

Limbic System Review

B. Puder, PhD

Limbic System Overview

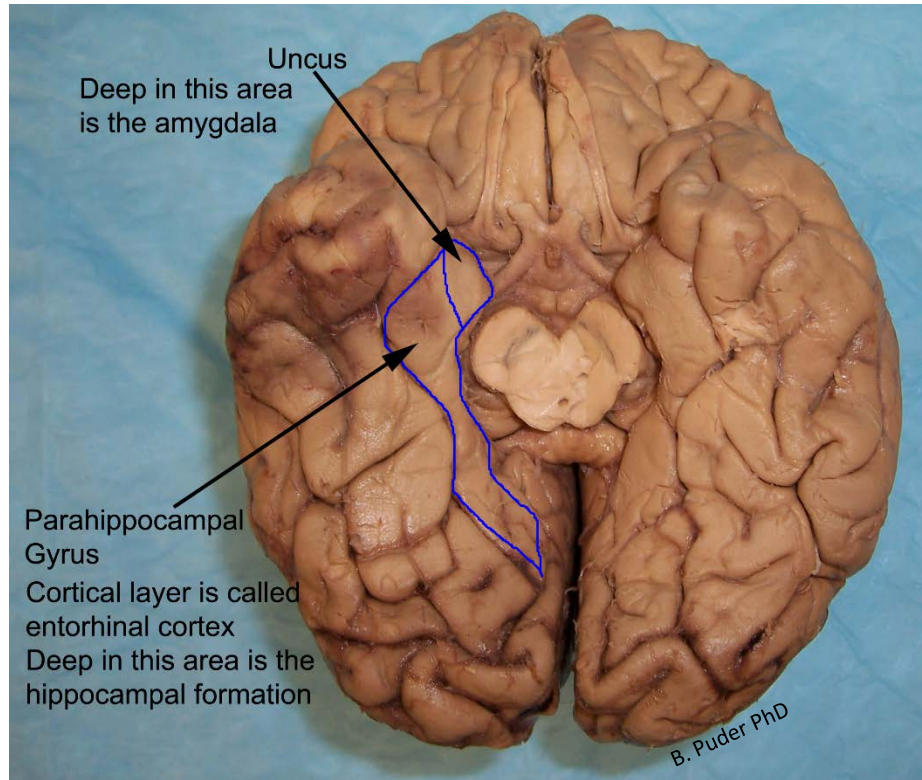
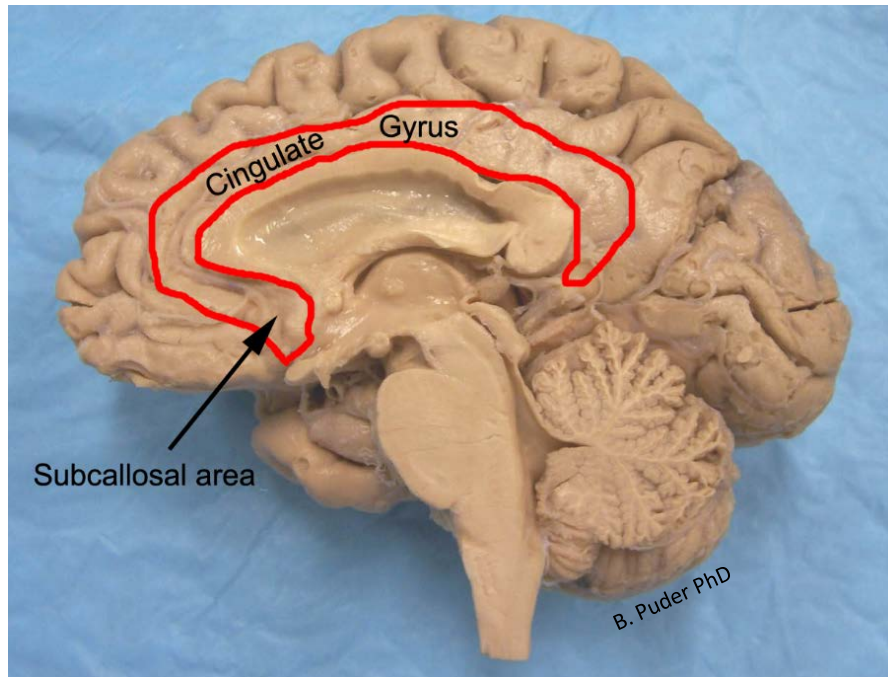
The limbic system involves structures not only in the limbic lobe, but also structures from outside the limbic lobe from the telencephalon, diencephalon, and brainstem.

