Indian Institute of Technology Kanpur

National Programme on Technology Enhanced Learning (NPTEL)

Course Title
Basic Cognitive Processes

Lecture: 32
Memory - IV

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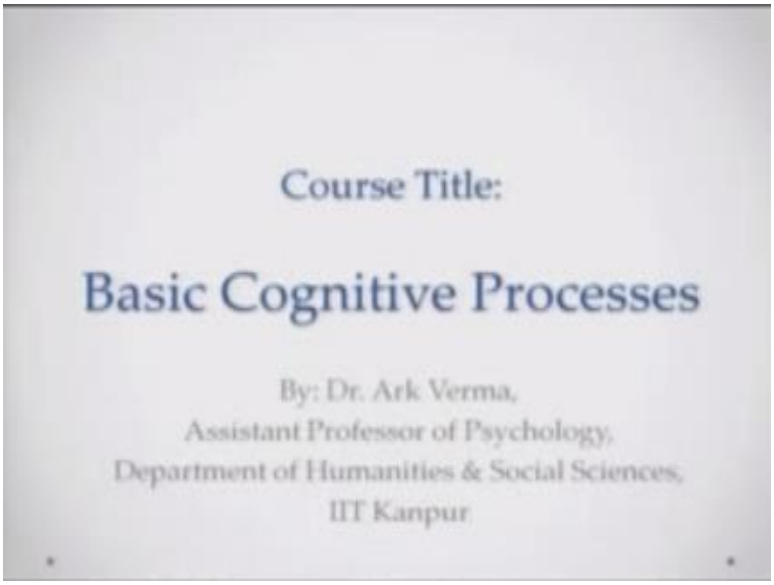

Hello everyone to the lecture series on basic cognitive processes I am Dr. Ark Verma from IIT Kanpur.

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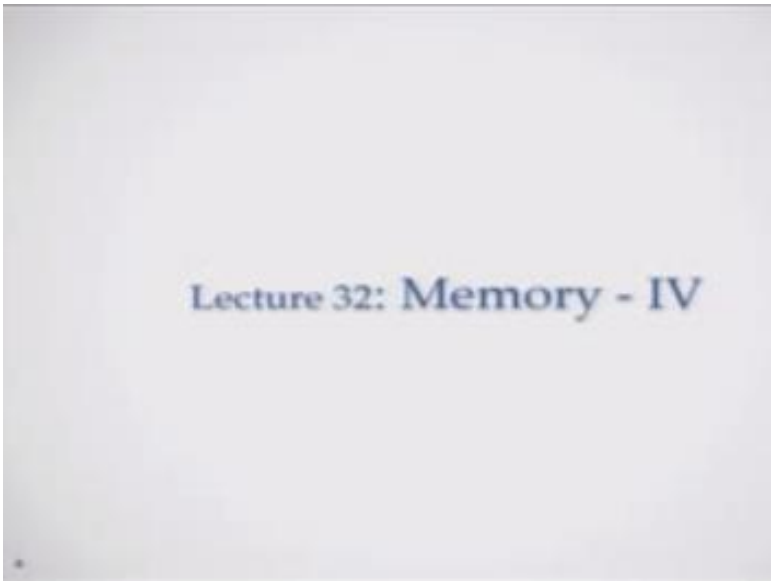

Now in the last few lectures we have been talking about memory we have talked about sensory memory we have talked about short-term memory and you have talked also about a concept of working memory. Now the sensory memory and the short-term and the working memories are still much smaller stores are still stores which hold information for not more than a few seconds and in that sense they are more akin to you know memory that comes and goes and it kind of in a more dynamic set up but what is that aspect of memory which we referred to in the first lecture as providing us the sense of continuity of life that writes as the sense of being in prices the sense of that we are X Y or Z now that kind of memory is basically referred to as what is called the long-term memory.

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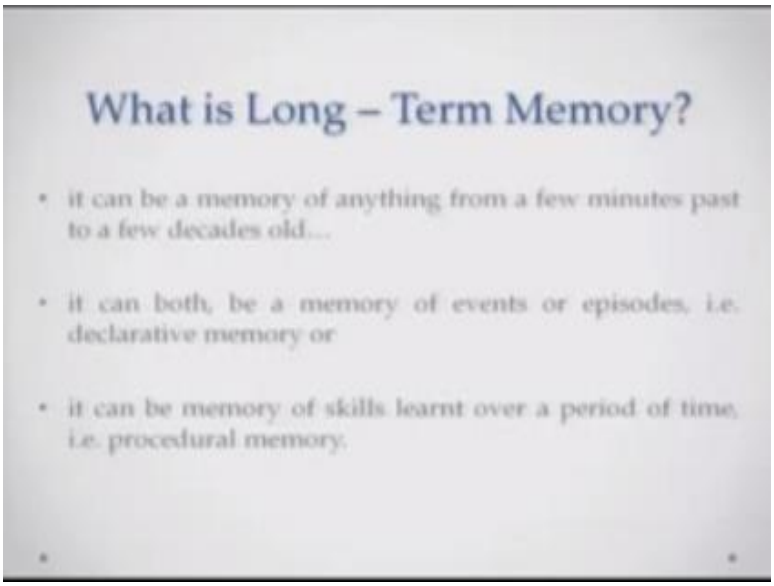

Now long-term memory can be the memory of anything from just a few minutes past to your entire life to a few decades old anything any information that you remember from so long ago also long-term working memory can both be a memory of events will your birthday when you were six years old your let us say if you got selected to a particular position or you got selected for a you know great college or something like that or say for example the memory of in India won the World Cup in you know 2000 those kind of things our memories of events or memories of episodes that basically comes under what is called declarative memory.

Now long-term memory also by the way includes the hold of skills that we have learned that we pick up while growing up say for example when you first learn to ride the bicycle or a bike or a car or those kind of things will you just you know learn to draw you learnt say for example even things like you know the way you and to speak and those kind of things. So procedural memory basically is the memory for all the skills you have gained over a period of time.

So long-term memory in that sense includes everything that you can say that this is something that I know all of your knowledge is basically pretty much in your long-term memory, now what happens if say for example your long-term memory is damaged or say for example you cannot

remember items for you know more than a very small amount of time here is an excerpt from Goldstein's book about conversation I think this is from Oliver's access book.

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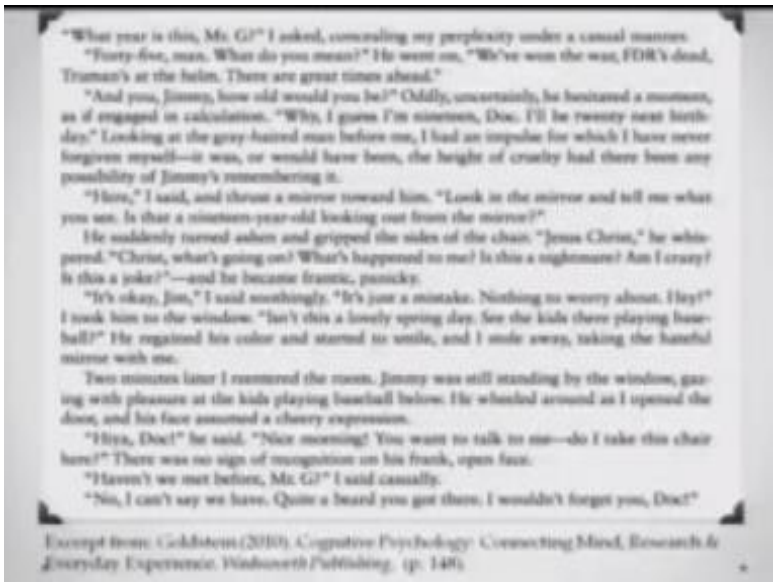

"What year is this, Mr. G?" I asked, concealing my perplexity under a casual manner.

