Indian Institute of Technology Kanpur

National Programme on Technology Enhanced Learning (NPTEL)

Course Title
Basic Cognitive Processes

Lecture: 27
Attention- III

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National program of technology

Enhanced Learning (NPTEL)

Hello everyone welcome to the course basic cognitive processes I am dr. Ark Verma from IIT Kanpur we have been talking about attention in the last couple of lectures we in the first lecture we talked about visual search we talked about how you use attention to search for particular objects in your environment say for example whether you follow a process of features looking for specific features whether you press and follow process of looking for combination of features and then we talked about how do you do this selection we talked about selective attention today we will talk about what is called divided attention now it is no surprise you know and it might not come as a novelty to any of you for that matter.

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That we do for the most part do two things at once say for example this gentleman right here in this figure is actually driving in trying to text at the same time and this is actually where you start misusing your capacities of dividing nation okay in this particular course will try and see how good or a bad decision something like this will be we will talk about the fact that we can handle more than one information more than one kind of stimulus more than one kind of location at the same time yes.

We can do that we will also do talk about the limitations of being able to do that how do we do that what are the you know processes involved in doing that and how does our attention facilitate or sometimes acts as a limitation in doing two things at the same time this one however is a bad example to follow so we let us move towards investigating what divided attention does in a safer scenario of a particular lab.

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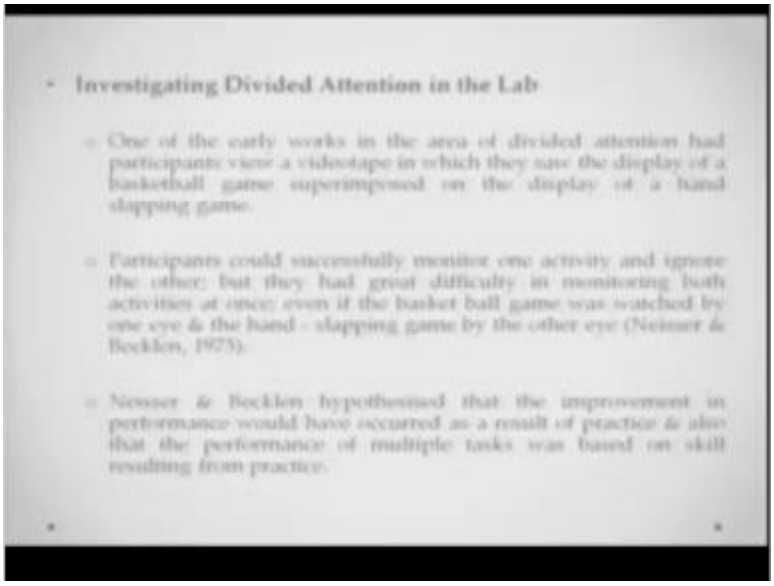

Now one of the early works done in the area of divided attention had participants view of videotape in which they saw the display of a basketball game superimposed on the display of a hand slapping game so they were these individuals they were actually you know they have brought two in front of the screen maybe it was presented and they were actually looking at two activities at the same time they are looking at a basketball game and also at the same time looking at the display of a hand slapping game now these participants could successfully monitor one activity.

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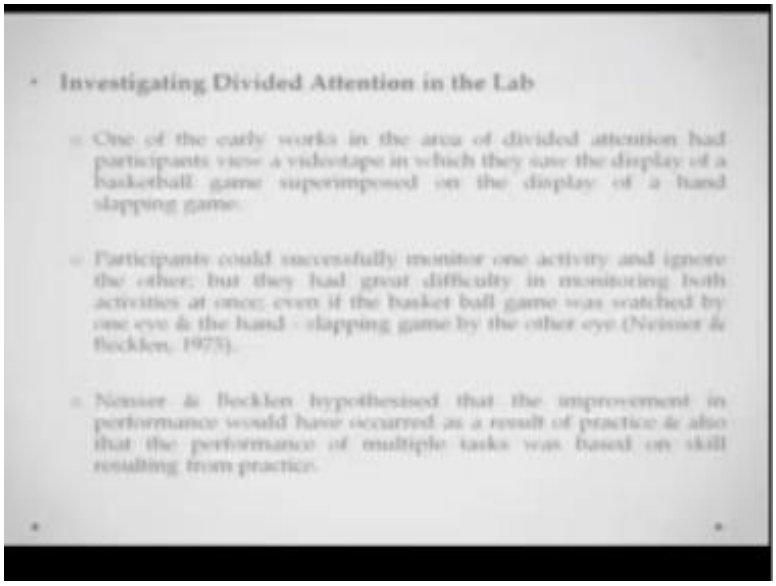

And ignore the others if they were told that you just focus on you know viewing the basketball game or say for example if they were advice to just focus on the hand slapping game they could do that very successfully but in a third condition if they were asked to follow both the games simultaneously and you know do some kind of reporting about what happened and something like that they had great difficulty in one sharing both these activities at the same time even if the basketball game was washed by one eye.

And the hand slapping game by the other I said you can do everything I'll just divide one of my eyes to doing this on the eye so doing if I Am not really sure how possible that is but even if people would use a strategy as interesting as that they were not really successful in doing that now.

