Memory
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Lecture - 13
Retrieval of Memory - III

Hello, I welcome you all in the lecture series of memory. Today, we are going to start lecture number 13 and the topic is same as retrieval memory. As we studied in the previous lecture about the retrieval process, along with retrieval process, we studied about the consolidation process, consolidation of memory and how upon retrieval it can become malleable in nature. Along with that, we also studied if some modification can be done or no modification can be done, then the memory will go consolidation again. And this process is the reconsolidation, which suggests that memory, consolidation memory upon retrieval becomes malleable in nature. And upon treatment with pharmacological method, neuro stimulation procedure or any type of behavioral procedure, it may result into the amnesic effect and consolidated memory may undergo changes.

Okay, moving further in this direction today we are going to understand the effect of retrieval in improving the learning process what you see on your screen is a cartoon on your right-hand side this cartoon is indicating mean number of recalled responses or items mean number of recalled items number of items one can recall and the test. So, you can see first test when has been performed number of items recalled 24.8 as the test is increasing the number of recalled item is also increasing. This repeated test procedure can be seen as repeated retrieval. So, if there is a repeated retrieval trials are there, how it improves the learning process? To improve the learning process, more and more retrieval happens And each retrieval can be associated with each test.

So, number of time the test has been conducted, number of time retrieval has occurred, more number of time test has occurred, more number of time retrieval has occurred. As a result, improvement in learning can be seen. So, you could see that from 24.8, 28.01 items can be recalled. So, the underlying biological mechanism of retrieval process suggests how retrieval may improve the learning process and that is a prime concern to all the memory researchers working in the domain. To enhance the learning effect, if we

could understand the underlying mechanism of retrieval, it could be beneficial for us to to improve the learning.

One thing is very clear that the retrieval pathway might be very distinct from the encoding and storage pathway. As we studied in previous lecture that the encoding process and storage process are independent from each other and also independent together from retrieval process, encoding process and storage process may share some similarity in the neural architecture. However retrieval is very distinct mechanism than the other two. The reason for such assumption is as we studied in previous lecture that encoding and storage depend upon the sensory system. However retrieval process does not rely on our sensory system.

Of course, earlier we also studied that the internal information processing help us in the retrieval process that is internal retrieval process. Similarly, external cues also help us in the retrieval process. According to Roediger and Kapicke, testing not only it measures the knowledge, but also it changes. What does it change? It changes the knowledge, often greatly improving the retention of the test of the knowledge.

Indirectly, implicitly, it is suggesting every time an individual undergo a test, not only it is changing the existing knowledge, however, this can be treated as a retrieval process. More number of time an individual undergo testing phase, more number of time he or she has to retrieve the information. In the retrieval of information, the accessibility of information increases. Every time an individual is accessing the information, it helps the retrieval process and it strengthens the learning. However, the accessibility of information every time upon retrieval may vary.

What does this mean is that every time an individual is accessing the information upon retrieval, the exact same number of item cannot be retrieved. It may change. That is why the performance may get better and better with the testing phase, with the repeated retrieval. However, the accessibility of the information may vary. Now, this variation could be huge in number or could be silent in number.

This number could also indicate the specificity or the individual effect. And that is why whatever topics which we have covered till now, it is talking about the retrieval effect of

the individual. So, every time you undergo a test, you are doing a retrieval. Every time you are doing the retrieval, the accessibility of information is getting better. However, the accessing of information or the retrieval information every time you do will vary.

It will never be same. Retrieval practice effect is the benefit of retrieval because of using retrieval as a part of practice. More and more you practice every time, you do the practice you are retrieving the information, and this practice retrieval is benefiting your retrieval. So, it makes it better and better as you can see on this right-hand cartoon. Testing effect involve a memory boost that is what we are seeing here that moving from 24 to 26, 26 to 28, there is a boost.

There is an increase. There is a rise in the information that comes from a specific form of retrieval practice. This makes us curious to ask a question. If retrieval is improving the learning, as we saw in previous slide retrieval practice effect then what happens with repeated retrieval if test was there, and we are improving with every test retrieval practice is there more and more you practice more and more retrieval is their better retrieval is there then what will happen if you are doing the retrieval again and again and again. Remember, in previous lecture, when we were talking about the retrieval of consolidated memory, there only one time retrieval memory is undergoing, which is making memory malleable and labile, sensitive to disruption. One time.

