Indian Institute of Technology Kanpur

National Programme on Technology Enhanced Learning (NPTEL)

Course Title
Basic Cognitive Processes

Lecture-29
Memory- I

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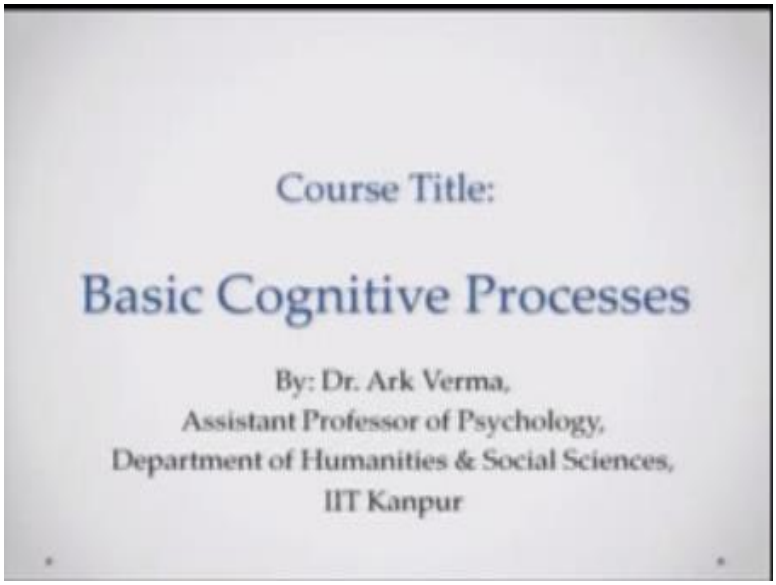

Hello everyone welcome to the course on basic cognitive processes I am Dr. Ark Verma from IIT Kanpur I will be talking about.

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Memory today now we have been in this course talking about different cognitive phenomena and what those cognitive phenomena mean to us and how do they help us live our lives how do they help us interact with the environment, now if you actually take a survey of whatever mental processes one does and whatever these mental processes help us achieve in life help us do memory appears to be a very interesting one why because memory is probably the all pervasive mental phenomena.

That is going on all the time today we will try and see what memory is about generally if I were doing it in a classroom I would ask you to generate a definition of memory, so what you can do is decide how you define memory quickly generate a very small maybe a one liner or a 2 liner definition of memory and keep it in your mind while I talk to you about you know something and how formerly memory has been defined now it is going through you know when I was going to make this thing there is this court of Tennessee Williams that I found out and Tennessee Williams says very interestingly.

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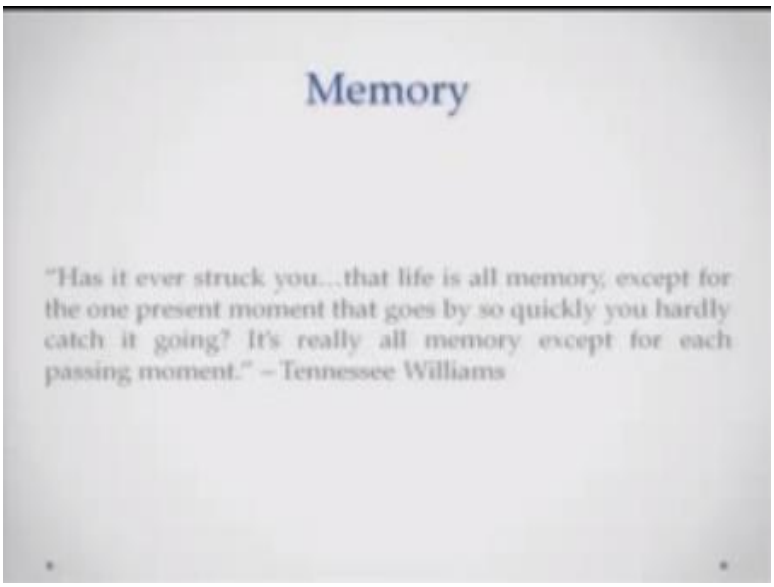

He says has it they were struck you that life is all memory except for the one present moment that goes by, so quickly that you hardly catch it going it is all really a memory except for each passing moment, now if I were to ask you which is that mental phenomena which is that cognitive process that gives you the sense of safe that gives you the same that sense of continuity that you are existing in this world that you are the same person that you were yesterday and say for example by replying about your future you will be the same person that you today are.

Everything that you know about this world everything that you have ever done everything that you have ever experienced say for example seeing heard tasted smelt everything that you have done on the face of this earth till this particular point in time while you are watching this particular lecture is all part of your memory obviously it might be different that you might recall some parts of those things very vividly some of those things not, so vividly but they still stored somewhere at the back of your brain.

Somewhere in the in your head and they form what is called memory in this particular chapter while talking about memory I will talk to you about, say for example the processes that help you store this information the processes that help you organize this information and also the

processes that help you use this information to do a variety of things say for example I give you a task hereto add two plus two to do some multiplication or, let us say to tell me a story or if I ask you to you know describe me what you did last evening anything that I will ask you to do will require you to draw on your memory and will require you to actually you know use your memory.

To look into this you know in the shells of the memory and bring out information, also if I do not ask you to you know do anybody do not ask what I say where exam will give you an apple to eat you will need to draw on your memory that Apple is the fruit and it is edible to actually act on that particular Apple again you are using some of your knowledge something that Is there some part which is you know obviously part of your entire larger memory system to be able to do anything.

That you would want to do a lot of people would say that even processes like thinking and you know dreaming and deciding have a lot to do with your memory whatever experiences you had overtime, how have you organized those experiences which of the experiences which of the you know events you have found that were very important to you have still you know been kept almost as vivid say for example I you know asked you to describe to me you know a vacation or a holiday that you spend at least five years.

Or ten years ago and tell me in great detail about what you did during that vacation if that holiday were you know a particularly pleasant or even in some sense unpleasant experience if it was salient, and if it were distinguish able for all the mundane everyday activities it is quite possible that even though the holidays 10 years or 15 years or 20 years back from, now you might be able to you know recall it you might be able to really vividly relive it in the current moment by drawing upon your memory.

So in this chapter we will be spending a lot of time about you know talking about different aspects of memory in the first few lectures, I will be talking to you about a particular model of memory that was given by Atkinson and Shiffring wherein they basically divided memory into sensory and short-term and working memory we will talk about that we will going further talk

about you know long-term memory as well which is basically about the information that you have you had kept for a longer time, we will be talking about errors in memory we will be talking about what does the brain have to do with memory what happens with when a particular area the brain is not responding.

We will be doing all of that in the course of the next few lectures and basically trying to understand how memory as a cognitive function really helps us you know find that sense of continuity of life find that sense of you know being who we are, so with that kind of background with that kind of you know in formulas background let us try and define what memories I am hoping that you had kept at too liner definition aid in mind and I am now asking you to match that definition with the definition I am giving up here so my definition of memory again.

