Lecture – 18
Memory Short Term Memory – Storage and Retention

Till now we have talked about iconic memory. Let us now move to the other form of sensory memory that is echoic memory. In case of iconic memory, we discussed that the total amount of information that can be retained is little more, but in terms of duration it had relatively shorter period compared to echoic memory because echoic memory can hold information up to 4 to 5 seconds.

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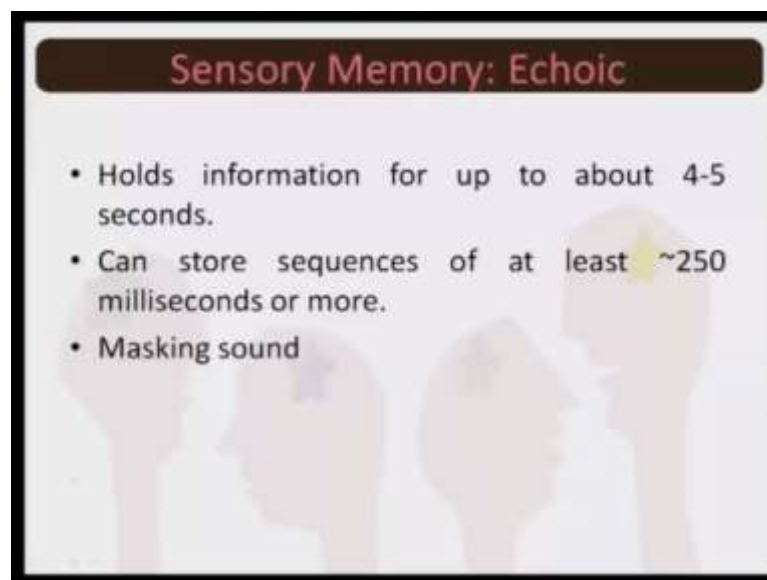
And furthermore it can also store the sequence of at least 250 milliseconds or more. Now recollect what we talked about in the previous lecture and this has done with the way we have talked about issues in case of sensation. We said that ear, specially the inner ear which has the fluid filled in the cochlea has the nerve endings and because the ripples that are created it takes little longer time to settle down. Therefore by default the amount of information that will be held at right at the level of the sensory modality will be little longer. Because in the previous case, in the case of eyes it was basically the sis to the trans configuration and back to the sis configuration, which was now basically facilitating the storage of information.

Where as in the case of echoic memory, it is the settling down of the ripples that is created in the cochlea and therefore we realize that in terms of the auditory impulse that we receive from the external world, the amount of information even though it might be less, compare to what we retained at the level of eyes, but in terms of duration we have much more longer life compared to iconic memory for auditory information, but the problem is because both of them have very limited period of time, Iconic memory for 1 to 2 seconds, Echoic memory for at max 4 to 5 seconds, the chances are that if you have a stimulus of the same intensity that enters the ear then there would be a muscle. You remember even in the case of iconic memory we say that brightness and pattern masking are possible even at the level of the sensory modality.

Similarly, here in the case of echoic memory the sound masking can take place and this becomes a barrier. Because it will not allow you to listen to what you call the purest form of the auditory impulse and retain it for a maximum of 5 seconds. Having discussed echoic and iconic memory, let us just now make comparison between the two. Iconic memory, in terms of duration it just 1 to 2 seconds, whereas echoic memory in terms of duration it is 4 to 5 seconds.

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So the life of echoic memory is little longer compared to iconic memory, but the advantage in the case of iconic memory is that, it can store, it can retain relatively longer amount of bit of information.

So, approximately somewhere between 11 to 16 items can be held in terms of iconic retention. Echoic retention the moment you have now two sounds of equal intensity masculine will take place. Now having talked about sensory memory, let us now go to the other form of memory that is the short term storage, the short term memory. Now in terms of life short term has much more longer life compared to the sensory memory.

Iconic just 1 to 2 seconds, echoic just 4 to 5 seconds, but short term can store information for approximately 30 seconds. So, 20 to 30 seconds is the elastic time limit for which information can be stored in the short term memory. This would mean get after end of 30th second, either the information which is at the level of the short term memory would trickle down go to the long term storage or it will be basically replaced,it will be flushed out by the incoming information and we saw in the comprehensive model of memory that loss of information takes place from all the 3 channels.

So, sensory memory, short term memory, long term memory from everywhere we have now loss of information, but in case of short term storage either the information moves on to long term storage or the information is lost and replaced by that incoming information, but you also interesting about short term memory is that the information that comes to short term storage is encoded.

