

Memory
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Lecture - 22
Episodic Memory Processing

Hello, I welcome you all to the lecture series on memory, and today we are going to talk about episodic memory processing. In the previous lecture, we discussed episodic memory and semantic memory in detail. While talking about the nature of episodic memory and semantic memory in detail, we were discussing autobiographical memory. The reason for such an introduction was that all types of episodic memory will be a type of autobiographical memory, but all types of autobiographical memory cannot be part of episodic memory. Autobiographical memory can be seen as a large personal, episodic, and self-referential memory, which is an umbrella term that comprises not only episodic memory, but also semantic memory. Now, we have to understand that this form of memory is a direct form of memory, a declarative form of memory, that plays a major role in an individual's life. So, if you see this cartoon, it depicts your birth date, the day when we were born, but that form of memory, we haven't formed it, we haven't experienced it, we haven't formed that memory or documented that event. into our memory. However, with reference to ourselves, that is a form of memory that leads towards a meaningful incident in our life.

Hence, this form of memory is a self-referential semantic memory. So, in an individual's life, in a person's life, there are forms of memory that are self-referential forms of memory. and do not only hold meaningful information but are also a part of autobiographical memory. Now, the reason for me to introduce you again to these two forms of memory is that the upcoming topic on self-reference is going to be a very important topic in episodic memory. In the previous lecture, we even discussed the different brain regions and neuronal structures contributing to the formation of episodic memory, semantic memory, and autobiographical memory.

Now, the self-referential semantic memory, when we were talking about it, there is a concept, an idea about the self-reference effect. Now, this self-reference effect refers to ourselves and the observation that links learned information to personally relevant information about oneself. And this actually holds the information strongly, consolidating the information strongly into one's memory system. The moment an individual attaches the information to themselves, the robustness of the information bonding increases. In a

normal setting, generally when we form a memory, we do not attach a lot of incoming information to ourselves. However, some information that we would like to register and consolidate

for a long period of time, we try to associate that information with ourselves. So, it has been documented and shown that when a list of personality traits is given to an individual and the individual is recalling or recollecting these personality traits, and at that time of recollection or recalling, if these personality traits match the individual's personality, then the robustness, attachment, association, and consolidation become more promising and robust in nature. Now, the reason being that we are all familiar with our personality traits, and as per psychological theories, there are different types of personality traits. It is very difficult for an individual to remember all types of personality traits.

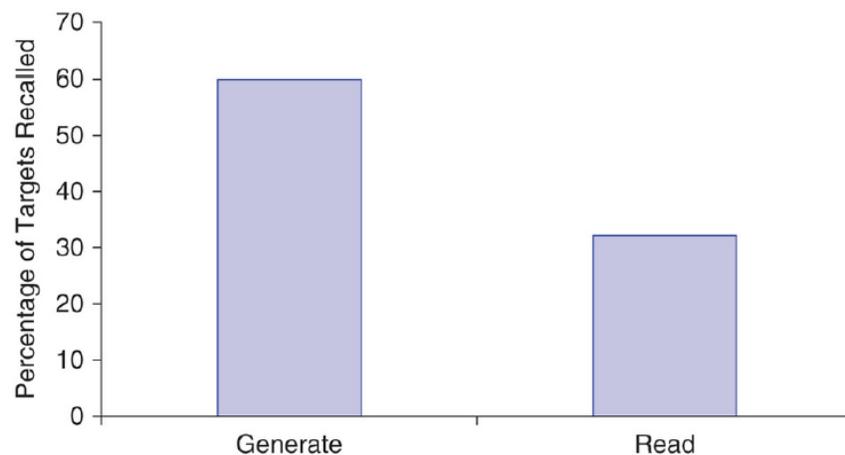
However, those personality traits which resemble our own personality become easy for us to remember. Even sometimes, when an individual is encoding these personality traits, if these personality traits are being referred to our dear ones, then also the list of items is registered robustly. For instance, not only is the list of personality traits presented to you, but out of this personality trait listing, if some of those personality traits match with your siblings, and some of those personality traits match with your parents, then those personality traits also an individual will encode. So, it could be seen as if you are at the center, keeping your self-personality trait there, and at the surface, if there is another circle where you are keeping your dear one's personality trait, then the encoding of this information will be robust, and then comes the part where you are keeping the acquaintances also.