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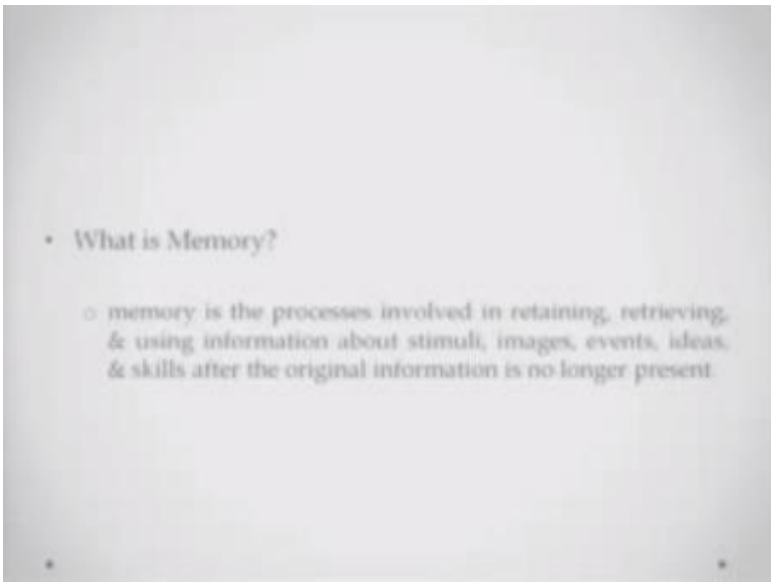

May be picked up from a particular book is that memory is the process involved in retaining retrieving and using information about stimuli images, events, ideas, skills and a lot of things you might add after the original information is no longer present that moment has passed that stimuli is not in front of you anymore or say for example that simply has come to you after a long time all of these thing show do you retain that information, how do you retrieve that information from

the back of your mind and how do you start using that information suppose you met somebody you know two years ago on a particular railway platform or maybe in a theater and, now you made him right in front of your house doing something and you kind of realize.

I said this is the person I know and you are kind of going to talk to this person, so all of those kind of things everything in that sense that you are going to do will draw upon your memory, now there is an interesting case of a patient called Clive fearing is probably referred to as the ten seconds man or the seven seconds man you can find you know a video documentary of his on YouTube Clive hearing what a man basically he had you know a particular kind of amnesia a disorder of memory where he could not recall anything for more than a matter of 10 seconds.

Now Clive fearing was maintaining a particular diary and one of these people went through his diaries and there is an excerpt there is a description, you know office diary right here and let us read it to you to give you a perspective of what happens when memory is actually not around when memory kind of gets damaged in a particular way.

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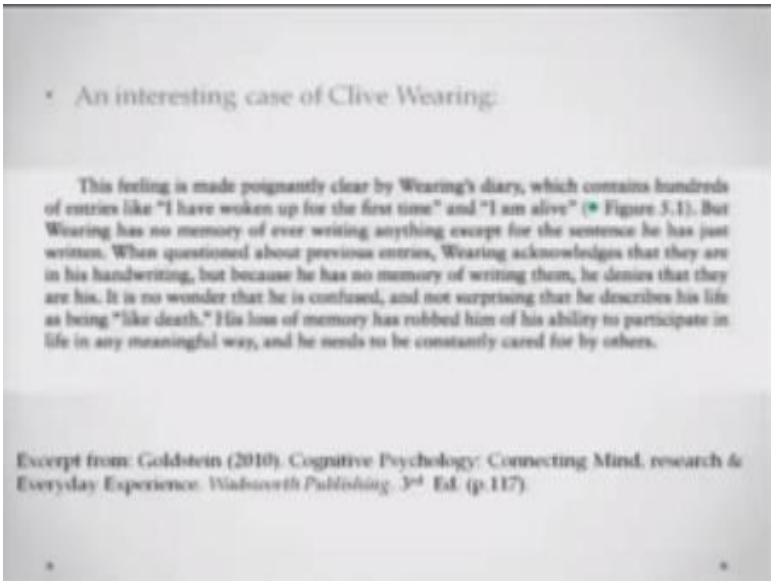

So this feeling of that loss of continuity this feeling of loss of the sense of selfhood can really exist which is you know made really abundantly clear by if somebody goes through Clive earrings diary and it contains hundreds of entries it contains hundreds, of entries and encoding I have woken up for the first time I am Alive or things like that he has no memory of who he is he has no memory of any pas the has no hopes of remembering anything in the future and those kind of things what does he do how do how does.

He maintain his type it is a very interesting documentary I am sure you find it on YouTube if you look for it, so Clive earring has no memory of ever writing anything it is a except for the sentence that he is just written so you give him history that you have been maintaining this very all why I turn through those faders as if it is some strangers very as if it is saying that you know seeing that Daddy for the first time as if he is writing anything ever for the first time people have tried to question Clive hearing people have tried to question him about this you know previous entries.

And fearing then acknowledges that they are in his handwriting so he remembers this is my handwriting but because he has no memory of writing them he denies that there is, so even something that is happening right in front of you imagine if you cannot really recognize that is it you or is it somebody else or you know does it really belong to you that is that kind of is a very major setback now it is no wonder you know if somebody has that kind of a memory loss and the kind of loss that bearing is having is really confused and is not surprising that he describes as being like death.

His loss of memory has robbed him of his ability to participate in life in any meaning full way and it needs to be constantly cared for by others, so memory in that sense is that cognitive functions if I may take the liberty of saying so on which all the other cognitive functions are actually based and are functions like you know the operating system is like the background against which all the other cognitive and mental activities are taking place and everything is taking place in this you know in the reference or in the frame of this particular memory, so in that sense I think if talked enough about how important memory is you know as a cognitive functions and I think that will be reflected in the amount of time we kind of are going to talk

about memory and the different aspects of memory in you know this part of the course, now if I can simplify and if I structure try and structure this memory for you how would you know really organize memory a very simple way of saying this is using the help of English they could be the present or the present tense.

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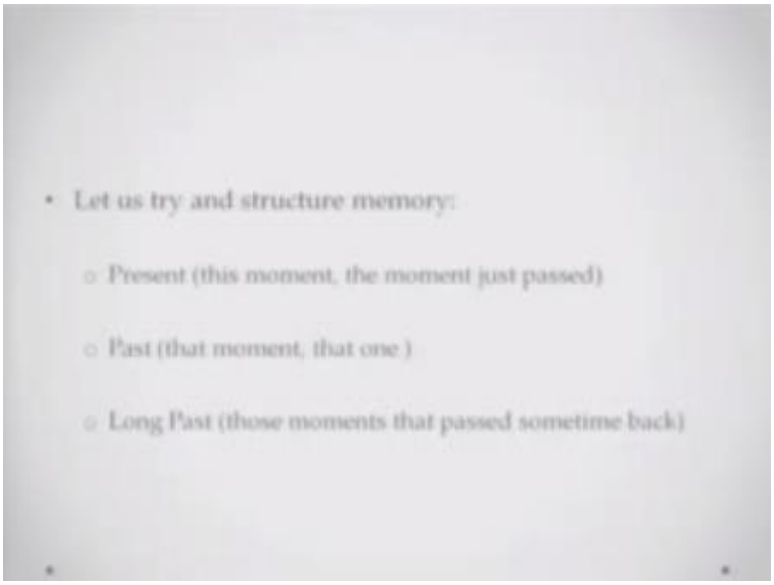

A for example this movement at this moment and the moment and actually just past as I was saying it so the past is already as recent, so that moment the one that past and the long pass will be that moment say for example when I had begun this lecture, so memory in that sense can be always into present and past and something that long past okay because memory is only about things that you have already experienced it does not really have that you know any sense of future or thinking.