"Forty-five, man. What do you mean?" He went on, "We've won the war, FDR's dead, Truman's at the helm. There are great times ahead."

"And you, Jimmy, how old would you be?" Oddly, uncertainly, he hesitated a moment, as if engaged in calculation. "Why, I guess I'm nineteen, Doc. I'll be twenty next birthday." Looking at the gray-haired man before me, I had an impulse for which I have never forgiven myself—it was, or would have been, the height of cruelty had there been any possibility of Jimmy's remembering it.

"Here," I said, and thrust a mirror toward him. "Look in the mirror and tell me what you see. Is that a nineteen-year-old looking out from the mirror?"

He suddenly turned ashen and gripped the sides of the chair. "Jesus Christ," he whispered. "Christ, what's going on? What's happened to me? Is this a nightmare? Am I crazy? Is this a joke?"—and he became frantic, panicky.

"It's okay, Jim," I said soothingly. "It's just a mistake. Nothing to worry about. Hey!" I took him to the window. "Isn't this a lovely spring day. See the kids there playing baseball?" He regained his color and started to smile, and I stole away, taking the hateful mirror with me.

Two minutes later I reentered the room. Jimmy was still standing by the window, gazing with pleasure at the kids playing baseball below. He whirled around as I opened the door, and his face assumed a cheery expression.

"Hiya, Doc!" he said. "Nice morning! You want to talk to me—do I take this chair here?" There was no sign of recognition on his frank, open face.

"Haven't we met before, Mr. G?" I said casually.

"No, I can't say we have. Quite a beard you got there. I wouldn't forget you, Doc!"

Excerpt from: Goldstein (2010). Cognitive Psychology: Connecting Mind, Research & Everyday Experience. Wadsworth Publishing. (p. 148).

It is basically about a conversation with a patient's of amnesia from patient of amnesia and then the author is kind of talking to this person and he basically asks him you know what year is this what is the time and this person basically has had amnesia since the age of 19 it seems so it kind of the person asked him what year is this and this patient replies it is 45 even is telling a few incidents that happened in the year 1945 and this person asks what is your age and the person and this guy replies that I am 19 years of age.

Now a lot of time has passed and this person is obviously not 19 at the moment it is many years later that this conversation is happening so our friend here the author who is having this conversation it trusts press the mirror towards him it is kind of an odd thing to do but he thrust the mirror towards me when you say is he kind of you know and it relates doing that and this patient yes really perplexed he gets really you know panicked at the sight of himself in the mirror and he has no memory since the time he was 19 to the time when say for example he is 38 or 45 or whatever point in time this conversation has been happening.

But imagine something like this happening to you know one of ourselves how would it feel say for example if the entire chunk of life is gone and it is absent and you cannot really remember anything about it that will be rather hard I would say another con with the same person say for example you know this guy the author here is trying to make him remember something so he kind of says.

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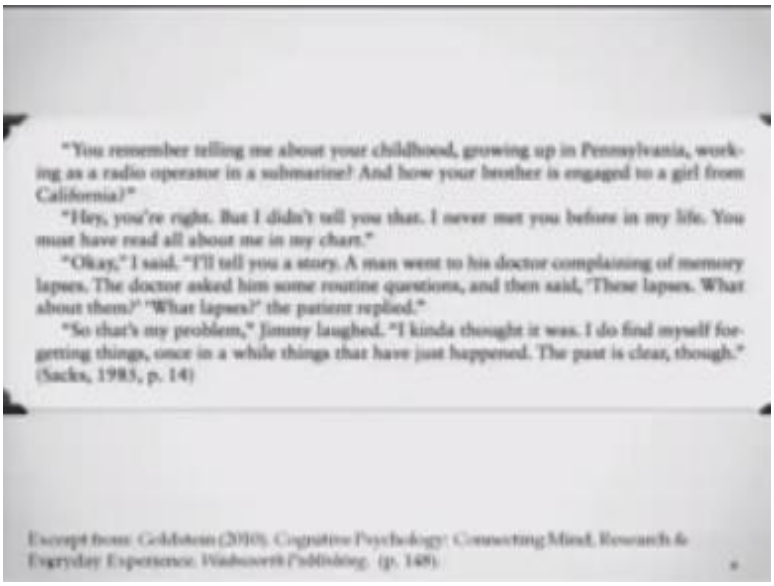

He tells to him that I remember telling me about your childhood growing up in Pennsylvania working as a radio operator and those kind of things how your brother got engaged to a girl in California so this person remembers yes you are right but wait I did not tell you that this information that you are telling me you cite but I do not have a memory of telling you all of this.

Now this is where this person the patient gets a really perplexed so the author is telling a story that a man I tell you a story that a man went to his doctor complaining of memory lapses and after he is told the doctor everything and the doctor says something the patient says what kind of lapses are you talking about. So it might be possible that the patient or amnesia and does not remember anything past a conversation and in that sense the person is living in that very short

span of time probably living that shortest man of time again because no new memories are being formed.

I remember a movie I think drew Barry more and Lee Adam Sandler appeared in this and the movie was called 51 first dates in that movie also you will find that you know the patient Drew Barry more or sorry probably Adam Sandler suffers from a particular injury in action and she suffers this kind of memory loss and the entire you know movie you will see that them, reliving that whole time of the first date they had because this accident probably happened just after the first date was completed.

Now these kind of movies and there are many movies on these kinds of things you will find you know in Hollywood and probably in Bollywood as well but what do these information tell us that memory is a very intrigued integral part of our lives and it is something that kind of forms the core of our existence and personalities. So let us now come back and try and define what long-term memory is and we have been talking about what long-term memory is about.

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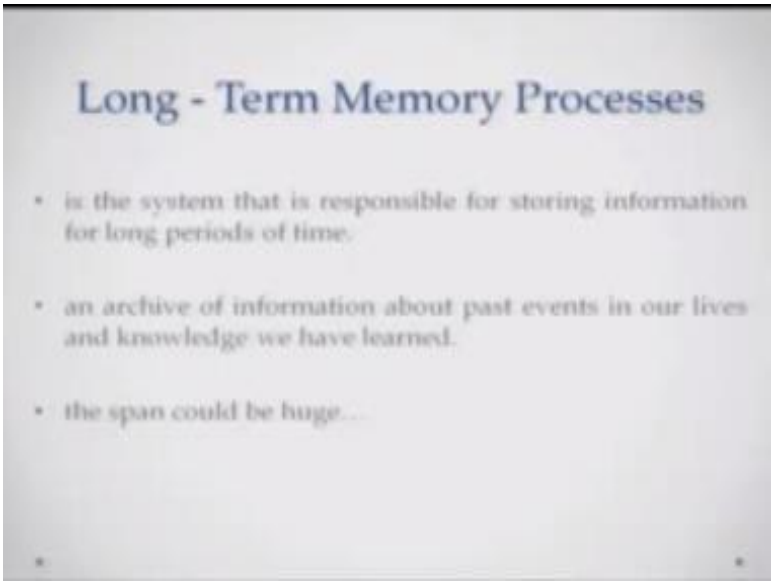

So long term memory or long-term memory processes are the processes and it is a system that is responsible for storing information for longer periods of time relevant information might not be forgotten ever but most information is stored there for a relatively longer period of time at least as compared to the short-term of working memory or sensory memory things it is supposed to be an archive of information about past events in our lives and knowledge about everything we have learned the span of long-term memory as opposed to the span of working memory your short-term memory as you have seen in the last lectures can be huge, it is probably very difficult to measure what the span of a long term memory is actually.

