**Introduction to Psychology**
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**Lecture – 17**
**Memory Models of Memory**

Till now what we have done? We have looked at how information is brought to the brain? How the brain assigns a meaning to it, based on our experiences that come to us how we learn certain things now we are moving to the next step. That is ones the information comes to us and we realize that there is a need for us to store it for little longer time for future usage.

Future usage could be say couple of seconds from now or it could be no even in the life time sometime. So, future is quite broad in that sense. So, when you realize that I need to store this information for little longer, I can use it in may be couple of seconds couple of minutes from now, or I might need this information much later in my life which is valuable for me. Then we try to store it and if we have successfully stored it then whenever needed we will like to retrieve it, if the process of storage works well if we succeed you know retrieving it from the storage this is what is called as memory, and in this third week we would exclusively focusing on the concepts that has to do with human memory processes.

Now, memory is basically studied in terms of mental processes that are involved in the storing and retrieving information. Now remember before memory we have talked about learning. The distinction between the two ways is that learning basically emphasizes on acquisition where as memory basically focuses on the retention and the retrieval of the information. So, if you acquire information that is what learning looks at? If you are more interested in terms of retaining the information and retrieving it wherever you need it then this is the part of memory. So, storage retrieval these are two important constructs that we would be looking at.

Now, memory system it stores information acquired through our sensory modality how the sensory modalities they help our brain in terms of an, you know perceiving things that we have already discussed in the first week. Now this information's which come to the brain might qualify to be stored for relatively longer time and therefore, memory

consists of many systems, arranging from storage duration and buffer storage which primarily will take the information to long term storage. So, depending on the fraction of second to life time duration of a storage we will further classify know memory into different sub types that exercise we will continue doing till the end. Therefore, memory basically is our cognitive system which is used for storing and retrieving the information.

With this basic information about memory, let us understand what actually we are going to do as part of this very now discussion deliberation for this full week we would be trying to understand what memory is, we would be looking at some of the dominant theories which tries to explain how human storage system works how the retrieval process works then we would be trying to understand that why is it important for human beings to memorize information? Why memory plays that important role and given the fact that memory plays now such important role? How many types of know retrieval and storage processes are there one is of course, based on the time line whether you know store the information for few seconds, little longer or much more longer or depending on how you truncate it. You have the information which runs for certain duration of time and then depending on certain qualities you truncate it.

So, this would lead to know all types of storage of information the strategies that we use and then we will come to the reverse of memory reverse of memory would basically be the process called forgetting. If you commit error know in terms of storing information or you have stored the information, but then you commit an error in terms of retrieving it, think of know something like this, you are now searching for a paper that you have filed in your cabinet your filing cabinet has that the specific paper that you are searching for that you are very sure about, but when you are search for it. You have know all types of problems may be that people some people give proper file names way are they will put such type of documents. So, they would only look for those file names ones they find the file name they will turn the pages and identify the paper this could be one.

The other situation could be that you make a random search and even in memory, we will see that random search actually does not work, some people might even go for no ordering things know putting things in certain orders in certain hierarchy that also works very well. Then you also might know the file the document based on it is relevance whether you would need it in the coming days, you whether you know need it know in

longer duration a papers which you think are redundant you will never need it depending on your classificatory scheme.

