Indian Institute of Technology Kanpur

National Programme on Technology Enhanced Learning (NPTEL)

Course Title
Basic Cognitive Processes

Lecture - 08
Modularity and Cognitive Neuropsychology

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Welcome to the course, basic cognitive processes.

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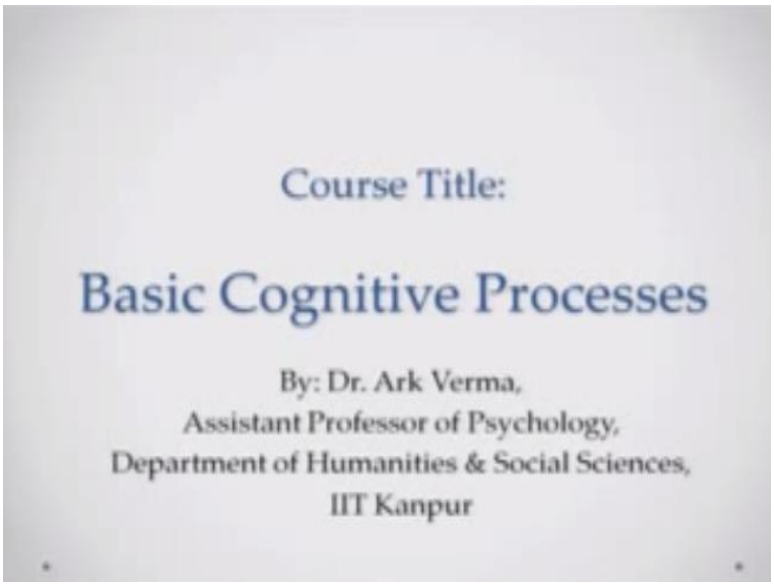

I am doctor Ark Verma from IT Kanpur.

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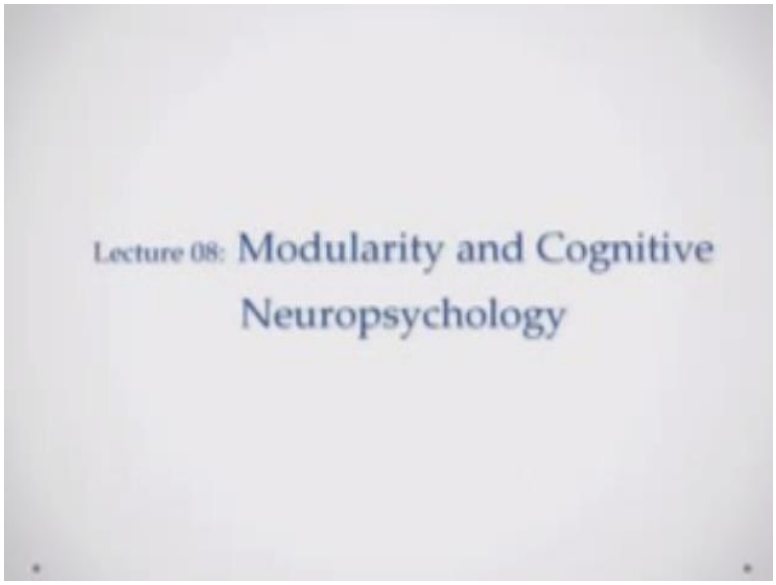

The title of today lecture is modularity and cognitive neuropsychology. In today's lecture we will talk about the approaches towards modularity, the concept of what modularity is, and we will also talk about how the field of cognitive neuropsychology helps us understand relationship between the mind and the brain. Again just to take a brief stock of what we have been doing till now we know what the definition of cognitive psychology is.

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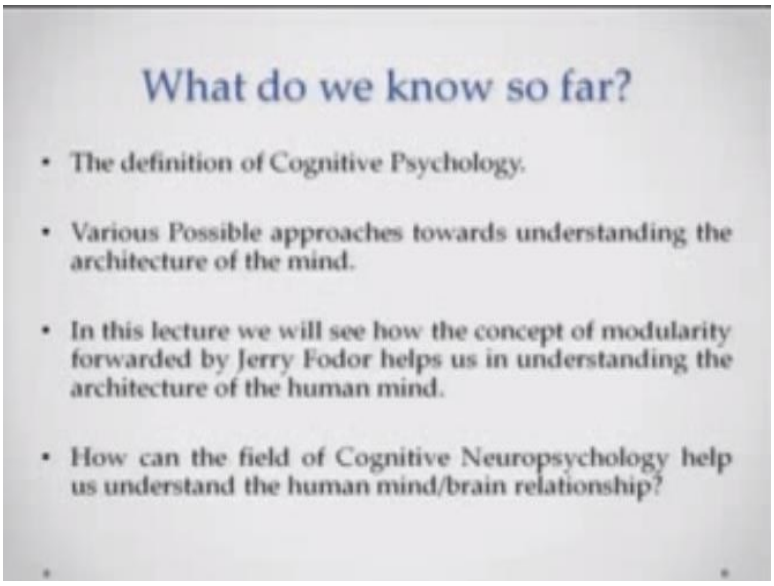

The fact that it is scientific study of the mind and mental processes. We also have in the last lecture about the various approaches that have been taken to understand the relationship between the mind and the brain. But in this lecture basically we will talk about the this issue of concept of modularity, which was given by Jerry Fodor and we will try and see how this helps us in understanding the architecture of the human mind.

We will also talk about how this field of cognitive neuropsychology, which is basically a field at a time to understand the damage brain or which basically attempts to how different cognitive disorder, gives us a peak into the workings of the human brain. Now one of the central concepts that I will be talking about in the today's lecture is the concept of modular design.

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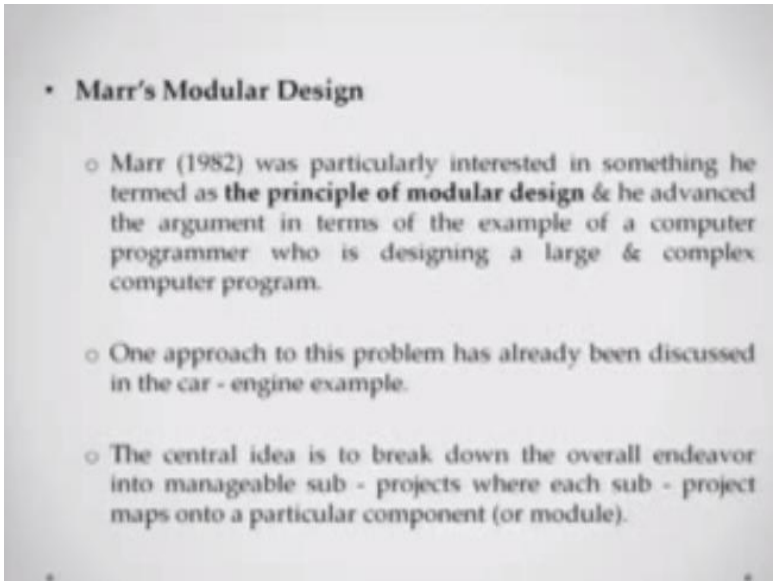

Now David Marr in 1982 actually put forward this concept as this principle of modular design and he advanced this argument, term of the example of the computer program, and talked about how particular programmer who is basically given the task of designing a large and complex computer programs will go about this task. Let us say that there is somebody whom we have asked to write a large program.

Let us say the program has to do the task of let say simple task of letting us understand what are the different objects what are the shapes in the visual environment, in that particular program, would basically have to have sub components okay. As any typical program, let us say for example there is a program of library you have to really write a program, that basically functions as a library, it should allow you to, you know issue books, it should allow you to register books that are return in and those kinds of things.

Any such programs if you one the program to do some mental activity like looking and seeing shapes, or typical computer program whom you want to really just use as a library program, will both need to have sub components. We have talked about this in the example in one of the

previous lecture, today we will also try and see how that example can be applied an understanding of this human mind and brain interaction.

Now the simple idea in this principle of modular design that David Marr gave, was the idea that we need to break down this overall lash program that should be broken down into smaller components each of which do a particular task and each of which are connected to each other in possible ways that help this takes to get completed, ok these are the things you really to do here. Now let us try to apply this to the human mind how the human mind, how does this model apply to the human mind.

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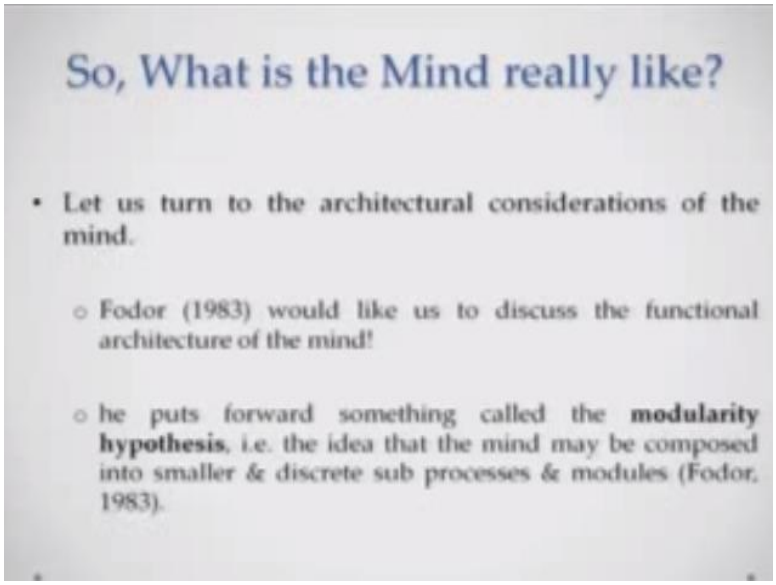

Jerry Fodor basically tells this you know approach to this course the goal of understanding the human mind okay. So Jerry Fodor basically takes this to how to understand the functional architecture of the human mind. He puts forward something called the modularity hypothesis, you know the idea the minds may be decompose into smaller and discrete sub processes and modules.

