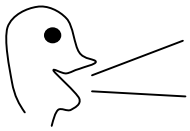
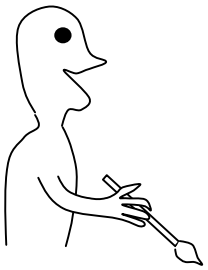
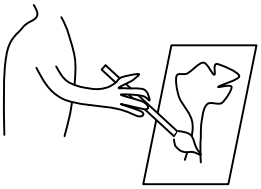
Declarative Memory
"Explicit"





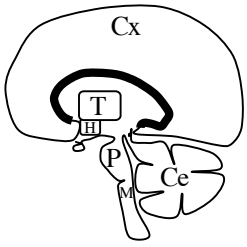
NonDeclarative Memory
Skill (& other)
"Implicit"

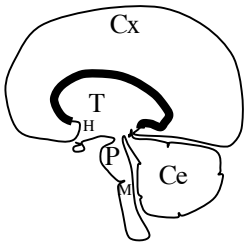


Cerebrum (cortex)

Thalamus
Hypothalamus

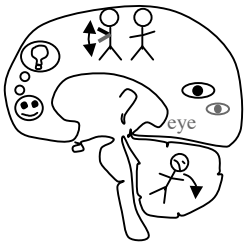
Cerebellum
Pons/Medulla

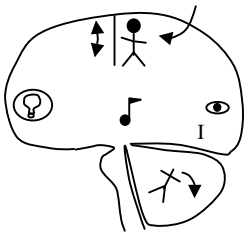




Motor cortex
Somatosensory Cx
Prefrontal cortex
Auditory cortex
Visual cortex
Text &
Shapes
Movement planning

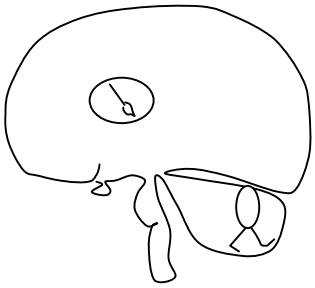
<u>Hat model</u>





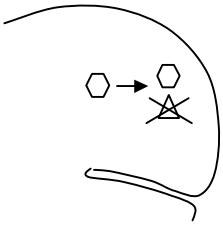
NonDeclarative Memory

1. Skill: Neostriatal Cortex



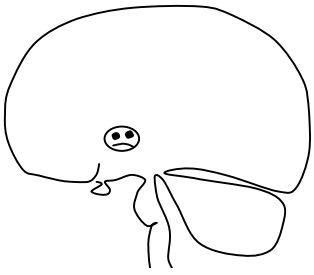
2. Skeletal: cerebellum

3. Priming & perception:
neocortex.



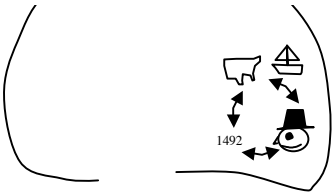
4. Emotional: amygdalla

(example: Simple Classical
Conditioning)



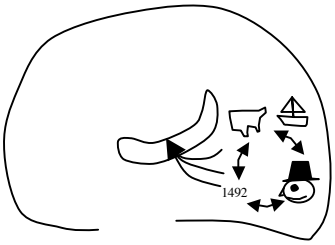
Working memory

Assoc. neocort. (minutes)

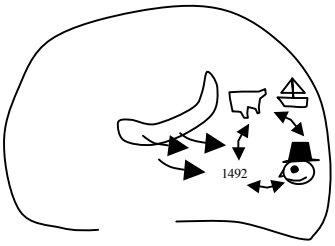


Creating Long-term memory

To Perirhin & Parahipp
--> entorhin
--> Hippocampus



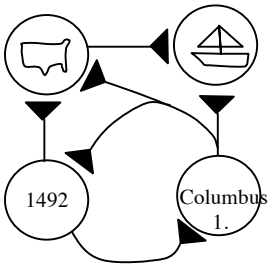
From Hippocampus
--> ER
-->Pe & Parahipp
--> Assoc. neocort



