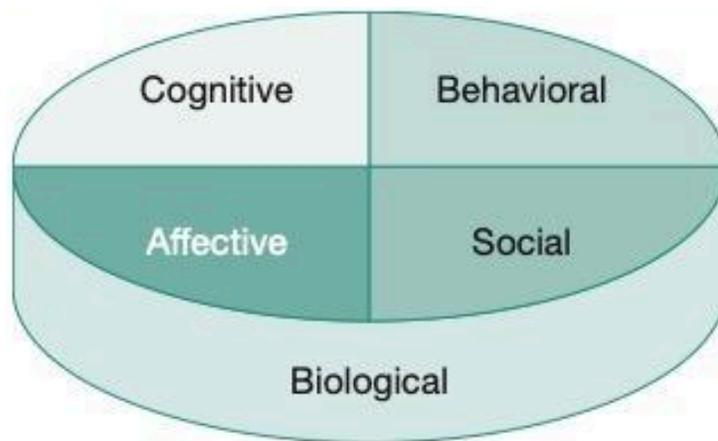


Memory
Prof. Manish Kumar Asthana
Department of Psychology
Indian Institute of Technology Roorkee

Lecture - 3
Methods of Studying Memory - I

Hello, I welcome you all in this lecture series of Memory, lecture number 3. Today, we are going to take our lecture forward from the earlier slide. In the earlier slide, I talked with you about the three approaches in the field of memory, social learning, cognitive psychology and cognitive neuroscience. Here I have brought you a cartoon which you can see on your screen. There are four pillars to this memory approaches.



Source: Darrel Rudmann: Learning & Memory (2018)

First pillar is the cognitive approach which we discussed in the previous lecture. The behavioral approach talking about the behavioral side of the human being. The underlying cause of these behavioral and cognitive processes, we see the beneath of these approaches is the biological approach. The biological approach give us an insight about the underlying neural mechanism. We have seen that memory is a complex and a simpler process.

If you have to remember a list of words, then it is easy to remember compared to if you have to remember a series of tasks such as to fly an aeroplane or to remember a series of tasks to control the nuclear power plant. When we are talking about the cognitive and behavioral approaches, we have to also address about the affective side of the human

being. How do they feel? How emotion plays a major role? How these emotional aspects alters our cognition and behavior?

What drives, what motivates an individual to learn and relearn? What motivates an individual to store, consolidate certain amount of information and to modify that old information with some new updated information? Social aspects are always the backbone of these approaches, and that is why in the previous lecture we discussed about in detail the social cognitive theory, where we discussed about the Bobo doll experiment, where the individuals, participants seem to be learning by imitating and observing the behavior of the elders. So, when we are talking about these four pillars of the memory approaches, we have to understand that the biological approach seems to be the underlying cause. Collectively, all these five approaches play a major role in the discipline of memory research.

And based on these five approaches, different disciplines and sub-disciplines of memory research exist in the modern world. As you can see on your cartoon, on your left hand side, some researchers try to understand the neural central nervous system, peripheral nervous system. In detail, to understand the reaction, the coordination and integration of the neuronal assemblies and how these coordination and integration of neuronal assembly results into the social cognitive behavioral and affective responses. Now the basic question comes to our mind, when an individual is thinking down the line about the special and pleasant moment in his or her life. Then we see that there are several memories, recollection happens at the same time. He thinks about his first visit to an international or domestic travel.

He thinks about his party time in his college or school time. He even remembers about his or her first birthday and also spending quality time with his or her dear ones. Now, when such instances, when such recollection of information is happening, the person has to rely on his memory. The question arises here is that, how accurately he or she remembers an event, how detailed information one can acquire and access from his memory. These understanding can give us clarity about not only the encoding process, the storage process but about also the retrieval process.

