Cognition and its Computation
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Lecture - 36
Learning Processes

Hello and welcome to this 8th week of Cognition and Its Computation. In this week we are going to talk about learning and memory. So, we shall have a discussion on the learning theories and then we will move on to the memory theories we will look into the different kinds of forgetting and why forgetting occurs and then we will discuss a little about the memory disorders.

So, in today's talk today's discussion we are going to primarily focus on some of the learning theory.

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So, whenever we talk of learning we generally what do we mean? So, it is such a common process that every day in every aspect of life we come across learning. So, learning as per the psychological theory, it is a hypothetical construct and it cannot be directly observed, but only inferred from observable behavior.

So, it learning implies a permanent change in behavior ok and also in the cognitive would say that also a change in the thought process now. So, what is the difference just ponder on this? Then what is the difference between maturation and learning? If we are talking of learning as a permanent change of behavior, but maturation with age is also a permanent change of behavior also brings about a permanent change of behavior then are they the same or are they different.

So, one very important aspect of learning is that if we want to count something as learning the change must be linked to some kind of a past experience ok. And this effort may not be a conscious effort or and you know in other words, it could also be a learning that happens unconsciously and we will discuss this from the perspective of implicit learning or non declarative learning later on. So, learning what happens to the brain when it when we learn.

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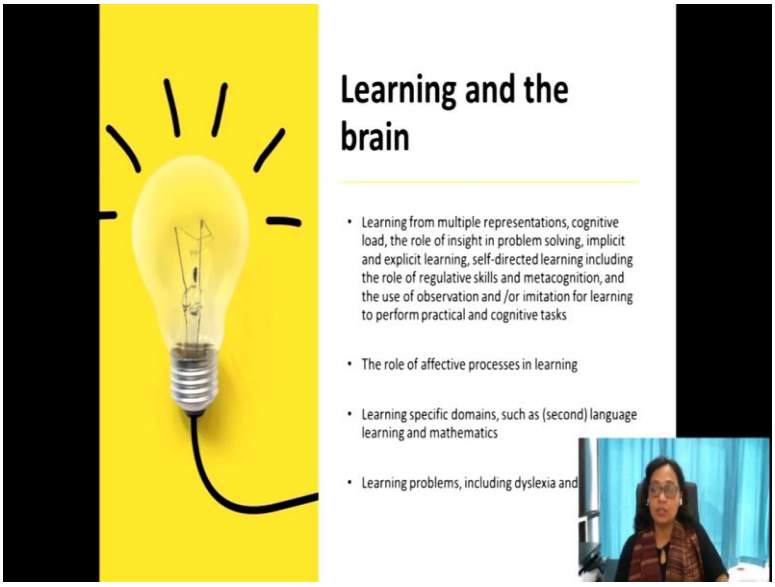

We are going to talk about these in details in the other lectures, but just to give you a brief idea. So, when learning occurs from multiple representation and from you know different perspective different ways of information acquisition. So, it brings about certain changes in the brain and there is also a role of effective processes.

So, the role of emotion the role of affect cannot be ignored when we are talking about learning and you will see when we talk about memory processes how important they are. Now there are you know the changes in the brain functionality can be recorded and can

be studied and that is why when we are today when we talk of learning as an impression, we also talk about brain studies that have brought about changes in learning.

One very important question that may come to your mind is, if you look at most of the cognitive psychology book you will see that they do not talk about learning, but they talk about the memory processes. So, why is it that you know we are focused on memory? How is learning related to memory and how is you know why do we study memory processes when we talk of registration and encoding we will get into these processes later on.

So, these are just questions that I want to raise in your mind, as to why do we talk about memory processes and not learning processes in the recent psychology book cognitive psychology book then how is learning and memory related. Now we will talk about it later, but I would also like you to ponder on this question and look around for more information on it.