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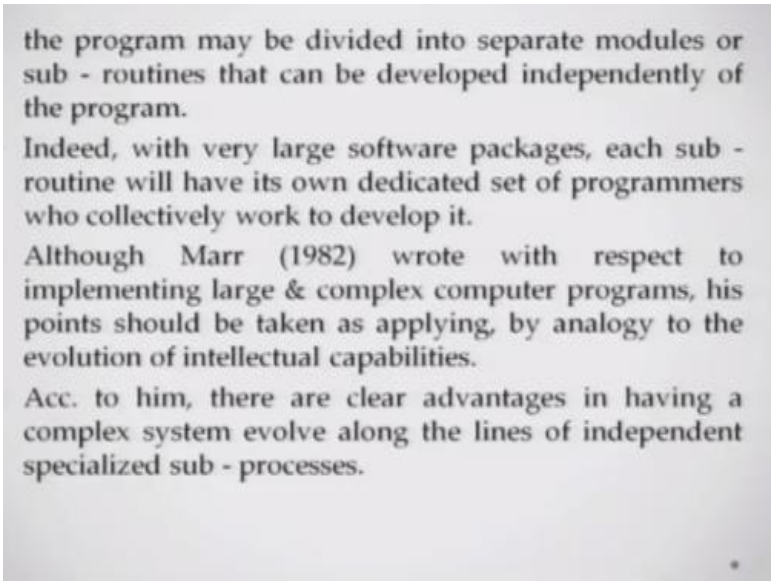

Now again coming back to this example of the program, this program basically divided into this separate modules or sub routines that can be developed independently of the program, to those of whom who may be from earlier with how writing a programs and texting a programs might know it there is a big programmer or a big coder 5000 line code or 10000 line code you have to write, there are people who actually undertake the writing of this sub modules. And then what is done is basically on this sub modules or integrated in a single program.

As if this was just one program which you know complete this task, which is as of this program, to complete okay. So say for example, very large software package like Microsoft office, or say for example windows and those of things each of this sub routine you have dedicated programmer who collectively work in just develop, just work on one particular sub routine. Now Marr basically wrote this with respect to large and complex computer programs.

He can actually be applied to how we think of the functional architecture of the mind as well say for example, if mind is can be thought of this simple program that helps this process all this information that we get this entire environment around here, and all of this possible output that we generate. Then we can actually think of you know many sub modules, for example if you

walking in a park you are actually undergoing a variety of experiences you are smiling lot of you know odors of the different flower, and would want to you know recognize them, you would navigate the path, and you would want to walk without bumping into anybody.

You might also want to think and decide, so the point and similarities three different module to be doing these things, you would need a module that process order and helps you to recognize the object to which order belongs to. You also say for the example, want to have a proper navigational component which is help you walk in this park without bumping into others, and you would to have a particular decision making kind of the module that helps you will decide an eliminate and whatever happen during a day.

And say for example whether the is good or bad you know, these different kinds of things, so you can take this example in this principle of this modularity in that David Marr forwarded and applied to how the mind really works you know to understand and functional architecture of the human mind might be. Now according to Marr, actually you know very clear advantage to having this modular design okay, in having a complex system, you divided into this sub process. Let us take about what these advantages could be.

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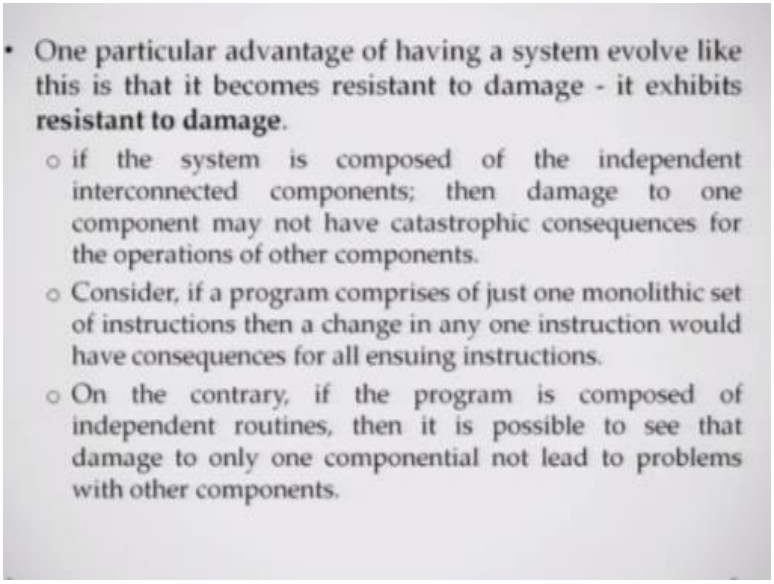

Now one of the particular advantages of having the system like this, or having this large system, booking down into sub components or modules of the David Marr has it, has the very important advantage that this makes the system resistant to damage. Now for example, if there is a one large computer program, and you would want to make a change to one of the lines of this 10000 line program.

The point it is very possible that if it is just indeed in one single program, that changing one line let say line number 2501 will actually change something from entire program. So if you want to really avoid that kind of a scenario, for that what damage too, is they actually have used different modules. So if you have to change something in a module it has consequence for that module itself okay.

And in that sense you have a system which will not break down, let say that one module is not functioning, everything in this function pretty much in this same way okay. So ay for example, you know this is something you know actually which can be explain that our program, if it is divided into subcomponents makes this resistance to damage, any kind of damage for that matter okay.

On the contrary also say for example if this program is compose of this independent routine it is also possible to see that damage to one of this component does not create for the problem for all the components or entire output of this entire program.

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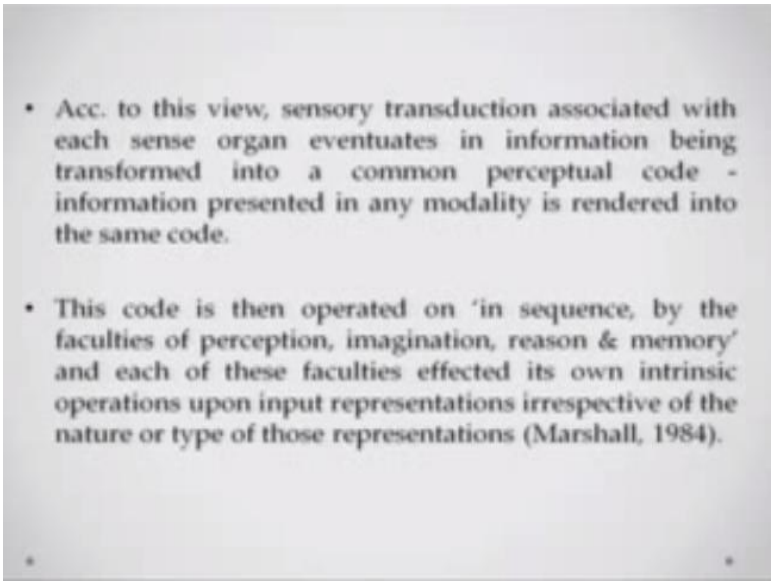

Now applying this view to the human mind or applying this architecture of human mind what can be said is that this sensory transduction processes you know human senses the eyes, nose, ears, basically each of these sense organs what it does it whatever the information that receives that is converted into some kind of information, that is usable by the senses, by the process which is called sensory transduction, it eventuates a information being transformed into a common perception quotes.

Say for example, that there is some information coming from the eyes, there is something you are hearing and something you say that you are touching okay. These three sensible inputs will all be converted into a particular perceptional code which will be the common code on which all of these other processor will work. So all of this different sense organs will actually convert this information into something of a common perceptional code and this basically is actually worked on by the higher cognitive processor like decision making, memory etc, okay.

This code then, as how does this really get evaluated by these higher cognitive process, Marr says that this code is then operated on in sequence by the faculties of perception, imagination, reasoning, memory, etc. And each of these faculties, they basically affect their own intrinsic

operations upon these set of input representation okay. So what this, what was the different source of information, the eyes, the ears, you know the noise, the skin, all of them give you the different kind of information, you convert it into the common perceptional code.

And let this common perceptional code, is worked on by this higher cognitive abilities, like memory like languages, if you want to talk about it, like say for example if you want to decide something about it okay. And each of this processors work on their own special way okay. And in some sense irrespective of each other say for example, that was the idea that David Marr was that limnastic code for or limnastic operation for the particular kind of information will happen independently of the perception you know processing will happen, or independent memory operation that will happen.

Now in that sense it kind of can be a good thing or a bad thing we will discuss this in more detail as we move ahead.

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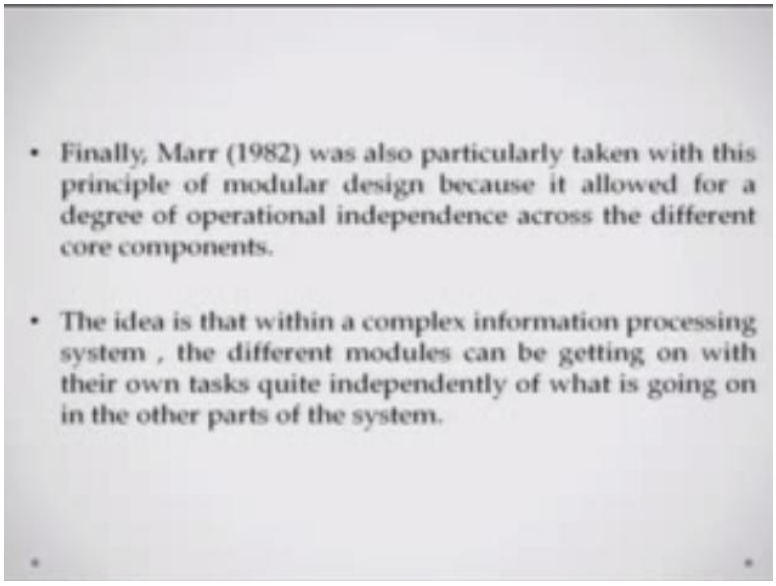

Finally in this way David Marr actually you know particularly taken with this principle of modular design, because it allowed for a degree of operational independence, memory does not need to depends on the perception, reasoning does not depending on the memory, you know it could just operate logically it does not need to take information from the memory. And the point is wearied the bit of the disagreement with the modular design with already starts scrimping in okay.

