Indian Institute of Technology Kanpur

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Course Title

Basic Cognitive Processes

By

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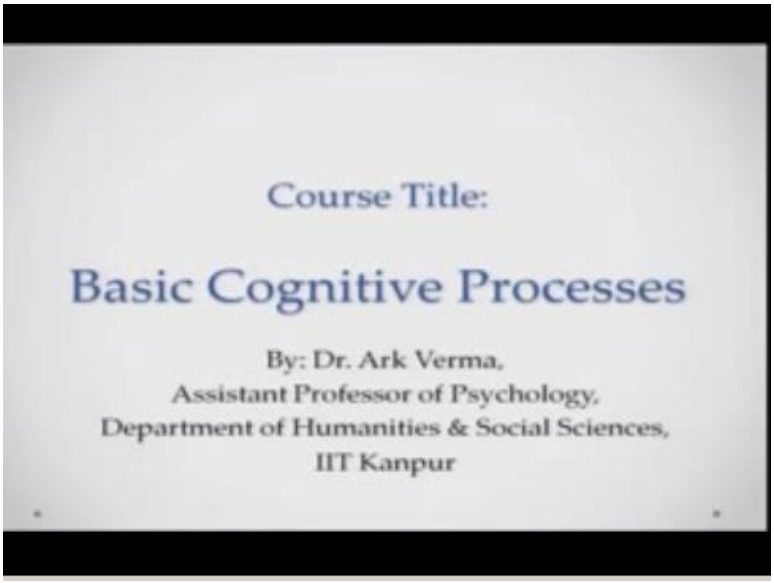

Hello and welcome to the course basic cognitive processes I am Dr. Ark Verma from IIT Kanpur the topic of today's lecture is research methods in cognitive psychology in the last lecture I talked to you about basics of research methods in psychology that was more to give you a background into what kind of research designs what kind of research questions and what is the general method of conducting research in psychology like in today's lecture I will talk to you more specifically about the kind of methods that have been used in cognitive psychology to conduct different kinds of experiments.

Now what do we already know we already know what the basics of you know what the basic research methods or the basic kind of research design in psychology is we know that there is a you know three types of design say descriptive co relational and experimental research design we also know that you know the emphasis basically in research in psychology is to be able to quantify aspects of behavior and in a way that they can be empirically measured only then we can actually make scientific claims.

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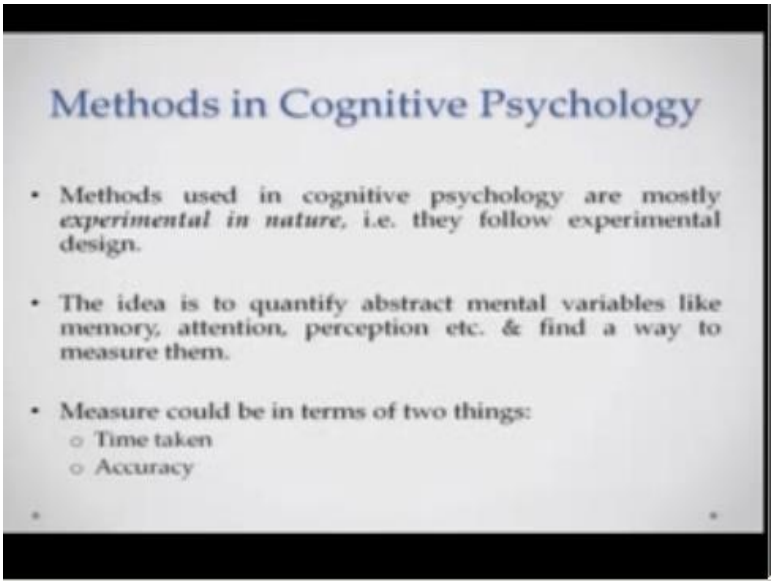

About you know particular visual phenomena we also in the last section of the last lecture talked about assets of reliability and validity of research findings now that is a very important factor which ensures that whether your research is you know dependable or not whether you are actually getting anywhere close to answering your questions and answering them correctly let us now talk about methods which are used in cognitive psychology specifically method sense cognitive psychology more or less are experimental in nature.

So generally we are actually you know into experimentation we are asking you know we are following the experimental research design that is to say we kind of you know are always interested in manipulating certain variables and testing the effects of this manipulation on certain

other variables what are the variables in cognitive psychology variables in cognitive psychology basically are those abstract mental phenomena which we try and quantify.

And then we try and investigate them by studying the effects of different things on these mental phenomena or say for example studying the effects of various mental phenomena on some other related or unrelated mental phenomena say for example how does attention influence perception say for example how does stimulus size or number of stimuli or type of stimuli affect your visual search performance or it affects your you know recall of items these are the kind of questions or that are generally asked in cognitive psychology.

Now what are the kind of measures that we do generally in cognitive psychology we are measuring stuff in terms of the time taken to process a particular thing or how accurately you process that thing. So these are the two dependent variables so these are two dependent measures about the dependent variable which we are actually taking into account now one of the most you know foremost methods.

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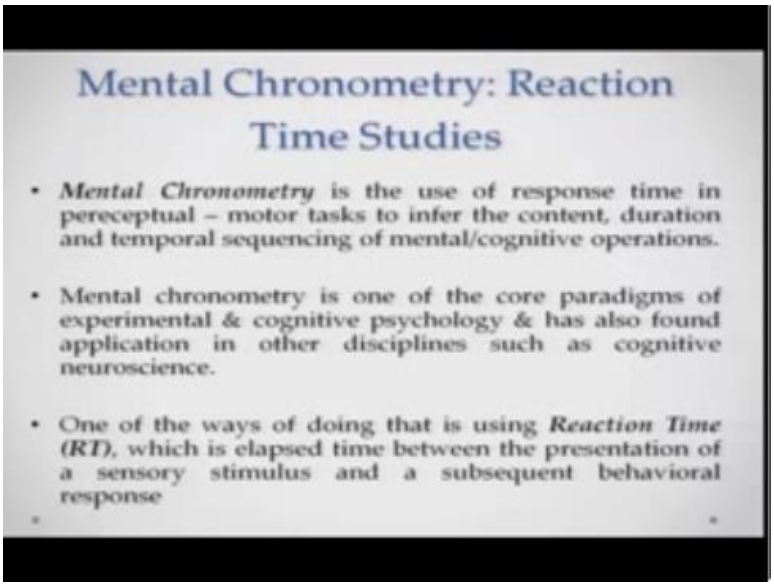

In cognitive psychology is mental chronometry what is mental chronometry mental chronometry basically is the use of response time in perceptual motor tasks to infer the content the duration and the temporal sequencing of mental or cognitive operations now what am I trying to say here I am trying to say that we assume that a particular behavioral response is you know basically it has in background different mental operations now we really want to you know check how those mental operations are done.

So what is the time taking say for example if I just asked you to compare two numbers how do you add the two numbers or how do you do this comparison basically what are the effects how do you know evoke there presentation of the number how do you then compare it and how do you decide to tell me whether one of the numbers is larger or smaller than the other these are different sets of mental operation that might you know underlie your simple response of just by pressing a button to tell me whether number A or B is larger this is basically done through you know this is basically the idea behind what is mental chronometry mental chronometry is one of the most you know important.

And code paradigms in experimental in cognitive psychology and it is also found used in other disciplines such as cognitive neuroscience we'll talk about that one of the you know one of the easiest ways of doing mental chronometry or using mental chronometry is to measure reaction time what is the reaction time the reaction time simply is the elapsed time between the presentation of a particular kind of a stimuli and the you know appearance of a subsequent behavior response so if I for example show you a particular number and if I just asked you to tell me whether it is a number or just a shape the time elapsed between presentation of that stimulus on the screen and the time you take to actually press a button and tell me whether it was a number of a shape is your reaction time.

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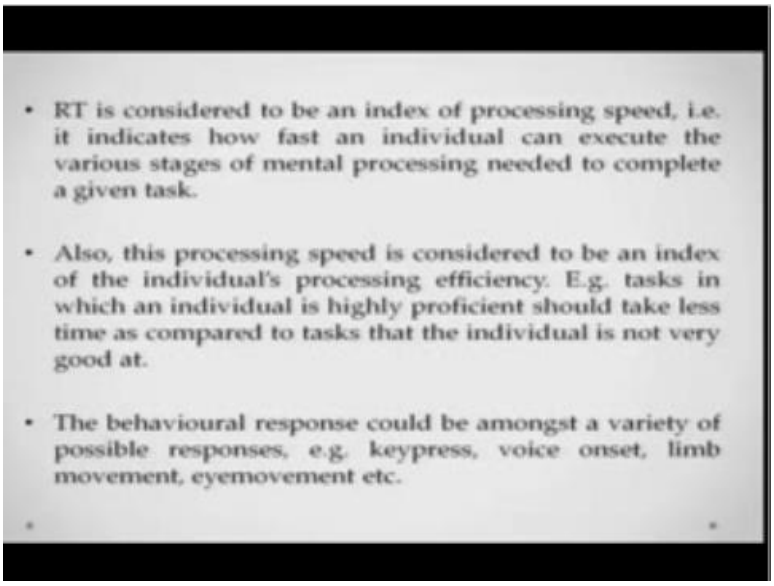

Reactions times are considered to be an index of processing speed you know how fast you did those processes okay it indicates how fast an individual can execute the various stages of mental processing needed to complete it given to us say for example the task I give you is to compare two numbers okay also this processing speed tells us something about an individual's processing efficiency things that an individual is very good at should take lesser time things that the individual is not very good at should take more time you know it's a simple reduction that can be made now there could be a variety of behavioral responses that one could take in this reaction time studies it could either be a simple key press response space yes for yes.

And for no it could be a voice onset you know you ask people to name particular pictures and you record their voice on set time another could be limb moments you ask them to wave their hands or move their legs something like that or it would be simply eye movement say for example if you want to ask the person to move their eyes from a point A to point B during a particular experiment depending you know the choice of what kind of measure you're actually going to use in a particular study depends mostly on the kind of research question that you fast.