You will put the paper accordingly same is the story with the memory processes also life experiences all the information that comes to you depending on several parameters we try to give it code, we try to store it and the coding is needed because the brain understands a particular type of language storage again you need to store it for longer time and also you need to give it a proper file name. So, that when you want to retrieve this information you can just search for that specific file name and get the information. So, from that perspective, if you look at the memory process memory has three distinct processes encoding storage and retrieval.
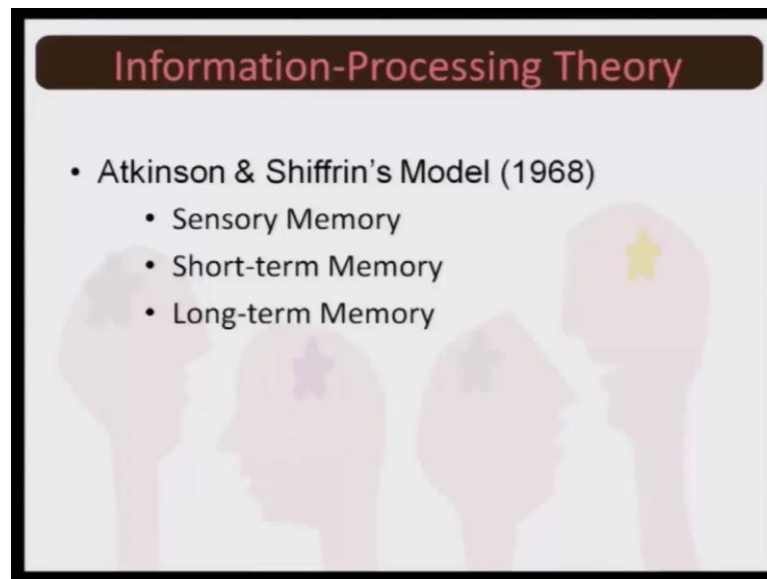
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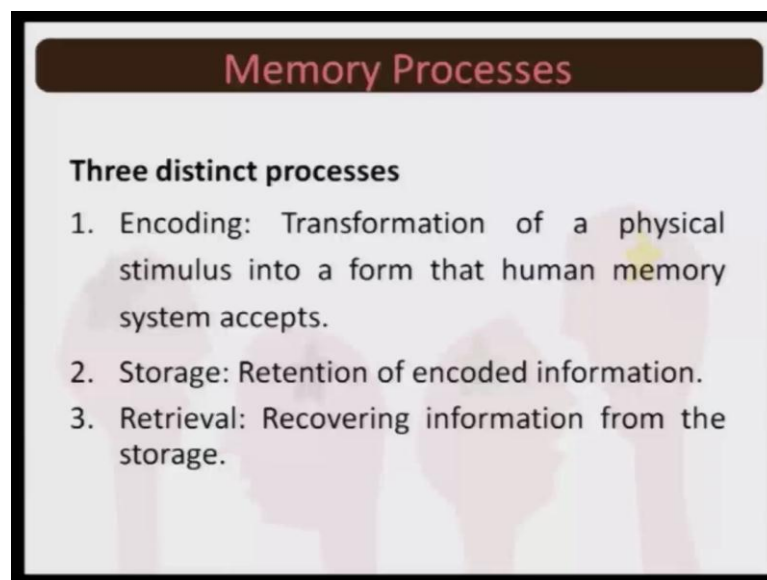


Now, encoding basically is the process of transformation of a physical stimulus in a form that human memory accepts. Now if I am looking at the camera right now there is no certain form and I perhaps have some idea of what type of function this form performs and based on this utility or based on this form I create an impression, I know that if I see an object like this what this should be called I know that if I want a function like this to be performed what is the instrument that I would need.

So, this is in the process of encoding the storage of course, is the process of retention the encoded information is reach the brain and now that encoded piece of information the brain will retain it with itself remember the storage would require a specific file name it

is just like, we save files in our computers say for instance, if I have to deliver a lecture on memory and if I make power point presentation I might know left to give it a name the file name memory because this will help me a lot in terms of know making search for where exactly is my PPT presentation that I have to use today. If I have say 126 power point presentations with me making random search will make my life hell. So, how you encode the information and how precisely how nicely how customize the file name you provide to the information that you have stored the plays a very crucial role and this crucial role comes into play when you try to recover the information that you have stored.

So, encoding storage and retrieval are three distinct processes which are of extreme relevance to memory processes two models.

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We would discuss one that can different model that was proposed in 1968, which tried to explain memory in trifurcated format saying that we have sensory memory short term memory and long terming memory.
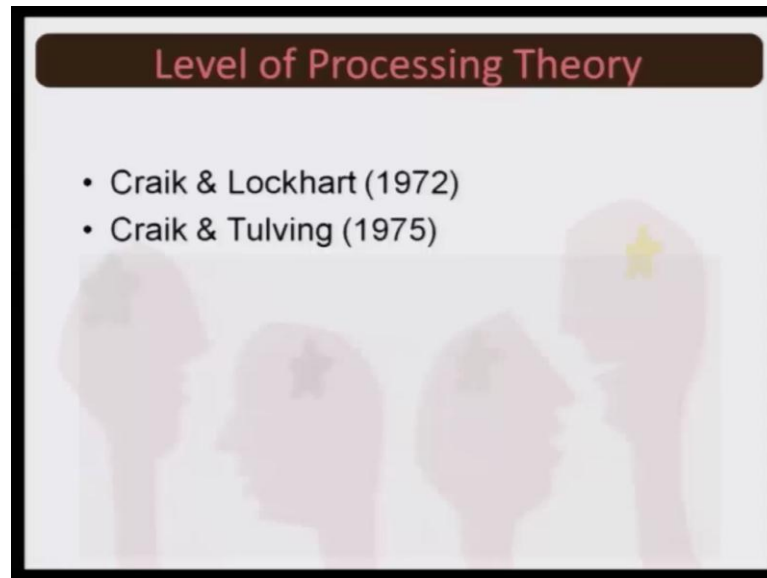
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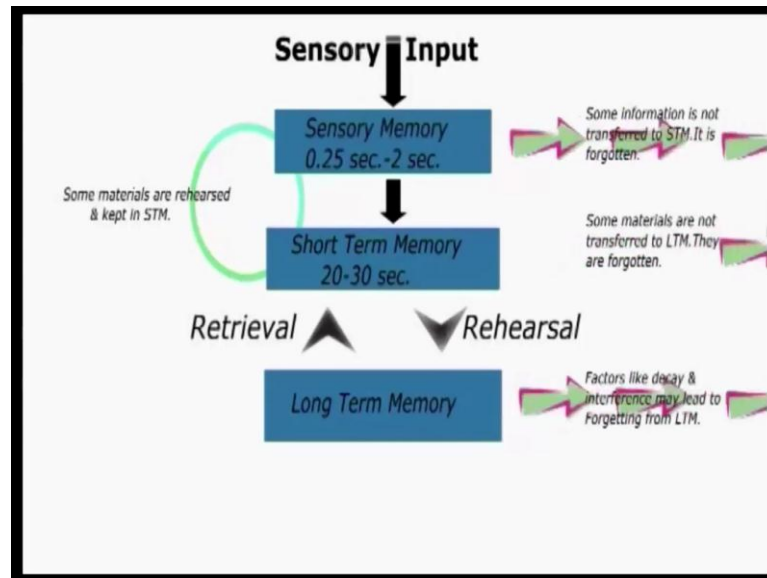