Now the whole idea is that this is also something say for example if you want rather efficient system can be useful. It might be a good thing let us say, let us assume that memory does not depends on perception, or reasoning does not depend on your memory, you know those king of things that David Marr was talking about. The idea was that in this very complex information processing system that is the mind, these different module can be getting on your own task, quiet independently your feature that, and quite independently of what is happening in the other parts of the brain okay.

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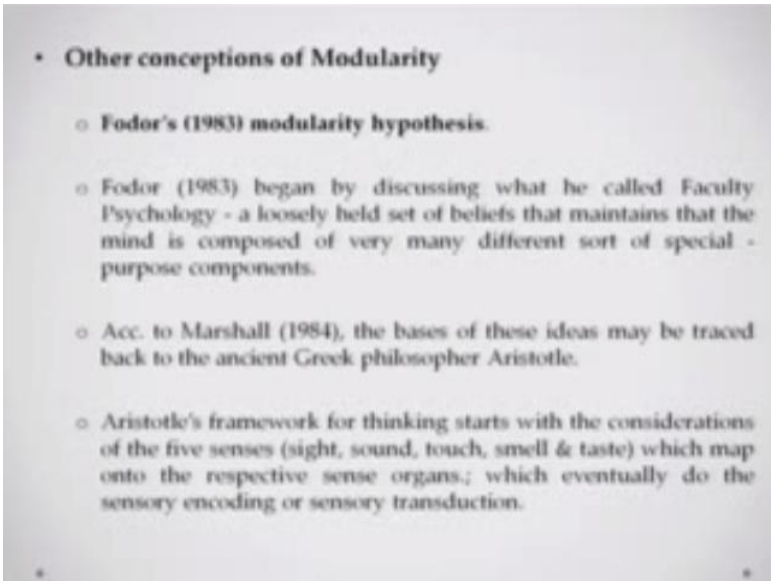

So this is what David Marr meant when you are talking about this modular design. Now it already starts feeling a little bit counter intuitive, but be with me as we go through this whole concepts of why modularity was propose, and as we go ahead in latter, lecture of this course we will evaluate whether we can apply this principle of modularity, to the way actually cognitive processing takes place, because this was something which was given way back in 1982.

We know a lot more about, how cognitive processing or how the mental functions you know, operate now. And in actually you know in that sense evaluate whether this was you know correct way of assuming how the mental architecture would be okay. So for now we will just discuss what basically David Marr have proposed. Now two much with Marr for now let us move to in other way in which modularity has been thought off.

So one of the other very popular formulation of modularity is given by, Jerry Fodor, and Jerry Fodor basically 1983 forwarded which is something know as the modularity hypothesis. Jerry Fodor basically began by discussing, what we called was the faculty of psychology okay, what is the faculty of psychology? Faculty of psychology is basically is this loosely held set of believes that maintains the mind is composed of many, many different sort of special purpose components.

You know if remember one of the earlier classes I have been talking about what are the different mental functions that, the mind undertakes each of these under mental functions can actually if you want theoretically be these different modules. So imagination could be a module, in that visual imagination could be a module, auditory, or otherwise imagination could be a module, or say for a example understanding could be a module, your ability of reasoning could be a module.

So these kind of things Jerry Fodor actually began discussing. Marshal basically 1984 says that the basis of this idea Fodor was putting forward in 1983, basically could be traced back, to the ancient Greek times you know of the Greek philosopher Aristotle. Just a quick flash back what Aristotle was saying. So Aristotle framework for thinking starts with the considerations of the five senses, we say that the five sense that we have sight, sound, touch, smell, and taste.

And each of these five senses map on to this respective sense organs okay. So for this we have eye, we have ear, we have the skin, we have the nose, and we have the tongue for each of these different senses respectively. Eventually these are the senses which, the sensory encoding of whatever information is coming in, and in sensory transduction which is basically converting of the sensory information to the form that can be processed by the brain.

Jerry Fodor drawing from what Aristotle had talked about, proposed two kinds of faculties, two kinds of abilities that the human mind or the human brain you might say will have. The first kind of faculties is proposed by Jerry Fodor where the horizontal faculty okay.

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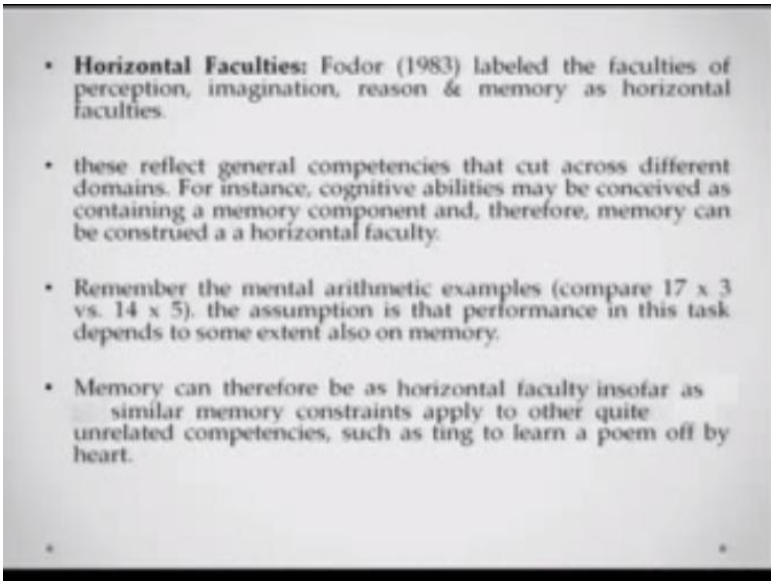

He labeled with faculties of perception, imagination, reasoning & memory as horizontal faculties. Now what is horizontal faculty let us elaborate. Horizontal faculties basically reflect general competencies okay, whatever the brain generally does on all different, all kinds of information okay. So for example, whatever processing really cuts across different domains, he is talking about colored and those kinds of things.

What all the brain does on every information that comes in, those kind of faculties could come up under this horizontal faculties category. Say for instance cognitive abilities may be conceived as containing a memory component, all cognitive abilities that is, and therefore, memory can be constituted as a horizontal faculty. Even if I am talking about, talking to you about language, if I am talking to you about reasoning, if I am talking to you about imagery, all of these will necessary have a component memory.

Say for example, if I ask you to describe the world in 20 sentences, you will definitely use your memory to talk about it. So language has a memory connection, if I talk to you about let us say deciding something, you will actually say for example the mental arithmetic example that we took in the earlier classes, comparing 17*3 and 14*5, you will do some computation and from the memory hold these results, and then compare.

So that also has a component of memory okay. So this is the way in which these different faculties was suppose to imply, supposed to be involved in whatever the brain is doing, and in that sense at a generic level. And these generic abilities were clubbed under this category called horizontal faculties okay. So memory in that sense can be constituted as a horizontal faculty in so far as memory constraints are like to other, and with unrelated competencies.

Such as say for example trying to learn a poem by heart, you will need to read the first line, second line, third line hold it, and then read the fourth and fifth line hold it, and then try and reside it back, so anyways does have memory component involved here.

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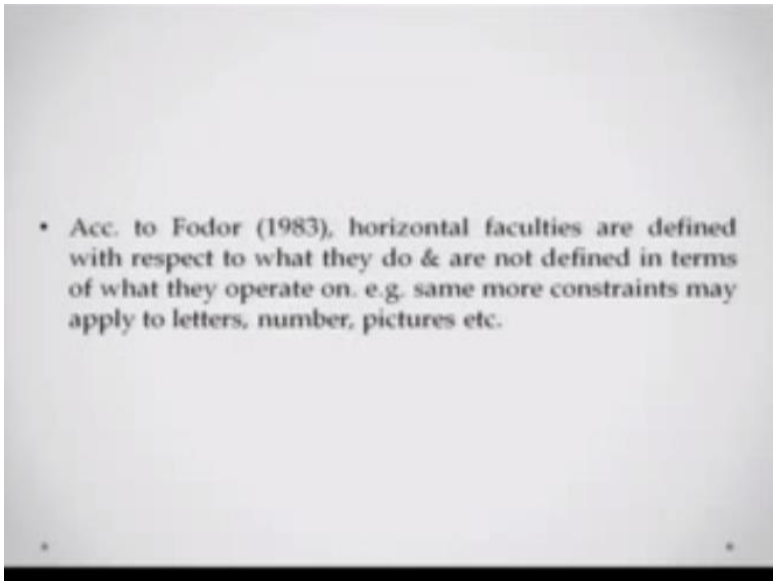

According to Jerry Fodor horizontal faculties then can be defined with respect to what they do and not defined in terms of what they operate on okay, these are general processer these are not concerned with say for example, what they are processing. Similar to if they remember you know we are talking about information processing in the last lecture, we are talking about how Shannon and Weaver visualize the information processing system, they were not really concerned with what is this information processing system transmitting and receiving.

They are concerned with what could be the parameters, what are the components of the information processing system. Similarly Jerry Fodor said that horizontal faculties basically are defined with respect to they are doing and are not what the respect to what they are operating on okay. So this is the one of the ways, in which we think of horizontal faculties.