In acoustic format say speech, sound, visual images, words they constitute, the code that is retained by the short term memory. Because these are meaningful things, speech has it meaning, sounds might have meaning, visual images would represent something and words which is again not nonsense syllables.
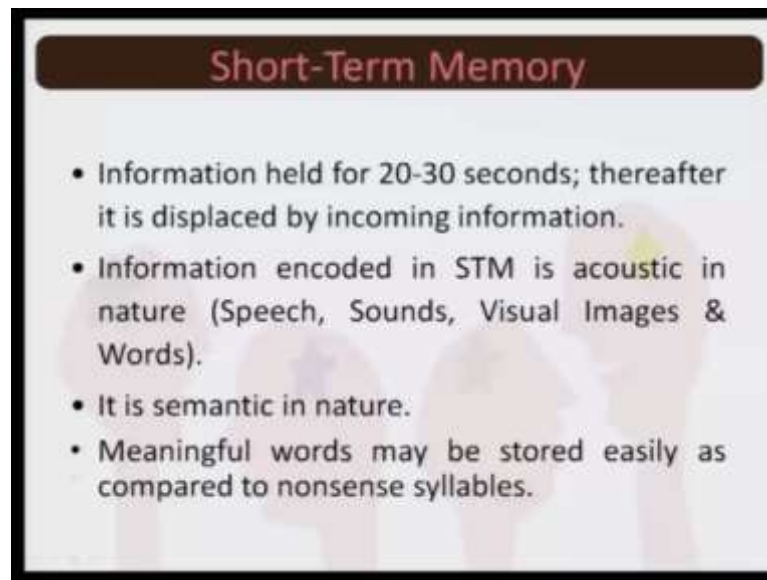
So, because it is word therefore, it would carry some meaning therefore, the information that comes to short term memory, it is largely semantic in nature, it is meaningful in nature and because meaningful words, meaningful symbols, meaningful sounds, allows you to process it in a different way compared to when you have nonsense syllables or you have thinks which are completely devoid of meaning. So, the movement you start elaborating it, you remember the (Refer Time: 06:36) know. So, perceptual level of analysis, structural level of analysis, semantic level of analysis, all of them had different impact on memory. So, if we go for meaningfulness then by default you elaborate the information, because you elaborate the information therefore, semantic things meaningful things will have a longer life compared to meaningless things.

There are the whole lot of research in psychology comparing meaningful words with nonsense syllables and there it has been uniformly realized, that meaningful words, they have stronger storage compare to the nonsense syllables. This thing is you know pretty obvious say for instance, if you are told rose, it is much easier for you to have a mental image of rose and there by remembrance of the word rose will be little longer compared to let us say XTPY which is nothing but four distinct alphabets that have been a temporally presented very neck to neck, because it has been pronounced altogether therefore, you might try your best recollect it, hold it for little longer, but then it is extremely difficult if such information, such set of nonsense syllables are presented to you in a sequence. What has further been realized in case of short term memory is, that if

you have a longer piece of information then the possibility is that you might break it into smaller chunks.

Now, think of a situation, you are given a number, a number which is, it has long-long chain of numerals. Let me show you this example and then I will come back to the discussion on (Refer Time: 08:40)

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Now look at your screen, I am writing certain numbers. If I ask you to memorize this number and retain it at least for 30 seconds because that is the duration of short term memory. Now if you start now memorizing each of them, you have longer chain now. So, you have total 14 digits here. Now if you want to memorize it as 14 different set of information, you are putting your short term storage in a big problem. Usually what has been realized that most of us either form chunks of 2 or 3 bits of information.

So, those who would form chunks of 2, would do something like this 6 5, 4 6, 5 1, 1 5,1 1, 3 1, 3 1 now this 14 basically becomes 1 2 3 4 5 6 and 7. So, simple 7 chunks now this is something that very easily your brain can store. You would realize that there are people who form chunks of 3. So, they would do something like this. So now you have one two three four and just five chunks life becomes much simpler. So, if I have to recollect the number it becomes very easy for me. Why it becomes easy for me? Because I am now trying to now memorize the number in terms of chunks.

So, I say 6 5 4 6 5 1 1 5 1 9 3 1 3 1 it is much easier. You would realize, that say for instance take when you have to recollect the mobile number which is a ten digit number in our country. If you have to memorize that number how do we do that and you would realize that even if you take your own example perhaps you do not remember more than three four mobile numbers. You remember mobile numbers of only those which matters to you, parents, siblings, best friends, something like that. Now what we do that if we have a longer set of information, we break it into pieces and these smaller forms of information, which is either I said know you can combine two of them or you can make a chunk of 3 bits of information, 4 bits practically you will not find people using 4 bits.

