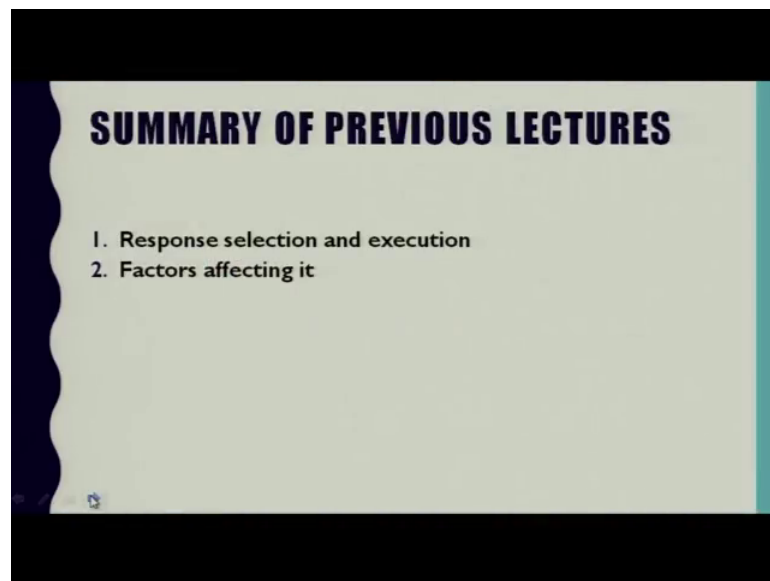**Applied Ergonomics**
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Lecture – 18

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So, welcome to this lecture. We were in the process of accomplishing this cognitive ergonomics part. So, so far in the previous lectures we have covered response selection execution and factors affecting that response selection and execution. So, now, another thing that we are going to cover is SRK model. So, it is nothing to do with the modeling or any Bollywood hero, it is SRK, it is skill-rule-knowledge model.

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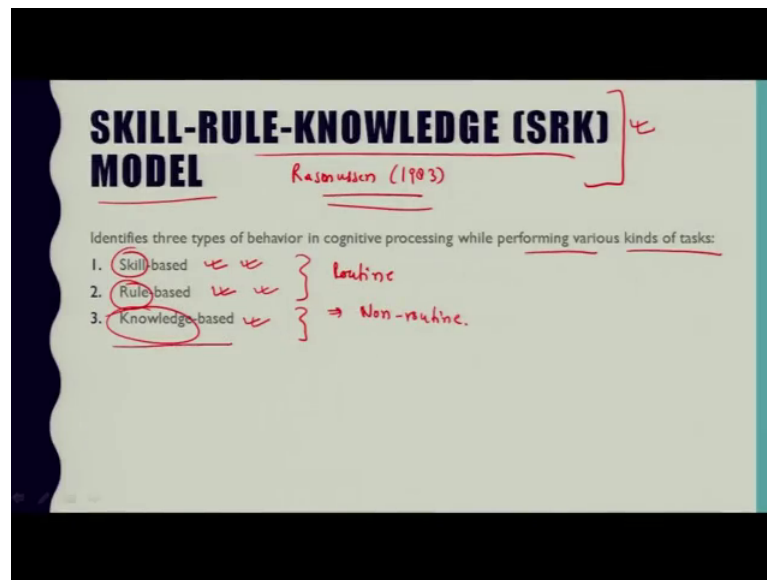
So, we will initiate with this particular model. So, the here S stands for skill, R stands for rule, and K stands for knowledge. So, this particular SRK model basically it was first proposed by Rasonussen in 1983 and it was very much site at in ergonomics and human factors literature. So, as we know that an ergonomics is also known as another name like that is human factors engineering. So, basically we are also in this course dealing with various factors that are related to human performance. So, in series with that we have covered physical ergonomics that is a straightly linked with the human functioning and as well as its response towards particular task. And next that we have covered is cognitive ergonomics, it is purely based on the information processing that has been done by that is used to done by human. So, that is why this human factor engineering is also considering these factors like skill, rules and knowledge.

