Applied Ergonomics

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Lecture –17

So, welcome once again. Hope you are ergonomically fit to understand this lecture and we are in continuation with the cognitive ergonomic completion.

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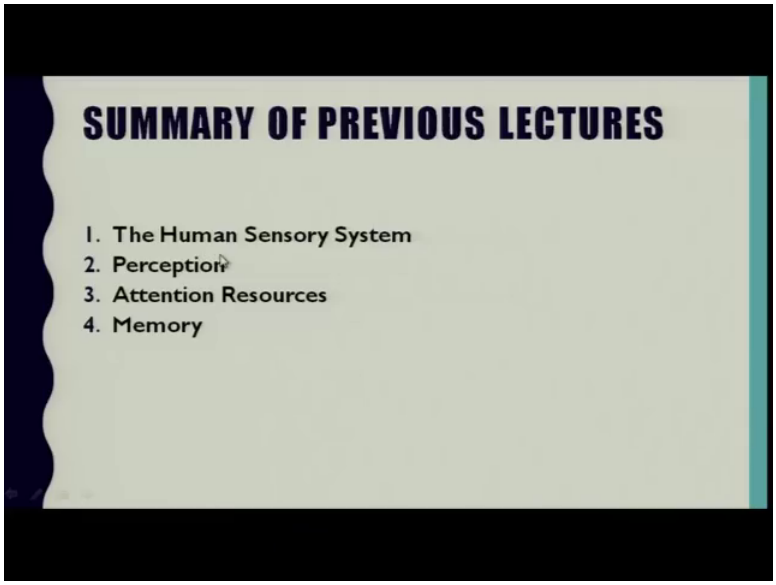

And in that series we have so far covered this human sensory system, perception, attention resources, and memory.

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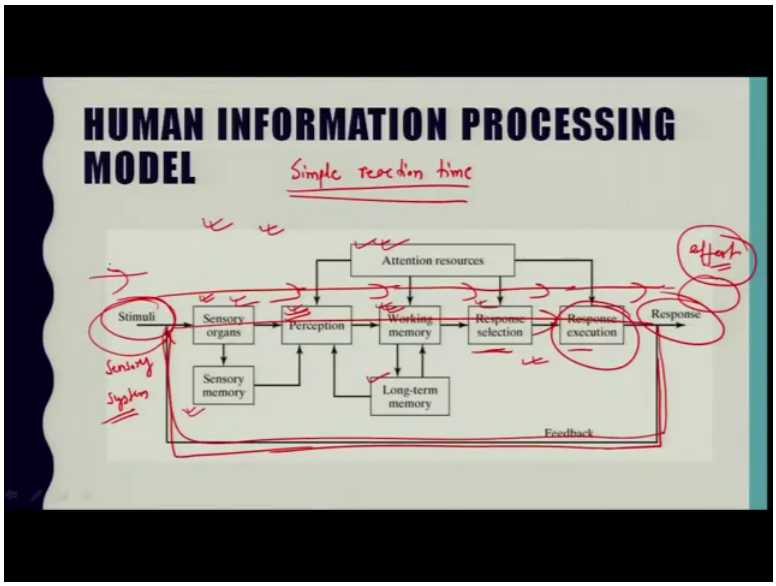

Now, since we are in line with the understanding this particular model; so far we have completed our understanding towards sensory organs, sensory memory, perception, working memory, long term memory, attention resources and now what the part is left is response selection and response execution.

So, today we will take these topics and enhance our understanding towards this particular topic that is cognitive ergonomics; so response, selection and execution.

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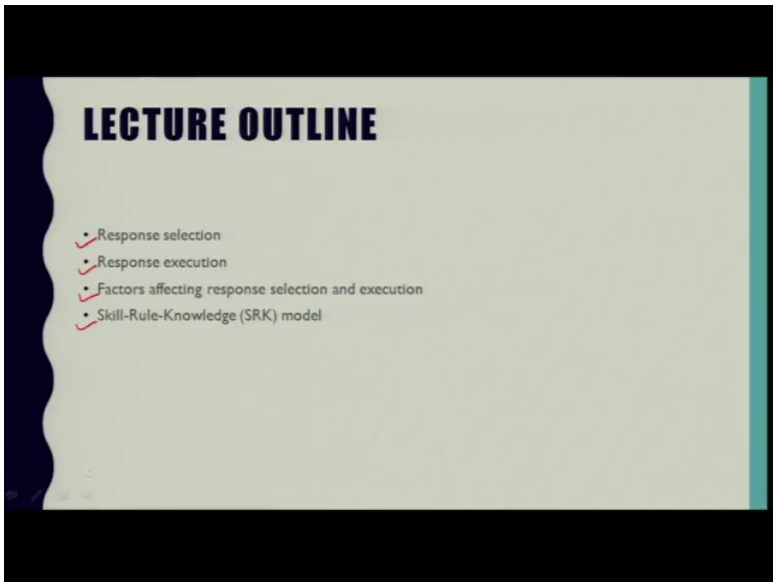

So, in this lecture we will be covering this response selection, response execution, factors affecting response selection and execution. And if time permits we will also continue with the SRK model.

