Limbic System, Olfaction and Memory

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Avinash Bharadwaj

Limbic System

- Limbic lobe and limbic system
- “Limbus”
  - Girdle around the diencephalon
- Lobe: hippocampus, PHG, cingulate gyrus
- System: Also includes Dentate gyrus, amygdaloid, septal area, mamillary bodies, thalamic nuclei

Limbic System

Cingulum and cingulate gyrus
Fornix
Ant nucl thalamus
Mamillary body
Hippocampus
Dentate gyrus
Amygdala
Parahippocampal gyrus
Hippocampus Etc

- Temporal horn of lateral ventricle
- Alveus
- Cell layers of hippocampus
- Polymorphic
- Pyramidal
- Molecular
- Fimbria
- Dentate gyrus
- Subiculum
- Parahippocampal gyrus
- Granule cell layer of dentate gyrus

Limbic System

- Memory
- Emotion
- "Preservation"
- The olfactory connection
- Visceral responses

Hippocampus & Connections

- "Entorhinal" cortex
  - Olfactory, cingulate, septal, hypothalamic inputs
- Opposite hippocampus
- Efferents to mamillary body + reciprocal
- Fornix...
The Hippocampal Circuit (Papez)

- PHG → Hippocampus → fornix → mamillary body → anterior thalamic nuclei → cingulate gyrus → PHG
- Integrity essential for memory
- Many smaller circuits
- Wide inputs

Learning and Memory

- Multiple memory systems
- Changes in neuronal circuits
  - Short-term memory
- Changes in membrane properties
- New protein synthesis and growth
  - Long-term memory

Memory

Categories not mutually exclusive

- Declarative memory
  - Events (episodic)
  - Facts (semantic)
  - Hippocampus, temporal lobe, diencephalon
- Procedural memory
  - Motor coordination
    - Striatum / cerebellum / motor cortex: Skills and habits
    - "Priming" (previous stimulus): Neocortex
  - Associative learning
    - Emotional response: amygdala
    - Skeletal muscle: cerebellum
  - Non-associative learning: Reflexes
Memory
- Facts and events
  - Short-term
  - Recall and consolidation
  - Long-term
- Hippocampal function
  - Associated areas
    - Fornix
    - Cingulum

Amygdala
- Emotion
- Defensive / offensive
- Fear / anger
- Sexual behaviour

Olfactory System
- Olfactory epithelium
- Olfactory nerves
- Bulb and tract
- Olfactory areas
Olfaction, Emotion, Visceral Responses

- Survival
- Recognition: threat, mate, food
- Memories
- Extremes of emotion
- Sights and smells

Temporal Lobe

- Parts of the limbic system
- Auditory area
- Part of the optic radiation

Disorders...

- This is not a list of disorders!
- Emotion, memory, sexual behaviour are very complex phenomena.
- Organic damage may be difficult to demonstrate.
- Neurotransmitter disorders
- Temporal lobe epilepsy
  - Aura
    - Olfactory hallucinations
    - Déjà vu
    - Fear
    - Autonomic phenomena
Disorders

- Anxiety
  - GABA and amygdala

- Depression
  - Amine neurotransmitters
  - Brainstem neurons with limbic connections
  - Drugs inhibit degradation or uptake of neurotransmitters

- Schizophrenia
  - Probable growth disturbance in limbic components