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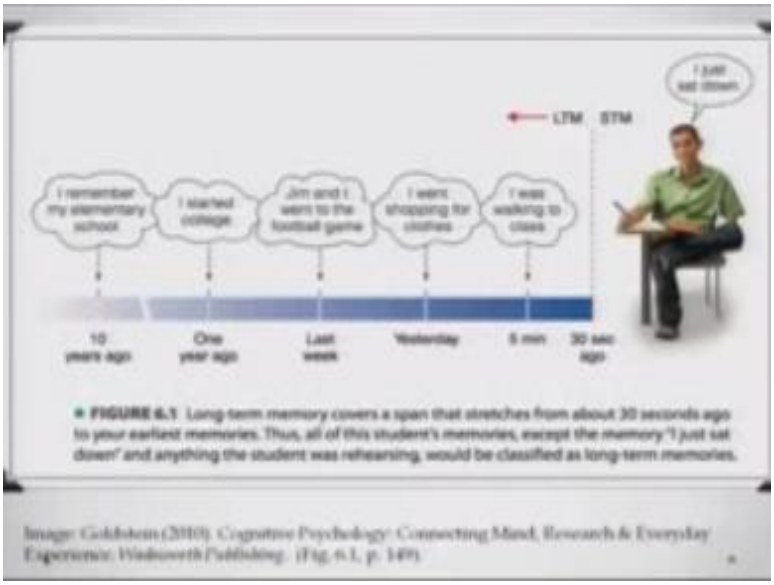

Here you can see a demonstration from Goldstein's but when this person is trying to remember what long the memory is the first aspect you know when the person just sits down on the chair is probably still in the short-term memory maybe it is going to be there up to a few seconds or maybe a minute at max but everything else since the most recent five minutes - as long as 10 years ago is all in the long-term memory.

So this is what I am going to be talking about in today's lecture that what is this what are the processes with which we store memories now we make memories in the long-term memory and

what are the processes involved in you know taking out information from there and using it and so on and so forth. Now what is the again a difference between short-term and long-term memory you can see say for example you know you meet somebody and that person you know is telling you about some particular episode.

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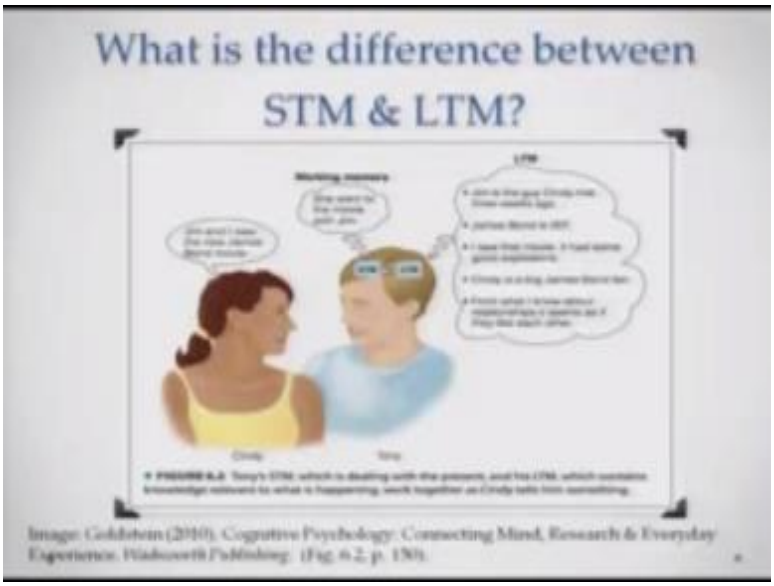

Obviously you are talking to this person you're making some judgments but in your long-term memory you're kind of trying to have all that information cells here in this conversation there is a Cindy and Tony talking. So Cindy tells that you know Jim and I went to see the first James Bond movie at the short-term at least the information that is being accessed or activated by Tony is the fact that you know Cindy went to the movie with Jim but in the long-term memory and there is this interaction obviously happening all this information about what James on James Bond is what that movie was about I have also seen that movie and judgments and decisions that see Cindy is probably a James Bond fan and those kind of things are all happening at the same point.

So all of that information is basically being drawn from the long-term memory it is sometimes it is obviously coming to the short-term memory when he is actively thinking about that and then going back to long-term memory. So this is something which you have to really you know

remember that whatever our common sense conception of memory is more basically efficiently portrayed in the concept of long-term ever any memory that we may talk about as laborers is generally and more often than not long-term memory here is the demonstration by Murdoch and in which he wanted to test the long-term memory of participants and you can also use this demonstration of on any of your friends.

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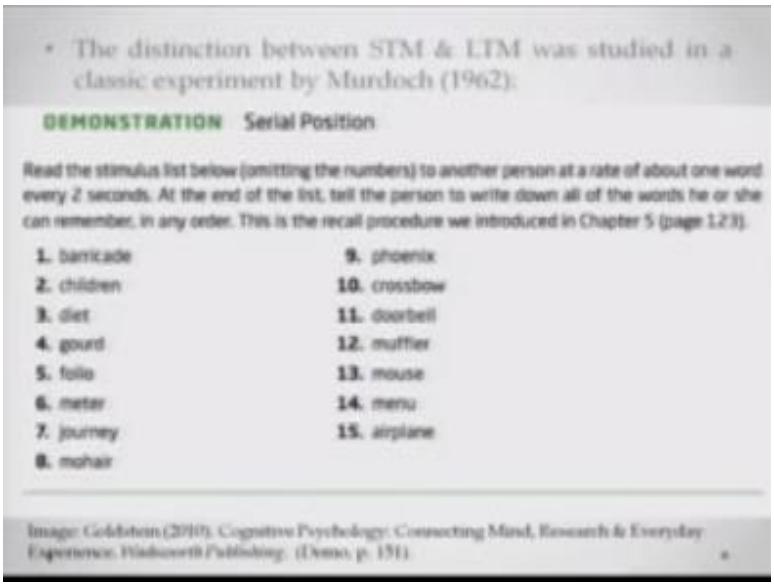

So the idea is that there are these 15words here and you try and repeat these words to one of your friends at the rate of one word every two-second and after that you ask this person to recall and rewrite those words or recall those words one after another in any order possible so the procedure will be termed to as free recall.

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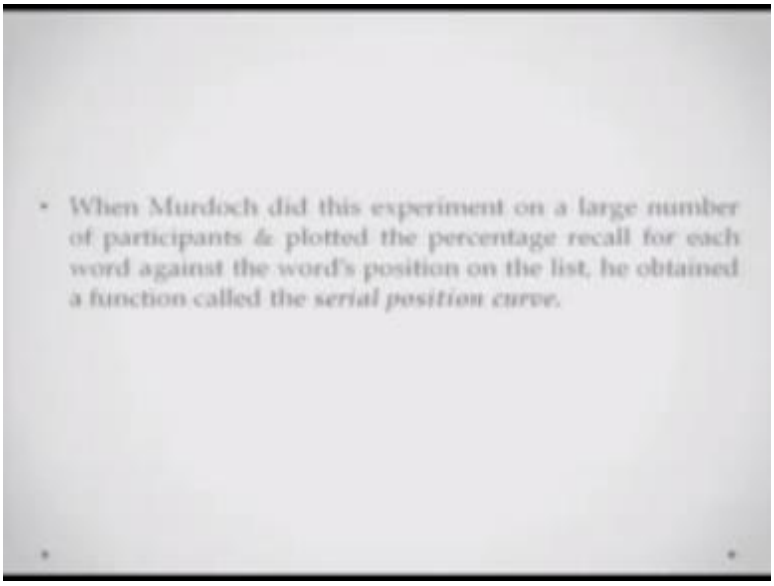

Now when Murdoch did this experiment with a large number of participants and he plotted the percentage recall for each of these words against the words position in it is in a particular in the list he obtained what is called a serial position curve. So what is the serial position curves serial position curve looks something like this.