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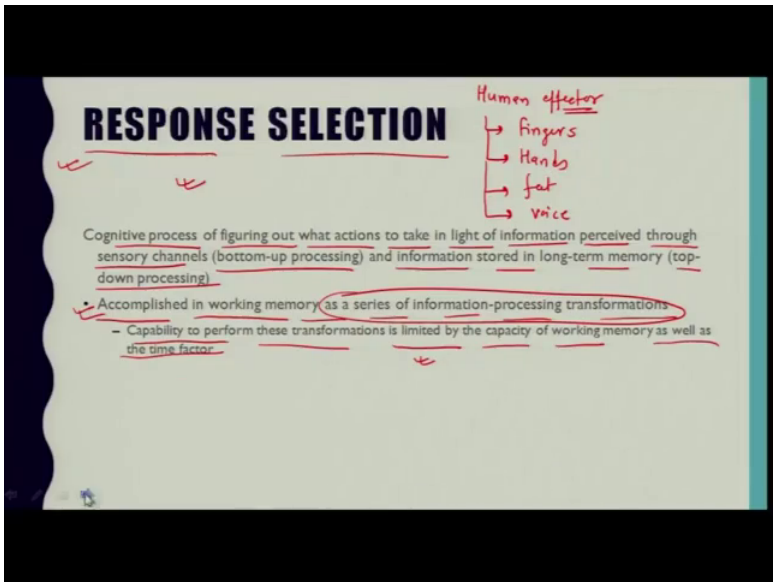

So, first of all response selection so, we need to understand that what is response selection. So, it is basically a cognitive process of figuring out what actions to take in light of information, perceived through the sensory channels that is in the model as a bottom up processing and information is stored in long term memory that is top down processing, if action is due in necessary it may take several forms like if you move your hand, if you walk, if you talk and or combination of these activities.

So, these actions usually performed by human effort. So, physical efforts are required, the example that I have given to you. So, human effectors maybe fingers that physical action can be performed by fingers; hands feet or even these human effectors also consider voice. So, the end actions can be passive also. So, basically it is accomplished this response selection is accomplished in working memory, as a series of information processing transformations.

So, its capability to perform these transformations is limited, by the capacity of working memory as well as the time factor. So, in order to develop our understanding for this is for selection let us take one example, suppose a person is reading a novel and here the only action is to continue reading, in that case the response selection is accomplished in

working memory as a series of information processing transformation. So, only a small number of chunks of information like facts figures images and ideas can be managed by working memory at one time and the chunks decay with the time unless focus is maintained by attention resources.

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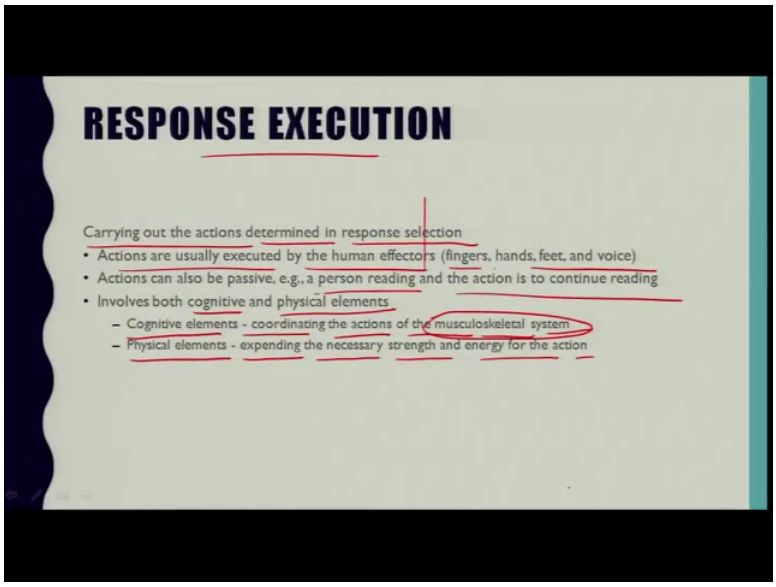

So, this was about the response selection and the next topic is response execution; this particular response execution means carrying out the action and the action which determine in response selection. So, it involves both cognitive and physical elements, cognitive element is concerned with coordinating the actions of the musculoskeletal system, this musculoskeletal system the description of which have we have covered in a physical ergonomic part and the physical element which deals with the expanding the necessary strength and energy to accomplish that particular action.

So, our action can be a direct active or passive. So, the actions can be executed by human factors, that we have just understood and the actions can be passive like person reading and action is to continue reading; so, as for as that particular model we can see that response selection and execution.