So, we will try to understand what the meaning of these three components are. So, basically this SRK model identifies three types of performance or behavior, so that is skill-based, rule-based and knowledge-based. So, these three categories referred to the type of cognitive processing that are performed in executing various kinds of tasks; it also takes into account the level of experience possessed by the person performing a given task. So, a situation in which skill-based and rule-based behaviors are exhibited tend to be rooting and situations in which knowledge-based behavior is exhibited tend to be non routine.

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So, now, this is skill-based. So, a skill-based behavior occurs when a person has gained a high degree of familiarity or proficiency in a particular task or any activity to the point where the task can be performed automatically, and it should not include the deliberate efforts. So, the task can be performed automatically and subconsciously. It is usually a task with significant manual content. The task using has high manual content. Attention resources required for skill-based activities are minimal because the motion pattern is automatic. Examples of a skill-based activities may include walking, riding a bicycle, performing a repetitive one minute walk cycle on any assembly line, in fact loading and unloading a production machine that operates on a semiautomatic cycle and produces the same part every recycle.

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Now, we come to the rule-based behavior. So, it occurs when a person performs a task according to a set of rules or set of instructions. So, a greater demands are made on attention resources in task a characterized by this rule-based behavior, because the rules or guidelines have to be consciously followed. When a person is learning a new task, but has not yet mastered in that particular task, his or her actions will be guided by rule-based behavior, because you have to follow and you have to perform a particular task and there is a set of instructions given. And since you are not expertise expert of that particular task performance, so you have to follow the rules. And in that case, there is a set guidelines that you have to follow to perform and to accomplish that particular task.

So, examples of rule-based behavior may include following a recipe in preparing a dessert. Following a checklist when starting up a chemical process setting up a fixture on a milling machine even while performing, we can think the medical test performed in any hospital. So, let us see if you are performing any test in a medical clinic, so that is also you have to follow whether you are expert or a new as a beginner if you are performing that particular task in both cases you have to follow a setup instructions and step by step procedure for that particular medical test. So, in the case of repetitive task, the task has been fully learned and the behavior transition from rule-based to skill-based.

Now the next behavior we need to understand that is knowledge-based behavior. So, if you first to the task and activities that require a high degree of cognitive processing because the situation is unfamiliar and the rules or past experiences cannot be applied. A person manifesting this type of behavior must define objectives, evaluate alternatives, mentally or physically test the consequences of the alternatives. As an example of knowledge-based behavior, we can take as an designing a mechanical component for a machine, diagnosing a medical patients symptoms, as an example we can also write as a solving a complex mathematical problem analyzing the results of any findings let us say if you are performed any experiment and you have to analyze that result. So, analyzing the results of a scientific experiment, so these are the examples that you can take for knowledge-based behavior. There are some times job situations in which more than one type of behavior is applied.

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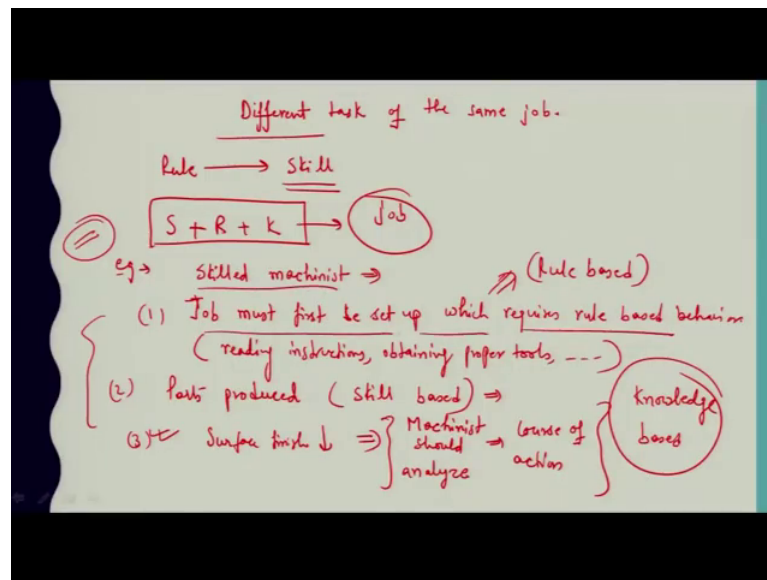
And like in most of the industries you perform different task in the same job, a worker can sometimes be guided by rules to perform a certain task, and at other times knowledge and analysis must be used to solve unfamiliar problems. In addition a worker may began a task using a rule-based behavior and gradually convert to his skill-based behavior once that job has been thoroughly learned. And in some cases all three types of behavior can be exhibited in the same job, for example, a skilled machinist may be assigned a rule batch production job that has to run in the shop before but by never by this machinist. The job must be set up which requires rule-based behavior. So, job must first be set up which requires rule-based behavior. It can be reading manuals, reading instructions, obtaining proper tools and fixing them to machine according to the instructions then the parts are produced which requires skill-based.

