

Memory
Prof. Manish Kumar Asthana
Department of Psychology
Indian Institute of Technology Roorkee

Lecture - 21
Episodic Memory

Hello, I welcome you all to the lecture series on memory. Today, we are going to gain more insight into episodic memory. In the previous lecture, we discussed long-term memory and the different types of long-term memory. Among those types of long-term memory, we discussed declarative and non-declarative memory.

We mentioned that in this lecture, we would talk about non-declarative memory, episodic memory, and semantic memory. Previously, we discussed the distinction between the two types of memory and the different brain regions involved in episodic and semantic memory. Let me take this discussion further and provide you with neuropsychological evidence about the different types of memory, such as episodic memory and semantic memory, how they are interconnected, and how they are distinct from each other. Now, the special case study of KC, who suffered extensive brain damage following a terrible motor accident. After the motor accident, this individual was able to form new information and also retrieve long-term memory information.

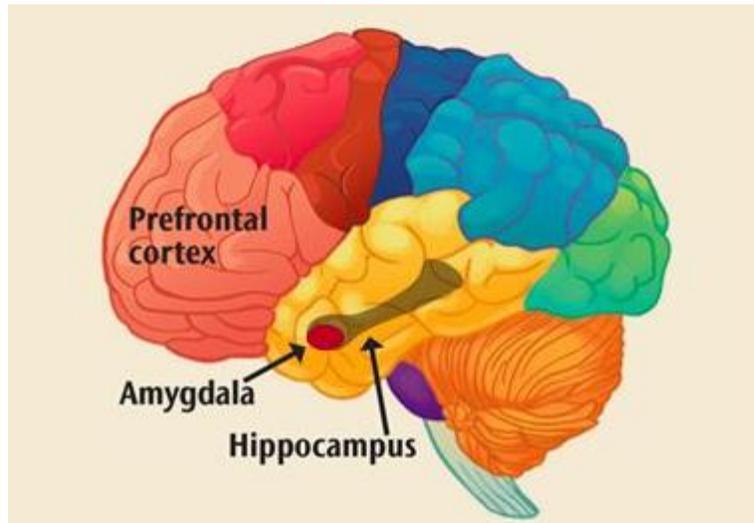
KC could retrieve this information from semantic memory. Normally, there was no problem with facts, figures, or related information. However, his episodic memory was severely impaired. So, while his semantic memory remained intact, his episodic memory was impaired. If you all recall, in the case of Henry Molaison, where the medial temporal lobe was removed due to excessive seizures and burnout, after the doctors removed this MTL, HM was not able to form new memories.

But he was able to retrieve the information. He had some semantic information before the surgery, but the later formation was a little challenging. Episodic memory was intact, so he was able to retrieve the information. While the KC case was somewhat distinct, he was not able to retrieve personal information or episodic information. He could not remember any details of his life at all.

This was a very unique problem where a person was unable to retrieve any information related to their personal life. He was even unable to form new episodic memories, which

means that the formation of new memories was also compromised in him. So both the encoding and retrieval from episodic memory can occur without damaging the semantic memory. So this encoding and storage were happening for the semantic memory, leaving the episodic memory impaired. These patients point to an important neurological difference between semantic and episodic memory.

That the two types of memory are very distinct. The two types of memory are very unique in their nature. The understanding of the difference between semantic memory and episodic memory can be understood through neuroimaging studies. Several neuroimaging studies to date provide us with a deeper insight into the involvement of different brain regions for episodic memory and semantic memory. What we understand is that the coordination and integration of different brain regions are responsible for the formation, encoding, storage, and retrieval of episodic as well as semantic memory.



The study done by Prince and colleagues found that different brain regions were active during the retrieval from different systems. When we are talking about the retrieval from different systems, then we are specifically trying to address episodic memory and semantic memory. What they reported is that the hippocampus seems to be involved in episodic encoding. Once you have formed a memory, once this personal event has been encoded and stored at the time of retrieval, the retrieval time could be after 1 year, could be after 2 years, could be after 10 years, or more than 10 years, then the hippocampus shows activation. So, the hippocampus is the site for episodic memory at the time of encoding and retrieval both.