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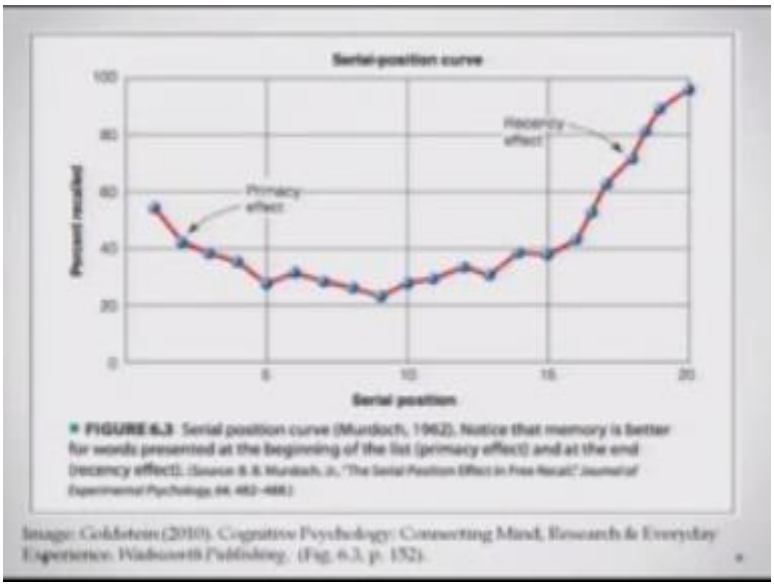

FIGURE 6.3 Serial position curve (Murdoch, 1962). Notice that memory is better for words presented at the beginning of the list (primacy effect) and at the end (recency effect). (Source: B. B. Murdoch, Jr., "The Serial Position Effect in Free Recall," Journal of Experimental Psychology, 64: 482–488.)

Image: Goldstein (2010). Cognitive Psychology: Connecting Mind, Research & Everyday Experience. Wadsworth Publishing. (Fig. 6.3, p. 152).

And wherein you will see net words in the first to fifth position or basically I remembered best and then what is remembered best is the words in the most recent conditions the words say for example in 1819 28th position or first second and third positions are those that will receive the best recall you will see the words which were told first are obviously remembered better but the best or the most recalled word are those who which are said most recently.

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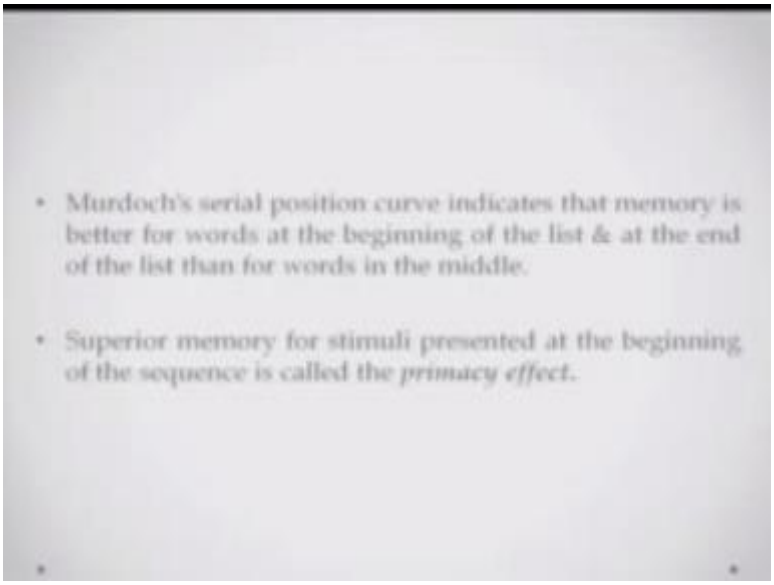

Now Murdoch's a serial position curve indicates that the memory is better for words at the beginning of the list and at the end of the list than for words in the middle of the list, so if you look at this figure here the worse in the middle of the list are the ones which are least remembered superior memory first stimuli presented in the beginning of the list has been termed as a phenomena called the primacy effect a possible explanation of the primacy effect or is basically that the participants did have the time to rehearse these words in the LTM.

So when I am saying when I am starting to say these lists this list of words say for example I'm starting to say let us say barricade children died ground folio and those kind of things as I am saying these words at the rate of you know one word every two seconds you have this chance because I have told you that I will ask you to recall these words later to rehearse these words you are probably also repeating these words at the same time while I am saying them in order to not forget them.

But when more words are added to the list your rehearsal kind of becomes lesser and lesser the words at the beginning of the list received your100% attention and received the best rehearsal but the words which came after the second third fourth fifth and tenth twelfth words they

received proportionately lesser amount of rehearsal and lesser amount of attention and that is why the recoil kind of you know decreases steadily while you are reaching towards the middle of the list.

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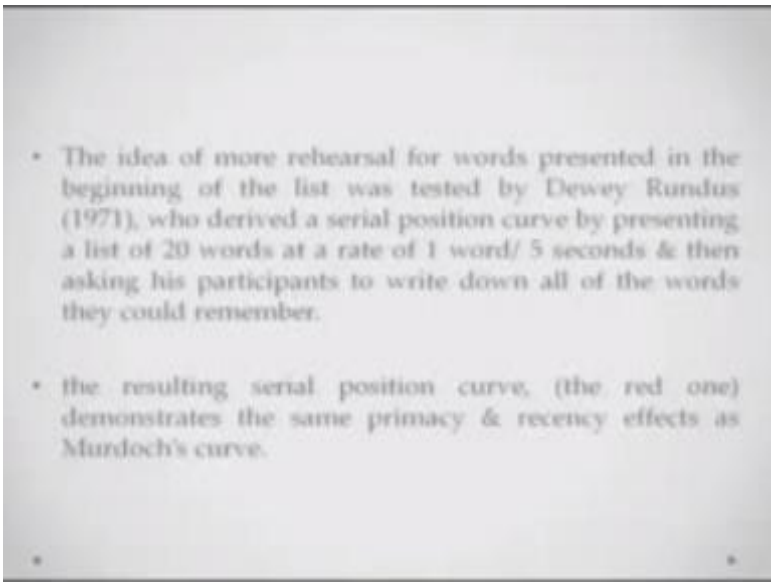

Now the idea for more rehearsal of words the day we run just wanted to test it and he again derived a serial position word by presenting a list of 20 words at the rate of one word every five seconds in a time for rehearsal and then he has his participants to just write down all of the words the serial position curve the red one here you will see.

