MEMORY

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- Memory refers to ability of brain to store and retrieve information,the necessary prerequisite for learning.

- Memory functions include

…holding information

…registration (encoding):getting information into memory e,g classifying books before placing them on shelf

…consolidation;process of stabilizing memory trace after initial acquisition

…storage;retention of information over time in memory

…retrieval;process of getting information out of memory stores to the conscious mind.

STAGES OF MEMORY

- Immediate memory (Working memory)
- Short term or recent memory
- Long term or remote memory.

- Depending on the mode of retrieval;memory is divided into:

a.Declerative /explicit memory

i)Episodic memory (remembrance of personal experiences at particular time and place)
ii)Semantic memory (facts,knowlegde of general information e,g meaning of a word)

b.Nondeclerative /implicit memory

Declerative is concious,intentional ,recollection of information and is dependent on hippocampus and medial temporal lobes for retrieval.

- Nondeclerative or implicit memory ;retrieval is automatic and unintentional and is reflexively and its retention doesnot involve processing in the hippocampus.It includes:

…procedural memory

…priming

…associative learning (classical conditioning)

- Immediate or working memory ….that actively holds pieces of transitory information in concious awareness,where it can be subsequently manipulated or used to perform the task
- An adult can retain 5-9 meaningful words in working memory
- Without rehearsal this information is lost in 18-20 sec
- Relies on prefrontal brain regions.

- Disorders of attention,focal lesions of superior frontal neocortex (8 & 9) and left frontal lesions cause profound impairement in working memory.
- Primary mechanism of working memory is executively controlled attention.
- Phonological working memory holds and manipulates verbal information .
- Visuospatial working memory holds and manipulates visual and spatial information.

Multi-component model of working memory:

4 component model Introduced by Baddeley and Hitch;

1.The phonological loop

2.The visuospatial sketchpad

3.The episodic buffer

4.The central executive

- The phonological loop:consists of two parts

..a short term phonological store

..an articulatory rehearsal component

the phonological store acts as inner ear remembering speech sounds where as articulatory process acts as inner voice and repeats the series of words to prevent them from decaying.

- The visuospatial sketchpad:is equivalent to phonological loop for visual memories .

- It allows the person to memorise the images of objects with its visual,spatial and kinesthetic components.

- The episodic buffer:

…can store more information temporarily

…can act as backup store which communicates with long term memory and components of working memory.

…recall of a paragraph comprising of 15-20 idea units .

…e.g is bus conductors ability to know which passengers on bus have already paid and which are newly arrived.

- The central executive:

…enables the working memory system to selectively attend to some stimuli and ignore others.

…determines what information has to be retained and to what storage it should go.

…it integrates and coordinates information in phonological loop,visuospatial sketchpad and episodic buffer.it has no intrinsic storage capacity.

- Disturbances of working memory produce difficulties in concentrating and performing new tasks including multistep instructions.

- Have problems with episodic memory because to transfer information into episodic memory it must be kept in mind by working memory.

- EPISODIC MEMORY

….explicit memory

…involved in storage and recollection of autobiographical events.

Components…

a.Items and objects (what)

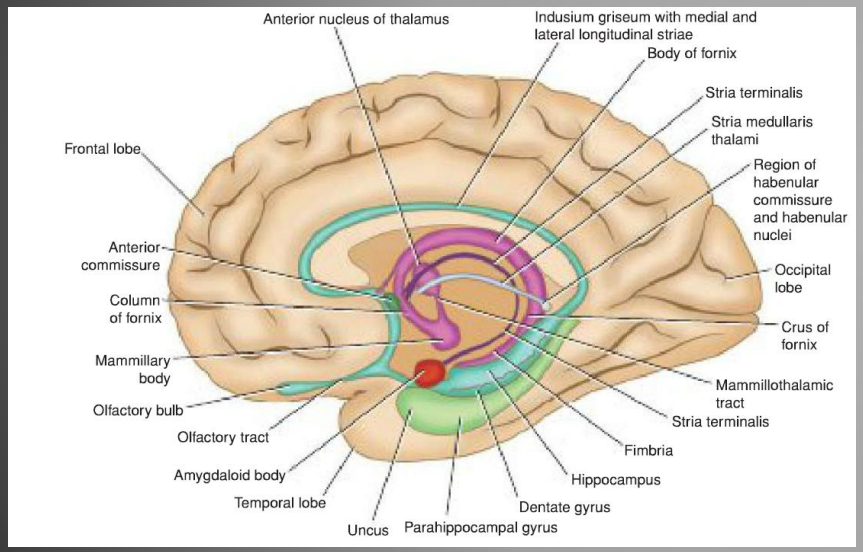
b.Spatial context (where)