Now, things become much easier and therefore, it has been realized that somewhere between 5 to 9 chunks can very easily be stored in short term storage. So, 9 chunks may will primarily mean that 9 into 3, if you are making a chunk of 3. So, 27 bits of information you are basically able to store for approximately 30 seconds. Similarly in children say if the minimum span is going to be 5, then 5 3's are 18. So, 18 bits of information a child can also store and then in terms of say if the number of items, now that we are extending that say there could be possibility of forming chunks of 4 then you realize that approximately research is show the 40 items can be stored forty discrete items broken into chunks an accordingly the chunked information when you recollect it when you store it, you realize that 40 distinct item can be stored right at the level of short term memory.

So, if you compare iconic versus echoic. So, the maximum that sensory memory could provide was at the level of iconic memory with eleven to 16 items, here is short term memory we go up to 40 items. So, this is the huge jump now, both in terms of pieces of information and also in terms of that temporal duration of the stay of information.

 Now two things are very interesting in short term memory, say for instance if you are given a list, a list which has say 20 names of people who can be your friends, you are told the list, you here it and then you are told to remember the nomenclature say for example, I Ramkumar, Vishwakarma, Pradeep Kumar Sinha, Arun Kumar Singh, Vishwanath Kumar Sharma, I keep on telling you names or the way the psychologists have done in terms of their experimental work.

That they have taken alphabets combination of meaningful and then nonsense syllables both in increasing order of difficulty, for examples h e he these are two alphabets he is a pronoun, s h e she three alphabets, but it has a meaning. So, the difficulty level has changed, from two alphabets he two, she three alphabets, then I say h o m e home; so 1 2 3 4 alphabets, so 2 alphabets, 3 alphabets, 4 alphabets.

So, with increasing degree in the list you also increase one alphabets therefore, this is called as a hierarchical difficulty level. Similarly if I make nonsense syllables I just put alphabets which has no meaning x t two alphabets and I compare h e he versus x t, the second alphabet was say the second word was she, now s h e and I say x t p, the third word was home which had four alphabets and I say x l z p. It has been realized whether you use meaningful words or you use nonsense syllables, two effects will very interestingly come forward and these effects combined they are called as serial position effect.

So, the position of the meaningful word or the nonsense syllable in the series, this is called serial position effect and serial position effect will have two things, primacy effect and the recency effect. Primacy effect the effect the recall of the items, which are presented in the primary stage in the initial stage that is the primacy effect if I start with the he-she home and go up to knowledge government statistics, the longer ones then you realize that the words which are a spoken in the beginning they have a better recollection why they have a better recollection because you were mentally ready for the test, you knew that certain words will be presented to you and you will be ask to reproduce it.

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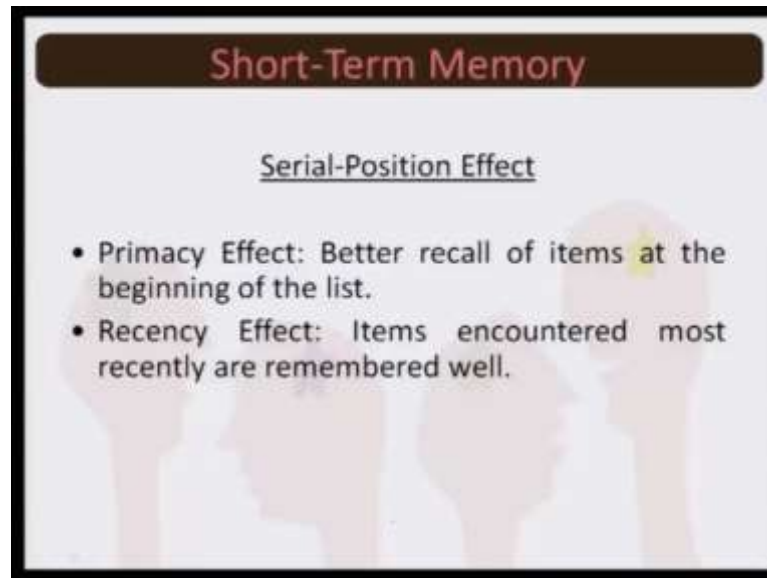
Then the words that come in the center, they have know the adverse effect in terms of recollection, but then the words which came towards the end, before the test terminated in your asked to recall the word those words also have a better probability you are being recalled and that is called Recency effect. Why? Because these were the item that you encountered most recently and because it was encountered very recently therefore, the chances of it being recollected is very high fine.

So, primacy and recency effects, these two are know very much dominantly found in short term storage. In the combined order, both these effects are called as serial position effect.

