Introduction to Cognitive Psychology

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Lecture - 11
Short Term Memory

Hello. So, welcome back to the second session of a Memory. As we discussed in the last class we saw what is a memory; what is the need for it? And what type of (Refer Time: 00:37) process this is. We also discussed about modal model of memory, what the modal model talks about or how memory is multi store in a single store kind of a concept.

So, in the single store memory was discussed as a processes, which work or which use a single store for storing, but different processes define different kinds of memories whereas, in the multiple store model there different stores in different processes are related to each store that is how the model is defined.

We also looked at the first unit or the first part of the modal model that we discussed in the last class and that was calls the sensory memory. So, we looked at what is sensory memory, what is the different aspects of sensory memory, different requirements of it and how does it work. We looked at 2 basic type of sensory memory these are the visual memory and the auditory sensory memory.

Now in today's class what we are trying to finish is short term memory. So, what is short term memory? Now looking back at the definition of the modal model memory is a 3 part system and it is also proposed by Atkinson Shiffrin; Atkinson Shiffrins model of memory. The first part of which is sensory memory and when an information is processed from sensory memory using attentional filters or intentional filters; information from sensory memory is passed on to something called short term memory.

Now, the short term memory store is basically thought of as a store, which has limited capacity, but it can store information for longer duration of time, longer than the duration which is available the durability of time which is available for the short term store or the S T S. Also the main difference between the short term memory and the sensory registers or the sensory store is the amount of information, which can be stored. So, basically large

amount of information is what the sensory register holds whereas the short term store can hold only limited information.

So, let us continue our this lecture on short term store and look at some of the properties of the short term memory.

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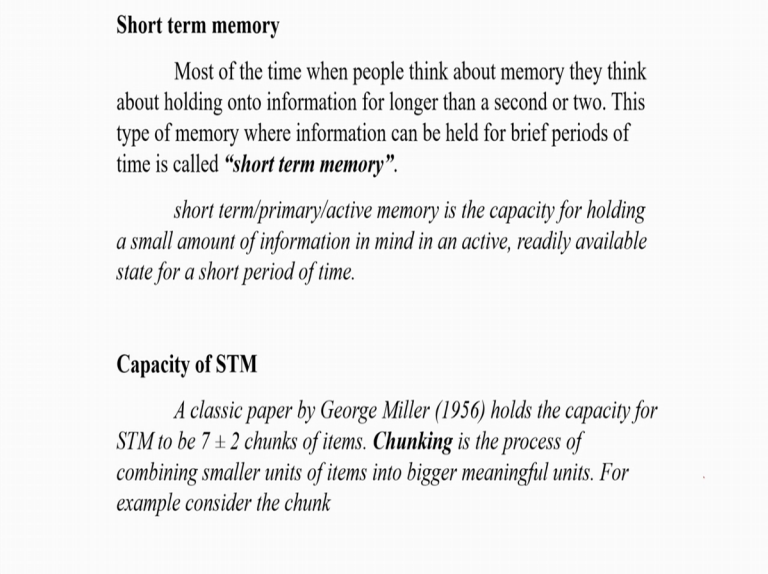

So, starting with definition of what it really means short term memory when people mostly talk about is a type of memory which people used for temporary holding information, think of a scenario like this you are on a call talking to someone. And within the call itself a number is given to you by the caller the person who is speaking to you gives you a number to dial to.

Now imagine a situation where you have nothing at your hand to write this number down. So, what do you do how do you remember this number or how do you make sure that the number telephone number, which has been passed on to you from the caller stays with you till the call ends. The most likely scenario or the most likely thing that most people do is vocally rehearse this number. And so, this number till the point of time that you are vocally rehearsing it stays with you if you stop rehearsal, then this number goes away.

And this particular temporary store where this telephone number or the number given to you by the caller stays is what is called the short term store. So, here mostly if not

rehearsed most information, which is passed on from the sensory register stays for no longer than a second 1 or 2 seconds. So, that is the time frame which is there and as we saw the time frame for which the information stores on to or stays on to the sensory register is about a 100 to 100 and 50 millisecond.

So, basically then short term store is a temporary store, which holds on to information little information, but for longer duration of time. Now as far as the definition goes short term or primary enactive stores it is the capacity of holding small informations for some limited period of time. Now the question again comes to us is what is the capacity of this store as we saw the capacity of the other store which was the short term store was huge it has huge capacity.

It can take in a lot of information, but then what is the capacity of the short term store also we talked about processes which are active during or which are inbuilt to the store? So, one of the processes which helps in passing information from the short term store to the short term memory is called the attentional process. So, basically attention is that process which takes an information from the [sorts/short] short term store, and depending on peoples motivation and intentions and the requirement of the task, move information moves on to the short term store to the short term memory.

So, as concerning the capacity of the short term store paper was written by sperling I am sorry George miller in 1956 and where he defines the store to be having a capacity of 7 plus or minus 2 chunks of item. Now when I say 7 plus or minus 2 chunks of item, what I am specifically trying to tell you here is that chunk is a word and it is a conceptual word. So, 7 plus or minus 2 chunks does not mean that you have to have 9 or 5 items into it, but a chunks of an item.

So, basically let us go ahead and define what a chunk is. So, chunk is a process or chunking is a process where meaningful units or meaningful materials, which are similar to each other are club together are categorized together. We will look into this in the chapter of categorization how this process happen, but for now chunking is the process of basically putting into a similar mean items, which are conceptually or meaningfully similar in nature.

For example, letters can form a chunk digits can form a chunk and certain other for example visual stimuli can form a chunk and that kind of a thing is chunking. So, the

capacity which has been defined by George miller in his paper is called 7 plus or minus 2 that is the maximum capacity of information, which can be stored into the short term memory. Now the thing is this is also called the magical number and very recent studies by neisser demonstrate that it is not 7 plus or minus 2 items, but it is rather 4 plus or minus 2 items that is the capacity of the short term store.

So, one thing is the capacity.