The limbic system participates in complex and interrelated behaviors such as learning and memory and social interactions.

Limbic Lobe

Limbus = ring, border, or edge.

The structures in this lobe make a ring around the medial rim of the hemisphere.



The Limbic lobe consists of the subcallosal area, cingulate gyrus, parahippocampal gyrus and uncus.

The limbic system is responsible for learning, memory, moods and behaviors.

Hippocampus

The function of the hippocampal formation is to consolidate long term memories from immediate and short term memories.



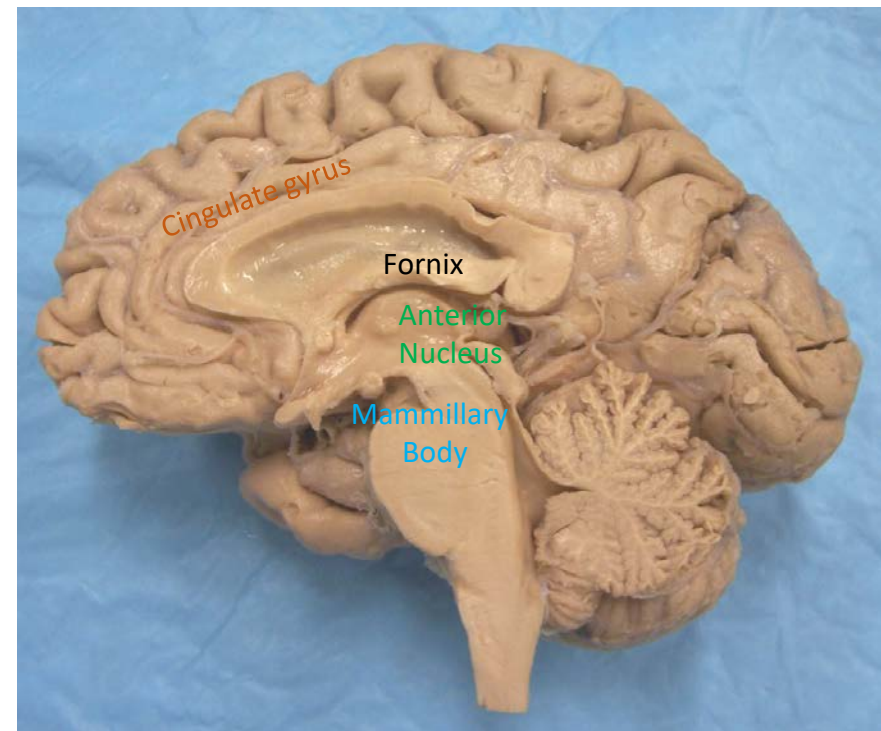
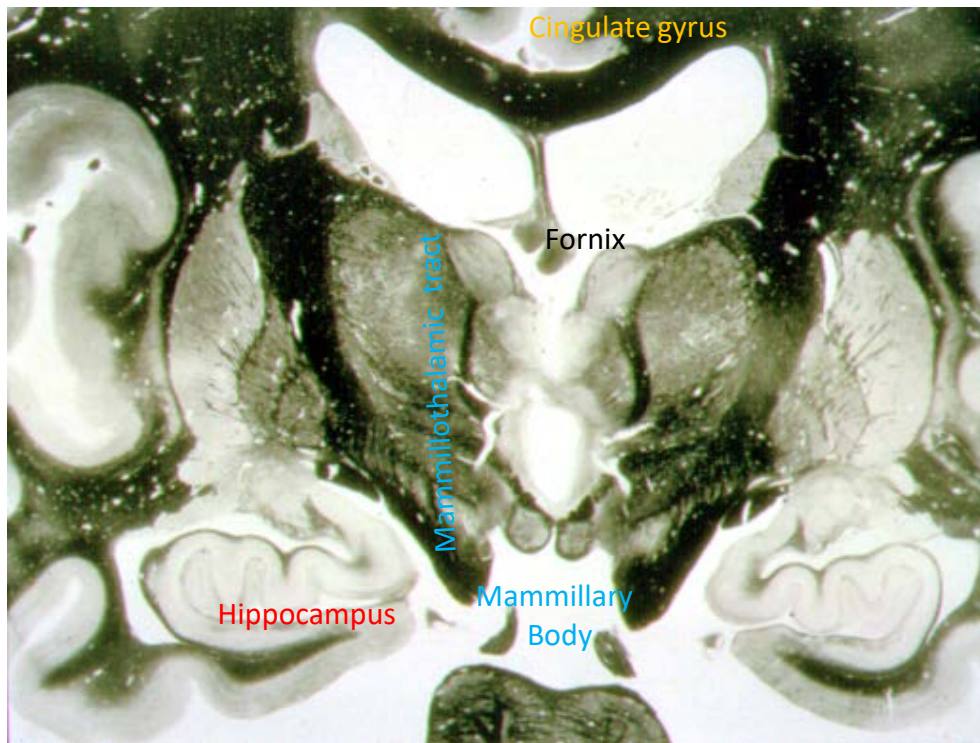
Coronal myelin stained brain section depicting the hippocampus