Here we are talking about if retrieval can benefit the learning, it can improve the learning, then what will happen if we undergo repeated retrieval? Repeated retrieval, the accessibility of memory shifts quickly with repeated retrieval. So what does this mean? You are accessing the information and accessing the information, we see a shift, improvement despite the available information. So more and more you are accessing the information the storehouse more and more you accessing it, more and more repeated retrieval is there which we see that a shift is being seen and this is not dependent on the availability of the information improvement despite the available information so more and more you are accessing the information the storehouse more and more you accessing it more and more repeated retrieval is there which we see that a shift is being seen and this is not dependent on the availability of the information

How much information is available in the system? So, when we are talking about this thing, you can think of a box with 100 items and when we are doing the repeated retrieval, then this does not mean that only 100 items will be retrieved. So, the point comes here is that what is actually happening? When at neural level when we think about this then assembly of neurons are there. Billions of neurons are coordinating with one another.

So as a result what will happen? This shift could be cellular shift can be seen. Synaptic shift. The information can be retrieved from different parts of the brain also despite the available information which is already there. Now with repeated retrieval, the total of remembered items may improve which means if 100 item list is there and if the person was performing upon one retrieval 20 items let us say this will improve 20 to 30 to 35 to 40 to 45 and so forth upon repeated retrieval.

So, keeping these keeping these items remembered change. So, every time when the memory is being accessed, every time when the memory is being retrieved, the variation can be seen. Here it is increasing constantly. However, it could also happen that the number could go 35, the number could go 34, the number could remain same as 35, or 36 or 38. So, this accessibility varies upon repeated retrieval.

So, remembering without relearning is referred as hyperamnesia. So, what is basically happening? Person is remembering the items without relearning them. So, individual hasn't individual has and counted 100 items and remembered, learned first time, only one time learning. But after one time learning, he is remembering the items.

So, when he is doing the repeated retrievals as he progresses, but not learning it, just trying to recall it, what we see the accessibility information may vary. And also, every time when the individual is accessing it, it is also not depending on the amount of information available. Now, the point is the recovering items will be higher than the forgetting items when the repeated retrieval is there. So, what basically repeated retrieval is doing? Repeated retrieval is making the accessibility of information easier retrieval repeated retrieval is making not only the accessibility of information better but also making the retrieval remembered better and better as a result the forgetting items As we

discussed earlier and we are going to discuss in coming lectures also, Ebbinghaus classical experiment 1885, forgetting curve.

Ebbinghaus would have done the repeated retrieval. Then forgetting curve would have been different. As we expect to see, repeated retrieval would have changed it and altered it. So, when forgetting is getting worse, forgetting items is less, then the accessibility of information is improving. Okay.

So, the point comes to the retrieval benefits. Retrieval benefits, if we talk about retrieval followed by the task improves the performance. So, when the retrieval is performed immediately when the task has been completed then we see an improvement. However, when there is a delay as you increase the delay in the retrieval and the task has been completed you increase the delay the performance will also be getting worse and worse. Initial testing also has shown that multiple retrieval routes has been created to access the information and that is why in previous slide we were talking about it despite the available information.

Despite the available information, a greater number of testing trials you are going through, a greater number of times you are retrieving, you are creating multiple retrieval routes. This multiple retrieval route also depends upon the nature of information. One has to be very clear that in the case of ambiguous information, in the case of complex information, in the case of high cognitive load information, retrieval route will be very very distinct than the problems which we are addressing easily. Mathematical problem at kindergarten can be solved quickly. However, mathematical problem of 12th standard would be very difficult.

But as the testing an individual is doing, more number of retrieval route he or she is creating, building to access the information. We know that retrieval when we were talking about it earlier, there is recall and then there is recognition. Recall testing is difficult than the recognition test. Now, in contrary, in different scenario, recall testing is better than the recognition test also, which we will address it shortly. But recall testing, why is it difficult than recognition test?

Because in recall testing, we have to generate memories. Generation of information is always difficult. Then matching of information. Matching of information do not involve complex cognitive functioning. However, recall always involve some sort of complexity in the human cognition.

Some individuals recall could be better. But for some individual recall is tricky because one has to generate while recognition between these two individual could be similar. So you see here with retrieval benefit also we are talking about the individual effect. Retrieval effect in an individual. And today itself, as we will proceed, we will see also the collaborative effect, the concept of collaborative memory, the group effect.

But till this point, we are still talking about the individual effect. Now, as I said, recall testing is difficult than the recognition test. As recall helps in generation of information. Hence the summary, writing after learning is better than MCQ. Now see, so couple of minutes ago, so it is two sides of one coin.