We know from the Ebbinghaus experiment that the forgetting curve, the rate of forgetting is high and as the time passes by it decreases and decreases. Though Ebbinghaus forgetting curve we will be covering in detail in coming lectures, but one thing is very clear that we do forget information with period of time, and if we do forget information with period of time then the question arises how accurately we are remembering the event from the past and how detailed it could go. Another concern which we always have because memory is a very dynamic process and formation of memory is very dynamic in nature. The question arises which information we store faster and which information we store slower. This understanding, that is why in previous lecture we have been talking about the different multiple approaches, social learning, cognitive, affective, behavioral, all these coordinate integrate and aid the memory formation.

So when we talk about which type of information stores faster then it is quite obvious we know that the information which has happy information the information which has some sad information being stored quicker faster and for long period of time. So when we have a memory about losing a dear one for long period of time and vividly we remember such instances, we vividly remember these information for long period of time. Similarly, when we acquire, when we achieve, when we are being rewarded in a society, that information also we store it in detailed fashion and quicker for long period of time. So, with this at least we know that emotional information have preference over the other type of information, and also emotional information seems to be have better recall accuracy than the other type of information such as neutral information. Another part is which information is challenging to store?

What type of information becomes challenging to store? The information which is challenging to store is which competes with the previous information. Many a time, what happens, if you talk about the individuals who are suffering from post-traumatic stress disorder or individuals who are suffering from anxiety disorder, for them undergoing memory modification is a challenging task. When these individuals undergo interventions, when these individuals form a new memory, then the old memory competes with the previous one, but it fails to leave its impression. As a result, the new

information seems to be challenging to store and the previous information seems to be dominant here.

Such instances also unravels and gives us an insight about the memory formation and the nature of memory. So, such information provide us clear understanding there are different types of memory, and different types of memory undergoing different type of neural mechanism. And different type of neural mechanism when we are talking about it, based on, depends on the type of memory nature. The neural mechanism may be similar, may be dissimilar, but they can never be identical in nature because 8 billion neurons, when they are coordinating with each other, the neuronal assembly may always have different impression and they leave different impression at each and every time in different context. So, the information which can be challenging to store could be the one which is weak in nature, the information which has weak association, the information which holds weak emotional value, the information which holds the least cognitive information will be little challenging to be stored. Another point which arises here is what are the limitations of memory storage?

When we talk about the limitations of memory storage, there are several aspects come into light. First thing is that the memory storage depends on the quality of sleep. Memory storage also depends on the lifestyle of an individual. An individual who is stressed, an individual who is exhausted, an individual who is having unhealthy lifestyle will always face challenges with the memory storage problem. Also, the limitation of memory storage is the age.

As literature has already been reflected and gave us insight that in the old age, the new memory formation slows down compared to the young age when we are young adults. Similarly, if there is a neurological damage, then the limitation of memory storage is there. So, the healthy lifestyle habits, age, and neurological problem could result into it. In some instances, we have also seen that the genetic composition play a major role in the limitation of memory storage and if we talk about the clinical cases where the lobotomy has been performed, there we also see when the mental functionality or the brain regions are not being there then also we have seen the limitation of memory storage. So, these important questions researchers have been asking in recent past and also past one century

and finding the answer to all these and many more such questions has actually helped the memory researchers to explore and delve into this line of research. Now, when we move forward, it is important for us to understand the methods which we adopt to study the memory.

The experiment that we conduct, in such experiment, the basic empirical setup is to have a set of observations that occur under a control circumstances. So we design an experiment with dependent and independent variable in a control environment of course this control design is unlike the real world. The real world where an individual is exposed to thousands of stimuli and he or she is being forced to select the stimuli, he or she is being exposed to so many stimuli based on his or her interest. But in order to study memory, the lab experiments has always been designed in controlling the environment and last one century of experiments especially if we talk about the classical experiment of Ebbinghaus who conducted the study on himself even he controlled the experiment in such a way to understand the forgetting encoding storage capacity of the individual. Now here, independent variable if you talk about the researchers ensure that the variables which he or she can manipulate under different conditions. So if we talk about independent variable, in coming example we will see that how the experimenter vary these independent variables and the variation of these independent variable how it impacts the dependent variable and the outcome of the experiment.