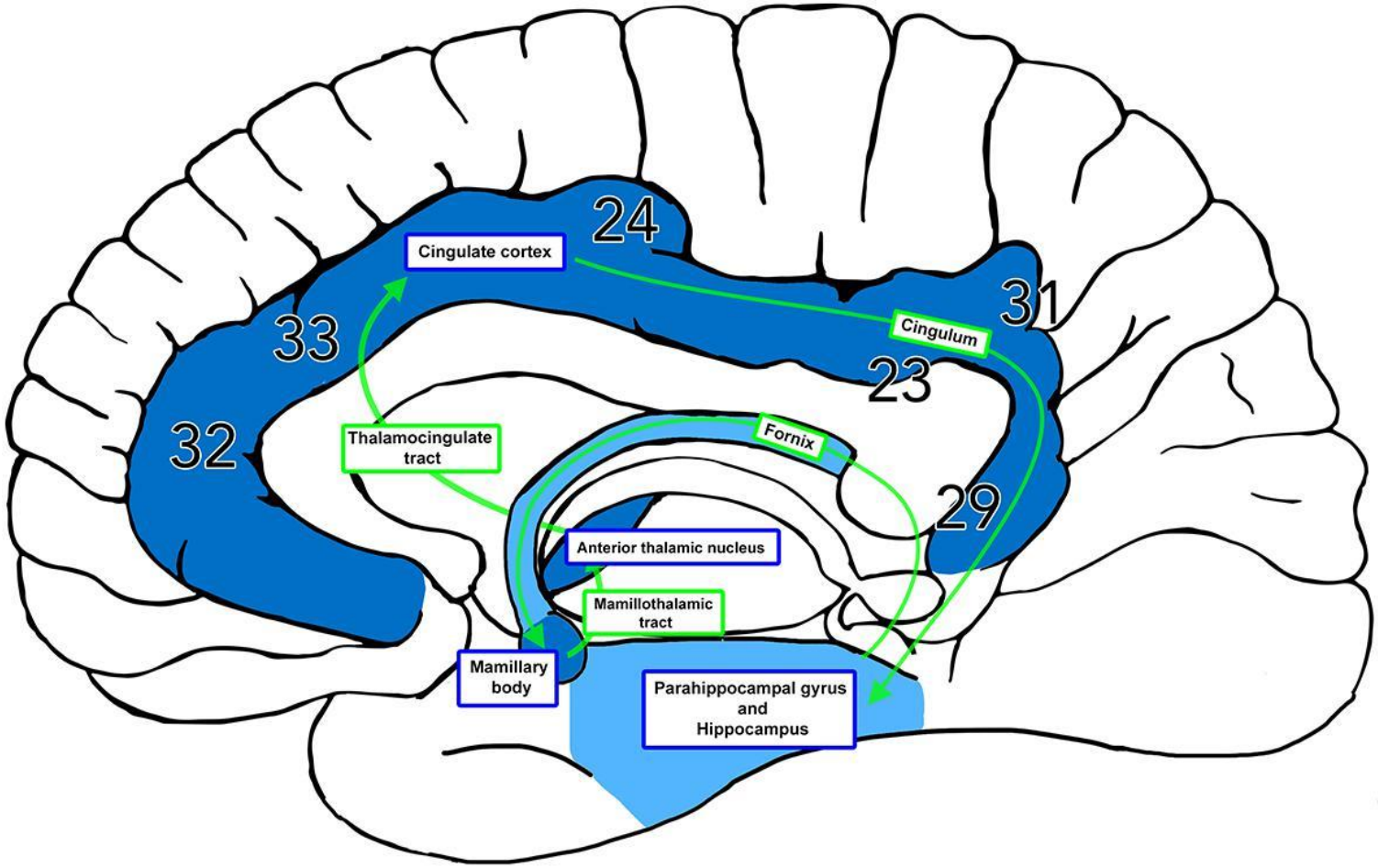
c.Temporal context (when)

d.Autobiography (I,myself,mine, we our)

