Indian Institute of Technology Kanpur

National Programme on Technology Enhanced Learning (NPTEL)

Course Title
Basic Cognitive Processes

Lecture – 33
Memory – V

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Hello everyone welcome to the course basic cognitive processes I am doctor Arc Verma from IIT Kanpur.

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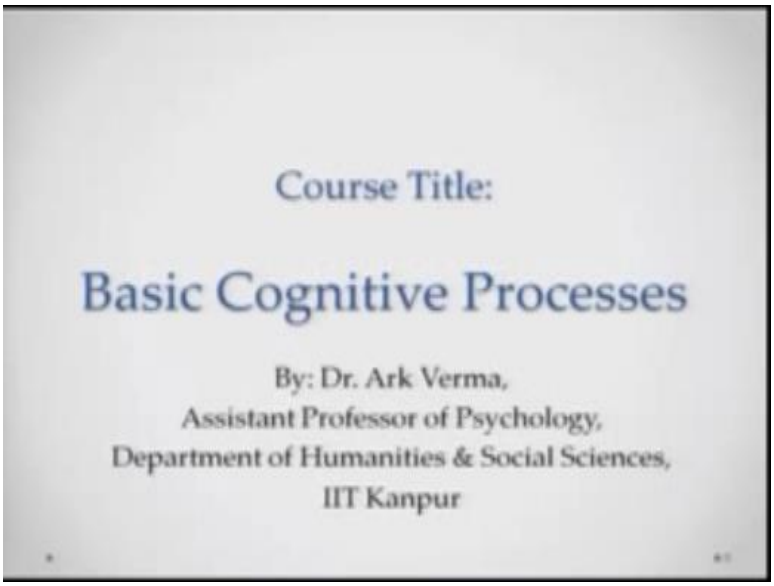

We have been talking about memory in our most recent lectures.

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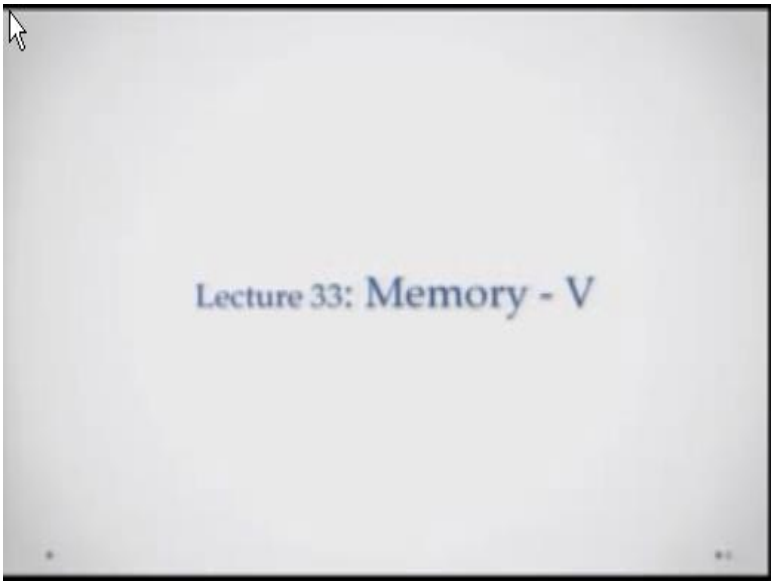

In the last lecture we also talked about long-term memory previous to that we have been talking about short-term and working memory and even sensory memory now today I am going to talk to you about types of long-term memory.

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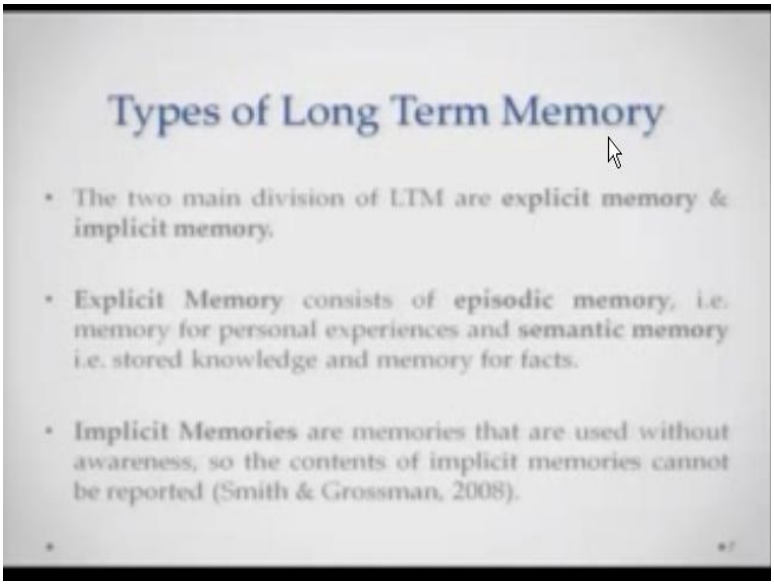

We will go into more detail about what are the different kinds of contents that long-term memory has and we will also talk about some of the investigations into how the different areas of the brain contribute to formulating these different kinds of memories also what happens when some of these brain areas are damaged and how does that impact peoples recording of that memory let us say two major divisions of long-term memory can be done along the lines of explicit and implicit memory.

Now explicit memory is simply that memory that you can recall and describe and you know talk about in more detail while implicit memory is that about which you cannot talk in more detail but you can certainly demonstrate that memory by performing a particular skill or engaging in a particular task on a different node explicit memory consists of two parts episodic memory that is memory for personal experiences episodes say for example as I was saying in the last class.

If I ask you to describe a summer vacation spent at one of your grandparents house those kind of things come under what is called explicit memory what comes under semantic memory is your knowledge about facts is your knowledge that you have gained over period of times that Apple is an edible fruit that peacock is a bird that whale is animal all of these are facts the Prime Minister

of India is Narendra Modi is a fact so all of those kind of information and you see lot of early school quizzes having general knowledge they basically ask you to remember.

So that all is also part of this explicit memory so explicit memory will contain the episodes that is the experiences you have had which you can actually simulate by remembering them reliving them in some sense and the knowledge of facts which you do not need to relief in any detail whatsoever but you at least need to remember what that fact particularly was now another kind of memory which I was just mentioning implicit memory is basically memories that are used without awareness so you are kind of using those memories without really consciously being aware of them so the contents of implicit memory in that sense cannot be reported.

The fact that I learned how to drive a car and that I drive a car almost every day now still does not mean that if you ask me exactly how did I learn to you know maneuver the brakes or how did I learn to you know control the pedals how did I learn that task I cannot really talk about that it was a procedure it was a skill that I acquired and obviously I have still retains that skill and that can be a you know demonstrated if I drive the car right.

Now but if you ask me to give a description that becomes slightly difficult and in that sense implicit memory is memory that cannot be reported but demonstrated via action so if you get these two basic concepts right this is pretty much what your long-term memory will contain.

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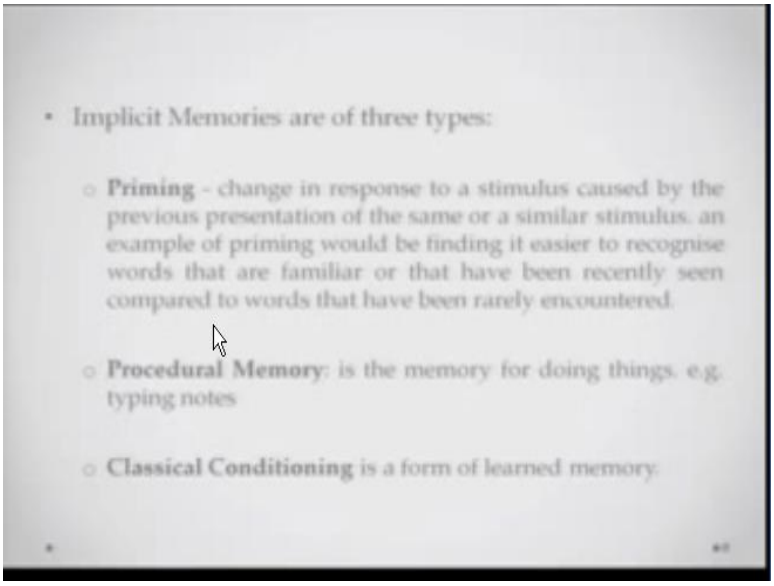

Now implicit memory trying to elaborate on that a little bit implicit memory can be of three types priming procedural memory and memory that is gained through conditioning now priming basically is a phenomena if you repeat a particular stimulus where you present a particular stimulus the presentation of this stimulus will kind of make you ready make you prepared make you react better to the presentation of another stimulus which is similar in some way to the first stimulus that was presented.

You will find it easier to recognize words that are familiar or the words that have been recently used if you are bleeding a particular novel you are reading a particular book and then maybe in this lecture I use one of the words that you have read in the book you will very quickly recall the meaning of that word so what has happened is that you have recently just read that book and I read that word in a particular book that will be primed by my mention of this word.

So your memory for the meaning of that word kind of gets revised in some sense another kind of memory under implicit memory is exactly the memory for doing things say for example for typing notes for riding bicycles those kind of things so procedural memory the memory for skills

and tasks is your implicit memory. Classical conditioning is one form of learned memory when you learn by remembering associations between two kinds of stimuli or events.