So first side says that recall testing is difficult. First recall and difficult to remember, to retrieve. However, when an individual has recalled and he has generated the information. In a classroom, when you have taken the lecture, when you go home, you prepare your notes, you generate your notes, and when you write a summary on the concept or idea what you have learned, that is always better than the multiple choice of question, where you just have to match it. Where you just have to match few items.

What we have seen retrieval during learning helps in improvement. While an individual is learning the same time they are doing the retrieval. What we have seen it improves the learning process. And that is the reason why if you see on your right-hand side the cartoon when we go with the kids to the market to the to super mall then we ask them to do a simple arithmetical problem more simpler arithmetical problem. If we give them at each and every different context then we will see that these individuals develop a high level of arithmetic skill. So, it is nothing, but it is actually a retrieval benefit which individual is trying to do in different scenarios.

Then another question comes the role of situation in the ability of retrieval. When we talk about this situation, we have to understand the situation could be a context, the situation

could be a state of an individual. In what state, internal state an individual is in or in what state, external environment an individual is in and how these two situations is affecting the ability of retrieval. And this is what the situational effect is all about. So, contexts provide cues which hints the encoding and retrieval interaction. In the same context, it is very rare that encoding is happening in one context, storage is happening in one context and retrieval is happening in another context.

It can never be like this that encoding and retrieval is happening in two different contexts. Some studies which I will be showing you reflected upon it when the encoding is happening in one context and retrieval is happening in another context, the retrieval effect is bad. It is not improving the learning. However, the encoding and retrieval environment when it is same, then the context behaves like a cue, aiding cue to the retrieval. As a result, the learning gets improved.

So, three contextual effects are there in relation to retrieval. Encoding specificity principle, how we are encoding the information and how specific information is being encoded. Second, transfer appropriate processing, how the transference of information is happening and how appropriate this transfer is there. Thirdly, the collaborative memory. So, what we have to see here is how the context, situation is affecting the retrieval process.
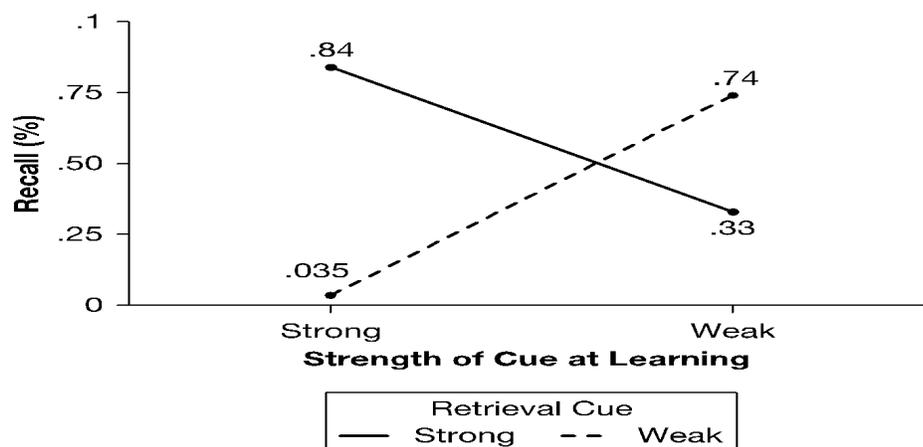
Now, the nature of retrieval cues can be congruous and incongruous. In the case of congruous, when the retrieval trials are congruous in nature, people can retrieve better.

When there is incongruency, participants, individuals are always going to take some time because of disparity between the two processes. The encoding information is having different template, and the retrieval cue is having different template. And when these two templates are having a mismatch, then incongruency arises.

And when this incongruency arises, the retrieval effect is weak. When the encoding template is matching with the retrieval template, then it's congruous in nature. Congruency is there, similarity is there. So, a context same context where the learning, encoding, storage, retrieval is happening, the context becomes congruous, and it aids in the retrieval. However, when the environment is changing, the context is changing, then the context is in congruous.

Accessibility of information can be altered after the memory encoding. What does this mean? This means that as we have been discussing earlier that any amount of information which we are storing, encoding, storage, retrieval but retrieval cannot be 100. Retrieval could be 80, 70, 60, 50, could be 100 as well, which is very rare by the way. So, this accessibility of information can be altered after the memory encoding.

So, what we can do? We can alter it, by adopting different procedures. Now, let us see the encoding specificity principle. What does it talk about? The encoding specificity principle suggests retrieval is good when the context of retrieval matches with the context of encoding.