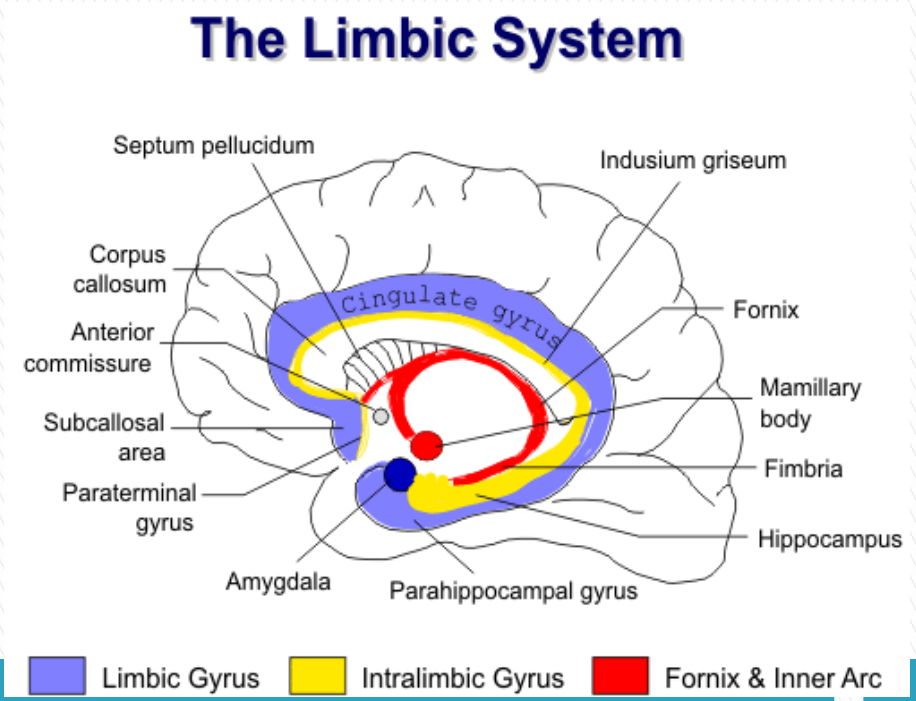
- e.g last year I and my friends visited the Sunderbans National Park in west Bengal and as described in National Geographic magazine, saw 5 white tigers there.