Say for example and it has been done you know very much I mean a lot of research in classical conditioning has been done in psychology from the simplest examples could be say for example if you associate a particular stimulus let us if you associate color white to something unpleasant and say for example every time you see color right and you know a shock will be administered to you later you will learn that color white saying you know stands for an unpleasant experience.

You can and we always link these kinds of memories say for example advertisement industry uses conditioning quite a lot say for example you see a lot of advertisements that are you know played on the television nowadays have pictures or have things that you know remind you of some pleasurable experience say for example a lot of advertisements have you know women appearing and posing for those particular goods which also sometime do not have anything to do with women.

So what is happening is the advertiser in that sense is using the sexuality of the woman to really promote you know associations for that particular product and that product today might be anything having nothing to do with women at all but if the person kind of goes to the store as he has been primed with that pleasurable experience and that pleasurable experience is linked with this particular product its very likely that the person will choose that product over I will field of so many different kinds of varieties.

So these three kinds of learning is even though are not really explicit and you cannot really talk about them that yes I am learning this association and I am going to use this information can still be useful and it will basically be manifested in your choices in your performances of tasks and whenever you are going to you know do something this is basically what explicit memory and implicit memory mean.

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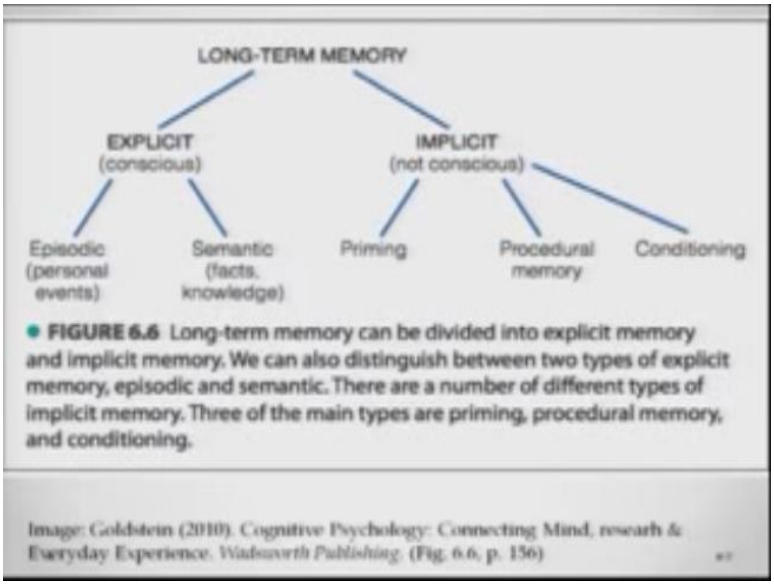

Now here in you can see again a graphic description of what the long-term memory can be you know structured as so you have explicit or conscious memory which contains episodes and semantic memory and then you have on the other hand implicit memory which is not conscious and you cannot probably talk about it as clearly and it basically has the three tasks of priming procedural memory and conditioning.

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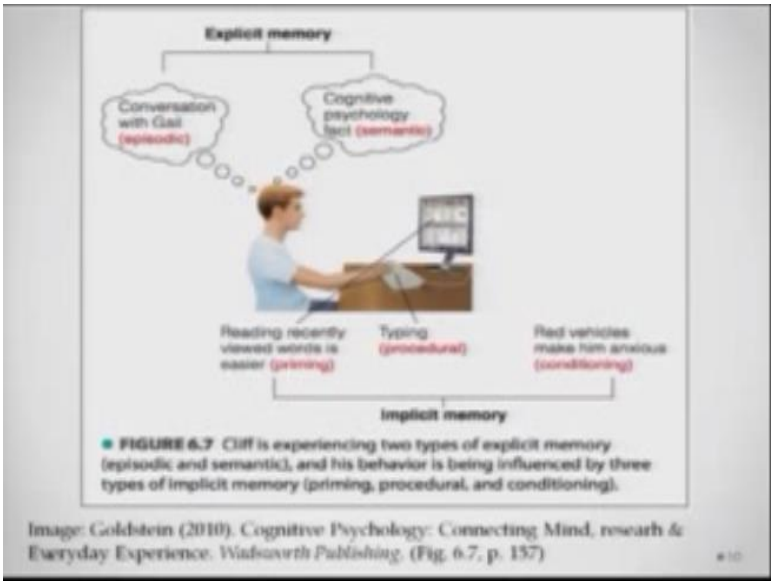

Now here in again is a demonstration of how somebody like cliff here is constantly being involved in using both explicit and implicit memories at the same time a very simple task that you are doing remember we started this course with saying that we will analyze behavior into many smaller components and see that how these smaller components were together or join together to explain that behavior that is pretty much what cognitive psychology.

So you see here cliff this guy is basically experiencing two types of explicit memory and three types of implicit memory at the same time he might be browsing something on the internet so he is probably you know maybe he is checking his emails so on one hand he is basically you know looking at this conversation with one of his friends which is episodic so he is remembering that conversation with his friend also.

He is looking at say for example maybe is you know remembering some fact about cognitive psychology at the same time which is his semantic memory he is reading recently viewed words so the words which he had might have read recently are read easier and the meaning is recalled earlier so that is priming he is typing that is procedural memory basically doing something that

you know he tells that reading red vehicles will make me anxious who is kind of that as well all of that is happening in the implicit level.

So you see at any point in I mean you can take your own examples as well if you are doing something say for example if I asked you to plan a vacation you to you know let us say a place any place in India maybe go or somewhere you might be you know aware of you know some you might be recalled of some of your previous experiences with that place so those episodes will be activated you might be you know aware of that Goa is you know city which has coast at the coastal area of India so you will remember that semantic factors well.

And then at the same time you might kind of you know use some of your other skills which are basically implicit in nature say for example the association that Goa is you know always thought of as a place to have parties and treasure is already that classical condition the mention of the word kind of makes you happy that is what classical conditioning is happening so implicit memory is also being invoked here.

Now this is again an example to say that we are using all these different kinds of memory almost all the time and this interaction and interdependence is already always playing out.

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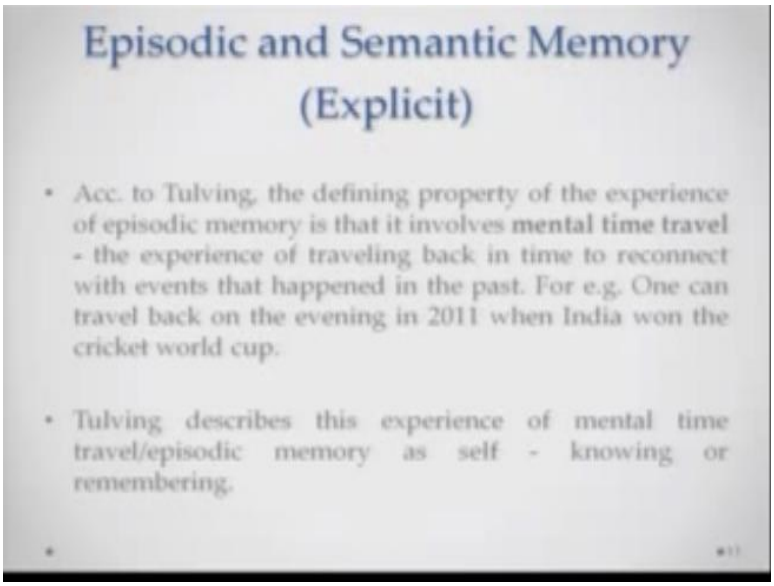

Now let us come to trying you know seeing some experimental studies about these explicit and implicit memory so we kind of gradually be talking about that now Tulving basically said that the defining property of the experience of episodic memory is that involves mental time travel so if I ask you to describe me in more detail about a vacation that you had in let us say in the year 2000 and where did you go and what were the experiences you had while you are recalling that going to that place you are transported in some sense to that time and era and in that sense you are experiencing back that entire episodes.

So that is pretty much what the episodic memory is doing it is asking you it is allowing you to do this kind of mental time travel delving he describes this experience of mental time travel that is episodic memory as self knowing or self remembering so as soon as you start looking into your memory and start recalling previous episodes that have happened previous experiences that you have gone through basically invoking or exercising your episodic memory it can be referred to as remembering or it can be referred to as self-knowing.

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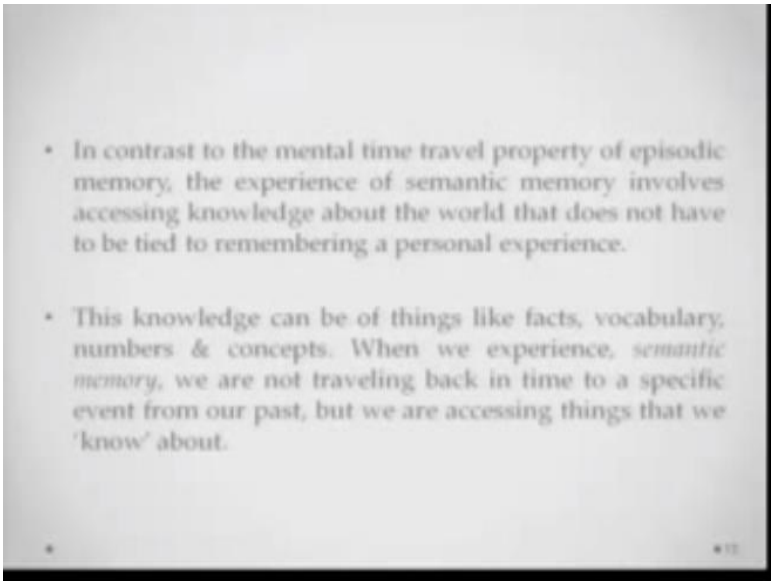

I n contrast with a mental time travel property of episodic memory the experience of semantic memory is a slightly narrower so the experience of semantic memory is basically involving just accessing the knowledge about the world that does not really necessarily have to be tied to that entire experience to answer some questions about particular facts whether Swan is a bird or it is a mammal or it will not really ask you to invoke the memory of when you first read about or saw a swan it.