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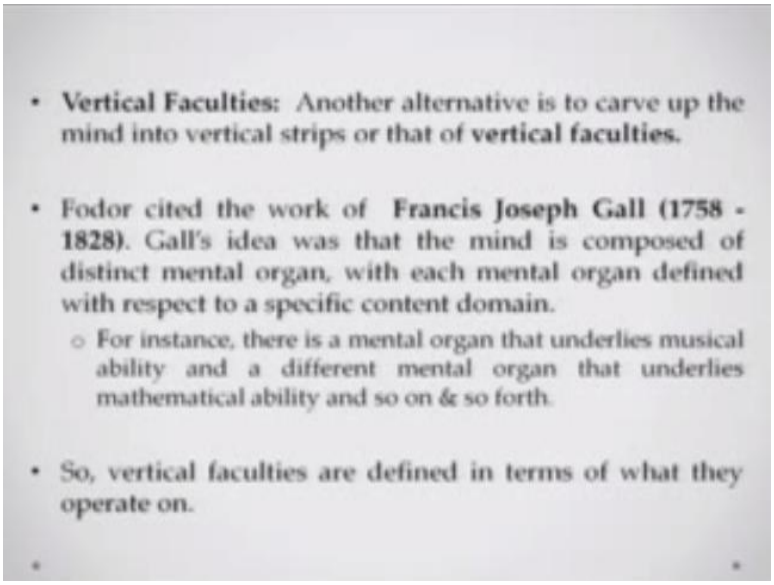

Another kind of faculties Jerry Fodor actually defined, or put forward was that of vertical faculties, what are vertical faculties. Vertical faculty is basically are the different kinds of information that are coming, that really later operated upon by the horizontal faculties. Now inspection for this where Jerry Fodor probably came from the month of French musician France Joseph Gall, and Gall had a very interesting conceptualization of the human mind.

Gall's idea was that the mind is composed of a distinct mental organ, and each mental organ was defined with respect to a specific content domain okay. I will elaborate on this in just a moment, So for instance, there could be a mental organ that underlies musical ability okay, and a different mental organ that underlies mathematically ability, and the different mental organ let us say that underlies sports ability okay. So Joseph Gall was actually and France Gall was actually thinking at that point of time, that each ability is associated with a specific organ in the brain.

And that is how we conceptualize or actually divided the whole brain into a separate portions which, let us just talk about that in some sense. Gall actually takes this arguments slightly further and proposed that each of these different mental faculties or mental organs could be identified within a unique vision of the brain okay. And he firmly believed in this, what he did was he

basically divided the brain into these particular bumps, he said there are these different bumps in the brain, structural points in the brain which could be interpreted as being associated with particular mental abilities okay.

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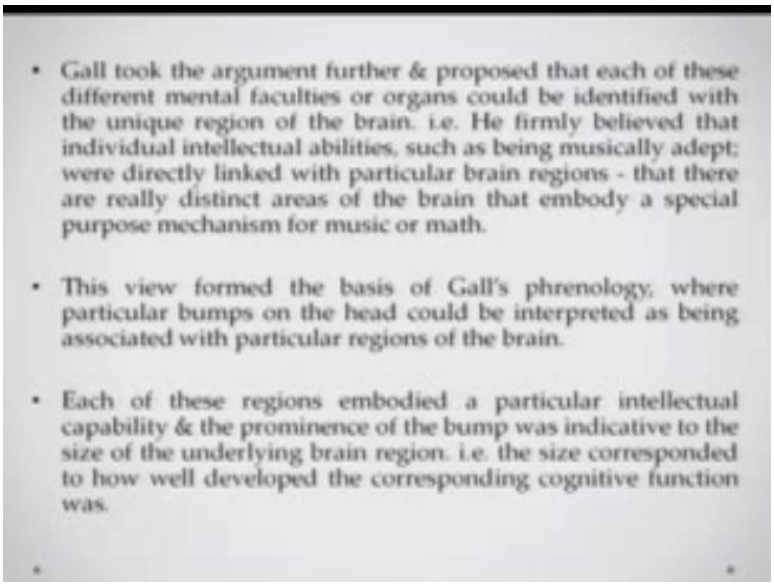

Each of these regions would embody a particular intellectual capability and the prominence of the bump, how prominent it is and how does it appear, basically would indicate that the size of the underlying brain regions. Say for example, there is a very important mental function, let us say the ability to do good math, you know maybe the underlying region or the bump associated the ability of doing math should be slightly larger as sometimes if you think that music is a simpler ability. So the region of the brain denoted to the musical ability will be slightly smaller okay.

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There is in that sense, here in this you can see that your, this is what the conception of France Gall was, that these are these different regions, and each of these different regions of the brain are doing something or the other okay. This is what France Gall said a way back in the 1700s and 1800s okay.

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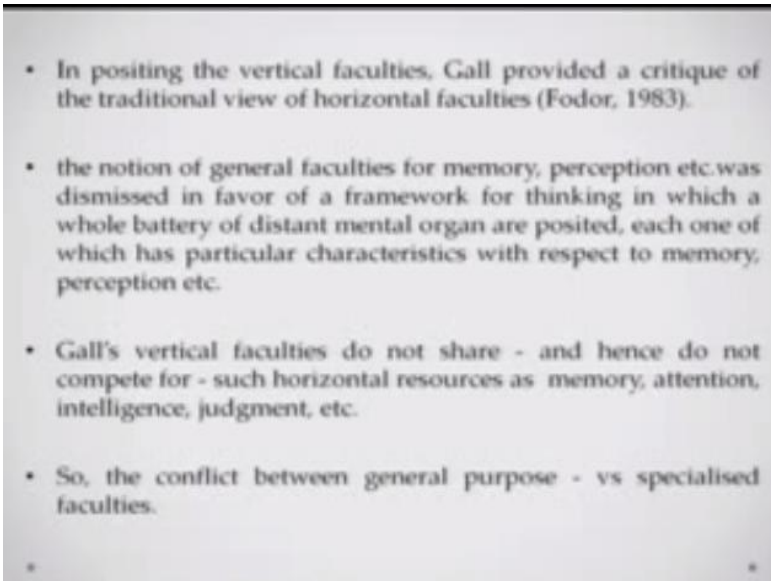

Now in positing these vertical faculties Gall basically provided a critic of the traditional view of horizontal faculty. So he basically said kind of pose this as a constitution what the horizontal faculties are and what the vertical faculties are. Now what we do with this was that is general notion of faculties for memory perception etc, was dismissed in fear of a framework for thinking in which a whole battery of a distant mental organ are posited okay.

In which each one has a particular characteristics with respect to memory, perception etc. So he is saying that let us better divide the brain not into general abilities like the horizontal faculties, let us talk about vertical faculties which are specific processes and each of these specific processes has a component for memory, has a component for perception. And in that sense, so imitation if you notice the last figure should have a component of memory, because you would remember what you want to imitate and as a component for designing and stuff like that okay.

So Gall's vertical faculties in that sense, they do not share and hence they do not compete with the horizontal resources for memory, or attention, or intelligence judgment etc okay. So there is this conflict between what these general purposes, mental faculties or horizontal; faculties or

these special purpose mental faculties or these vertical faculties, this is in which Gall was talking about. Coming back to what Fodor really wanted us to think okay.

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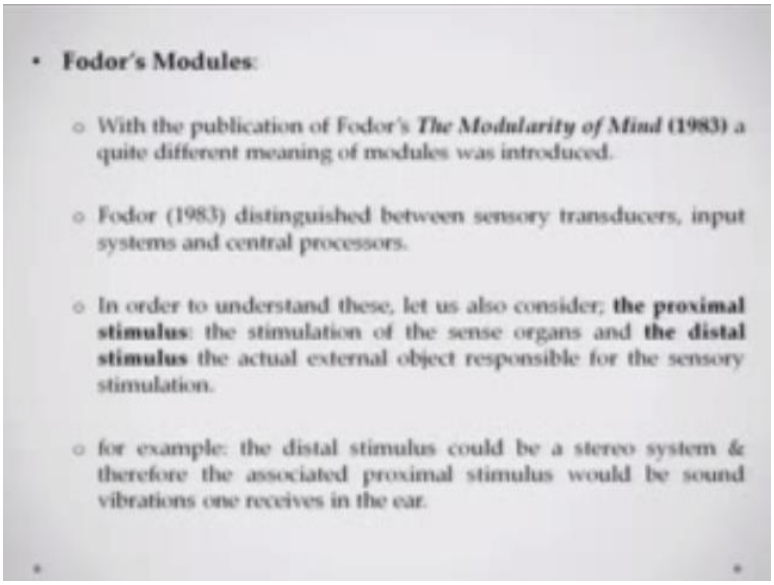

So Fodor wrote this book the modularity of mind in 1983, and slightly different meaning of modules was introduced by the Jerry Fodor okay. He basically distinguished between what the sensory transducers are, what these input systems, and what are the central processors okay, you can think of about this in a way, that there is certain information in the world and that information is received by you by virtue of these sensory organ which then convert this information into a form in which the brain can actually deal with, so that is the process of sensory transduction.

Once that information is converted into a common form after sensory transduction that information has to be acted upon, by the other higher areas of the brain which is your central processors. So take this example you know whole example with you and then use it understand what you are going to take about what fodder are meant with modularity okay. So in order to understand this another concepts introduced by Fodor was, that the concept of proximal stimulus, and the concept of distal stimulus.

The proximal stimulus basically is what is happening at the sense organs you know what is the stimulations that has been received at the organs. This distal stimulus will be what is the actual object that is creating this proximal stimulation. Say for example, distal stimulations could be a stereo system which is playing let us say in the next room or in same room slightly distance from you, and the associated proximal stimulus would be the sound vibrations that you eventually received on the ear. So this proximal stimulation could very if the stereo is kept very close to you, versus the stereo kept far from you.