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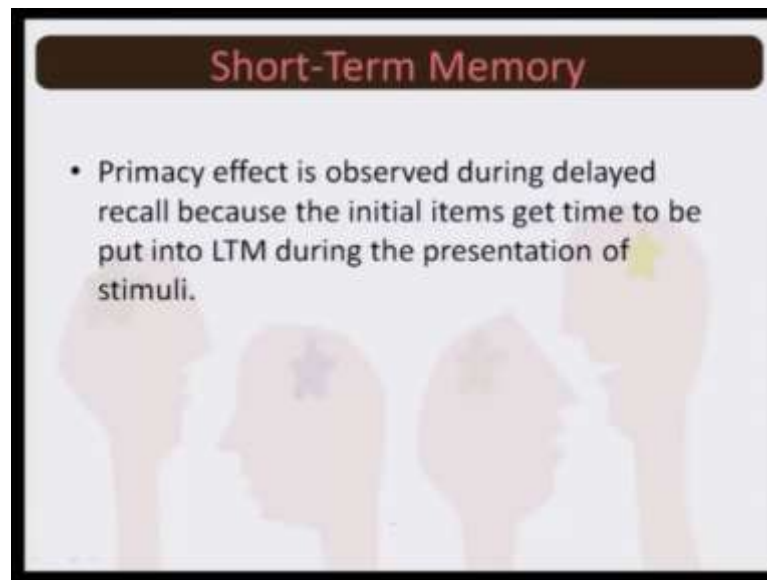
Now, primacy effect is observed during delayed recall because the initial items they get time to be put in the long term during the presentation of the stimuli. So, there is a possibility that although we say that this is something that you find in the short term storage there is a possibility that the information might trickle down to the long term storage as well. In terms of short term auditory memory there are now evidence for two short term auditory storage.

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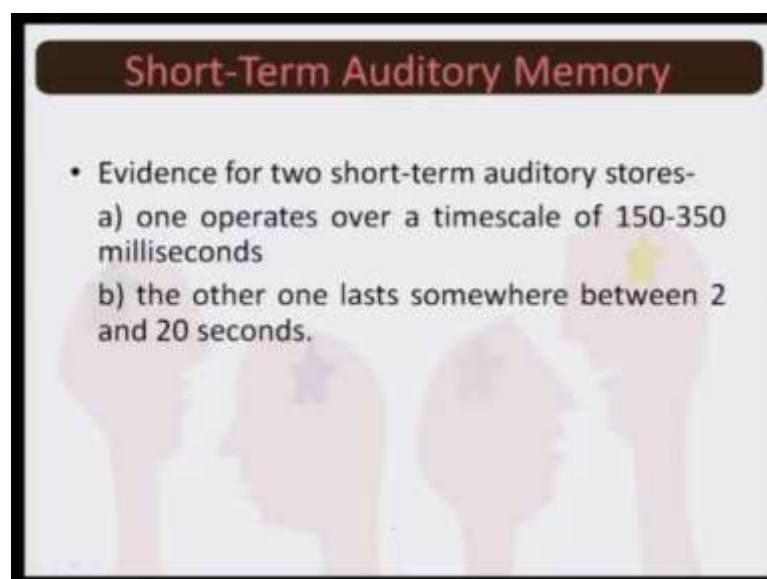
One which operates over a time scale of 150 to 350 milliseconds and the second one which basically lasts somewhere between 2 to 20 seconds, again you find that even though it is now more acoustic in nature, there could be a possibility, that there could be two different auditory storage system that is working, but remember one thing because we are on an introductive course we are also on a brief introduction to this very course.Therefore we will not venture into the details of all these things. There is also something called modality effect and recency - effect recency we have already discussed,

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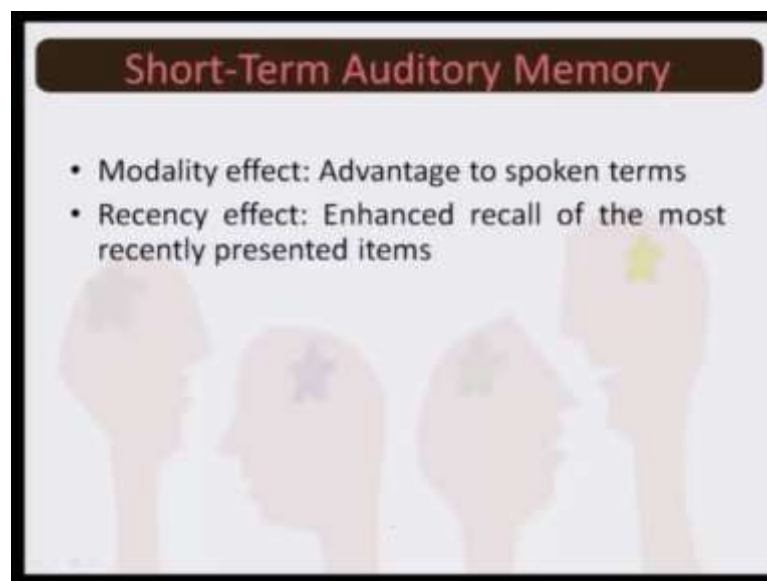
But in terms of auditory memory there are also advantage to the spoken words know. So, the modality that has been used for inducing the information, for sending the information to short term storage and the nature of that very single is something that also places it is role in terms of short term auditory memory. Now what is very interesting in short terms storage is that there could be a possibility of rehearsing the information. Why there is the possibility of rehearsal? Because the information has come and unlike the sensory storage, you have the possibility of storing the information for approximately somewhere up to 30 seconds.