 Memory starts with a sensory input received from the environment this input is retained for a very brief time arranging from 0.25 seconds to 2 seconds, some of these inputs are attended and rehearsed such input pass on to short term memory the unattended inputs are not transferred to short term memory and are forgotten the inputs can be held in the short term memory for 20 to 30 seconds. If they are further rehearsed they pass on to long term memory the unrehearsed once are forgotten the inputs moving to the long term memory as organized into categories they may remain here for days months or even lifelong and can be retrieved as and when needed decay and interference are some of the factors that lead to loss of information from a long term storage.

Because that Atkinsion and Shiffrins model they talked about the trifurcated structure of memory, just looking at it from a temporal point of view sensory short term and long term another theory was proposed by Craik and Lockhart in 1972.

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Which further got revised by Tulving and Craik and Tulving came for a word with a revised version in 1975.

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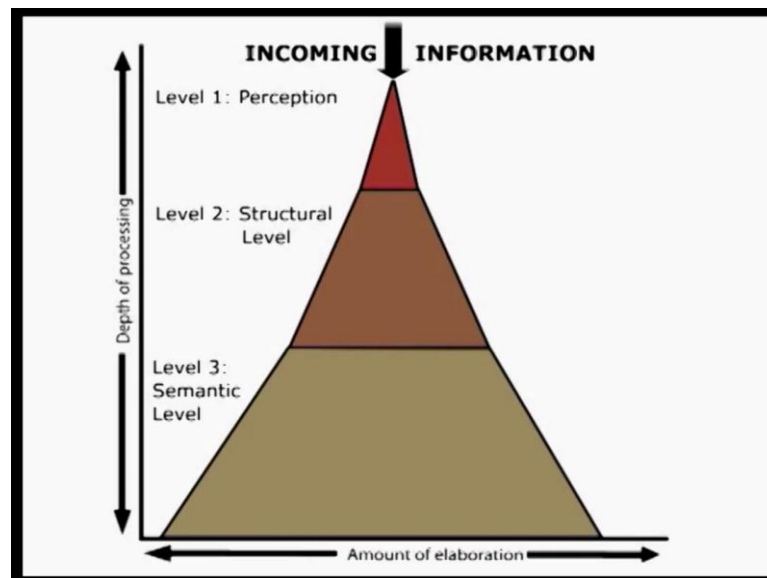


According to this model the incoming information can be processed at three different levels; perceptual level, structural level and semantic level. At perceptual level one becomes aware of the immediate environment. Structural level is somewhat deeper compare to the perceptual level. Here one emphasizes the structural features of the information. The deepest level of processing is the semantic level. Here one derives

profound meaning of the information, this model explicates that deeper the processing more is the elaboration, in other words deeper and meaningful analysis leads to durable memory of the information. Higher the elaboration more is the chances that the newly derived meaning integrates with the existing memories.

Now, you have seen the difference between the two models the first model which try to look at memory in terms of the three types of structures based on it is temporal programming, the second model which was more looking in terms of the elaboration process, whether you look at the information only from a perception point of view, whether you look at the information from a structural point of view or whether you go for an extensive elaboration there by suggesting that the more and more you elaborate perhaps you understand things better and if you have more if you have more of know semantic meaningfulness driven type of a memory you will store it better.