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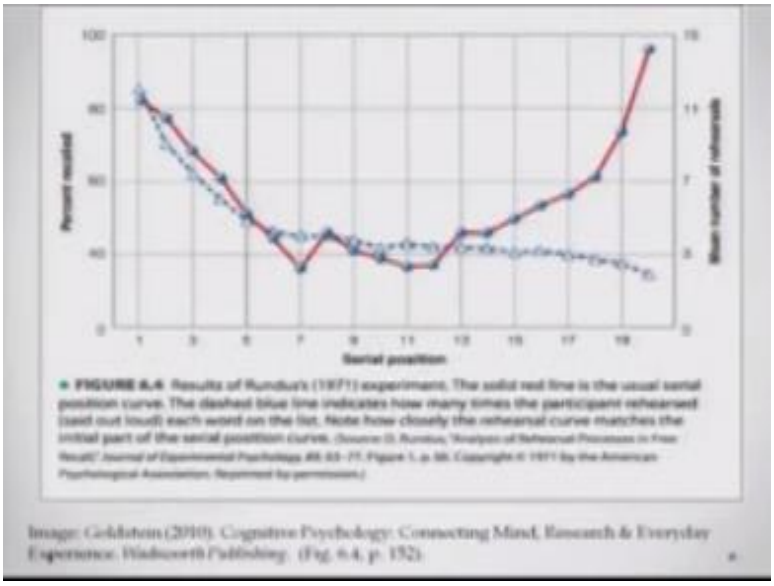

Image: Goldstein (2010). Cognitive Psychology: Connecting Mind, Research & Everyday Experience. Wadsworth Publishing. (Fig. 6.4, p. 152).

Basically came out pretty much the same as the curve that was gained by Murdock.

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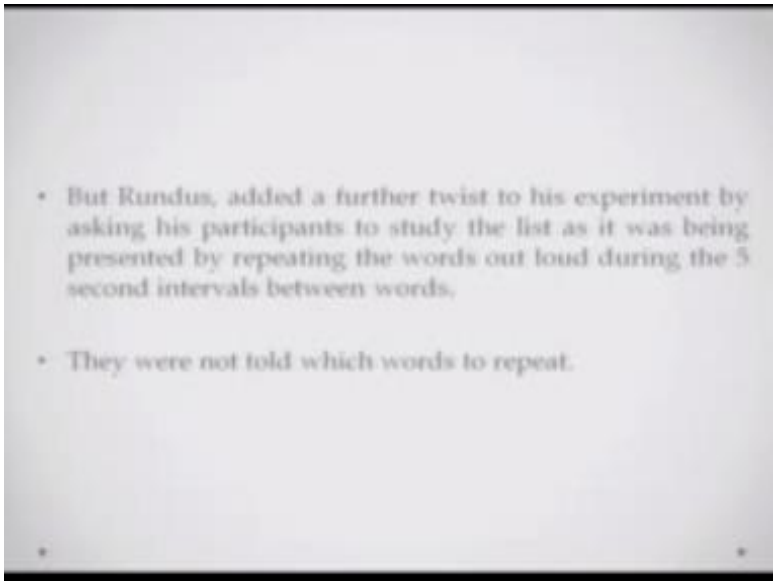

Now run d as actually he added a small twist to his experiment by asking his participant to study the list as it was being presented by repeating words out loud during the five-second interval between words so he said that while I am you know repeating a word every five seconds during that five seconds you repeat whatever words I have already said they were not told which specific words to repeat they could probably the parts were free to repeat whatever words they would want to hear is you can see the performance the dashed curve here which you see the blue one.

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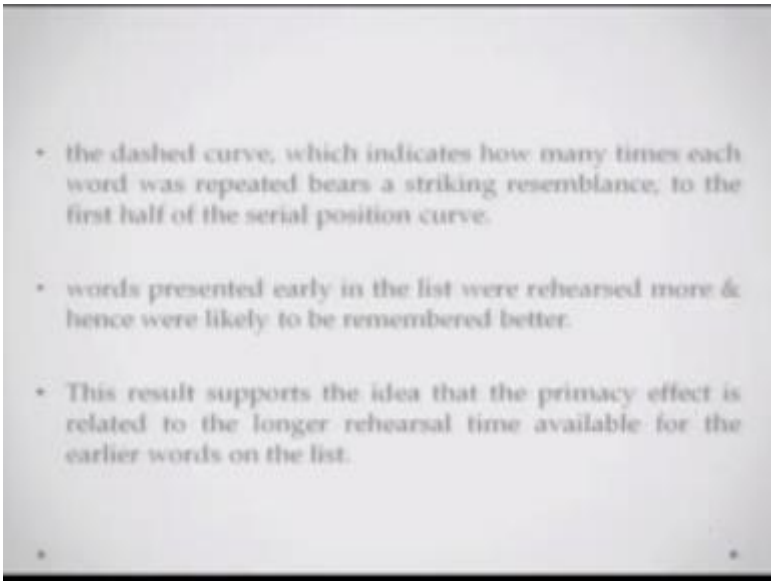

Basically indicates how many times each word was repeated and it was found that how many times the number of times each word was repeated very striking resemblance to the first half of the serial position. So you will see this if you notice the first half of the serial position curve tells you that the verse in the beginning of the list were remembered better now because you know that which are the words most rehearse you see that these are actually the words which were most rehearse.

So the amount of rehearsal for the words at the end of the list is the lowest the amount of rehearsal for the words at the beginning of the list is highest and in that sense this amount of rehearsal may then very well be you know used as the reason to account for the primacy effect. Now this is how you know you can see that very cleverly designed experiments can tell you a lot about mental phenomena.

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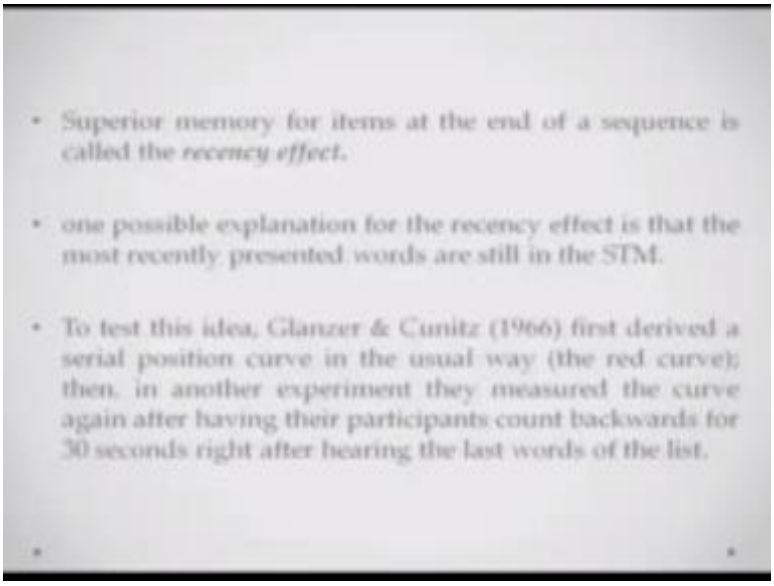

Now superior memory you have seen also in the same figure here that there is very good memory that is very good recall for words at the end of the list, so superior memory for items at the end of the sequence or the list is called the resence effect one possible explanation for the recency effect is that some of these items are still present in the short-term memory that is there but Glanzer and Cunitz wanted to test this idea.

So they first derived a serial position curve in a usual way and I will show you that figure very soon and then what they did was in another experiment they measured the curve again after having participants count backwards for 30 seconds right after hearing the last word of the list so that there was no rehearsal or no maintenance happening for these words at the end of the list.