The posterior region of the temporal cortex was more associated with semantic memory. So, the temporal region is involved in the semanticity. So, there were different brain regions for episodic encoding and semantic retrieval, and their roles play a major role. In a previous lecture, we even discussed it; the right prefrontal cortex is involved in episodic memory, while the left prefrontal cortex is involved in semantic memory.

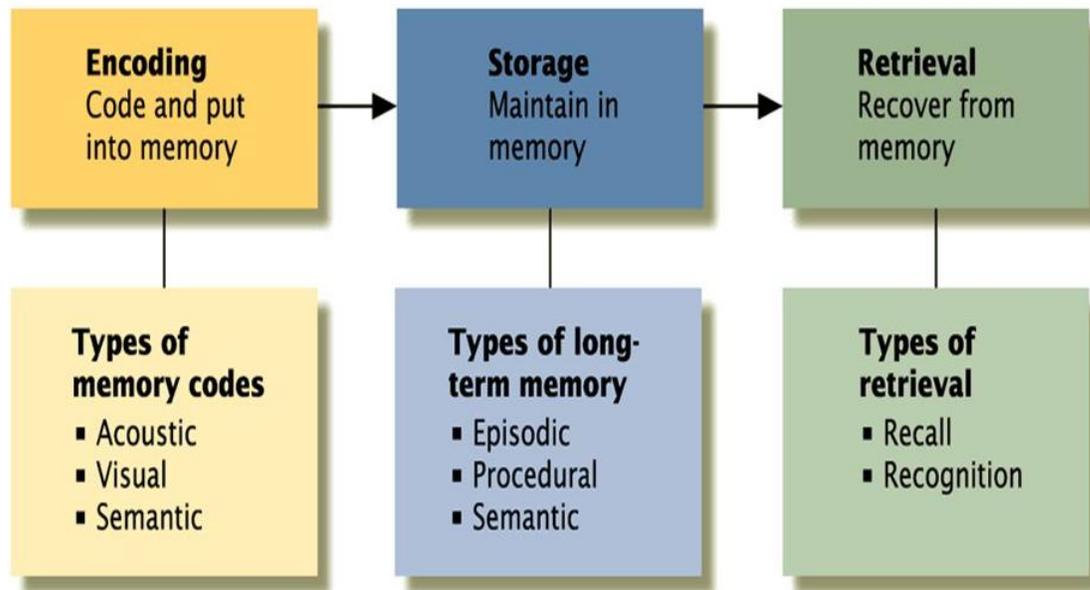
So, the distinction between the different brain regions plays a crucial role in episodic and semantic memory. These different brain regions are coordinating with each other and have dense projections with each other. It is noteworthy here, when we are talking about the left prefrontal cortex activation for semantic memory. Right prefrontal cortical activation for episodic memory, this does not rule out the fact that the right prefrontal cortex for semantic memory is also showing activation.

The threshold is not as high as the left prefrontal cortex. Similarly, the left prefrontal cortex is also showing activation at the time of episodic encoding or episodic information retrieval. But the threshold is not as high as the right prefrontal cortex. This suggests that both regions are showing activation. However, the preference is there.

For episodic memory, the preference is in the right prefrontal cortex. For semantic memory, the preference is in the left prefrontal cortex. But both these regions show activation. So, for semantic retrieval, the posterior part of the left prefrontal lobe is involved. And for episodic encoding, the anterior part of the left prefrontal lobe is involved.

So, the activation is there. However, the threshold is different in nature. When we talked about the memory processes, if you remember, initially we have seen this slide discuss this memory process in detail earlier also that there is an encoding process, where you are trying to code the incoming information into memory. So, understand one thing: the incoming sensory information cannot be processed by the brain. The brain needs the neural information. This neural transformation is what we call transduction. So, once the neural information is there, then only this information gets encoded.

After the encoding, the information goes for storage. Not all information that you have encoded will be stored. Based on the preference, based on the choices, based on the selection, based on the optimization, based on the cognitive load, storage will happen. Once the encoding and storage are done, then the recovery from memory, recovery from long-term memory will happen.



