Psychology of Learning

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Lecture – 13

Memory and Cognition (Contd.)

Hello viewers, welcome back to this NPTEL course on the Psychology of Learning. So, we were discussing about memory and cognition. So, to continue with that let us start the discussion. Initially we have just started our discussion about working memory model. As you can see the working memory model that is actually the short term memory has been renamed as the working model memory model because working model is considered as the workbench at the moment on which we work with issues and topics. Till we complete the task and till we resolve the challenges etcetera, we still go on working on this workbench.

So, how this working memory model actually functions? As you can see the central executive is there. It is also there in information processing model. Central executive unit actually determines, gives the direction,n gives the command: what to do with which information and data. So, central executive means, the decision maker and it executes the plans. It gives the instructions to all other components of the brain. As you can see again so, here it has the two things: One is the visual sketch pad another is the phonological loop.

The thing is that we receive the information through various sense organs. So, visual sketch pad is that which actually holds the visual information. So, pictures, images whatever the visual images information that we collect, we receive from the environment, they are processed by this visual sketch pad. Similarly, all the verbal things all the auditory components that is being processed by the physiological phonological loop.

So, here these two components. How do they process the information? This episodic buffer is actually the attentional process through which actually we work on: how to process these things that means, how to catch hold our attention and how to process it again and again. So, that is the things. So, we can do one thing. We will discuss in detail. So, how this episodic buffer actually works? How does say attention span or attention platform work to catch hold of all these things?

And again it also assimilates the visual information through the phonological things and other information that we receive from the environment. So, it actually integrate all these things integrate all these things compile all these things. Thereafter from episodic buffer the information goes to episodic LTM that is the long term memory. Similarly, how this visual sketch pad works on how we interpret visuals and visual semantics form and how from the phonological or auditory information to how these are being stored in the in terms of the language. So, that we will discuss in detail right now.

So, assumptions here again. So, here working memory has certain assumption assumptions>it means it has been developed on the basis of two assumptions. First is thing we receive the

information through dual channel. So, that is called auditory and visual. So, that is called the dual channel is another component of the working memory. So, human this is an assumption that human information processing consists of two separate channels whatever information we receive through visual or pictorial or visual processes and what are the other auditory acoustic things.

So, that is why it is named as the dual coding theory by Paivio and Baddley in 1998 they started developing this working memory model. So, dual coding theory dual channel is the first assumption. Second thing is that limited capacity that our memory system information processing system cognitive processing the system has a limited capacity like how do we receive the information how much how long can we stay it can we hold it for the for the processing that is a verbal processing verbal information and the visual channel. So, the verbal and visual channels at any point of time how much information they can hold on and what is I can say the sensory register at the moment that register get into the sensory register how much time how much how long can we stay with the information can we retain the information. So, that is why you know we have already discussed like for example, the visual visual memory capacity of the sensory register how long we can remember the visual information like the digits that attention span on the basis of the digit span digits that we can remember like for example, 5 plus minus 2 or 7 plus minus 2.

Similarly, the auditory auditory memory also at the sensory level it also holds we can hold it for few seconds like this thing. So, but unless and until we further process it it will be it will fade away. So, that is where the limited capacity the brain has a limited capacity our information processing system has a limited capacity and to process the information that means, to hold the information in the initial stage and third is the active processing. And for meaningful learning the we need to need to put extra effort need to further process the information. So, meaningful learning requires the substantial amount of cognitive processing to takes place in the verbal and visual channels.

So, that is the that is for example, as so, these are the three basic assumptions on which the working memory model functions. First thing is the dual channel model, second is brain has the different visual and the verbal channels they have the limited capacity to process the information and the active process. And for getting the meaningful learning and to store it for the long term memory. So, we need to actively process it. So, these are the basic assumption now next we can say yes.

Now, there are different components that is involved in memory working memory model this is the central executive that is which that means, which decides what to do with the information how to process it which strategies to implement how which what are the what could be the plannings all the instruction and planning the command is being given by the central executive. So, visual sketch pad is that it holds the visual memory visual images in pictures all the thing in visual information and the phonological loop what it receives and holds this auditory verbal components. Now, here again so, central executive further process it the thing is that types of knowledges are there for example, one is the procedural knowledge that we will discuss later on. Procedural as like how to that means, know hows know hows of the information procedural knowledge and abstract semantic information is that when we interpret it with the meaning. So, it may be in abstract form, but semantic is that when we make it more meaningful to understand it and retain it and other things other processing are also there.