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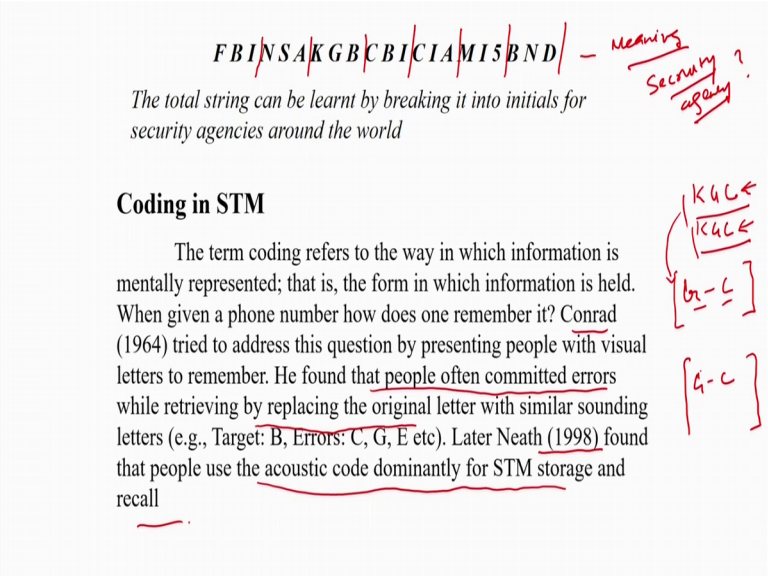

And the next thing to I example of how chunking really works? So, if I show you this strings, which is on the top of this particular slide. And if I ask you to remember this if I show this string to you for let us say a 100 milliseconds or for 1 second and then I ask you back to relate back what are the number of things that you are seeing or what are the number of letters that you are seeing here it becomes a difficult job.

So, I will demonstrate what chunking is what chunking really does is to make meaningful sentences or club meaningful sentences together. So, one way to remember this whole strain is to understand the fact that this strain has acronyms from the famous detective agencies or basically security agencies of the world.

So, what I do is if I can break into 3 chunks F B I is 1 agency N S A is another agency K G B is an agency C B I is an agency C I A is an agency M I 5 is an agency and B N D a is an agency. So, these basically can be chunk into smaller chunks the meaning of the

chunk or the meaning of the bin, which holds these chunks together is security agencies. And that way you will be able to remember this whole number of digits or this whole strings of digits.

So, this is basically what is the process of chunking? Then another thing that you want to know is how are things coded into S T M and it was very expressive to us that coding in the short term store was dependent on modality. So, different modality has different codes in the short term store. So, is it also true for our S T M what is the way in which information is coded into the S T M, that is an interesting thing to be looked at.

Now the coding in S T M generally happens to be in terms of the acoustic feature or in terms of the acoustic way. So, information mostly are held on to your S T M in an acoustic trays, which basically means that they sub vocal rehearsal that we are talking about in earlier example where we were looking at how this number was given to you by a friend over a telephone.

And so, you need needed to dial this number what you tend to do is mentally rehearse it. So, when you are mentally rehearsing it your are doing a acoustic rehearsal. Now just to prove on the fact that it is acoustic trace that is the way of how items are coded or how items are stored on to the short term stored or short term memory a conrad 1964 he conducted a famous experiment.

And so, what is experiment was he gave people some letters to remember a string of letters to remember and later on ask them to remember these letters back, for example, k G C or T B C kind of a thing. And what he found out from the remembrance that when people try to remember these letters back, what he found out that people confused or committed errors while retrieving or in retrieval by those letters which sounded similar together.

So, basically letters which sounded similar or which appeared similar, they created more confusion or more errors, then for those letters strings in which letters were not similar together. For example, in terms of when a visual presentation of letters were done. So, 2 presentations of these letters were done in one case K G C kind of a thing was given to people and in we in a auditory manner in or through a auditory stimulus in the other version of the experiment this K G C was shown to people.

And so, when this kind of a stimulus were shown to people, it was that people made more confusions when auditory testing was done. And what happened here is that K the K or the G confused more with C, people made more confusions with C, where as in terms of in terms of the visual people did not [con/confused] confused with the letters G N C.

So, it is basically the caustic code or it is basically the acoustics or the [pho/phonemes] phonemes the basic speed sound, which made the confusion. And that led to the idea that it is coding, which is happens in the S T M is mostly in the acoustic form Neath in 1998 he found that people use acoustic code dominantly for S T M storage and recalls.

So, basically people do some kind of a sub vocal rehearsal and it is not mental images it is not imagery that people make of items in the S T M people generally make an acoustic trays or an acoustic image I would say let us not use the word images on acoustic trays of any information, which has to be put into S T M and basically then remember it that way.

Now the question then which is in front of us right now is what is the retention duration and how does forgetting take place in S T M? Not to prove the way in which retention is done in S T M or how items are retained in S T M? And, what is the way in which forgetting takes place in S T M several experiments were discussed.

And so, what I will try and do at present is show you 2 different versions of the experiment. In first version which is called the brown and Peterson task will see that decay has been named as the reason for forgetting, where as in the Volgon Orgon task I will trying to show you the same explanations, are the same results from the Peterson and Brown experiment are how it is explained in terms of interference?.

So, basically there are several theories of how items get moved out or items are forgotten. And so, there are 2 popular theories of it one is the decay theory, which basically goes ahead and says that items, which are not used for a longer period of time they decay. So, they what happens is that the trace the memory trace is erased and they got they get decade or without use the theory of not you says that they slowly wither away with time so, that trace itself disappears.

Another theory of forgetting is the interference theory which says that if items of similar nature, they come in contact with each other or if one item is presented and the second

item, which is similar in nature to the first item is presented alongside. Then one both the items will compete with each other and there will be an interference.

So, basically in the next session in long term memory when will discuss will also discuss on to the interference phenomena for now these are the 2 modes of forgetting. So, what people were wondering is what is the nature of forgetting or how things are forgotten into S T M and how they are stored?

So, let us then look at these experiments one by one the first experiment is called the brown and Peterson task.