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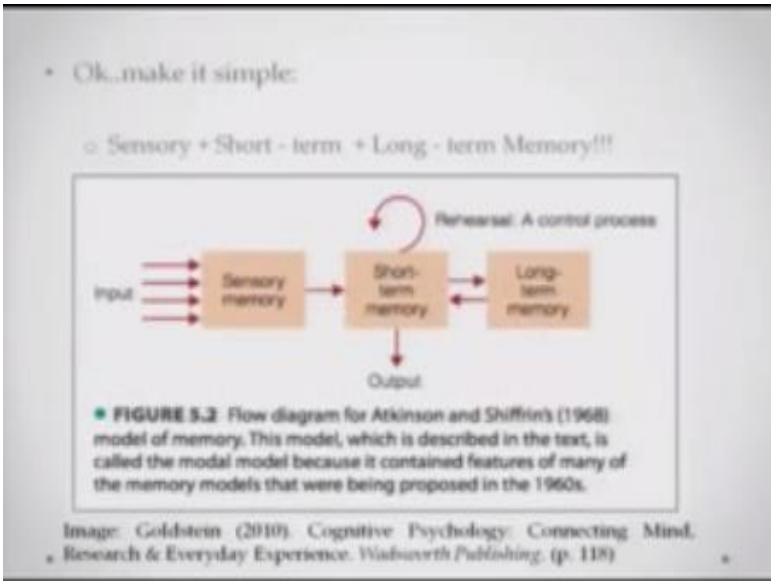

Or something like that now, here is the flow diagram of Atkinson and Shiffrins model of memory and this model again this figure is drawn from Gold stein's book on cognitive psychology here and you can see there are three aspects of memory that Atkinson and Shiffrin define they say there is at least three parts to memory the first part is sensory memory, so as you are experiencing the world through your five senses there is information that is imprinting impinging on these senses and while this information is impinging on your senses.

You might have a recollection of them and that is what is your sensory memory it is very little and we talked about this pan and those kind of things in today is lecture at a later point in time the second important aspect of you know memory that Atkinson is identifying is the short-term memory there in some information for a very short term you probably want to do something with that information use it in some particular way the third is long-term memory things which have you have experienced long back are not really very long back things.

Like starting from you know a few minutes to a few hours to a few decades and you see that there is a constant you know give-and-take between short-term memory and long-term when you say for example today I ask you about your address about where you are living or where you are

living five years ago you will draw that information from your long term memory bring it to the short-term memory and give me a particular output, so you see the output is linked to short there will be anything that is performative anything that you are doing in this world will draw on what is called your short-term memory input is a first address at the sensory stage so that is your sensory memory.

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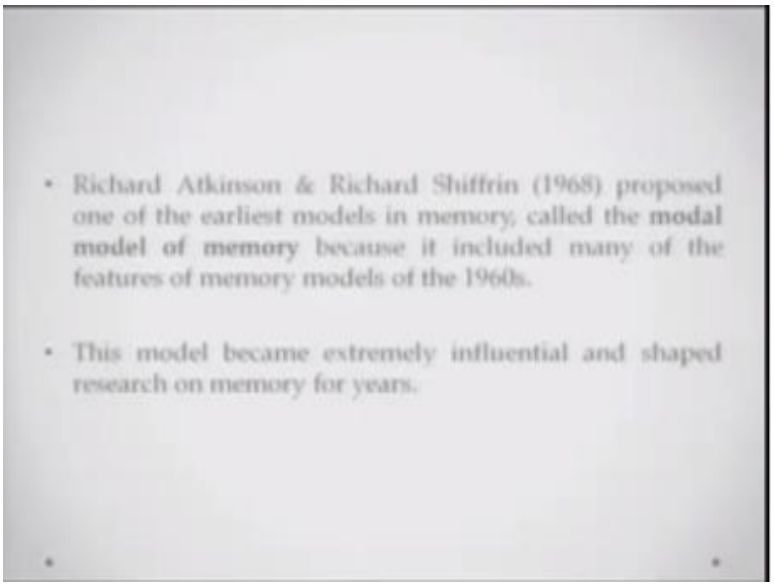

So Richard Atkinson and Shiffrin they gave this model in 1968 and this model was referred to as the modal model of memory because it included almost everything or almost the different kinds of features that were present in memory models of those days, this model had been extremely influential and kind of shaped and gave direction to memory research for a lot of years for many years that were to come.

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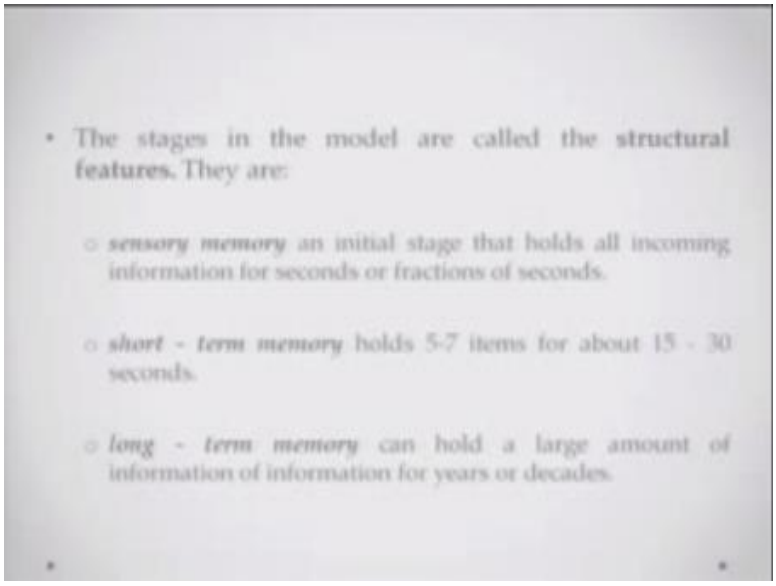

Now the stages in this model are called structural features so these are components of memory so to speak, so the first component is sensory memory sensory memory is that initial stage that holds all the incoming information from the sensors remember I have not talked about attention yet so I am talking about all the information that is coming in that stays for around almost just a fraction of a second or just a few seconds this is what is your sensory memory from sensory memory if you for example attend some informations.

It goes to your short-term memory it is held there for around 15 to 30 seconds and it has a very small capacity of around five to seven items, so how the sensory information is passing from the sensory memory coming to your short-term memory for further processing but it still stays there is no for not more than 15 to 30 seconds the important part the part on, which we draw upon for doing anything is called the long-term memory the long-term memory can hold a large amount of information over years.

Take is you know if I if you were say for example 25 years of age if I ask you things that happen to you while you are 5 years of age you will at least remember some salient things maybe you will remember something very specific from your childhood that where is there has it been all

divided because you are not constantly thinking of that thing while you are living your life so it was tucked away very safely very you know in a very well-organized wakes in somewhere in the back of your memory a scope or memory store and given a particular cue given a reason to recall it you will certainly recall it.