So, if these types of, this is how the separation, segregation, and categorization are happening. So, information related to self will be encoded and consolidated robustly, then the information which is encoded and consolidated for the dear ones will be better than the acquaintances' information. Now, what has been seen in this regard is that the activation of the prefrontal cortex and the anterior cingulate cortex has shown activation in this regard. Why are these things seen as increased activity? It is because of the personality trait matching. It could not only be a simple association, but it could also be a reward system or it could be activating the achievement that there is a personality match trait where I could recognize such a personality and have a reflection of this personality in myself.

As a result, the reward system in the anterior cingulate cortex is getting activated. The self-reference effect is activating the prefrontal cortex and ACC, other than the normal brain structures, which are the prefrontal cortex and the temporal lobe, as we discussed in the previous lecture. Now, the prefrontal cortex is getting activated because execution is required, and this execution of information of the personality trait list is that the categorization, segregation, and distinctness are required, where an individual has to ensure which type of personality trait belongs to me, which type of personality trait belongs to my dear ones, and which personality trait belongs to the acquaintances. And as a result, there is a scale which an individual forms for his self-reference understanding.

Okay, now moving further, researchers working in the area of episodic memory and semantic memory have suggested that there is also a concept like the generation effect, where an individual has to generate the information. And here, the generation of information, where an individual is making it, they are simply making the generation based on the association which one has formed with the reading. So, in this idea, there are two types of generation of information that could happen. One type of generation of information is when an individual is reading a text and then he or she is generating the concept and information, and in another case, he is doing the free generation call where he just has to generate the item rather than changing many other things.

So here you could read the word like 'rose' and 'hose'. So the acoustic similarity is there, but semantic similarity is not. So acoustic similarity generation may not require that much effort. However, semantic similarity may require it may require some effort.



For instance, when we have to generate the condition like 'mash' and 'crash'. So, this is an acoustic similarity rather than a semantic similarity. Then, when we are talking about acoustic similarity, because we are proposing the sound similarity is there, that is why

acoustic similarity is being seen here. Then, semantic relates to meaningful similarity. Then another type of similarity is there, which is known as articulatory similarity, so the articulation is going to be similar in this regard. Okay, now, when we are talking about the enactment effect

The enactment effect is the same as the idea in the similar direction of the generation effect, where an individual has to generate freely, then he or she generates based on acoustic similarity, semantic similarity, or articulatory similarity. But enactment suggests that performed tasks are remembered better than those that are simply read. For instance, when I say, 'Cut the paper.' When you are reading this, 'Cut the paper,' versus when you are cutting the paper. When you are performing the action.

So, what we see when you are performing the action versus when you are reading the action is that the performed action is going to be more robust in memory formation than just reading the text. Now, such understanding has already been established in many scenarios and conditions. What we have seen is that practical exposure practical experience has a more robust effect than just reading the information. And that is why when an individual joins any industry or any larger organization, practical training is also provided along with the training manual. It could be that people might have read it, may have understood it, but at the time of executing the task, they may not recollect it or retrieve it 100 percent.

This is what we have understood earlier as well: the retrieval of information cannot be 100 percent. One cannot be so sure that 100% of the information can be retrieved. Based on individual differences, retrieval varies. Hence, that is why the enactment effect emphasizes that the action performed versus reading the action is different, and the performed action seems to form a more robust memory than the retrieved one. So, here what you see is the percentage of target records. The generation of this percentage of target records is easier to do rather than an individual having to do the reading, just like you read the condition of a rose hose and then have to generate a condition mash crash, okay.

Taking you further in this direction, let us understand the idea of episodic memory and semantic memory from the perspective of organization. Now, we know what perception does to the incoming sensory information in the human brain: it not only provides meaning to the incoming sensory information but also tries to organize it as per the individual's needs. So, the individual creates several subcategories or major categories,

and this information is provided within these different categories. So, when we are talking about categories, the categories of fruits, the categories of vegetables, and the categories of professions.

Separate categories are being formed, separate categories are being organized, and when the incoming information is there from the sensory register. So, based on this, the information classification, based on this information categorization, based on this information organization, starts to happen. So, organization means imposing a meaningful structure onto the material to be learned. So, whatever material we are planning to learn, the organization ensures that a meaningful categorization or organization is formed. Now, we know about the organization from the discipline of organizational psychology that in an organization, more than 100 employees are there.