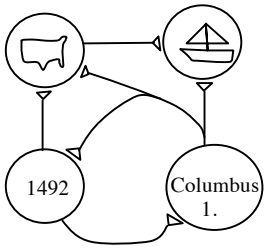
Formed Memory
(doesn't need hippocamp)

Strong

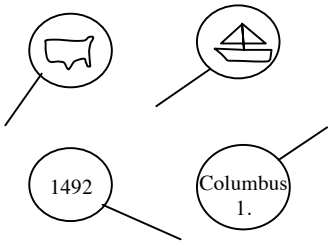
(Circles: neurons?
groups of neurons?)



Weak

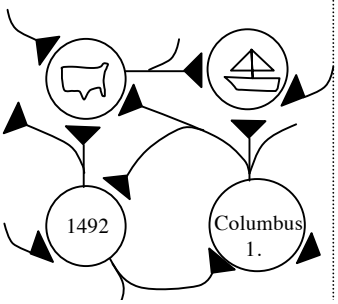


None

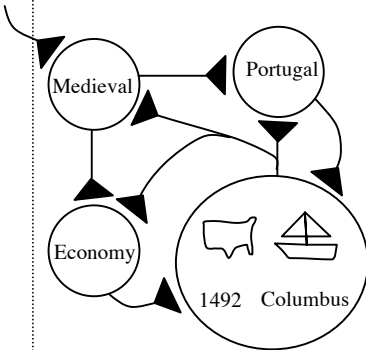


Expert
Chunking
Context

POOR:



BETTER:



Text to accompany minute sketches on working memory and formation of memory

A model for working memory, development of longer-term explicit memory, and strength of memories

1st sketch: working memory uses various parts of cortex; here shown is visual cortex and association cortex for Columbus' voyage to the New World. Working memory does not require the hippocampus and associated Entorhinal cortex and so on. Working memory elements can be processed to create long-term memory via the declarative memory pathway shown previously.

2nd sketch: When conditions engage long-term memory formation, this input to hippocampus results, after processing in the hippocampus, in output that 'consolidates the memory'. The output is via the same brain areas, in reverse order, to the cortex to create the long-term memory. Once formed and well-established, the long-term memory no longer needs the hippocampus in order to be recalled.

3rd sketch: First, how can we represent a declarative memory? Model/sketch here is for the same elements linked above as a "memory" starting with, in this case, "Columbus", which has links to the concept of a sailing ship, to the New World [represented by US map, here], and the year 1492. In this memory, one could start with Columbus to retrieve the entire memory, OR 1492 to retrieve the entire memory. According to the lines/triangles, this sketch indicates that one could NOT retrieve the memory starting only with an image of the US/New World or of a sailing ship, because this memory doesn't have connections in that direction. What do the circles represent? The circles COULD represent individual nerve cells [neurons], in principle. They probably are groups of cells that are themselves linked to form a memory of an image of a sailing ship, a year, and so on. Current evidence is fairly good that groups of linked cells such as these are activated to recognize a word or a person "Columbus", a shape within a broad category of shapes "sailing ship", a geographical area "New World", and a number that represents a year in history. Thus, each circle represents the group of cells that together hold the word/idea "Columbus" etc.. The lines from the circles to triangles represent a signal sent to another cell/group of cells. The triangles are the locations where the signal to the other cells are released/sent [the messages have a physical reality; they are chemical 'messengers' such as 'neurotransmitters'; more on these terms later]. A large black triangle represents a strong connection (e.g., a large 'synapse' or multiple synapses [an oversimplification]; more on this term later).

4th sketch: A weak memory differs from a strong memory in our representation by smaller, open triangles. Thus, weak memories are weak because they have fewer or smaller or less active connections ['synapses', again] to other cells (actually groups of cells). A person learning about Columbus' voyage for the first time would have this kind of weak memory. A person who is in the progress of forgetting or removing this memory would also have this kind of weak memory.