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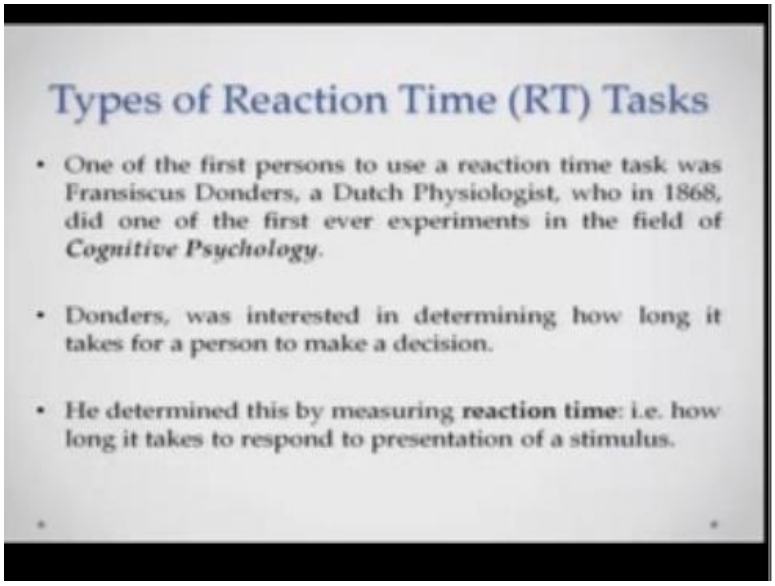

Now let us talk about different types of reaction papers now one of the first persons who ever used a reaction time task was Francis with jaundice now dawn this was a Dutch physiologist who in eighteen say it was interested in determining how long it took for a person to you know take a decision he basically conducted on the first experiments that can be considered to be an experiment in cognitive psychology.

So how did he do this he basically determine this by measuring the reaction time that is how long it took his participants to respond to the presentation of a kind of stimulus.

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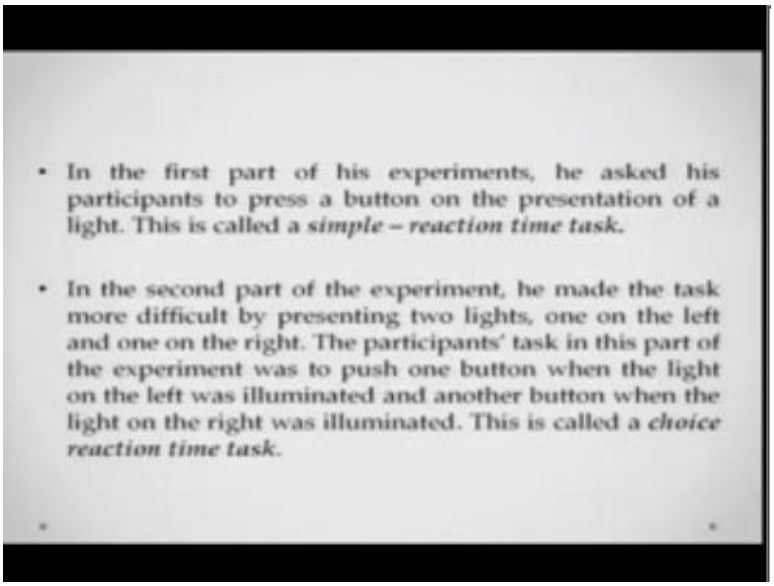

Let us go further ahead in the first kind of his experiment on this which we presented his power difference just with the you know dot and ask him to place a button on the presentation of this story it was a dot of light on a particular dynamic screen now this kind of task was termed as a very simple reaction time task wearing you just have to see whether the dot is there and you have to place a particular button in the other part of his explaining what Danas did was he made the task slightly more difficult he presented now one dot to the left side of the you know screen.

And another door to the right side of the screen he now asked his participant to press button a when he you know when the light on the left side was lit up and button B when the light on the right side was later now this you can see is a systematically more difficult task than the earlier simple reaction time task we were talking about.

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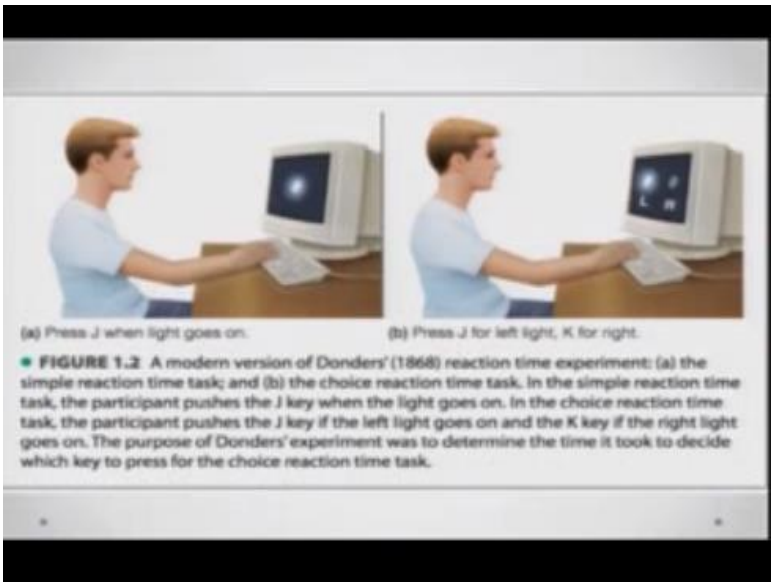

Here you can see the set up for these kinds of tasks on n figure a you can see that the instruction is just to press a light when you know just to place a key J when the light goes on and in the second setup you can see that the participant has been asked to press J for left light and K for right light so in that sense systematically there is more effort or more mental processes are there let us say you know how let us go into how the comparison of these two tasks are.

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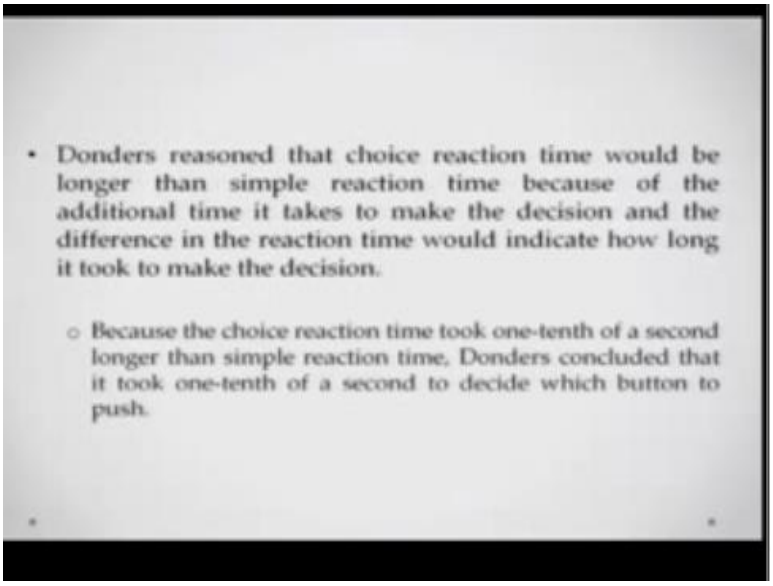

Donders reason that the choice reaction time task would take longer than the simple reaction time task because the addition because the additional time it takes to make the decision you know you have to see where the light came and then you have to decide which of the buttons you're going to press ok that is why he is basically you know thought that the choice reaction time task will take more time than the same action Rangers.

And now if you subtract the simple reaction time task from the choice reaction time you will get a number which will actually tell you how much time it took to decide which key was supposed to be placed this is a simple subtraction technique which Donders use and in that sense you actually talked about how you can really you know calculate the amount of time that is taken in each step of a particular mental process okay.

So donders in that sense in this example found out that the choice reaction time task took one tenth of a second or let us say100 milliseconds longer than the simple reaction time task and very easily through subtraction he could actually tell that the decision to Defiance the decision to about which button was to replace took about 100 milliseconds.

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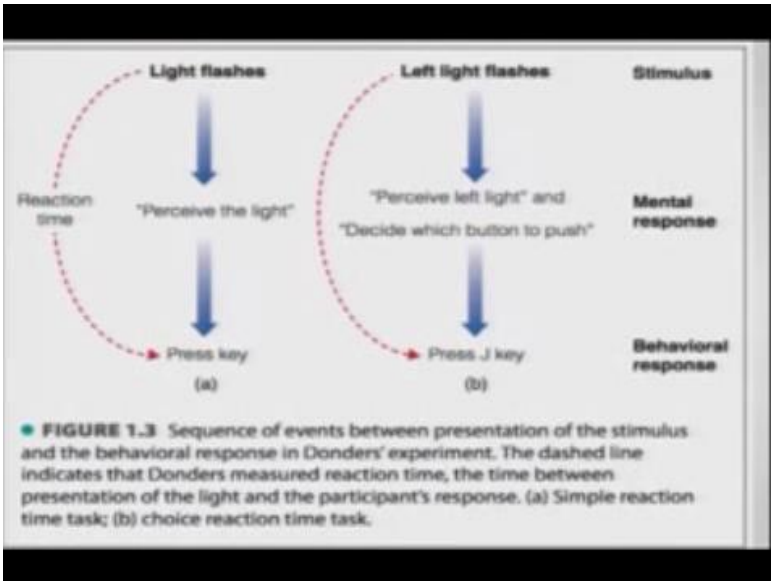

Here is a kind of a you know graphical representation of what might have gone on in those tasks you can see that when the light maybe not in the simple reaction time task in panel a light flashes you perceive the light and you simply press the key in panel B a particular side you know left or right light flashes you perceive the light but you then have to decide which button is going to be pressed whether you know J or K then you press the J key because the left light has been you know as been presented in that sense you can already see that there was a step added and that is what actually took the made the batsman took side a longer time.