So, important feature of this response selection and execution, is shown as the feedback loop in our this information processing model. So, as the action is being taken it is verified through the operations of sensory system, perception, working memory, attention resources and motivation also and response selection. So, many of the actions

in response execution are largely automatic, carried out as a closed loop control system. So, now in this particular lecture we will try to discuss these two topics related to response selection and execution.

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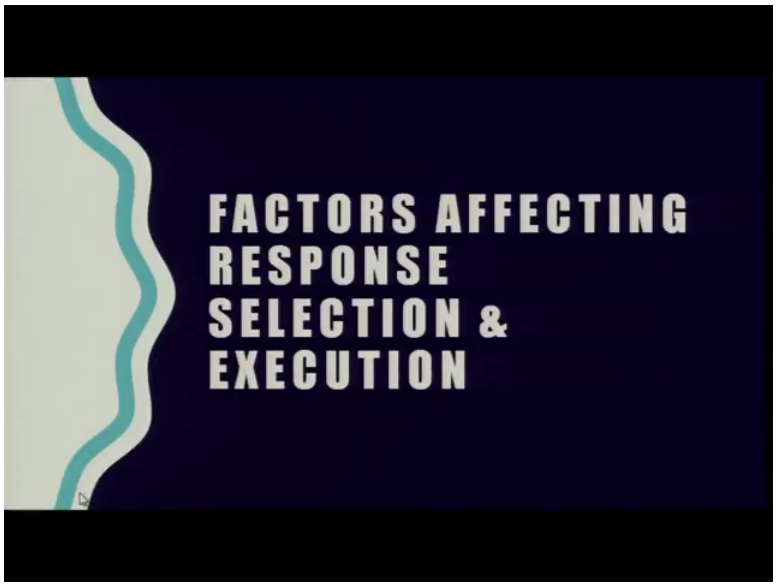

So, the particular first that is a response selection is concerned with the factors. That is affecting response selection and execution. So, in particular those that affect the speed and ease with which a selection is made in cognitive processing. So, here as a next topic we are going to discuss about the factors affecting response selection and execution.

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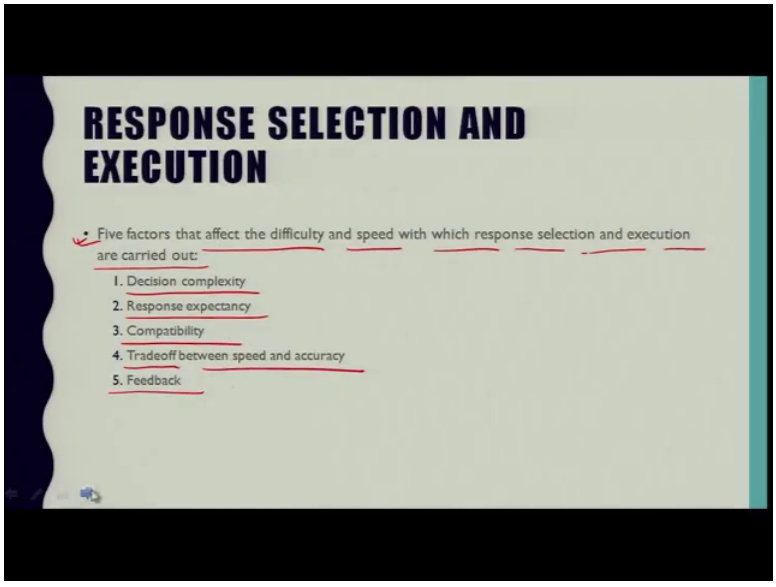

So, basically there are five factors which seem to be especially important in affecting the difficulty and speed with which response selection and execution is carried out.

So, these are the factors the first factor is decision complex complexity, the second is response expectancy, third is compatibility, fourth is tradeoff between speed and accuracy and fifth one is feedback. So, one by one we will take these factors and understand what their role is in response selection and execution.

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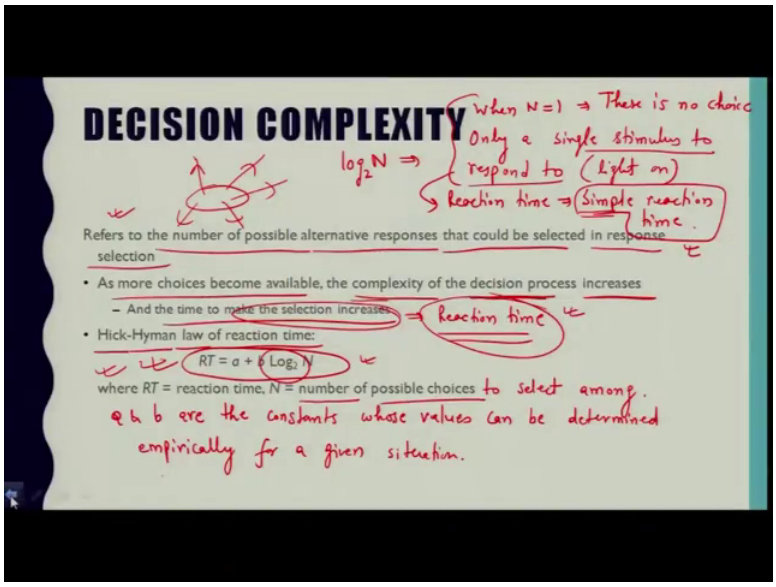

So, first of all we will discuss about this decision complexity. So, decision complexity refers to the number of possible alternative responses that could be selected in response selection.

