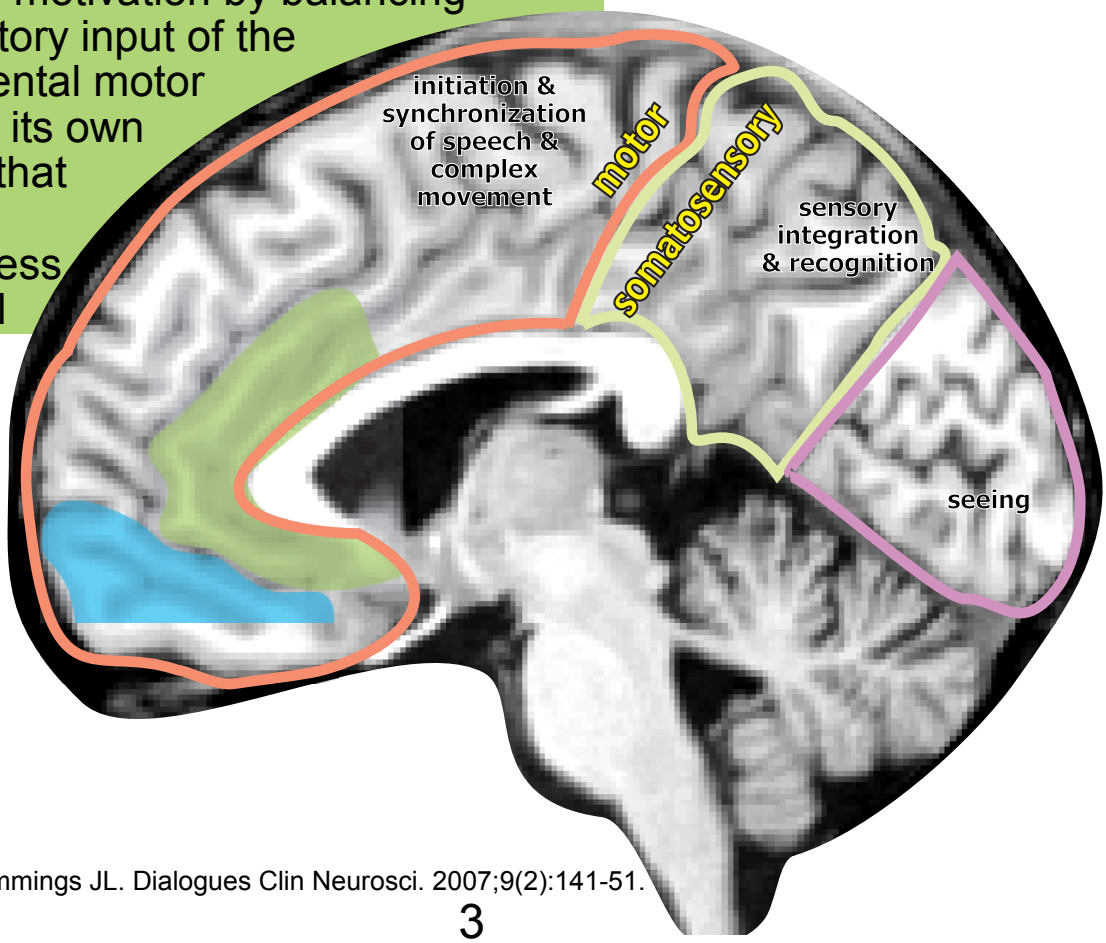
frontal | temporal | parietal | occipital | limbic

Dorsolateral circuit
mediates executive functions such as organization, planning & attention

Orbitofrontal circuit
mediates socially appropriate behavior, impulse control & empathy

Anterior cingulate circuit
produces motivation by balancing the inhibitory input of the supplemental motor area with its own stimulus that supports wakefulness & arousal





*Bonelli RM, Cummings JL. Dialogues Clin Neurosci. 2007;9(2):141-51.

