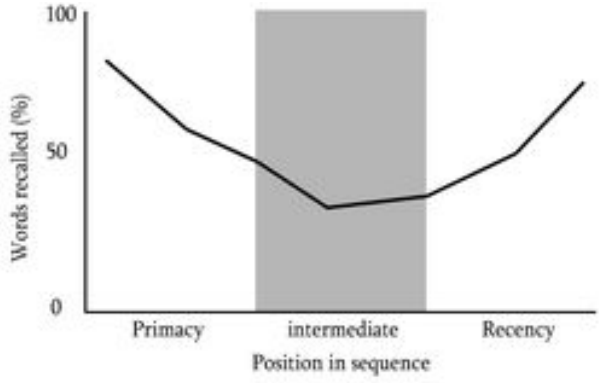
HUL763 (COGNITIVE PSYCHOLOGY)

SANKET SANJAYPANT HIRE (2016CS50402)

Working Memory

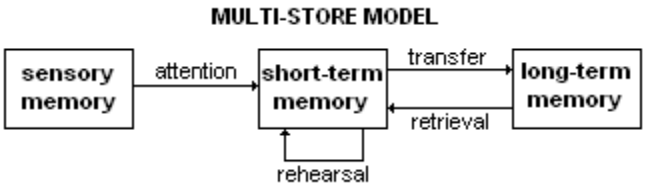
Working Memory was presented because of the fact that Short Term Store (STS) was problematic in many reasons. Since, Idea of Short Term Memory is a limited capacity store with 7 plus/minus 2 items, as the maximum entitlement of item and also for a time duration of 20 seconds; this proposed a number of problems.

The First Problem that it posed is that the Short Term Store limits the number of information(items) that can be stored in memory. Also, in a standard serial position curve, people should not be able to retrieve items in the middle of the list.



Here, the items in the intermediate portion of curve should not show any kind of better recall. And information familiarity plays a better role here in the betterness of remembrance.

Also, in terms of interference, for example auditory item (auditory cue or auditory test item) and a visual test item when they were presented to the people in STM or where the people were asked to remember these 2 items (auditory and visual), people were not showing any kind of interference. So, the fact of the matter was that the STM was a little more than it was perceived into the Atkinson & Shiffrin model.



The Atkinson and Shiffrin model states that the memory is a 3-part system which starts with sensory register(memory) and then followed by short term memory and then followed by the long term memory.

These 3 memory modules are called “stores” in the Atkinson & Shiffrin Model. The Atkinson & Shiffrin Model also defines certain control on active processes which move the information either from one store to another or move information out of these stores. It also discusses “Attention” which makes information move from the Short Term Register to the Short Term Memory and from the Short Term Memory the information is moved to the Long Term Memory depends on a process which is called a “rehearsal”. So, this is how the items move from one store to another. Also, decay and interference are the 2 phenomena which happen in terms of long term memory as well as the short term memory.

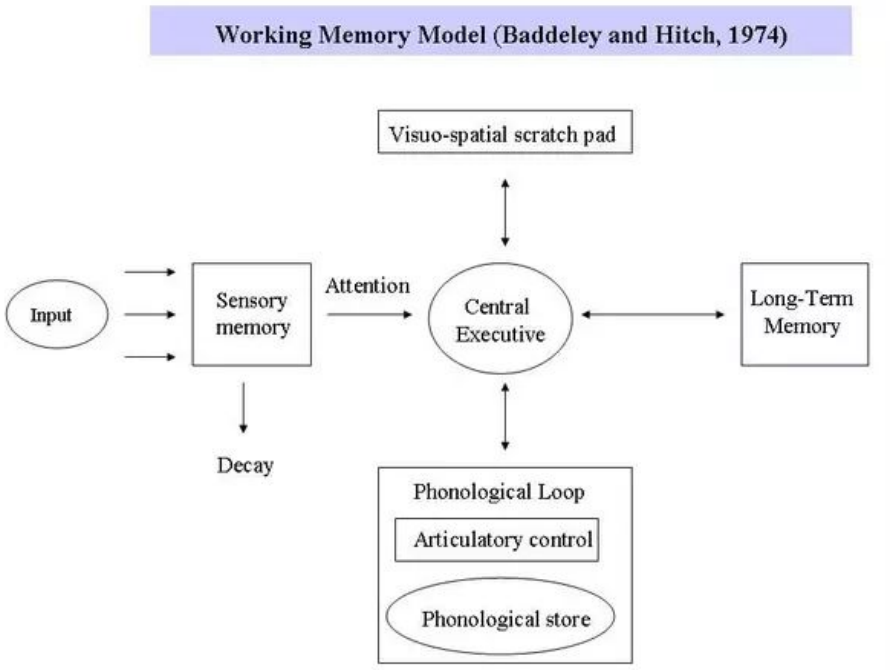
So, we basically look at 2 positions we look at -
(1) interference and
(2) in terms of items in the middle of the list or those items which people are familiar with (they showed higher amount of retrieval or certain type of rules of remembrance which required the activity of the LTM, those somehow went ahead and, help people in terms of the memory.)