Anatomy of episodic memory

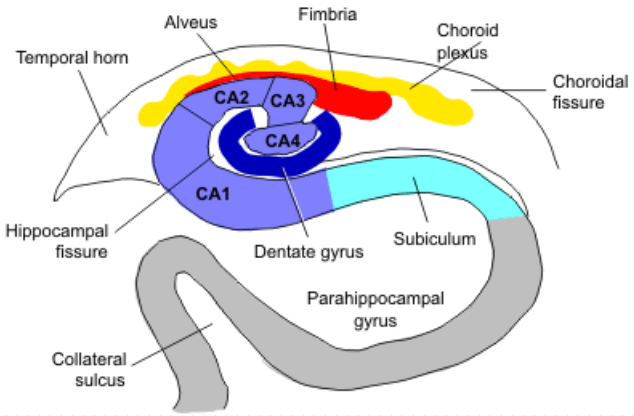


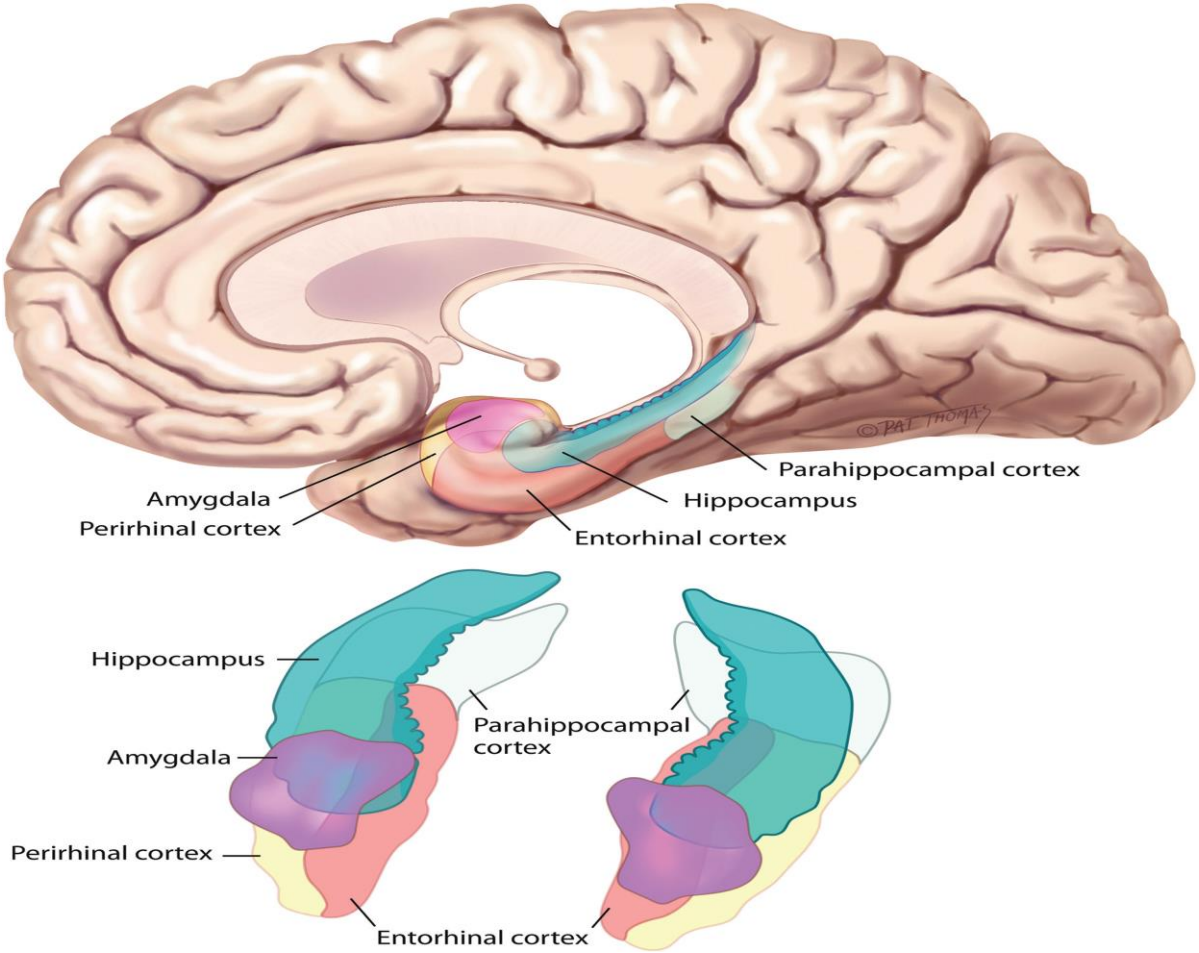

24
Cingulate cortex
31
33
Cingulum
23
32
Thalamocingulate tract
Fornix
29
Anterior thalamic nucleus
Mamillothalamic tract
Mamillary body
Parahippocampal gyrus and Hippocampus