Major Prefrontal - Subcortical Circuits

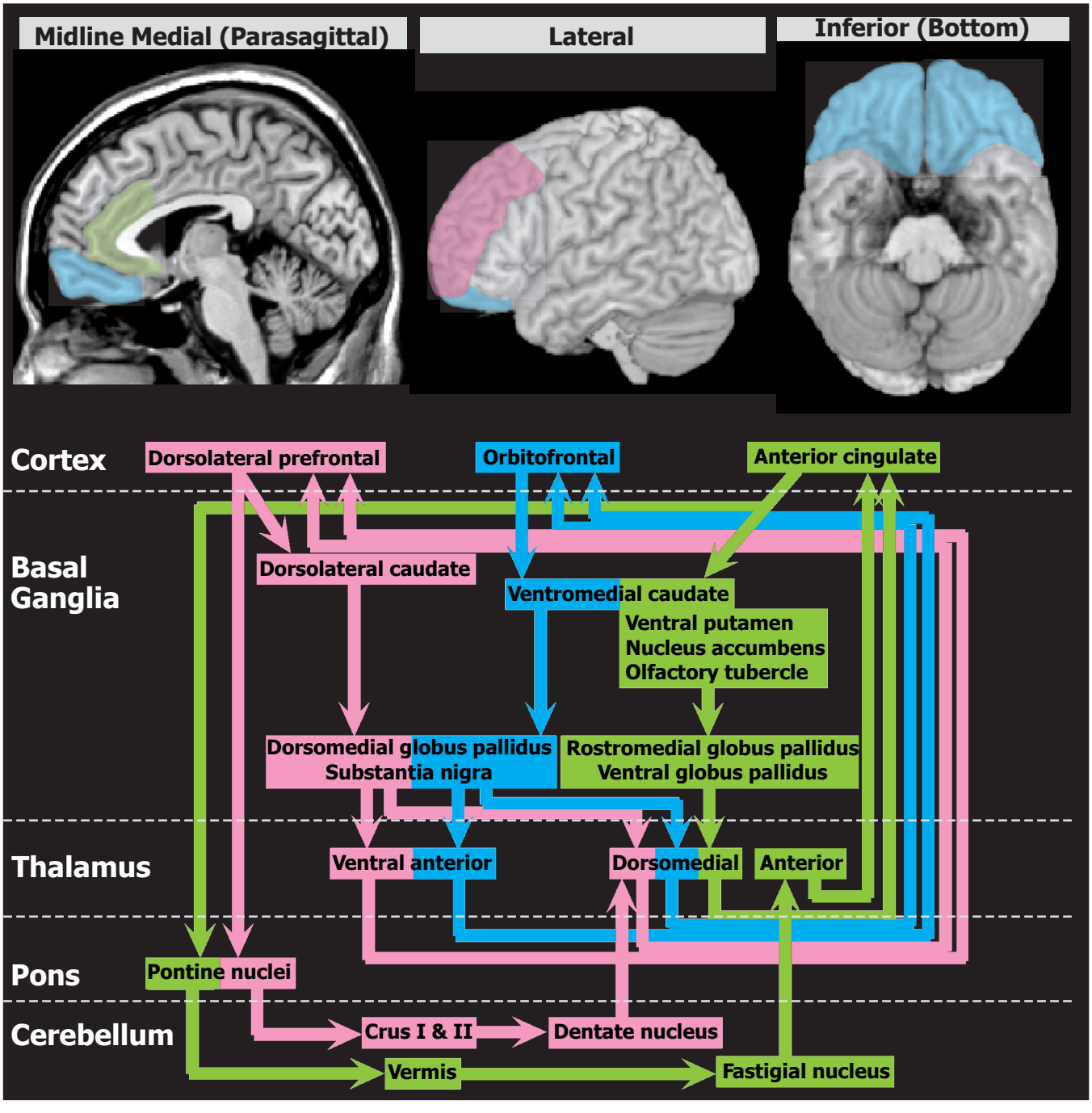
In psychiatry, the prefrontal cortex is generally divided into three principal areas. Each area has reciprocal connections with subcortical structures that form cortico-subcortical circuits.

These prefrontal-subcortical circuits are formed by chains of neurons with cell bodies in gray matter structures (both cortical and subcortical) connected by the axons which form the white matter. Recently the evidence supporting a similar reciprocal circuit to the cerebellum has strengthened, although its functions are still controversial.