With this conceptualisation, another kind of store perceived and thought of was called the working memory store. So, the information processing model of Atkinson & Shiffrin (1968) describes the information processing as being a two part process -

(a) The information representations being stored called either as “STM/LTM”.
(b) The structure storing it describes as “STS/LTS”

These authors (Atkinson & Shiffrin) conceived STS not only as a store for 7 or fewer pieces of information for a few seconds but found that the information in STS somehow activates relevant information from LTS and gathers some of this information into STS.

The problems caused by the Atkinson & Shiffrin Model as mentioned above led to the emergence of a new kind of store(memory) system which was developed by Baddeley and Hitch in 1974.



Baddeley & Hitch (1974) performed a series of experiments to test the working memory model. The design was to have participants temporarily store a number of digits while simultaneously performing another task such as reasoning or language comprehension. The hypothesis was that if the STS capacity is taken up by stored digits fewer resources are available for other tasks so the performance on the other tasks suffer. For example, if 2 kinds of tasks are given and one task is being stored onto the STS or short term store, then what happens is that the next task given to you, if it is a multidimensional task paradigm. And if a second task is given to you, then that second task will not be processed. Or else if the task will be processed the performance will be really bad. Further, let's discuss the Baddeley & Hitch's task.

Reasoning Task with Letter Recall

In this task, people had to keep some letters stored (a number of digits.). So, a 6-digit or 8-digit frame was what the people had to store onto their memory. So, they had to remember these 6 digits for a 6-digit frame. For example, let's say the digits in 6-digit frame are {2,8,6,4,3,7} and

people were asked to commit to memory this particular kind of system. Or people can be given another kind of logical decision-making task. For example, the letters “AB” are presented to the people;

Now, what people are required to do while holding onto this 6 or 8 digit task into memory is basically tell us as quickly as possible verify the statements -

Given - “AB”	
“A” precedes “B” ?	True or False
“B” is preceded by “A” ?	True or False
“B” does not precede “A”.	True or False

Reasoning Speed and Letter Recall

Result of the experiment says that, if the number of digits held in memory are between 2 to 3 then the performance of the people on the letter verification task (“AB” verification task from above) was similar to what was there if no digits were given to people. So, 2 groups of people were there -

1st group → a control group has no digit to keep in memory and then do the sentence verification task or letter verification task and

2nd group → people had 2 or 3 digits in their memory and were needed to do sentence verification tasks or letter verification tasks. Whereas, it was found out that the number of digits that has to be kept in the memory was more than 6, then the performance went down.

Some interesting results were found out like, if the negative sentence was used like this : (“B” does not precede “A” → True or False) or if the negative sentence was used like this : (“B” is preceded by “A” ? → True or False), the verification task was lower or somehow less still leading to poor performance.