So that is what long-term memory is there is no real you know not a lot of studies done about the you know limitation of size in this long-term memory but certainly any information past 30 seconds or past one minute till you know maybe the time since you were born is all there in your long-term memory now Atkinson and Shiffrin also describe the memory system as including what are called control processes.

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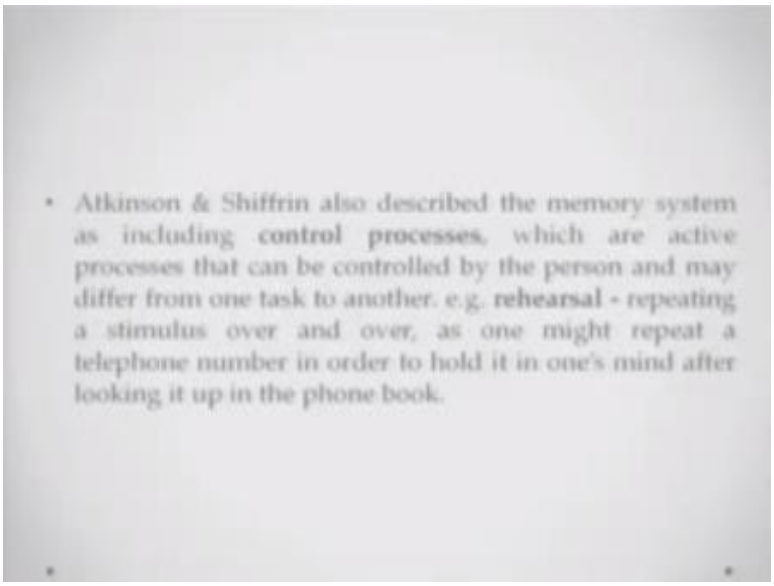

So they said if there are these control process which are active and they can be controlled by the person and then may differ from one task to the others if I am giving you a particular task to remember something to remember a set of digits to remember a particular number of words or sentences you might engage in what is called rehearsal what is reversal it is really simply what people do repeating a stimulus over and over again as one might repeat a telephone number say for example in order to hold it in one is memory and so that one does not have to look in the

phone book okay say, for example if you were on phone somebody is telling your particular you cannot find that paper you might want to keep repeating that number till the time that you get a you know paper or pen or say for example till after you have cut the call and you can see that in your mobile phone.

Let us take an you know an active example again borrowed from Goldstein's book say for example there is a girl called Rochelle and she wants to you know look up its area.

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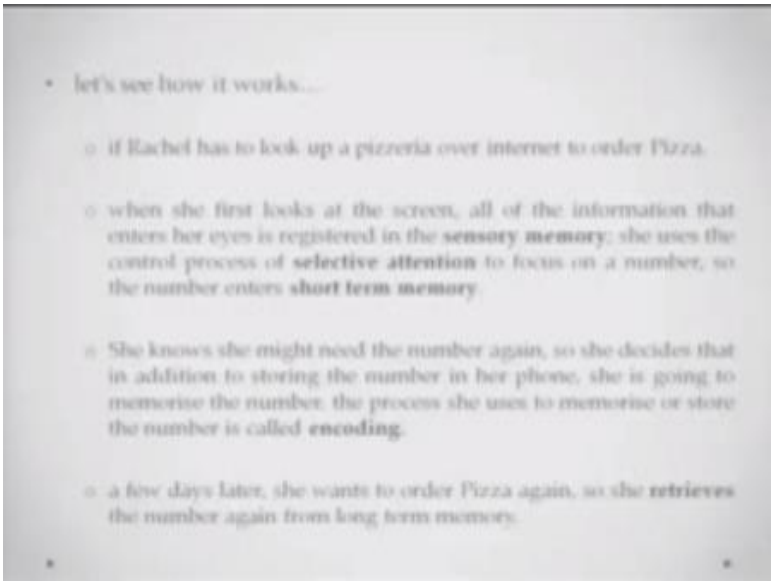

In order to ask for a pizza so what is he would do is she was on the internet she looks on the screen all of the information that enters her eyes is registered in what is called the same cinema so if you are looking at a particular page on the internet you kind of all of that you know the sentences and everything is coming into your eyes that is what is called this century every information is getting registered is the sensory memory now she has to use the control process of selective attention.

Because she wants to look for a particular pits area or she would not says he gets attracted by a unique name of a particular pits area, so she does that she focuses on one particular number and

because she is focusing on this particular number this has entered what is called her short-term memory, later she knows that she might need to call number against to order the PISA next time and again she does not want to go to the internet and do that process again so what she does is she decides then in addition to storing the number in her phone she is going to memorize the number .

Maybe there is somebody you know who would want to remember information as well so she kind of tries to memorize this thing, so what she does is she does some rehearsal she processes the process that she will use to keep this number via rehearsal is referred to as in according so what she is doing is by rehearsal she is encoding this information storing it somewhere in her brain, so that she can you know call that number back to us for the piece so a few days later she also Auto keys again she will need to retrieve this number again from her long-term memory.

And dial that particular number so again a graphic here where panels a B C and D panel as he is actually looking through for the numbers.

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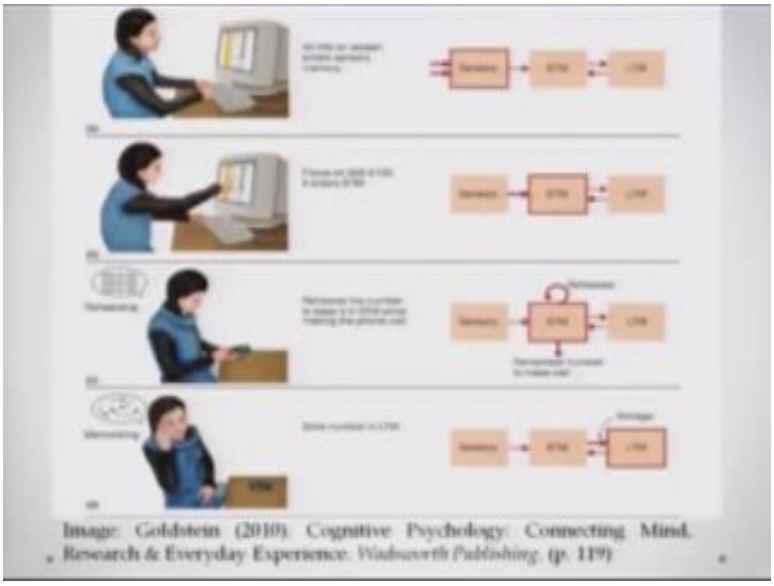

In the same they are there in the sensory memory panel B she is focusing on a specific number which then enters the short-term memory panel C she is rehearsing to encode that number in the long-term memory, so that she can call upon that number at a later point in time so here is V rehearsal information grows from the short-term memory to the long-term memory and it stays there becomes part of whatever that large storage where thing is for.