This must basically rule-based behavior this comes in the rule-based. And part production is skill-based behavior. Once the work cycle pattern has been learned a machinist has perform many similar job in the past and the worker quickly becomes rooting. So, finally, the surface finish on the part began deteriorate being during production and machinist must analyze the situation to determine what course of action should be taken to correct that particular problem. So, when things are not well, so what will happen machinist should analyze the situation and decide the course of action based on his experience and knowledge, so that comes in the category of knowledge-based.

So, now, I hope things are clear that here this particular in an industry or jobs set especially in manufacturing sector when I have taken this example of machinist or the worker who is producing some sort of job. So, and as a killed machinist job must be set up which requires rule-based behavior, so that is a rule-based. When part is produced and frequently he is producing part, it will come in the skill-based. And once something is not happening properly, so machinist should analyze the situation and based on his past experiences he should decide the course of action that has that is knowledge-based.

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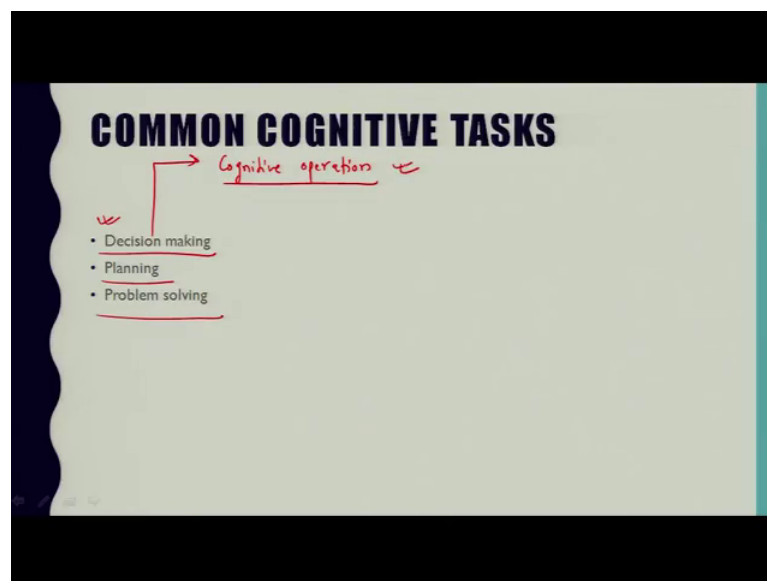
So, now, the next topic that we need to cover is common cognitive task. So, since we have discussed in detail about the cognitive ergonomics and now we are become aware of the cognitive activities. Just to recall that those cognitive activities are whatever the activity that you performed with the help of with the use of your brain. It maybe if you are thinking, if you are writing something, if you are reading something even if you are playing chess that is also one of the cognitive activity. And if you are deciding something on a particular situation, if you are solving any problem and whenever you are making decision. So, all of these activities are the examples of cognitive activity.

So, in that context most common cognitive task which we can discretized are decision-making, planning and problem solving. So, as far as we will take these three things one by one. So, as far as this decision-making is concerned, so this is particular a cognitive

operation in which a person makes judgment to select one alternative over other possible choices in order to achieve some objective or to satisfy the required criteria.

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Decision-making is a central activity in human information processing because it is an integral part of so many other cognitive processes. So, it is like an mental processing in which a person makes a judgment to select one alternative over other possible alternatives in order to achieve some sort of objective. As far as elements of typical decision-making situations one alternative must be selected from among multiple options, some information is available about options. Timeframe is relatively along and there is uncertainty about operations and outcomes. So, as far as decision-making situations are concerned, it may be planning, designing, problem solving and as well as some sort of troubleshooting.