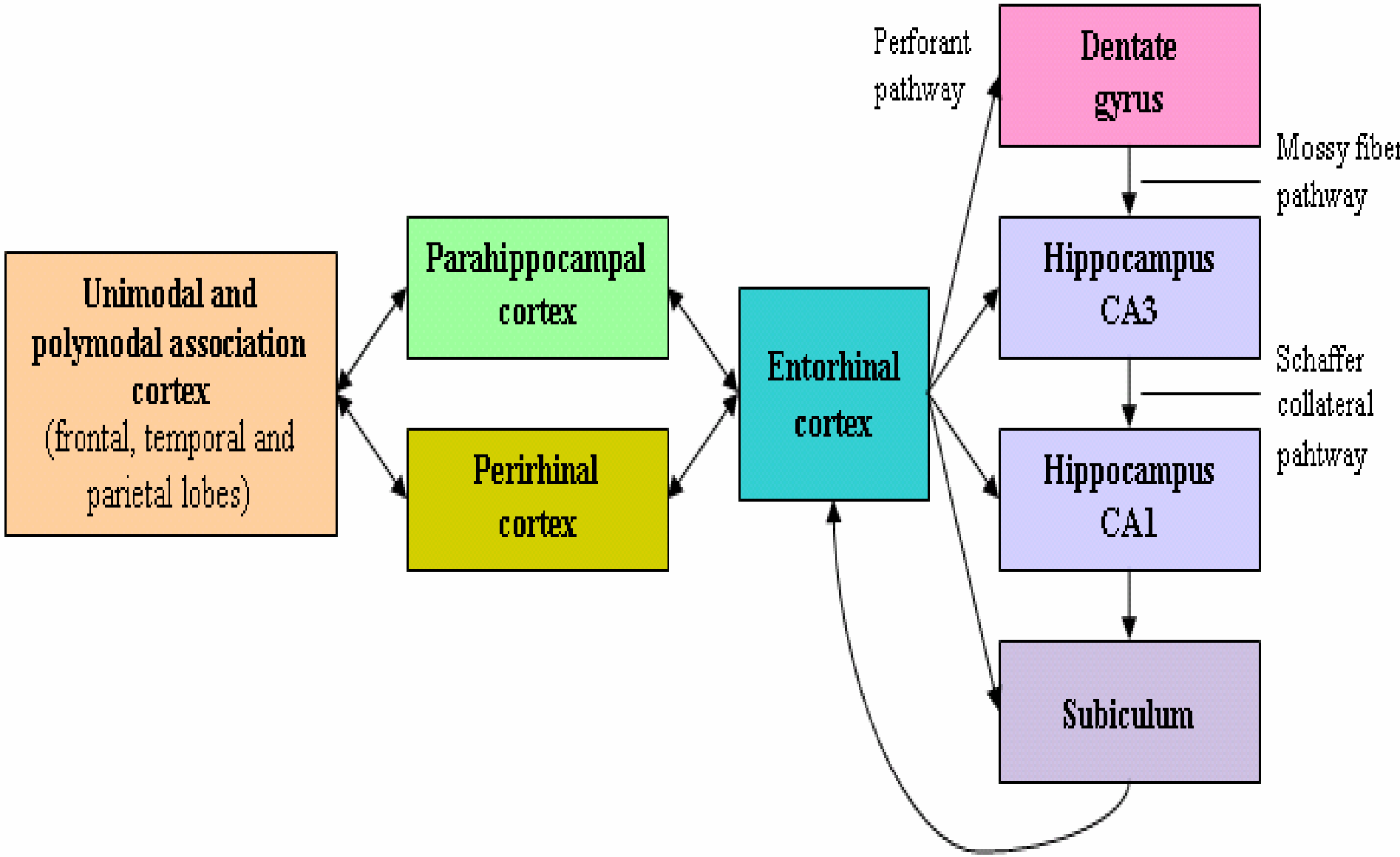
The Limbic System



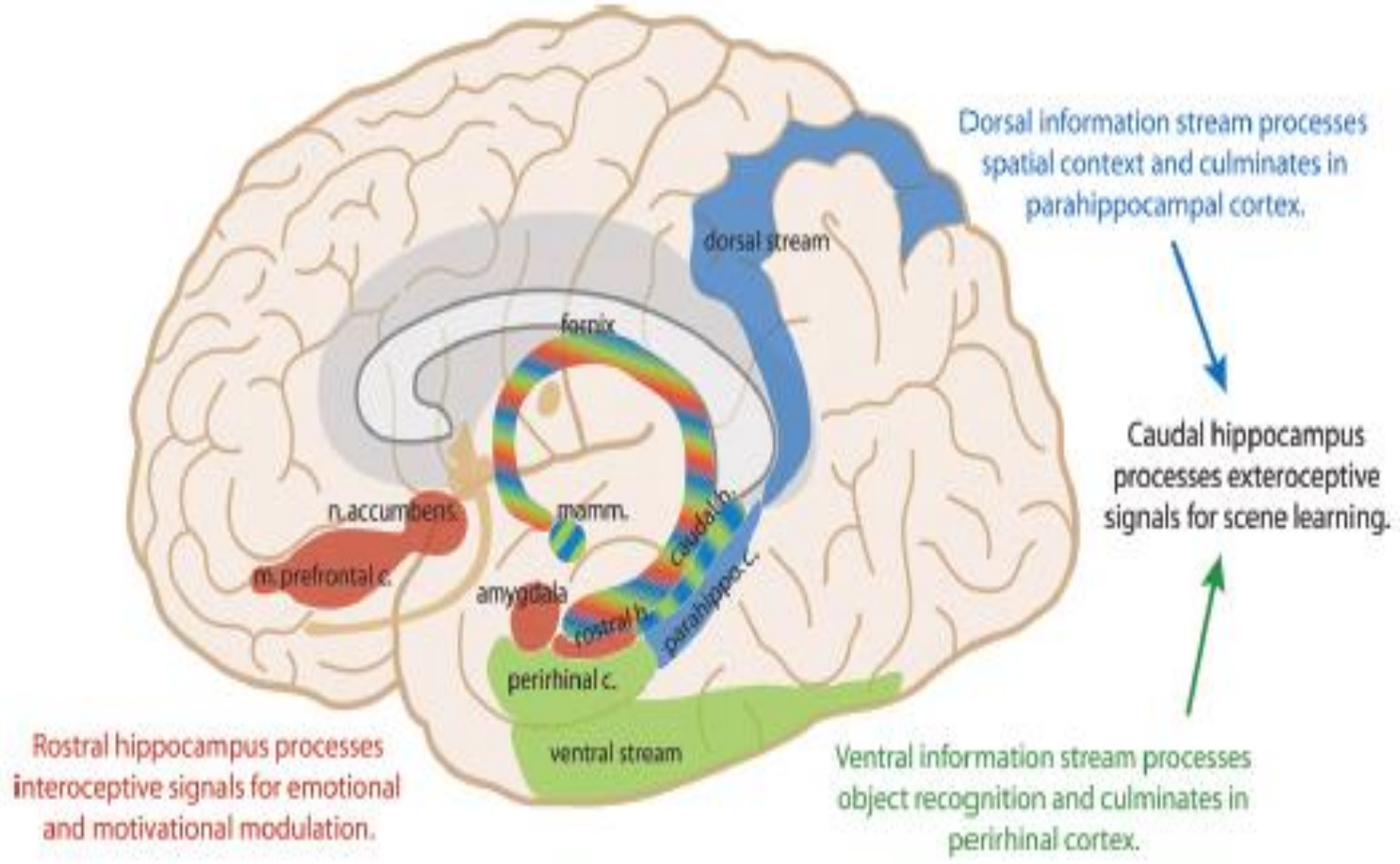
Hippocampal Anatomy




Amygdala
Perirhinal cortex
Parahippocampal cortex
Hippocampus
Entorhinal cortex
Hippocampus
Amygdala
Perirhinal cortex
Parahippocampal cortex
Entorhinal cortex


Unimodal and polymodal association cortex
(frontal, temporal and parietal lobes)
Parahippocampal cortex
Perirhinal cortex
Entorhinal cortex
Perforant pathway
Dentate gyrus
Mossy fiber pathway
Hippocampus CA3
Schaffer collateral pahtway
Hippocampus CA1
Subiculum

- the perirhinal cortex is crucial in signaling {what}information where as parahippocampus cortex in involved in {where} information.



G 4. Medial temporal lobe processing of exteroceptive and interceptive signals for memory formation. The ventral stream from the occipital be projects information about object recognition, while the dorsal stream from the parietal lobe conveys spatial information. The rostral terceptive signals convey emotions and motivations.

FRONTAL LOBES AND EPISODIC MEMORY:

Important for episodic memory esp for registration (encoding) and retrieval .it is involved in:

- Active retrieval of information
- Recollection of source of information such as knowledge of when and where something was learned
- Assessment of temporal sequence of events i,e placing events in the order they occurred.

- The frontal lobes are similar to the FILE CLERK of the episodic memory system
- The medial temporal lobes to the RECENT MEMORY CABINET
- Other cortical regions to the REMOTE MEMORY FILE CABINET.