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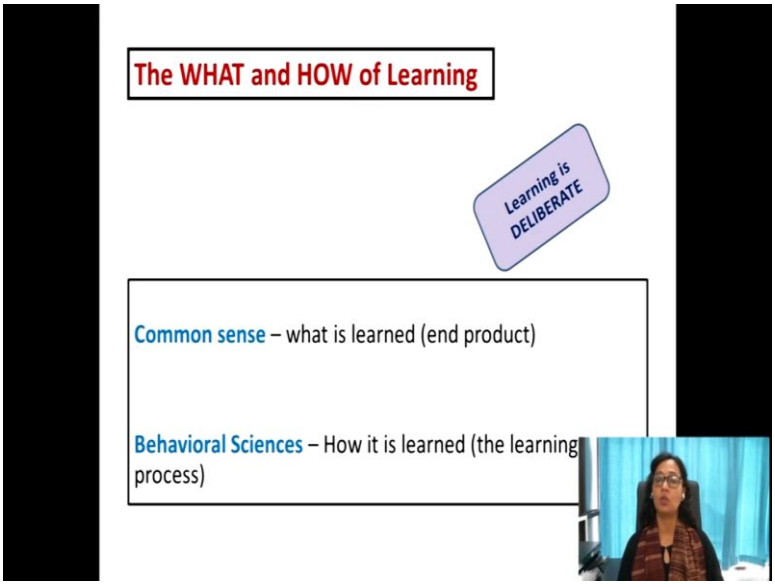

So, when we talk of learning in the common sense or in daily parlance we discuss or we talk about what is learned, but so, that is more of a more of an end product, but in behavioral sciences when we talk of learning and in cognitive sciences when we talk of learning we talk of the process of learning how is it learned and this is what brought about multiple theories of learning theories and approaches of learning.

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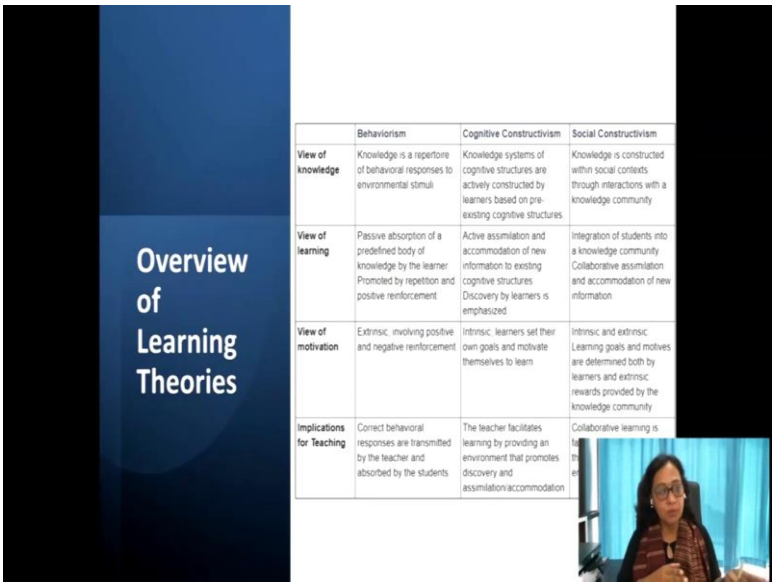

And the learning theories primarily may be broken up or divided into three groups. So, one is the behaviorism school or the behavioristic school or psychology, the other is the cognitive constructivism and third one is the social constructivism their approaches and their views of learning are quite different ok. So, behaviorism school the school behavioristic school their focus has been on the individuals behavior and in their perspective, they generally look at the subject or in this case the learner as a passive absorber and where you know the information is learned because of repetition and positive reinforcement.

The cognitive school on the other hand as you can understand involve cognition. So, engages the processes of cognition and state that there is an active assimilation and accommodation of new information to existing cognitive structures and this is through the process of discovery. So, if you look at the theory of insight by the cognitive school, you will see that there is a process of discovery that the cognitive school focuses on.

The social constructivism theory theories like Vygotsky in fact, even Piaget they focus on a community learning and how the information is integrated by students at large to you know and assimilated for accommodation of new information. Now these are more of from the developmental and social perspective.

So, in our discussion of learning theories, we are going to primarily focus on a few of the major behavioristic school theory and one or two of the cognitive school theory.

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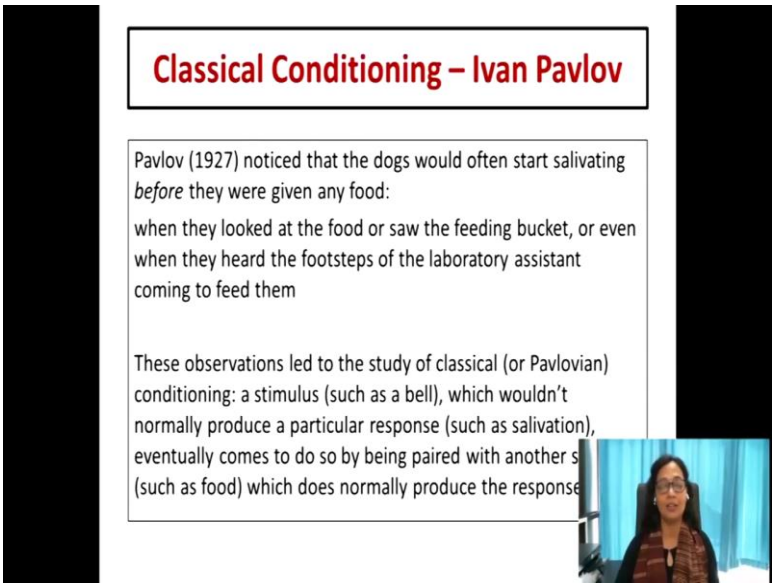