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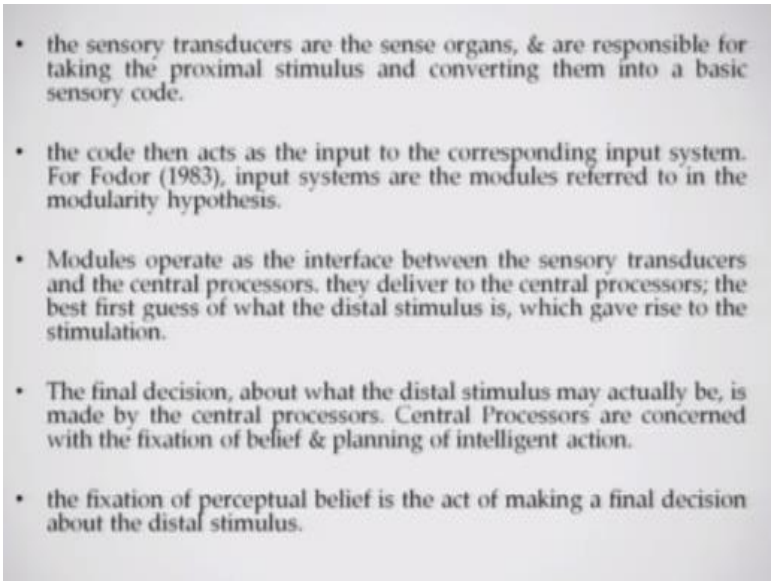

The sensory transducers which the sense organs are responsible for taking this proximal stimulus and converting them into a basic sensory code which will be worked upon by the sensory transducers. Now this code then acts as a input to the corresponding input system. So let us say there is a input system that processes auditory information. Now for Fodor these input systems are the modules that referred to in the modularity hypothesis. If you remember what Marr was also same.

These modules have to interact as an interface between the sensory transducers and the central processors okay. These will be the subunits that we will be working with okay. So the final decision about what was the distance in this, say for example somebody ask you judge a song that is playing on this stereo. So what was the distal stimulus maybe is has to be made by the central processors okay.

So these central processors are concerned with the fixation of belief and planning of intelligent action. And say for example if a nice song is being played, something that you want to here, so then you will shift all your retention to it or something unpleasant is being played and you want to stop it, that kind of decision has to be taken by the central processors. The fixation of the central belief or this fixation of a perceptual belief actually is this act of making a final decision about the distal stimulus, that is what the main job of the central processors would be.

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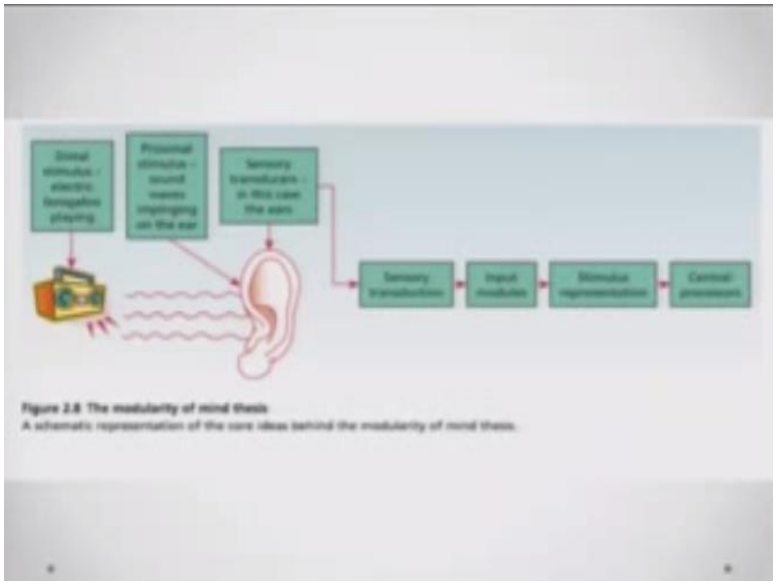

This is visualization of this entire process, you can see that there is a distal stimulus, and the proximal stimulus and you can see that the end of this entire thing is the central processor which will finally decide how you react to this same function.

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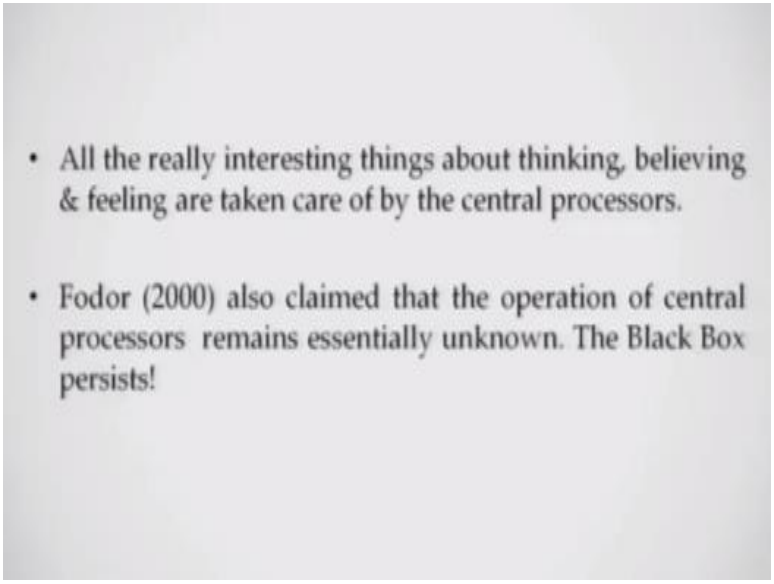

All this really interesting thing about thinking, whether you like something or not, whether you heard this before or not, those kind of decisions basically are taken care by the central processors Fodor in 2000 also claimed that the operation of central processors actually remains essentially unknown. The black box is still not really clear, in 2000, so for example in much a head, you know after this modularity hypothesis is proposed still it kind of remains unknown to us. Let us try to make sense of what these modules are.

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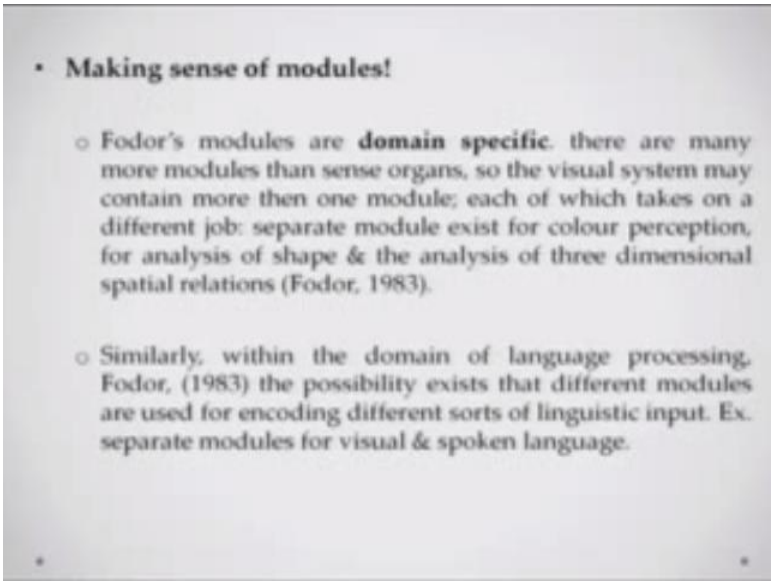

Fodor says that these modules which are functioning are domain specific okay, there are many more modules than sense organs. So the visual system may contain more than one module. Say for example, it could be one module of color, one module processing depth, one modules processing shapes and contours. So the entire visual perception system is not a single module, it can also be divided into many sub modules okay.

Similarly, say for example the domain of language processing there could be a couple of modules one which deals with visual language or one with the spoken language that is pository language.

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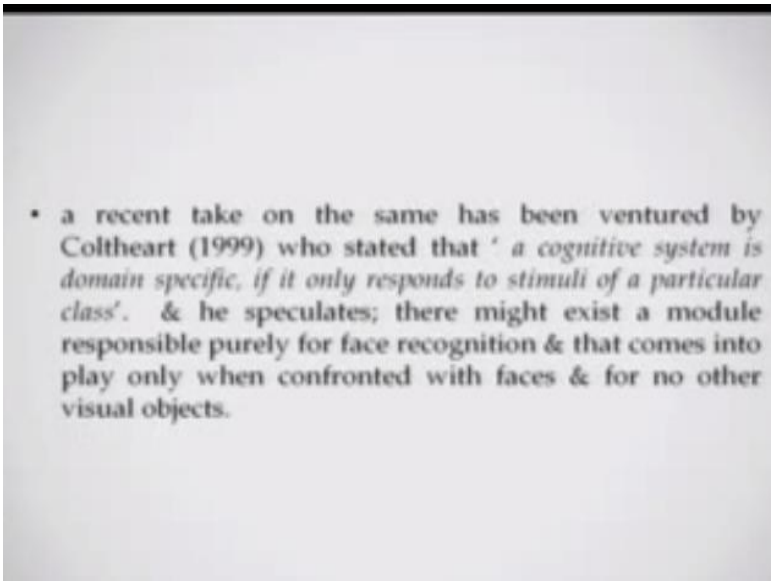

The reason take on this basically has been taken by a Coltheart, where he says that a cognitive system is domain specific if it only responses to stimuli of a particular kind. And we will discuss a lot of experiments as we go ahead, one of these examples that we come across is the particular area of the brain, we response only towards, it is called the visual word from repeat the area of the brain only two faces which we have face from face area.

So these could be thought of as modules that actually deal with only a particular and a specific kind of a stimulus okay. Now let us try and apply this whole concept of modularity to how the brain is actually suppose to function okay, let us talk about what is called modularity and cognitive neuropsychology.