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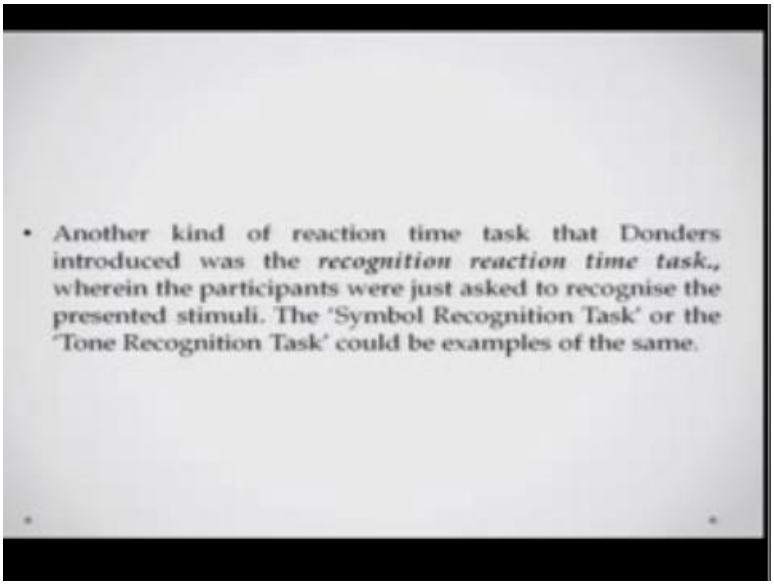

Now another kind of reaction time – that Dantas introduced was the recognition reaction time task in this kind of task for the participants were asked to or to basically you know recognize the kind of stimulus was presented if you see in the simple reaction time task they were just asked to press a key when a particular stream this was detected here they were asked to determine what depth similar S was for example to determine whether a particular symbol ascended way let us say if I just asked you to determine K among your set of different air letters that is a example of a symbol recognition task this task is slightly more difficult than the simple reaction time task now.

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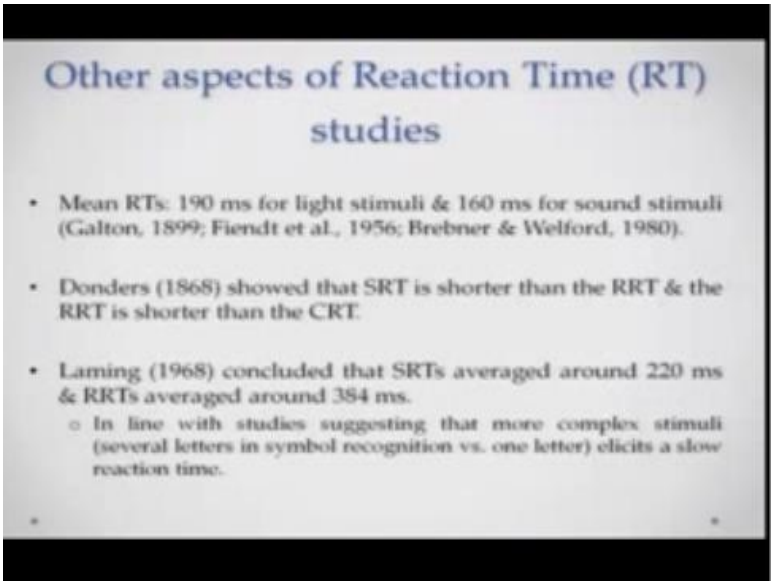

Let us talk to talk to you about a bit of you know but if other factors about reaction time studies so there is some knowledge which is been there say for example the mean reaction times for light stimuli is generally around 190milliseconds main reaction times for sound and stimuli is generally about 160milliseconds Gonders showed that the simple reaction time task a simple reaction time is shorter than there cognition reaction time which in turn is shorter than the choice reaction time.

So choice action time in that sense is the most difficult of the three kinds of reaction time task naming 1968 concluded that simple reaction times generally averaged around 220 milliseconds whereas the recognition reaction times generally measured around 4384 minutes this was in language studies that suggested that more complex stimuli say for example several letters you know you b actually need to see a panel of several letters among which you will recognize one letter during a recognition reaction time elicitor slower reaction so this is something which is already found out.

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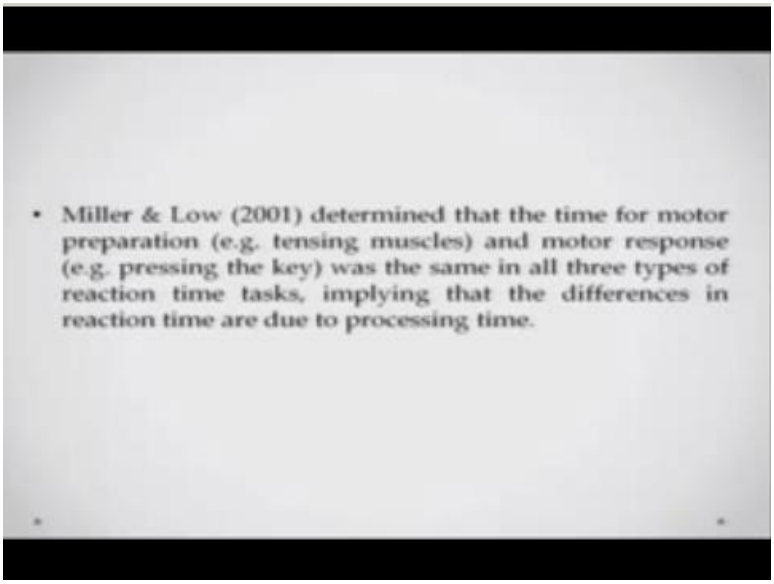

Miller in low into the hunt 1 they determine that the time for motor preparation so you know you have to prepare your hand for actually being able to press the button motor that is that will lead to a particular kind of tensing of muscles and the motor response when you finally press the key I was generally same in all the three kinds of reaction time task in the simple reaction time task in the recognition reaction time task and in the choice reaction time task which led him to which led the authors to conclude that the differences among these kind of you know on in these tasks the simple reaction time the cognition reaction time and the toy section time is basically only due to processing time because

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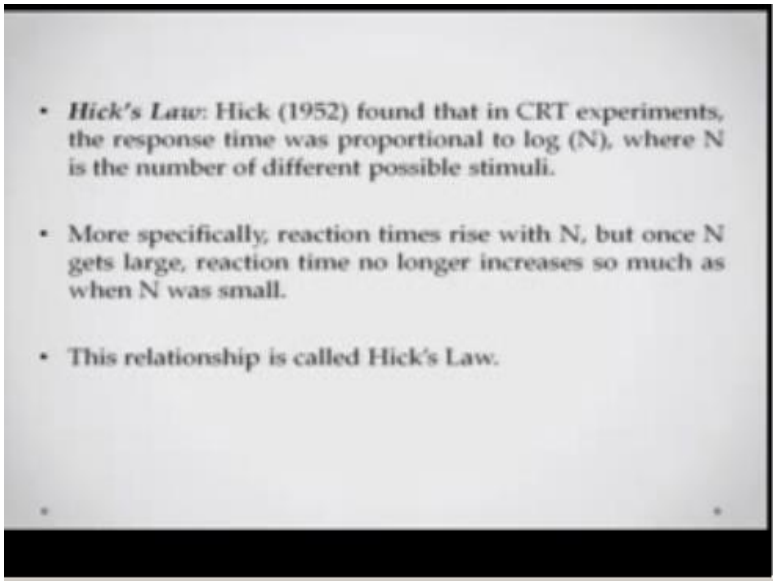

There is a stage added each time you actually change the task now an interesting finding about choice reaction time experiments is that the response time is proportional to the log of n where n is the number of stimuli in question so number of stimuli that you present more specifically you can say that reaction times generally rise within if you have more stimulus reaction time will rise to a particular point but after you know N or the number of still gets sufficiently large then the reaction time does not increase anymore so this kind of relationship between the number of stimulates and the reaction time was called the Hicks law.

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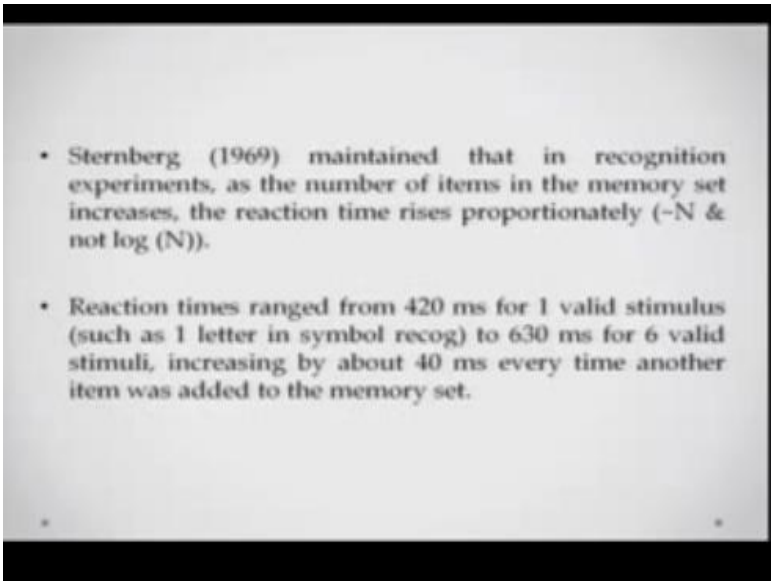

Sternberg in1969 maintained that in early era cognition experiments in the area in terms of a recognition reaction time task the number of items in the memory set increases the reaction time then increases proportionately so he said that you know reaction times are proportional to n and not the log of n in case of a recognition reaction time or in case of a recognition experiment he actually showed.

You know participants you know he measured reaction times for participant for one valid stimulus in a panel of Stream light compared to you know six valid service and they found that reaction times was around four twenty milliseconds for one valid solution a dirty task and 630milliseconds for a valid similarly inagita so basically the reaction times were increasing by almost 40milliseconds every time you increase the number of stimuli in the set.

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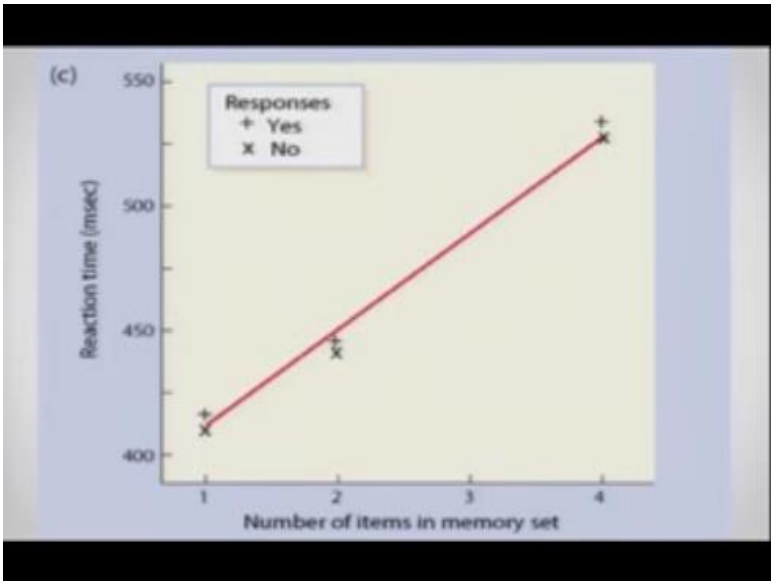

So this was a set of say for example you have to just recognize a in the panel of four letters versus if you have to you know recognize L in a panel of six or seven letters something like that so what he basically thought was that these were the stages in doing this we have a stage of encoding what is the Sigma I presented comparing at whether there is L or not in Darren and then decide which button to push and those kind of thing and then finding responding so he showed here you can see that the number of items in the memory set and the reaction times are actually you know it is related in a positively in that sense the they are directly proportional to each other.