So, when we start with learning, we cannot deny the discussion on Pavlov Ivan Pavlov. And Pavlov who was actually conducting experiments on the physiology of trying to understand the intestinal movements of dogs and he saw that dog again this was a this was a chance finding, he saw that the dogs would start often start salivating before they were given any food.

And when they looked at the food or saw the feeding bucket or they heard the sound of the individual approaching who fed them that would bring about salivation. So, these

observations led Pavlov to develop a new theory of learning and this theory has been well known and established as a classical conditioning theory. And Pavlov theory as most of you are familiar with

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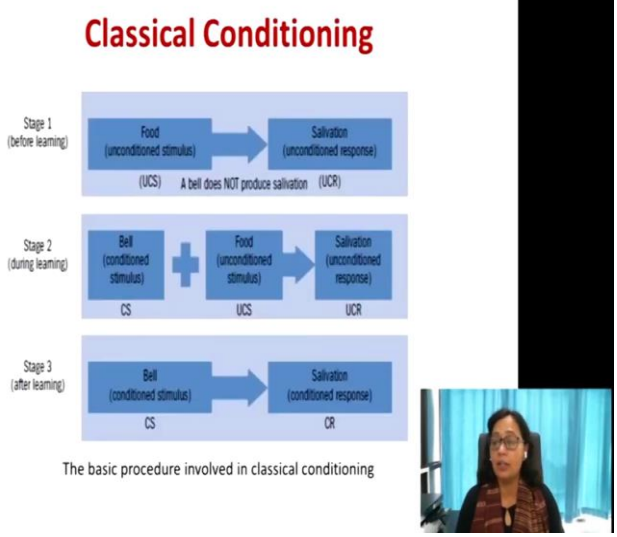

. So, I will just brief through it speaks about a conditioned and unconditioned stimulus so, that is the food that brings about an unconditioned response that is salivation. Now what is an unconditioned stimulus? Something that is not trained or learned.

So, if you just you know substitute the word conditioning with the word learning I think it will be easier for you to understand. So, the food is an unlearned stimulus why is it unlearned? Because the food does not imply you know brings about a natural response of salivation it does not if the food brought about a fear then that would not be a natural response.

So, that would be. So, then that would make the food a conditioned stimulus for the conditioned response of fear, but here in this case when we talk of salivation which is a natural response, you see it is when the food precedes it becomes a natural stimulus. So, it does not it is not trained or its not learned.

Now, the next state. So, this is the first stage is before learning has actually happened, but in the stage 2 where the a new stimulus in this case the bell in Pavlov case the bell the sound of the bell was paired or was placed in together with the natural stimulus. So,

that is the food and what happened after consecutive pairing? So, consecutive presentations together salivation occurred, but this time initially the salivation occurred because of the food.

Now, the bell also took on a new meaning. So, what does that mean? That the bell has acquired the meaning of bringing about the food. So, or as an indicator that the food will come. Now this by itself is gives the status of the to the bell of the conditioned stimulus. So, now, what again if you substitute the word conditioning with learning? So, it is got it is become a learned stimulus learned because it has a separate meaning.

Now, if the bell sound of the bell was loud and it caused the startle response, then that would be a natural response and that would make the bell a natural stimulus, but in this case the bell which by itself cannot naturally bring about salivation. Now has been paired with the food to bring about a response a new kind of response that is why it has taken the stage of or taken the state of a conditioned stimulus.

And in stage 3. So, after consecutive pairing in stage 2 in stage 3 what happens? So, that is after the learning has been done the bell by itself even when the food is not present the bell by itself can elicit, the response that was actually naturally attributed to the food. So, it can the bell brings about the response of salivation.