Will just you know the myth the facts that Swan is a word is automatically invoked it is automatically brought to your memory and you can answer this question in a second or two so ideally the semantic memory is basically not about episodes but it is just about facts so not really you do not really need to travel back in time to where you first saw this one or where you first read about the Swan or were told about this one you do not really need to get all of that information because that is not relevant to the task.

So what you do is you just get grab the fact that is one is a bird and throw it towards me and say that yes this is the fact and this is what I know and you are doing this with the help of what is called your semantic memory.

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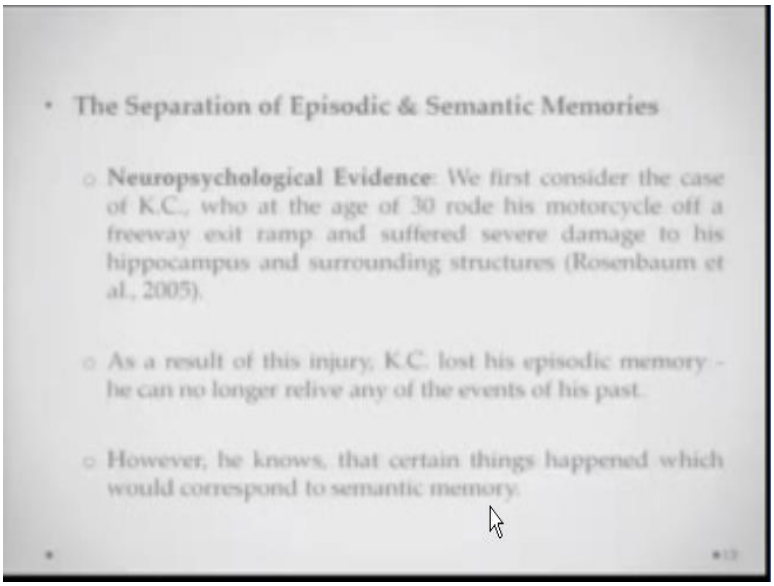

Now there have been neuropsychological evidences on the separation of semantic and episodic news so there has been a lot of debate and there has been it has been said and shown time and again that episodic memory and semantic memory are two different aspects of memory so one of the neuropsychological cases that I can talk to you about is the case of KC who was a guy who was riding his motorcycle at the age of 30 a kind of you know event of a freeway exit ramp and suffered severe damage to his hippocampus and the surrounding structures.

So what happened is as result of this injury KC basically lost all of his episodic memory he now cannot remember anything or any of the relevant events of his past however he knows that certain things happened that would correspond to what is called semantic memory I will tell you things like.

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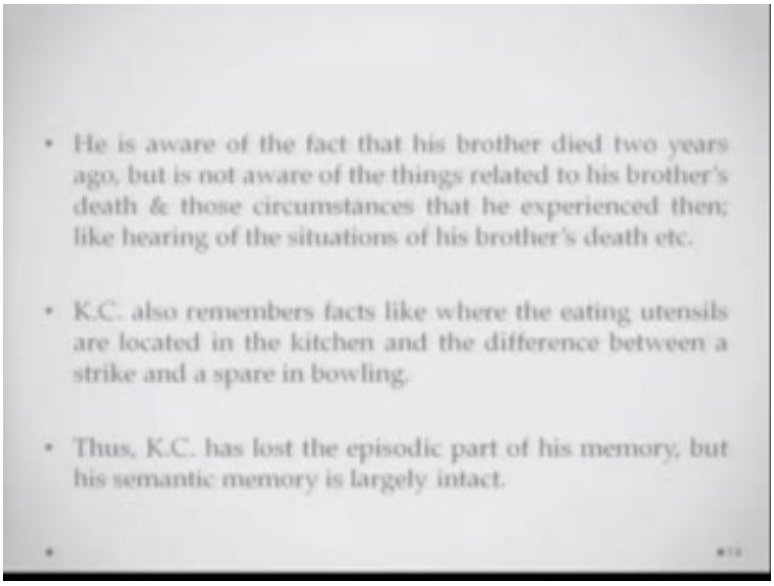

he is aware of the fact that his brother died two years ago now that is a fact but he is not really aware of the things related to his brother brothers death and the circumstances that he experienced the fact that office but brother he is notable to recall that.

KC also remembers the fact that where say for example eating utensils are located in the kitchen and the difference between a strike and a spare in bowling so here members these things as facts but he does not remember the episodes linked to where he learned all of this knowledge also KC has lost so KC basically on the basis of these things you can say he has lost the episodic part of his memory but the semantic part of his memory is almost all right okay.

Because he knows all the facts he knows the Sinister either reside he knows you know what the kitchen is he knows you know other things about the bowling game but he just does not know whether he has bowled it ever over say for example if you ask him to describe where did you where did you go to bowling last week he would probably not be able to tell you that.

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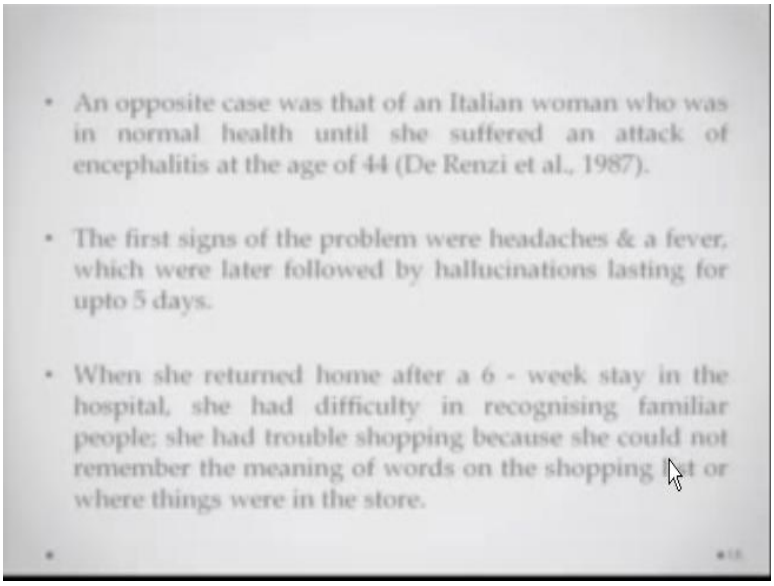

A contrary case to this one to the case of KC was that of an Italian woman who was a normal health until she suffered an attack of encephalitis at around the age of 44 now the first science of problems after this encephalitis attack were headaches and a fever which was later followed by hallucinations lasting up to four or five days now when this woman returns home after a six-week stay in the hospital she started having difficulty in recognizing familiar faces familiar people she also had trouble shopping because she could not remember the meaning of the words on the shopping list.

So she would read a shopping list you shall not remember what these things are which are written here she would no longer recognize famous people she could no longer you know recall facts such as the identity of who we throw in was or the fact that Italy was involved in World War two because she is a Italian woman you could ask these kind of questions she all of these semantic facts all of these things are completely absent.

However despite this severe impairment of memory for semantic information she was still able to remember events in her life that would going on currently so she could remember what she had done during the entire day that say for example I woke up at you know 9 AM I had I had my

breakfast I went for a walk and I you know did some study all of that she remembers and say for example also things that happened weeks before or months before basically those that were episodes.

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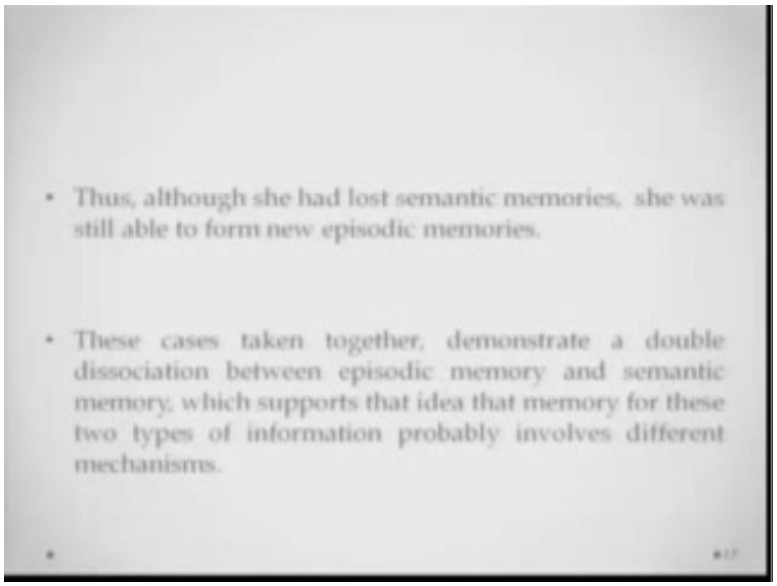

So although she has lost all her semantic memories this Italian woman is still able to form newer episodic memories now if you kind of contrast the cases of KC and the case of this Italian women and you put them together it will basically demonstrate to you what is called a double dissociation a double dissociation between episodic memory and semantic memory so you know certainly that episodic and semantic memory are two different concepts and administered by probably two different brain regions.

