**Cognition and its Computation**
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**Lecture - 26**
**Types of Attention, Theories Broadbent Triessman**

Hello and welcome to the 6th week of the course Cognition and Its Computation. In this week we are going to talk about the Types of Attention. We are going to discuss about the couple of Theories.

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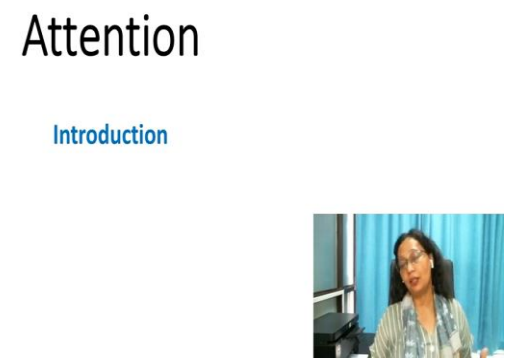


We are going to talk about the alerting orientation and executive network of attention. Then we will move into the disorders of attention and then again to perception. So, for perception we are going to discuss about object, depth and distance and movement perception and finally, we will end the 6th week with constancy a perceptual constancy and with a short discussion on illusion.

So, what is attention? So, when we talk about attention its a common thing its a common term that we often use in our daily literature daily terms,

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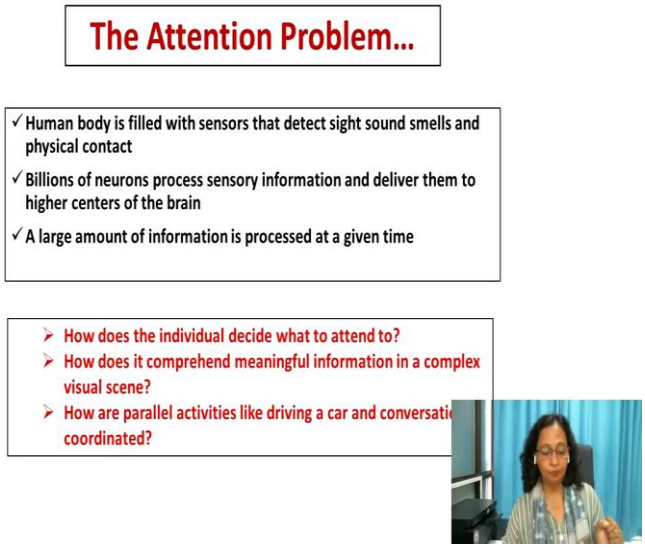


But when we cannot try to explain it what exactly do we mean. So, attention primarily is a an important factor for all the cognitive processes. So, if we discuss about attention. If we talk about how an individual attends to then this problem is has been approached by philosophers, by psychologists, by computational scientists and mathematicians and so on.

So, what we know that the environment around us is filled with multiple number of stimuli. And our human body is filled with sensors, that detect these stimuli. So, like for a visual stimuli, auditory stimuli, textual stimuli and so on. And there are billions of neurons that are trying to process this information for us to comprehend our environment. Then and we also know that is this information gets processed in a temporal sequence in you know in time.

But how do we decide, what to focus on to what to attend to how do we comprehend information in a complex visual, see say in a marketplace, say in the airport. If you are looking through a monitor how do we understand? And not only that, where how do we know what to focus on? And if there are if you are trying to do parallel activities how can we switch our attention from one to the other? Like driving a car like typing or for that matter right now you are trying to read the slide as well as listen to me.

So, this is a problem that has been you know a focus again a for many different kinds of theorists and scientists. So, attention seems to imply the ability to direct cognitive

resources to some event. So, what is this event? For example, right now you are listening to me talking you are focusing your cognition. Now what is that? The ability to comprehend the information imparted over different modalities. From the slide, from my words, from looking at you know me on that picture on the inset and you are trying to you may be also thinking about something likewise along with as I say a few words.

So, there are multiple number of things that you are doing. And these are important for comprehending the environment, but along with this, there are some things where you focus your attention and then switch to another event. So, you may be looking at a slide and switching to what I am saying and then on again to the inset picture and so on.