So, this is the basic procedure it that is involved in classical conditioning and in stage 3 the salivation is again in expectation of the food, but where the food is not present in stage 1 you will see the food was present also in stage 2 the food was present. Here the animal has learned that this even when the food is not present, but the sound of the bell is that will bring about the. So, the sound of the bell is going to bring about the food. So, the salivation is in expectation.

So, salivation now that is why because the stimulus the conditioned stimulus brings about this response of salivation which the in this case a food does not this becomes the conditioned response. So, this is basically the procedure involved in classical conditioning that Pavlov spoke of and Pavlov worked on animals.

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Now, this theory was further extended to explain learning principles in human and Watson and his associate Rayner worked on humans.

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So, what did Watson and Rayner do? In 1920 they try to induce fear into a baby ok and Albert little Albert was about 9 months old was a small baby who was you know who loved furry animals. So, what Watson and Rayner did? They induced little Albert sorry was 11 months old and what they did was they induce the fear of furry animal into this child by conditioning.

And here what did they do? They use the strike of the allowed sound as the conditioned stimulus. So, the loud sound would the loud sound would bring about a natural response of fear the sorry here they use the loud sound and what when they introduce the when they introduce the furry animal with the sound it got fed and the animal took on the role of the conditioned stimulus not the I am sorry I mentioned the loud sound to the say response of the conditioned stimulus if the furry animal that took the response of the conditioned stimulus.

And they and brought about the response of fear. So, just imagine the natural response of the human of this child little Albert towards the furry animal was one of pleasure, but the loud sound brought about a natural response of fear or alarm in this case. Now the loud sound was paired with the animal with the furry animal and the child transferred the fear of the sound to the animal expecting that and was fear scared of the animal.

Now, expecting that the loud sound will occur when the animal is given to him. Now this is what how phobias are created this is what Watson and Rayner depicted. This theory was their experiments were criticized the reason being that they had induced phobia on such a small child, but had not removed it.

So, this, but beyond the criticism if we look at Alberts experiment little Alberts experiment, we get to understand that how you know classical conditioning is also very very you know common among us. So, we when we learn language initially when we pick up a language we learn it by pairing. So, the in children's books or in children's classes in Montessori, you generally use a lot of gestures or objects to teach a child.

So, what we try and do is we try and pair it. So, an apple is with an apple ok nowadays of course, if I tell you an apple you might think of an iPhone or you might think of the image of a half apple ok, but earlier or you know when we teach a child we teach a child. So, if we say it is the cup then you have a cup in front and so, that the child can pair the image with the cup ok.

And in fact, most of our you know learnings are by pairing are by classical conditioning this is what that is why classical conditioning though there have been lot of criticisms of the behavioral school classical conditioning cannot be ignored and we in fact, you will see that you know associationism is something that is very very well explained through brain studies as well.

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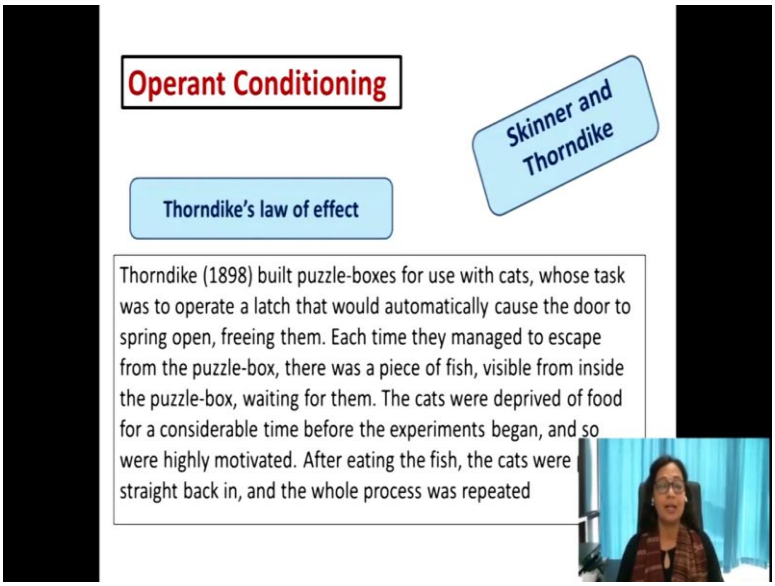

So, that brings us to the next very important theory of learning that is operant conditioning and in this we are going to talk about two major theories one is by Skinner and the other is by Thorndike. So, now to start with Thorndike, Thorndike through his study on animal behavior he specially worked on with cat he founded the theory of Connectionism. And Thorndike theory state that learning is the result of association forms between stimuli and responses.