Now, before you understand what rehearsal means and what the two different types of rehearsal are, understand this information by recollecting one of your past experiences. I am just trying to state a situation and you try to recollect something that you had experienced in the past. Say you look at telephone number in the directory 2 5 9 7 0 2 4

that is the number that you read in the telephone directory and then you start moving towards your say drawing room, where the handset is kept. The telephone directory was put somewhere else the telephone handset is put somewhere else and what you have to do is to remember this number till you dial it. So, what we do usually we remember 2542592592597024 - what are we doing remember we are chunking the information.

So, 259 forms one chunk, 7024 forms the other chunk and then once you come to that handset and you dial 2597024 the moment you have completed the dialing you forget the number that you have tried to store for that period. You knew that the significance of this storage is only till you successfully dial the number. You were rehearsing the number, but what you are actually doing? You were rehearsing because you wanted to retain information only till you could successfully dial it. This is called Maintenance Rehearsal.

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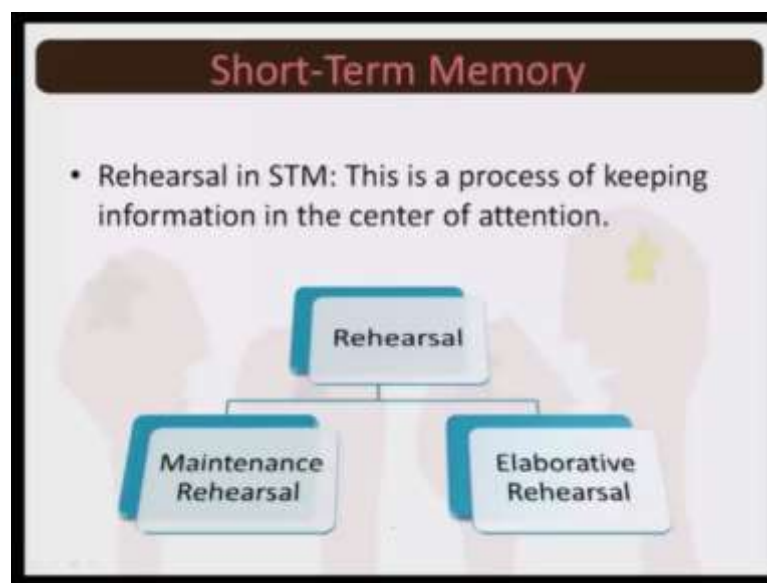
You are maintaining the information till the goal is achieved the goal is to dial this number, that is it. The second set of rehearsal would be when you go for more and more of elaborative expansion of it. So, you receive the information and then you start elaborating it. So, while rehearsing it you try to understand who this man is and in what way is he related to my father? Why is he is that my father has asked me to convey this to him over phone? His name is exactly the name of a neighbor of mine who have also been a good friend of my father. He was we are now stretching that information know. This rehearsal now is becoming elaborative in nature.
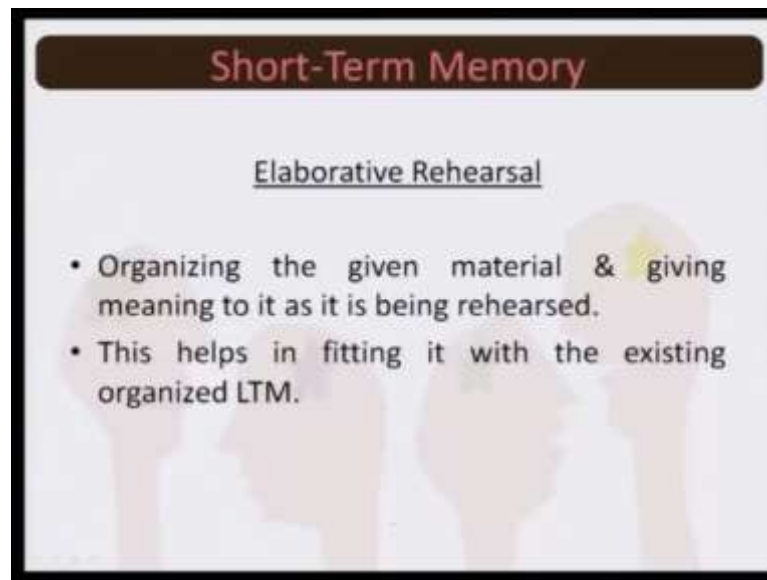
Therefore in short term there is a possibility of a rehearsal, which could either be maintenance oriented or it could be elaborative in nature. If it elaborative in nature we say it is elaborative rehearsal. If it is only for given period of time then it is called Maintenance rehearsal and rehearsal plays an extremely important role in short term storage.