Now, attention and consciousness as you can well understand. These this is very very closely related with another phenomena, that is consciousness. And attention and consciousness are often spoken of synonymously. So, what is consciousness? Consciousness seems to be the experience of an event even after it has been selected.

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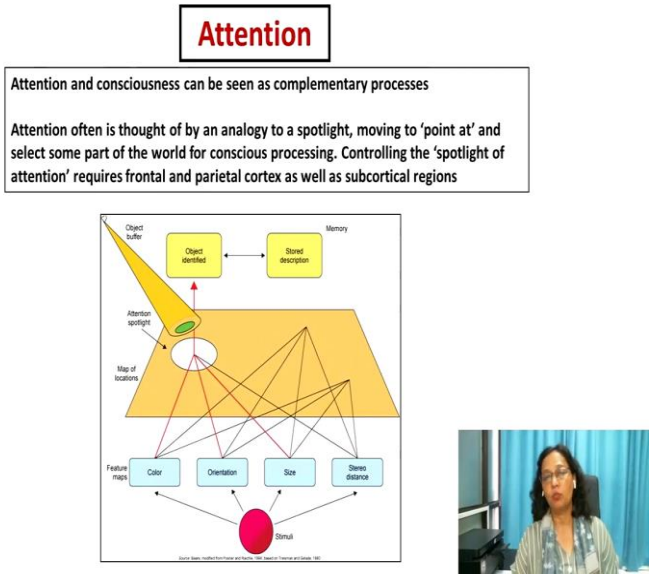


So, if it is you are aware of something ok. Now, we can often decide what to become conscious of. So, whether to continue with talk turn on a television stop thinking about a friend and so on. So, you are consciously you are being aware you are aware of what to focus your attention on.

Now, attention is so, has been historically to used to describe a diverse set of subjective psychological experiences. Initially attention was considered as a unitary event, but with time researchers realized that there are multiple events that fall within the multiple cognitive actions activities that fall within the purview of attention. So, phenomenal logically attention is subjectively experienced by all people, who are conscious, alert and capable of at least some degree of introspection. Why are we mentioning this?

So, here introspection I am not talking of from the structural schools view, but what I am trying to say is that a person who can look within to assess the information. So, that is what I am talking of when I say introspection. Now, William James who is known as the 'Father of Modern Psychology, provided one of the best phenomenological descriptions of attention in his principle of psychology.

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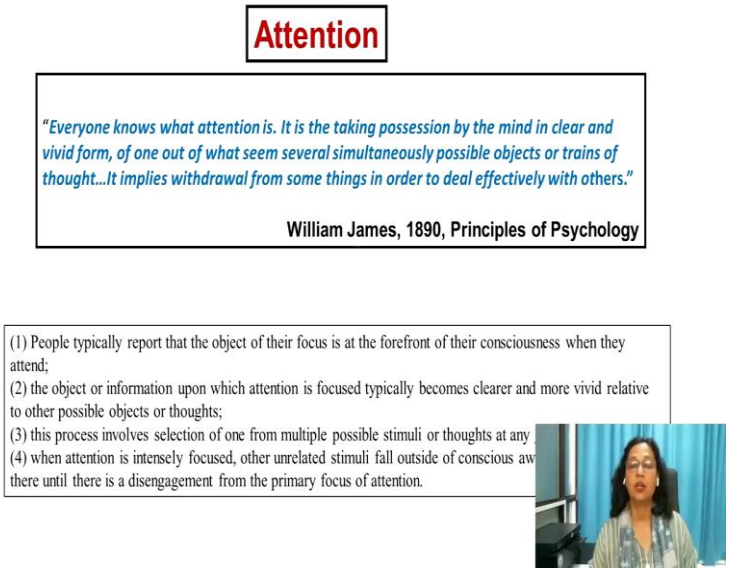


And everyone knows what does he say let us see. Everyone knows what attention is? It is the taking possession by the mind in clear and vivid form of one out of what seems several simultaneously possible objects or trains of thought. It implies withdrawal from some things in order to deal effectively with others. So, he mentioned this in his book in 1890 in Principles of Psychology.