So, what to do with the visual information and phonological auditory information that is that

command is being given by the central executive. So, now, the basic principles how this working memory functions first thing is that these two visual and auditory information system they are quite independent. Relatively independent processing system in work in working memory visual information channel is independent and auditory also. Then, but simultaneous and mixed mode of presentation like for example, whenever we receive the information there may be simultaneous and parallel form of information receiving like the multimodal. Multimodal, but when suppose whenever we are learning in any classroom situation whenever simultaneously we are seeing at the visual pictures as well as we are also receiving the verbal information.

So, mixed mode simultaneous mode through multimedia presentation can also enhance our working memory system because we are not only processing the visual information, but auditory information also gets strengthened. So, both the here both the types of information they complement each other. Now, working memory is a predictor of wide range of complex cognitive task planning problem solving decision making etcetera. For example, especially in the workplace or in the study academic environment also suppose we are dealing with multiple information number of information some academic information some you know some official work some personal things some other things. So, multiple when we are engaging number of tasks cognitive tasks it is it and it is related to you know taking some decisions related to problem solving it related to you know some writing something like that in terms of performance outcome.

So, then it is a so, how quick how quickly how competently how comprehensively that we could do it that predicts actually the working memory capacity. So, working memory it has a wide range of it is not limited to one task at a time it also it can deal with the multiple cognitive task. So, central executive is responsible for controlling in the overall system and performing all the information giving all the commands related to what to do what not to do which cognitive strategy need to be applied all these things. So, visual sketch pad in maintains and manipulates the visual information. So, whatever visual information that we receive the visual sketch pad actually manipulates maintains what to do with that information and as per the command it receives from central executive.

Then the phonological stores in a loop actually stores the rehearsal verbal information. So, information suppose along with the suppose along with the visual things also we need to remember certain digits some formula some you know verbal narration something like that. So, phonological loop actually stores and engages and practices some rehearsal kind of things. So, now this visual sketch pad holds maintains the visual information phonological loop stores and rehearses the verbal information. Then what episodic buffer does? Episodic buffer actually is the attentional system that function as a storage structure to integrate the multiple sources of information.

So, that is for example, not only it holds the attention to practice both the things both the visual and auditory information verbal information, but at the same time in the some kind of spatial information are also there, some kind of environmental contextual information are also there. So, how to integrate? So, episodic buffer works on receiving other information from multiple sources and how it can be integrated how it can be integrated along with this visual and verbal information that is the task of the episodic buffer. For that particular time being for that particular time slot particular episode how it blinks how it integrates all kinds of the information from both verbal visual as well as the spatial information that the human beings that we receive from the different context. So, as you can see same thing central executive it

gives the command what to do with the suppose we need to remember it further then phonological loop will be activated. Similarly, if we need to work on the visual information is relevant.

So, that is we need to work upon it. So, how to that means, how to remember it how to work on it then how it can be converted from there it can be converted into visual semantics that is meaningful when we add meaning when we interpret it phonologically by that means, all the verbal information how do we store that is in terms of language in terms of verbal interpretation narration something. So, in between the episodic episodic buffer works may be that in between we receive some other information then episodic buffer actually it integrates everything then it sends to the LTM long term memory. So, here we can say this is the functioning model of the working memory in the movement it we receive the information etcetera. So, now, what is this fluid system and crystallized system? Fluid system is the initial stage like you can say what is the level of our system at the raw level at the initial stage then with interpretation with meaning with training with education when the knowledge and information get consolidated then it converted into crystallized system ok.

So, that is the basic two types of intelligence has been given here fluid intelligence system is that our biological basic status basic perceiving grasping power basic basic holding power basic basic basic cognitive processing skill and then when with training and education and practice that gets strengthened then it becomes the crystallized. So, here central executive. So, here main role is being played by the central executive as the main component because it is responsible for all kinds of executive processes including action direction and it also decides what to which information is relevant that to be addressed and which are irrelevant how to be rejected all these things how to suppress all these things undesired actions undesired information and then again to monitor and supervise the way information are being integrated that is also the task of central executive then coordination of the multiple cognitive processes to be executed in parallel. May be that are that means, to restore to restore and further work on visual information and verbal information may be that we need to do something else may be we are we should do some not just rehearsal, but some writing some sketching some drawing some designing something. So, what needs to be done in order to consolidate this and integrate these things that command should also be coming from the central executive.