So, basically the output of this decision-making is our decision. Decision can be classified as good or bad, it may be a right or wrong, correct or incorrect, optimal or suboptimal. So, often times these classifications cannot be assigned until long after a decision has been made, it can be seen whether the selected alternative did in fact, achieve the objective that was sort after. So, ergonomic interest in this particular decision-making is to better understand the mental process by which decisions are made and to provide after word tools techniques or guidelines to minimize the probability of

making wrong or bad decisions, so that is why this particular ergonomic as important ergonomic interest lies in this decision-making.

Because there are various disasters that has happened before that is just, because of some flaws in making decisions or human errors. So, that accidents or tragedies that have listed in very first lecture of this particular course in which lack of human factors or decision-making ability is resulted into a lot of deaths of human being and related disasters. So, that for just because we care the importance of this particular course is lying here and as far as cognitive part is very much important to understand.

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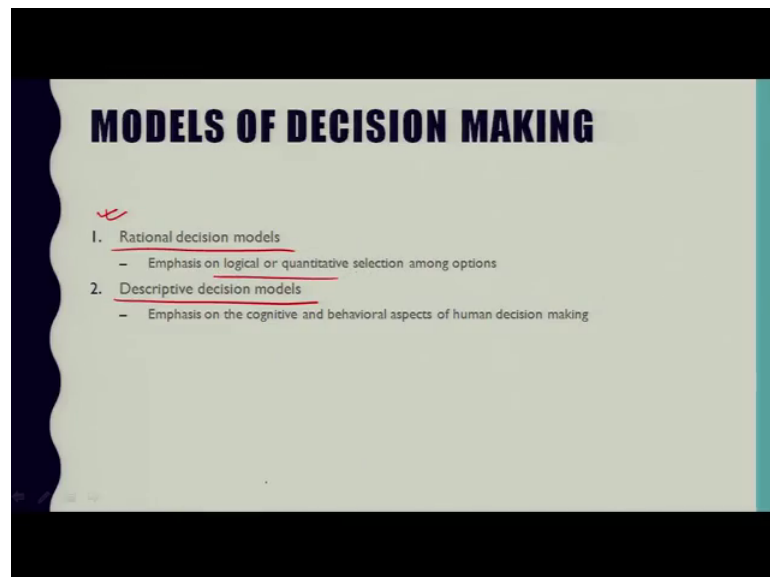
So, now, there are various models of decision-making. So, the models of decision-making can be divided into two categories first is rational decision models, second is descriptive decision models. So, in the rational decision-making models that is based on the classical decision theory founded in ergonomics and statistics, and they represent basically the logical approaches to decision-making, but people often do not make decisions based strictly on logic. So, a descriptive models try to represent the behavioral aspects of human decision-making.

So, first of all we will discuss about this rational decision model. So, in rational decision models the emphasis is on logically or quantitatively we can say determining the optimal alternative along the various options. So, this rational decision model is based on the way people should make decisions. So, basically it is also called normative decision model because they represent decision-making the way people should make decisions. In fact, the way people should accomplish it not unnecessarily the way people actually do accomplish it. So, rational decision-making model use multi attribute theory.

So, here we can write as well this particular rational decision model use multi attribute utility theory in which an overall value is calculated for each alternative based on scores of various attributes that are used to judge the alternatives. So, the overall value is calculated using one formula which I am writing here that is V i equals to summation from j equals to 1 to n U j a i j this fix. So, this is the multi attribute utility theory. So, where V i is overall value of alternative i; u j is utility or weight factor weighting factor in fact weighting factor for attribute j; and a i j is the score of attribute j for alternative i and here n is the number of attributes used as decision criteria. So, if it is visible I am writing here that n equals to number of attributes used as decision criteria and the logical decision is to select the alternative with highest V i. Based on this approach in fact we will come back to this particular example.

Before that another thing that we need to learn here that rational decision models can also be used to compute the expected value of a set of alternative by multiplying the payoff for each outcome by respective probability of that outcome, and then followed by subtracting the cost of the alternative that is p i small p i capital P i minus C i. So, where this E V i is expected value of alternative i, this small p i is probability of alternative becoming the output, and capital P i is payoff value of alternative, and this C i is the cost of alternative.