Dependent variables are the observations that we measure or record in responses to the independent variables. So, when they are being varied, then we see the changes in the dependent variable. Now, if you are a psychology student, then it will be very easier for you to understand dependent and independent. But even if you are not a psychology student, you have to understand that these are the basic, fundamental concepts and idea of any psychological cognitive or cognitive neuroscience experiment or related discipline experiment these are basic fundamental variables Then, another point to it is the random assignment of it.

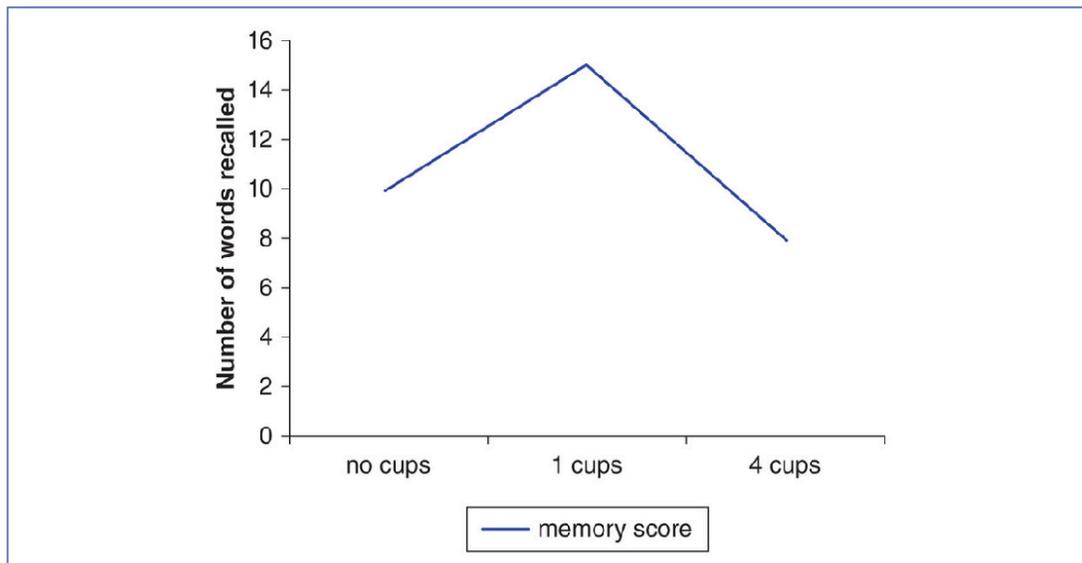
Any particular participant is equally likely to assign to any condition. So, the first two conditions, first two points if you see, the first point is the experimental condition and experimental design and experimental group and the second is the control design. So, two

groups are always been taken. Control group is always seen as a baseline. Or control group is always being used to see the changes or the alteration which an experimenter is making in the experimental group.

So if there is any manipulation is happening in the experimental group and there is a change in it, then we compare it with the control group. Sometimes this procedure can be double blinded. In most of the scenario, in most of the cases, this double blind is actually a single blind procedure, which means experimenter knows the condition under which participant is going to be. Either the participant is going to be in experimental group, or either the participant is going to be in control group. However, the best methodology in such studies is to keep the double blind procedure.

But due to the cost, the time and many other variables, these procedure, double blind procedures seems to be changed into single blind procedures. But the outcome, the

Figure 1.4 Graph of memory as a function of caffeine consumed. This graph shows a potential hypothetical outcome. A small amount of caffeine boosts memory, but a larger amount hurts memory. In fact, research shows that caffeine can hurt memory even at relatively small amounts. The y-axis is the number of words recalled.