So, all the coordination of the subsystem of the working memory that is the responsibility and task of the central executive it coordinates what to do with which type of information if something because suppose when we are receiving n number of topics issues and challenges different tasks have different nature different quality different complexity different demands etcetera. So, depending on the nature of the task depending on the nature of the problem working memory decides what to do with which component what to do with which issue. So, it is not just about know hows, but is know what and how this can be accomplished. So, that all the kinds of that that has to be decided by the CPU that is central executives and the all the commands all the directions all the all the integration everything is being supervised and monitored and executed by the central executive. So, phonological loop permits to maintain the auditory information with a rehearsal mechanism that prevents rapid decay because you know it for it holds for few seconds auditory information only at the first hand on the outside it it holds only for few seconds and unless and until we make practice rehearse it remember it repeat it will be it will fade away.

So, that is the rapid decay how to prevent it. So, phonological loop now how to prevent this further decay rapid decay with rehearsal and practices. So, then visual sketchpad also it permits

to maintain a manipulated spatial information visual information as well as spatial information because related to space for example, related to space these are also the some visual clues and cues. For example, we can create the navigate the mental map for the mental images for for example, suppose we are venturing into new place. New place is of course, our destination is one part, but while reaching towards the destination we come across different kinds of space some different kinds of pictures and different kinds of visuals etcetera.

So, how we integrate all this spatial information that is in and around with this visual image or the main core image or the main main important vital image visual visual image or the clips etcetera that is also important. So, it takes into account not just the visual information that is been that we are directly receiving, but the background spatial other information also and how to manipulate, how to maintain, how to integrate all these things. So, it is it is constituted of two subsystem one is the specialized for visual information another latter is the spatial information. Specialized visual information that is the task visual task that is we are having right now and the spatial information is the background information other relevant information available at the context at the moment. And episodic buffer is that temporarily it integrates the phonological things.

So, it integrates all this phonological auditory verbal components that we receive visual information that we receive as well as a spatial information. So, we when we try to convert it into a meaningful theme meaningful topic meaningful issue meaningful topic and meaningful theme or meaningful learning. So, then we have to blend it integrate it perfectly. So, that for example, the semantic information. So, the meaningful when we interpret it into suppose primarily the experience of learning.

For example, when we ventured into a new place or we receive some kind of some visual things, we also listen to the other voices or the verbal information etcetera then again we have we are also experiencing the spatial in a spatial information spatial data. So, how do we integrate that to interpret the whole situation? So, whole situation to a very comprehensive very unique unique representation of a particular episode that is episode of the particular event. So, semantic information. So, when suppose we just think of an example of a suppose we are visiting we have visited the musical concert musical concert. So, musical concert the voice musical part is there the pictorial part is there as well as the spatial part is there.

So, how do we blend it and integrate it perfectly to create a unitary episodic representation that is that that will be kept in our memory ok. So, it provides that is why it provides the interface between the subsystem of working memory and the part of the LTM specialized for episodic memory. So, in as of all of us we know that in order to keep something in the LTM or any information to be saved in the LTM it needs to be processed thoroughly, it needs to be practiced thoroughly, it needs to be you know you can say it needs to be processed thoroughly. So, so that is why working memory like the episodic buffer is directly connected to the LTM because there is a so episodic unit because. So, in long term memory also one unit of the long term memory is also related to working memory.

So, when the working memory information where the episodic buffer is transacting with the long term memory. So, the unit of long term memory which relates to this episodic memory episodic memory it interacts. So, there is a continuous interface between the two subsystem one is working memory subsystem and another is the LTM subsystem. So, for example, so that examples like recollection of specific events that integrate time place and emotions.