Now, if let say one example we will take here that the state lottery worth 20 million dollar, the tickets cost is one dollar the chances of winning per ticket is 1 by 700 million. Should a person buy 5 tickets, this is buy. And a person if a person wants to buy 5 tickets should he buy five tickets and what is the rational decision using expected value. Now, we need to calculate about the decision-making using decision-making using expected value. So, since his chances for winning is and then in fact, winning per ticket is 1 by 700 million. So, there are basically two alternative here first keep the 500 dollar and second one is buy five tickets with a potential 20 million dollar payoff.

So, the first alternative has an expected value of zero as the same goes that nothing ventured nothing gained. But another option is an in fact another alternative is the expected value of the second alternative we have to calculate and how we can calculate we will use this formula E V i equals to small p i into capital P i minus C i. So, here this

probability of the alternative become the outcome is p i is 5 into 1 upon 700 million. So, now, the thing will come out as I have actually put here as an resolution. So, you can check with the help of that formula that 5 into 1 by 700 million into this 20 million dollar minus this particular as so this particular statement is expected value of alternative.

So, that is coming out if you solve this particular term. So, you will be getting E V equals to this is large calculation. So, something like I am putting here this dollar twenty something thousand minus five. So, you it will give you 0.143 minus this 5, it will give you like minus 4.86 that has been given here. So, this is the possible equation and this final thing that has come out as an that. So, this is E V i this whole term is E V i and now it is coming out as a minus 4.86. So, it is clearly indicating since it is negative. So, a rational decision maker what he will do. So, rational decision maker what not take chance on a state lottery ticket because that particular expected value is coming out as a negative. So, he will not take chance in any case if he when read that particular quotient and it and if normal human being if you will read that. So, based on the chance of winning per ticket he will not allow that particular person to participate in that that lottery. So, now, these things have been covered.

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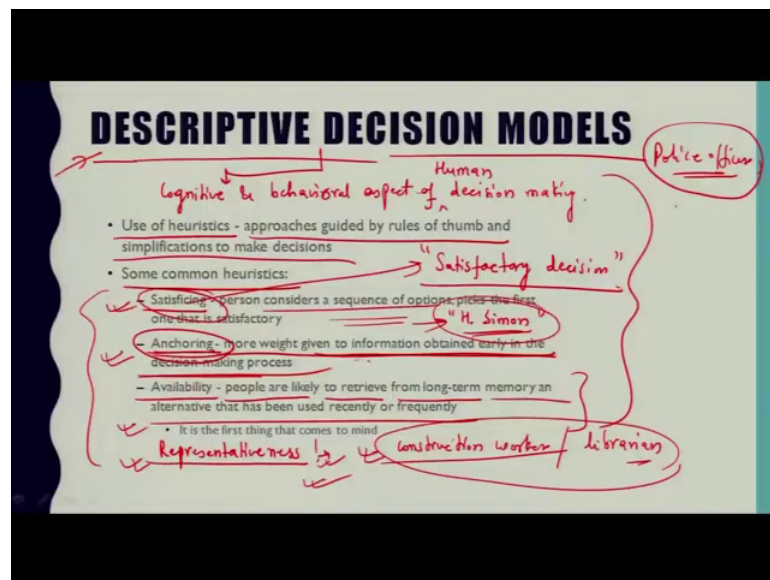
So, now that model is left as a descriptive decision model. So, one model was rational decision-making model, and second model is descriptive decision model. So, the trouble with the rational decision model is that the people often do not make decisions according

to that model. Like our lottery ticket buyer loses money by purchasing state lottery ticket, but he keeps on doing hoping that some at some point of time is luck will be there, and he will win, although his chances are very much very rare like the chances of winning was 1 upon 700 million. So, he will hope of his lucky day and he will participate each and every time in the lottery. So, because people do not work always obey the structure of rational decision-making.