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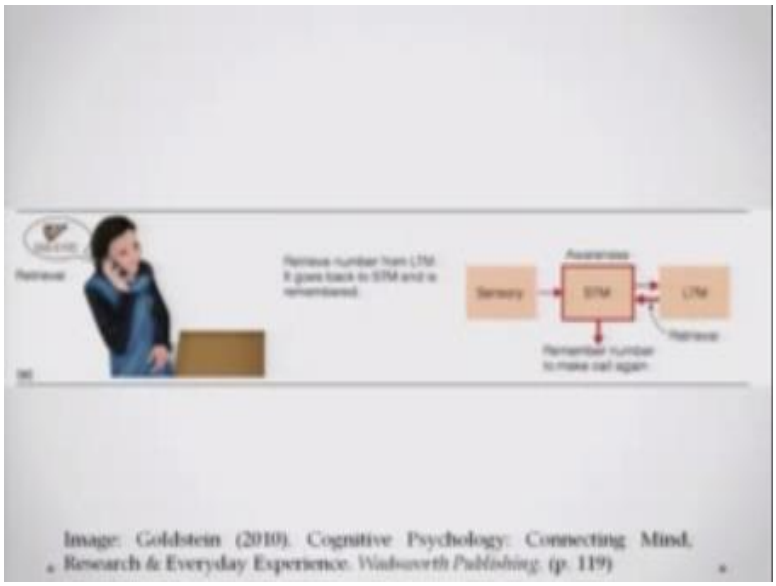

So she needs to call the Pizza next time the other day maybe next week then she can from her memory recall and use that number to dial for a bit obviously, she can look in the phone as well but maybe say for example if you know she wants to recall and use it she has at least memorized the number maybe a she has to tell it to somebody or something like that okay, so here you saw how a very simple task.

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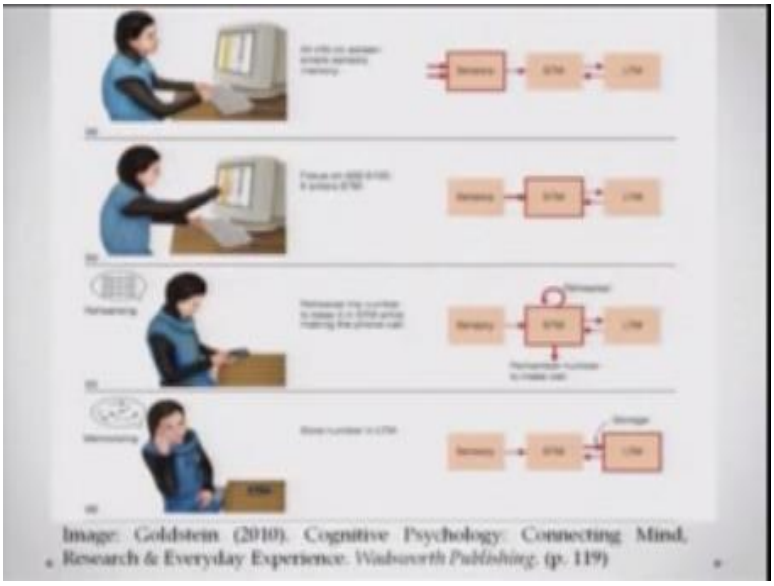

Of looking for a page area calling it does involve all three kinds of your memory it involves control processes like selective attention and rehearsal and using these control processes that is how you deal with the information that you are getting from the environment most times it could be any other example it could be an example with meeting some breaks and those kind of things, let us now talk about sensory memory sensory memory I will be going to each of these processes now in some detail so that we kind of understand them in more in a much better sense.

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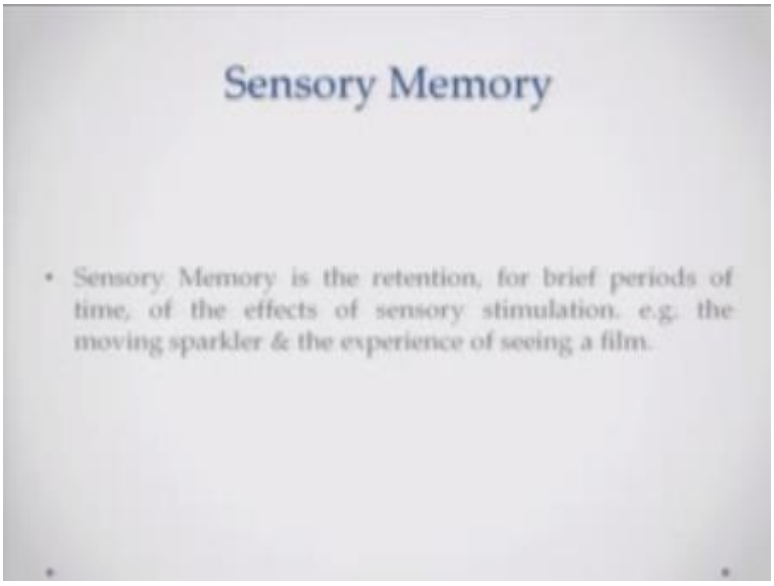

So sensitive memory is the retention time is for very brief periods of time of the effects of sensory stimulation, so sensory memory is the retention for brief periods of time of the effects of sensory stimulation if you see something if you hear of fading voice if the for example you see a moving sparkler.

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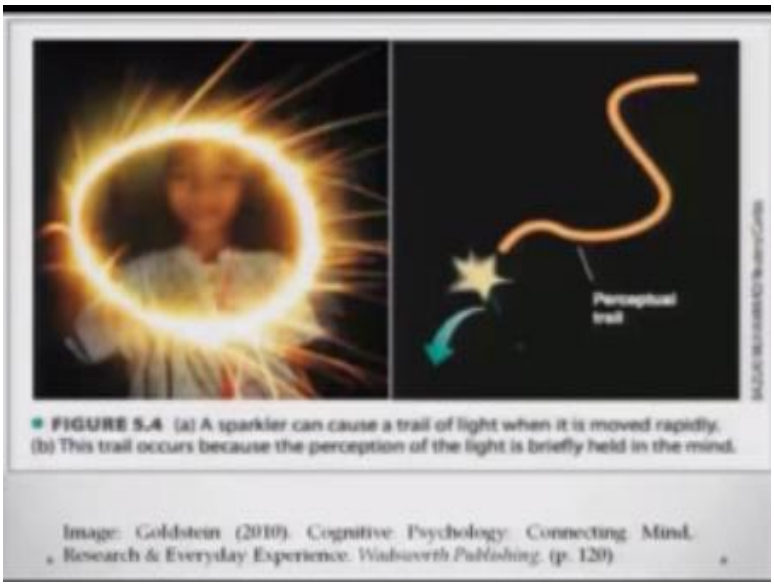

FIGURE 5.4 (a) A sparkler can cause a trail of light when it is moved rapidly. (b) This trail occurs because the perception of the light is briefly held in the mind.

Image: Goldstein (2010). Cognitive Psychology: Connecting Mind, Research & Everyday Experience. *Wadsworth Publishing*. (p. 120)

I think we have done it a lot in the value or some kind of vessels if you actually take the sparkler and if you kind of move it around you will see this wave of your smoke that gets formed and you kind of remember that wave of your smoke and that is basically what has registered on your sensory memory.