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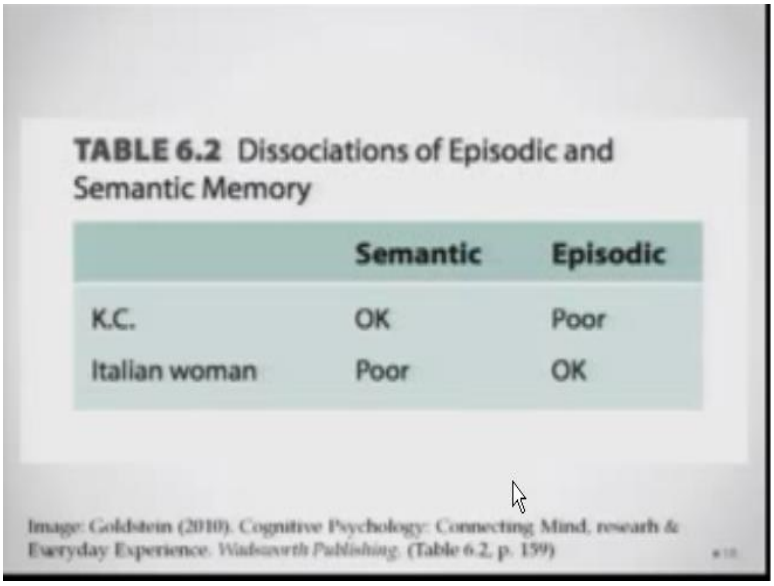

So hearing you can see this double dissociation aware but if you do not remember what double dissociation means you might refer to one of the lectures on the methodology part varying double dissociation basically tells you that if a patient is okay in scale A but deficient in skill B if patient one is bad at scale A good at scale B patient two is good at scale A and bad at scale B you can you know deduce from this that scale A and scale B are basically different and are administered by different brain regions.

So this is what you kind of find here that KC is good at a semantic memory but poor at episodic memory and this Italian woman is poor at semantic memory and good at episodic memory.

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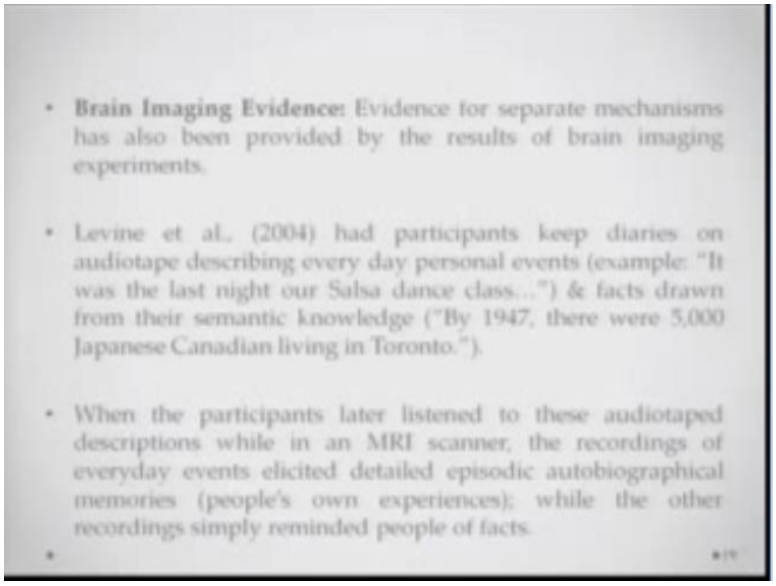

Now there has also been brain imaging evidence to show that semantic and episodic memory are different so Levine el.al they did their experiment in 2004 they asked the participants to keep diaries and diaries on audiotape describing everyday personnel even say for example it was the last night of our salsa dance class we went for dinner at this particular restaurant and all of these facts from their semantic knowledge as well that by 1947 there are 5,000 Japanese Canadians living in those kind of factual knowledge is and whatever episodes.

They are having and they of audio taped all of these you know in a cassette and all of that so when participants later were made to listen to these audio taped descriptions while they were in an MRI scanner the recordings of everyday events that is episodes elicited detailed you know episodic autobiographical memories while the other recordings which were basically factual knowledge reminded people only of facts and semantic memory was invoked.

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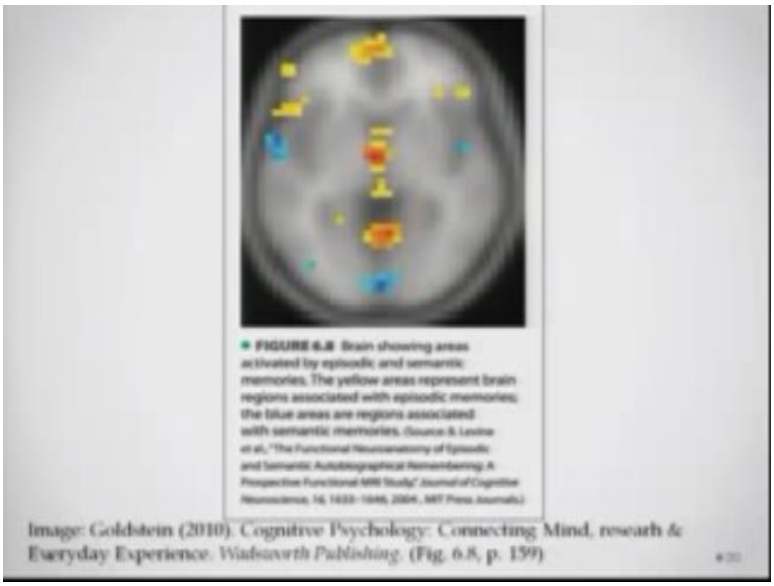

Here you can see brain areas that were activated by episodic and semantic memories you will see the yellow areas are basically those activated by episodic memories and the blue regions are those activated by a semantic memory so you will see there is also a neural level dissociation between episodic and semantic memories as I demonstrated in the you know by the cases of KC and this Italian women.

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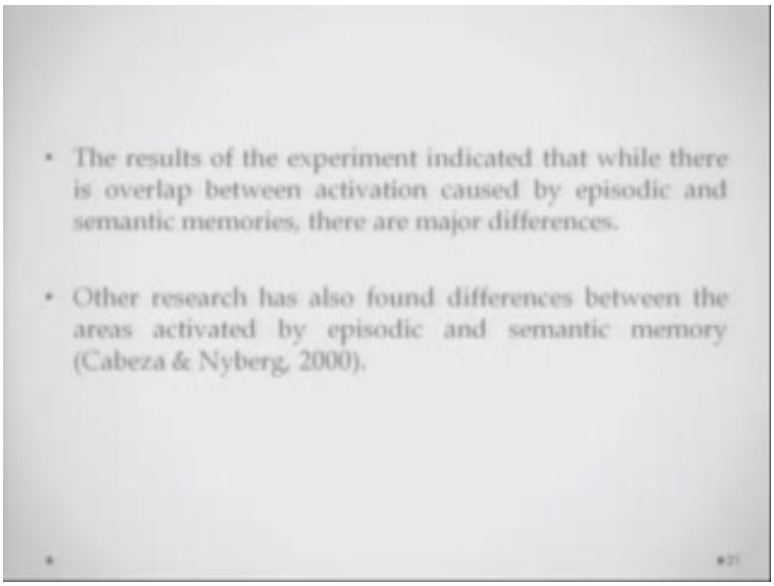

Now the results of this experiment just to summarize indicated that while there is an overlap in the activation caused by episodic and semantic memories there are certainly major differences other research has also found the differences between areas activated by episodic memory and semantic memory.

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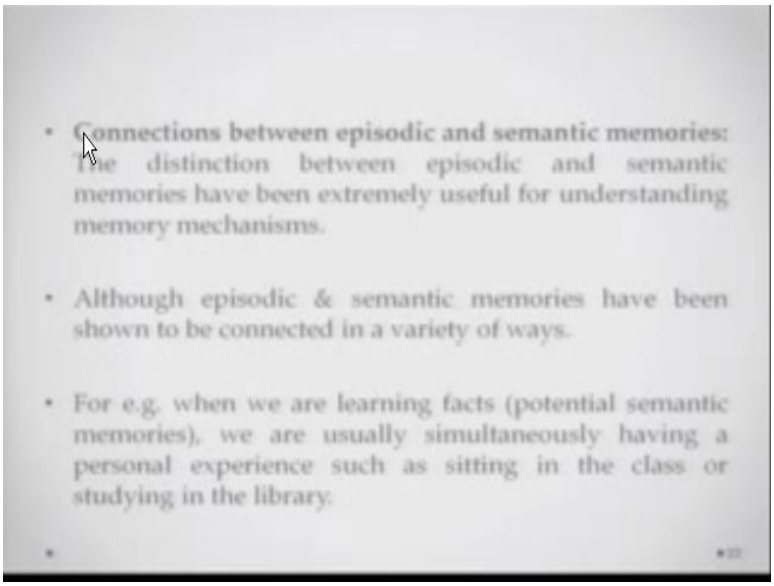

Now there have been also obviously we demonstrated right away that episodic and semantic memory are two different things but there has also been reports of connections between episodic and semantic meaning obviously they have to be connected to you know form a coherent story and give us this coherent sense of being so the distinction already although has been made between episodic and semantic memory they have also been shown to be connected in a variety of ways.