Other models have been developed that attempts to explain the way people actually do make decisions. So, decision-making is not dependent on one factor it depends on multiple factors. So, this other model is known as descriptive decision model. So, this particle model emphasizes on cognitive and behavioral aspect of human decision-making. So, this particular model is dependent on cognitive and behavioral aspect of decision-making basically human decision-making. So, these models recognize that people often make decision using heuristics. What is that heuristics? So, approaches guided by the rules of thumb and simplification rather than detailed analysis. So, there are basically some other techniques or you can say some common heuristics that people use in decision-making first is satisficing, second is anchoring, third is availability.

So, in this particular satisficing heuristics that decision maker considers a series of options until one is found that is satisfactory this that alternative is then selected because finding a better alternative is not worth the additional effort. Term satisficing is derived from satisfactory decision; basically this concept is attributed to H. Simon. So, so given the limitation of working memory and perhaps the need to make a decision-making within limited time frame satisficing is a practical and reasonable way for people to make decision, so that has been given by this person.

So, next heuristic is anchoring heuristic. So, in that people tend to give more way to the information obtain early in the decision-making process, so that is the final decision is influenced more by early information that anchors the process then by the information obtained subsequently. So, here as a summary more weight given to the information obtain early in the decision-making process.

Another heuristic is availability. So, here people are more likely to retrieve from long term memory a hypothesis that has been used recently or frequently and the first thing that comes to mind and it is therefore, assume to be reasonable hypothesis for making a

decision or solving any particular problem. In this way there are the three it is another kind of heuristics is representativeness basically heuristic. So, in this heuristic basically a person makes a decision about a given entity because it appears to fix the minds prototype of that entity.

Like for example, if you are ask to decide if a certain individual we are not knowing we do not know, so is the construction worker or librarian. So, our decision would be influenced by the persons appearance related to how we perceive the appearance of the construction worker and the librarian. So, how one can represent oneself, so that recognition can be dependent based on the appearance of a particular person. So, heuristics are often used as a method of convenience, but there are other situations in which people are forced to make decisions quickly under adverse dynamic conditions. Like the people that sometimes find themselves in the kind of situations include the like surgeons operating in emergency situation or firefighters fighting a major forest fire or any police officer engaged in pursuit of crime suspect or college student nearing the end of one hour quiz that is too long. So, in this way this s about descriptive decision model is completed.
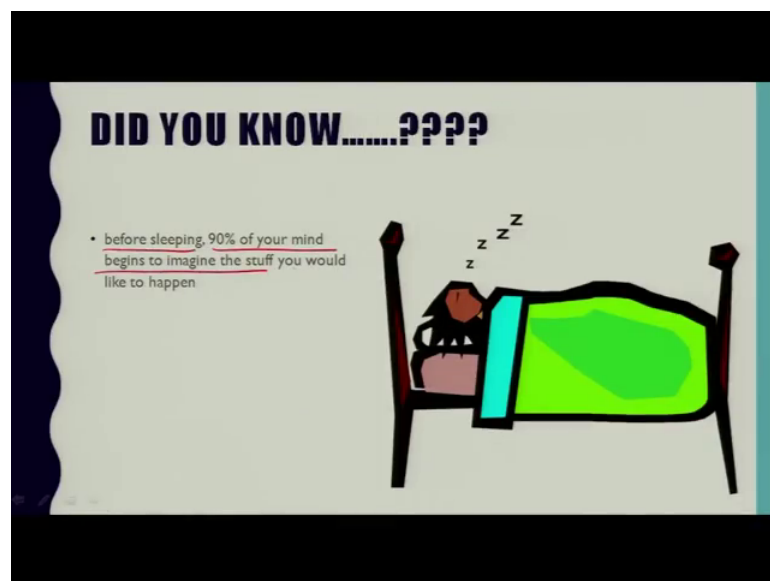
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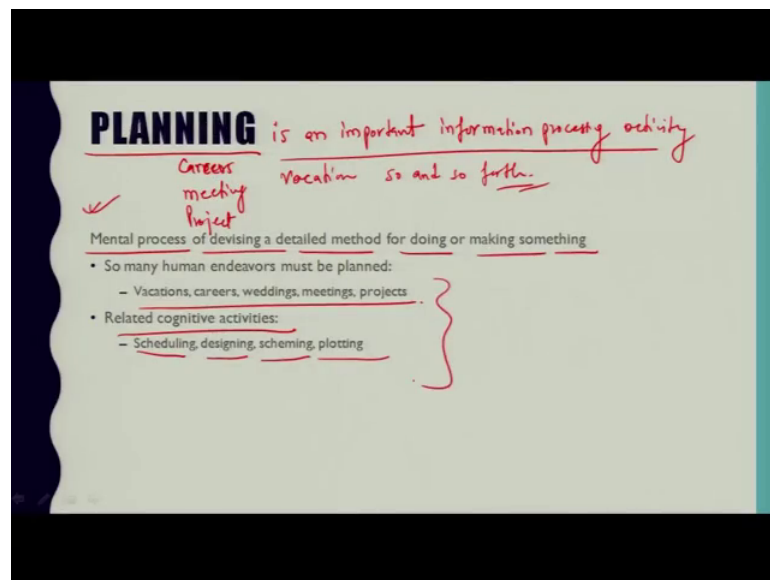
So, now the another section that we need to cover is planning. So, planning as is normal English word and you can take out the meaning of this particular world as it is. So, it is in a technical way, you can you defined it as a mental process of devising a detailed