Features of frontal lobe amnesia:

- Impaired free recall ,cued recall normal
- Source amnesia…important for source memory rather than the item memory.item memory will be normal.when asked to learn the separate list of items patients are impaired at detrmining if the word was on ist or 2nd list and not the actual recognition of items.in contrast ,temporal lobe amnesia is concerned with actual recall of items but not its source.
- Severe confabulation…associating memory with wrong context,incorrect temporal sequence and wrong specific details produce severe confabulation

LONG TERM STORAGE: two theories for long term storage of episodic memory

…consolidation

…contextual binding theory

Consolidation is thought to occur at cellular level and at system level

- Cellular consolidation refers to cascade of molecular processes that occur immediately after learning and stabilize the cellular and synaptic changes produced by learning.

- Systemic consolidation …memories will be forgotten unless they go through consolidation process that effectively transfers the content of those memories to the neocortex such that they are no longer dependent on hippocampus.

it occurs during off time periods during sleep .during which hippcampus replays previously encoded events to neocortex.

- Contextual binding theory….

….assumes that episodic memory is not consolidated to neocortex.

….assumes that hippocampus has a necessary and not just a temporary role in episodic memory.

SEMANTIC MEMORY…

- Explicit memory
- Factual knowledge includes memory of meanings,understandings,concept based knowledge and general knowledge about the world.
- Examples colour of elephant,presidents of countries etc
- Subject can continuously replenish such knowledge by reading and conversation

- Brain area concerned with semantic memory is inferolateral temporal lobe. E.g korsokoffs syndrome.
- It is also thought to reside in multiple cortical regions such as visual association area for visual memories and temporal cortex for auditory memories.
- Semantic memory also depends upon the frontal lobes for retrieval.

IMPLICIT MEMORY

- Retrieval is automatic without concious awareness.

1.Procedural memory…skills .

Areas involved are straitum,cerebellum and supplementary motor area.

2.priming..recognition of words and objects by prior exposure to them and is dependent on neocortex.

PHYSIOLOGY OF MEMORY

- Synaptic plasticity …short ant long term changes in synaptic function.
- Synaptic conduction can be strengthened or

Weakened.