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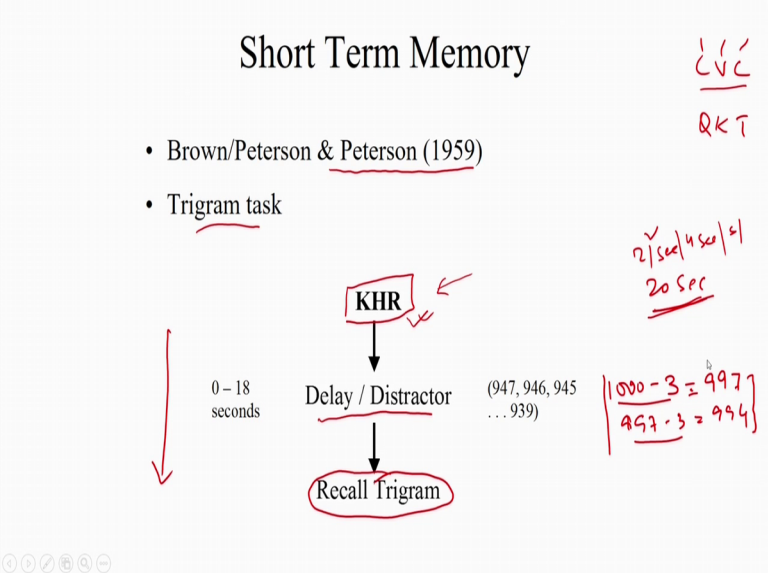

So, what is the task all about and so, this experiment was done by brown and Peterson in 1900 and 59. So, what is the experiment all about? Now in the brown and Peterson experiment is a very easy experiment to look at a digit string was presented to people.

So, digit string like this was presented to people. And what they had to do this digit strings were generally a trigram a 3 letter word or 3 letter trigram. A trigram is basically a 3 letter word which does not make a sense? Because if you have sensual word here then the chances of you recalling it will be better because it make meaning and so, what trigram is used? And basically the start starting point of trigram of or who started the use of trigram was basically, when was; what he did was he created 3 letter words or the formats C V C, which is the consonant vowel consonant format. And so, in C V C he

combined 3 words together or 3 letters of the English language together. So, that they do not make any meaning for example, K H C or Q K T.

Now these words do not make meaning and so, they are combined together and this is what the trigram is. So, in this particular experiment an arrangement was done in which people were shown this kind of trigram. And so, after they were shown this trigram they were asked to commit this trigram to memory.

So, basically someone is showing this trigram and they were asked to commit this to memory. Later on they were said to count back from one 1000 in threes. So, the first will be 9 or let us say 7 and then the next will be 9 9 7 minus 3. So, will be 9 9 4 and so on and so forth. So, keep on counting like this. So, a task was introduced so, the working of the task is that a distract this kind of a trigram was introduced, people were made to commit this to memory sub vocally remember it. So, you were given this task and sub vocally remember it and later on a daily distracted task like this was given it is called the and back counting task, here what you need to do is that you have to count back in digits of 3 this kind of a thing and keep on counting.

Now people were stopped at several points of time starting from 20 seconds delay. So, within the first 20 second they were. So, people remember this task and they started counting back. And after the first 20 second they were stopped and asked you to relayed back this trigram this is called the recall trigram phrase in which after the first 20 second people were asked to stop.

So, within this 20 second people are counting back. Now one thing is that that this counting back task the and back count and back counting task as it is called, it requires a huge amount of short term memory it requires a huge amount of attention. And so, most attentional resources will be diverted to it. And so, chances of the any chance of people to basically sub vocal rehearse this particular thing is not possible it is not at all possible in this task. And so, this was to demonstrate the fact that this K H R or thus recall was basically due to decay.

Now people were stop at 2 seconds time after the counting start started. So, they were made to recall the trigram after 2 seconds, 4 seconds, 6 seconds till 20 seconds. So, after every 2 seconds they were made to stop this counting task and recall back the diagram, what really happened what is the result of this experiment?

The result of this experiment showed that after 18 seconds. So, this is what the results looks like.

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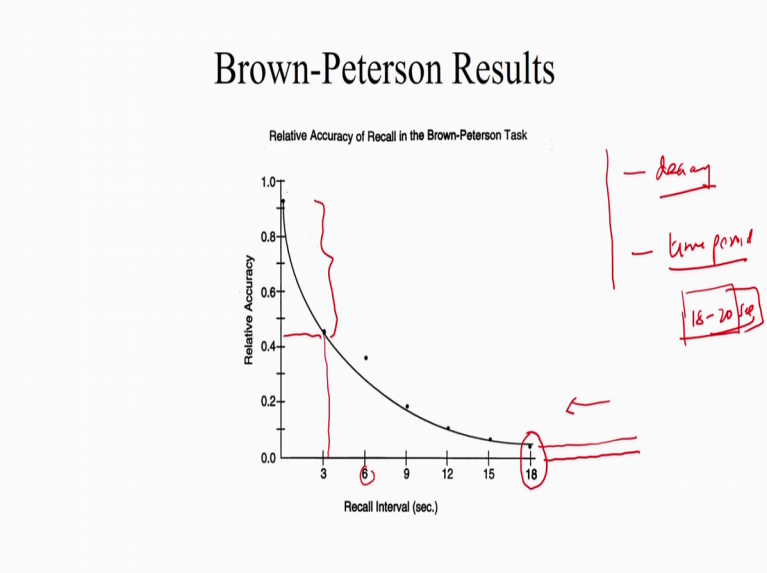

If you look into it initially what happened is this is a relative accuracy, which is there in the recall interval of time. So, what the first thing that shows or that is evident from this particular result is that at 18 seconds the curve becomes a sort of a asymptote. And so, which basically means that the recall accuracy does not fall any more. So, the curve falls parallel to this, but if you look into it for the first 3 seconds there is a maximum fall of accuracy. So, this is the portion if I draw this then this is the kind of portion, which is there immediately there is an accuracy.

So, just let us say half a second the accuracy is almost 1, which means that people are almost highly accurate 80 percent accurate in recalling the or more than 85 percent accurate in recalling the trigram back, but then as you proceed in time by the by the first third second, by the third second of still the start of that counting task people almost loose the accuracy by or the accuracy drops down by 42 to 43 percent.

By the next 6 seconds it drops to almost let us say around 35 percent and then similarly it keeps on dropping till it becomes stable at 18 seconds. And this idea give or this task give 2 prominent result 1, that decay is the reason for the forgetting since, the task was so, heavy the working memory task which was used was so, heavy what happened is people did not get time to repeat. And, so, the trees of memory trace of this task went on

decreasing till it reached a very low level, which is nearly 0.1 here, the 0.1 chances of accuracy here after 18 seconds.