And what James does is, he characterizes a high or a you know attention highlighting some of the essential elements of the phenomena. So, what are they? The typical people typically report that the objects of their focus is at the forefront of their consciousness

when they attend. The object or information upon which attention is focused typically becomes clearer and more vivid relative to other possible objects or thought. So, it is like a spotlight.

This process involves selection of one from multiple possible stimuli or thoughts at any given moment. And when attention is intensely focused other unrelated stimuli fall outside of conscious awareness. As I was talking about the spotlight phenomena and remain there until there is a disengagement from the primary focus of attention.

So, if we look at this picture. So, it is like there are many other things within that stage, but the individual is; so, attention is like the use the analogy of a spotlight where when the individual is focusing attention on a particular event or an object that is where the spotlight falls.

The rest of it is may come to maybe focused on or maybe may come to the attentive conscious, when that spotlight shifts and as William James puts it that they it is the attention is intensely focused, often unrelated to stimuli falling outside conscious and remain there until there is a disengagement.

So, until there is a disengagement there will be the focus will be on this particular spotlight phenomena or the event. Now, while this definition does not account for the breadth or complexity of the processes. That we now label as attention it highlights some of the most important experiential qualities of attending. That is why we have not done away with the definition though its as old as 1890 ok.

Cognitive psychologists in the recent century that is during the middle of the 20th century tended to attention or focused on attention as a single process as I was mentioning, but gradually we realize that no its not one single process, but it has many other cognitive processes involved. Now, attention directs behavior with reference to the spatial and temporal characteristics of the situation.

So, when an information quantity is reduced, the temporal spatial frame of reference from which the information was selected is focused. So, there is a focus on a particular event and other temporal spatial regions are deemphasized. Now, we are looking at this spotlight phenomena where you see that others are deemphasized ok, but this and you

know, therefore, you know this analogy or spotlight came into being as we were discussing. Now, there are different types of attention.

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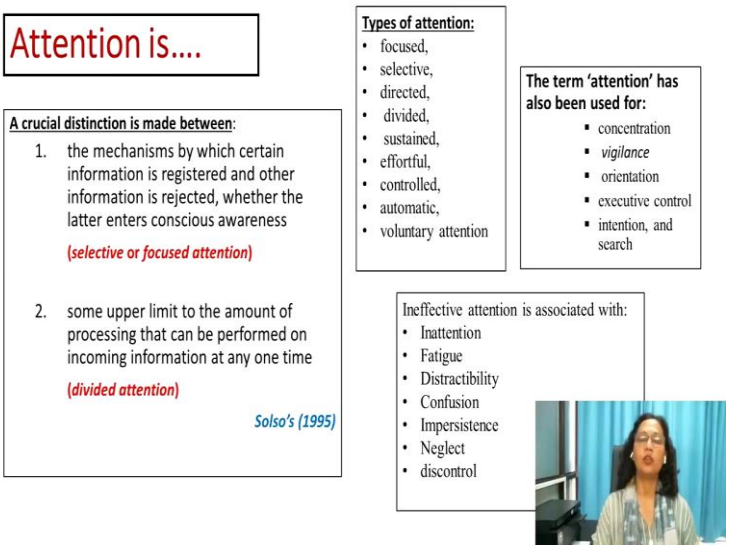


So, what are they? They include focused attention, selective attention, directed attention, divided attention, sustained attention, effortful attention, controlled attention, automatic and voluntary attention. So, we start with what is automatic and voluntary attention. Automatic attention is where by default the individuals attention is drawn. So, as you can well understand it is primarily, because of the stimulus features.

So, no matter to give you an example no matter if you how focused and how attentive to we you are at this point in time listening to this talk, it may be that your if there is a loud sound just outside on the periphery your attention will immediately be drawn to that. Now, that is not because there is a lack of interest or motivation or you know conscious awareness to this event of listening to the lecture, but it is because of the stimulus characteristics. The amplitude maybe the wavelength of the of that sound that draws your attention.