The definition fits readily in to the context of decision making situations in which, a person must decide among several alternative courses of action like, if you are doing a particular work and you have multiple options and now you have to decide which option to choose. So, you if you will be having a number of possible choices and in that choice you have to select a particular response. So, as more choices become available to the decision maker, the complexity of the decision process increases and as the complexity of the decision process increases the time to make the selection also increases, it follows that as a decision complexity increases time to make the selection will increase; this particular time is referred to as the reaction time.

So, time to make the selection of any for a particular response is known as your reaction time. So, this particular reaction time can be modeled by a relationship known as Hick Hyman law of reaction time which is expressed as this particular equation as RT equals to a plus b log base two and so RT is the reaction time and n is the number of possible choices to select among these a and b are the constants distance, whose values can be determined empirically for a given situation. So, to establish Hick Hyman relationship the subject is shown up q to which he or she must provide a corresponding response, as the number of possible q which is the number of corresponding responses increases.

The choice reaction time also increases, but not as a linear function and state the function is logarithmic. So, log to the base 2 this particular log base 2 is used to be consistent with the binary digit system which is used in information theory. So, like when n equals to 1 meaning there is no choice, but only a single stimulus to respond to as an example, light flashing on. So, there is no choice for that so light just flashing on. So, the reaction time is known as this particular situation, when there is no choice on a single stimulus to respond to then this particular situation or reaction time is known as simple reaction time.

So, now basically this simple reaction time, is as we can see that this particular time is needed by human information processing system to self the stimulus and for the signal to pass through all the phases that we learn in the human processing model like this one. So, that how we can define that simple reaction time, we can see and we can understand with the help of this human information processing model. So, what that simple reaction time is, it means that the time needed by human information processing system to sense their stimulus and for the signal to pass through perception, working memory response selection and execution and engagement of the a factor to perform a particular.

Let us say effort or mechanical action or any as an output. So, for sample press a button with ones finger. So, here in this case the normal time is known as simple reaction time. So, this particular simple reaction time is indicated by the value of the parameter a in the Hick Hyman equation. So, typically value of a are one under one second. So, with a one second these your response is decided by the stimuli and as well as you go whatever the particular signal you get while sensing, while given signal with the help of this stimulus.

Now so, we have understood that this these equation and now the next topic is a response expectancy.

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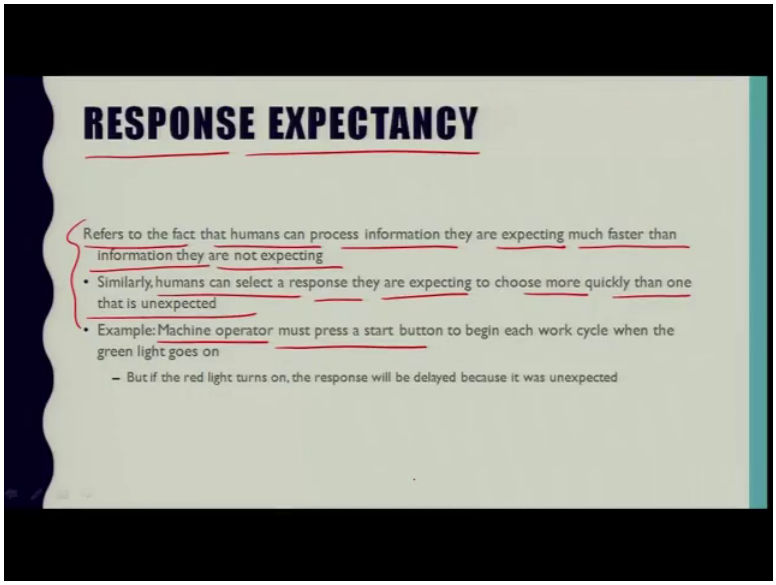

So, we have to understand this response expectancy. So, expectancy refers to the fact that humans can process information, they are expecting much faster than they can process information they are not expecting. So, a similarly humans can select a response, they are expecting to choose much more quickly and accurately then one that is unexpected.