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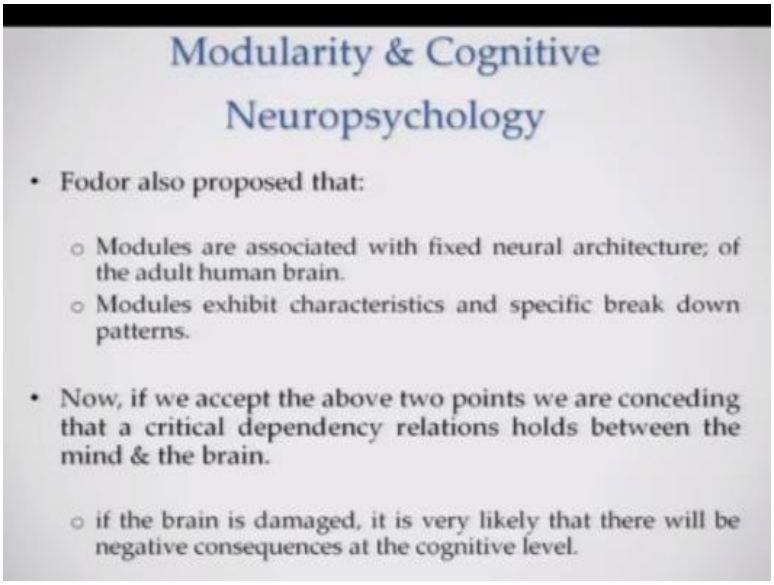

Fodor proposed that these modules are associated with fixed neural architecture of the adult human brain. So the human brain can be divided functioning to these different modules. Modules exhibit characteristics and specific break done patterns. Say for example, there could be a module about color processing that might go away, there could be module about a speed production that might go away and that kind of sense.

Now if we accept the above two points which we are conceding that modules have a fixed neural structure and modules can have specific characteristics of break down etc. Then what we are trying to do is, we are actually assuming rather critical dependency between the mind and the brain okay. This is a very interesting part to which cognitive neuropsychology really helps us.

If the brain is damaged, just taking this example further, if the brain is damaged then it is very likely that there will be negative consequences for a particular module that was associated with that region of the brain okay. And I think this is what you even might have heard of different people, sometimes they are undergoing things like the stroke or something like accident in which particular and specific abilities are lost, even memory loss happens or loss of language happens, loss of a particular kinds of visual practicalities happen.

All of those kind of things are happening consequent to a brain damage. So there is that relationship between the mind and the brain, they are to be seen.

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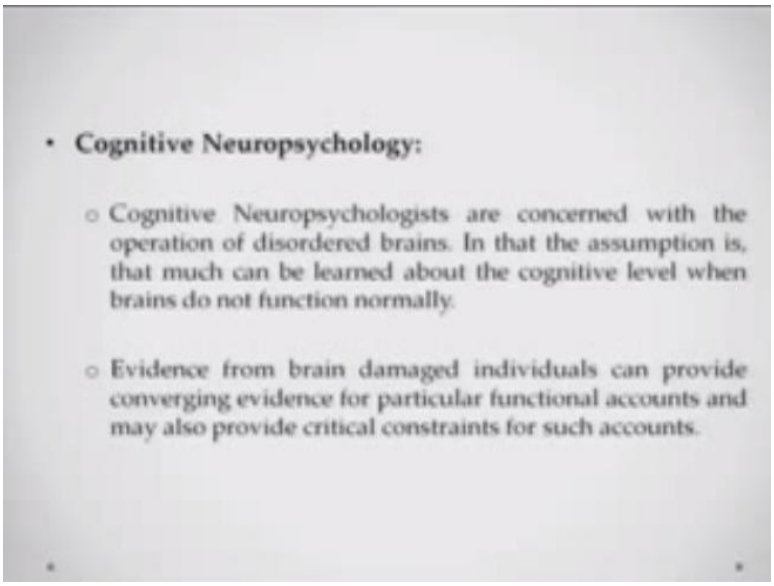

Now what is cognitive neuropsychology? Cognitive neuropsychology basically, or let us say what cognitive neuropsychologists are concerned with is the operation of disordered brains. You know brains which have particular kinds of defects, you know and the assumption here is that much can be learned about this cognitive system, or what the mind is when you actually look at the brains which are not functioning normally, you know you can look at the broken machine and you can think about this part is not working and this thing is not happening.

So this part is related to that particular kind of output, so this is the kind of relation that we try to maintain, try to deduce when you are actually talking about the cognitive neuropsychology. This evidence from these brain damage individuals the patient from various hospitals can actually provide us converging evidence for particular functional accounts and we also provide a critical constrains for such accounts.

Say for example, you thought that particular area A was involved in reading, and area B was involved in speaking, and you come across the patient in which area is damaged the person is, but the person is able to eat completely you know accurately. It will help you remove that assumption that area A was linked to reading that can happen. Another kind of another flavor of cognitive neuropsychology is developmental psychology,

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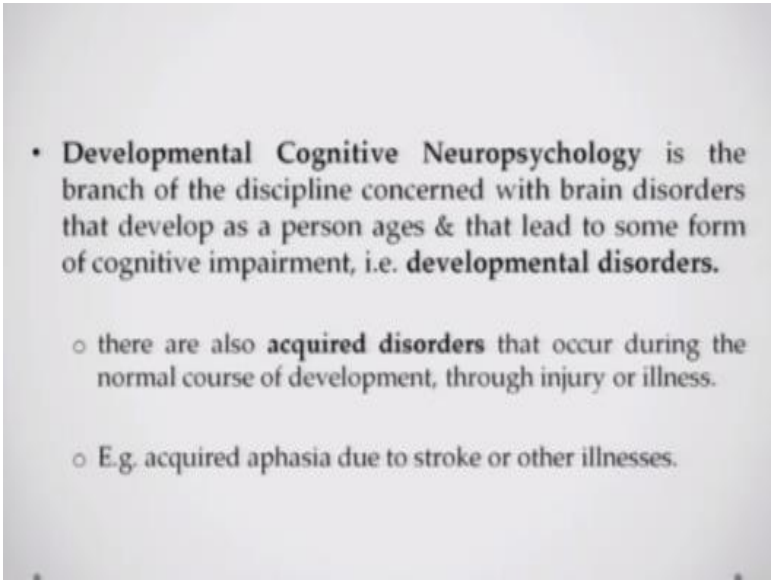

Developmental neuropsychology is the branch of the cognitive neuropsychology which basically deals with brain disorders that develop as a person ages, and that lead to some form of cognitive impairment that is developmental disorders. There are also acquired disorders that occur during the normal course of development through injury or illness, say for example N-stimulitis or stroke etc, and the example could be some people acquired aphasia that is loss of language or a particular loss of particular component of language due to stroke or other kinds of illnesses.

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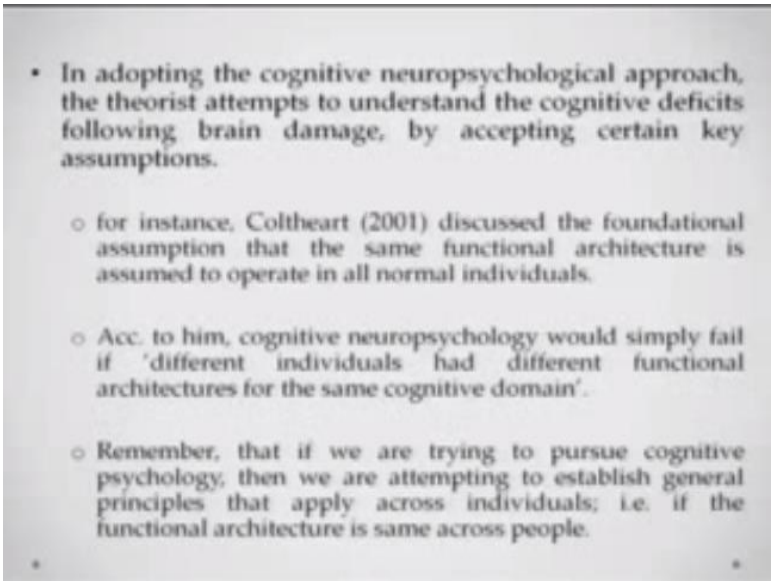

Now in adopting this cognitive neuropsychological approach the therosit basically attempts to understand the cognitive deficits following particular or specif kinds of brain damage. One of the things that one does is except certain key assumption, what are those assumption let us say one of those are say for the example as Coltheart said you have to have a foundational assumption, that some functional architure is operating across all human all normal individuals.

You know something say for example, eyes or there is a particular area of the brain, let us say area of the event, of the occipital cortex which is the part of the brain which was visual inputs operates in all the individuals, there should be nobody who actually sees through the frontal cortex okay, that basic assumption one would have to maintain to have any theory about how would mind and brain realtionship really works.

According to Coltheart as he says, the cognitive neuropsycholgy would actually simply fail if different individuals had different functional architectures for the same cognitive domain. For example, which I just gave also remember that if we are trying to pursue cognitive psycholgy then we are trying to establish a general priniciple that apply across individuals. The whole idea of this field is that we are actually reducing theories which would apply to all individuals.

If things were so, that there were so many individual differences and each brain is completely different from each another brain, then it is will be difficult to really generate any general purpose theory which would apply acorss individuals. Now the logic behind cognitive neuropyschology is very simple.

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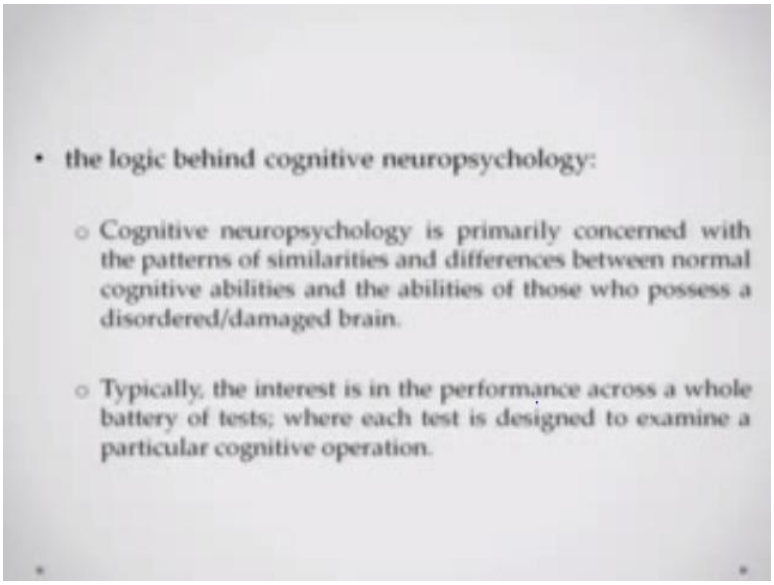

Cognitive neuropsychology is primarily concerned with the patterns of similarities and differneces between normal cognitive abilities and the abilities of these people who have a disordered or damaged brain. What is you know, what are the specific abiities of the person with damage in area is X of the brain, and what is the cognitive ability of the person who does not have damaging area form on a paticular task, so we try and compare this okay.