Now, this you know this phenomena is involuntary attention or automatic attention. Voluntary attention is where we consciously direct the attention to something say if you are asked to focus your attention on only the you know people who are wearing a yellow shirt or if you are watching a football match. You are following this the people,

following the team who has you know who has a particular kind of colored uniform. Now, if that is your team that is your favorite team.

Then you are trying to focus your attention consciously, voluntarily on those people wearing that particular color. So, here the color by itself is not drawing your attention or the salient features of the external stimuli are not drawing your attention, but it is your conscious interest in that phenomena. Now, coming back to other forms of attention so, the focused attention. The term focused attention refers to the amount of information selected at a given time and relative to the temporal spatial constraints of the situation.

For example, when we attempt to solve a mathematical equation we direct concentrated effort towards various solutions. So, focused attention is active, whenever demand task demands necessitate demand or necessitate engagement of cognitive resources in a particular area, in a directed manner.

So, this is generally what we follow when we are trying to do cognitive problem solving. What is selective attention? This refers to an aspect of attention that is highly related to focused attention and more often than not you will find focused attention and selective attention going hand in hand.

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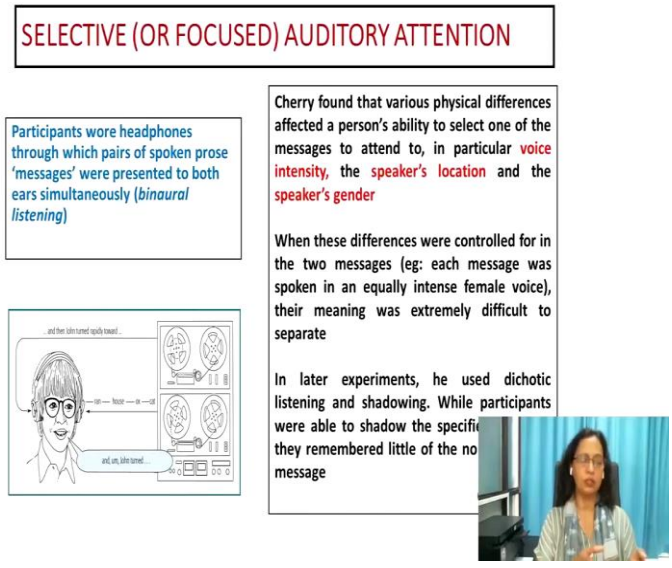


So, it is a process by which informational elements are given priority over others. So, when you are listening to a particular radio song. Say for example, we are we try and

focus on that song or when you are trying to listen to somebody talking in a party, in a group you to a specific person, you are selectively focusing your attention on that individual individuals voice. So, in simple terms you are giving priority to that particular stimulus. Divided attention in reality mostly we do multitasking ok.

So, you are driving and talking to somebody or you are I often see students cycling around while they are talking over the phone. Now, they are managing two activities together. So, what do we do in reality mostly we distribute our attentional processes to many things at a time ok. And another very common example is listening to music or listening to you know doing watching movie and doing math.

So, divided attention is difficult, because interference may create may be created when there is a competing stimuli. What does that mean say? You are a riding a bicycle and as well as talking over the phone. If you are at a crossroad you stop one of the activities, because then it becomes competing. Otherwise one is automated and the other. So, the cycling part is automated and you are talking over the phone, but the moment you know you come at a crossroad the stimuli into complexity is heightened of a riding around or manipulating the crossroad.

So, at that point you talk stop talking. So, and that competition happens in divided attention only when you know that is the time when it creates interference. So, sustained attention, attentional performance varies as a function of the temporal characteristics of the task. So, when a task requires attentional persistence for a long relatively long period of time we call that sustained attention.

So, you know high vigilance task, like you know following a radar signal, following you know scrutiny or a securities at a border. I trying to look out for the slightest change say on the sea. I saw you know in our in the India Pakistan border at the sea we have near Gujarat, I have come across soldiers who have very less amount of hours you know when they are looking out at the sea for any kind of activity.

So, a stray boat coming to the side of India and so on. So, now, the reason for this is that as this task of focused of sustained attention is very demanding. The working hours are comparatively lower. One very interesting phenomena, that is seen in such task is that mostly the low frequency events a attention to low frequency events has different

processing requirements than attention to high frequency events you know. So, the there are many factors that may affect how you are attending to a stimuli.