Also another important thing that was demonstrated here was that that time period for which any item get stored on to the short term store. And the time period which was determined through their experiment, where brown Peterson was 18 to 20 second. This is a time period through which an item will be in your short term memory, if not rehearsed. And after 20 second a rehearsal does not happen then most item from the short term memory will go away. And so, the duration of the short term memory from this experiment is 20 second.

Now, brown Petersons task which explains decay as the reason for the delay can also be explained by the Waugh and Norman task, but before that let us look at the results from brown and Petersons task study interpreted that failure to recall occurs during the decay of due to decay of memory traces and so, within the first 20 seconds now.

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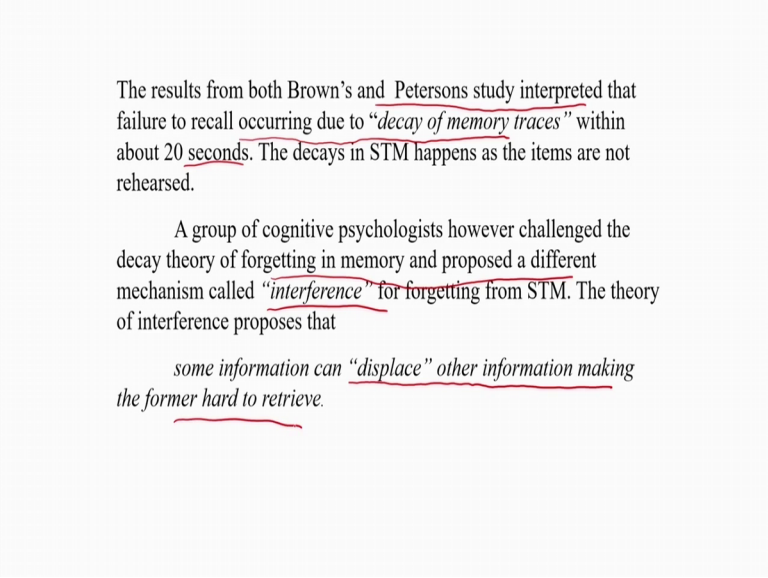

Another group as I said that Waugh and Norman try to explain this result in terms of interferences. So, what they said is that they challenge the decay theory of forgetting and memory and proposed a different mechanism, which is called interferences. So, interferences as I explained to you is a phenomena in which what happens is that 2 items, which are similar in nature they compete with each other and so, they block to the recall

of one item or the important thing to remember is that they have to do 2 task have to be similar in nature and they have to be competing.

If, they not competing, if people are not focusing on both the task then the interference phenomena will not happen. So, basically then interference theory says that some information displays another information making the former hard to retrieve. As the second item compete with the first item and since they are similar in nature people confused and second item is pushed out or interfered out from the memory.

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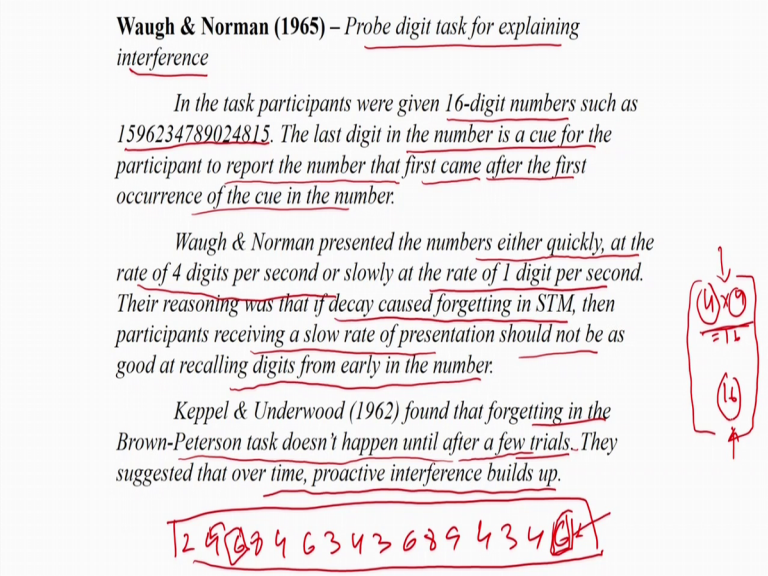

So, on explanation of the same brown Petersons task or Waugh and Normans interpretation of what happens in terms of forgetting and time delay in S T M another task was designed, which is called the probe digit task for explaining the interferences phenomena or interferences forgetting from short term memory. What was the task it is a very easy task to look at it is a 16 digit number task.

So, a 16 digit is presented to you at one goes. So, you have things like 2 4 6 8 4 6 3 4 3 6 8 9 4 3 4 2 3 4 5 6 6. So, this kind of set up is presented to you. So, one example is given here. The last digit now this digit then serves as a cue. So, a digit like this a string like this is presented to people and what they have to do is to first recognize the last digit. And this serves the cue now what is the task the task is to basically go ahead and name the letter, which proceeded the first occurrence of the last word hear. What do you mean

by that I mean by this is that this 6, which is the last digit in this strain this cue and so, what is the first occurrence of this the first occurrence of this is here.

And so, the letter we proceeds the first occurrence of the 6 is 4. And so, what people had to say is 4 was the correct answer. So, you had to people as last digit in the number is cue for the participant report a number, that the number that first came after the first occurrence of the cue the number. And so, that is what it is and so, 4 is the answer here.

So, this is the task a 16 digit number is presented you have to remember the last digit, remember the first occurrence of the last digit and remember the number which preceded the first occurrence of the last digit. Now there are 2 versions of this task in the first version letters the presented very fast. So, either a very quickly at the rate of 4 digit per second for this whole string was presented at the rate of 4 digit per second. And so, people had to then go ahead and so, first the string was presented and then the string was presented in the manner in that 4 digits very quickly were presented to people and then from the last one.

So, 4 fours a 16 4 presentation are there 4 digits presented together into 4 different times next is 16. So, you have to last remember the last one, remember the last digit and then remember where the first occurrence of the last digit on the fourth panel was there in and go ahead and tell me the first number, which occurred in the first occurrence of the last cue and or they were another presentation which was one digit per second.