5th sketch: No memory at all. A person who never learned this memory could have in their brain all four of these elements: the New world, Columbus, dates in history, and sailing ships, and could know a great deal about each of them, BUT would have no connection between them. Hence, the idea of either 1492 or Columbus would never activate any of the other concepts.

6th sketch: If the sketches above were for a 'Novice' memory, what might be a representation of an expert's memory? I made two versions of the sketch. The first simply adds more connections to related areas. After creating that first sketch, I asked myself whether I had all of the important elements (including all of my terms), and realized that I did not.

So, I modified it in a 7th sketch that DID capture all of the important elements. THIS PROCESS IS A VERY IMPORTANT EXPERT-LEVEL SKILL IN MAKING GOOD FOLDED LISTS & MINUTE SKETCHES.

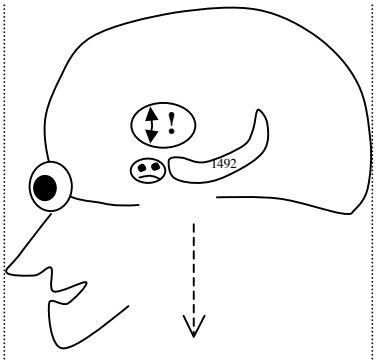
7th sketch (lower right corner of the page): I decided that an expert would have all of the ideas of 1492/Columbus/Sailing ship/New world in a single chunk, so I put all four in a larger circle (representing a larger and more complex network of cells—a chunk in expert memory). Next, I decided that an expert would link this chunk to other, equally complex chunks, such as Portuguese history (a novice might link to Portugal, but ONLY hold the name and location of the country), the late medieval period (a novice might have only the year, with no historical context for Europe), and to economic systems (a novice might link Columbus voyage only to the motivation of a search for gold or spices, where an expert would link to currency systems that use a 'gold standard' along with the benefits and flaws of such systems for developing productive industries, and to the reasons why spices commanded such high prices, relative to other goods).

Areas involved in
long term mem.

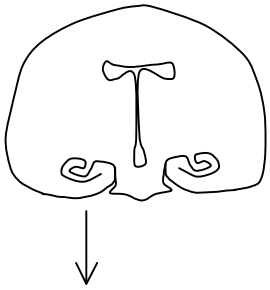
(neo)Striatum

Amygdalla

Hippocampus



Hippocampus

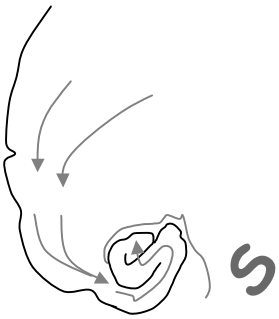


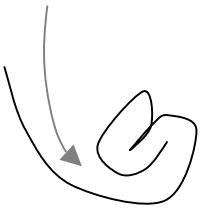
Declarative Memory
(Brain view: cross section)

Cortex (vis/aud/…)

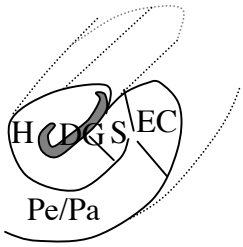
Perirhinal cortex
Parahippocampal cortex

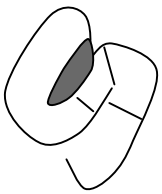
H/DG/Sub
Entorhinal cortex





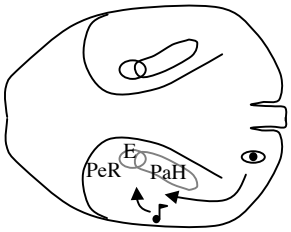
Hippocampus
Dentate Gyrus
Subiculum
Entorhin Cort
Pe/Pa cortex





Hand model or S model!

Amyg & Hip



Entorhinal cortex
Perirhinal cortex
Parahippocampal cortex