

## The Limbic System

### Components:

- \* principal effector organ = Hypothalamus (connected to the autonomic nervous system)  
Hippocampus (dentate gyrus and Ammon's Horn)
- \* intermediate effector organs = Amygdala and Lateral Septal Nuclei
- \* Limbic association cortices = cingulate gyrus, parahippocampal gyrus, subcallosal gyrus

### General Role of the Limbic System

- provides the means for defining subjective properties: The perception or recall of a stimulus involves 1.) the limbic system which senses a "feeling" about the stimulus and 2.) the sensory association cortex which provides the basis for the description of the perception that one feels.
- it endows certain perceptions with the sense of urgency that lead to "fight or flight"

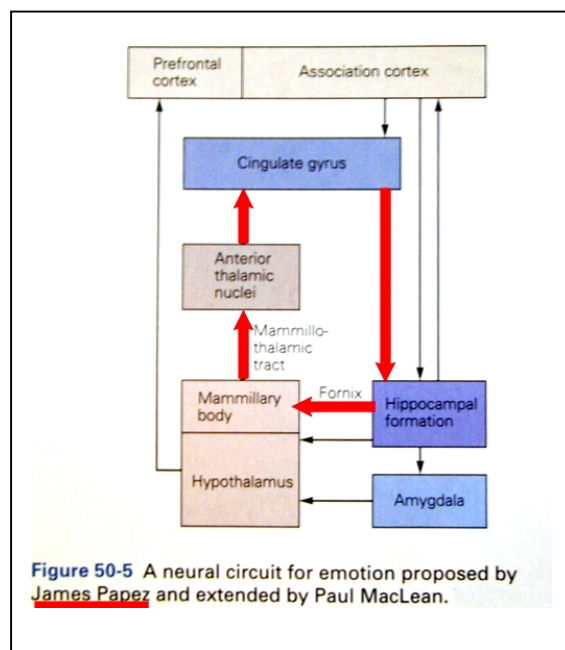
...more specifically...

- \* Hypothalamic circuitry provides the basis for judgment in relation to hunger, thirst, and sex drive
- \* Amygdala is involved with autonomic, endocrine, and somatomotor activities – it is active during emotional interpretation of visual stimuli and can enhance memory, which requires the adrenal glands
- \* Septal Nuclei are active in autonomic, emotional, somatomotor, and associative processes – lesions of this area increase the tendency to learn tasks quickly and perform them more efficiently once learned
- \* loss of hippocampus = no cognitive recollection of the fear-producing stimulus
- \* loss of amygdala = no unconscious response to emotion-laden stimuli

### Brief History

James Papez (1937) proposed a cortical circuit that he thought was responsible for processing of feelings and emotions: The PAPEZ CIRCUIT

- the conscious (cortically mediated) aspects of emotion and the peripheral manifestations (hypothalamically mediated) aspects must interact.
- Additional research has modified Papez' view, shifting the role of coordination between hypothalamus and cortex from the hippocampus to the amygdala.



*The hippocampus is interposed between neocortex (through connections with the cingulate and parahippocampal gyri) and the septal-hypothalamic output core of the limbic system. Because the anterior thalamic nucleus projects to the cingulate gyrus, it plays a prominent role in hippocampal circuits, as does the mammillary body. The fornix is the major output pathway from the hippocampus, but carries some afferents as well. The mammillary body projects to the anterior thalamic nucleus through the mammillothalamic tract.*

## Control Connections

- Descending pathways from the hypothalamus & midbrain tegmentum to brainstem and spinal cord (ANS, reticular, somatic NS), via the stria medullaris and fasciculus retroflexus
  - affect: mood, affective behaviors, physical state (hypertension, tachycardia, sweating) via pituitary to endocrine system (hypophysis)
- Ascending projections from the brainstem to limbic structures via the Medial Forebrain Bundle
  - affect emotional and instinctive behaviors: Cognition = awareness of sensatio); Computation = analysis of experience in context of memorie); Conation = the desire / volition to take action

## Clinical Relevance

- Korsakoff's Psychosis (Amnestic Confabulatory Syndrome)
  - Characterized by anterograde and retrograde amnesia and anosognosia
  - Associated with chronic alcoholism (...thiamine deficiency)
  - Damage has been noted in mammillary bodies, DM thalamus, PAG
- Septal Rage Syndrome
  - Characterized by behavioral over-reaction to most environmental stimuli
  - Associated with lesions of the septal nuclei
- Dyscontrol Syndrome
  - Characterized by impulsive sociopathic behavior, intolerance of frustration, and violence with the patient reporting that he/she feels out of control and does not want to be violent
  - Associated with lesions of the frontal or temporal lobe
- Kluver-Bucy Syndrome
  - characterized by a loss of the ability to recognize objects visually and the tendency to examine all objects orally
  - associated with bilateral temporal lobectomy
- Hypersexuality
  - associated with lesions of the orbitofrontal cortex
- Perceptual Abnormalities (hallucinations) or Cognitive Derangements (delusions)
  - characterized by delirium or, for the latter, violent outbursts
- Disinhibition of emotional expression
  - characterized by pathological laughing or crying
  - classified as an organic brain disorder due to a lesion of the frontal cortex
- Placidity
  - characterized by indifference and lack of concern
  - consistent with a bilateral frontal leukotomy