So, as an example of in order to understand these sentences, let us take a machine operator and machine of operators required to press a start button at the beginning. Let us say every semi automatic work cycle in response to a green light on the machines control panel, the operators reaction time will be very rapid and accurate; however, if all of sudden the red light turns on instead of the green light, this can be perhaps this can be due to malfunctioning. So, or it is indicating malfunctioning. So, the operator's response selection will be more difficult because that red light at that particular time is unexpected, for that particular machine operator. So, both the time to respond and the probability of the error will be greater.

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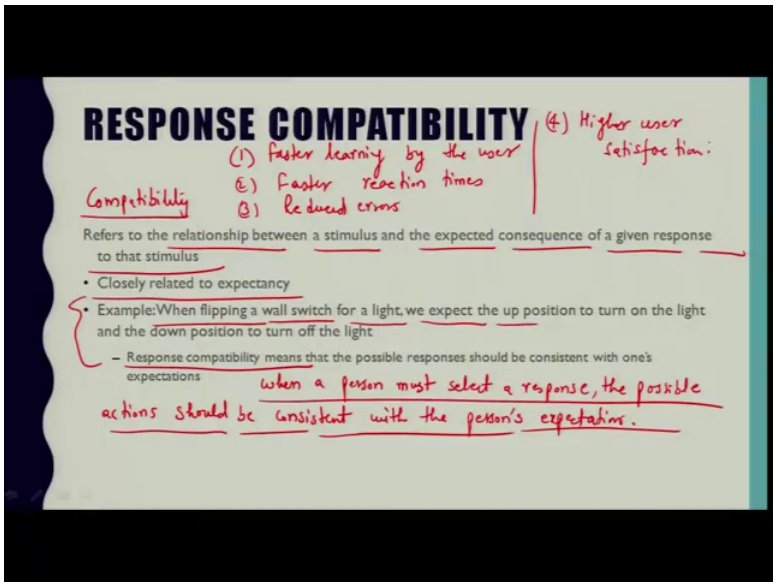

So, let us talk about compatibility. So, here we need to understand that response compatibility. So, basically this compatibility refers to the relationship between a stimulus and the expected consequences of a given response to that stimulus. So, basically in this way compatibility and expectancy are closely related. For example, when a flipping on flipping on a wall switch for a ceiling light, let us say our expectation is that flipping the switch toggle to a position and will turn the light on and the flipping it down we will turn it off.

So response compatibility in this case means that, when a person must select a response. This response compatibility means that, when a person must select a response the possible actions should be consistent with the person's expectation. So, the control designed with the good compatibility offer following benefit that I am going to illustrate you, the kind of benefit it offers when the control design with good compatibility. So, the first kind of benefit is faster learning by the user, second is faster reaction time reduced errors and as well as higher user satisfaction.

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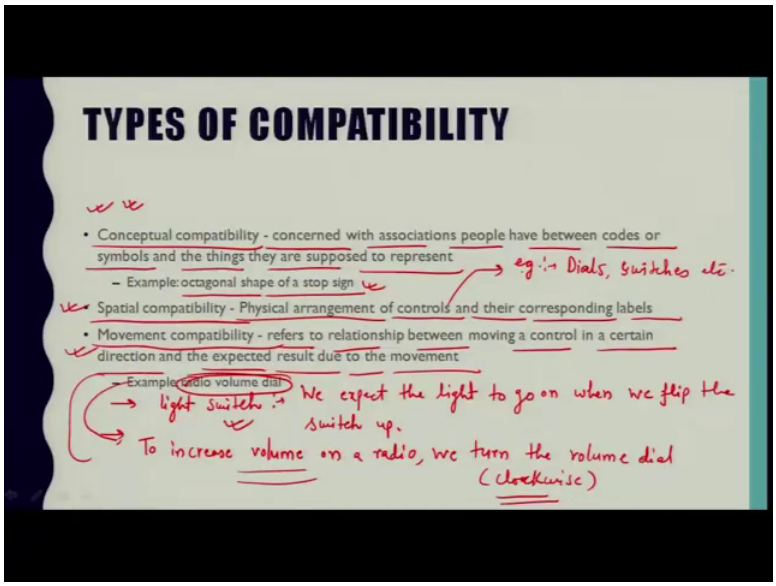

So, here there are basically 3 types of compatibility that can be distinguished, in fact all of which relevant in response selection and response execution, first is conceptual compatibility second is spatial compatibility and third is movement compatibility. So, this conceptual compatibility is concerned with the association people, have between codes or symbols and the things they are supposed to represent.

For example let us say for a given program the icons at the top of computer monitor screen, are designed to identify the operation that is performed when usually cursor is clicked on that particular icon. So, this is one of the simplest example that we can take because everybody uses computer work as a workstation and so this particular icon clicking and identifying the operation that is performed on the basis, I have just clicking the cursor. So, that can be considered as an example of conceptual compatibility.