So for example if we are learning facts potential semantic memories maybe you are now you know paying a lot of attention to this video and learning something about cognitive psychology and learning something about let us say in this lecture episodic and semantic memory you are simultaneously usually having an experience as well so maybe you are sitting in a particular room maybe their weather is good outside maybe you know you're kind of having this episode of sending in a particular room and listening to this particular lecture.

So why what you will recall let us say is the facts about things about you know episodic memory and semantic memory from this lecture you will also take away with you this episode of sitting at

a particular place and listening to the lecture so a kind of very similarly you know things that people do in classrooms.

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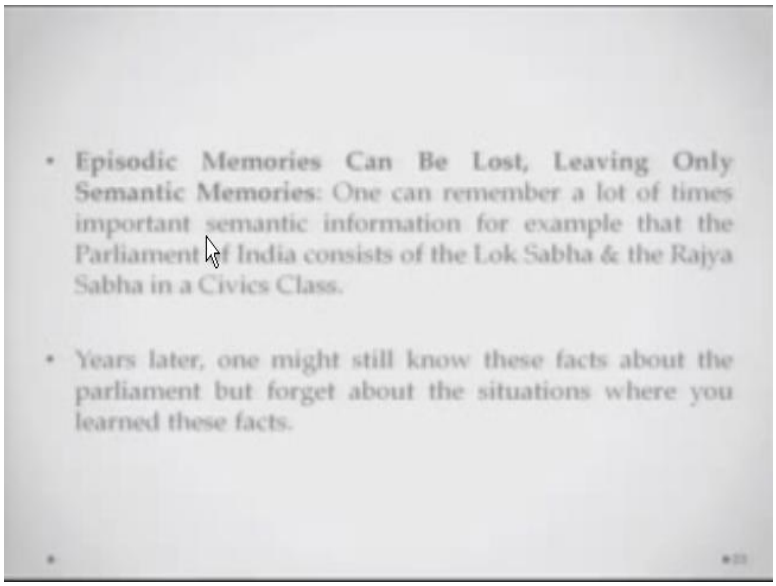

So episodic memories I am just kind of going to elaborate this connection a little bit episodic memories can be lost leaving only semantic memories so 20 years from now maybe you might still remember what an episodic memory or what semantic memory means but you might forget Varian or in which setting or say for example which room were you sitting in watching the video that you remember these facts that you first got aware of these facts okay.

So this is one of the ways to show that you know during a particular event during a particular episode in life you might sometimes you know recall that episode and the semantic facts as well but it can also be possible that you kind of do not remember the episode what do you at least remember the fact it really it happens very often where the people who have traumatic experiences.

Now semantic memory can be enhanced if associated with episodic memory now research has shown that you try and you know associate this knowledge of facts with you know with different

kinds of episodes with the entire episodic experience you can enhance your semantic memory and it can stay on for much longer say for example if the knowledge about.

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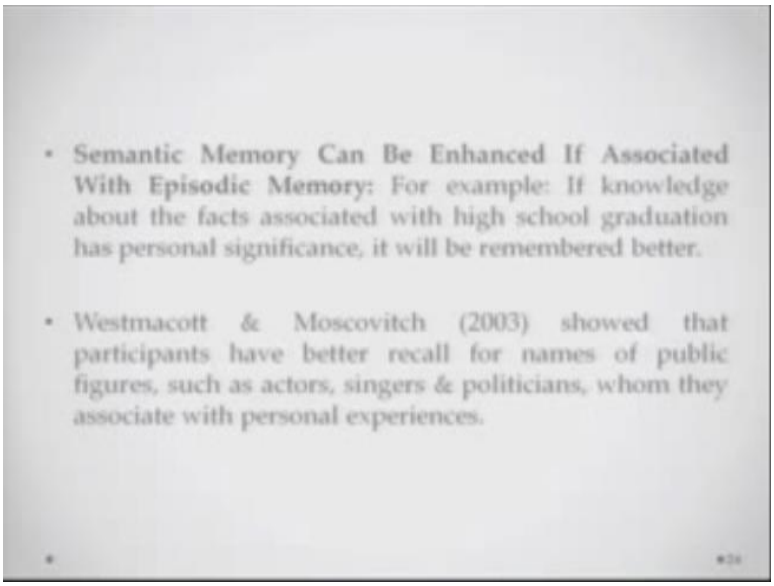

Let us say the facts associated with high school graduation somebody is you know farewell party after 12^{th} class or 10^{th} class you know has some personal significance it will be remembered better you know a farewell party in class 12^{th} or graduation courses you might have done if something very significant happened maybe something pleasant suppose you have won a particular you know we had in our College Mr. and Mrs. fashion if you kind of won that kind of a sashay you will probably remember that entire event much better.

Maybe a you know till the time you grow old so the idea is that semantic memory that the fact that you won mister or miss fresher at that day if you kind of linked it with that entire episode of your fresher function of farewell function you will remember that much better now vest-pocket and Moscow which they showed participants did actually have better recall for names of public figures such as actor singers and politicians whom they would associate with personal experiences.

So say for example if you have a particular you know you are a fan of a particular bollywood actor or particular cricketer or somebody and you probably found him you know you met him on a particular airport while you are traveling you will remember this person may be better okay if it if it if this person is you know kind of associated with any personal experience.

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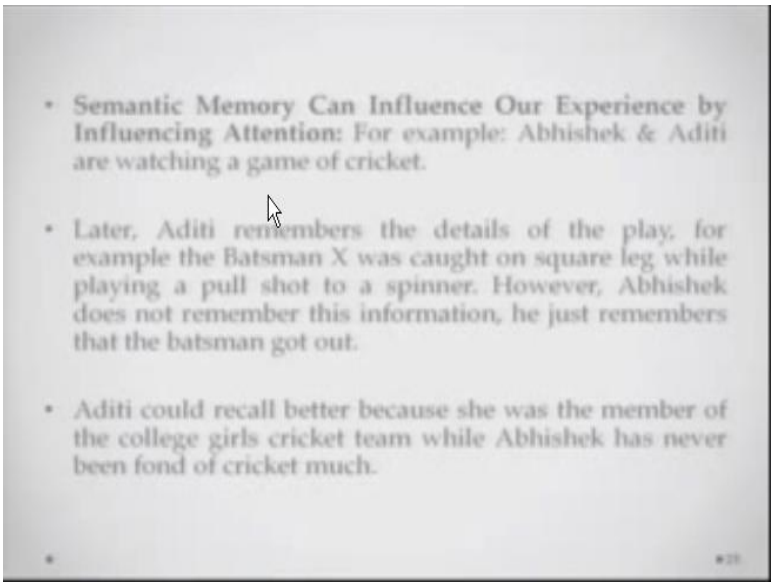

Coming to the third fact semantic memory can influence our experience by influencing our attention so the knowledge of facts the you know all the facts that you remember can also influence your experience by influencing how you look at things or how you attend to things so for example Abhishek and Aditi are watching a game of cricket and later when they are asked to recall whatever happened in the game.

So Aditi remembers the details of the play here members say for example batsman X got or square leg or fine leg by playing a pull short to a spinner so its adequate detail that is there but Abhishek does not remember this entire information he just remembers that the batsman got out now it is probably because Aditi had been a player of cricket she has you know figured in a girls cricket team in a school so she kind of remembers each and every detail about that thing while Abhishek who is never been fond of cricket so much he does not remember it.

Now it remembers chess example which we were talking about in one of the earlier lectures because your semantic memory has this knowledge of this facts you will attend to details better and this attention to details will impact your memory much better so this is again one example showing that semantic and episodic memory are linked together.

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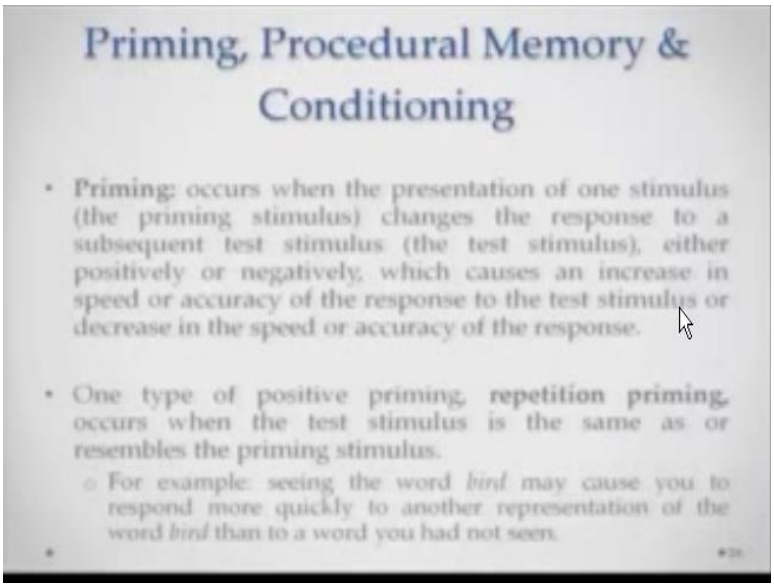

Priming procedural memory and conditioning are aspects of implicit memory and now let us talk a little bit about them myself now priming basically occurs when the presentation of one stimulus which is the priming stimulus changes the response of an change the response to the subsequent test stimulus now say for example if I prime you with the word and then I later you know ask you that whether Swan is a bird or not because you have been primed with this concept of you will be able to answer that question much faster.