So, 16 second 16 repetitions were there here for repetitions done with 4 digits or 16 deputation 1 number at a time was presented people were asked to do the task.

Now Waugh and Norman they reasoned that if decayed cost forgetting in S T M, then participant receiving the slow rate of presentation should not be able should not be as good at recalling digits from early in the number, which basically means that is if the first occurrence of the last digit in the 16 digit string comes in the first half or towards the middle of the list, when people should not be able to remember this, but this is not what happened. Keppel and underwood they found it for getting in the brown and Peterson's task does not happen until after few trials.

So, what happens is this is not the answer the found they found that they were similar kind of forgetting which was there, but then if words were similar if decay is the reason then this kind of answer should come.

But this is not for they found they found that quite similar kind of forgetting into both the versions of the task. And so, this Keppel and underwood they found that forgetting in the brown and Peterson's task does not happen until a few trails are happened. This suggests the overtime proactive interference builds up.

So, what happens is that in the 4 into 4 kind of a said what happens is due to proactive interference, if digits appear in the later half if the first presentation of the Q happened in the later half forgetting was more, but if the presentation was in the earlier half forgetting was less. So, this kind of an result was what was found from Waugh and Norman, which basically suggest that interference is the reason for forgetting.

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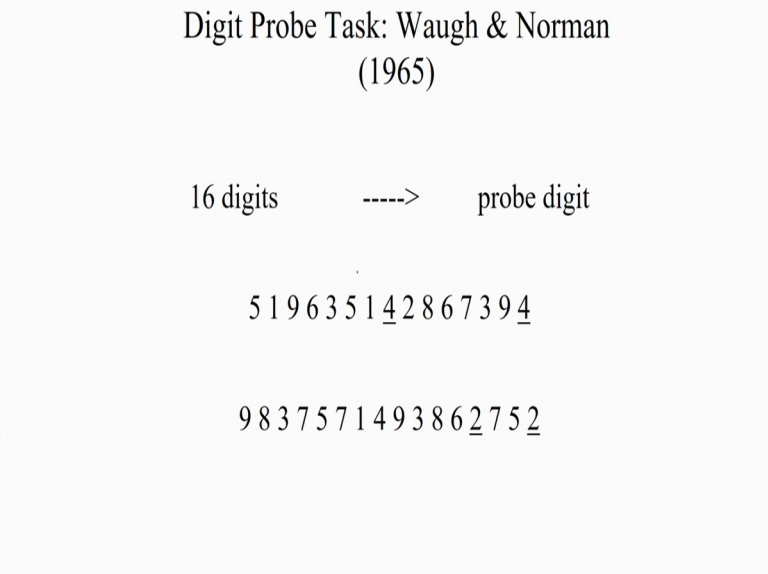

So, this is how the task look like this 16 digit task this is the first occurrence of it and this is what you tend to remember.

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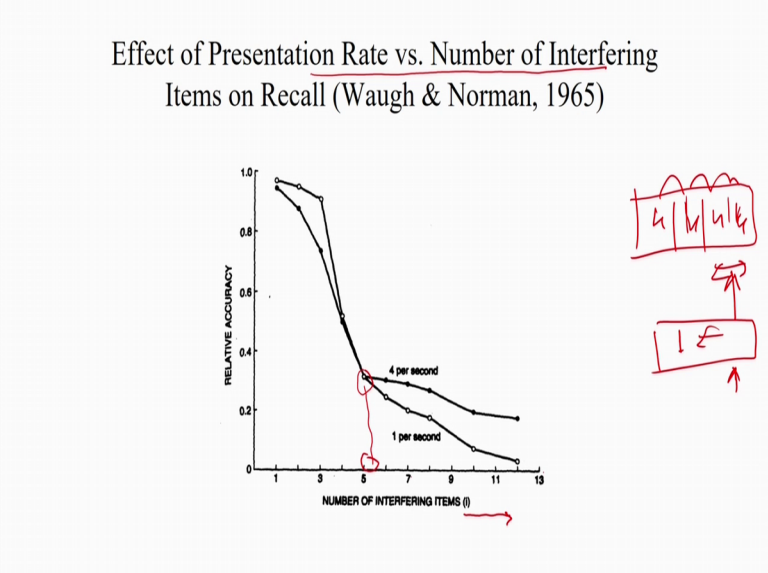

And this is what Effects of presentation rate versus number of interfering item is looked at. So, if 4 items are there then you tend to have so, if you look here the number of interfering items are 5 if this is there at 4 seconds, both the 1 second and the 4 second presentation are almost similar in terms of relative accuracy, but then if the number of digits, interfering digit number of interfering items are more, which means that the number of letters, which are presented or number of letters with preceded the first occurrence of the cue.

So, if my cue is like this let us say 16 digits. And so, 4 digit so, a block 4 into 4 what happens is if my cue the first occurrence of cue, falls here somewhere and the chances of forgetting the accuracy of forget will go down in the 4 presentation group, but not in the one presentation group, but then what happens is if I am presenting it in 1 1 word at a time there would not be any interference and so, there will be no forgetting at all here.

So, this basically is a complete example to basically go ahead and say that interference is the reason for forgetting. And so, this graph in itself explains 34 hours per second is there. And how it relates to number of interfering item is the number of interfering item is 5, this is where both the list matches, but as it goes to 7 the 1 word has lower accuracy then the 4 word items. This happens, because in the 1 word the interference (Refer Time: 30:14) more since 1 word represent a one after another so, there will be lot of interference, but in this there only 4 presentations on the interference will be less.