So, whether it is efficient or not, because you not necessarily you know what you are looking out for. And there are these factors of attention are not necessarily you know affected by motivation, fatigue and boredom. So, not subjective factors, but there are many other factors that may temporal factors that may affect sustained attention. Effortful attention. So, what is effortful attention?

So, there are some tasks, that require great effort. Such tasks are more apt to demand conscious awareness. And these tasks these effortful tasks influence the capacity to perform multiple other tasks. For example, you know if you are listening to a radio it is not too difficult, while engaging in moderate physical exercise like walking say you know or maybe doing some casual exercise, but if it is if you are trying to do extreme physical exertion then it may compete with your attentional focus.

So, the effort that you take at a task is also very important when you are trying to do when you are trying to pay attention. For example, so, if you are doing increasingly difficult physical exercise at such times people become increasingly aware of their heart beats or other signals from the body. So, your attention shifts more towards your body and you know focusing on other information outside from outside channels becomes difficult.

Now, most of the earlier work on attention are based on auditory attention and much of this research centered around dichotomous listening task. So, what is dichotomous listening task? In a typical dichotomous listening experiment participants wear a set of headphones and they hear two messages at the same time. One in each here and I ask to shadow one of the messages, what does that mean you follow or you watch you know that message.

So, most participants are able to attend to one message and tune out the other. So, its like you know if I decide to follow my right ear so, two different messages are been given to two ears. I follow what is being said on my right here I cannot I remove this out. So, Broadbent saw that you know when the rate of information transmission exceeds the channel capacity of a system. The message is not transmitted to entirety. And. so, what Broadbent did was? He had a couple of questions in mind. That how can how do people

follow messages? How do they filter unwanted messages? Is it necessary to filter unwanted messages?

And you know overall how does this shifting of or you know selection in attention takes place. So, what; so, this brought about Broadbent's theory of a field of theory of attention and this theory is one of the early selection theories, why? Because it we will discuss this a little later anyway. So, Broadbent's basic assumption was that sensory information comes through a system and until some bottleneck is reached. So, unless there is a block there is too much of information at a point it will flow in smoothly.

And when there is a bottleneck. A person chooses which message to process on. Based on some physical characteristics. Now, we are talking about the salient features of that input of that stimulus. So, the person is set to filter out the other information. So, in a dichotomous listening task that he actually used initially to work on his theory. He proposed that the message to each ear was registered by, but that at some point the participant selected one ear to listen with.

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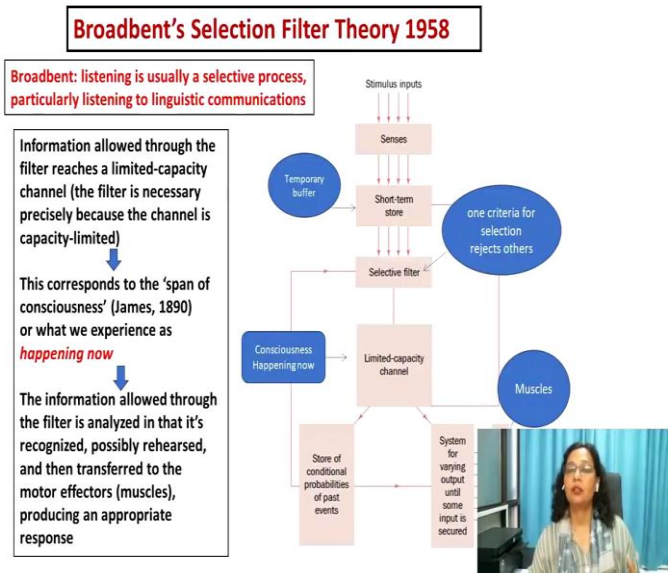


So, its like I listen to both and then I finally, decide no. This is the ear that I am going to focus on. And a crucial feature of this theory this or rather I should say this Broadbent's filter model is its proposal that we select a message to process on the basis of physical characteristics. Like the ear, which ear I shall be using on the pitch. This hypothesis made a certain amount of neuro physiological sense, why? Because the messages

entering the ear arrive through nerves. And nerves also vary in which frequencies they will be stimulated ok.