And he says that such associations or habits becomes strengthened or weakened by the nature and frequency of their pairing. So, that is a stimulus response pairing. So, how often they come together. So, Thorndike term these approaches as contiguity and reinforcement. So, what is contiguity? Contiguity is the association that is formed between stimuli or between stimuli and response because they are presented in contiguity or together one of the subsequent.

Reinforcement on the other hand occurs because of the consequences of the behavior. So, specifically because the behavior leads to pleasant consequences, we follow that behavior again or we repeat that behavior or if it leads to a punishment then there is an elimination of that unpleasant behavior.

So, Thorndike theory was based on the paradigm of stimulus response and he primarily focused on trial and error learning. So, he said that we learn through multiple trials and in fact, his experiments with cat show a highlight or emphasize on this trial and error

learning principle. And he says that these responses some responses come to dominate over others because of the reward the way the rewards are given.

And the hallmark of this connection connectionism was that learning could be adequately explained without referring to any unobservable internal state. So, here when we talk of behavior at school, they are their emphasis is specifically on observable behavior and you will see that this very very clearly projected in Thorndike theory.

So, now. So, Thorndike what he did was he built puzzle boxes and he used cats and their task was to operate a latch that would automatically cause the door to spring open freeing them and if they happen to so, with multiple trials when they tried out first there was a lot of random behavior, but then they managed to a when whenever they managed to escape the puzzle box, there was a reward or a piece of fish and this reward was visible from inside.

So, the cats were hungry and that is why they were motivated to reach the food and after eating the fish the cats were put straight back in. So, initially there was more of random behavior, but gradually the randomness in their behavioral expression reduced and the cats were likely to find their way to reach the reward. So, that is by pressing the lever adequately.

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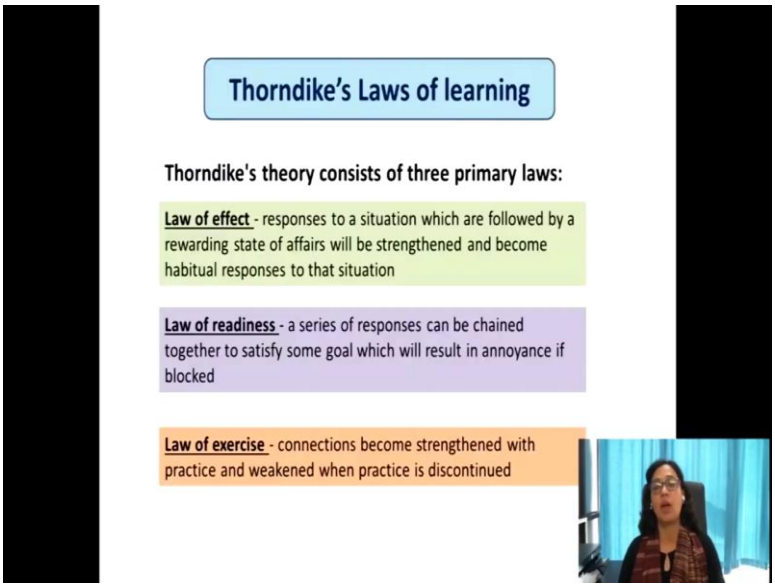

So, from here Thorndike derived three laws of learning and his the three primary laws that Thorndike talks of is law of effect. So, that response to a situation which are followed by a rewarding state of affairs will be strengthened and become habitual responses to that situation. So, this law states that if the response is a pleasant one that response will be strengthened and it is likely to become habitual in future.

So, in simple terms, the likelihood of that response to be repeated will be increased. Law of readiness state a series of responses can be change changed together to satisfy some goal which will result in annoyance if blocked. So, the whether the learner in this case the cat is ready to do a certain set of responses to reach the goal and so, here is a hungry cat you can see the reward.

And after a sequence of responses if that leads to a goal that will be repeated and if that is not reached or if there is a blockage then that would create an annoyance. So, it is Laws readiness case also implies that there should be a readiness for the response also that response has is pleasant and there is a desire to have to reach the goal.

In this context we will talk about another kind of reinforcement or the negative reinforcement right after this. So, the third is the Law of exercise which states that connections become strengthened with practice and weakened when practice is discontinued. So, this is something that we often hear the teachers say and you will see this very very well represented in brain functionality.

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So, this brings us to the next theory of conditioning and this is the operant conditioning theory by Skinner and Skinner actually is characterized as a radical behaviorist. So, his theory also ignores internal psychic processes and focuses on the relationship of behavior to external environment.