The third perspective on memory is what is called as the neural network perspective. Now neural network basically now talks about know the groups of modules. So, it says that there are various modules which form a group and these modules basically they help perform simultaneous functions memory is nothing according to the neural network perspective.

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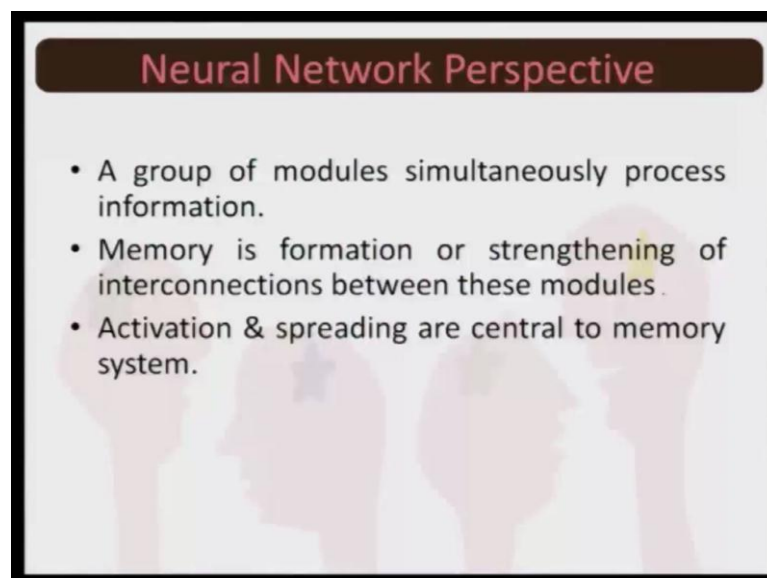


But it is formation or strengthening of these interconnections which get form between different modules, now the activation and the spreading they are the two central

components from the neural network perspective related to memory. So, what happens you get the information from the external environment you encode the information, you have modules which would be entertaining those encoded information and ones the traces are formed when you repeated the second time, and it gets the strengthened. Now two or more modules they get inter connected and this formation if it is repeated it gets strengthened when you activate it you are able to store the information now more and more is the low formation of the module more and more is the connectivity between different modules. The more spreading takes place you have better memory. So, there is a spread of this strengthened associations the stronger the association, the more wider the network better would be the memory and this is how the memory system gets operationalized this is the neural network perspective.

Now, that we have discussed three important concepts know the module given by the Atkinsion and Shiffrins the module given by Craik and Lockhart, which further got revised in collaboration by Tulving and the neural network perspective, if we combine all these information and try to revolve a comprehensive model of memory. So, what is memory all about, how does our memory function? This is how we would explain it.

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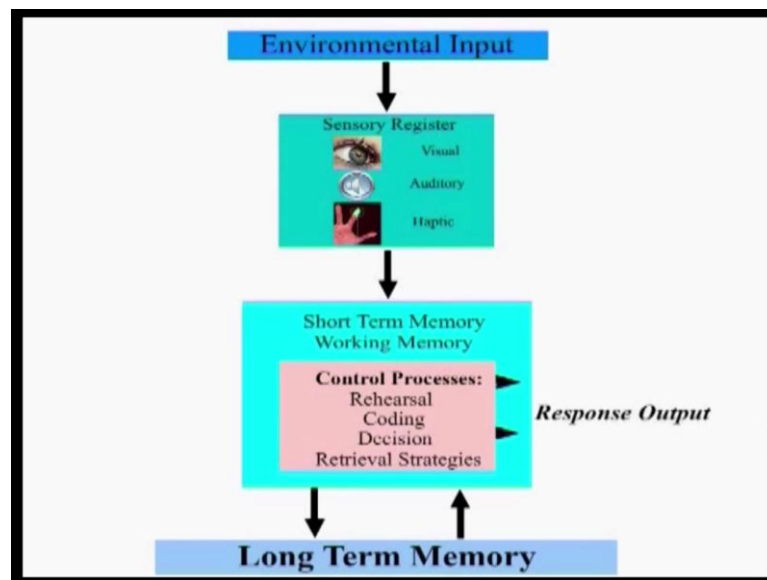


This is what you get if you summarize the existing knowledge on memory system, then our sensory register mostly gets information from the visual auditory and the Haptic senses, the rehearse information then moves to the short term memory system those

encoded and rehearsed further moved to the long term memory system. Depending on our decision to respond to the environment we use certain retrieval strategies to get the desired information from the long term storage, the response outputs are mediated by our working memory.

Now, let us go back to our first week, what we discussed there was that visual kinesthetic, somesthetic, vestibular, auditory, olfactory all these channels they are basically meant to provide information to the brain, given the fact that the brain receives stimulus from all these sensations, one can think that if memory is guided by the information that comes to the brain then ideally it should store all type of information.