So, in some way though this theory was criticized, but in some way this theory does make sense to neuro physiological in neuro physiological terms. So, but again as I said, because of the criticism there were some criticisms to this theory. And it was soon realized that Broadbent's theory was not all true. The classical example of the; so, its not only the stimulus feature. That is you know the physical properties of the stimulus, but it was soon found that even the meaning, if there is a subjective meaning that is important to an individual that would draw attention.

For example, the classic example for this is the cocktail phenomena. So, what does the cocktail phenomena mean? Say in a party in a cocktail party. Where there is a lot of noise where there is a lot of conversation going on. You are focusing on a particular conversation with somebody, but in say in the other another corner of the room is somebody points out or calls out your name, need not be loud maybe the stimulus intensity is pretty low, but because that stimulus then your name is important to you, it will draw your attention.

So, the meaning also is important. So, other rather than the sounds, rather than the physical characteristics of the sounds the meaning is also important for you know selection process or the filter process.

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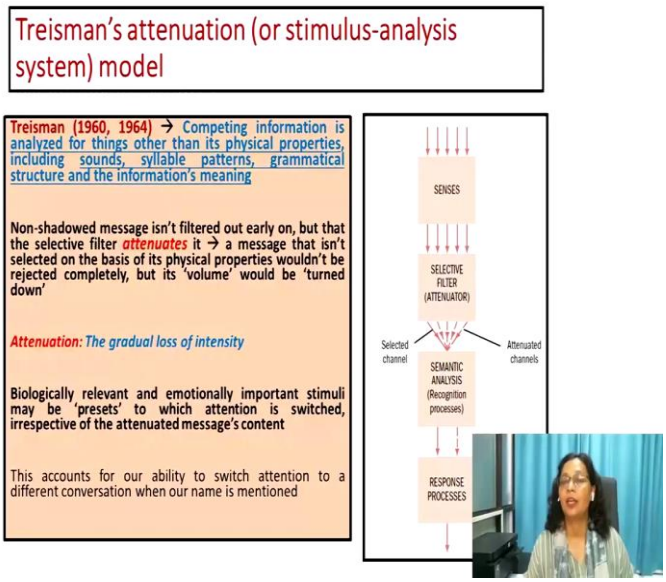

Now this brought about another theory ok, with some modifications of Broadbent's theory and this was given by Treisman in 1964 and Treisman proposed a modification. So, what did she say? Say at this theory her theory came to be known as the attenuation theory.

So, she hypothesized that certain messages would be attenuated. Sorry what does attenuated mean? It means that it can be weakened as if you know the volume knob is slowed down. So, when we focus on something for the rest of the phenomena. We are still processing that information. So, that is what Treisman emphasized on that. That information is still being processed, because if it was not processed then like Broadbent suggested. Then we would not be able to hear our name.

Because we if you just focus on certain physical characteristics of a stimulus, then the rest of it and the rest of it is not being processed and I would not hear my name in a room in a noisy room, but Treisman says that its more than that. So, the they are all processed, but the volume is tempered down. So, that is why you know attenuated. So, it is, but its not filtered out completely. So, in a task the unattended ear in a dichotomous task. The unattended ear is you know for processing information, but and its not eliminating information.

But the semantic selection criteria could apply to the messages. So, if there is a meaningful message, then the ear would switch and you would hear that part. You would pay attention to something on the you know other side ok. And she emphasized that in that she found in her experiment most participants actually continued to shadow the prescribed ear. And it was easy to follow the message that is not being attenuated than to apply semantic criteria.

Now, the late selection. So, these theories Broadbent's theory and Treisman theory are known as the early selection theories. The late selection theory is another alternative phenomena to paying attention and this was offered by Deutsch and Deutsch in 1963 and this proposed that all the information is processed completely without attenuation. Then how do we filter how do we focus on if there is. So, much of stimuli that is being processed how do we understand any meaning there would be too much of noise.