It is not rocket science. I told you that when the same context is there, where the encoding and storage is happening and similarly retrieval is also happening in the same context. Then retrieval is good. How can we see this? Earlier we discussed about the Pavlov's dog conditioning experiment where the dog was being conditioned with the bell but indirectly dog was also conditioned with the context.

So whenever the dog was being brought into the experimental room, he was starting to salivate. Salivation was the conditioned response. The similar response which dog is giving when the food was given to them. So when the context is same where the encoding has been occurred and retrieval is being performed in that same context, then

The retrieval is very good. And this principle, we call it as encoding specificity principle. So what you see on your screen is the strength of cue at learning.

Strong cue, weak cue. So strong learning, sorry, strong learning and weak learning. Okay. This is the percentage recall on your Y axis and this solid bar is indicating strong cue. So, when the strong learning and strong cue is there, recall is okay. Same context. When the weak learning is there, but also the strong weak learning is happening but the strong cue is there.

What does this mean? At the time of encoding when the cue which is being used is similar in nature having familiarity, dominance, frequency then the recall is very higher but when the cue is weak, when there is a mismatch, then even if you use this strong retrieval cue, associated cue, but at the time of encoding, when those cues were missing, then the association will not happen. As a result, weak learning will occur. And when we talk about the same thing with the weak retrieval cue, Then though the learning is there and is strong, but the cue which has been provided is weak, remote, the association will not happen here. As a result, the recall will be less.

But when the cue, when the learning is weak and the cue is also being remotely associated, recall could be done easily. Now, the curve diagram what you are seeing here depends on the task itself, the word list, the list item, how many list items are there on the list, what is the association between the two items, if the queue is related or unrelated, all these things play a major role. When we talk about the retrieval process, we see here that it is very much contrary to the information processing model. The information processing model which is a very simple model that the sensory information is there and then the perceptual processes is there, response, attentional system is there throughout. And this response execute this perception get the feedback from working memory which gets from the LTM and then this is response is connected to the feedback and this loop goes on and on and on.

So, what we see with this model is that in retrieval model, when we are talking about the context is an important aspect and parameter, here the context is not very much important. It is moving in one direction, bottom-up approach. There is the stimuli, you

sense it, you process it and you execute. So, encoding specificity predicts an improvement when retrieving the information. So, if there is an improvement, then retrieval of information is better and better.

It also talks about how better the retrieval is, better the prediction becomes because the improvement in learning is quite obvious as the number of time retrieval is happening. Three aspects of learning context, when we are talking about the encoding specificity principle, when encoding context and retrieval context is same, then the retrieval is good. Similarly, three aspects of learning context, one could be physical in nature, physical context, physiological context, physiological state. At what physiological state are you in? This is the same physiological state which we talk about the fight and flight condition.

And then the mood. What is your mood at the time of learning? If you are in happy mood or if you are in sad mood. When you are in happy present mood It seems that you learn better for a long period of time. But when your mood is bad, when you are feeling sad, learning doesn't happen.

And even if it will happen, then it is not so long-lasting and sustainable in nature. So, what did we study? That retrieval improves the learning. When there is a retrieval trial, Retrieval leads to testing and testing leads to improving of memory. More the test is there, better the retrieval is.

Repeated retrieval makes the accessibility easy. Every time the accessibility is there, the amount of remembered item may vary. Retrieval, repeated retrieval, when we talk about provides the accessibility but does not ensure the similar number of items will be remembered. Retrieval benefit, we have seen that it helps in the improvement of learning. It helps the individual to consolidate information for long period of time.

How the situational effect is there? The context, different context is different way the learning will be. We are going to see in coming lectures also different scenarios, different environmental condition and their effect on the retrieval. And then we talked about the encoding specificity principle. The environment in which encoding is happening, if in the same environment retrieval is also happening, retrieval will be good.

Improvement in learning will be seen. But when you change these two things, then the improvement in learning cannot be seen. This methodology, researchers have used it in the conditioning paradigm where they use a AAA context. Learning is performed in A, Retrieval is performed in A, and testing has been performed in A. All three contexts, same.

Context is same. But when we see ABC model, all contexts are different. Or ABA model, testing context is same as learning. This kind of alteration is very common in fear conditioning, fear context conditioning. Understanding the underlying neural mechanism can give us lot of understanding about the retrieval processes as well.

So, I will stop here and we will see each other in next lecture. Thank you.