This is called one kind of a semantic priming there could be very simply even a nepotism priming a cell say for example if I repeat repeatedly present one word one kind of test stimulus to you which is the same or as resembling the later stimulus that we come in you might be able to answer questions about that later stimulus faster and it has also been shown experimentally say

for example if I you know show you the word bird you might respond much more quickly to the representation or same bird or something you know which is also a member of the bird class.

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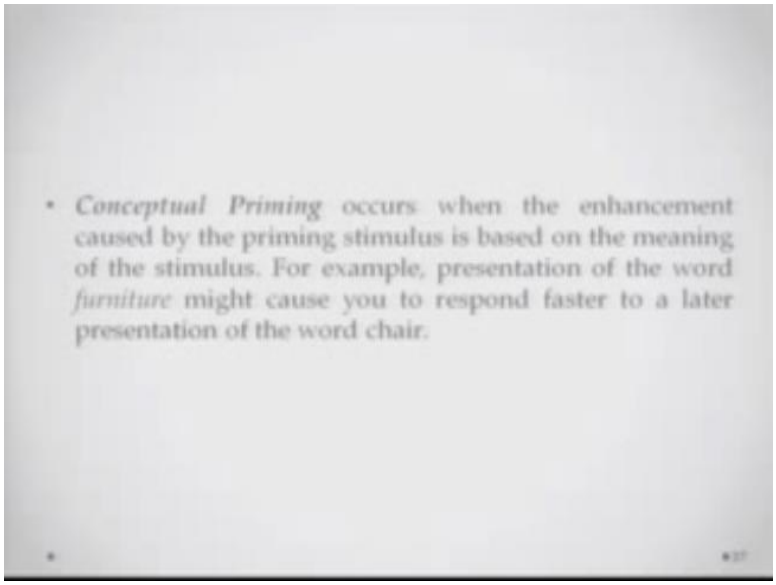

Conceptual priming occurs when the enhancement caused by the priming stimulus is based on the meaning of the stimulus if I repeat the word furniture to you and later the test stimuli consists of let us say a chair or a table or a sofa you might be able to respond to chair table or sofa much easier in much faster way as compared towards so typical paradigm of priming is I will probably just explain this right away is that you see a test stimulus then there is a gap and after that yes you see a priming stimulus and then there is a gap and after that you see what is called a test stimulus.

Now on the basis of the relationship between the priming stimulus and the test stimulus your responses to the test stimulus might be increased or decreased be faster or smaller slower be more accurate or less accurate so if in an experimental setting I mention the word furniture in one of the episodes in one of the screens and then after some point in time on the I present the word called table and I asked you whether it is you know a real word or it is not a real world you

will be able to answer that it is a real word faster because you have just been primed with the word furniture.

So the knowledge associated to all the furniture is activated and because table is part of that knowledge it gets primed and you can answer anything about the table much quicker and much more accurately that is what conceptual priming basically means.

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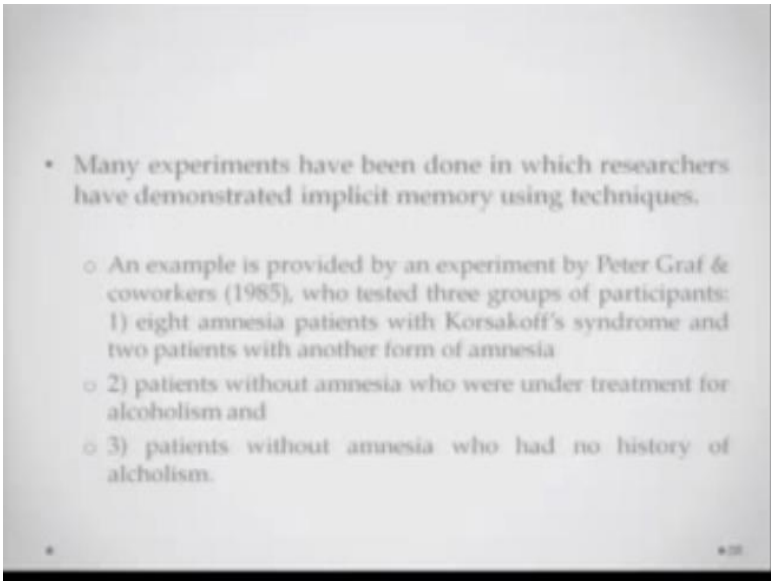

How many experiments have been done in which searchers have demonstrated implicit memory using a variety of techniques say for example an experiment was done by Peter graph in colleagues who tested three groups of participants there were eight patients with coworkers syndrome now coworkers syndrome is basically a disorder as a base is a very acute memory disorder which happens due to alcohol abuse so people do know how people suffer from very you know a very severe amnesia and it could cannot remember a lot of things.

So patients without amnesia who were under tree so the second group consisted of patients without amnesia and were under treatment for alcoholism so the first group is coworkers syndrome people who are alcoholics and amnesic both the second group is patients who are not

amnesic but they are alcoholic and the third patients who had who did not have amnesia or were not alcoholics so three groups of patients they had.

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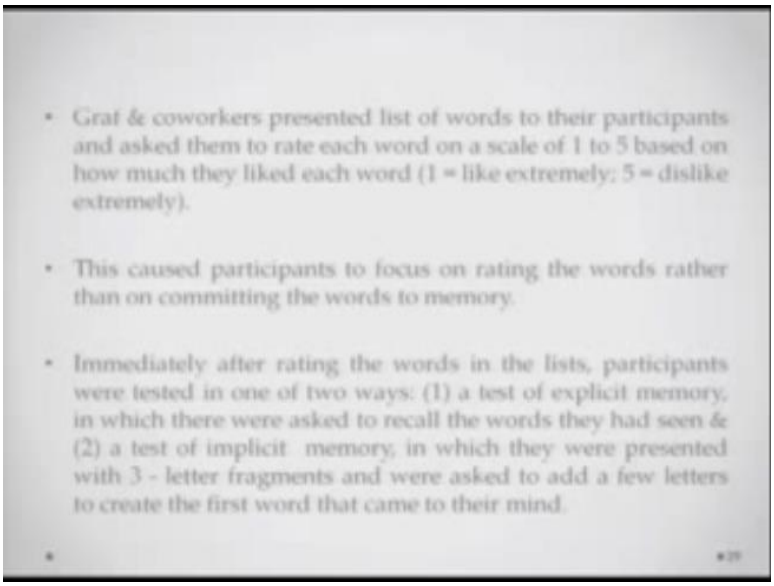

They presented these patients with a list of words and ask them to read the words on the scale of 1 to 5 as to how much they liked the word so one mint I like this word very much five mint I dislike this word completely now this basically got the participants focused on rating of the words and they could not guess that they will be asked to recall these words later that is what happens immediately after rating the words in the list participants were tested in one of two ways either they were given a test of explicit memory so they were asked to recall these words or they were given a test of implicit memory in which what happened was they were given a list of three letters and they had to add some more letters to make and the words okay.

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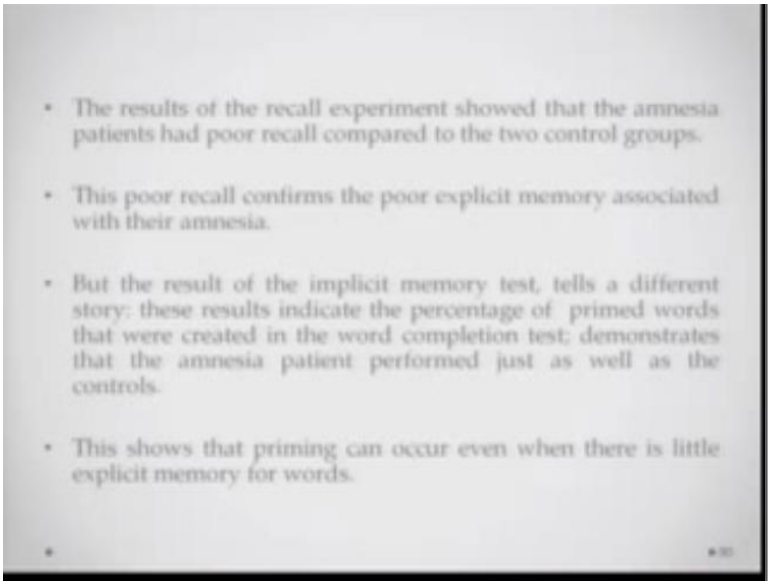

To make newer words and let me make the words that came to their mind so the result of the recoil experiment showed that people with amnesia performed very poorly and they had a poor recall as compared to the two other control groups now this poor recall kind of confirms that the poor explicit memory is there so they are a kind of obviously what is expected with patients of amnesia well the result of the implicit memory test tells a different story it was found that the percentage of primed words that were created in the word completion test demonstrated that animistic patients also performed as well as the control.