So, what do these 100 employees do? There are small, small subunits, subsections, substations there, subsystems are there where these 100 employees are being distributed as per their skills, abilities, and the nature of the task. Similarly, when the incoming information is 100 or 100 plus information is coming, we provide a meaningful structure to these different categories, and we try to pass this information. So, if you are making a category of fruit, vegetable, profession, and the incoming stimuli is the tomato, then the tomato will be falling into the category of fruit or vegetable. We do this organization, and we put them into the specific category.

Now, it causes the learners to focus on the meaning of the material. Once you have formed the category, it provides a specific focus to the readers, to the learners, and provides easiness. We always remember one thing: the topic like memory we are studying to optimize our memory system. The topic like memory we are studying to enhance our awareness. The topic like memory we are studying to understand the nature of memory and the type of memories which are playing a role under different scenarios at different time points.

Such understanding allows the user not only to form a robust memory but also to understand the nature and complexity of the incoming information, its categorization, organization, and distinctiveness. So, when it increases the depth of processing, it is also an effective way to improve encoding. What does this mean? Depth of processing. If you remember the previous lecture, we have been discussing rehearsal and then elaborative rehearsal.

Elaborative rehearsal involves providing elaborative information to the incoming sensory information. As a result, the encoding becomes robust, and the storage becomes robust. When the encoding and storage are robust in nature, then the retrieval of information becomes robust in nature. Now, such understanding gives us an idea clear support and insight that even in organization, when there is depth of processing involved, there is a way to improve encoding.

The whole purpose of such processing, elaborative rehearsal, or depth of processing is to improve the encoding process. How can we enhance and promote the encoding process? How can we enhance and promote the storage process? The reason why we would like to promote the encoding and storage processes is that the environment in which we are living is poorly designed. The environment in which we are living has bad cues that fail to aid the memory system.

As a result, in order to improve this, Elaborative rehearsal or depth of processing can be a simple tool to make the encoding and storage process more robust in nature. Another aspect is the distinctiveness. So when we are talking about the distinctiveness, the uniqueness which we are referring to, so the unique meaning of each item. If we see the categories here like fruit category, vegetable category, or profession category, let me take only one simple category such as the fruit category.

So if we are taking the fruit category, the apple, orange, mango, banana, blood, pineapple, watermelon. Just see this fruit category apple, orange, mango, banana, blood, pineapple, watermelon. Among these fruit lists, in the category of fruits, there is a fruit list.

These fruit lists are there. But the word like blood is very unique and very distinct from the others. Blood is not a fruit. Blood is a liquid which supports life. But this blood is a unique word and distinct word here.

So, at the time of recall, When we talk about the people who will be able to recollect blood quite easily and more frequently than the other list of the fruit categories. Similarly, if you see an example here listed on the screen, it is the action like jump, hop, fly, swim, crawl, putter, vomit, run, skip, skate, flip. Now, vomit is going to be separated out easily. You may select it because of its unique and distinct characteristics of this action.

Vomiting is an action which most of us have encountered and have an unpleasant feeling about. So, the moment we experience this, the uniqueness of this action is separated out.

Similarly, like the category of fruits, we identify the word blood. So, the advantage of distinctive items over less distinctive items is known as the von Restorff effect. Now, the von Restorff effect was given by Restorff in early 1933.

Her work has given a direction towards the organization and distinctiveness. And talking about the isolation effect, here the word like blood is isolated among the list of the other items. The word vomit is isolated among the list of the action words. Now, but at the time, as I mentioned, Restorff was working in 1933, the action by the Hitler's army had stopped her from working; the anti-Jewish movement was there, and as a result, her excellent work seems to be limited and has been

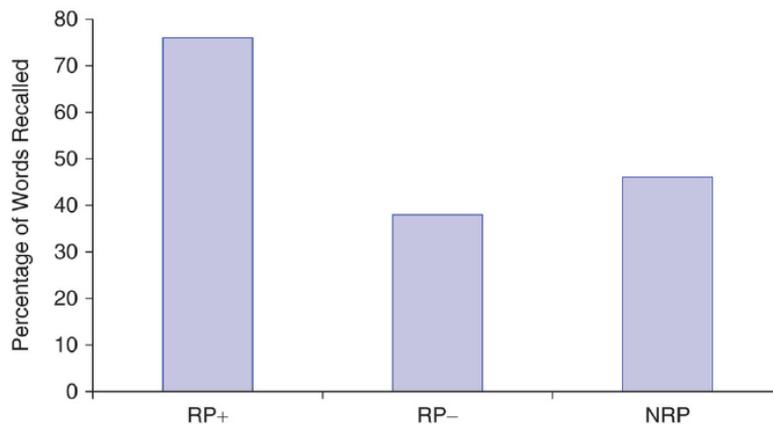
isolated and has received less attention from memory researchers. But today, we understand her idea, her concept, and her understanding of distinctiveness, which gave us a lot of insight into such aspects. So, when she introduced the concept of the rest of the effect and the isolation effect, we understood how this isolation occurs in the list of items here, what you see in the list, the reason, and also how the rest of the effect implies isolation. When such uniqueness and distinctiveness are present in the list of items, these items seem to stand out. Just like when you see a cartoon here where the red person stands out among the blue standees.