method for doing or making something. So, it is a very obvious sentence. So, develop before something must be done, so planning is an in fact important information processing activity because so many human interviewers must be planned and that planning maybe may be any activity it maybe it may be your planning of careers, any meeting planning of any meeting, planning of any project vacations planning and so on and so forth. So, here in this relative cognitive activity is include scheduling, designing, scheming and plotting, they all required the planner to envision the realization of a desired goal to achieve, so that was a brief introduction about planning.

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I am closing this lecture right now so before I closing this lecture just a fact that do you know that before sleeping 90 percent your mind began to imagine the stuff you would like to happen.

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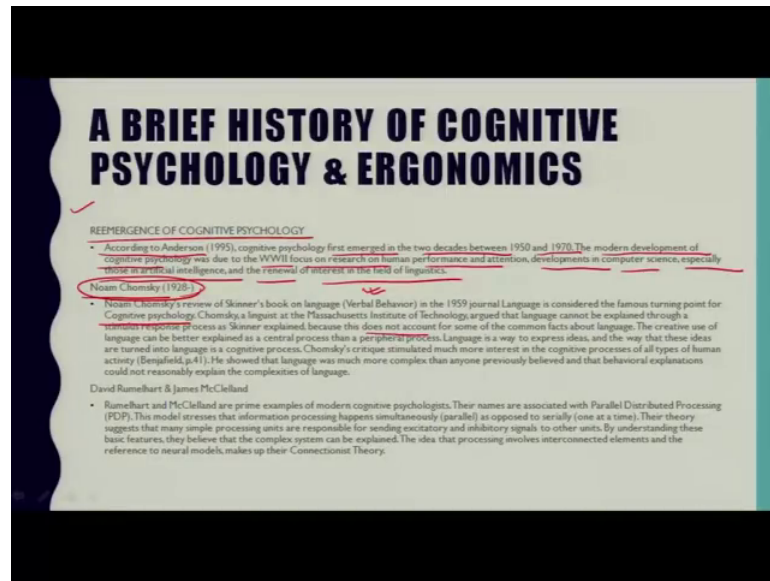
As far as brief history of a cognitive psychology, there is another series of contributors. So, reemergence of cognitive psychology, so according to Anderson cognitive psychology is first emerged in the two decades between 1950 and 1970. The modern development of cognitive psychology was due to World War second focus on research on human performance and attention. Developments in computer science especially those in artificial intelligence and the renewal of interest in the field of linguistics. Another scientist Noam Chomsky in 1928, Noam Chomsky's Review of Skinner's book on language that is based on verbal behavior in 1959 general language is considered the famous turning point for cognitive psychology.

Chomsky a linguist at the Massachusetts Institute of Technology argued that language cannot be explained through a stimulus response process as a Skinner explained because this does not count this does not account for some of the common facts about language the creative use of language can be better explained as a central process then a peripheral process. Language is a way to express ideas and the way that these ideas are turned into language is a cognitive process. Chomsky's critic stimulated much more interest in the cognitive process of all types of human activity. He showed that the language was much more complex than anyone previously believed and the behavioral explanation could not reasonably explain the complexity of the language. So, with this I would like to close this lecture.

Thank you.