Now, for Skinner behavior is a result of its consequences. So, this means that the perceived consequences of behavior determine the degree to which that behavior is likely to reoccur. So, in this context Skinner spoke of two kinds of behavior. So, one is the respondent behavior elicited by a known stimulus and an apparent behavior that is not elicited by a known stimulus, but emitted by the organism and that the. So, these are the two kinds of behaviors that Skinner talks of and for Skinner the operant behavior is not correlated to any known stimuli.

So, he holds Skinner holds the conviction that stimulus are irrelevant to the understanding of operant behavior. So, most human behavior is operant in character and itself like we suddenly begin to whistle, it is controlled by its own consequences, but respondent behavior depends on the stimulus.

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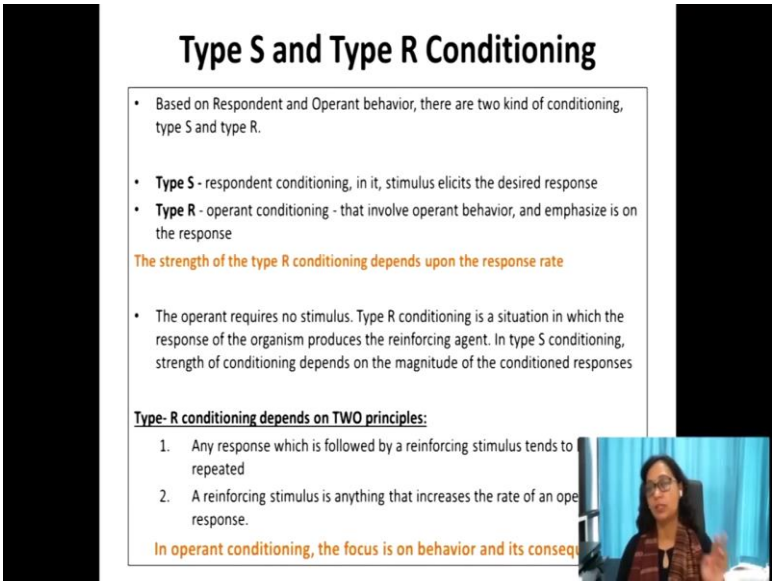

So, based on the respondent and operant behavior Skinner talks of two kinds of conditioning the Type S and Type R conditioning. So, Type S conditioning is respondent conditioning and in it the stimulus elicits the desired response and Type R or operant

conditioning involves operant behavior that and it emphasizes and it on the response the strength of Type R conditioning depends on the response rate.

So, as you can well understand the operant conditioning the operant does not require any stimulus this is very important. So, Type R conditioning is a situation in which the respondent response of the organism produces the reinforcing agent and in Type S conditioning strength of conditioning depends on the magnitude of the conditioned stimulus.

So, for Type R conditioning there are two principles that Skinner talked about. So, one is any response which is followed by a reinforcing stimulus tends to be repeated. You see that again this theory is completely focused on behavioral mechanisms and observable behavior. So, he says that the response is based on the reinforcing stimulus. And a reinforcing stimulus what is the reinforcing stimulus? It is anything that increases the rate of the operant response.

So, here the focus is more on the reinforce term and the focus of operant conditioning as a whole like the behavioral theories is on behavior and its consequences. So, Skinner theory speaks about the next stage that what is going to happen as a consequence of the reinforcer.

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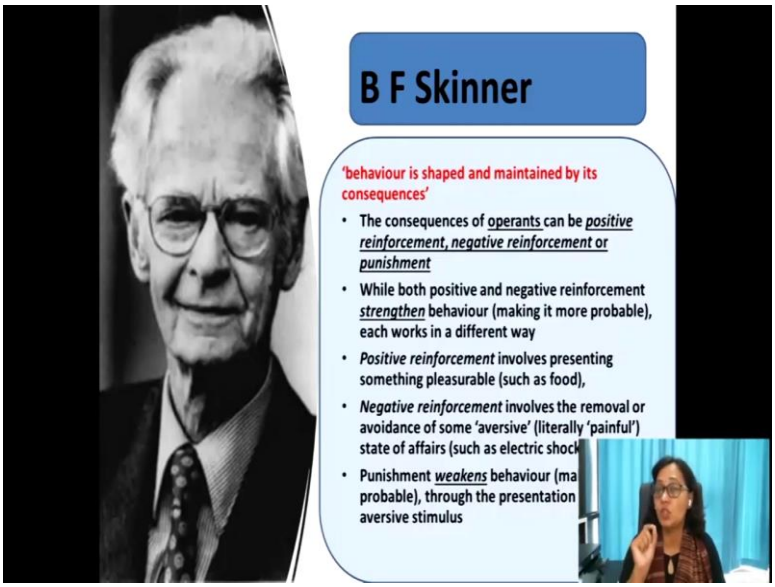