So, such aspects, such phenomena, and such processes can be used and have been used in the discipline of human factor engineering, where the uniqueness of the system function, where the uniqueness and distinctiveness of the system function are highlighted so that an individual does not have to put too much effort into the identification of such items. Let me spend some time here on inhibition in episodic memory. Remember, we have discussed collaborative inhibition. So, collaborative inhibition, some of those terms, some of those facts, and information we may be discussing and revisiting again in a couple of slides. So, if you see, if you talk about inhibition in episodic memory, we previously discussed how collaborative memory leads to collaborative inhibition.

Inhibition is nothing but an active interference that reduces the likelihood of recall. So, at the time of recall, when some information needs to be recalled, there is interference. Because of the present information, because of the learned information, or because of the already available information, such information tries to inhibit the recall. And such blockage or inhibition affects the performance of inhibition. So, when you are retrieving your personal information, the already available information may either interfere, or the

currently available information may interfere with the episodic memory, resulting in inhibition.

So, retrieval-induced inhibition, when we talk about it here, is a very simple thing: when you are retrieving information, this retrieval of information interferes with the retrieval of other related information. So, which means that if retrieval one is happening, And retrieval two is happening, Then this retrieval one is going to inhibit the retrieval two information. Such inhibition seems to be playing a role, and the reason could be because of several factors.



The nature of the information, the robustness of the information, the boundary conditions of the memory even come into play when we talk about the sensory stimuli, saliency of the stimuli, expectancy, and the effort where an individual is putting in effort to recollect or recall. So, such inhibition, which we are seeing, is quite common and seems to affect episodic memory. So, Anderson and his group in 1994 gave a word list to individuals and asked them to engage in retrieval practice. So, they just had to retrieve and practice the items. So, this is retrieval practice plus, where the targeted items from the practice category are there.

And then there was retrieval practice minus, where the target items were from unpracticed categories. So, they did not have to practice those items of the list, and then there was the NRP, where the non-practice category was there. They did not have to practice; the items were not the target items from the non-practice category, which they had not practiced. Now, when we talk about these practice plus, practice minus, and non-practice retrieval trials, we see the recall. How the recall will be altered or changed based on these three categories of information.

Definitely, when we are talking about the RP plus retrieval practice, then we see that retrieval practice is positive in nature, which means the items are being retrieved, and the target items are there from the practice category. So, the performance of the recall will be higher, which you can see here. It is quite obvious; it is not unique in its form. Because we know if the items are coming from the practice category, then the frequency of familiarity with it, and the dominance of it, is going to aid us in the recall. However, in the case of the

RP minus, the retrieval practice is being performed from the non-practice item, from the unpracticed item list, which you have not practiced. In that case, the familiarity is not there, the frequency is not there, and the dominance is not there. So, the performance will be affected, which you can see is happening right here. So, there is a big difference here. The controlled group here, the controlled group which we are having, the non-practiced category is there where the practice is not being performed at all.

There, we see the retrieval of this is there, which is almost slightly higher than the retrieval practice minus items. Two reasons are there for such a distinct nature of this pattern, which could be familiarity and frequency of the item. Now, the familiarity and frequency of the item from the unpracticed category should be slightly higher, from this category should be higher than the non-practiced category. However, because the non-practiced category item is totally relying on the free recall, as a result, the recall is getting better.

But in the RP minus category, the recall has to be dependent on the category, which is limiting and inhibiting the retrieval process. Hence, we have been discussing this in the previous lecture that when the free recall is there, it seems that the performance is better. So, this difference that we are noticing here is because of the regeneration. Okay. Taking you further down the line about the inhibition, another form of inhibition is the part-set cueing.