Papez Circuit

The Papez circuit originates and terminates in the hippocampus.

This pathway was described by Dr. Papez and plays a role in learning and memory and expression of emotion.

This pathway allowed scientists the first clue as to the role of the limbic system.



Hippocampal cell bodies project **axons (fornix)** to synapse on **Mammillary body** that project via the **Mammillothalamic tracts** to synapse on the **Anterior thalamic nucleus** which projects its axons through the **Anterior limb of the internal capsule** to synapse on the **Cingulate gyrus** whose axons project back down to synapse on the **hippocampus**.

Hippocampal Lesions

A lesion to the hippocampal formation impairs the ability to form long term memories. Less severe lesions may cause the impairment to learn new things easily, or may forget to return to a previously started task if interrupted.

Alzheimer's disease is excessive neuronal cell death not attributed to normal aging and thus causing severe cognitive dysfunction and death.

Neurofibrillary tangles and neuritic plaques destroy the functionality of the neuron.

The entorhinal cortex of the hippocampus and nucleus basalis of Meynert are the first areas to show evidence of Alzheimer's disease.

Korsakoff syndrome is caused by a thiamine deficiency and can be seen in chronic alcoholics. Neuronal degeneration is seen the mammillary bodies, fornix, hippocampus and dorsomedial nucleus of the thalamus.

Signs/Symptoms include:

Dementia

Confabulation

Memory loss

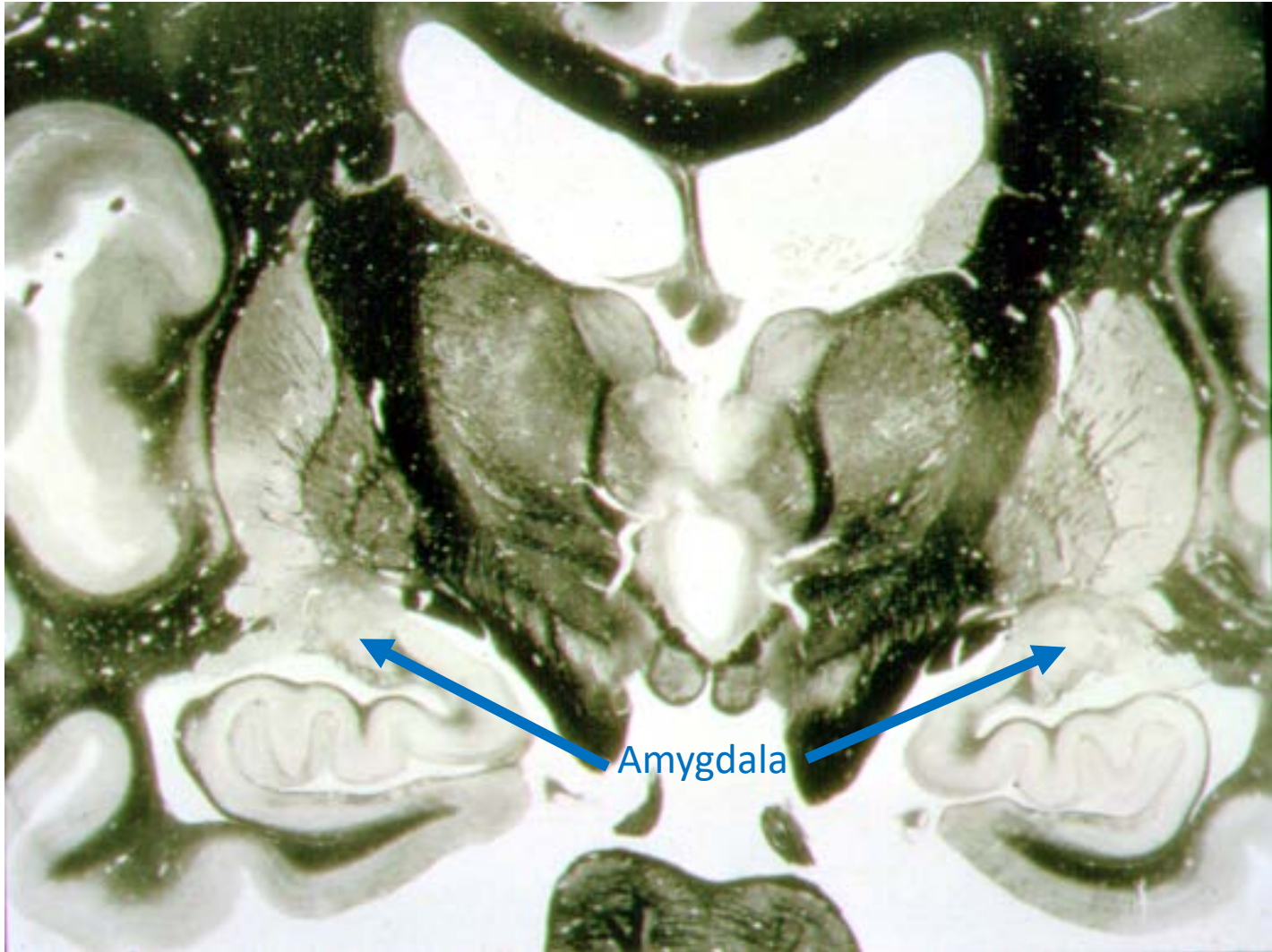
Confusion

Cerebellar damage (ataxia)

Wernicke-Korsakoff syndrome has the signs/symptoms listed above plus a Wernicke's aphasia (Receptive, Fluent aphasia)

Amygdala

Located deep within the uncus of the parahippocampal gyrus



Amygdala Lesion

Kluver-Bucy syndrome:

Lesion in the temporal lobe mainly affecting the amygdala.

Signs/Symptoms:

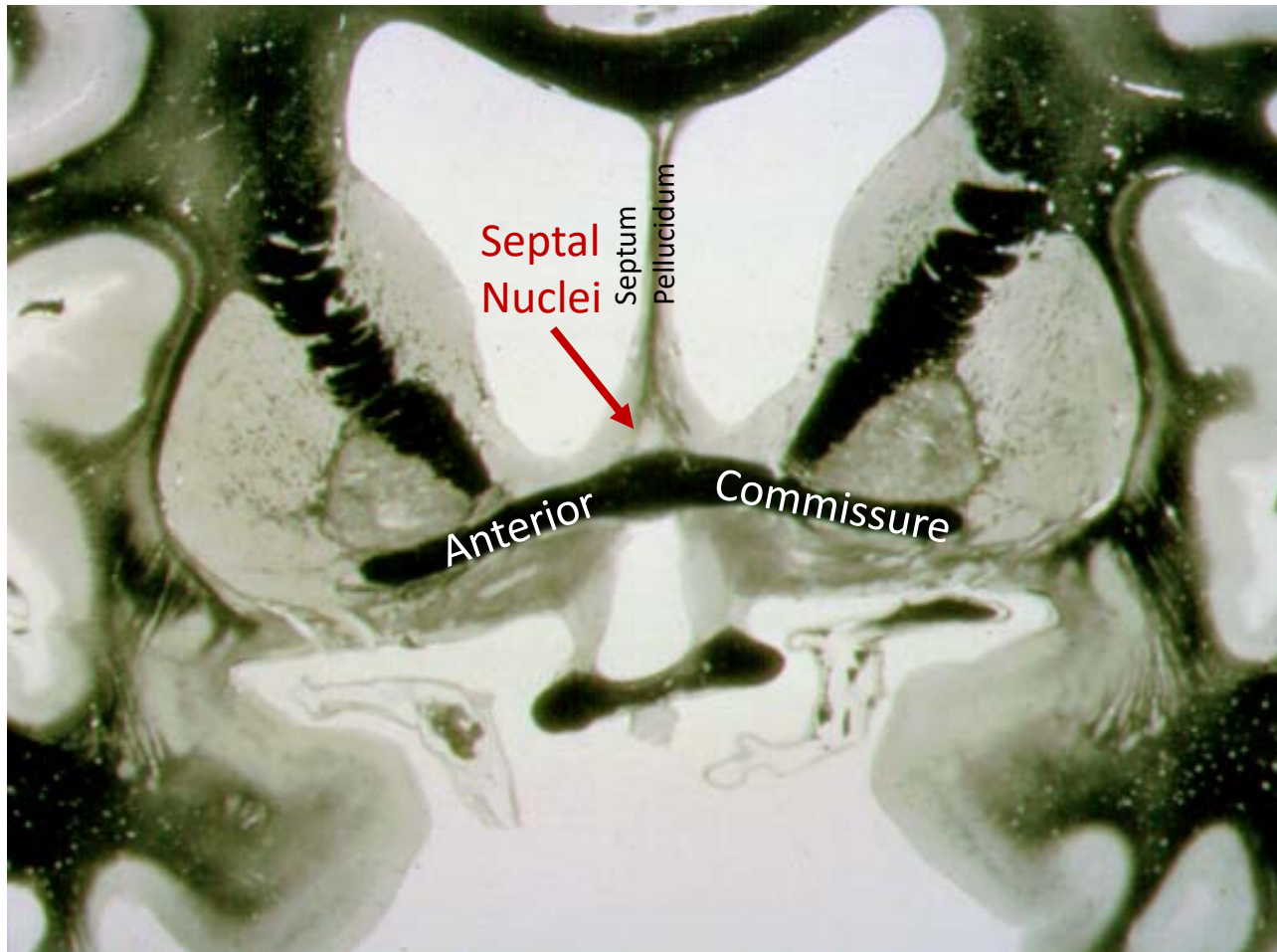
1. Visual Agnosia
2. Hyperorality
3. Hypermetamorphosis
4. Hyperphagia
5. Placidly – not fear or anger
6. Hypersexuality

Septal Nuclei

Septal nuclei are located anterior and inferior to the septum pellucidum.

Septal nuclei project emotional olfactory information to the Habenular nuclei of the diencephalon.