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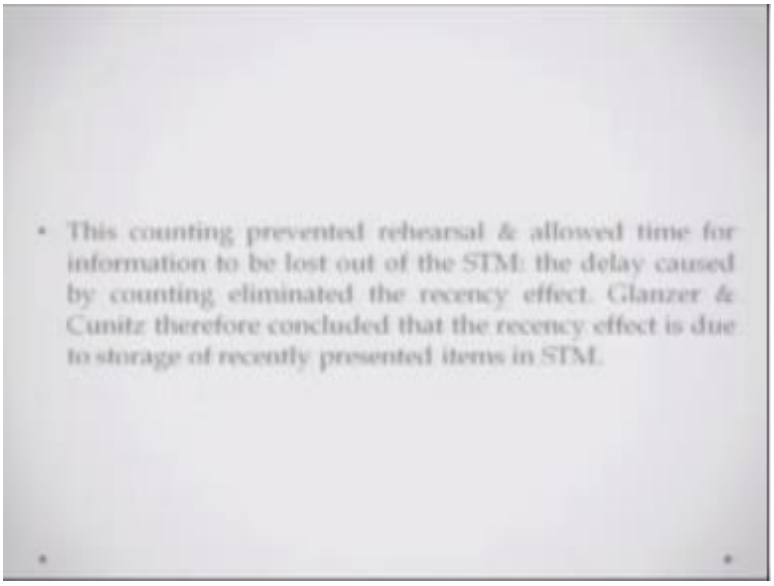

This counting prevents the rehearsal and allowed time for information to be lost out of this short-term memory and then this delay caused by counting eliminated the recency effect so there's no recency effect in the curve that you see is obtained by claims or include units. So you see you can obviously manipulate the amount of result that is gained and that amount of rehearsal is certainly going to you know play with the amount of recall that is going to happen. Now let us talk about how you store information in long term how do you push information to the long term and we will talk about that.

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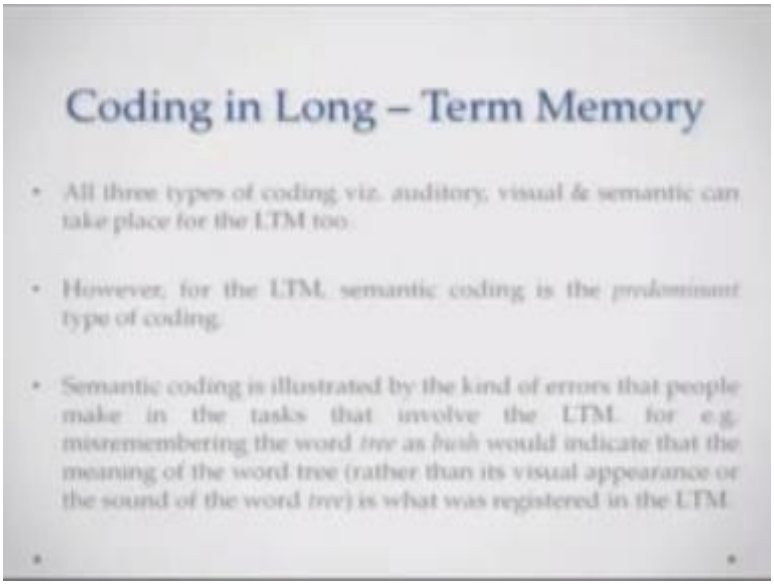

Now all three types of coding auditory coding that is by virtue of sound visual coding by virtue of visual perception and semantic coding that is by meaning can take place for the long-term memory as well but the preferred coding strategy for information the long-term memory has to be semantic coding. Because if you analyze the words for their meaning if you analyze how new information is related to the older knowledge that you have already had that will basically you know very deeply plant the new information and your recall will be better and you might be able to remember this information a relatively longer time.

Now semantic coding is basically illustrated by the kind of errors that people do the kind of errors they mistake in these kind of recall tasks which involve the long term memory say for example miss reading words like tree as bush will indicate that the person got the gist of the meaning of what the tree is but he probably did not remember the exact were kind of confusing two words which mean alike.

So maybe that is why you got infused between the tree and the bush, so you are not remembering the exact word but you are remembering the gist of the idea.

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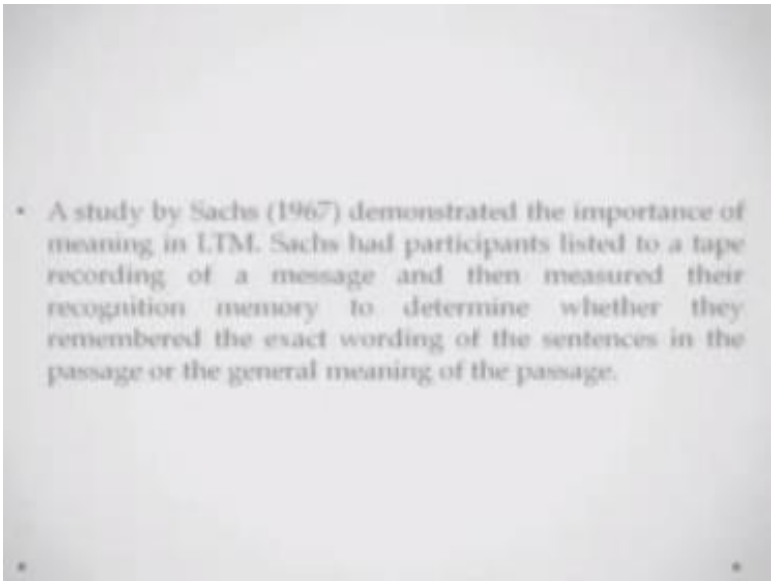

That is how semantic encoding is achieved a study by a Sachs in 1967 demonstrated the importance of meaning in the long term memory sax had participants listen to a tape recording of a message and then measured there cognition memory to determine whether they remember the exact wording of the sentences in the passage or the general meaning of the passage.

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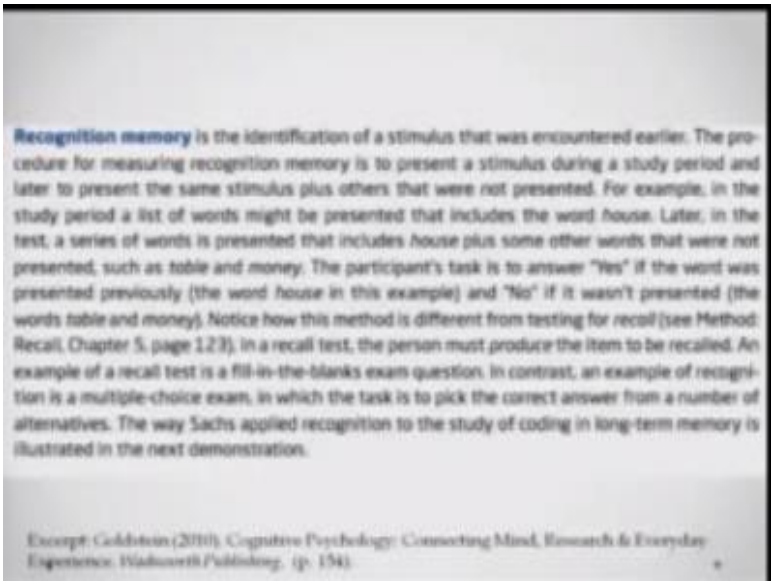

This demonstration of our say for example when you really want to check for somebody's long-term memory one of the ways to do that is basically testing for a recognition memory recognition memory basically is just that if you have remembered a list I will give you a couple of you know proms I will give you some cues and then I will basically asked you whether these two items were the items that were presented in the initial list that I asked you to memorize that is pretty much what the recognition memory is about.

And this is different from recall memory because recall memory I am not giving you any cue I am just asking you to remember right out of your memory whatever I had told you earlier if you have played or if you have you know watched say for example TV a program such as KBC you will see there is they are basically checking for the recognition memory or not really the recall memory now an experiment similar to what Sachs did?