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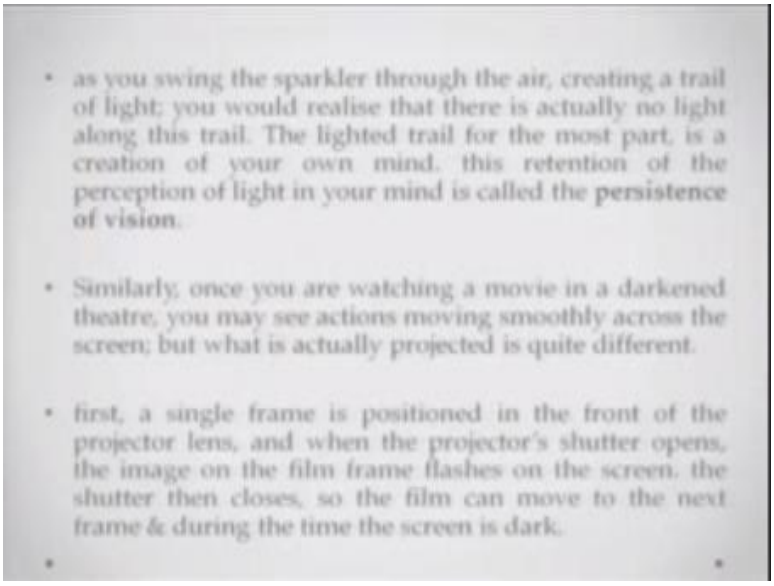

Now as you sing this something that already talked about so I just ping the swing the sparkler through the air creating a trail of light you would realize that there is actually no light present at that point along this way you are moving this you sing that there is light moving, but you have actually moved the sparkler away from that position you still see that trail of light that trail of light being there because you are seeing it is basically referred to as persistence of vision so even though the lighted trail is not there is the creation this is the one which you seeing right away.

Is the creation of your own mind and this retention of that visual perception is called persistence of vision you might see that in some time say, for example it might also happen that you know somebody said something to you and it is gone away but you know that voice keeps ringing in your ears that is probably persistence of auditory information similarly say for example let us take this example if you are watching movie in a darkened theater, you may see actions moving smoothly across the screen but what is actually projected on the screen.

Is quite different what is projected on the screen basically is a single frame and then the other frame and in the other frame in quick succession from each other but what you see because of this persistence of vision is a continuous movie, so a single frame is positioned in the front of the

projector lens then when the projector shutter opens the image on the film flashes on the screen the shutter then closes so the film can move on to the next frame, so basically it is frame by frame you are being shown particular stills but if all of those stills are shown are shown in a particular you know a sequence say for example what is called frame rates per second FPS then what you see is you will see a particular movie when the next frame is right in the front of the lens the shutter reopens the flashing the next image on the screen.

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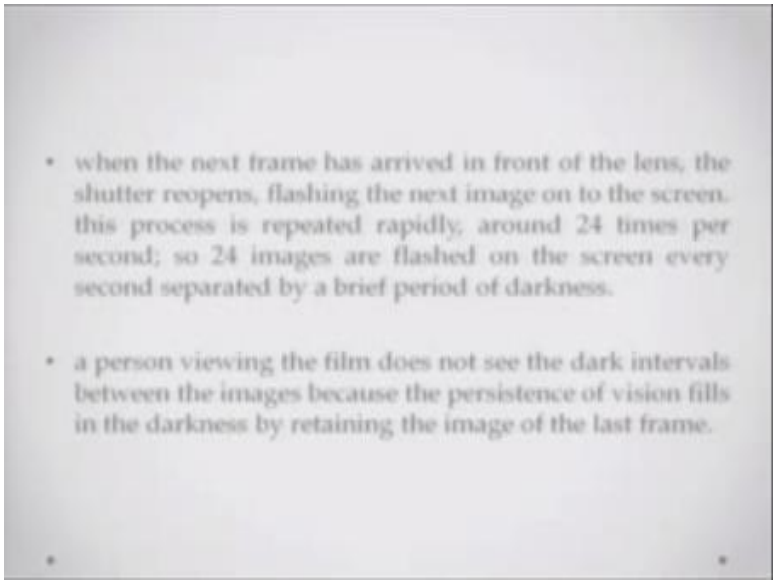

And it kind of happens around 24 times per second so 24 images are flashed on the screen every second repeated by a brief period of darkness, but you do not see the darkness you do not notice that these are separate frames and in that sense you basically are using this persistence of vision to construct out of your own mind what the movie is like so a person viewing the film does not really notice this dog intervals between the images because of persistence of vision and because this process of vision fills these the gaps of darkness which are there between the changes of each frame.

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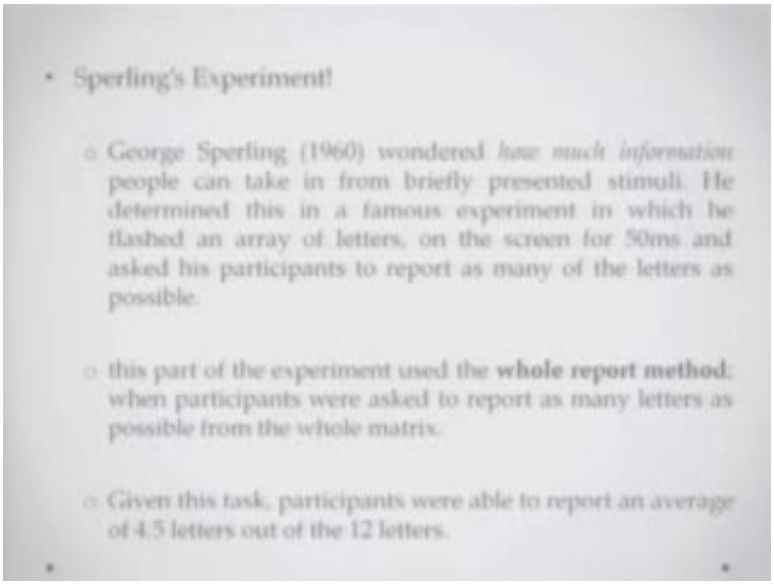

Now I will describe to you a very interesting experiment that is kind of drawing on this particular phenomena George Sperling in 1960 he wondered how much information people can take in from very briefly presented stimuli, so he determined this in a famous experiment in which what he did was he flashed an array of letters on the screen for around 50 milliseconds 50 mill seconds is a much smaller time period and then a participants to report as many of the letters as he can so this part of the experiment was called the whole report method.

So the idea is some array of letters will be flashed for around 50 milliseconds and the participant will be asked to report this the number of letters the number of digits that they actually see so given this task what happened was that the participants were able to report on an average around 4.5 letters out of the 12 letters.

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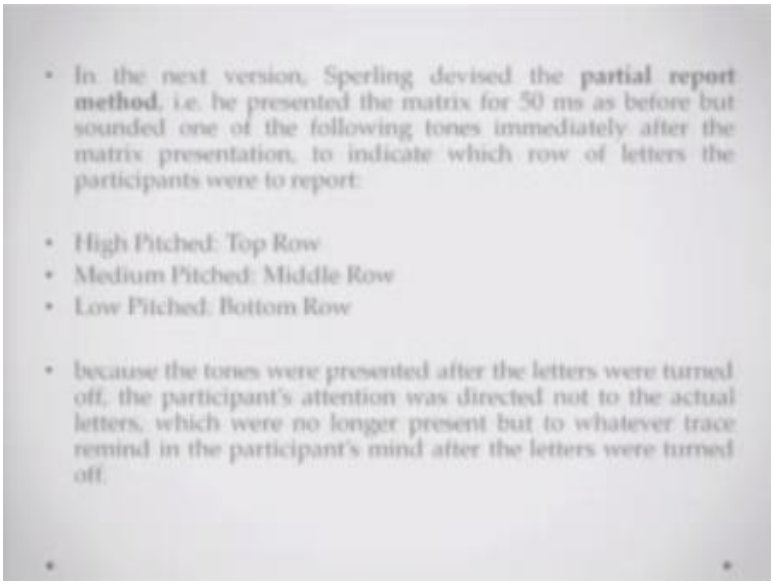

So this is how it was done.