Now, let me give an example say if your mother for instance just comes and know keeps her palm on your shoulder without hesitation within fractions, you would arrive at a conclusion that it is my mother this recollection you are you are not looked at your mother, it is only the touch of the mother which made you identify, make a correct identification that it is our mother. Where as if somebody else touches you are not able to provide the correct meaning to it why and this gives you a feel that fine a touch based memory could also exist.

Previously I was telling you that, if I look at a camera and I know this is called camera the structure the form the function both. So, next time if I see this structure I know this is camera and if I needed something to be recorded I know which instrument can perform this function and then I will say I need a camera. So, it is the visual part it is the understanding of the mechanism and now imagine another situation you are somewhere know who close to a railway track you are not able to see a train, but you hear the sound of a moving train, just with the help of this auditory input you can sense that fine this the source of this very sound is a moving train which perhaps is now at certain distance from me.
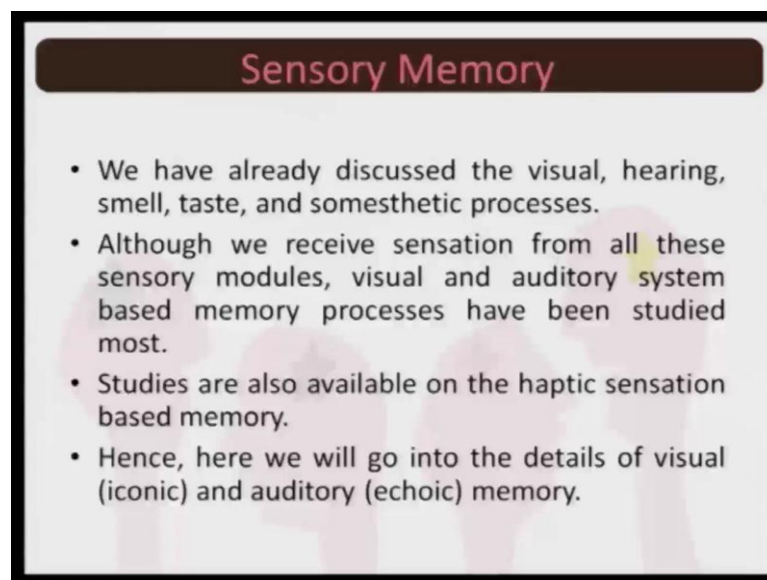
Now, one sound how does it make you understand that this comes from the train again there must be something that the brain has stored based on the auditory process say somebody gives you something to taste you put it on the tip of your tongue. Yes I remember there is something else also which resembles to this taste or this taste is equivalent to something that know you and the person with whom you are sharing this

experience also is aware of then you realized that there could be a taste based memory also.

So, what I am basically trying to tell you is that because the brain receives inputs from all sense of all sense modalities you can assume situations and you can very easily indentify cases from the real wall situation where your own experience will tell you that this part of my memory is basically guided by the input, which has come from a given sense modality having said this let me confess that research in psychology has largely been conducted only using two sense modalities the visual processes and the auditory processes. So, eye and the ear these are the only two sense modalities through which how the information is captured how it is processed how it is stored how lot of research is going to in it and the third set of research which is not as now comparable as the visually or auditarily guided research in memory is the touch based memory.

Rest of the sense modalities they have not been examined as thoroughly as the first two and then the third one, therefore, we will for our understanding of sensory memory will focus on only three types of memories.

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## Sensory Memory

- We have already discussed the visual, hearing, smell, taste, and somesthetic processes.
- Although we receive sensation from all these sensory modules, visual and auditory system based memory processes have been studied most.
- Studies are also available on the haptic sensation based memory.
- Hence, here we will go into the details of visual (iconic) and auditory (echoic) memory.

Now, the sensory memory which has to do with vision that is the iconic memory sensory memory that has to do with auditory process that is the echoic memory and the sensory memory that has to do with Haptic sensation the touch based sensation, but because largely research has been guided by the iconic and the echoic memory. So, for this very

module tenor or brief module we would be no talking exclusively with respect to the iconic and the echoic memory.