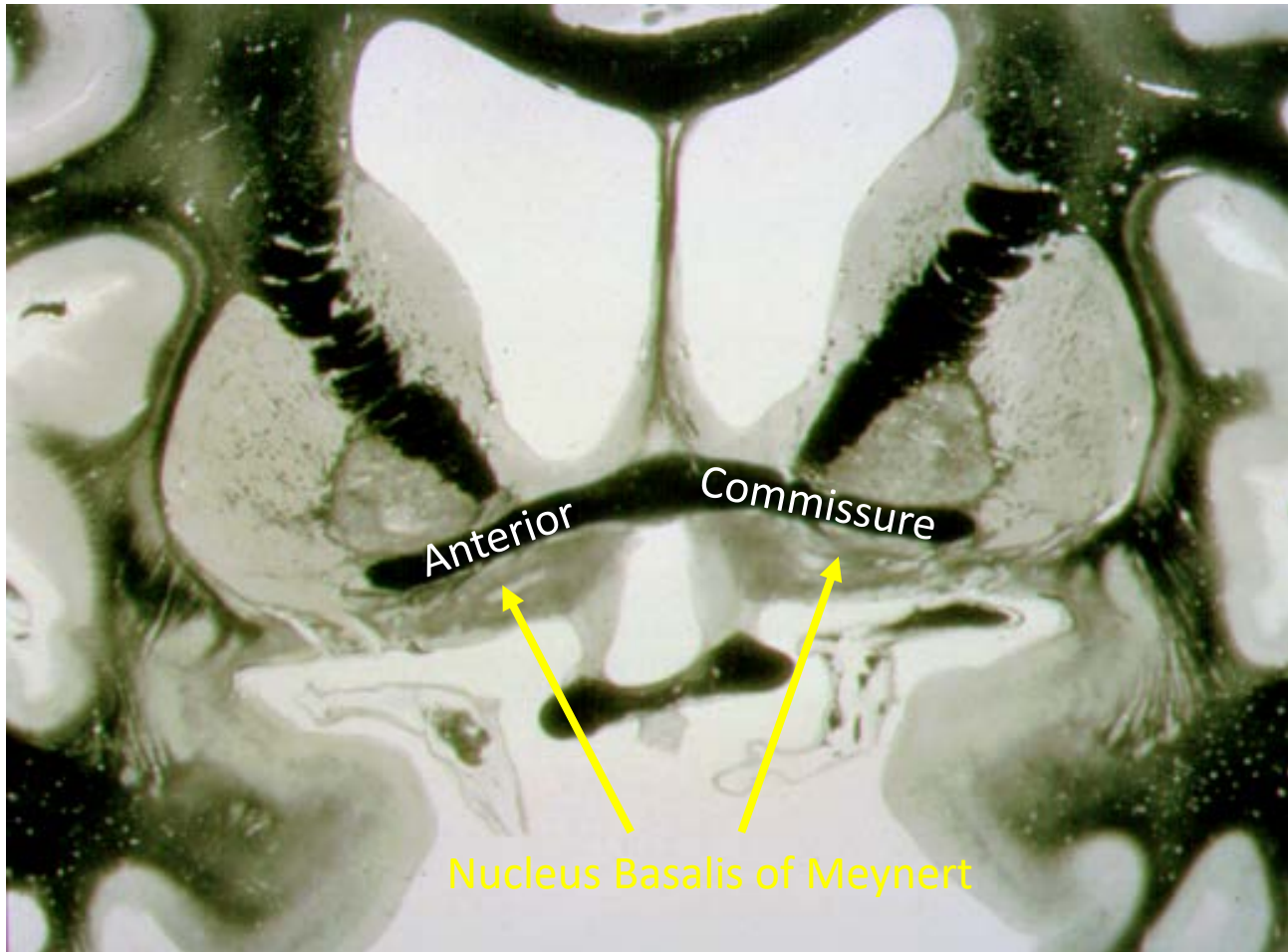
Lesions to the septal nuclei can cause rage behavior.



Coronal myelin stained brain section depicting the septal nuclei

Nucleus Basalis of Meynert

This nucleus sustains significant neuronal cell death in Alzheimer's disease.



Coronal myelin stained brain section depicting the nucleus basalis of Meynert

Nucleus Accumbens

This nucleus is called the “Pleasure Center” of the brain and is considered to play a role in addictive behaviors.