Experiment 1 :

0, 1, 2 items preloaded → reasoning task → letter recall

Experiment 2 :

0 or 6 items → reasoning task → letter recall

Results of Experiments performed were :

Table 4-3 REASONING TIMES AND LETTER RECALL UNDER VARIOUS MEMORY LOAD CONDITIONS

Experiment 1

	Memory load (number of letters held in memory)		
	0	1	2
Reasoning times	3.20 sec	3.31 sec	3.31 sec
Letter recall	Essentially perfect		

Experiment 2

	Memory load		
	0	6	
Reasoning times	3.27 sec	3.46 sec	"Equal stress"
Letter recall	5.5	3.7	
Reasoning times	2.73	4.73	"Memory stress"
Letter recall	5.8	5.0	

Note: In both experiments, a memory load of 0 was a control condition. In these conditions, subjects performed the reasoning task, and only then were they given the set of letters for the memory span task. Thus letter recall of 5.8 in the 0 Memory load condition means that 5.8 letters were recalled immediately after their presentation, where presentation followed the reasoning task.

Adapted from Baddeley & Hitch, 1974.

So, Baddeley & Hitch found out that the 2 codes which are different - one is the logical code and the other is the digit code. Now, if the 2 codes are different, then with lesser number of items (digits) to be stored, the performance was not getting poor or not hampering in anyway.

This suggests to us that, the way STM is conceived in the Short Term Store, that if the number of digits are more, there will be poorer performances. That means the Short Term Store as conceived by Atkinson & Shiffrin is a store which holds onto the similar kind of 7 acoustic code in acoustic code form, similar kind of 7 plus or minus 2 items was not true.

Baddeley (1991) found out that there was no common system for cognitive processes.

Also, the fact that Memory load does not disrupt the performances. Which means, if lower memory load are given (i.e. if 2 tasks are given and if 1 task requires some kind of a memory load or a given little memory load), then the performance on the second task was not hindered in anyway.

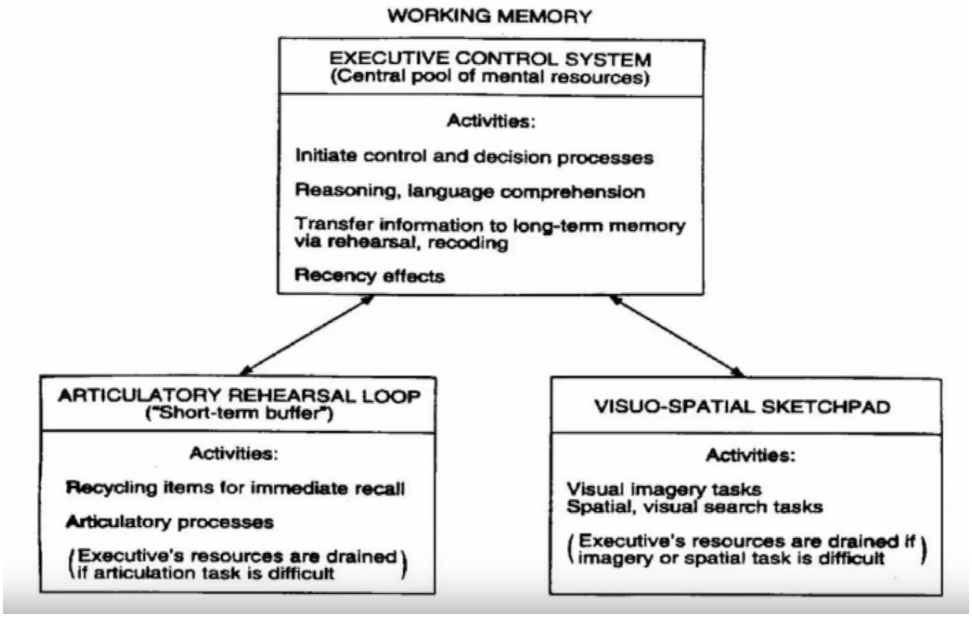
From the results figure, it is observed that if the load was more then the reasoning time and letter recall was higher in both the “equal stress” and “memory stress” cases.
Also, it is observed that when the memory load (number of letters held in memory) were 0, 1 and 2 → the reasoning time was very less (nearly 3.31 seconds).

But, as the load increased, the number of times almost increased to 5 seconds for reasoning. This demonstrates things that -

(a) Parallel task processing can happen in the STM store as per Atkinson & Shiffrin.
(b) STM is a limited capacity store.
(c) Multiple Tasks and Interference can also be processed as per the experiments upto certain extent.

Baddely and Hitch Model gives important factors about STM such as STM can talk to LTM and at the time of processing can borrow the rules from long term memory (that’s how the verification happens).