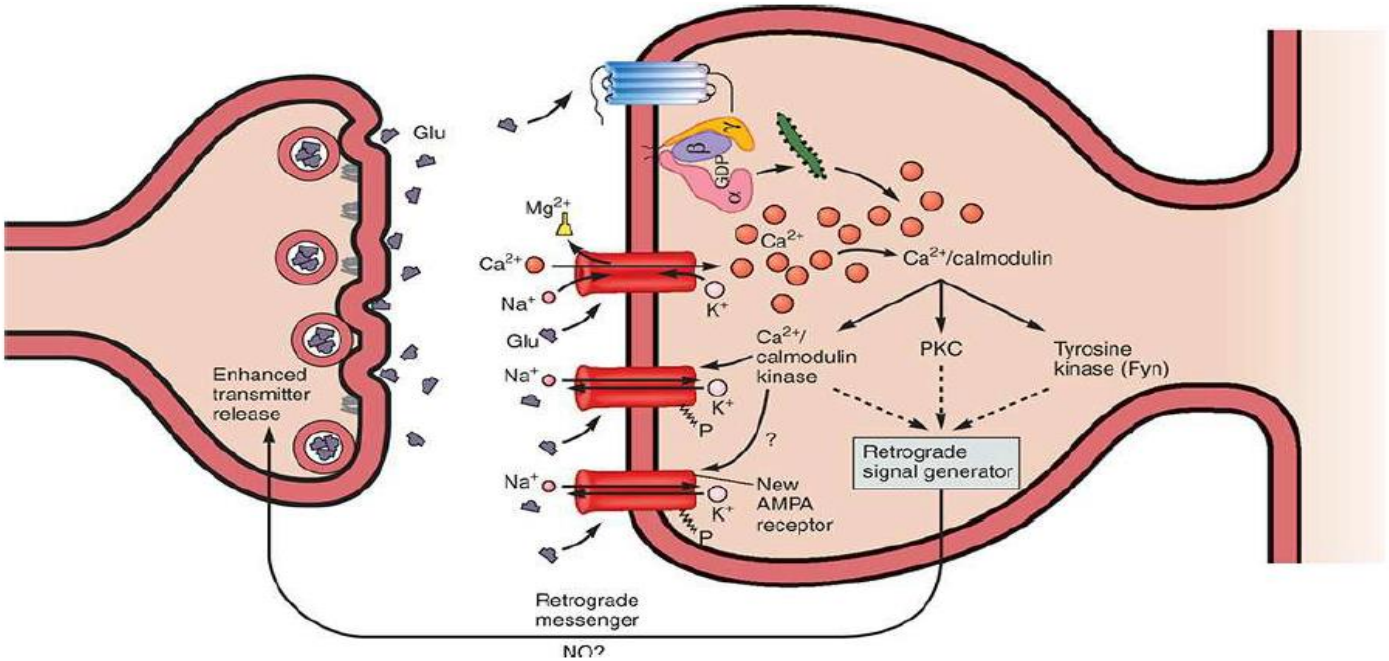


FIGURE 15–3 Production of LTP in Schaffer collaterals in the hippocampus. Glutamate (Glu) released from the presynaptic neuron binds to AMPA and NMDA receptors in the membrane of the postsynaptic neuron. The depolarization triggered by activation of the AMPA receptors relieves the Mg^{2+} block in the NMDA receptor channel, and Ca^{2+} enters the neuron with Na^{+}. The increase in cytoplasmic Ca^{2+} activates Ca^{2+}/calmodulin kinase, protein kinase C, and tyrosine kinase which together induce LTP. The Ca^{2+}/calmodulin kinase II phosphorylates the AMPA receptors, increasing their conductance, and moves

PHYSIOLOGY OF MEMORY:

- Involves electrical,neurochemical and structural changes in synapses and dendritis.

- Immediate memory information can be maintained by persistant neuronal firing for many seconds after the removal of stimulus.

spiking neurons are the basis for short term memory.

- Intermediate and long term memory require synaptic plasticity.
- Synaptic plasticity is ability of synapses to strengthen or weaken synaptic transmission.
- Short term plasticity lasts for milliseconds to minutes
- Transient accumulation of calcium in presynaptic nerve terminals which cause neurotrasmitter release.

- Long term synaptic plasticity (LTSP) creats long term stable memories.
- It is associated with structural changes within the synapse like the size of dendritic spine is increased.These are enlarged permanently.
- Two postsynaptic (dendritic spine) glutamate receptors NMDA and AMPA are involved in LTSP.

ASSESSMENT:valid memory tests presume that

…. patient is reasonably attentive

….can relate to and cooperate with the examiner

…has no defect that impairs language compehension or expression

- Immediate memory

…recall a memory after a trace interval of few seconds e,g repitition of series of digits.

- Recent memory

…after interval of minutes to hours e,g current date,detaits of breakfast.

- Remote memory

…recall of facts and events that occurred years previously

- Immediate recall (short –term)…tested by …digit repitition

- Orientation (recent memory)…orientation to time and place test the patients ability to learn continually changing facts.

- Test items…

1.Person…name,age and birth date

2.Place…location, city location and home address

3.Time …day,date,time and season

the only items sometimes failed by normal individuals are exact date.

…normal college graduates usually miss by 1 day

Where as normal people without high school education miss by day 2 or even 3 days.

- Remote memory:tested by personal information

….where were you born

…school information

…vocation information

…family history

- New learning ability..assesses the patients ability to learn new material .
- Tested by four unrelated words:

1.Brown
2.Honesty
3.Tulip
4.Eyedropper

- When a patient cant recall ,it is possible to obtain memory storage by the use of cues

…semantic cue (one word was color)

..phenomic cue (hon for honesty)

if patient cant recall but recalls if asked whether the color was green or brown ,it means there is no defect in acquisition or storage but retrieval.

- Scoring : normal individuals under the age of 60 recall 3 out of 4 words after 10 min delay

- Verbal story for immediate recall

Sensitive method of assessing short term verbal recall.

- Paired Associate Learning..highly sensitive measure for new learning ability

presentation lists

Weather-box

House-ncome

High-low

Book-page

Score..normal patient under 70 is expected to recall the two easy paired associates and at least one hard associates

THANK YOU