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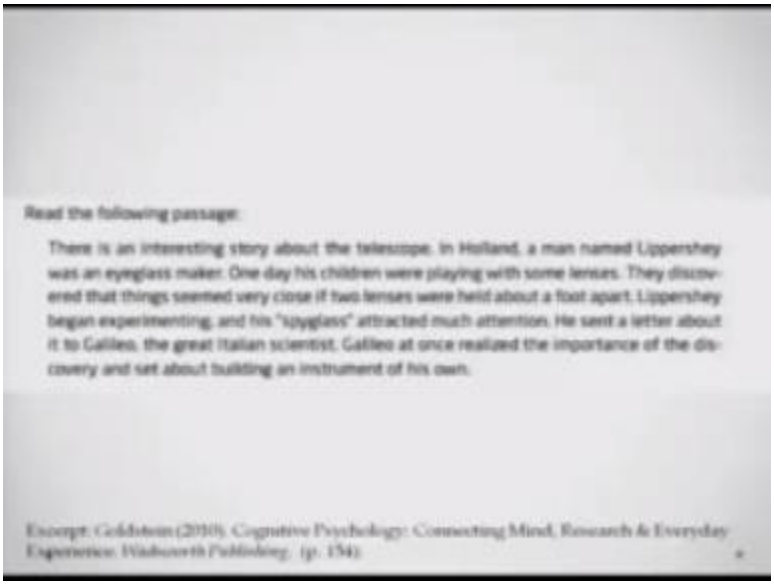

So I am going to tell you a story avail a small story I will take a bit of a test so in Holland a man named Lipperhsey one day his children were playing with some lenses they discovered that things seemed very close if two lenses are held about a foot apart, Lippershey began experimenting and his spyglass attracted much attention he then sent a letter about it to the Galileo an Italian scientist Galileo at once realized the importance of the discovery and set about building an instrument of his own.

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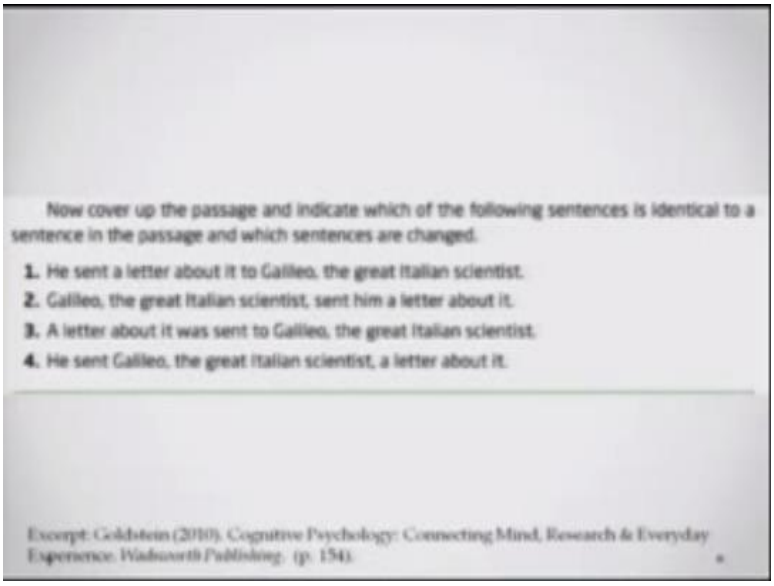

Now this was the passage now can you tell me which exact sentence indicates which in basically and how this is changed, so now you have covered to the passage and now basically you have to indicate which of the following sentences is identical to the sentence in passage and which sentences are changed. So he sent a letter about it to Galileo that great Italian scientist Galileo the great Italian scientist sent him a letter about it a letter about it was sent to Galileo the great Italian scientist and he sent Galileo the great Italian scientist a letter about it.

Now which of the ones is the sender's that is exactly mentioned in the passage earlier so I think this one he sent elated about the first one is basically the correct one a lot of people kind of mix it sentence one is the only one that is identical to the one in the passage.

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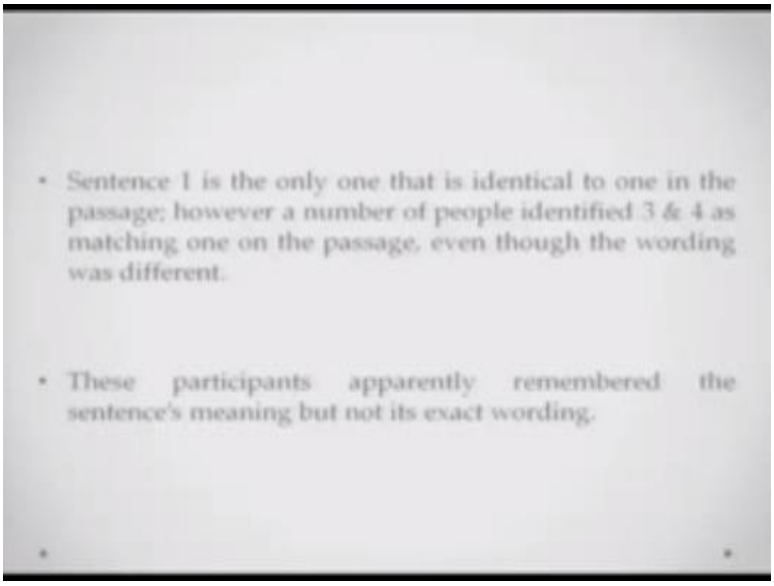

However a lot of people identified numbers three and four as the matching as matching the one on the passage even though the wording was different why are they doing this it is just said right away one of the reasons could be that these participants are apparently remembering the gist and the sentence is meaning but not its exact wording this is pretty much how we store information in the long-term memory.

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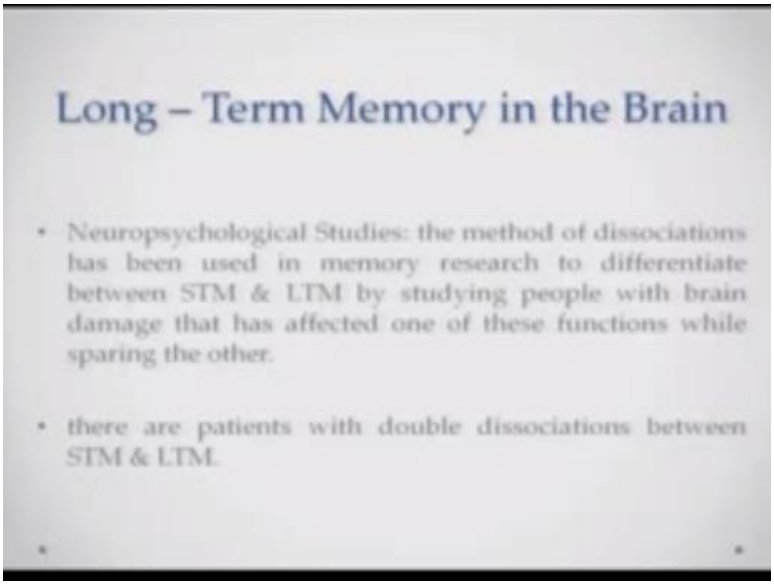

Now coming to long-term memory and the brain there have been neuropsychological studies about investigating things in the brain, the method of dissociations has been used in memory research to differentiate between short-term memory and long-term memory by studying people with brain damage that has affected one of these functions by sparing and sparing the other. So there could be patients whose short-term memory is impaired but long-term is intact the might be patients whose long-term memory is intact but short-term memory is impaired.

So there was a very famous patient called Henry Melissa and Glenn Humphreys was a very famous psychologist who worked with him all his life now HM basically and has been referred to as hm ever since so Hm basically was having seizures.