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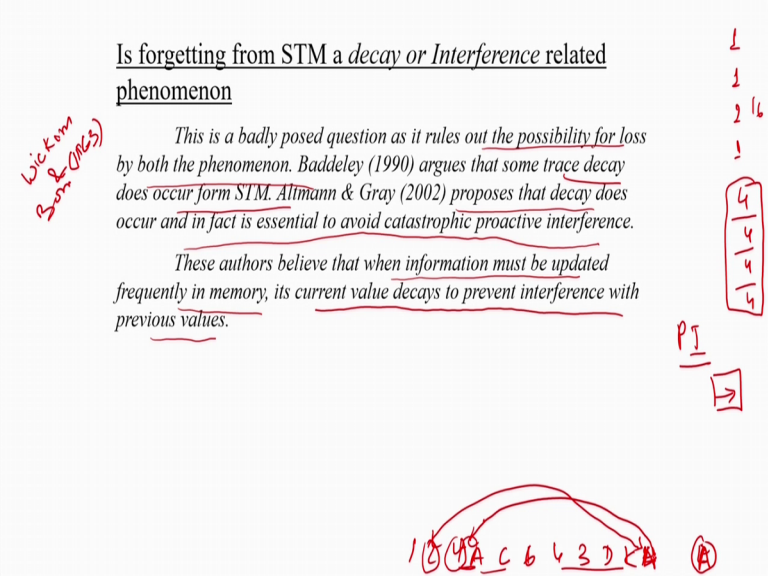

Then the question is forgetting from S T M a decay or interference related phenomena.

Now, it is a badly cross question, why because it rules out the possibility for loss by both the phenomena. And so, broad badly said in 1998 argues that trace decay does occur from S T M Allmann and Gray also proposed that decay does occur in fact, essential to avoid catastrophic proactive interferences. Which, basically both these people go ahead and say that it is not one over the other kind of a thing both the factors decay and interference they go ahead, and then they basically relate to each other to actually go ahead and show that this kind of interferences is happened or both the items are responsible for the interferences.

Now, these are authors believe that information must be updated frequently in memory is current value decays to prevent interferences with other previous value.

So, another interesting thing that can be that was looked at is that if interference is there is a reason why forgetting happens in short term memory phenomena which is call the release from proactive interference. Now as we saw in the Wrog and Norman study it was basically proactive interference, which was the reason why forgetting happened and forgetting happened in the one word item very clear explanation what happens is since it is one word presentation.

So, there will be 16 occurrences of it and so, more number of interferences, but in the 4 word items or 4 word presentation there only, 4 different presentations which are there and so, interference are less proactive interference are less in number. And so, what we have here and interesting things that we have here is that a phenomena called proactive release now what is proactive release.

So, Wickoms and Bon an experiment was done by Wickoms and Bon in 1963 and what these people said is that the phenomena of proactive release from proactive interference should be evident, if interference is the reason for forgetting in the brown Peterson task.

Now what these phenomena really say is that if interferences happen, because similar items are presented. So, if items are different items are presented to people, then what would happen is they would show interference or the performance would increase and that is what exactly happened?

So, what these people showed that if similar type of items was used in brown and Peterson task. So, if letters only if I used then people had lower higher forgetting rate and that, because it was due to interference, but then if on one particular presentation you had letters as well as digits coming in. So, you have a number a 16 digit number where you have letters and digits fill into it and so, you have to tell me the last occurrence of either a letter in a digit.

So, the display would look something like 1 2 4 A C 6 4 3 D K kind of a thing and let us say E is the last here and so, or a is the last here and so you have to tell me the digit 4, which comes after the first occurrence of the letter A, in this case the forgetting was known to be less. The reason given was released from proactive interference which means that when items was switched. So, here what happened is items were switched. And so, some items where letters and some items were numbers, in this case the proactive interference is were less.

And so, in those cases where you had to remember a letter a digit after a letter in those cases the interference is were less, but if let us say if the last word here is not K, let us say if it is 4 and people have to remember the a number, which comes or that the item which comes after the first occurrence of 4, which is 2 now since 2 and 4 are both digits.

And so, they will create more proactive interference, but if let us say the last word is here A or let us say that this is 4 and A comes in before 4 in this case a is remembered more. So, if the word which appears after the first occurrence of the cue is a different word is not the same as the 1, which is the cue and proactive interference says will be very less, because for the phenomena, which is called the release from proactive interference.

So, how is information retrieve from short term memory that is another thing to be looked at and discussing? So, we looked at how it is stored what is the manner in which forgetting happens? What is the time and what is the duration for which and items stays in S T M? And what is the kind of coding, which happens in S T M?

So, in this particular next step will look into how is information retrieved from S T M what is the way in it. So, Saul Sternberg he designed and explained, to look at how items are actually retrieve back from S T M.

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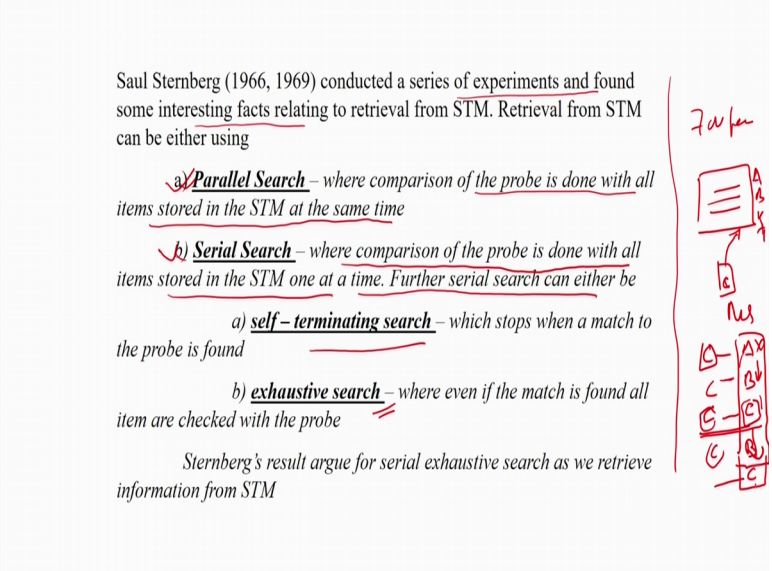

And what did he find. So, what was his task like his task was search for information in serial or parallel form. So, he had people look at a display like this where 7 or few letters where. So, 7 or few letters were given to people to be kept in the memory bank to be remembered into their memory. And then later on a cue was presented to people so, let us say we have 7 or few letters, which people have to remember. So, these letters are A B K T kind of a thing and then they presented with C people are presented with C and what they have to look at is to find out whether this C is presented here or not.

And so, they have to hold this in memory and then later on verify this cue or these probes cue whether it is present here or not. So, from his experiments he came up with a very interesting example or a very interesting proposal. And what is this proposal he conducted this kind of an experiment and found some interesting results what was it is first something called parallel search happened.