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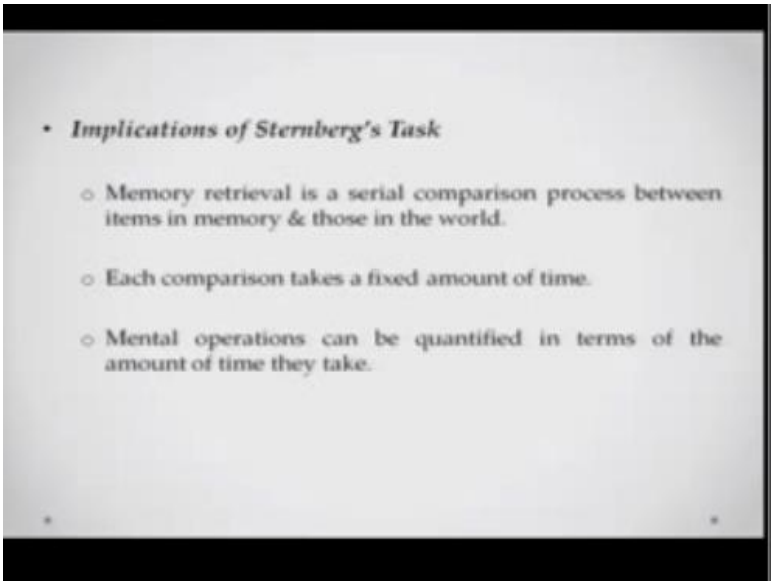

Now what kind of implication scan be you know drawn from Sternberg star at least one that memory retrieval is a serial comparison process okay so for example that is why the number of items you raise it kind of serially or in early it increases your reaction time second is each of these comparison takes a fixed amount of time.

So for example one compare generally should take around 40milliseconds that is why the amount of reaction time increasing with each adding simply was around 40 mill second snow mental operations I mean overall something which actually comes out from you know Sandburg star skills that mental operations and actually we successfully quantified in terms of amounts of time they take so the stage you know takes that a particular stage takes a particular amount of time was validated in some sense in this kind of a study.

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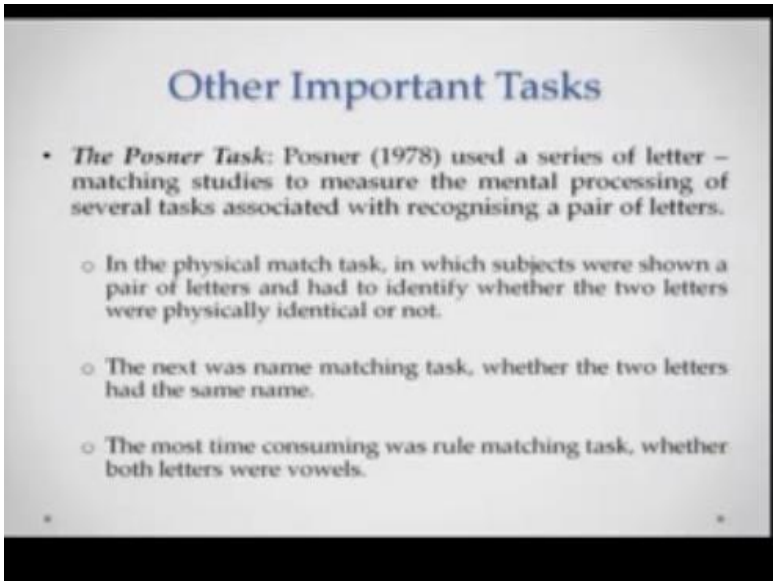

Now coming to some other important reaction time studies of the past so one of the more important studies was done by Posner Mike in 1978he basically used a series of letter matching strand and a task there to measure the mental processing of several tasks you know associated with recognizing a pair of letters so he had a physical matching task in which the subjects were just you know shown a pair of letters.

And you had to identify whether they were identical or not in a second name matching task we hear – just tell whether they were the same indent same letters or not whether they had the same name or not and in the third or the other kind of task was that whether they were wobble whether they belong to the same category according to a rule or not so whether they are both wobbles or both consonants.

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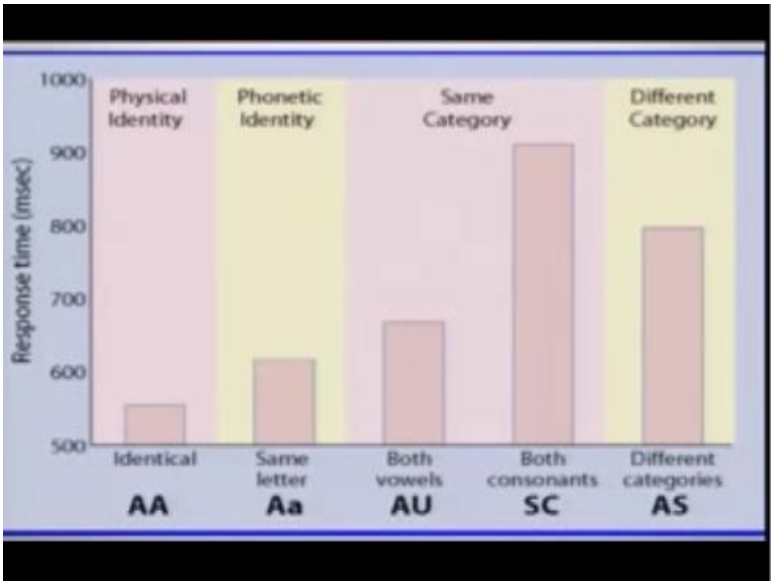

Here is the setup so you can see the lowest reaction time is taking a physical identity you know say for example both are is the slightly more time spent while you have asked the phonetic identity is small a or capital a third is whether they were both wobbles or not so you see that the reaction time increases linearly here okay so this is one of the ways.

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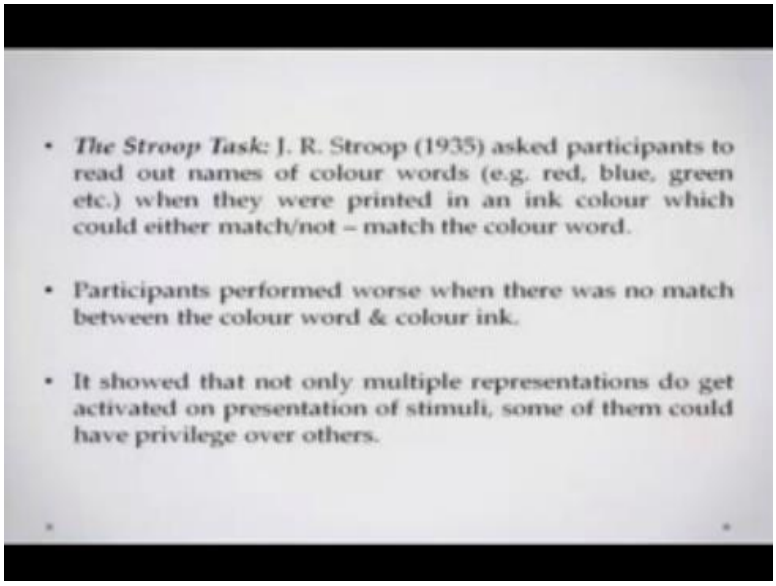

Basically we shared tells us again confirms the findings which we actually drew from the earlier Sternberg's task another important task was just Rove strangely strokes Stoop task which basically we are and he asked what's meant to read out names of color words so even talked about you know red green blue orange etc but they were printed in an ink color which could be either congruent to the color would say for example red is presented in red ink or it could not dissented greening something like that he found out was what he found out was that participants performed worse when there was no match between the color word and the color ink.

And it also tells us that you have multiple times of representations you know can get activated when you're looking at a particular solicitors see it these are the kind of stimuli that were used so for example red is presented in red ink.

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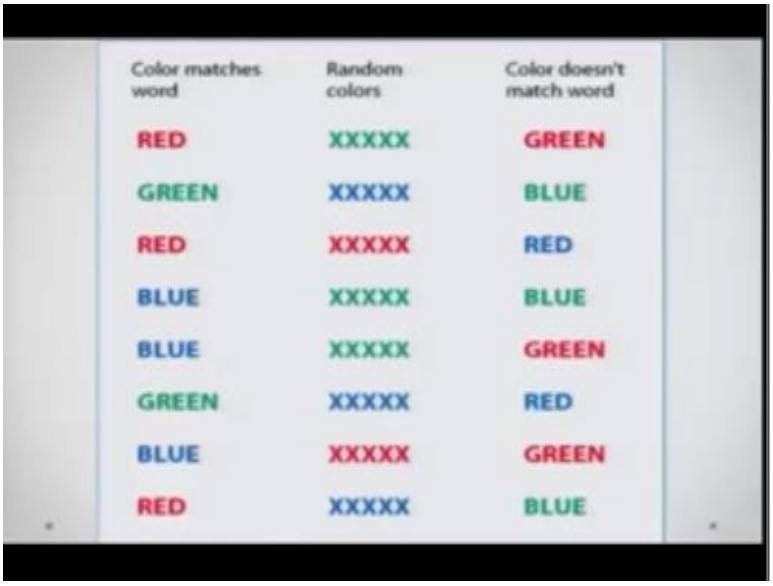

Where is red is presented in blue ink or say for example green is presented in green ink or cleaner certain inhibit reading so these are the kind of you know stimuli that we use.

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This is what the performance of words could be like so you were actually seeing green written but it is presented in green ink so you actually have to just name the color of the ink so that is what is leading to this conflict.