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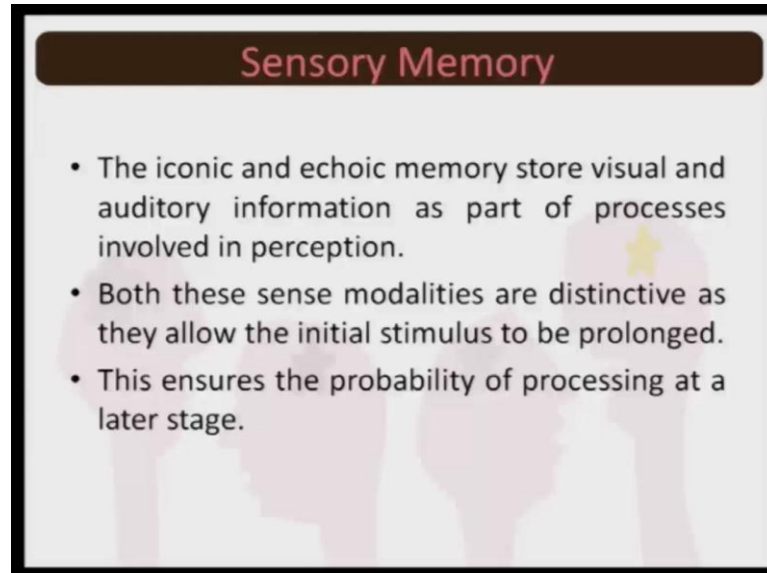


Iconic and the echoic memory basically, now they store visual and auditory information as part of the process involved in perception. So, eye and ears both are responsible for the process of perception they are the first source the biological entity in our body which receives the signal from the external world. Now both these sense modalities are distinctive because they allow the initial stimulus to be prolonged this means that when the eyes they get activated because the light falls on the retina you remember in perception we had said that the sis state converts into the trans state and again gets back to the sis state because it has to be ready enough to receive the second set of single.

Now, this varied transformation the at the level of retina the rod cells and cone cells the light falls and the sis configuration becomes in the trans state the time that, it will take to get itself back to the sis state is the time which basically the eye gives to it gives to itself to retain the information for certain period of time. So, the visual information although it has cross to the optic track till this know information till this chemical configuration realize the information is stored at the level of eyes this is iconic memory, now recollect what we have discussed about the auditory mechanism what we discussed was that the sound wave it enters to the middle ear, it goes to the inner year where in the cochlea we have the fluid and the wall of the cochlea which is the hair follicles this fluid starts

shaking there by making movement in the hair follicles these hair follicles in turn triggers current in the nerve circle this neural circle.

Finally, is perceived by the brain assign the meaning and thereby we hear meaningful things in, but recollect your other experience of throwing a piece of stone in a still water or if you do not have that experience recollect the experience of know collecting water in a bucket that falls from the tap, you close the tap and one or two drop still falls in the buckets and you realize that the ripples create in the water it takes certain time for the ripple to settle down.

Now, convert this to the walking mechanism of the ears the cochlea has the fluid the fluid shakes. So, once the shaking has begun it will take time to slow down and then gradually get stabilize. So, that would been that till the fluid in the cochlea now moves then, hair follicles will also move and till the hair follicle moves ear is capable of retaining the auditory information and this the source of echoic memory. So, what happens? Eyes and ears both are now capable of storing the information for shorter period of time to ensure or to allow you the probability of processing this information at a little later stage and these are the biological foundation of sensory memory specially remembers we are only with reference to iconic and echoic memory.
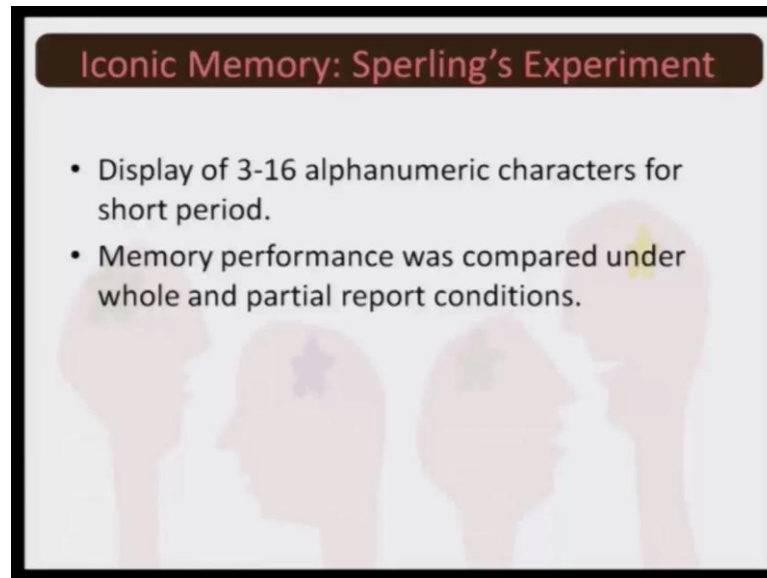
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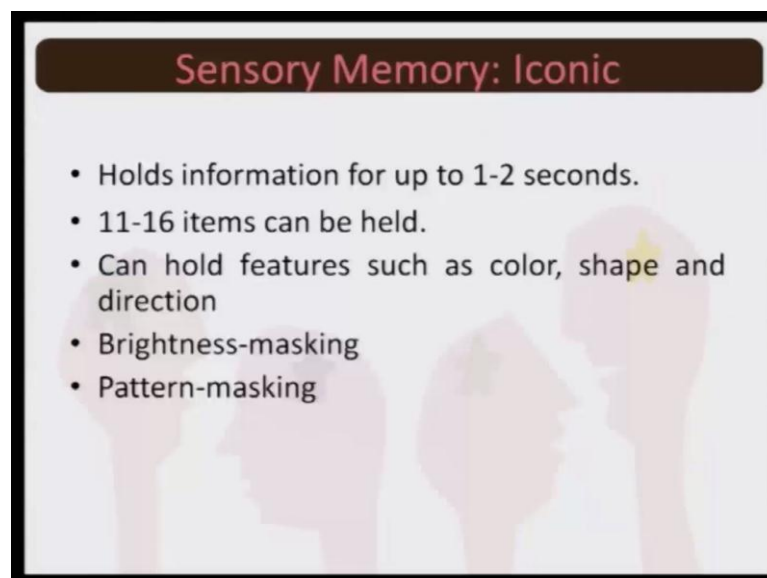