Dorsolateral circuit
mediates executive functions such as organization, planning and attention

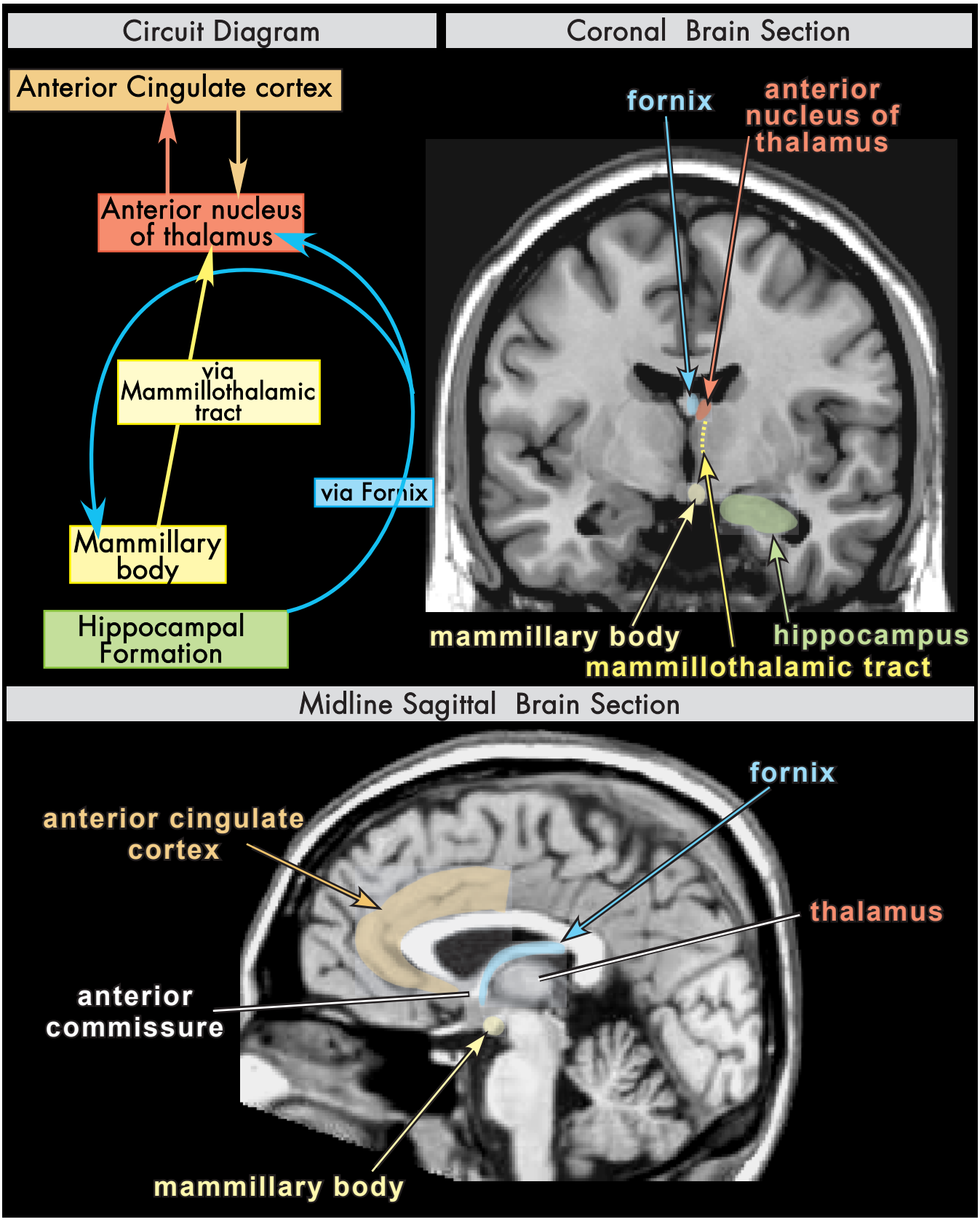
Orbitofrontal circuit
mediates socially appropriate behavior, impulse control, and empathy

Anterior Cingulate circuit
produces motivation by balancing the inhibitory input of the supplemental motor area with its own stimulus that supports wakefulness and arousal