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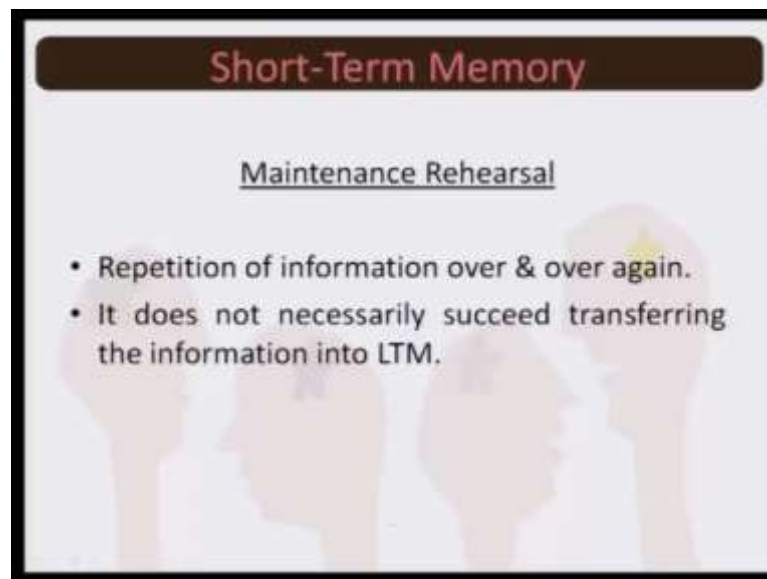
Now, in maintenance rehearsal the reputation of information is seen over and over again, but it does not necessarily succeed transferring the information to long term memory. Whereas, in elaborative rehearsal there are chances that the information will be transferred to long term storage. Compared to maintenance rehearsal in the case of elaborative rehearsal, the organization is done of the given material in terms of providing meaning to it while it is being rehearsed?

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Short-Term Memory

Elaborative Rehearsal

- Organizing the given material & giving meaning to it as it is being rehearsed.
- This helps in fitting it with the existing organized LTM.

So, you are rehearsing it, but you are also trying to give meaning to it and therefore because meaning is being assigned, therefore it helps in fitting this very information. Get the information that already exists in our long term storage. Because the information is now put in hierarchy it is put in a meaningful order therefore, it resembles to the pattern that suite to the long term storage. Therefore elaborative rehearsal is bound to push the information towards long term storage. Pushing information towards longer storage memory means that the information will now be available to you even after the lapse of 30 seconds duration.