Now, iconic memory that has to do with the eyes can hold information for up to 1 to 2 seconds. Remember when you will come to the echoic memory you would realize that

ears are able to store information for little longer period of time compare to eyes why that question we will take up when we come to echoic memory. Now what happens in the case of iconic memory shorter period of time just 1 to 2 seconds, but then you have longer piece of information 11 to 16, items can be held right at the level of eye for 1 to 2 seconds you can imagine the capacity of iconic memory further what is far more interesting is to understand the fact that feature which are extremely important for us to perceive the world such as color such as shape, such as direction you remember illusion example that it had arrow added line feather added line. So, direction was there different lines are different colors entire the principle know bubbles that used to come as examples all of them were colored.

So, the shape color the direction all these features can be stored and eleven such information 11 to 16 such information can be stored right at the level of eye what would this mean this would mean that, when you saw examples whether it was a line whether it was horizontal whether it was vertical whether it was a bubble whether it expanded. Whether it moved in what you call vertical direction diagonally horizontally everything you could store right at the level of the eyes, multiple information up to two seconds this is what happens at the level of eyes and this is called iconic memory; however, our iconic memory has 2 limitations first. If you vary the brightness level ones you now change the brightness then, you realize that you now some degree of masking has taken place right now the level of brightness was this much you add one more glowing light or you switch off one more light and you realize that the brightness pattern has changed because in perception also we have discussed this based on know the balance between white gray and black the perception quality changes.

Therefore 2 information can get masked it can interfere. So, this is called brightness masking similarly we can have pattern masking more than one pattern, if it super imposes one gets over lead over the other and you get a combined image of the two. This will be called as patterned masking. So, in terms of efficiency we know 11 to 16 items color shape direction all such important features for up to 2 seconds that is the capability of the iconic memory limitation it know has it is limitation. When you tamper the brightness level and if you vary the pattern then also it has certain limitations with respect to iconic memory let us also discuss one of the interesting experiments done by Sperling.
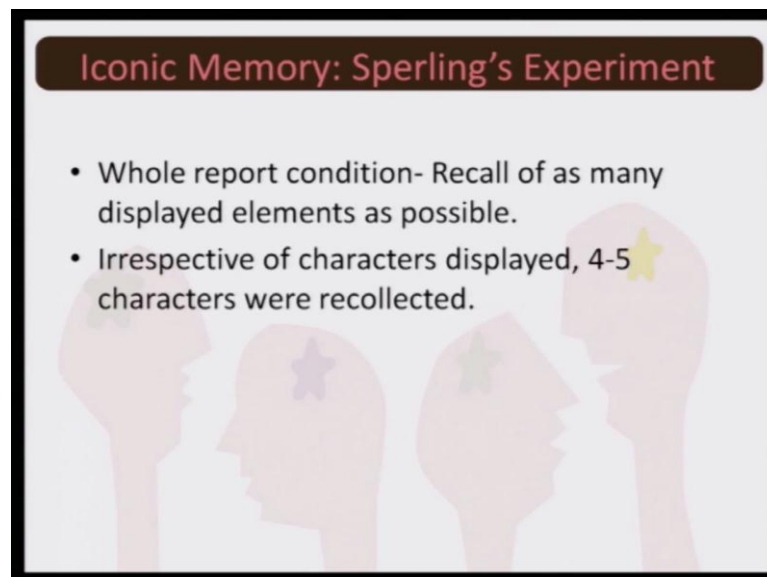
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Iconic Memory: Sperling's Experiment

- Display of 3-16 alphanumeric characters for short period.
- Memory performance was compared under whole and partial report conditions.