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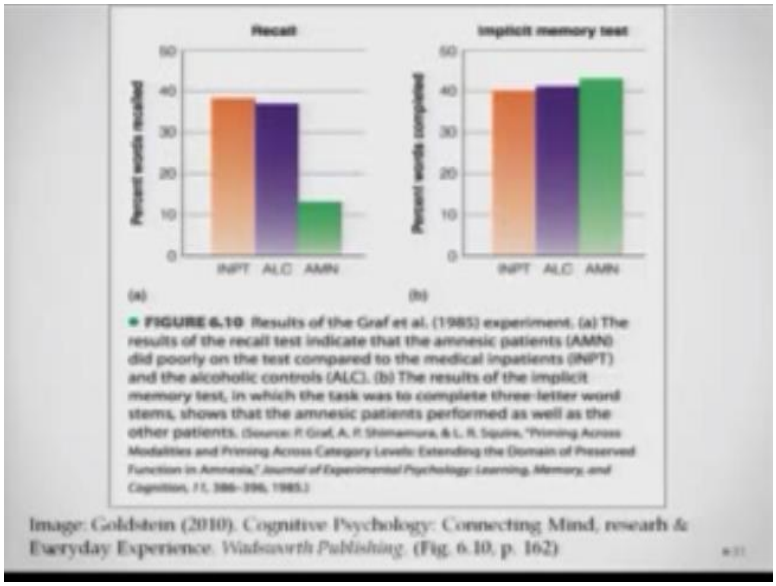

So here in you can see the results you see the implicit memory test the amnesty group performs as good as the alcoholic groups and the inpatients we are in the exclusive recall test the amnesic group Affairs much poorly as compared to the inpatients and the alcoholic group so this is basically one of the tests which also tells you something about you know memory that priming or say for example implicit memory might still be left intact even though explicit memory has been suffered you know has been as severe you do things like amnesia.

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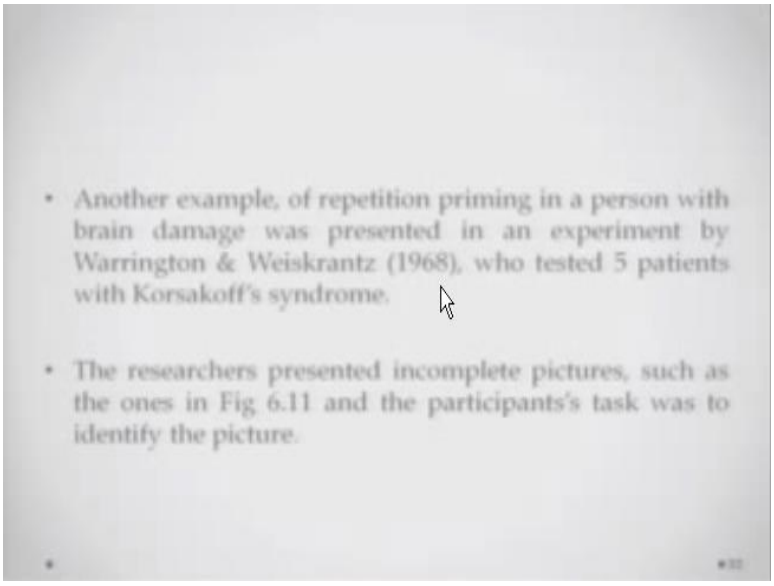

Another example of are petition priming in which a patient with brain damage was presented with you know I was he was participating in an experiment by Warrington and Vice France and they were testing five patients with coworkers syndrome so the researchers presented incomplete pictures such as the ones which I will show you right away.

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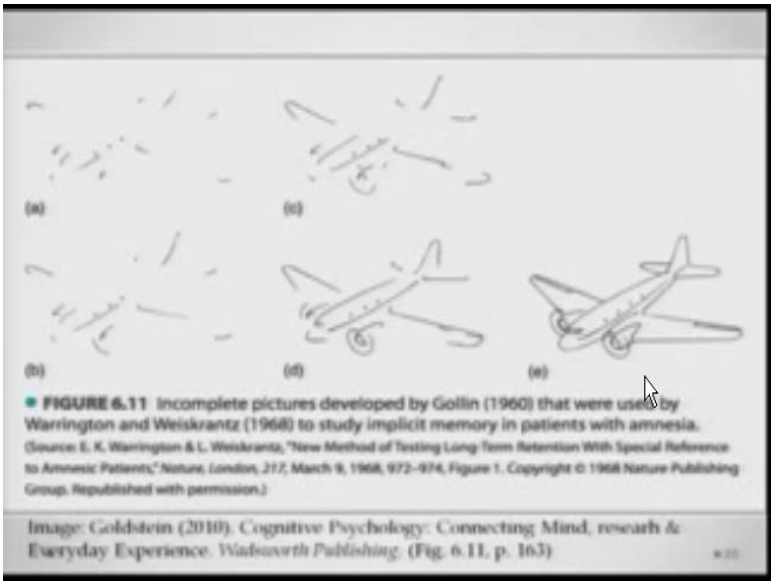

So these incomplete pictures were presented to five patients with coworkers syndrome.

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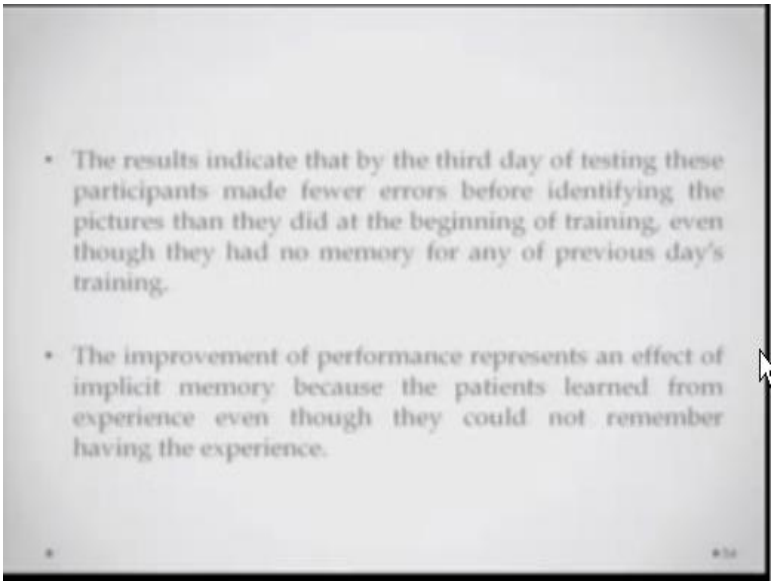

Now what happens is and they were asked to complete this and they were basically asked to identify what these pictures were so you were shown pictures like this and they were asked that what of what each of these pictures meant so the results indicated that by the third day of testing these participants would make much fewer errors before identifying the pictures than they did at the beginning of training even though they had no memory for any of previous days training so if you ask them what did we work on yesterday they will probably not be able to answer.

B ut if you ask them to recognize these pictures they will they are slowly getting better so some learning is essentially happening some implicit memory is essentially being formed again an example of you know to demonstrate that explicit and implicit memory are slightly different skills now the improvement of performance again just to summarize represents an effect of implicit memory because the patients are learning from the experience even though they cannot remember the having that experience or they cannot remember the episode of that experience here you can see their performance.

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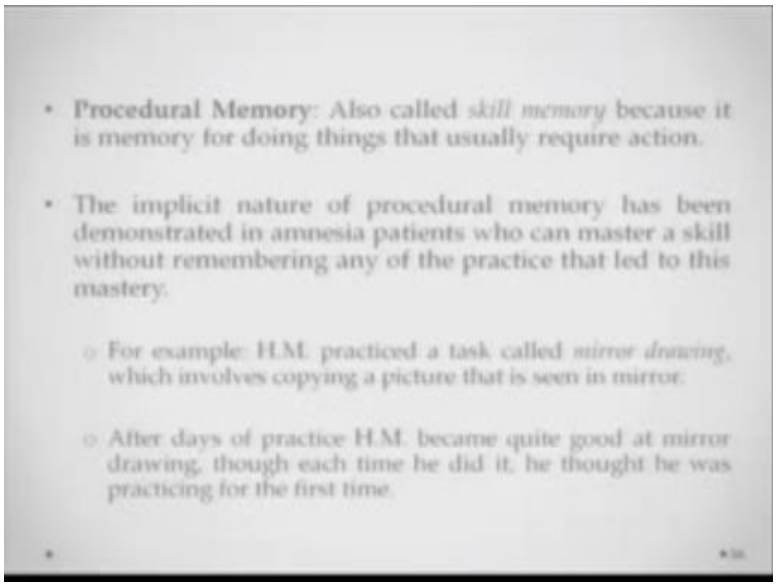

Now procedural memory basically is all so-called skilled memory because it is memory for doing things that usually require action now the implicit nature of procedural memory as we have talked earlier as well has been demonstrated in amnesia patients who can master a skill without remembering any of the practice that had that has led to this you know scale advancement with HM they were doing this task called mirror drawing every day he would go to the psychologist and the psychologist will teach him to do mirror drying and Mira drying is basically this you can see.

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You are looking at an object in the mirror and trying to draw it so with HM he had to just copy this you know thing you know by seeing in the mirror and he was doing it after days of practice hm big basically became very good at mirror drawing though if you ask him about the episode he will not remember he would probably say that you know it is the first time I am doing this task but he's certainly getting better at it so implicit memory certainly you know getting increased and is getting better.