So, B F Skinner speaks primarily of one primary principle that is shaping and he says that behavior is shaped and maintained by its consequences. The consequences of operant. So, that brings about a change. So, in this case in Skinner's theory as compared to classical conditioning you will see in fact, in Thorndike also as compared to classical conditioning.

The learner there is a passive individual in Skinner's theory and also in Thorndike, the individual in this case the learner is operational operative to bring about changes in behavior and the consequence of operant's he says it can be positive reinforcement, negative reinforcement and punishment.

So, the different kinds of reinforces that an individual gets is holding the key for the response for the consequent behaviors that are to occur in future. So, the positive and negative reinforcement they strengthen behavior while. So, what is called reinforcement? Positive reinforcement in simple terms is reward I do a good action and I get a reward for it negative reinforcement on the other hand is removal or avoidance of some aversive state of affairs.

Like a cat is put in a meal which has where it is constantly being a giving a mild shock. So, if he finds the if he presses the right lever then that shock will be stopped. So, initially there are random movements and then when he finds the right when presses the lever that is the right response the shock is removed. So, the aversive stimulus is removed. Now if you think of this in a classroom situation a child who is trying to draw negative attention of the teacher by pushing people throwing thing shouting throwing tantrums. When the child is ignored continuously till that individual stops the aversive behavior sorry stops the unpleasant behavior.

So, still there is an alteration in the response then the aversive stimulus is stopped in this case for the child the teacher ignoring him that is the aversive stimulus now once the child alters his behavior does something that is desirable like the cat pressing the right lever that is the desirable response once the child does the desirable response the negative stimulus is stopped.

So, that is negative reinforcement for both the case of positive reinforcement as well as negative reinforcement. The objective is to strengthen a desired behavior in the case of punishment as we know of punishment; punishment is to is used to stop a behavior.

So, punishment weakens behavior. So, if some behavior is done then there is an averted stimulus. Now the difference between negative reinforcement and punishment is that negative reinforcement there is an aversive stimulus from the onset to make the child learn something to make the cat learn something.

In this case for punishment the aversive stimulus is given only when the a wrong response is made. So, see if the cat presses the wrong lever there are two levers if the cat presses the wrong levers he gets a shock and that is the punishment that will weaken that behavior that will stop that behavior and redirect to the positive the desirable behavior.

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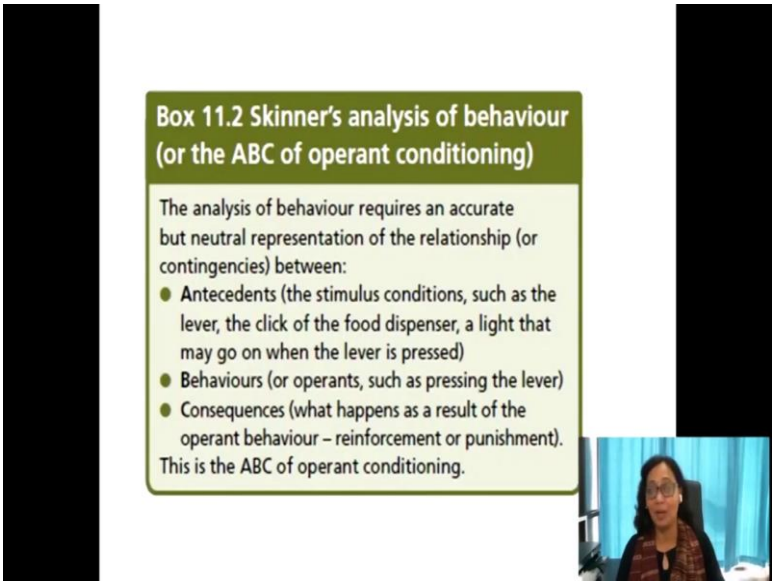

So, a Skinner Skinner's theory is very very well adapted in the behavioristic school of psychotherapy as well and it also is very very well adopted in school situations. So, Skinner's analysis of behavior talks about the ABC. So, what is ABC? A is the antecedent that the stimulus condition that brings about that such as a lever the click of the food dispenser a light may go on when the lever is pressed.