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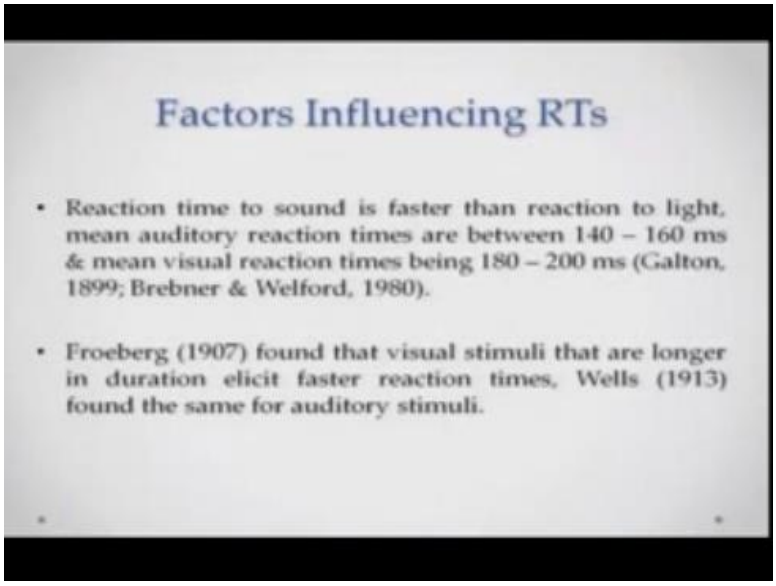

So these are the three you know very basic kinds of reaction time tasks which have been very important over the years and have guide lot you know not many reaction time studies what could be the other factors you know that could influence reaction time so it is two of them I will mention here say for example it is known that reaction time to sound is much faster than reaction time to light say.

For example the reaction times of sound being generally around 140 to 160milliseconds reaction to visual stimuli being somewhere between 180 to 200milliseconds also Freiberg found out that visual stimuli that are presented for longer durations elicit faster reaction times because it's got more time to process let us say and wells found the same finding for auditory stimuli so this is so much about the reaction time.

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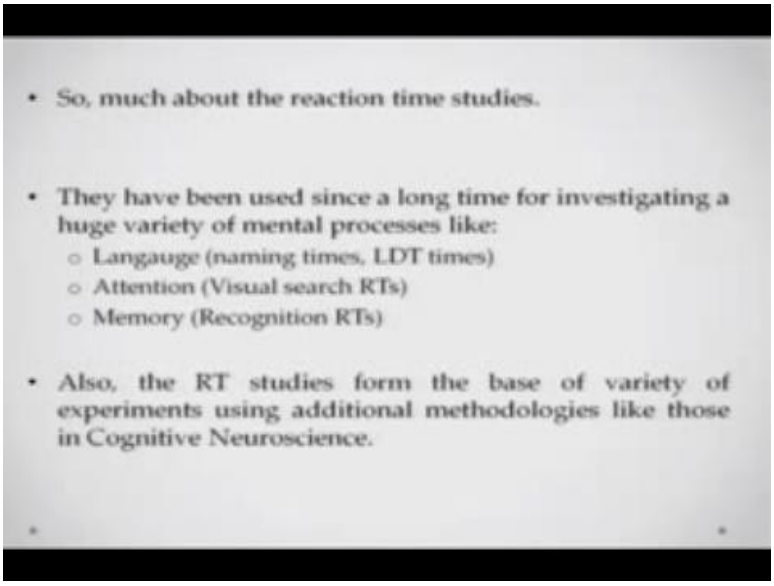

Studies reaction time you know the studies have been used to you know study a variety of mental phenomena say for example like perception and comprehension of language using naming times when you actually see a picture and you name it you read a word and you name it lexical decision times whether a word you know whether the presentation this is a valid word or not a valid word attention say for example visual search kind of a paradigm so you are given you know a scenario well you have to look for that red X in you know number of OHS or else something like that also a memory say for example you are asked to recognize whether a particular shape was presented in one of the earlier trials or not something like that.

We will talk about this in much more detail when you are actually discussing these different community functions and discussing the kind of experiments that have been used to study them now the reaction time studies actually have also you know found having formed the base of the variety of experiments which are used in additional methodologies like you know fMRI etc in fields like cognitive neuroscience now cognitive neuroscience basically let us talk about what kind of methods are used in cognitive neuroscience.

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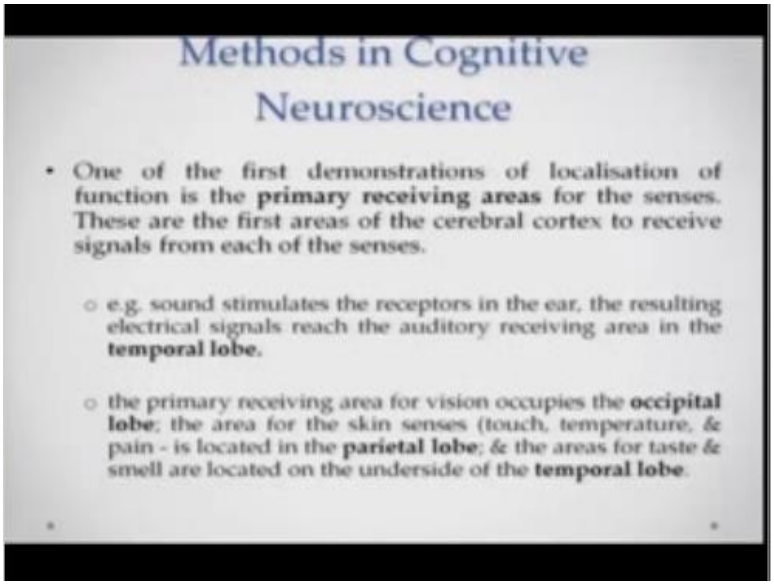

Now one of the most important concerns of cognitive neuroscience is basically you know localizing the function so the whole idea is that experimental designs in cognitive neuroscience are designed you know are basically intended to let us know or to study whether a particular cognitive function can be reliably associated to a particular structural region of the brain okay.

So that is why most of the methodologies used in cognitive neuroscience are actually designed to do just that now one of the first demonstrations of the localization of function basically you know comes as the you know the demonstration of primary receiving areas for the senses primary seeing areas basically are the first areas of the cerebral cortex to receive signals from each of the senses if you remember we were talking about this in our lectures on cognitive neuroscience now for resembles town west and you know sounder stimulates the receptors in the ear and these receptors basically you know send electrical signals.

So the auditory receiving area which is there in the temporal lobe of the brain so that kind of relationship is being made similarly the primary using area for vision information or visual information occupies the occipital lobes there is where the all the information from the eyes goes to where in this basic or initial visual processing takes place similarly the area for skin senses

which is touch temperature pressure pain those kind of things is basically done first in areas located in the parietal lobe.

So here you can see that these are specific areas which are processing these are specific areas of the brain which are processing specific kinds of input that our body receives you know we see something we hear something we touch something those kinds of things areas for taste and smell are located under the temporal lobe now what does the frontal lobe do the frontal lobe basically receives signals from all of these senses and it actually plays a very important role in perceptions that involve the coordination of information which is reaching through their ideas.

And see what is on one of the basis of sites inference of a place you might need to decide whether you want to stay in that place for a longer time or you want to just move out of that place this kind of you know decision-making is actually done in the frontal nose wearing they're actually you know evaluating the different kind of sensory input that you get it.

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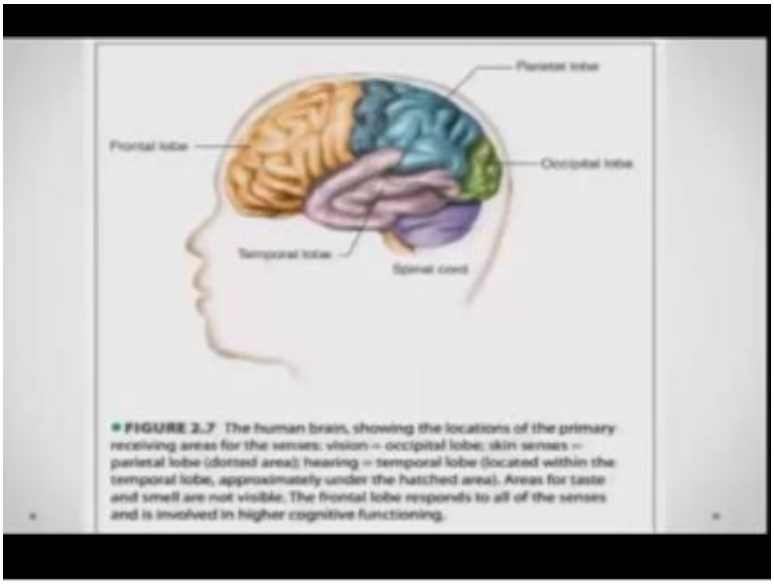

Okay, now here you can see again the frontal lobe the temporal occipital and the parietal lobes in this figure.

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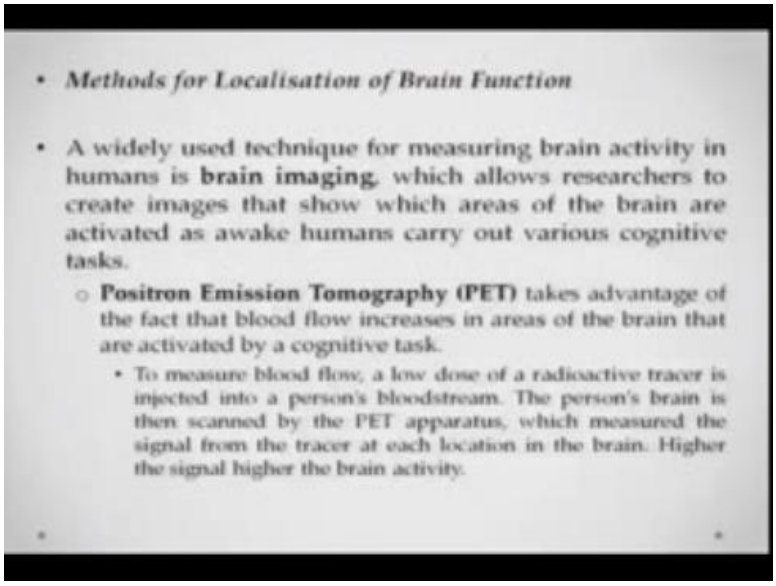

Now let us talk about these methods of localization so a widely-used or you know technique for measuring brain activity in response to this environmental stimulation is the technique of brain imaging brain imaging basically allows researcher to create images that show which areas of the brain are activated when the humans are awake and that involved in carrying out various cognitive tasks one of those areas I am not really going to you know do a very exhaustive or an in detail examination of these things and just actually give you a flavor of what these methods are so that when you are actually talking about experiments using these methodologies while we are doing you know studying various cognitive functions a kind of you know gives you a way of understanding what we're talking about.