So typically the interest is in the performance across the whole battery of generally whole battery of test is given which will test different aspect of the particular cognitive function. And the performance of the these two individuals, one with the damaging area X and one with out damaging area X are tested, and compared on this critical parameters, that is how you come to

know, that area X was involved in this specific kind of ability under the umbrella of this particular cognitive function.

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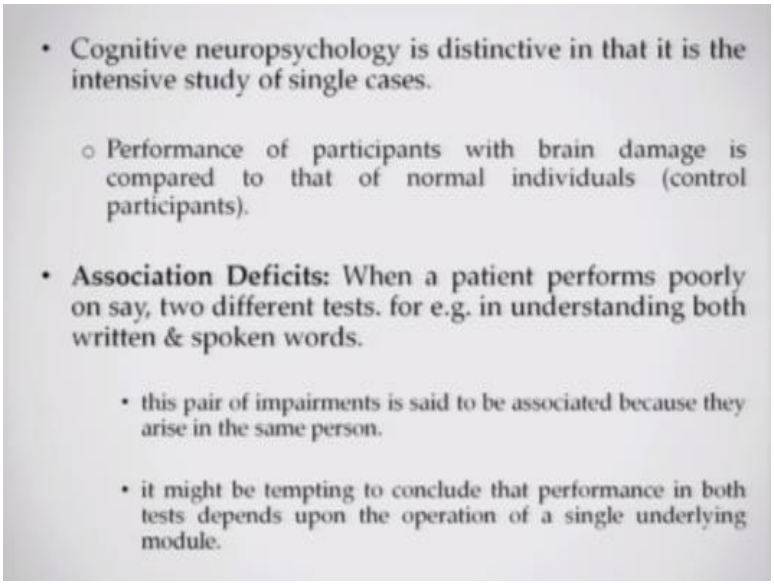

Now cognitive neuropsychology in that sense is finally distinctive, because it really also talks about something detailed analysis of single case studies okay. Say for example, it compares the performance of particpants with brain damage, to that of say for example, if there is a patient who has damage as seen earlier in area X, how does this performance compare to the performance of other normal indivduals.

So we do invest a proper importance in a single cases as well okay. Now there could be two kinds of deficits which you find in cognitive neuropsychology, let us talk a bit about that. First kinds of deficitis is your association deficits. Say for example, if there is a patient performs poorly on say two different tasks, say for example in understanding written words and in understanding spoken words. These are two diferent tasks okay.

Now these kind of impairments can be said to be associated because they are arising the same function, same person okay. That there is a same person who cannot understand written words

and who cannot understand spoken words. It might be tempting also to conclude that the performance in both tests depends upon the operation of a single underlying module. So what you can easily say language is basically involved in both undertanding written words and understanding spoken words, of this person should have a problem with language. That is why this kind of things is happen, but there is more to that. We will talk about that in a while.

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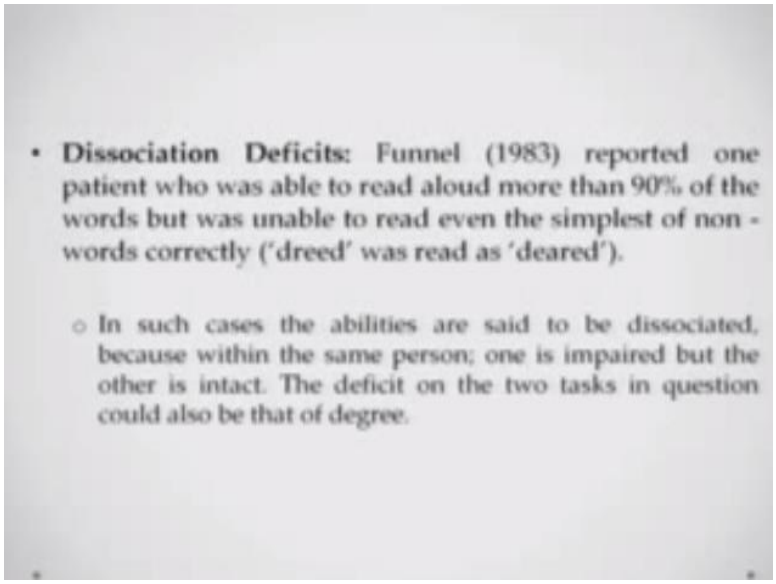

Another kind of deficit, that one could talk about is that disassociation deficit. Say for example, Funnel in 1983 reports one particular patient who was able to read aloud more than 90% of the words, but was unable to read aloud even the simplest of non words. Now what is the non words, non word is something that can is that arrangement of words that can be pronounced, but does not have any meaning okay.

There could be a person who is being able to read aloud all the words, but not being able to read aloud any non word, why should this happen, you know what is that critical thing missing in this person B. In such cases what we assume is that these abilities are said to be dissociated, reading of non words and reading of words are said to be dissociated within the same, because within the same person one is impaired, but the other is intact.

Now this deficit on the two task in question could also be that of degree. So for example, he could read 50% of non words, not all the non words okay, that could also be one of the things to be consider. Now let us look at these two examples or these two kinds of deficits slightly more closley.

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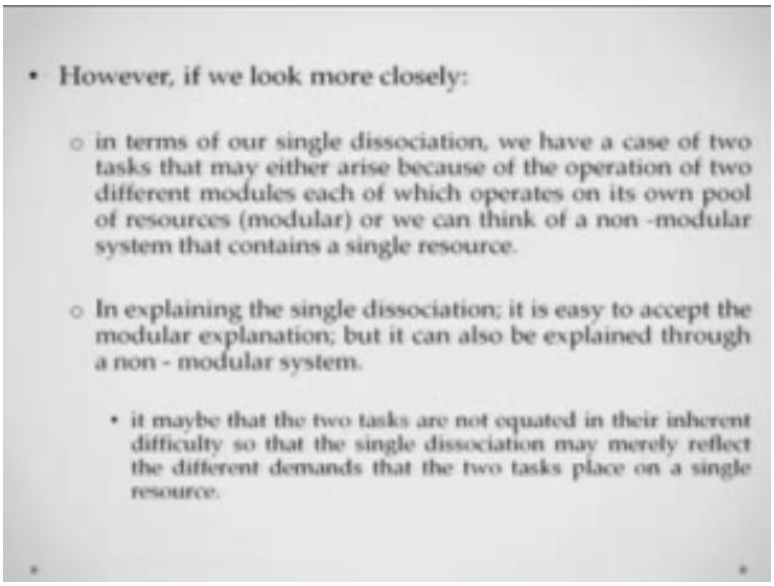

In terms of our single dissociation example, we have a case of two tasks that may either arise because of the operation of two diferent modules one which understands written words, one which understand spoken words. Or we can think of a non modular system that contains a singe resource, in which basically both of the functions are implied okay. So there is a stimuli source whocich would helps you understand in the single resorce.

In explaining of the single dissociation then what we can say it is easy to accept the modular explanatin okay. But it can also be explained through a non modular design okay, as I said in the example just now. So you can apply the modular explanation that a single body was substantially these two functions tha is why the single asosicated definite or you could say both these modules have been damaged in the same peson that is where something has happened.

So a modular versus the non modular expression are both feasible here. So but say for examle, another way of looking at this is that maybe the two tasks are not equated in their inherent difficulty. So that is the single dissocaition maybe reflect the different demands on a single resource as we were talking about the modular resource.

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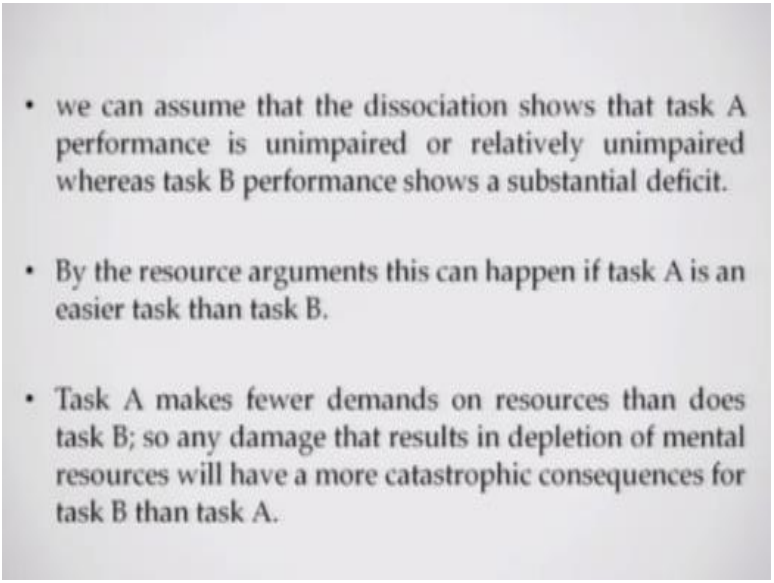

We can assume that the dissociation is showing the task A performance is unimpaired or relatively unimapaierd whereas task B performance shows a substntial deficit, reading written words or understanding spoken words. Now by the resource arguments this can happen if task A is an easier task than task B. So the same ability is damaged and the demands on this ability or the demands on this resources is mor by task A and less by task B.

So you can say that task A will be damaged, but task B will still be there, because it is only less demands on the single resource okay, as I said the task A and the demands on resources and the task B, so any damage that results in the depletion of mental resources will have a more catastrophic impact on task B than task A okay, or we will have a more catastropic impact on the more difficult task, the one which makes more demands okay.