So, which means that when people have studied some information in a set, already learned information is there, but not all of it. So, this inhibition on the unstudied item is seen. So, what we remember is that there is learned information. And this learned information, when people are studying this information, the inhibition starts to happen because of the set of information which is already present there. So, when this happens, this we have seen in learning L1 versus L2 language, when an individual is forming the L1 category and the L2 category is there.

The L1 category, when we are talking about, is our mother tongue or native language. Now, when you learn the next new, forming a new category, this new category is going to interfere with the previously available category. And this interference is because of the set of items. Now, when we talk about the small list of items, when we are retrieving the list of items, this list interferes with the retrieval of the other parts of the list. So, what we are seeing here in the part-set cueing is that whatever we have learned previously is trying to be interfered with the new learning items.

Now, in many cases, what we have seen, if we leave the language context aside, then in the cognitive psychology domain, what we have seen, the parts that pertain to the letters depend not only on the frequency, frequency dominance, and familiarity, but also on the years. Words, unique words, emotional words. So, these are the categories that provide a unique list to the set of list items. Another form of inhibition is directed forgetting, where an individual is directed to forget. Why is it required for us to direct an individual to forget information?

If we take the scenario of an individual suffering from post-traumatic stress disorder or an individual having a panic disorder, in these scenarios, in these cases, an individual has a pathological memory, and a simple cue for a war veteran like a doorbell can trigger their trauma about the war field, or a perfume smell can trigger the trauma of a young individual about their childhood molestation. Now, such traumatic individuals face lives that become a living hell. As a result, in order to provide aid, therapists, memory researchers, and many more scientists across the globe have tried to come up with novel intervention methods. There are several novel interventions currently, such as neuro-stimulation procedures, imagery re-scripting, cognitive control, cognitive behavioral therapy, behavioral therapy, exposure therapy, etc.

But here, in relation to memory, we talk about directed forgetting. So, the researchers give a direction to the individual on how they can forget the information that is pathological in nature. Now, always remember one thing. You can direct an individual and train them to overcome the pathological memory. However, if you give them a drug, if you give them high stimulation, or if you adopt a high stimulation procedure such as ECT, then these types of interventions lead to amnesia.

And when the amnesia happens, there is not only a loss of information or a specific loss of information, but the information associated with that specific information could be vast in nature. And we do not have a clear understanding of what the vastness, projection,

and association of that specific information with the other information are. So, a simple word like 'bank' can refer to a river bank or a money bank. If any of these things we are talking about, these two banks are distinct from each other but they are connected to each other. And now, if you have been traumatized at a river bank and if a pharmacological method or ECT method is used to block this trauma, then remember one thing: this river bank also has some projection to this money bank.

So, the complete blockage of this may also block this stream. And when this stream is blocked, there is a total loss of information. As a result, the individual suffering from this memory loss may lose a major portion of his or her life. Now, we do not know how far this projection goes or how far this projection is connected to the other information. And the blockage of this information may indirectly be blocking this information as well.

And when two pieces of information are being blocked permanently, the information associated with them will also be blocked permanently. Or the projection from this to the other nature of the information to the other information will also be blocked. So, this is how these things are. So, in a typical directed forgetting paradigm, participants are given a list of words to remember, and then the experimenter instructs the participant to forget that list and gives the participant a new list to remember. So, this list, but what we have seen, the remembrance of the first list, if you remember, earlier we were talking about the primacy and recency effect.

Whenever there is a primacy, then the information is entering into your long-term memory. And whenever we talk about the recency, we are talking about the working memory involvement. So when the forgetting of the first list is being instructed, by the time we are told to forget list 1, some of those items have already been transferred into your long-term memory. So because of this primacy effect, some robustness will be there, and when the recall or retrieval occurs, some of that information will be retrieved or recollected.

Now, when we talk about directed forgetting, it does not mean that there will be 100% forgetting. It does not mean 100% erasure of information or 100% inhibition of information. So, the group given the instruction to forget the experience shows poorer recall performance compared to the groups who are not given the instruction to forget. In a simple experiment, researchers gave two lists, list 1 and list 2, and when the instruction was given to forget list 1, people performed better in recalling list 2. However, when the

instruction was not given to forget list 1, but to remember list 1 and then remember the new list, recall showed interference from list 1.

Now, let me talk to you about prospective memory. When we talk about prospective memory, it is a form of memory that involves future plans, what we are going to do in the future. In the future, one has to prepare a to-do list: item 1, item 2, item 3, item 4, item 5. These items need to be performed sequentially. These items need to be performed sequentially.