So the first method we can talk about is positron emission tomography bearing and this method is basically you know one which takes advantage of the fact that blood flow increases towards areas of the brain that are involved or activated by Ford in your cognitive task say for example there is an area of the brain that is sensitive to viewing faces so every time.

I see you know I show you a face in an experimental setup or otherwise the blood flow to that area of the brain which processes faces will increase okay a very simple reduction to make so to

measure blood flow how do you measure that you know the blood flow is increasing in that area so what you do is a very low dose of a radioactive tracer is injected into the blood okay and the person's brain is then scanned by a PT X period a flutist wherein a person actually lies down as a big scanner where the person is sent in and then this scanner actually measures the signal from the pressure okay at each location in the brain higher.

The signal higher the brain activity so for example if you're showing me faces and there's the area of the brain you know which is responds selectively to faces I will see much higher activity of you know much higher brain activity in that particular area and that can be measured and logged by the scanner now PT basically it has any weekly researchers to track changes in blood flow and thus to determine which areas are very involving activity you know this kind of measurement is called functional imaging now how do you really you know say for example most tasks that we engage in are not very simple tasks.

So how do we really do it so one of the techniques that researchers have developed to determine this is at which areas are specially involved in which sense economy functions is this subtraction technique now this is a rather simple technique what is done is you first measure the brain activity in a controlled state you know when the resting say for example kind of a resting state so the person's not doing anything is just closing his eyes.

And relaxing and you are measuring their then you know where this tracer is you just measure the activity of the brain in the resting state okay I actually take an elective let me take an example of a particular study - you know illustrate what a subtraction technique is so for example there is a study which was data which was designed to determine which areas of the brain are activated for a person when he manipulates a particular object.

So what they did was the first measured the activity generated by simply putting the object in the person's hand okay so the person is just holding the object and you measure the brain activity at that point of time this will be taken as an example of a control state.

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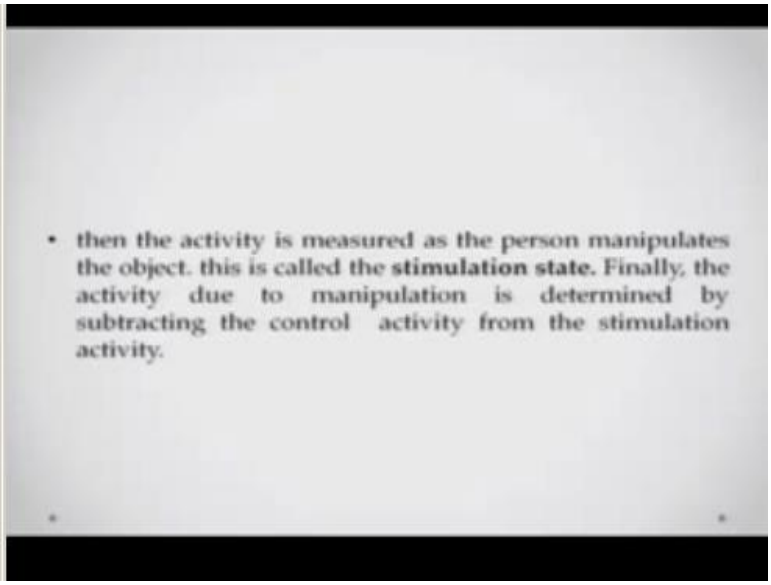

Next what you could do is you measure the activity when the person is actively manipulating that object you know it's turning it around and say for example if it is a ball or all is turning the object around in the hand and then you again measure the brain activity at that point that is your stimulation state finally what you do is you do this manipulation you subtract the you know brain activity in this contest emulation state and you subtract the activity of the control state from this activity for example if the activity.

Let us say I am taking a random number is a up to 100% in areas XY and C in the stimulation state and the activity in these areas XY and Z were just around 40 in the control State this subtraction will give you the number 60which is pretty much the amount you know the kind of you know activation that happened in response to what the person was doing that is manipulating the object this is a simple method of subtraction.

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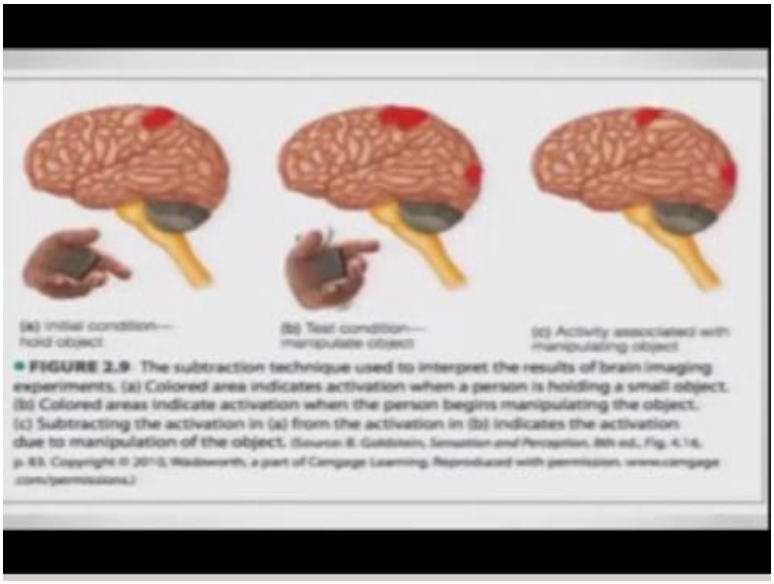

Here you can see this you know happening in a sort of a demonstration you will see and the leftmost there is an initial condition where the person is just holding the object B is your test condition whether the person is actually already manipulating the object and C basically shows you the subtraction so you can see that you know the area say for example in the you know dorsal part of the parietal lobe are basically involved in some sense in manipulation of the object because that is the part that is left there in the motor areas that is .

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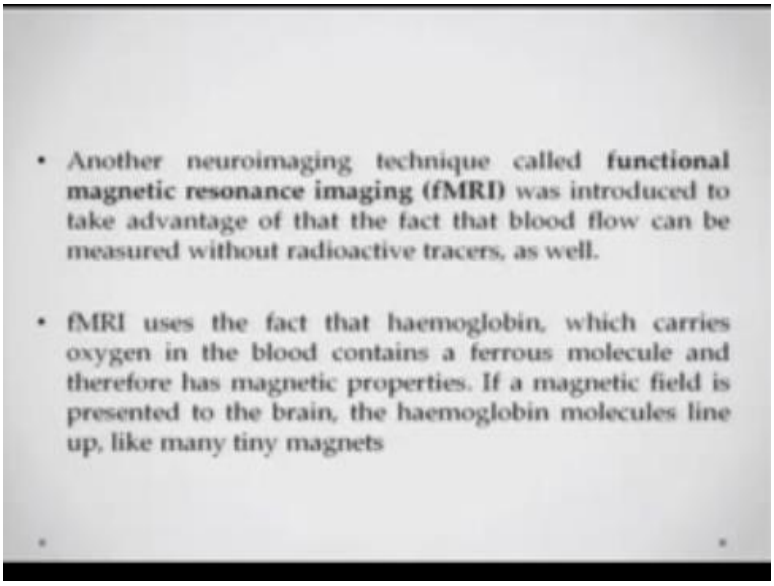

Now another kind of neuron imaging technique is called functional magnetic resonance imaging you know this was introduced to take advantage of the fact that blood flow can also be measured without injecting any kind of radioactive tracer so for example some people might be averse and you know there might be afraid of participating and experiment which injects a radioactive substance with a blood.

So you know for help of those kind of experience or dealing with those participants you could have something called the functional magnetic assonance imaging now fMRI as it is called as the you know abbreviation is it uses the fact that hemoglobin which is a molecule in your blood carries an oxygen carries oxygen in the blood okay and it contains a ferrous molecule but something that is attracted to magnet.

So okay it has magnetic properties now if a magnetic field is applied to the brain these hemoglobin molecules they start lining up like many tiny you know they align themselves to the magnetic field that is being applied now.

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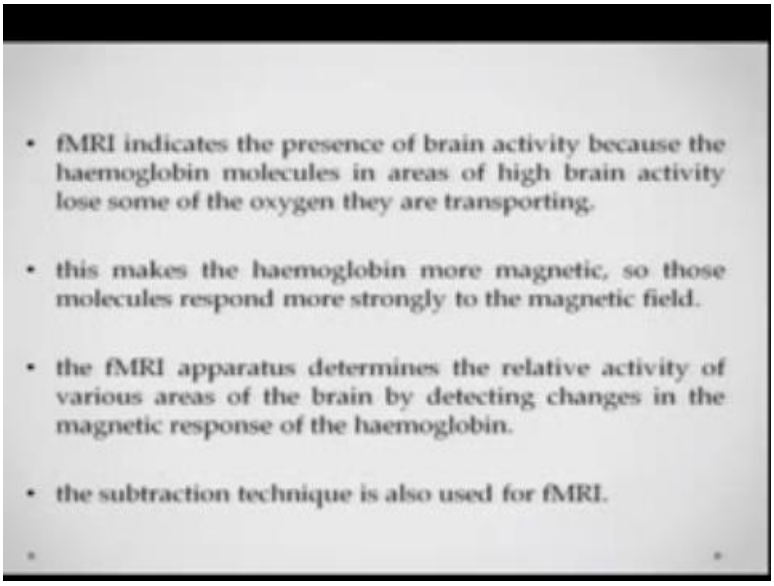

FMRI basically indicates the presence of brain activity because similar oil molecules in areas of high brain activity lose some of the oxygen's they are actually transporting this basically makes the hemoglobin more magnetic and also the molecules can then respond more strongly to the magnetic field and you can actually measure that so Fmri apparatus basically determines the relative activity of various areas of the brain by detecting changes in the magnetic response of hemoglobin.

