LIMBIC SYSTEM

The limbic system operates by influencing the endocrine system and the autonomic nervous system



Components

- Amygdaloid body
- Hippocampus ("seahorse")
- Cingulate gyus
- Parahippocampal gyrus
- Hypothalamus
- Mamillary bodies
- Anterior nucleus of thalamus

Functions

- "Emotional brain
- Emotional and motivational aspects of behavior.
- Provides emotional component to learning process:
 - Especially the amygdala.

Associated with memory

Especially the hippocampus.

Associated with pain/pleasure, rage

The limbic system,.



The reticular formation,





- Entry of information to the limbic system is either
 - directly to amygdala
 - indirectly to hippocampal formation, via the entorhinal area.
- The limbic system , via the hpothalamus and its connections with the
 - <u>outflow of the autonomic</u> nervous system
 - and its control of the endocrine system (pituitary gland)
 - is able to influence emotional behavior .
 - Like reactions to fear ; anger ; sexual behavior .

- It is able to influence motor responses through projections to nucleus accumbens, which forms a part of the basal ganglia.

Amygdala

- Large nuclear group in temporal lobe.
- Afferents:
 - Olfactory tract
 - Solitary nucleus
 - Parabrachial nucleus
 - Limbic neocortex:
 - Cingulate gyrus
 - Parahippocampal gyrus

Amygdala Connections



Functions of the Amygdala

- Relate environmental stimuli to coordinated behavioral autonomic and endocrine responses seen in species-preservation.
- Responses include:
 - Feeding and drinking
 - Agnostic (fighting) behavior
 - Mating and maternal care
 - Responses to physical or emotional stresses.



Anterior Cingulate Gyrus Functions

- Emotion and awareness
- Mediates conflict between emotional desires and intellectual values
 - "wanting" and "likely harm or wrongness"
- Intellect control of emotion





Hippocampal Formation

Lateral View

Posterior View





Hippocampal Formation

- It consists of the hippocampus, the dentate gyrus and part of the parahippocampal gyrus.
- The hippocampus is formed by an infolding of the inferomedial part of the temporal lobe into the lateral ventricle.

- The dentate gyrus lies between the parahippocampal gyrus and the hippocampus. Anteriorly, it continues into the uncus .

- The hippocampal formation receives afferents from the inferior temporal cortex via the entorhinal area .

- It receives fibers from the contralateral entorhinal area and hippocampus via the fornix and hipoocampal commissure which consists of transverse fibers linking the posterior columns of the fornix on each side.

viewed in the floor of the inferior horn

of the lateral ventricle.

- The hipocampus is concerned with converting recent memory to long term memory (permits a link to previous experience).

-- The efferent fibers which converge on the ventricular surface of the hippocampus are called fimbria.

-They pass posteriorly then superiorly to become continuous with the crus of the fornix which curves forward beneath the splenium of corpus callosum.

-- The fornix is the principal efferent pathway from the hippocampus. It is C- shaped fascicle of fibers that links the hippocampus with the mammillary body of the hypothalamus.

- The 2 crura unite in the middle line to form the body which divides into 2 columns .
- These curve downwards forming the anterior border of the interventricular foramen then enter the hypothalamus.
- Most fibers terminate in the mammillary body .

Memory

- Memory is the storage and retrieval of information
- The three principles of memory are:
 - Storage occurs in stages and is continually changing
 - Processing accomplished by the hippocampus and surrounding structures
 - Memory traces chemical or structural changes that encode memory

Stages of Memory

Transfer from STM to LTM

- The two stages of memory are short-term memory and long-term memory
- Short-term memory (STM, or working memory) – a fleeting memory of the events that continually happen
- STM lasts seconds to hours and is limited to 7 or 8 pieces of information
- Long-term memory (LTM) has limitless capacity

STM to LTM include:

- Emotional state we learn best when we are alert, motivated, and aroused
- Rehearsal repeating or rehearsing material enhances memory
- Association associating new information with old memories in LTM enhances memory
- Automatic memory subconscious information stored in LTM

Categories of Memory

Skill Memory

- The two categories of memory are fact memory and skill memory
- Fact (declarative) memory:
 - Entails learning explicit information
 - Is related to our conscious thoughts and our language ability
 - Is stored with the context in which it was learned

- Skill memory is less conscious than fact memory and involves motor activity
- It is acquired through practice
- Skill memories do not retain the context in which they were learned

Structures Involved in Fact Memory Structures Involved in Skill Memory

- Fact memory involves the following brain areas:
 - Hippocampus and the amygdala, both limbic system structures
 - Specific areas of the thalamus and hypothalamus of the diencephalon
 - Ventromedial prefrontal cortex and the basal forebrain

- Skill memory involves:
 - Corpus striatum mediates the automatic connections between a stimulus and a motor response
 - Portion of the brain receiving the stimulus
 - Premotor and motor cortex

Mechanisms of Memory

- Long-term potentiation (LTP) is involved and is mediated by NMDA receptors
- Synaptic events involve the binding of brainderived neurotropic factor (BDNF)
- BDNF is involved with Na⁺, Ca²⁺, and Mg²⁺ influence at synapses

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