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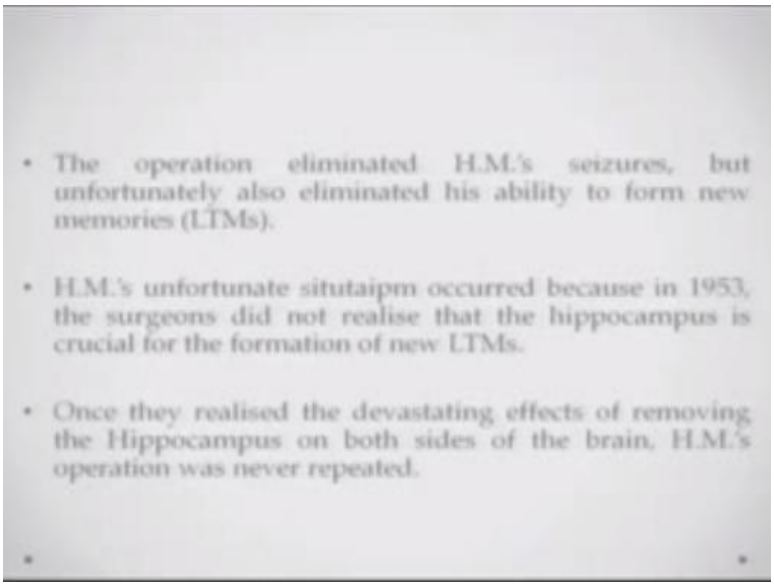

And what happened was that he was having these epileptic seizures and the doctors of that era and they basically eliminated part of his temporal frontal temporal lobes where in the memory was supposed to be there, so that operation that was basically meant to eliminate his seizures also unfortunately eliminated his ability to form. New memories now it seems unfortunate situation occurred because in 1953 the surgeons did not realize that the hippocampus is crucial the hippocampus got removed safer campus is crucial for the formation of new long-term memories once they realize the devastating effects of removing the hippocampus on both sides of his brain HMS operation was never repeated on any other patient ever.

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Here is a picture of Henry Molaison he died recently I think a few years ago while still being a subject of one of the studies he a lot of memory research has been done with the help of HM another way in which a long-term memory has been studied is by using methods of neuro imaging.

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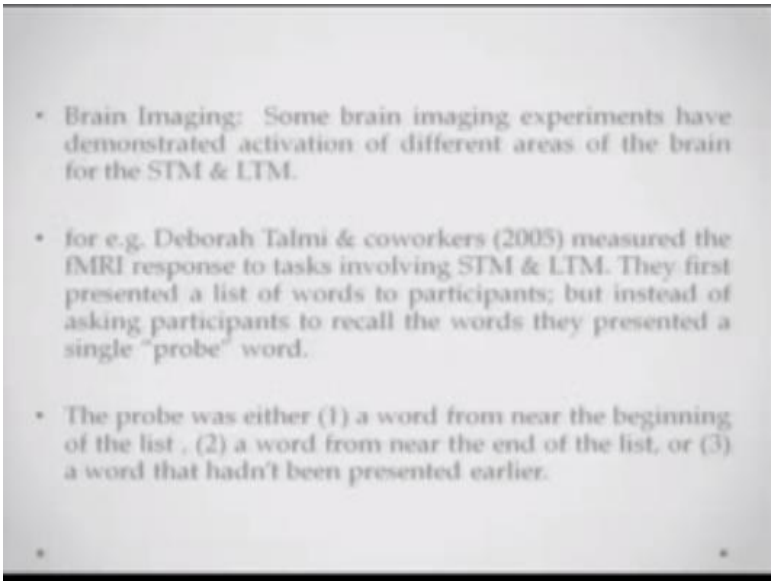

Some brain imaging experiments have demonstrated the activation of different areas of brain for short-term memory tasks versus long-term memory tasks so for example Deborah Talmi and colleagues measured the fMRI response to a task involving short-term memory and long-term memory he first presented a list of words to participants but instead of asking the wordsmiths to recall the words they presented a single probe word so they are looking for any cognition test the probe was either a word from near the beginning of the list or a word at the end of the list or a word that had not been presented earlier at all.

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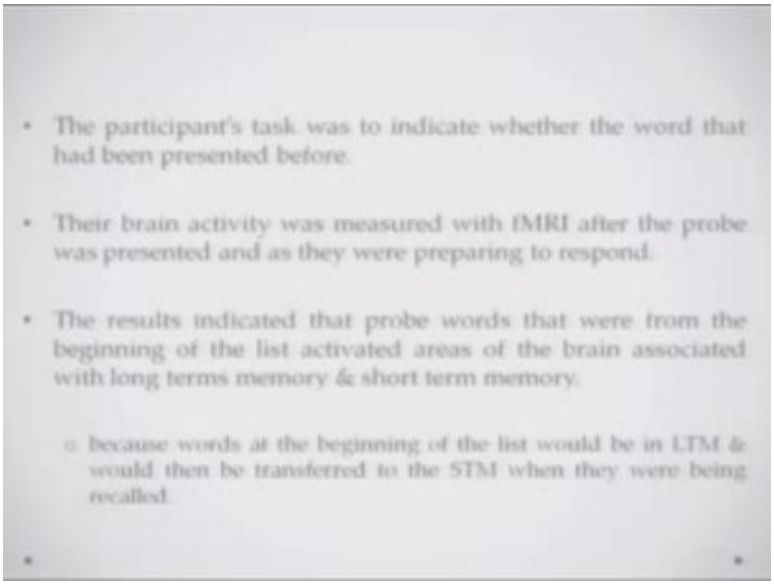

The parts minced asked was to indicate whether the word has been presented before, so a very simple task based on recognition memory now their brain activity was measured with fMRI after the probe was presented and as the participants were preparing to respond the results indicated whatever they found out with respect to brain activations indicated that the probe words that were from the beginning of the list you know activated areas of the brain associated with long-term memory and short-term memory because words of the beginning of the list would be in the long memory and would then be transferred to the short-term memory because they are being recalled.

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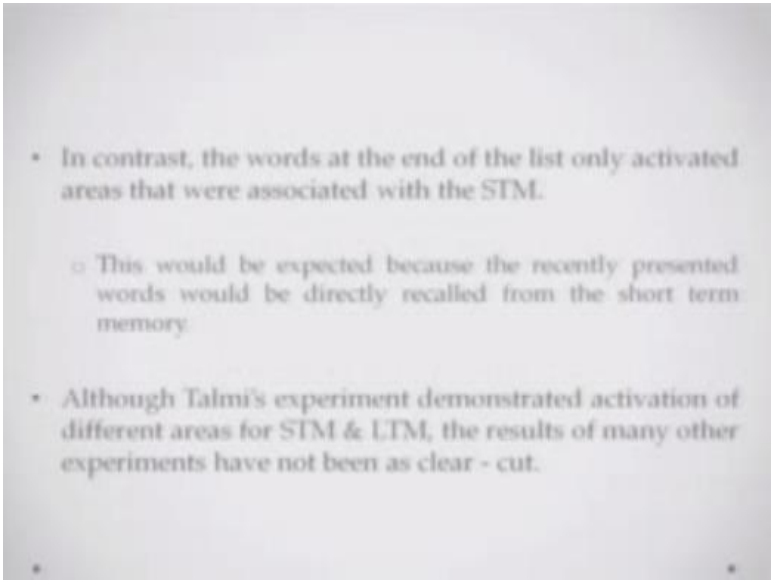

In contrast the words at the end of the list only activated the areas from relevant to the short-term memory because these words have not already got to the long-term memory all the Talmi's experiment demonstrates very well the activation of different areas for short-term and long-term memory the results of many other experiments have not been really as clear-cut now you can probably think that this might be the case because short-term and long-term memories might not be as disconnected from each other as a theoretical model would you know make it to be this is all about long-term memory and I hope you kind of followed what long-term memory is about and how it is important in the next lecture we will start talking about some other aspects of memory, thank you.

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