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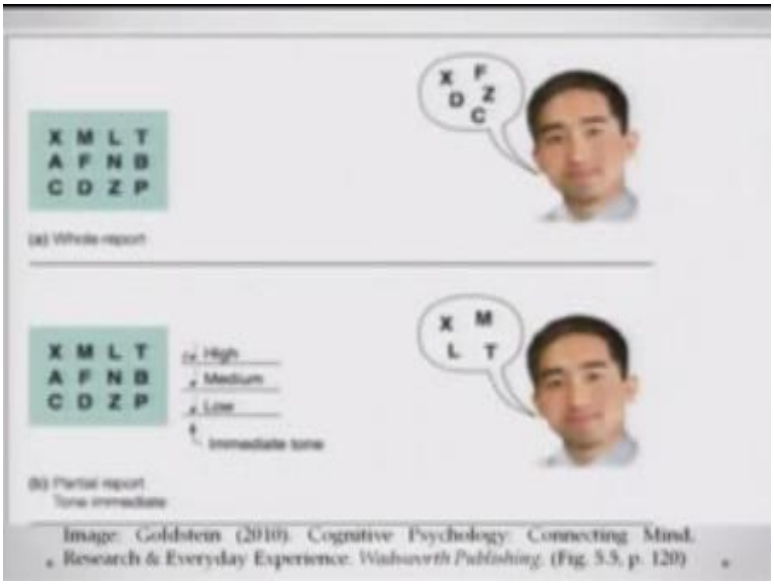

If you can see at the first panel the whole report panel there were three rows of four letters each and every time the participant is just being able to tell about four or five letters, so in the next version what he decided he decided to use what is called the partial report method so what he did was he presented the matrix for 50milliseconds before but he sounded one of the following tones after the matrix presentation to indicate which row of letters the participants were to report, so if it were a high-pitched tone then it was the top row that they had to report if it were a medium pitch tone then they had to report the middle row.

If there is a low fish tone they had to talk about the lowest row because the tones were presented after the letters turned off the participants attention was directed not to the actual letter because they have come and gone but to the persistence but to the trace of you know of those letters that are remaining in these participants minds once the letters have been turned off, so this is an example of what the partial report method was like what do you predict would have happened.

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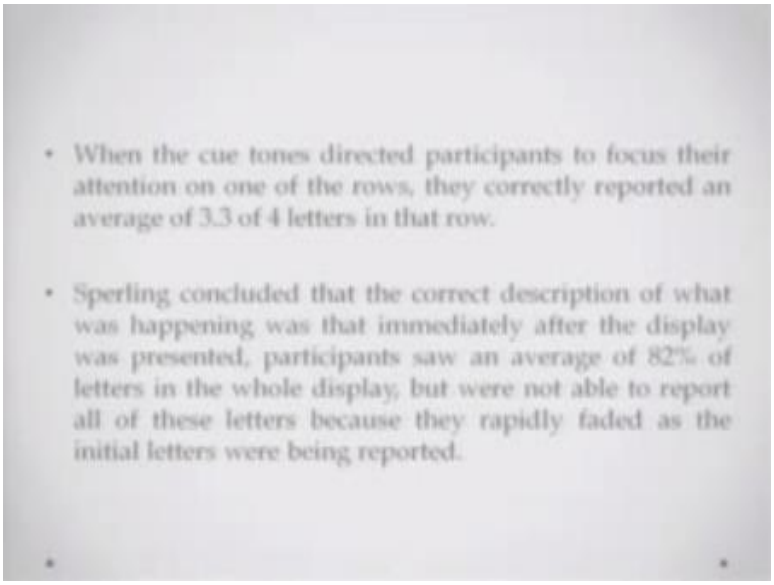

When the cute tones directed the participants to focus their attention on one of the rows they correctly reported an average of 3.3 or 4 out of 4 letters you know, so the accuracy and the amount of the information they could now report has been enhanced quite a lot because they are being told to focus on a very limited span of information Sperling concluded from this experiment that the correct description of what was happening was that immediately after the display was presented participants on average about of 82 % of the letters in the whole display.

But they were not able to report all of those letters because they rapidly faded away after the initial letter was being reported.

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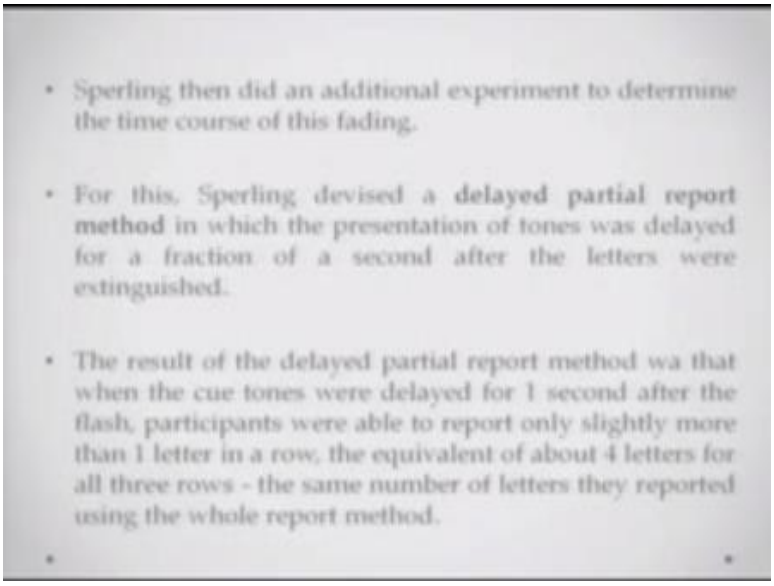

So spelling then he does an additional experiment to determine the time course of this swearing so he wanted to check what is the time course in which these information fades away, so for this Sperling device a delayed partial report method in which the present about giving them time to rehearse this thing so the result of this delayed partial report method was that when the cut tones were delayed for one second after the flash participants were able to report only slightly more than one letter in a row.

The equivalent of about four letters for all three rows and the same number of letters they reported using the whole report method, so if there is this time gap between the tone and the presentation of letters then the participant is not being able to reported, so here is the delayed partial report method.