Source: Darrel Rudmann: Learning & Memory (2018)

expected outcome from double blind and single blind, it has seen that it remains the same. There is not much variation one has seen in the recent past. So, as I was telling you

earlier about the dependent and independent variable, let us take a scenario where we are talking about the effect of coffee on memory recall. So, if you are consuming more coffee, our assumption is if you consume more coffee, then more recall is there.

So, if you are consuming less coffee, then less recall is there. So, if there is 0 cup of coffee you have taken, so the recall should be less, which we see here. This fits with our assumption. This is a control group where you have not given a coffee. So, the manipulation you are doing in the group with the coffee so you have given a group with one cup coffee and what we see is that one cup of coffee has been provided to an individual and the recall seems to be higher.

But then when the two cup coffee is given or four cup coffee is given then the performance should be here somewhere here but it seems that the performance has come down it has decreased. The reason is that the people have recalled equally as zero cup coffee even lesser than that. This effect is because of the arousal performance curve, what we have seen if you increase the arousal level performance will increase. However, after certain level the arousal level keep on increasing the performance seems to come comes down. This is we have studied in this Dodson's curve. And literature has already been talking about it, the arousal performance relationship where the performance is on the Y axis, arousal is on the X axis and inverted bell shape has been seen already.

As the arousal level increases, performance increases, but after reaching certain time, then the performance starts to decrease. So what we see is that the number of words are increasing and it is in relationship with increase in number of coffee, but this is limited after one cup the performance seems to decrease. Now, here the dependent independent variable what we have discussed independent variable is the coffee consumption and dependent variable is the recall of the letters. So, this recall is seen as the dependent variable. Let us see when we talk about the memory recall.

So, how do we measure? So, these are the basic standard measurements which we do in the memory literature. First measure is the recall. How many words or list of items one can recall? And this recall indicate the amount of information individual has encoded and stored.

This is a very simple and easy procedure. So, what one has done in the lab setting? You give a list of 20 words and then you ask an individual to recall. So, recall is the production of memory also. Many a time you give them a task of recall the list of 20 fruit categories, or 20 vegetables or 20 professions.

So, what they have to do? They have to produce the memory. They have to recollect the information from their memory. So, this is the recollection, where they are producing a memory. Now, recall can be seen of different types.

Sometimes it is also seen as serial free recall. Serial free recall follows serially. You are doing a free recall, but you have to follow a serial. So, if I give you a list of series of items, milk, bread, egg, sun, day, Monday. So, you have to serially recall these list of items.

When we tell you free recall, then you just have to recall it freely. Another type of recall is the cued recall where we are providing a cue to an individual and then they have to recall it. Generally, cued recall is seen in multiple choice types of questions. So, if we talk about the free recall here, here we generate the memories. So, we can ask them that write two paragraphs on India's independence.

So, people can start writing about the several movements which we had. We can even talk about the World War II and the contribution of World War II in India's independence. Different individuals will write differently and this is a free recall. Whatever we have studied in our school time, whatever information we have recollected, whatever we have experienced, this experience can be from reading books or from watching movies or by listening somebody, our elderlies. So, we based on this recollection of information we write and this is a free recall.