Another example that we can take here, as an octagonal shape at sign at a road intersection, just to stop the vehicle. Now we come to the spatial compatibility, which is concerned with the physical arrangement of controls and their corresponding labels. So, this example of this spatial compatibility we can take as dials and switches etc. The third kind of movement compatibility is basically it refers to the relationship between moving a control in a certain direction and the expected results that will occur due to that moment, the light switch example illustrate the movement compatibility. So, example we

can take as a light switch, we expect the light to go when we flip the switch up. So, this is that example of movement compatibility.

In another example when we rotate a controlled dial let us say a clockwise so we expect the variable that is controlled by to increase, as an example if you take this radio volume dial. So, here this can be explained as to increase the volume of sound or a radio. So, what we need to do we have to turn the volume dial in a certain direction, like in most often radios when you rotate the knob in the clockwise direction. So, you will be able to increase the volume. So, this is these are the examples to understand the movement compatibility.

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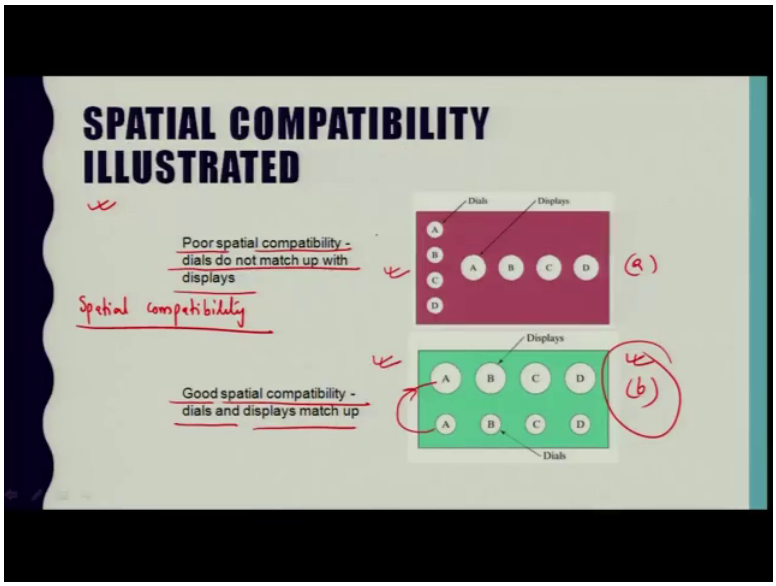

Now, this is a particular example that has been put here for a spatial compatibility illustration. So, basically here you can see that there are two alternative arrangements of displays and their controls. So, the arrangement let us see if this is figure a and this is figure b. So, here you can see that the arrangement in b these are the dials A B C D and these are the displays A B C D, here in this figure b A B C D are the dials and what the response and display is A B C and D.

So, here you are here you can visualize these two figures and you will find that the arrangement in b is more intuitive or we can say that good a spatial compatibility then the figure a. So, here the poor spatial compatibility because the dials do not match up with displays and here in the figure b dials and displays match up. So, in this case this

particular example has been taken in order to understand the spatial compatibility in a much lucid manner. So, this is example for spatial compatibility understanding.

So, here they have shown the two possible arrangements of displays and their control dials. So, here the arrangement of b is more a spatially compatible than figure a. Now the next topic is a tradeoff between speed and accuracy.

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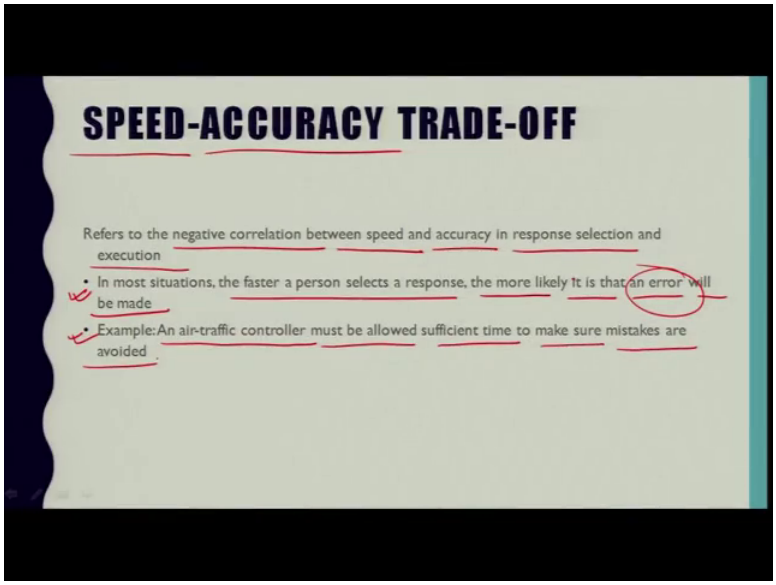

So, here the speed accuracy tradeoff refers to the fact that, in most situations of a response selection and execution faster. A person selects a response the more likely it is that an error will be made. So, you can easily understand with your daily life activity, when you perform a particular task in a hurry and in most of the cases their task gives you somewhat error. So, that is the kind of example that has been taken to understand the speed and accuracy, like a speed of performing the task and a accuracy in terms of results.