So, when comparison of probe is done with all items stored in the S T M at the same time then it is something called parallel search. So, if C is searched with every of this item everyone of this item it is a parallel search, but when a for comparison or the probe is done with all items stored in the S T M 1 at a time it is called the serial search.

So, the question here was this kind of 2 searches could be the result of this experiment. Now if you remember the first lecture we talked, but something called structure process trade off and we saw how Saul Sternberg the same experiment is described here, how Saul Sternberg went ahead and described this whole process of serial verses parallel search. And he gave reasons for what really happens, how the structure and the process compensate for each other the same thing.

Now, within the serial search Sternberg basically proposed that there are 2 versions of the serial search. The one is called the self-terminating search in which what happens is as soon as. So, this c will be search with a or compared with a if it is not a match this C will again go into searching with B, which is next letter.

So, this is mine letter items, which is in the memory set and this is my probe C goes ahead and matches I have C here and as soon as the c matches with this a self-termination happens. So, the list is not further searched of all these the list has 7 items as soon as this C is there here I have a no match or the matching proceeds to be if it is not matched here it will proceed here, but as soon as the match is there a self-termination will happen a self-termination will take place.

But in another form of search which is called the exhaustive search what Sternberg's says is it that no matter the fact that this C is matched here this C is again matched to the next item which could be the B or which could be another C. So, the whole number of items which are there in the memory set will be searched one after another, with the probe. And that is what is called serial exhaustive search and what Sternberg argued is that the way in which short term memory search basically that serial exhaustive search.

So, no matter if even if you get a clear search first of all there are no parallel searches in S T M that are always serial searches and even if the serial search is done it is not a self-terminating search, even if a match is found to the probe, even if some items matches the items that you are looking for in your S T M the search will continue till the end of the list. This is because the this the exhaustive search takes place and the one probable reason could be the fact that multiple copies of the item would be there and so, the requirement of that makes you to do something called the exhaustive serial exhaustive search.

And so, to test so, a review done by hunt 1978, found that people of all sorts showed result with consistent with the idea that retrieval from S T M uses serial exhaustive search although the search rate changes with the group.

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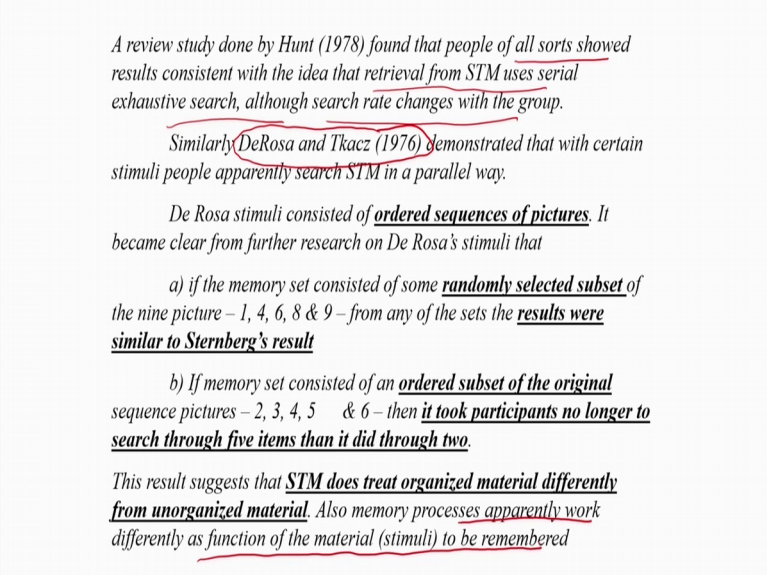

Now De Rosa and Tkacz 1976 demonstrated that we certain stimuli people apparently do search S T M in a parallel way. So, basically de Rosa came up with an experiment to show that both the serial as well as a parallel search does happen in S T M.

So, the designed a sequence kind of a stimuli to test that and the results of their study was. So, let us look at the stimuli that they use for their experiment. So, in their experiment they gave a situation like this a stimulus like this.

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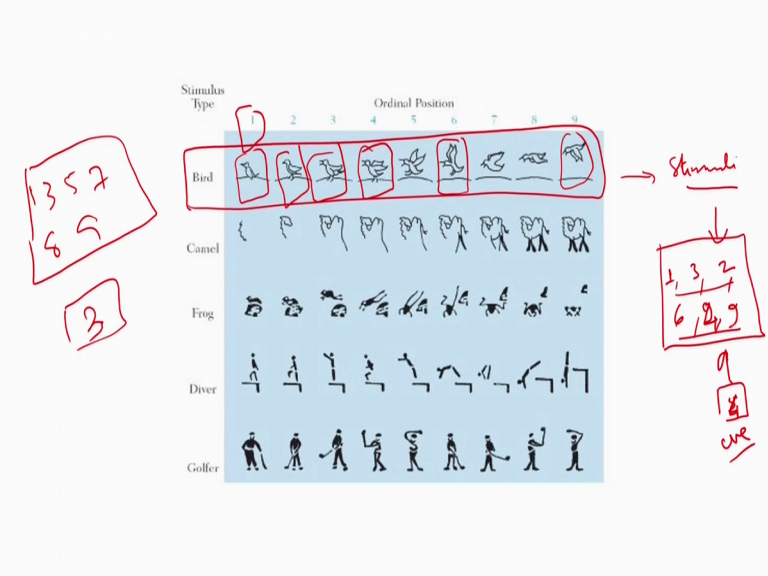

Now if you look at the stimulus there are 1 2 3 4 5 different stimuli and what we look at is basically a stimuli in action.

So, there are several natural actions of the stimuli for example, look at this person who is playing golf. So, you see that it move from frame to frame as you look at it is diverse. So, he gets up and prepare themselves make this move, pens down, lunches in self into the air, then dies forward, make this move, dies forward and then lands below or a look at how this bird goes and fly. So, these are the ordinal position these are the positions in which basically, the sequence of action should go and these are the number of action where these stimuli is done. So, what is the result of study like this, what happens in a study like this.

So, in a study like this Derosa found that the stimuli consisted both of as I said it consisted of number of ordered pictures in one after another. And the result of the study says that if the memory set consisted of some randomly selected subsets of 9 pictures from any of the sets the results were similar to Sternberg's results.