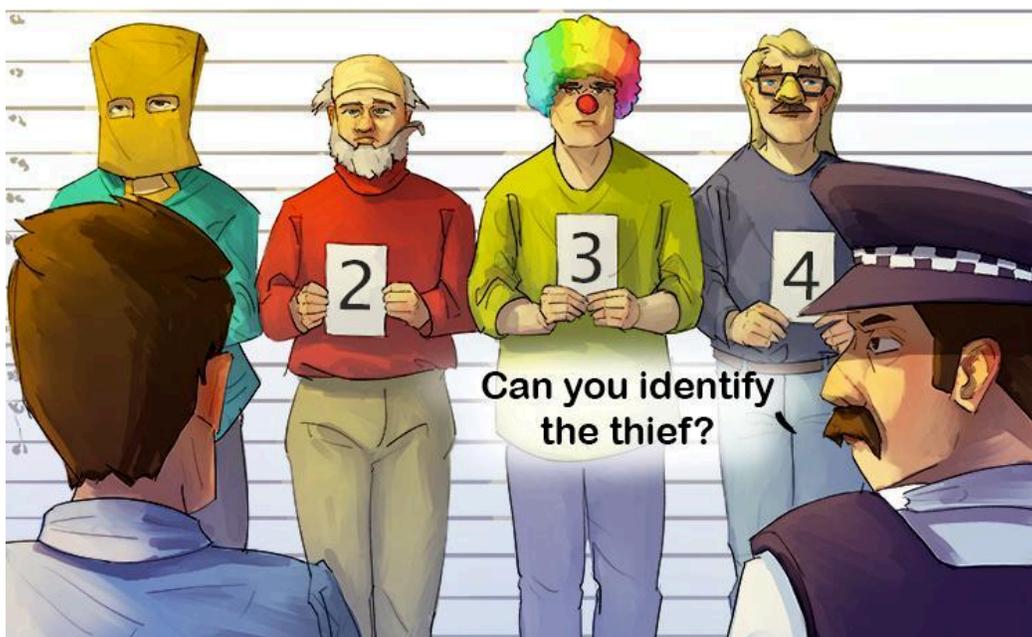
Then another example could be, describe everything you see on this screen. So what you see on your screen, a man thinking about a thunderstorm, lightning and also the hailstorm or the heavy rainfall. So this, if somebody is asking you, then this is a free recall. Someone say that, oh, it's like a black current food or anything in association with that. A wild thinking can be seen as a free recall as well.

So cued recall as I said, it is a specific cue has been given to an individual such as movie list of Shah Rukh Khan. So movie list of Shah Rukh Khan, so many hundreds of movies you might have seen or you may recollect. But if I say movie list of Shah Rukh Khan, that is a specific cue. But then I say movie list of Shah Rukh Khan from 2010 to 2014. That is a specific period of 4 years.

And then you have to provide me a specific list. So the movies which has been released before 2010 will not be part of this cued recall list. But movies, any movie which has been released after 2010, then will be part of this cued recall list. Another thing is what is your birthplace, so this is also a very specific question. A specific cue is there you will be providing a specific answer and here we don't need to generate any sort of movie, that okay, my birthplace is where the small village, 2 lakh inhabitant, dry zone and it's close to national capital of India and so and so forth. So you provide an answer very specific as a cue has been given.

The cue here is your birthplace. So this type of test has been a standard test where people evaluate that how much, what is the percentage, what is the accuracy with which you can recall these things. So, recall are of different types. Based on this, experimenter or researchers do the evaluation. The another part of measurement is the recognition.

The recognition when we talk about this means that, matching one's memory to a presented choice. So whatever information, knowledge, experience we have consolidated. We try to match the presented choice with us with the existing knowledge or the consolidated information which we are having. So this is a very common example that



you see if you have been theft, if you have been robbed, then you go to the police station and you tell them that okay you have been robbed, there is a thief wearing a wig of rainbow colors, so then they bring the thieves in front of you and then with the blind screen you have been asked to identify the thief can you identify the thief. So, if you have

Source:

<https://www.merriam-webster.com/dictionary/recognize>
<https://www.merriam-webster.com/dictionary/recognize>

experienced because you have been robbed, you have been, you know, have met this unpleasant event, you have experienced this and used unpleasant event, you have encoded, you have stored it in your memory.

Now, when a person say that, recognize the person, recognize the thief. If the thief is among these, then what you do, you try to match the presented choice with your existing knowledge and if there is a match that yes there is a thief person number 3 with the rainbow color wig then you say that he is the thief and this is what we mean as a recognition. So, recall where we were talking about the generation of memory, here we are talking about the matching of memory. So, recognition can be of old or new, seeing an item in the presented list of the items. So, what we do is very simple task.