Source: <https://iqmalmadam.blogspot.com/2018/08/topic-5memorylearning-and-improving.html>

Now, this retrieval, which we have discussed in detail, does not mean that the entire information will be retrieved. The entire information can be retrieved from your long-term memory. Even when you are accessing the information, what percentage of information we can access is itself very inconclusive. Studies have shown and also have affirmed that a hundred percent accessibility may not be possible.

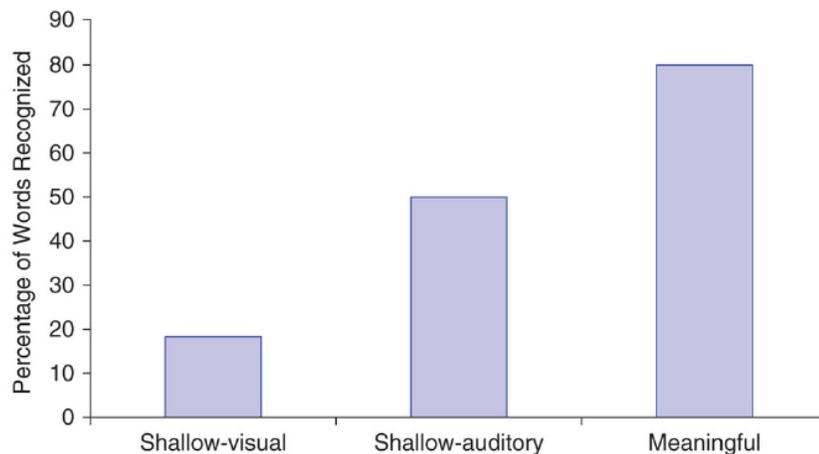
Now, when we talk about encoding, the type of memory codes could be acoustic, visual, or semantic in nature. Now, remember one thing: here we are talking about the acoustic, the sound-related information, visual related to visual information. What you can see, but types of memory code could also be related to other types of sensory information, such as tactile information, where blind individuals try to register the information based on their tactile perception. Semantic, meaningful information. Words are being coded easily, remembered fast, stored better, and retrieved better in relation, in comparison to non-words or non-meaningful words.

Storage is a type of long-term memory. It can be episodic, procedural, or semantic. Now, we know that when we talk about these, procedural is the indirect memory, while the other two are the direct memories. Okay, the retrieval part, the type of retrieval. In the previous lecture, we discussed in detail recall and recognition.

Two different types of retrieval processes. Recall is where the generation of memory happens. Recognition is where the matching of information happens. So, when we talk

about the memory processes—encoding, storage, retrieval—we also have to discuss the levels of processing. And when we talk about the level of processing, we have to discuss in detail the type of learning.

Craik and Lockhart in 1972 proposed that there is incidental learning. Incidental learning refers to when an individual encodes information not by actively trying to remember the event, but it is registered or learned as a by-product of perceiving and understanding the world. So, here the individual is not putting in an effort to learn, but based on the incoming sensory information, providing meaning to it, doing the categorization to understand the surroundings, this is incidental learning. Indirect learning happens incidentally.



Source: [Based on Craik and Tulving \(1975\)](#)

There is no active effort an individual is putting here to learn. Then there is intentional learning. So, if we talk about incidental learning, let me give you an example of a classroom. In a classroom, where we do not put an active effort into understanding many things.

The classroom rules. The body language of the teacher. How the teaching is being conducted. All those things can be incidental learning from kindergarten until you graduate. Intentional learning.

People actively engage in learning information. Because they know that this memory, this consolidation of experience, is going to be tested in the future. So, when you are studying for your examination, when you enter into the second standard, you start studying from day one because you know that there is going to be a sessional, a midterm examination, and then an interim examination. So, you are studying with the intention that this

knowledge which I am acquiring, this consolidation of experience which I am doing, is going to be tested later. Then, another aspect of processing is the maintenance process.

Whatever information you have acquired, you repeat over and over. Rehearsal. And if you remember, we have been talking about rehearsal in certain instances. In several instances, we have been discussing this. Rehearsal.