So, these are some of the example. So, there is a system. So, integration of all the subsystem working memory subsystem and the long term memory subsystem, then only then only it can be it can be materialized, it can be it can be resulted in a particular permanent episodic memory and stored in our long term memory. So, for example, is you can you can say yes input sensory input it input from the environment we are receiving sensory memory at this at this sensory moment then we are giving the attention giving the attention. So, so here we are receiving the information for example, actually short term memory has been has been taken as a working memory because unless and until we work on this it will fade away.

So, once we want to retain it. So, later on this memory is the sensory memory that is whatever we receive from the background with attention and with further processing then we hold it in the working memory. So, here we sense a visual visual information and the auditory information that we we receive. So, when it these are in the working memory then then here actually in order to retain it this rehearsal recall repetition etcetera etcetera. Now here actually in working memory how this CPU functions this is the central executive say executive conductor of the brain. So, here in working memory itself this is the unit this is the unit that functions how before that before it goes to LTM.

So, central executive as we we receive the visual visual information to be processed by the visual sketch pad and the auditory information to be processed by the auditory channel and then this is the you can say conscious awareness this is the you can see episodic buffer. It is episodic buffer how it is connected to a long term memory as well as how it organize and integrates all these information. So, this is the basic structure of working memory system the same thing. So, here also visual case a central executive is here it processes both the visual information and the phonological things. So, articulatory control everything all they are related to auditory things and in between also it integrates the spatial information then it is connected to LTM and it is a reciprocal again the information goes and come back and goes and come back in this way.

So, it is so, it gets strengthened. So, it is a two way process. So, thereafter in the final once we completed the task when we finalized the task when we verified the task and we complete the task then it may be it will be stored in the long term memory. But before that all the exercises being executed by all this all the subcomponents subdomains subcomponents of working model subsystem of the working model that will be an ongoing process. So, once we complete complete then it will be resolved. So, here we can say here we can say the working memory system is actually is a kind of platform work base right now it is a workbench right now we are working like right now unless and until we complete the task is the workbench is the workspace that right now we are doing it unless and until we complete the task the all the interactions and information processing are going on and thereafter once it is done then it will go to the LTM.

So, this is the summary. Working memory is a limited capacity store for retaining the information for a brief period while performing the mental operation on that. Working memory is a multi component system: it has the visual system, it has a spatial system, it has a biological system, it has a buffer. The buffer is there. It also integrates the special information. So, it is a multi component system. It is important for meaningful learning for reasoning for comprehension for analysis all kinds of thinking process. It is important. Working memory theories also assume that the complex reasoning and the learning task require a mental workspace to hold and manipulate the information. So, depending on the difficulty level of the learning task or the problem, we need to hold it, we need to keep it for some time with the

working memory. We need to resolve it. We need to practice it. We need to think about it. We need to analyze it. You need to synthesize all the information and evaluation. So, it is a kind of workspace. It is a kind of workspace which actually gives us the opportunity to further process the complex information with various kinds of thinking abilities cognitive abilities like reasoning analysis then evaluation critical evaluation reflective thinking all kinds of things to manipulate the information and store it.

So, this is the whole system. So, working memory you can say it is subsystem. Actually it exercises, manipulates and maintains a lot of other cognitive activities to store the information in the long term memory this is the theme and essence of it. So, nowadays, for all kinds of research and educational research and other kinds of thing we are focusing more attention on working memory. How to enhance its capacity? How to introduce different kinds of cognitive strategies or different kinds of effective strategies or motivational strategies to motivate the learner? So, that they can hold on to the information for a longer period of time and try to think and analyze it and reflect upon. So, reflective thinking and critical thinking has been emphasized again and again because unless and until we exercise our thinking power, how can we resolve it? So, nowadays it is not just about straight away from sensory memory to short term memory to long term memory. No it is not that.

So, in the beginning the information was in a short term and it has gone to long term memory now. Within the short term memory the information we receive is named just as the sensory memory. And the short term memory is converted into working memory because we if we need to work upon it then we have to hold it for some time. And exercise some other cognitive processes some exercises some rehearsal some practice. And we need to apply strategies to save it in the long term. So, here also we apply different strategies: mnemonic strategies like cognitive maps, mind mapping, cognitive concept mapping, sketching and making the comprehensive narration or summarizing all these things. Also we need to practice so, that we can better remember it. So, this is all about working memory now we we will go to the next part in the next session. Thank you very much.