So if a particular area is involved in crossing a particular kind of stimulus there will be a higher magnetic response coming from those areas so you are actually measuring the amount of you know magnetic response that is coming from an area if that is more while doing a particular task then that area is involved in doing that task again you can use the logic of the subtraction technique with fMRI as well.

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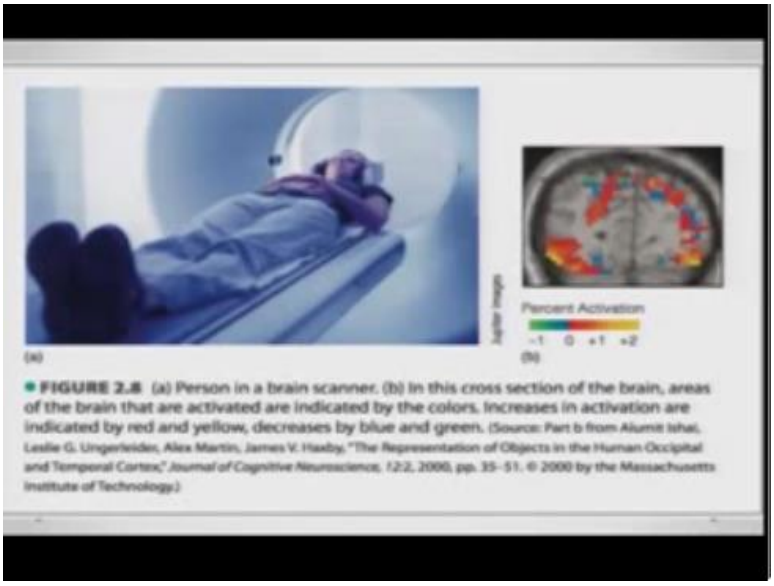

So this is this you know a prototype of the scanner you can see the person is lying in the scanner and you can see here on the right panel that activation you know is being measured so ranger say for example the areas in green are least activation areas in yellow are more you know having more activation here.

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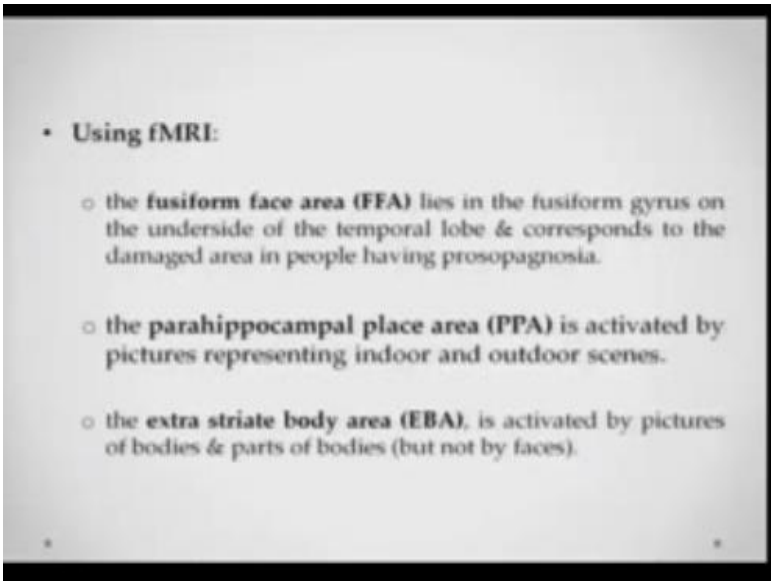

What has fMRI has been used for actually localizing a variety of cognitive functions two particular brain areas say for example there is this area called the fusiform face area which lies in the fusi form gyrus on the underside of the temporal lobe and basically correspond to the damaged area in people having possible nausea.

So people who cannot really you know see faces or recognize faces have damage in this area it is another way of saying that this area's involved in a perception of faces the para hippocampus area basically is activated by looking at pictures of indoor And outdoor scenes similarly the extra striate body area is actually activated by pictures of body parts and parts of bodies but not faces here.

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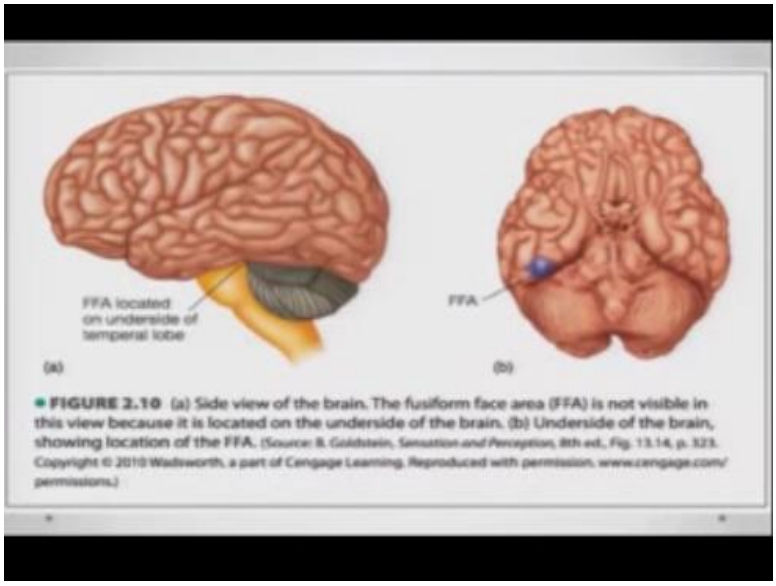

FIGURE 2.10 (a) Side view of the brain. The fusiform face area (FFA) is not visible in this view because it is located on the underside of the brain. (b) Underside of the brain, showing location of the FFA. (Source: B. Goldstein, Sensation and Perception, 8th ed., Fig. 13.14, p. 323. Copyright © 2010 Wadsworth, a part of Cengage Learning. Reproduced with permission. www.cengage.com/permissions.)

You can see the fusi form face area in this figure here you can see you know that the inner finally the para hippocampus area place area is being activated by places that are in the top row but not you know body but not by other kinds of stimuli which are in the bottom row in the lower part you can see the EBA getting activated by body part so body like part but not in the not virustremely which are there in the bottom room so these are some of the ways in which a particular areas of brain have been linked with particular processing of particular kinds of stimuli

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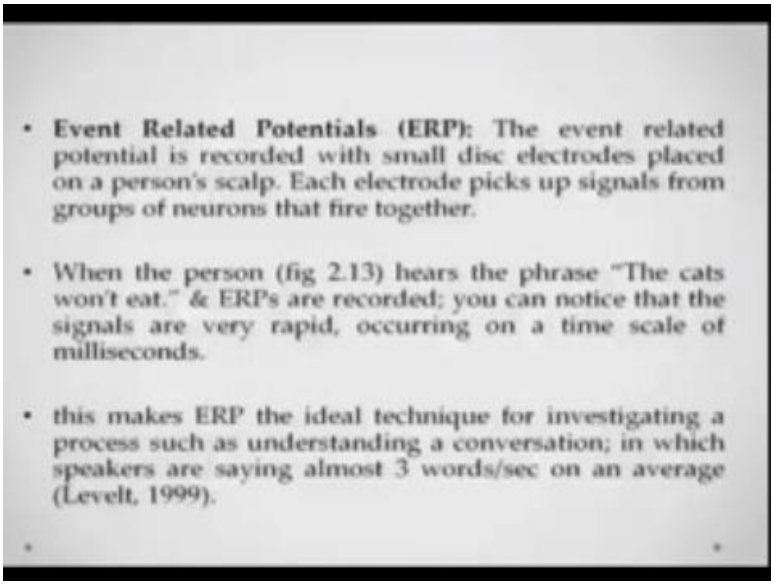

Another technique which is a very interesting technique which we can talk about this the technique of event related polling so this is basically a sub part of a broader technique which is electro encephalography which is basically measuring the electrical activity in the brain now one of the drawbacks with the methods we have been talking about till now fMRI and Pt is that they have very good spatial resolution they can actually tell you which area processing is going on but they have a very low temporal resolution they do not tell you at in real time how the processing is happening you know a general kind of reaction time in a PT or an fMRI study is around a few minutes.

Now we know that you know brain processes stimuli very fast you if you really want to know how what kind of mental you know stages have been gone through while passing about instantly you would want to have a much better temporal resolution that temporal resolution is given to us by this technique called PRP which is event-related potentials now what is ERP the event-related potential basically is recorded by putting a small disc of electrodes placed down on the person scalp each electrode picks up signals C from the groups of neurons that fire together in the brain under the skull now when say for example a person hears the phrase.

Let us say we have given him you know to read something like the cat won't eat and then ERPs are recorded then you can notice that the signals are very rapid because the question is actually reading these you know stimuli there is reading these words and this is this electrical activity is happening on a scale of milliseconds now because of this very good temporal resolution ERP becomes the ideal technique for investigating processes that are happening in real-time you know say for example how well or poorly a person is understanding a conversation that is ongoing.

And in which they for example you know in right the example of conversation because it is another fast process a person generally speaks about three words per second in an average way so it's a rather fast person you are if you want to really understand that you would want to use a method like ERP so this rapid response of ERP.

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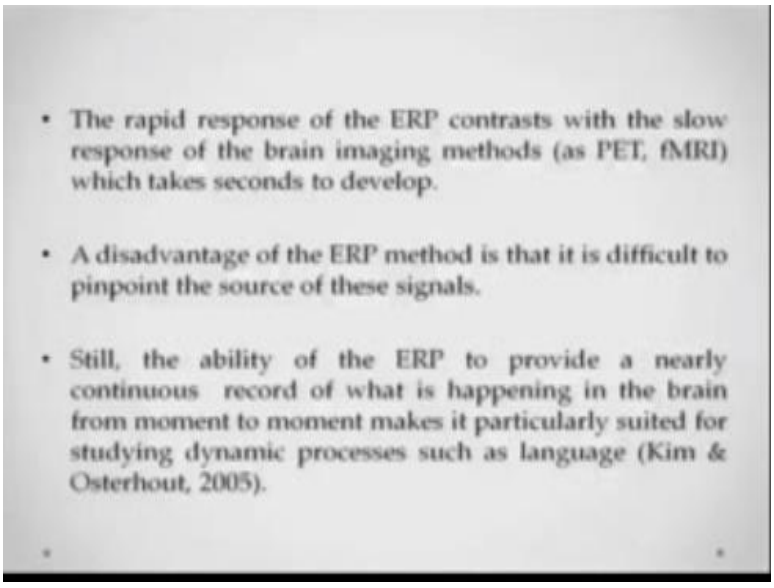

As I said contrasts with the slow response of brain imaging methods which we've talked about now one disadvantage of the ERP method by the way is that it is difficult to pinpoint the source of these selected prediction okay these signals you gain while it can tell you know at what time what is happening but it cannot really tell you very signals are source from and it is understandable because you cannot really know exactly which set of sails this signal is coming

from and this also you know the scalp and the hair and everything that the scalp that is actually underlying the you know these electrodes.