So, there is a negative correlation between speed and accuracy in response selection and execution. So, in between the speed and accuracy a proper balance should be achieved, between these 2 performance measures for the given response situations. So, if a very high accuracy is required in a particular application. So, then enough time must be given to the person or it should be allowed the person should be allowed to select the correct response.

As an example if you can take the air traffic controller case. So, in that a air traffic controller, he must be allowed sufficient time to make sure that mistakes are avoided and then there is a one specific example here that I have put, but you can take any example in your based on your daily life activities and there you can check your response selection and corresponding execution.

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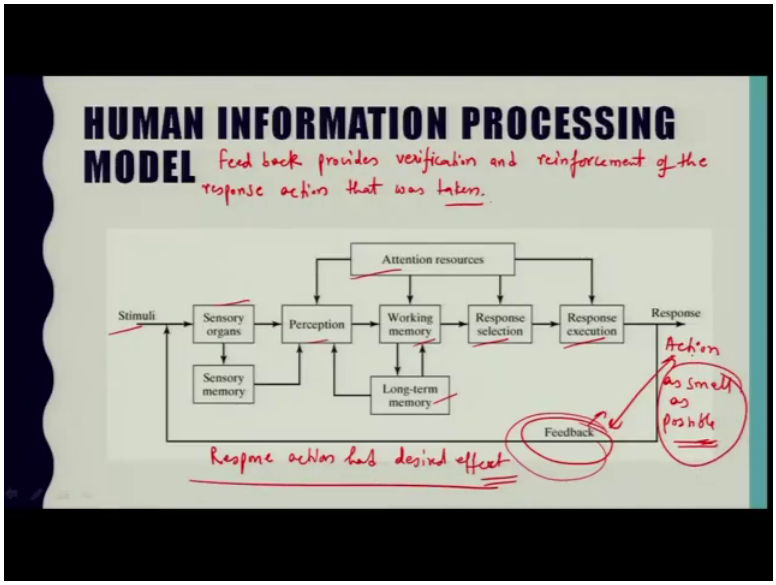

Now the next topic is feedback, so again I am putting this figure for you to understand familiar about the last word of this particular model because we have understood the stimuli sensory organ, perception attention resources working memory response selection and execution long term memory and now the thing that is left is only feedback. So, this particular feedback loop, allows a person to see or hear or feel the effect of his or her action.

So, feedback is important in response selection and execution because, it provides this feedback provides basically a verification we can say and reinforcement of the response action. So, the time delay between the response action and the feedback should be as small as possible, otherwise the individual cannot directly confirm the response actions and in fact that, individual cannot directly confirm that the response action have the desired effect.

So, in order to have the desired effect, so there should not be any time delay between response action and feedback.

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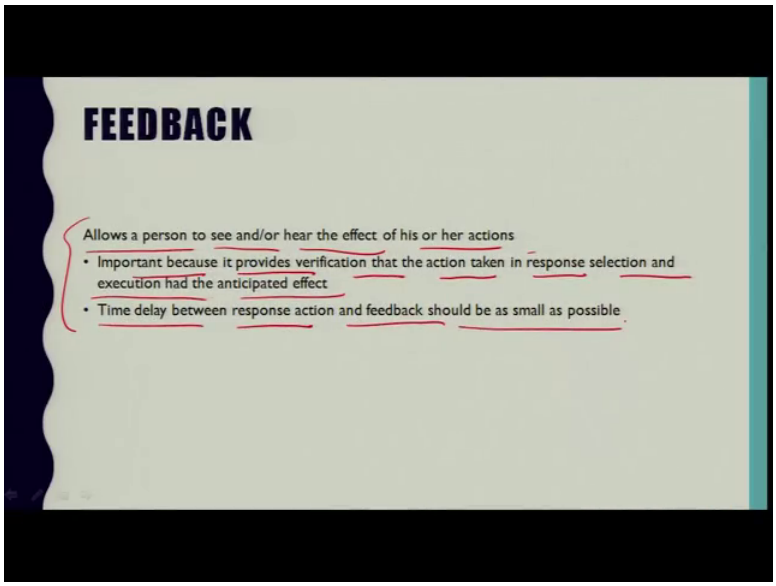

So, as a summary of this feedback topic, so it allows a person to see or hear the effect of his or her actions, it is import important because it provides verification that the actions taken in response selection and execution have the anticipated effect and time delay between response action and feedback should be as small as possible.

So, now going to close this lecture before that, it just a fact that psychology says the people who are lying to you tend to look up and to the left try to understand this fact.