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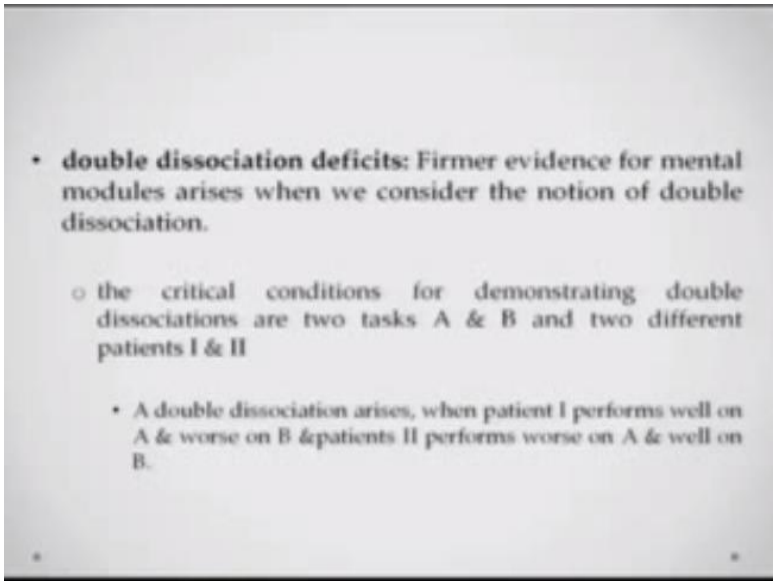

Now try and understand, let us try and understand, double dissociation, what is happening in double dissociation. Further evidence for mental modules arises when we consider the notion of double dissociation okay. Say for example, if you find a patient in which there are you know two task, task A and task B and you two patients, patients one and patient two okay. So what can happen is say for example is the double dissociation arises if in one case patient one performs well on task A, but performance worse on B.

And patient B performs worse on task A and well on B. So you have this kind of a dissociation, that there is in the same person, task A is fine, task B is damaged, and on the other person task B is fine and task A is damaged. So by this, by comparision of these data from these participants you can actually deduce, that there is no way that the task A and task two are linked, and in that sense you have to expect the modular explanation, than task A and task B, are being observed by two different modules, make sense?

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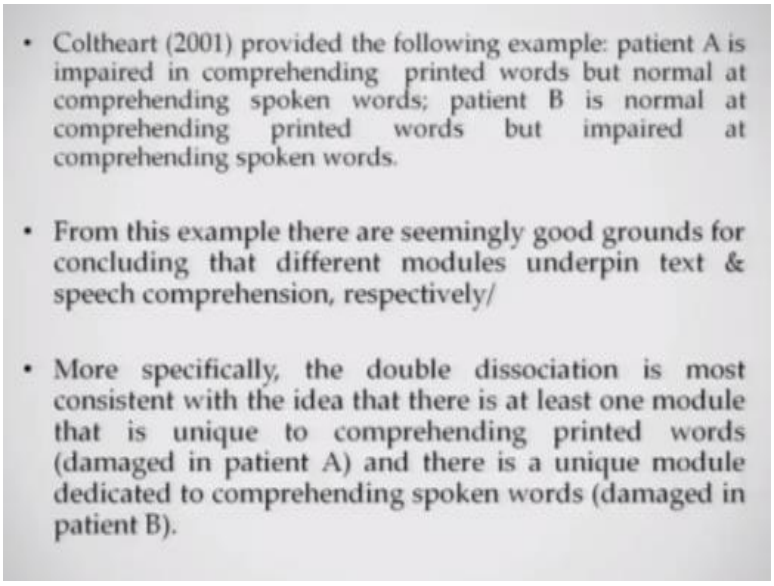

Now Coltheart basically gives an example, it takes an example for patient in 2001 and he says that patient A is impaired in comprehending printed words, but normal at comprehending spoken words, and patient B is normal at comprehending printed words but impaired at comprehending spoken words. So this kind of pattern of deficit basiclaly provides you good grounds for concluding that the different modules and underlying text comprehension and speech comprehension, respectivley okay.

More specifically, the double dissociation basically is most consistent with the idea that at least one module that is unique to comprehending either printed words or spoken words is slightly different okay. So at least one module is unique and is in unique modular compares talks about spoken words okay.

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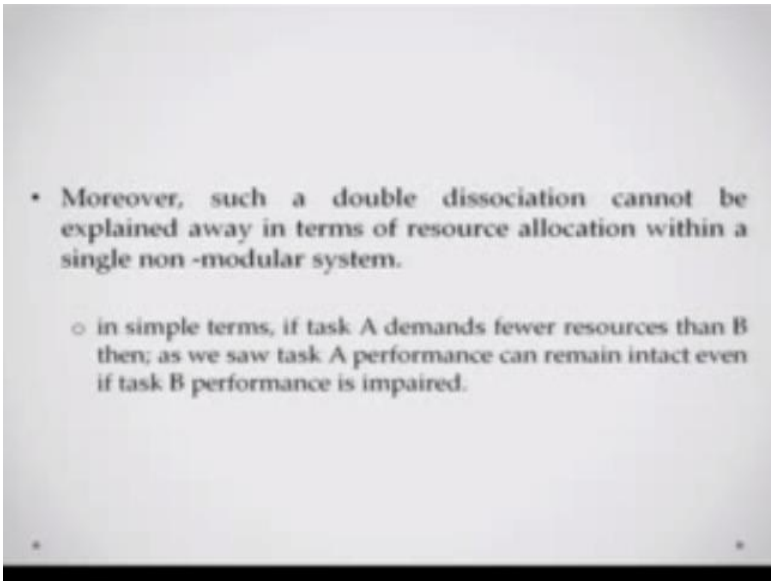

Moreover in case of double dissociation, such a double dissociation you cannot explained away in terms of only resource sanitation, you cannot say the task A was slightly less difficult and task B was more different that is why this pattern of deficit have emerged. So in simple terms if you say for example, if task A demanded fewer resources than B as you saw task A performance can remain intact even if task B performance is impaired okay.

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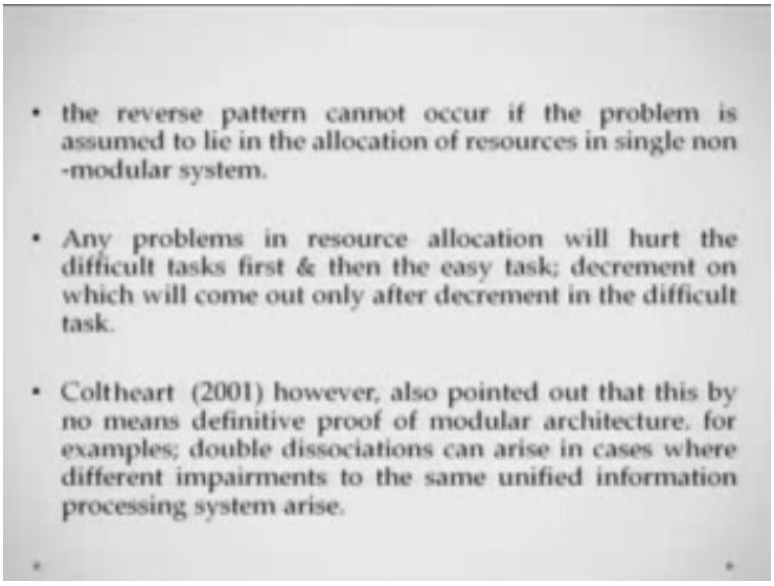

Now if that is possible, but still reverse pattern cannot occur if the problem is assumed to lie in the allocation of resources in single non modular system, something which is happening in the double dissociation case okay. Any problems in resource allocation will hurt the difficult tasks first, say for example, if you say the task A was difficult, task B was easy, then the other example in which task A is damaged and task B is not, you cannot explain that okay.

Because if it is a single resource, then more difficult task will be effected first. But we saw in the case of patient B, that different task was damaged, but this more difficult task was expired. So that you will not relaly explain them using a single modular design that kind of forces you do explian or accept this based on two different points.

Coltheart actually takes this and he says that this by no means are various definitive proof of modular architecture. For examples, double dissociations can arise in cases where different impairments or the same unified information processing system is there. But for now we will actually accept the two explantion forwarded of associated deficits and dissociated deficits, and how they can actually help you to deduce wheather particular ability is served by the comman module, or by two different modules okay.

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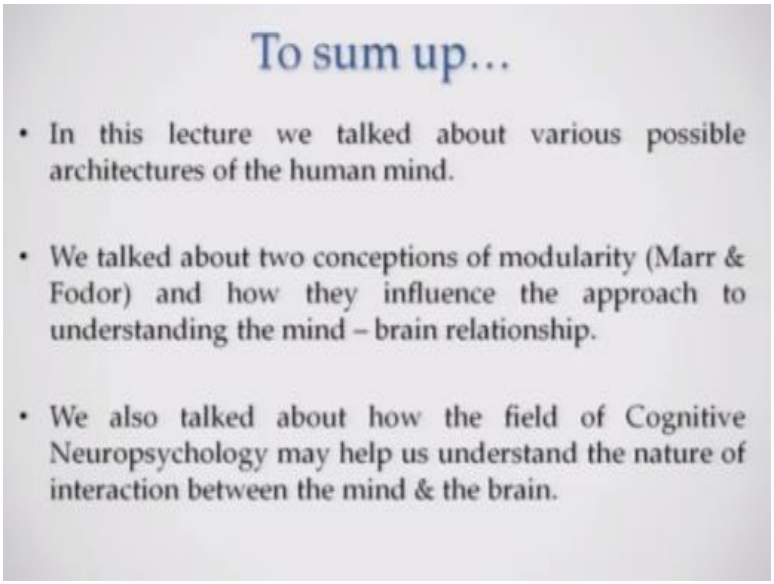

Now just to sum up, the lecture for today we talked about various possible archiectures of the human mind using the modularity example something from Marr and also from Jerry Fodor we talked about also how cognitive neuropsycholgy can help us understand the nature of the relationship between the mind and the brain okay, thank you.

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