So that is basically something which is very difficult to determine still the ability of ERP to provide a nearly continuous record of what is happening in the brain makes it a very you know nice method to study say for example dynamic processes as I said language attention those kind of things let us take an example so as a method of investigation as I said ERP could be very useful say for example indistinguishing how a person is processing the form of language or say for example whether it is syntactically correct grammatically correct that is or not or you know better it is meaningful or not meaningful okay.

So as ERP consists of a number of ways that occur it you know different delays after stimulus is presented these have been linked these different kind of waves have been linked to different aspects of language just to take an example then400 component which basically is means negative and 400 means 4headmilliseconds so this negative 400component is actually linked to persons processes of meaning if you processing something which is meaningful which is say for example not meaningful.

And does not really fit in whatever you've read earlier the n400 component might come or say for example if you're reading something which is not grammatically correct a p600 component might comma which is a positive peak of around 600mentions at around 600 sec.

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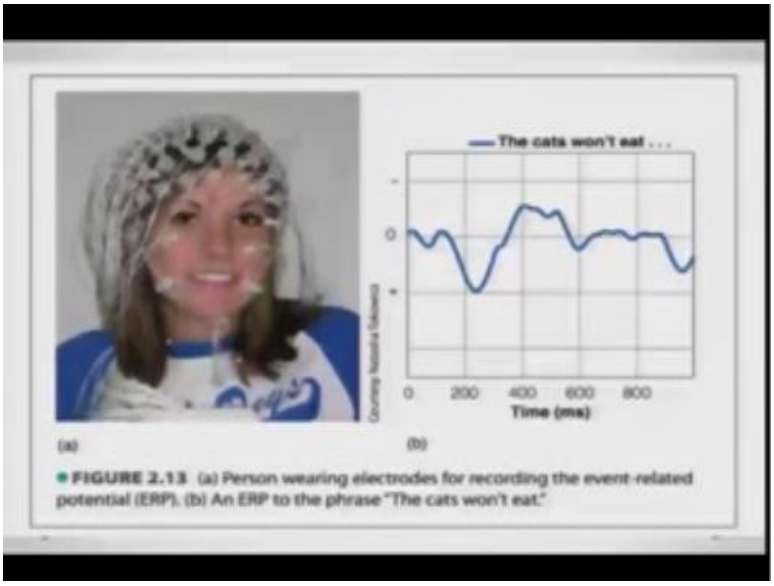

So let us say is this example you know here you can see on the left there is a person which having always having this electrical you know the scalper this a set of electrodes on her head and she is reading something called as you know reading this is a fragment of a sentence called the cat's would not eat now you see how you know the brain activity or the electrical activity is going on in the brain at this point okay the person has just read this fragment the cat's won't eat now you actually change this a bit.

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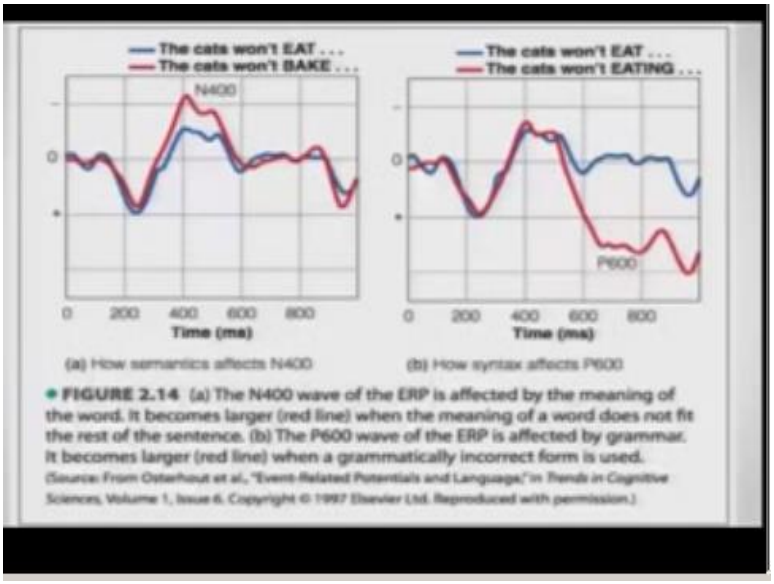

FIGURE 2.14 (a) The N400 wave of the ERP is affected by the meaning of the word. It becomes larger (red line) when the meaning of a word does not fit the rest of the sentence. (b) The P600 wave of the ERP is affected by grammar. It becomes larger (red line) when a grammatically incorrect form is used.
(Source: From Osterhout et al., "Event-Related Potentials and Language," in *Trends in Cognitive Sciences*, Volume 1, Issue 6. Copyright © 1997 Elsevier Ltd. Reproduced with permission.)

And then you have two kinds of sentences one kind of sentences one kind of sentence is basically have a meaning anomaly and the other kind of sentences have a grammatical anomaly so you see cats would not eat and cash would not wake now if you read the cache would not bake they will be a response from the rain which says that cash generally do not bake so this sentence is no meaningful in this kind of setup you can see there is a negative peak you can see on the Left panel at around 400milliseconds so in ERP studies generally negative is on the top as you can see from the figure.

So you have you see speak around 400 milliseconds a negative peak on the right panel you can see the cache won't eat and cache won't eating there is this is just a mistake of grammar in the second sentence so here you can see in the right panel that is a positive peak which is kind of coming up around 600 milliseconds so in this sense these two components of ERP tell you how fast and how quickly you are detecting these kind of anomalies by reading particular sentences okay.

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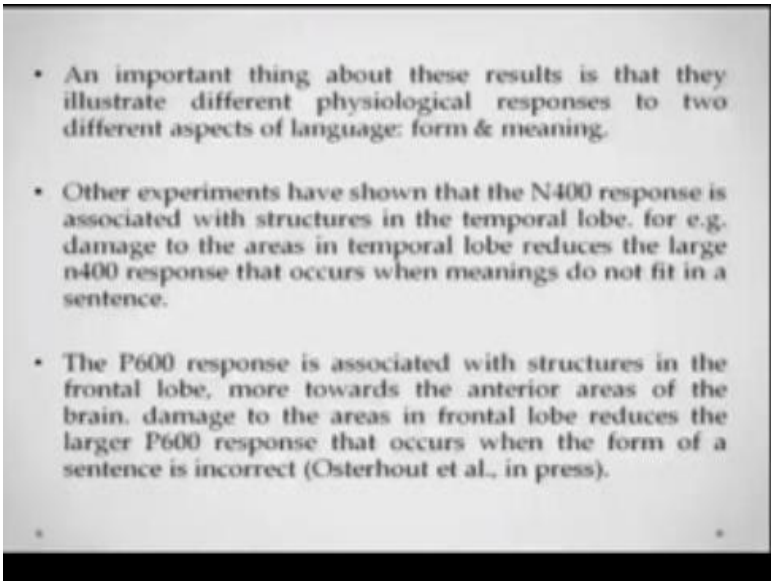

So this tells you a very important thing that you know there are different physiological response to understanding meaning and different physiological response to understanding the form or the grammatical correctness of you know of any language that you reading it could actually very well be any language sentences regiments want to use so another other set of exponents have also shown that the 400 response is associated with structures in the temporal lobe and damage to areas in the temporal lobe actually reduces the amount of n400 respond that will occur when you come across same sentences like the cats would not bake or say for example.

The cats eat stew or something like that the p6 alert response has been associated with structures in the frontal lobe okay more towards the anterior part of the brain that is damage to these kind of areas in frontal lobe them has been found to reduce the larger P 6 and responses that occur when the form of the sentence is incorrect.

So in that sense you can actually you know in some sense estimate that these areas are involved in this kind of processing at that particular time scale nowadays I would like to observe that people are actually you are not doing using a combination of techniques so you're going to generally see people using a combination of ERP and fMRI wherein they actually get a very

good spatial resolution and a very good temporal resolution to go with it now those kind of research designs will also come across when you're actually talking about these different cognitive functions.

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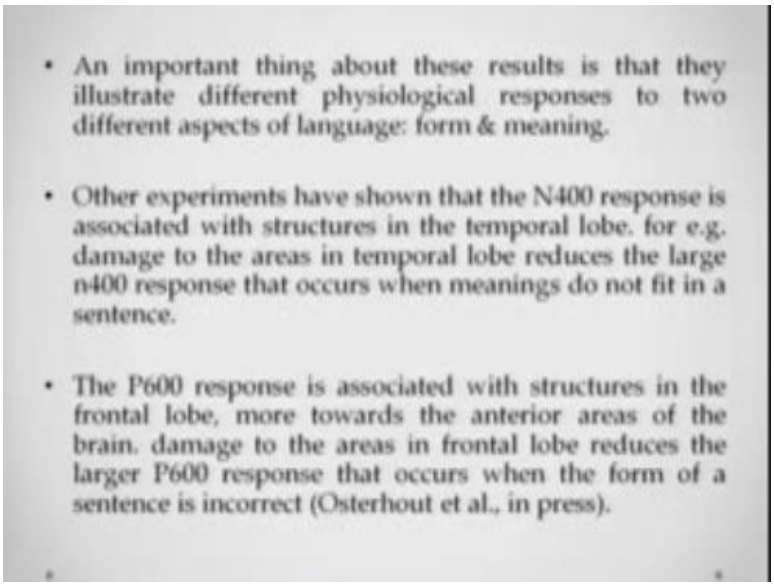

Let us sum up what we talked about in today's lecture we talked about your variety of ways in which research methodologies have been used to talk about these abstract maintain tasks abstract mental functions which we have been searching about in the cognitive psychology domain okay we talked about reaction dying tasks and how there action time tasks are when you should investigate different mental functions we talked about neuro imaging tasks like PT and fMRI and we finally talked about electroencephalographic tasks say for example ER piece that is all for today and this was basically about their search method specific to A combinational thank you.

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