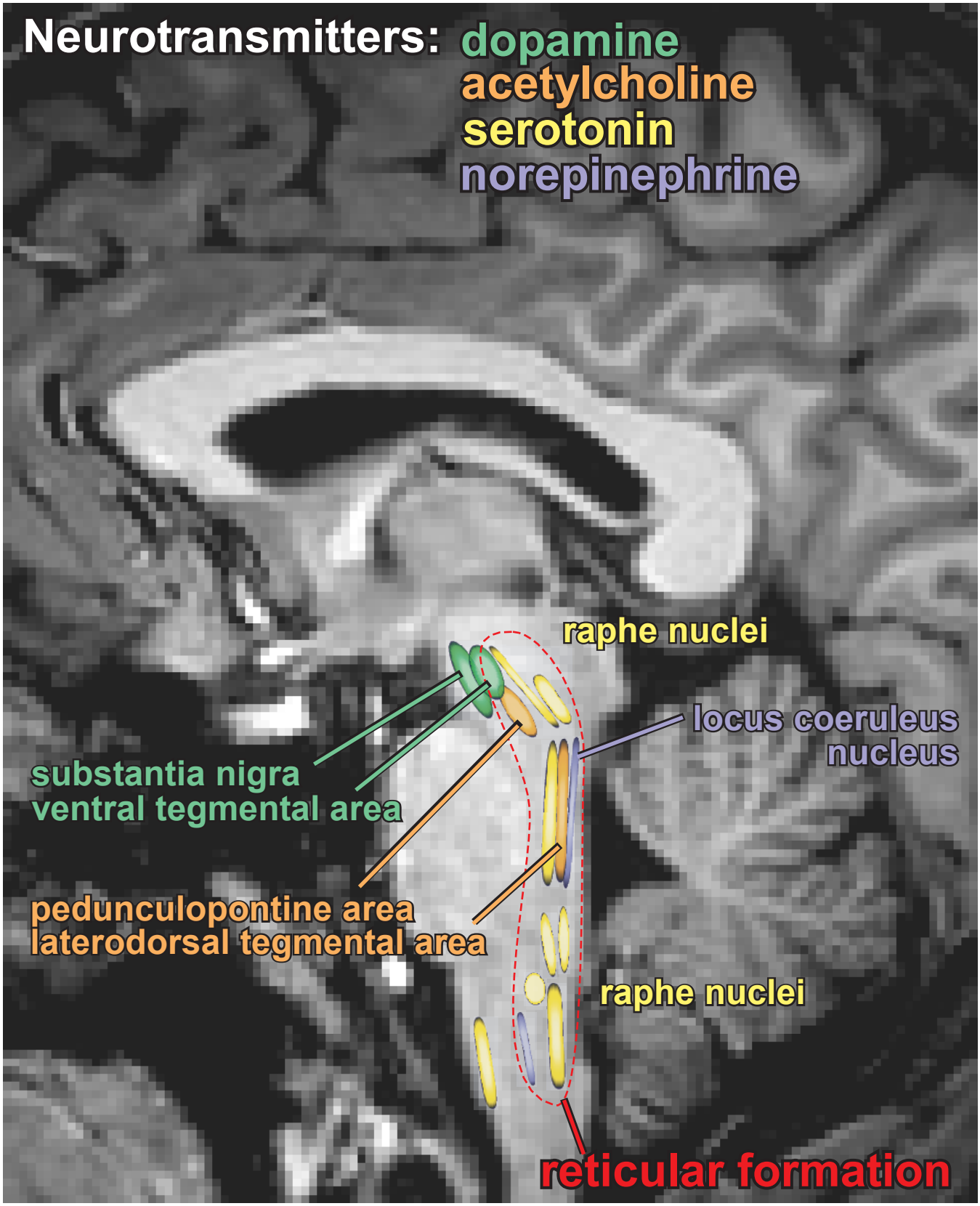
Circuit of Papez

A schematic diagram of the emotion and memory circuit of Papez is color-coded to match the summary of subcortical structures and the sectional atlases. The location and extent of the Anterior Cingulate cortex (light gold), fornix and mammillary body are indicated on a midline sagittal magnetic resonance image. The locations of the remaining structures are shown on a coronal magnetic resonance image.



Brainstem - Amine Neurotransmitters

These small brainstem nuclei project very widely in the brain. They provide essential modulation of the brain systems that subserve multiple functions including behavior, cognition and mood. The approximate locations and extents of nuclei that are important sources for a particular neurotransmitter are color-coded onto a sagittal magnetic resonance image.*



*Hurley RA, Flashman LA, Chow TW, Taber KH. J Neuropsychiatry Clin Neurosci 2010;22(1):iv, 1-6.