Baddeley Working Memory Model



The working memory model contains -

(a) Executive Control System

(b) Articulatory Rehearsal Loop

(c) Visuo-Spatial Sketchpad

Other than these systems, it contains an Episodic buffer of WM (Baddeley, 2007, 2000) which is defined as a limited-capacity storage system responsible for integrating information from various systems of WM (eg, phonological loop, visuospatial sketchpad) and for activating long-term semantic and linguistic knowledge, into a coherent whole.

Here, the working memory attention processes reaches the central executive which is a flexible system responsible for the control and regulation of cognitive processes. It directs focus and targets information, making working memory and long-term memory work together. So, the attentional process in different modalities reaches the central executive of the working memory. The Executive takes the information from the short term store and then manages this information by redistributing it to the 2 substores - namely

(1) the phonological loop or the articulatory rehearsal loop and

(2) the visuo-spatial sketchpad

Information which is verbal or auditory in nature is pushed onto the articulatory loop. Whereas, information which is spatial in nature, which requires a visual medium is pushed onto the visuo-spatial sketchpad.

If a task requires people to do reasoning, language and comprehension then in those cases, central executive comes into focus and does its functioning. This is done by executive by talking to the LTM through an episodic buffer.

Central executive also transfer information to long term memory by rehearsal and recoding. So, whatever answers we get from the control processes which have been borrowed from the LTM and the information which is inputted to both the articulatory loop and the visuo-spatial sketchpad when makes some kind of meaning or if it needs to be stored through a process of rehearsal it is transferred to LTM.

The Effects like recency and primacy are also verified by the central executive.
Now the central executive takes in the auditory information and pushes off this information into the phonological loop. The phonological loop has an idea of subvocal rehearsal. So, it does auditory rehearsal. Short term stores only talk about the auditory codes, but then the working memory does not only talk about auditory codes, it also talks about image code.

The phonological loop has auditory code as the way of remembering things. And so, the information which is passed on or the STM if it is the auditory nature is pushed from the working memory onto the phonological loop and then this item is rehearsed back in terms of subvocal rehearsal.

The phonological loop model advanced by Baddeley (1986), consisting of a short-term store and a subvocal rehearsal process, is the most influential current account of verbal short-term memory. Convergent evidence for the model is provided from a range of research traditions including experimental cognitive psychology, developmental psychology, neuropsychology, and neuroimaging. A similar diverse range of findings indicate that the phonological loop plays a key role in vocabulary acquisition (Baddeley et al., 1998; Gathercole, 2006).

The visuospatial sketchpad (VS) is the section of one's normal mental facility which provides a virtual environment for physical simulation, calculation, visualization and optical memory recall. It is important to note that the visuospatial sketchpad is part of the working memory, and it holds the information it gathers during the initial processing of it and if it is retrieved later from the long-term memory, to produce the recollection of an image (a place, someone's face, etc.)

Visuo-Spatial Sketchpad

The degree of development and usage of the VS varies greatly from person to person. Some people use their visuospatial sketchpad often in normal thought processes, while others use it very little. It can be developed with practice using visualization and conscious effort, though everyone has their own limits of both patience and aptitude. As with all other aspects of memory, the more one tries to use the visuospatial sketchpad, the easier it will be. The mind can be "trained" to strengthen the response, and by doing exercises of visual recall, one can strengthen the VS to produce much sharper, clearer images on demand. Overtime, the recollection of one image can change from a general recall to one with crisp detail through practice and patience.

Logie's elaboration of the visuospatial sketchpad.

Logie has proposed that the visuospatial sketchpad can be further subdivided into two components:

(1) The visual cache, which stores information about form and color.
(2) The inner scribe, which deals with spatial and movement information. It also rehearses information in the visual cache and transfers information to the central executive.

Three main findings provide evidence for the distinction between visual and spatial parts of the visuospatial sketchpad:

(1) There is less interference between visual and spatial tasks than between two visual tasks or two spatial tasks.
(2) Brain damage can influence one of the components without influencing the other.
(3) Results from brain-imaging show that working memory tasks with visual objects activate mostly areas in the left hemisphere, whereas tasks with spatial information activate more areas in the right hemisphere.