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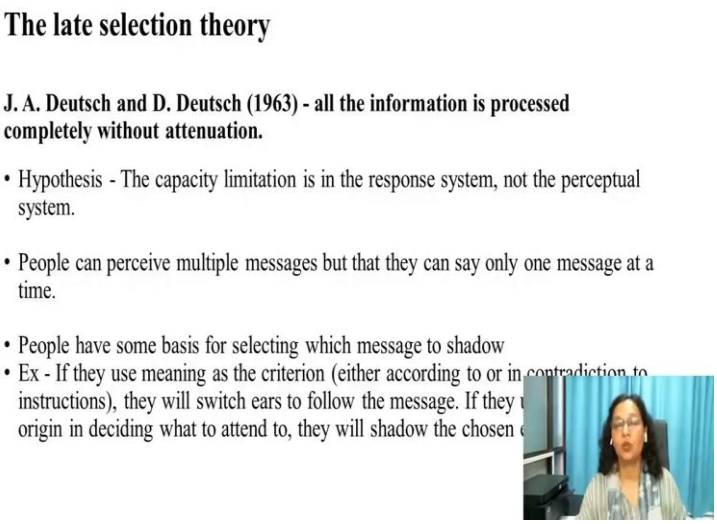


So, Deutsch and Deutsch hypothesized that the capacity limitation is in the response system and need not in the perceptual system. They claim that people can perceive multiple messages, but they can say only one message at a time. So, the processing takes place later or rather I should say the selection process takes place later. That is why this is known as a late selection theory.

So, I process all the information, which one I am going to respond to is selected later consciously. So, that is why you know I respond to my name being called out. I respond to anybody on the word saying something related to psychology. So, even if they say psychotherapy. Psi is something that will draw my attention anytime. So, and you know what my students have actually checked that out. You know experimentally with me ok.

So, now people need some basis for selecting, which message to shadow. So, even in the Dichotomous task this was seen. If they use meaning as the criteria then they will switch ears to follow a message. So, they will pick up the common words. If they choose the direction as a criteria or the ear as a criteria they will shadow a ear. Irrespective of what is being said. So, this is basically the selection process of what to follow and what to respond to comes later. That is what Deutsch and Deutsch suggested.

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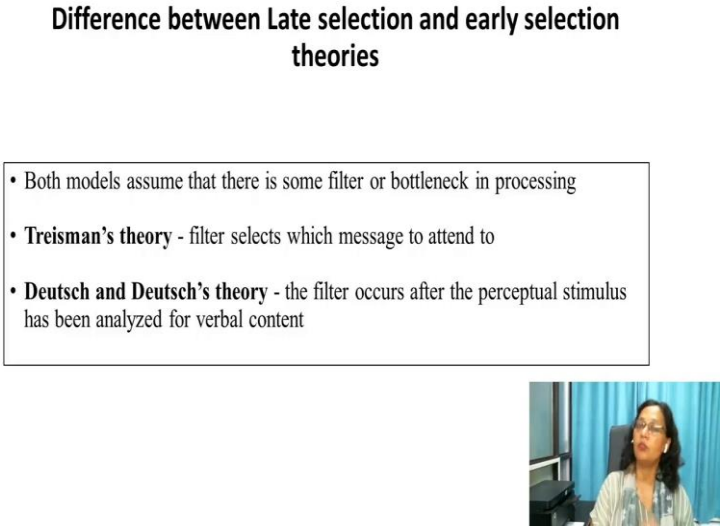


Now, the difference between the late selection and early selection theories both models assume that there is some filter or bottleneck in processing. And Treisman theory that the improvement on Broadbent's assumes that the filter selects which message to attend to whereas, Deutsch and Deutsch theory assumes that the filter occurs after the perceptual stimulus has been analyzed for verbal content.

So, they emphasize Deutsch and Deutsch primarily emphasize more on the semantic processing, than on the physical attributes. There are many more theories of attention, but I will not be discussing them. We will share some handouts and you can look at most of the theories for yourself. So, that is how we shall end our lecture here ok.

Thank you.