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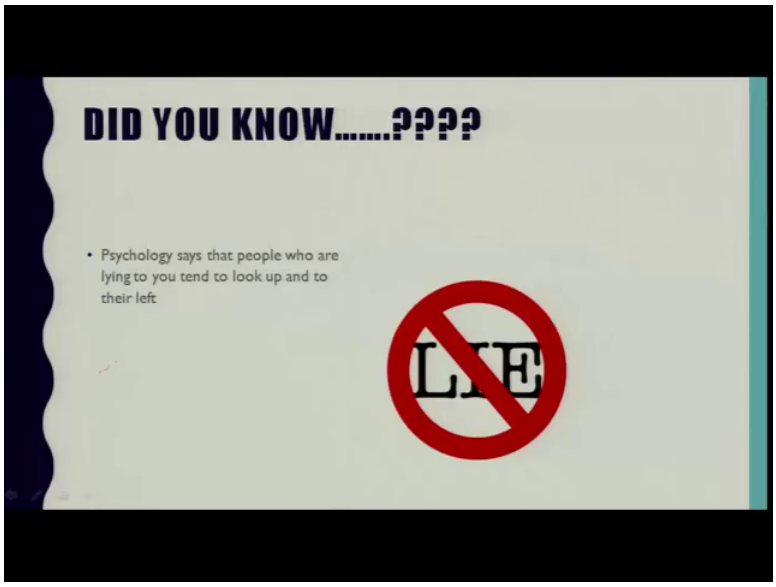

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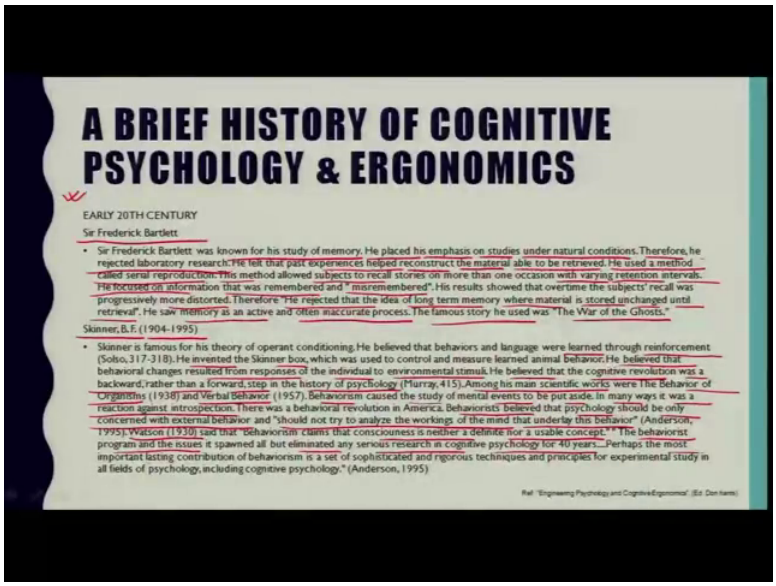

And as for the previous let us have a brief history of a cognitive psychology and ergonomics that we are parallel covering from past some of the lectures, when we have initiated this cognitive ergonomics. So, just to recall the contribution of a several researchers in the earlier early 20 century, sir Frederick Bartlett was known for his study of memory he placed his emphasis on a studies under natural conditions. Therefore, he rejected laboratory research; he felt that the past experiences helped reconstruct the material able to retrieve.

He used the method called serial reproduction, this method allowed subjects to recall a stories on more than one occasion, with varying retention intervals. He focused on information that was remembered and miss remember his results, showed that overtime the subjects recall was progressively more is distorted. Therefore, he rejected that the idea of long term memory, where material is stored unchanged until retrieval he saw memory as an active and often in accurate process the famous story he used was the war of ghost.

And the scientist I would like to summarize his work also, that is a skinner BF. Who is the tenure was from 1904 to 1905. So, he is famous for his theory of operant conditioning he believed that the behavior and language would learn through reinforcement, he invent the skinner box which was used to control and measure learned

animal behavior he believed, that behavioral changes resulted from responses of the individual to environmental stimuli.

He believe that, the cognitive revolution was a backward rather than forward step in history of psychology, among his main scientific works were the behavior of organisms and verbal behavior in 1957. In fact, behaviors caused the study of mental events to be put aside, in many ways it was a reaction against introspection. So, there was a behavior of revaluation in America behaviorist, believe that the psychology should be only concern with external behavior and should not try to analyze the workings of the mind that underlay this behavior.

Watson in 1930 said that behaviorism claims that consciousness is neither a definite nor a usable concept, behaviorist program and the issues it issues it is spanned on, but eliminated and its serious research in cognitive psychology for 40 years.

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Perhaps the most important lasting contribution of behaviorism is a set of sophisticated and rigorous technique and principles for experimental study in all fields of psychology, including cognitive psychology. So, that is all for history of a cognitive psychology, there is a graffiti for you just read it and enjoy this course that is all for now.

Thank you.