The concept of chunk that we talked about 7 plus minus 2; 7 minus 2 will be 5 and 7 plus 2 will be 9 you remember in chunk, we said 5 to 9 chunks can be stored. So, this is basically the outcome of 7 plus minus 2 this is called Magic number, because this allows the information to be ordered in the form chunks and this chunk, combination of it can be stored with us for a relatively longer period. So up to 30 seconds maximum of 9 chunks and if you combine them together, then this helps us a lot in terms of arriving at a decision.
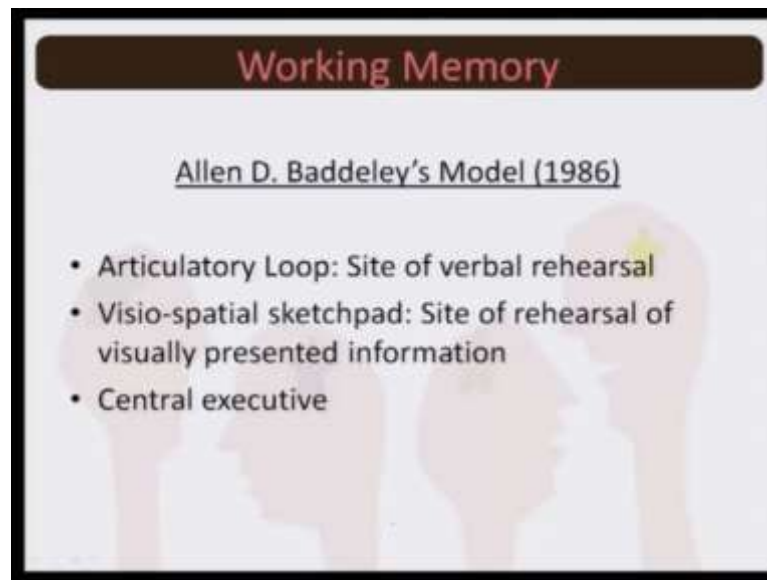
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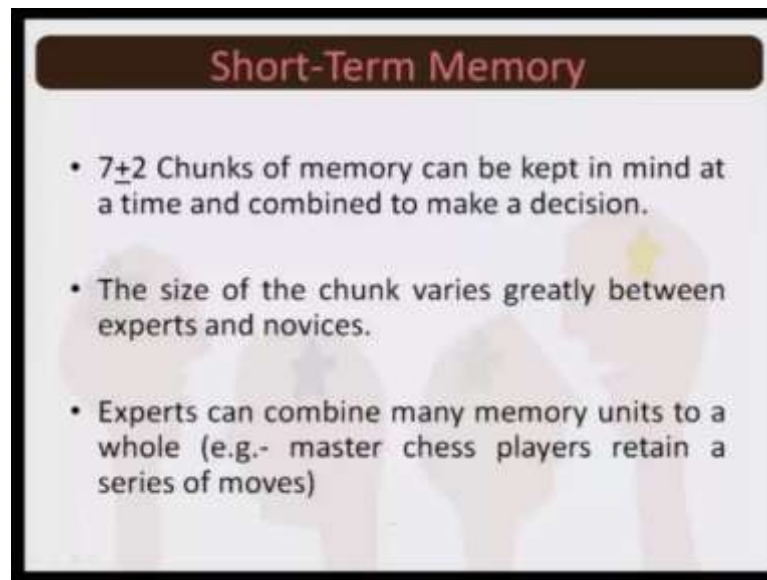
Now, the size of the chunk varies greatly between experts and novices . Especially if you compare now let us say children, then they try to memorize number, telephone number, the ten digit mobile number for instance, they usually do not show the tendency of now making chunks of 3 or making chunks of 4, but gradually with little more experience we all start doing that, even children start doing that, but even though we might have grown up, if you take adults, who are not say chess players and compare with say chess masters, you would realize that chess masters have much better memory and then use span of memory like anything because they have to retain a series of moves.

So, you need a very good storage system that helps you recollect what was the step that your opponents had taken in a series and this will help you anticipate what could the probable movement of your opponent if you make this type of move and again studies show that experts can combine many memory units into a whole if they are master of that very field compared to if somebody is just beginner.

Another interesting concept that was introduced to short term memory was the concept of working memory given by Allen Baddeleys Model. Allen Baddeleys model talks about 3 things - Articulatory Loop, The Visio-spatial sketchpad and the Central executive.
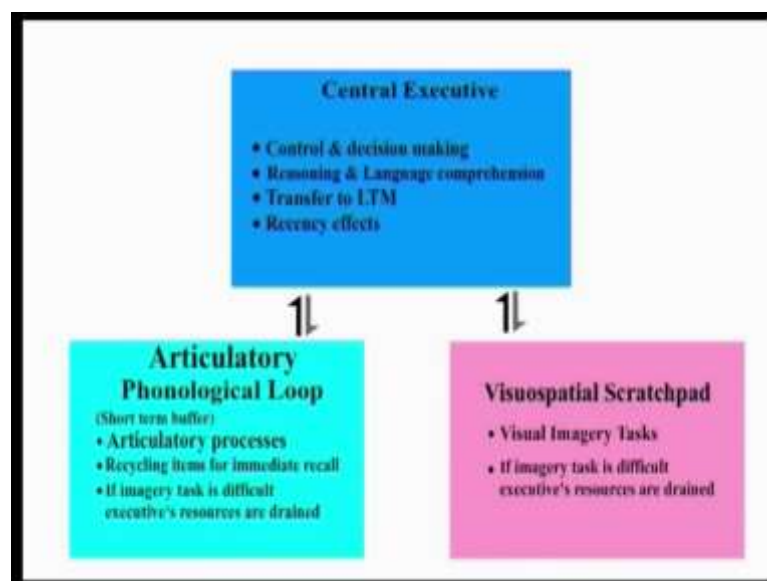
Allen baddeleys model of working memory comprises of 3 things, Central executive, Articulatory loop and Visuo-spatial sketchpad. The central executive as a control over things and plays role in decision making, Reasoning, language comprehension and transfer of information to long term memory are the tasks that it controls. Recency effect also a function of the central executive. The central executive depends upon articulatory loop it is also known as phonological loop. It is the short buffer where verbal rehearsal takes place. The articulatory loop recycles items to facilitate immediate recall. The central executive also depends upon Visuo-spatial sketchpad, it is also known as Visuo-