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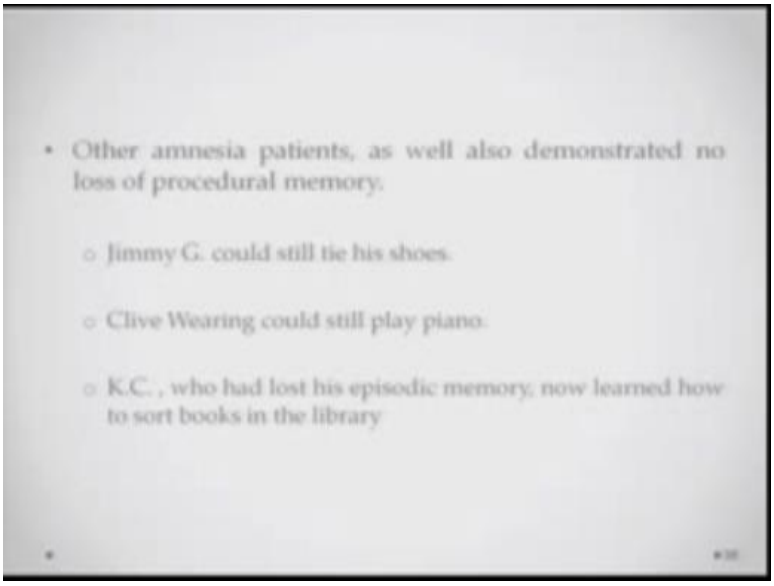

This was the case with other amnesic patients as well see for example Jimmy G the person we are talking about in the first and would still tie his shoe so he knows at least that skill is still there Clive earring who was a pianist I have been talking about him in the earlier lectures still could play a piano KC this guy who suffered a motorcycle accident later became a librarian he learned to sort books in the library and could live his life you know decently even after that so you will see that these kind of you know facts.

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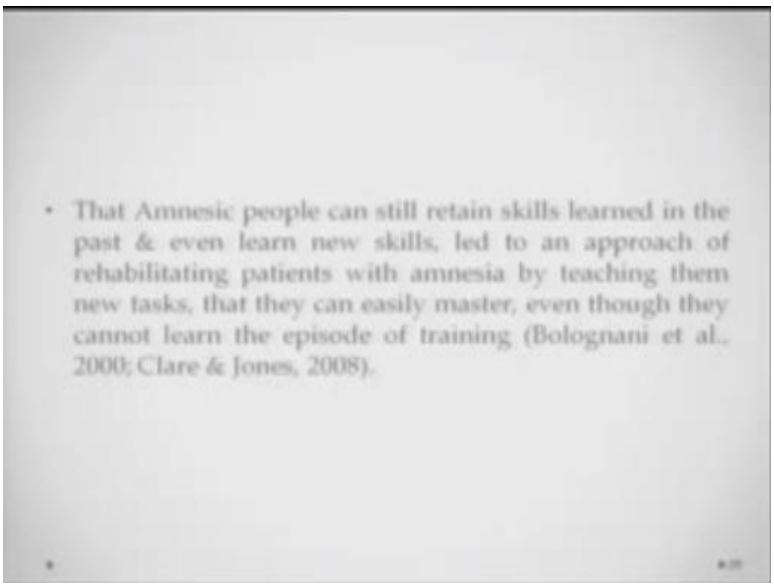

These kind of demonstrations that amnesic patients can still retain skills learned in the past and even learn new skills they basically led to an approach of rehabilitating patients with amnesia by teaching them new tasks okay so it is okay I mean whatever is lost the episodic semantic part whatever is lost that's alright the implicit tasks that they can still learn are actually taught them and you know they even though they will not remember the episodes of training they will certainly remember you know the training they have got they will certainly remember the skill they have got.

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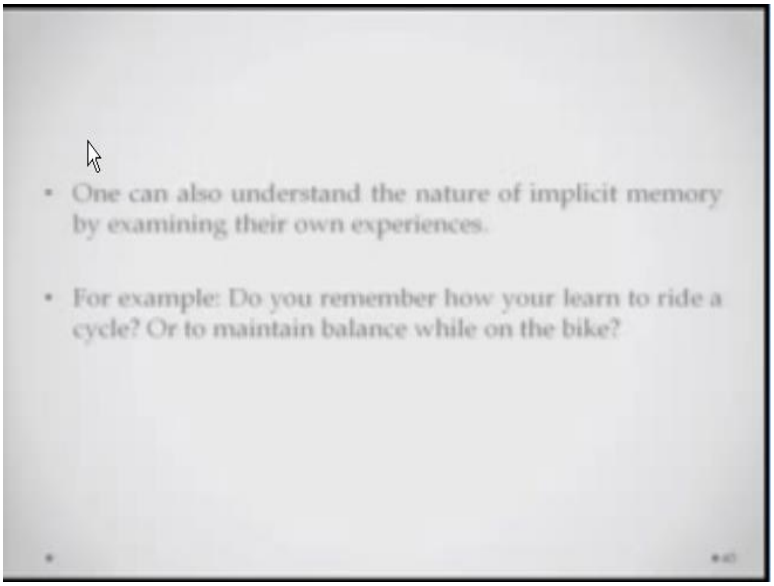

And you can obviously also you know associate this with your personal experiences say for example do you exactly explicitly remember the day you learn to ride bicycle or a car or say for example how to maintain balance while you are riding on a bike but obviously if given a bicycle you can demonstrate by riding it that you know the scale of riding a bicycle so that skill is there but that episode might obviously be forgotten.

So another last kind of implicit memory thing and we can talk about is classical conditioning now classical conditioning basically happens when two of the following kinds of stimuli are playable so there has to be neutral stimulus that initially does not result in a particular response and there has to be conditioning stimulus that does result in its one say for example and this was basically this is being borrowed from a one Pablos experiment done long ago so he presented food and food naturally generates a salivating response and then what he did was he paired the food with the bell which again gave the salivating response because the food is presented.

Later it was found that these the dogs who with which this experiment was being done they started salivating to the bell alone so what the dogs have done is they have linked Bell with the

food so every time they or whatever I suppose they were giving to the food is now also being given to the Bell as well.

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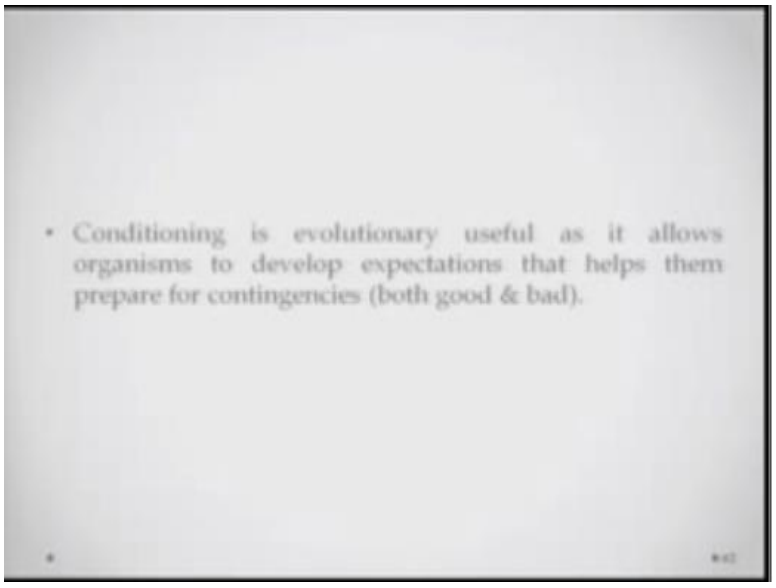

So conditioning is actually a very important thing you know it is evolutionary useful as well because it allows organisms to develop expectations that helps them prepare for contingencies so you know say for example that if you have seen a snake or say for example if you know there are dark clouds in the you know in the sky it might be going to rain you know there is a high chance that it will rain and you will immediately you know go and grab your umbrella if you are going out for a walk now classically conditioning again is an implicit thing so you have this knowledge and you might use.

This knowledge but you might not necessarily say well obviously the example of the umbrella you can still say that I know how it is going to rain but how did you know it how did you automatically guess biasing the thing by seeing the black cloud that there is going to rain so you have kind of learned this over and over again because you've made this association there is so many other skills we have learned through classical conditioning which are important parts of our implicit memories and which kind of also define how we interact with this environment.

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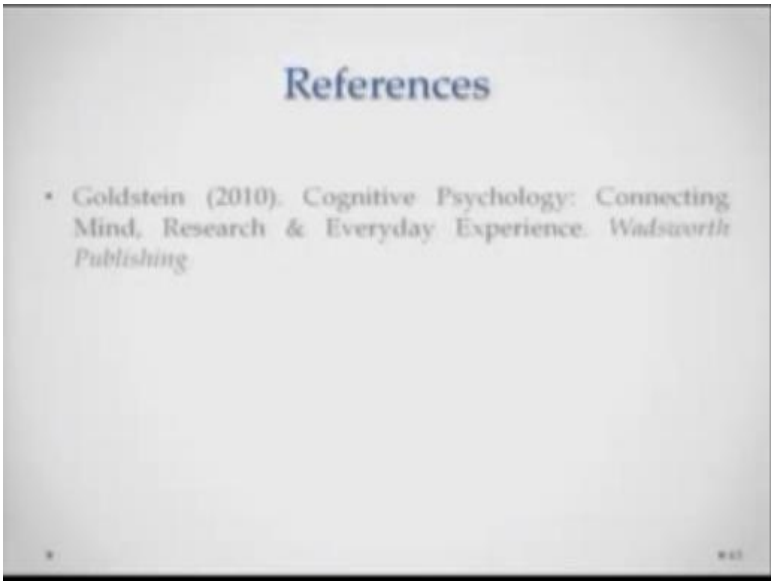

That was all about to memory about explicit implicit memories about episodic semantics and procedural priming and conditioning memories and in the next lecture we will talk about some other aspect of memory thank you.

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