We present a series of items to the participants and let us say 20 items are presented on the list and this list could be starting from cow, milk, sun, hot, coffee and so forth. These item list an individual has to see. Now, if the recognition that same list after learning the test is given to them and where the individual has to see the list and say that if it is an old list or is a new list. Let us say one of these item like sun I replace with wind. If I replace sun with wind and if I replace coffee with tea, and presented in this 20 item list again, then the individual has to see the list, and also has to recognize that the sun has been changed to wind, coffee has changed to tea, so the list becomes a new list. So seeing an item in the presented list of the items, individual has to either say old or the new.

Now, to make such a decision, to make such recognition, less amount of time is given to them, a very brief amount of time, because here we are testing the ability to recognize the item. If a large amount of time is given to the participant, then their accuracy, then their choice of selection may reach to the 100% accuracy. But in order to test the ability of an individual, how well they recognize the item, how good their memory performance is, we

have to do this task in a limited amount of time. Then another type of recognition is the forced choice recognition task. This forced choice recognition task we talk about is also known as multiple choice recognition task.

So multiple choice recognition task, if you talk about here, we say that what is the color of the apple? And here we are providing them with multiple choices. Red, black, purple, and white. Now, what you are doing? You know the color of the apple if you have experienced it in the past, then you or you have learned about it in your kindergarten, or in school time the color of the apple, then you will try to match this information with the available choices to you. The available choices are red, black, purple and white. So if somebody hasn't experienced the color of the apple, then he is having four choices and he may end up in selecting black, purple or white also.

But if you have experienced it, if you have consolidated this information, if you have stored this information about the apple, then you will match with red. If I would have given another option here like a, b, B 3 and 4, which you can see on your screen, I would have given you c option green or I would have also given d option yellow. Then the problem would have been multiple choice recognition. Multiple choice means red is also correct, green is also correct, yellow is also correct. Leaving the other three options as it is because they do not match.

So, here you have been forced to choose or recognize the item. So let us summarize here a bit. What we have understood and learned from this lecture number three is that, along with the three major approaches which we discussed earlier there are four major approaches in addition to that biological approach is there. Biological approach is suggesting the underlying neural mechanism of the behavior, the underlying neural mechanism of the cognitive processes, the underlying neural mechanism of social learning, the underlying neural mechanism of emotional or affective feeling is very crucial in memory research. And last several decades, researchers have tried to understand the underlying neural mechanism of the social, cognitive, affect and behavioral side. This understanding, this insight is helping those individuals who are suffering from memory disorder. and that is why, it is very important for us to understand

these multiple approaches. To have a gestalt approach towards the memory research, it is very important for us to include these different branches of discipline under one hood.

To study the memory dependent independent variables are same, but in memory research it could be very very specific. But the standard procedure, standard method like many other psychological studies, or like many other psychological related studies we are adopting it. So here, we use several such procedures, control environment, double blinded studies, to understand the nature and the formation consolidation of memory processes. Memory recall, memory recognition are the two measures in which we understand the memory performance of an individual. How much in an individual is recalling, how much person is able to recognize, plays a major role and give us an insight. How much information an individual is registering, how much information an individual is recognizing. Recall, recognition are two distinct processes. They may share similar mechanism, but they are very distinct in nature.

Last several decades of research has revealed that the memory recall also depend upon the overlearning. Memory recall depend upon the frequency, dominance, familiarity. In contrast, recognition depends upon the consolidated information, experienced information which an individual has acquired over a period of time. If somebody has acquired and experienced more information, more recognition is possible. If an individual has acquired consolidated limited information, less recognition will happen.

This comparison one can do the recognition in a kid, 5 year old kid versus recognition in 50 year old elderly. The recognition of different schemas are there. And we see that recognition and recall are like many other memory measures. These two measures have been extensively used in this study. In coming lecture, we are going to study some more measures and I am going to share some more measures related to memory studies.

Thank you.