spatial sketchpad as I told you and it has do with the rehearsal of visually presented information.
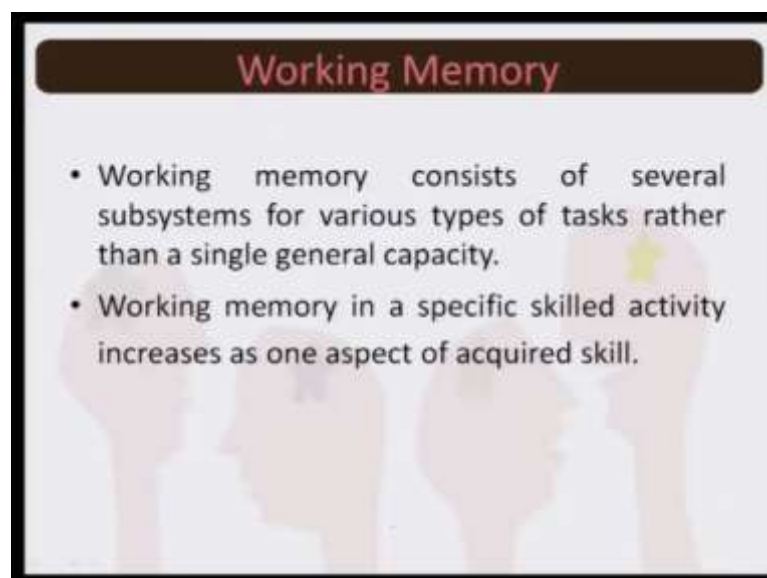
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This animation shows you the location of working memory in the brain. This is the area twelve of the brain and is responsible for object related working memory. Close to it is area 47 which is responsible for face working memory and this is area 46 and it is responsible for special working memory.
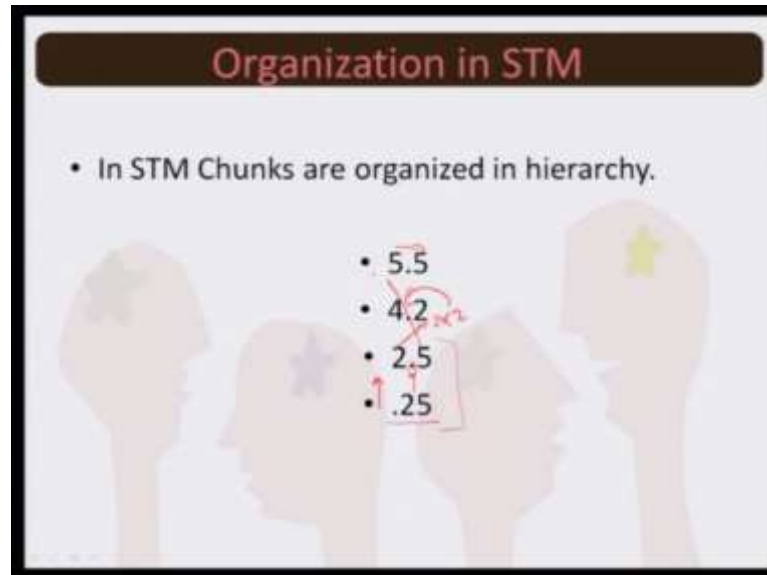
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Now, working memory basically consists of several sub systems of various types of tasks rather than single general capacity. A working memory in a specific skilled activity increases as one aspect of acquired skill.

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What is also very interesting to know is that the information the chunks that we form, they are organized in hierarchy in the short term memory. If you try to disorganize it then storage becomes problematic.

Now, you see your screen. You see 0.5. 5 the moment you go up, you realize that the decimal place has changed now it becomes 2.5. Now you can use different strategies to memorize this information, but one interesting thing could be that you realized that the first number was 0.25, then you realize that this moved up and the decimal position changed. So, basically you remember only one set with repositioning of the decimal point and then you say that this very information, this is how it moves. So, 2 moved to the third position it became 2 into 2 which was 4 and this 5 moved to the top and this was repeated. Now you jus organize thing like that and then you realize that remembering this information is not at all difficult, but if you do not organize information in the hierarchical order recollecting it becomes very difficult, retaining it becomes difficult.

So, whether it is elaborative rehearsal whether it is maintenance, both will have problem. Maintenance of course, you will have problem in because the numbers are not, what we

call arranged in hierarchy rather they are more random based. If you go for elaboration then elaboration by default when it try to make it little more meaningful thereby try to arrange it in hierarchy.

So, with this we have completed our discussion on short term storage when we meet next in our third lecture we would be talking about long term memory.