So, if let us say that I give you a number of positions to verify. So, what I do is let us say from the first stimuli here I take in ordinal positions 1 3 2 6 9 4 9. And then I ask you to verify whether 5 is there or let us say 4 is there in this set or not. So, that is what you need to do. So, this is the fourth position which is there and I have selected the first position, the third position, the fourth position; obviously, the second position then. So,

this is the way in which it is the sixth position followed by the fourth position and the ninth position.

And so, they are in a unordered list and so, you will have to go and search whether this is there are not. So, in this kind of search when the cue has to be searched in a display like this in a situation like this, in a feature like this. Then a serial exhaustive search is what happens here, but then interestingly if an ordered set is used.

So, instead of using instead of using this kind of a random sequence if I gave an ordered sets. So, if I take positions number 1 3 5 7 8 and 9 and if I give you to find whether 3 is present here or not parallel search exists. So, items when they are presented randomly, if the memory set if the test item that you have to find out in the memory set and the memory set consists un unordered kind of a setup and unordered kind of a lists, where all ordinal positions or randomly mix ordinal positions are present, then in those cases what really happens is the search is more or less of the type, which is popular to what Sternberg says is it is serial exhaustive search in nature.

But then when if I have an ordered position if I have an ordered search in those cases if I take 1 3 5 7 8 9 and search, whether 3 is there or not there are parallel searches which results here. So, that is what this says. So, result were similar to Sternberg when random selected subset was taken, but when ordered subset was taken to participants no longer to search 5 items then it then for 2 and so, generally there was parallel.

So, this results suggests that S T M does treat organize material in different form the organized material also may be processes apparently work differently as a function of material that has to be remembered. So, basically the search is both can be both parallel and serial or different types of searches are there, but when it is ordered material it could be serial exhaustive, when it is not ordered may be it is parallel or it could be a simple self-terminating self-search. So, depending on the material which is been presented and type of task which is there it is decided, what kind of search will happen.

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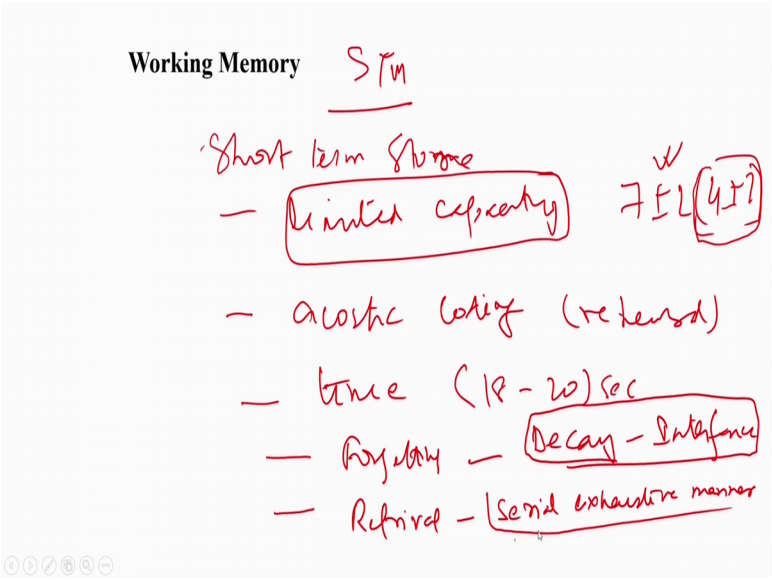

Now the problem was that S T M as we saw here is basically then quickly defined what it is S T is basically a short term memory, S T M is a short term store which has first of all a limited capacity.

So, one of the thing which we should be aware of is that it has a limited capacity and the capacity here is 7 plus or minus 2 although year Neath came up with a new idea that it has 4 plus or minus 2 item that is what it is, but will not discuss this right now will focus on to the original millers idea that it has 7 plus or minus 2 items to be looked at, then the second thing is the way items are coded. And so, mostly a caustic coding happens in short term memory the type of coding that is happens in short term memory or the way items are encoded on to short term memory is acoustic, in nature it is basically in terms of verbal.

And rehearsal is the main reason for this kind of storage and then the time period for which any item can remain in the short term store without being reputation is 18 to 20 seconds and this is an output from the brown and Peterson task. Also the fact that forgetting mostly in short term memory can happen both from decay and from interference. Mostly it is interference, but then we have decay also as a reason and so, mostly it is a interplay between decay an interference, which let us you loose memory from short term store.

And the last point that has to be that can be remembered here or that has any value here is that retrieval from this kind of a store is basically mostly in a serial exhaustive manner.

So, serial exhaustive search basically or serial exhaustive way of replacement of this particular materials, but depending on type of material used this serial exhaustive search could also turn up to be a parallel exhaustive search or some other form of search which is or which could be needed.

Now we have looked at what S T M is and what it does and what is the various ways in which S T M works? But there was a debate which was going on within the community of cognitive psychologist and that was that at times S T M was somehow not approved off what do I mean by this. If you look at the first instance of my definition of the short term store I explained to you there is something called the serial position effect.

So, what we found out in the serial position effect is an effect like this. So, what happens is a list of numbers are given to you a list of items are given to you and asked to remember. Then what happens is the items at the beginning of the list and items at the end of the list are remembered more than items at the middle of and this 2 things are called the primacy and recency effect.

Now it was found out in several experiments that if items which had some kind of personal meaning to people and even if they were presented in the middle of the list they had a higher chance of remembering. And so, this lead several people or several psychologists go ahead and question this idea of a single store which does not do anything.

But stores information for some period of time and know act on to it the question this particular store. For the question was, whether short term store, was a static store or a dynamic store and number of questions were done. Also this interference does interference work on to all kind of items which is store? So, if there is a (Refer Time: 49:23) item and if there is a auditory item where, whether this kind of interference that we talk about whether it happens on 2 different modalities or different encodings of items which is there.

So, if different versions of items are presented a different types of items are present, whether this interference will there be there or not and several studies reported that it was not there.

So, was conceived the idea of working memory. So, in the coming class we look into what is working memory and how does this working memory concept go ahead and take up or basically replace the concept of short term memory.

Thank you.