When we were talking about how the information moves from sensory memory to short-term memory, which we also referred to as working memory, later moving to LTM. Here, rehearsal. When we do more and more rehearsal, the information becomes more and more robust. So repeating over and over, overlearning, overlearning, less forgetting. How to overcome forgetting?

Rehearsal benefits in that. Then there is another aspect of processing, which is the elaborative rehearsal, where you process the meaning of the information and provide more detailed information. You elaborate the information. You parse the information with details. You add more cues related to the information, which aids you in the long run.

And in elaborative rehearsal, what you are doing is making more and more connections, neuronal connections. The interesting part was that when Quick conducted this study with Lockhart, he understood that there are different forms of learning. But he wanted to understand if this maintenance is playing a role in the semanticity of the information and the episodic information. And if the answer is yes, then how shall we investigate? Moreover, if the elaborative rehearsal can lead to deeper processing, deeper insight, in-depth understanding, and the rehearsal is superficial in nature.

So, with this notion, they designed this experiment where it was a very simple task. There were three different categories: shallow visual, shallow auditory, and meaningful. Meaningful is elaborative rehearsal. Maintenance rehearsal could be classified into these two parts: shallow visual and shallow auditory. So, the word was given to them: 'chip,' and visual shallow was, 'Does the word have any capital letter?'

So participants have to say, 'No, there is no capital letter in the word.' Auditory shallow said, 'Does the word rhyme with skip?' Now, 'chip,' 'skip,' 'whip.' All of them have an auditory similarity. So, auditory shallow, yes.

Visual shallow, no. It contradicts. If we had written the chip with a capital letter, then the answer to this question would have been yes. The other part is the meaningful part. Does it fit with the following sentence?

The boys were only allowed to eat one potato chip. Each. Yes. How many dashes do you require in 'how many memory dash you require in your phone'? Does it fit?

Does the word fit here? Yes. How many memory chips do you require in your phone? Now, what they realized is that when the shallow visual is there, the percentage of words recognized is less than 20%. And when the shallow auditory is there, then it was a little higher, double that of the shallow visual.

But when the meaning is involved, The percentage of recognition was approximately 80%, suggesting that elaborative rehearsal leads to deeper processing. When people are encoding the information with some meaning in it, with more elaboration, they are enhancing the neuronal architecture. When it is superficial in nature, when it is at a surface level, only the visual information, shallow visual like this, does it have, because this is, a person does not have to do deeper thinking here. They just have to respond to it superficially.

Yes and no questions. In that case, when the sentences do not require meaningful insight, then they are shallow, and maintenance rehearsal is enough to maintain the information. And this is what we do: maintenance rehearsal. Something which we have acquired in our working memory, we do the rehearsal.

We are just maintaining the information, whatever we have learned. But if we have to elaborate the learned information, we may tend to add more and more information, then we may have to spend more time thinking. As a result, The retrieval of the elaborative rehearsal or the meaningful information will be more, while the retrieval for the visual, shallow visual, and shallow auditory seems to be less than the meaningful. So, the hypothesis of Craik and Tulving was correct, and they proved that elaborative rehearsal requires different sites.

Let me summarize this lecture here. Neuropsychological evidence about episodic memory and semantic memory. We studied this in the lecture. Different parts of the brain come together, integration happens, and they contribute to the formation of semantic and episodic memory.

Now, it is important for us to know that when we say episodic memory shows activation in the right prefrontal cortex, this does not rule out the fact, nor does it suggest that the left prefrontal cortex does not show activation for episodic memory. It does show activation, but the activation does not reach the threshold. Similarly, semantic memory shows activation in the left hemisphere but not in the right prefrontal cortex.

Neuroimaging studies suggest that the posterior parietal cortex, posterior frontal cortex, and anterior frontal cortex play roles in episodic and semantic memory, respectively. We even understood the role of the medial temporal lobe in memory processes.

Memory processes include encoding, storage, and retrieval. Here, we are also further discussing maintenance rehearsal, elaborative rehearsal, incidental learning, and intentional learning. These processes help us in building episodic and semantic memory information. Let me close this lecture here.

In future lectures, we will study more concepts and ideas related to episodic and semantic memory. Thank you.