Now, three to 16 alpha numeric characters were displayed for shorter period of time and performance in terms of memory was compared under two conditions the whole report condition and the part report condition.

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Iconic Memory: Sperling's Experiment

- Whole report condition- Recall of as many displayed elements as possible.
- Irrespective of characters displayed, 4-5 characters were recollected.

Now, in the whole report condition recall was now in the whole report condition recall was basically suppose to be done with respect to as many information as many elements of information, it was initially presented how much the participant is able to recollect now irrespective of that characters displayed it was realized that only 4 to 5 characters

were recollected this was the whole report condition where the recall was suppose to be of maximum possible number of elements what happened in the case of partial reporting condition.
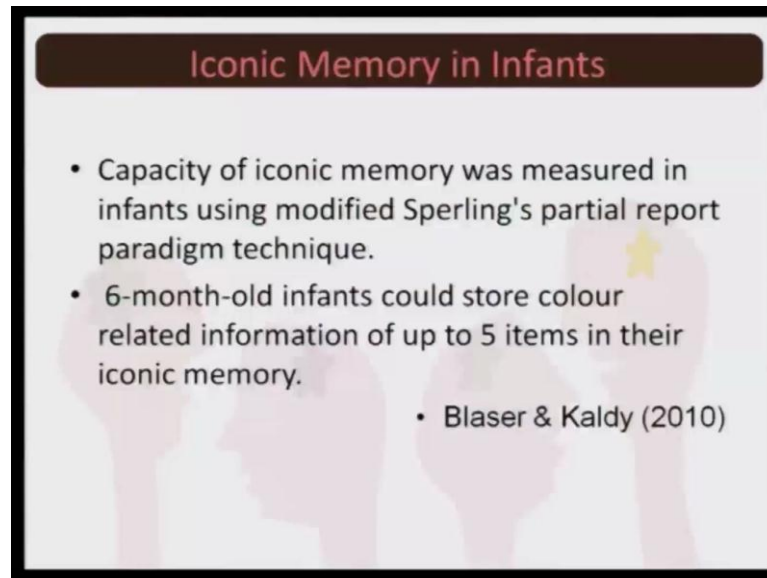
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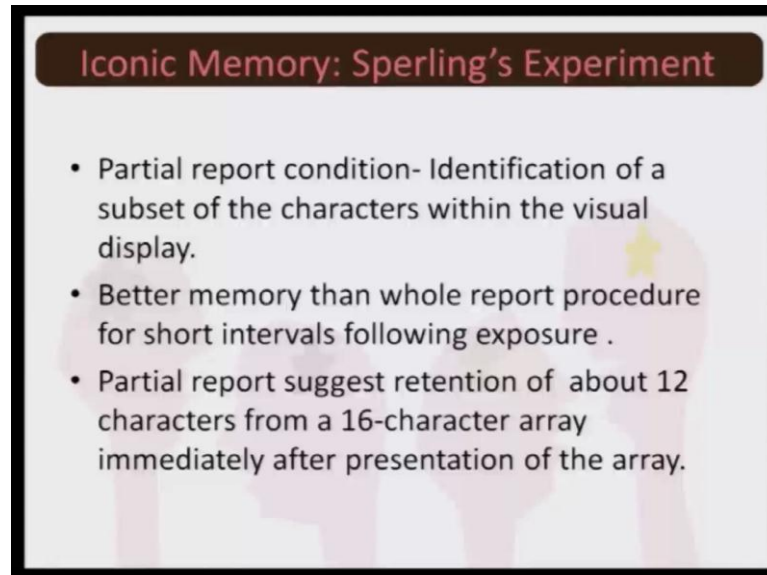


In the partial reporting condition the participant was basically suppose to identify the subset of the characters within the visual display and it was realized that memory was better in this case. So, better memory compared to whole report procedure and partial report also suggested that retention is possible for about twelve characters from a 16 character array. So, if this alpha numeric character there was 16 alpha numeric characters 12 at least could be recollected in the partial report condition suggesting that, if you are allowed this freedom to go for a partial recall this is a better condition compare to the whole recall condition.

Another interesting information of research not so very old conducted in 2010 which tried to you know modify, Sperlings partial report paradigm technique and tried to find out if iconic memory works in the case of infants also because whatever we were discussing had to do with adults.

Now in infants this very study found that and even for human children who were just 6 months old they could also store color related information and up to 5 items were know stored at the level of iconic memory. So, you can visualize that right from very early stage in our life iconic memory vision based memory which basically serves us for a very brief period of time not more than 2 seconds, time plays an important role when we met tomorrow we would be talking about echoic memory.