So, that condition the situation that brings about the behavior behaviors are the operant's where the individual is operated and taking an action actively participating in the learning situation and consequences what happens as a result of the operant behavior. So, this is known as the ABC of operant conditioning.

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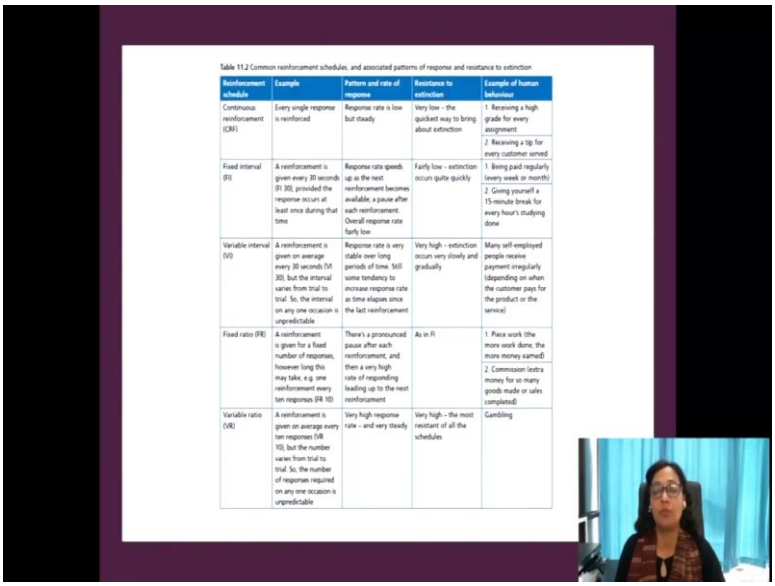

Now, Skinner talks of reinforcement and he speaks about different kinds of reinforcement principles and here he talked about the four kinds of of reinforcement actually five kinds. So, he calls them schedules of reinforcement. So, one is a continuous reinforcement where every single response that the subject does the learner does is reinforced and there are the other is based on interval on a fixed interval or a variable interval and a fixed ratio and the variable ratio.

So, you can go through this chart this is by this has been wonderfully depicted in growth a classical example of fixed interval is, fixed interval is where the reinforcement is given after a fixed amount of time and so, it is like salary being given at the end of the month or the report card exams happening at the end of semester. Variable interval is like the price test or where you are given you know incentive.

So, based on the kind of sales that an individual has done and this. So, if there is. So, when we talk of the reinforces strengthening the learning behavior it has been seen that the rate of the best reinforcers that has been effective is the variable ratio. So, we spoke about the interval the next is the ratio. So, giving fixed ratio is after say a certain number of correct sales an individual is being rewarded. Now this is one way of an incentive as well as compared to the variable interval where in variable interval the time may be a variable it not dependent on the correct responses.

Now, the ratio schedule is based on the number of correct responses. So, one is after a certain number of fixed responses. So, if you get in schools this is pretty often followed to manage in contingency management of behaviors like if a child gets the first prize in three subjects then he will get a book if he gets the three books then he will get another gift and so, on.

So, similarly this is also followed by corporate companies. So, if you make x number of sales then you get a foreign trip or if you get x number of sales then you get a certain amount of money as an incentive. So, this is not dependent on time as I was just mentioning about the variable interval schedule and as you can well understand this keeps the motivation for doing the work.

But the variable ratio schedule is the best why? Because there the number of responses number of correct responses are its known that if you make a certain number of correct responses you will get a reward, but how many after how many will you get a reward that is not known. So, for every time the motivation is maintained because there is an anticipation that this may be the time after which I will get the reward and a classic example of this is gambling.

So, people who buy lottery tickets and people who gamble are they know that they know of cases where people have received reward ok, but they do not know after how many such attempts they might get. So, if their anticipation is that they may perhaps get it the very next time. So, now. So, this is basically the theory of the schedules of reinforcement that Skinner talks of.

And in this section today we are going to we just summed up the primary three theories of learning that classical conditioning by Pavlov, operant conditioning by Skinner and Thorndike laws of learning and theory of learning in there are multiple other theories of learning and I was just thinking that maybe what we will discuss in the next classes a few of the other theories specially Hull theory which in very brief I will be talking about and because it is again based on it is a synthesis of Thorndike and Pavlov theory and we will move on to some of the other cognitive theories of learning. So, that is about it for now.

Thank you.