That is a different type of story. However, the future plan is already being laid out to you, and how the execution has to be performed, that is going to be talked about in the prospective memory. So, prospective memory deals with future plans. And in training and in the engineering discipline, the application of prospective memory is immense. As I was telling you earlier, reading a manual versus the practical use of the manual are two different things.

So, once you read a future plan, that might be different, and once you execute the future plan, that will be different. So, participants are given a designated target task, such as remembering to remove cupcakes from an oven. A very simple task has been given. It could involve three steps. It could involve four steps.

Depending upon the individual, and depending upon individual experiences, the prospective memory may change. If you are familiar with the task, then your future plan may be short, quick, robust, and specific in nature. However, if you are not familiar with the task, then the future plan may be extended and may require some more effort. Then, participants were asked to occupy themselves with another task at the same time. So, when two different tasks are given, people tend to make the plan as per their preference list.

And that is why the to-do list is there on every researcher's desk, on every teacher's desk. What do I have to do today? The alternate task is intended to remove the designated target task from the working memory, and the reason is that already in the future plan, people have to hold information in their working memory until they execute the task. So, an alternative task is being provided so that the target task gets removed, gets interfered with in the working memory. Now, in the presence of competing attentional neurons, prospective memory performance can decline rapidly.

What does this mean? This means very simply that there is attentional control, there is attentional processing, there are attentional resources required. When there is a competition between attentional demands, then the future plan and the performance on it can decline rapidly. What does that mean?

It is that imagine a scenario where you have an exam 1 and then you have exam 2. Both exams are on the same date. Now, which paper you put more emphasis on, which paper you do not put more emphasis on depends on the nature of the paper itself and depends on your preparation and practice towards that exam. Based on such understanding, you divide your attention, and once the attention has been then these two attentional systems could be more, could be less; attention 1 could be more, attention 2 could be more, attention 1 could be more and attention 2 will be less, or vice versa.

Based on these attentional systems, the performance is also going to vary. What we have seen is that as the attentional system is divided, the prospective memory performance decreases. So, we discussed the prefrontal lobe, which is critical in performing the prospective memory task. Why is the prospective memory task there?

Because the relationship of attentional resources with the prospective memory clearly indicates that the prefrontal lobe coordinates with the prospective memory task, as the attentional system is governed by the prefrontal cortex. So, a direct relationship can be established here because the attentional system is involved in the prospective memory performance. So, the frontal cortex plays a direct role here in the prospective memory performance. Now, let me summarize this presentation.

What we have studied is the self-referencing effect. The self-referencing effect, which we earlier studied in autobiographical memory, plays a crucial role in self-referencing semantic memory. The moment we bring ourselves into the learning of information, the consolidation of information, its robustness, and the consolidation of experience increases. We tend to remember information more the moment we have referenced this information to ourselves. Then, in another aspect, we discussed the generation effect.

More and more, we generate. It depends on several processes. The first type of generation is free generation recall. Free recall is there. And in another aspect,

We are doing the generation based on a read-only condition. You read only and then you generate, such as rash, hash, bash, crash. So if this is a reading condition, then we have to

generate bash and crash. Then we talked about the organization of information and the distinctiveness of the information. How is the organization happening?

How are we organizing the information? In the organization of information, we are particular about the encoding of information. How is the encoding happening and what is the nature of the encoding? If the information is self-referenced, then the organization performs better, and we can make several categories, we can make several categorizations. And in this categorization, the list of items which are present in each organization, if they have unique characteristics, like we give you an example of a fruit and in the middle, the blood is coming.

That distinctiveness, that uniqueness provides specificity in the retrieval of that particular information. So, the nature of the information present in that stimulus is so high that the user or the participant does not have to put effort into the retrieval. Then we discussed the inhibition in episodic memory, how the inhibition is affected. And then we discussed that there are several parameters in which the prior learned list interferes with the upcoming information or the retrieval of one information blocks the retrieval of other information. And in doing so, there is a part-set cueing effect, and then there is the part-list effect.

While talking about this inhibition, we even talked about directed forgetting. An individual has to be directed to forget information so that he or she may overcome the pathological memory or learning process. And finally, we discussed future memory planning or future plans, which is prospective memory. The task which has to be executed in the future, we plan them, we make a sequence of it, Maximizing the bottom-up processes which help in future planning.

If we are familiar, if we are dominant with that information, it provides an aid in our planning system. Okay, let me stop here, and in the next lecture, we are going to continue talking about episodic memory. Thank you.