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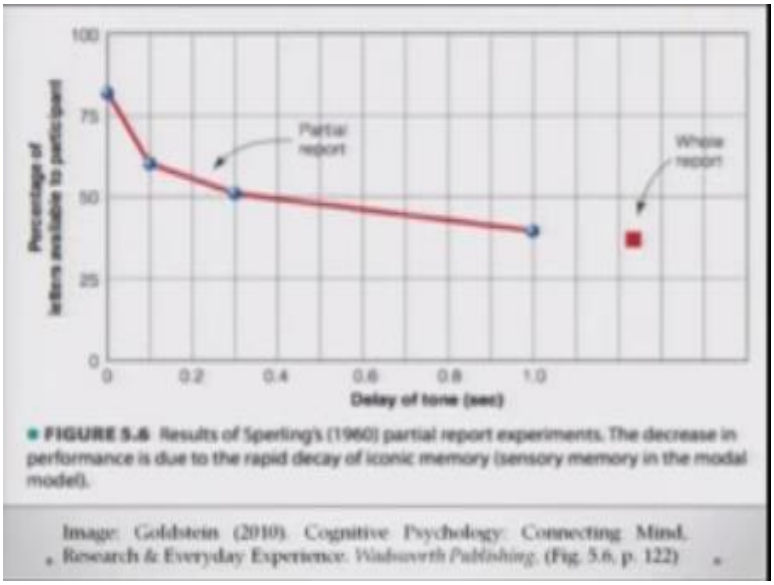

FIGURE 5.6 Results of Sperling's (1960) partial report experiments. The decrease in performance is due to the rapid decay of iconic memory (sensory memory in the modal model).

Image: Goldstein (2010). Cognitive Psychology: Connecting Mind, Research & Everyday Experience. *Wadsworth Publishing*. (Fig. 5.6, p. 122)

So this is wearing you can see that from whole report to partial report or delayed the whole report is the lowest at the right part and the partial report is around in the memory and the accuracy is much better.

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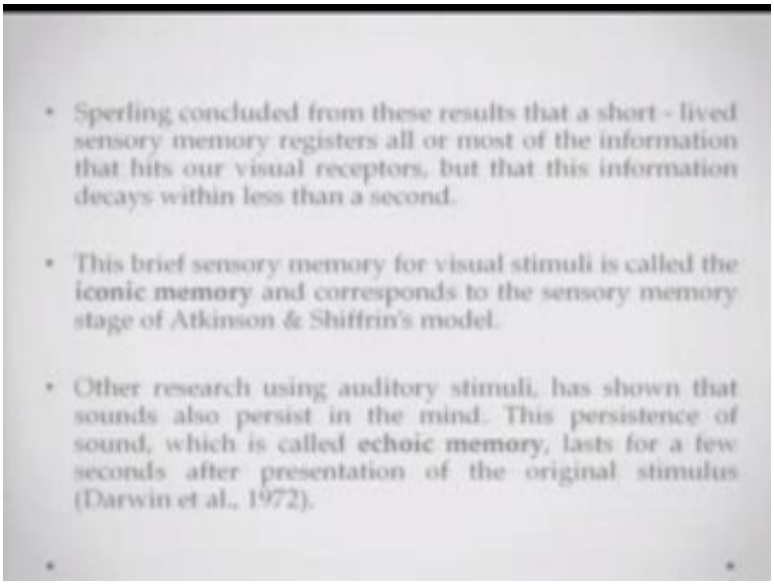

So spelling concluded from these results that a short-lived sensory memory operates or registers all or most of the information that first hits our visual receptors but that this information the case within less than a second, so if in the toll is coming one second later than the presentation of this person is do not have any clue of which information they have to report so their reporting time or accuracy kind of goes up to what the whole report method was like, so this brief sensory memory for visual stimuli has been referred to as iconic memory and it corresponds to the sensory memory for vision.

And it kind of falls in the sensory memory stage of Atkinson and Shiffrin model other research has also been done using auditory stimuli and it has been shown that sound also persists in mind but the persistence of this is or is referred to as the a quake memory it kind of lasts for a few seconds after the presentation of the original stimulus and that since the range of a quake memory or auditory sensory memory is slightly longer than that of visual sensory memory or iconic memory.

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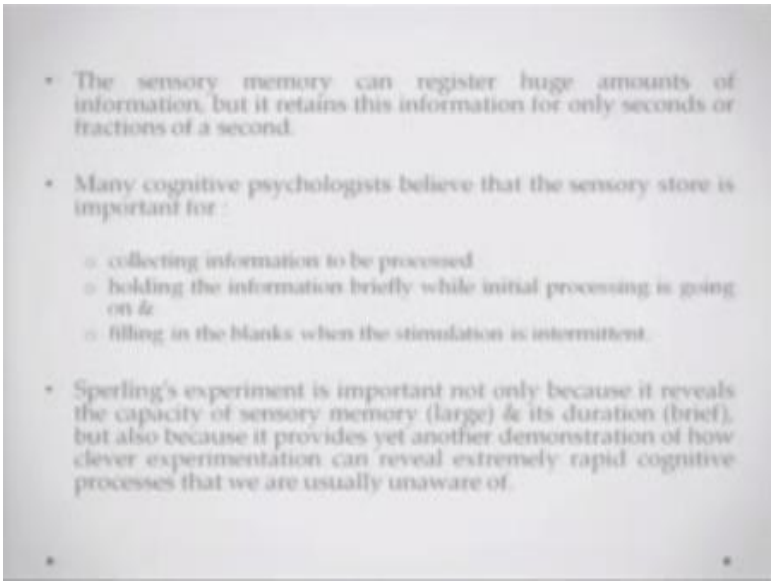

Now the sensory memory register can register huge amounts of information but it retains this information only for very few seconds or fractions of a second many cognitive psychologists believe that the sensory store is important for at least three things first is collecting the information the halves we process second is holding the information briefly while the initial process is going on and third is fill in the blanks when the stimulus is interpreting so something that was happening.

In frame rates and while you watch a particular movie spoiling experiment is important not only because it reveals the capacity of one the capacity of sensory memory because it is much larger and its duration which is much briefer but also price yet another demonstration of how a clever experimentation can actually you know tell you something very important about this cognitive and mental phenomena.

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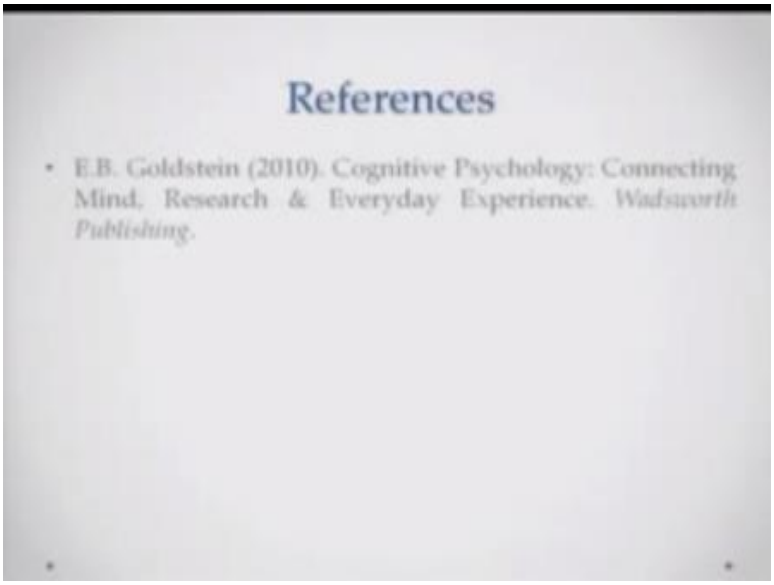

This is all about sensory memory in the next lecture I will talk to you about short-term memory.

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