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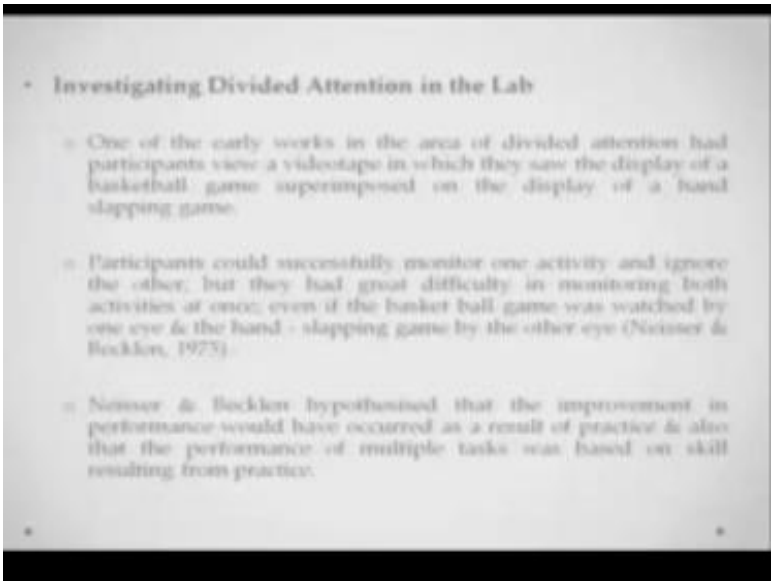

Nigel and Declan who did this study they hypothesize that the improvement in performance could have happened we know if the publicist would have practiced B enough now as a result of practice they would have acquired the skill of monitoring each of these games first and then each of these games simultaneously now this is where your ability of divided attention comes in attention we have seen that is the ability to select information and work at one information and one time and the other information and later but this is a different kind of thing that you are saying that you can attend to more than one thing more than one event or object or location at the same time so this is what is called divided attention.

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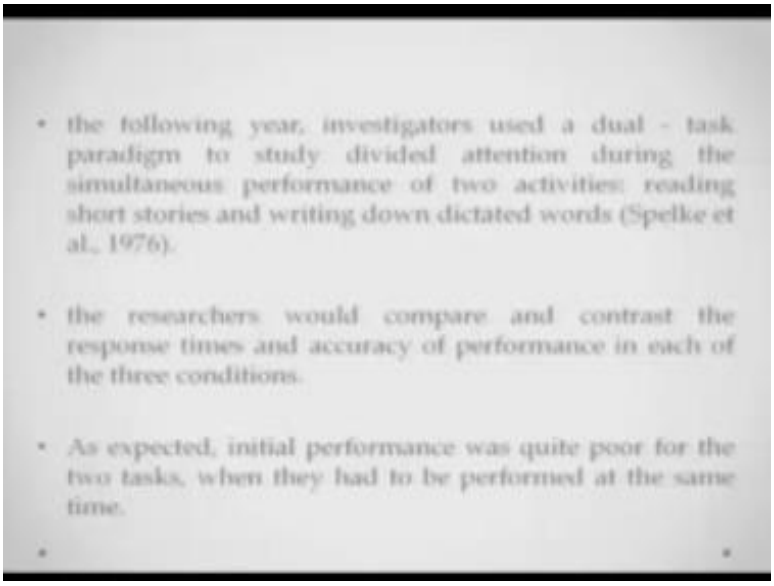

Now in the following year the same investigators they use dual task paradigm to study divided attention during this simultaneous performance so earlier was observation this is a performance task and the two activities these participants were performing worse reading too short stories and writing down dictated words so in one activity they are actually reading a short story and there with the second thing they are being dictated some words and there to write that down so two activities are happening here.

Now the researchers actually would compare and contrast the response times and accuracy in each of the three conditions what will be the three conditions the first condition will be doing the reading task the second condition will be doing the dictation task and the third in the most important condition for our purposes is a condition wherein they are doing both of these tasks simultaneously now as expected the initial performance was quite poor across the two tasks you know when they had to be performed at the same time.

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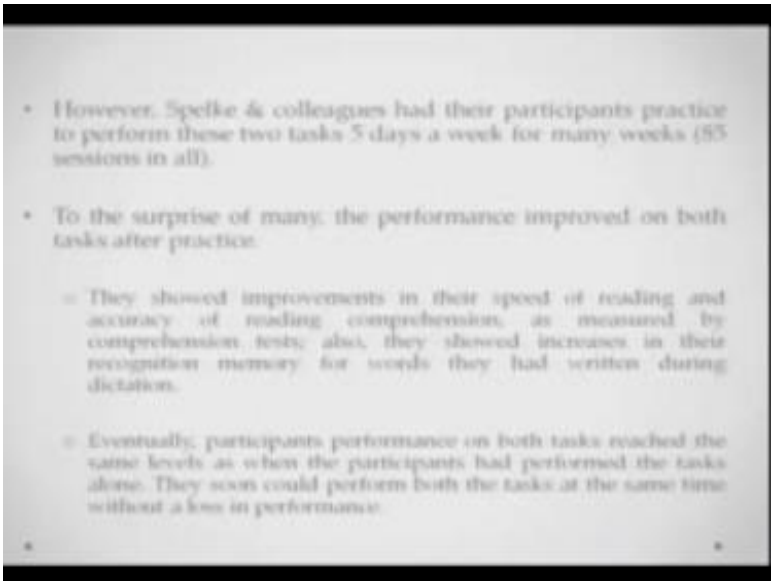

But spelke& colleagues they had their participants practice to perform these two tasks five days a week for around 17 weeks total of 85 sessions in all so they kind of spend a lot of time practicing these two skills reading a story taking dictation at the same time but to the surprise of many the performance actually improved on both the tasks after practice so the participants were showing improvement in their speed of reading and the accuracy of reading comprehension as measured by the completion tests on whatever passages they were presented with also they showed increases in their recognition memory for words they had written during the dictation part.

So they are kind of not only getting better at each of these tasks independently they are getting better at performing these tasks together so eventually these participants performance on both the tasks also reached the same levels as when they would perform each of these tasks alone so that is quite an improvement in itself now they could perform both of these tasks at the same time without any loss in performance on both say for example if you would say that I have this hundred percent capacity of doing a particular task if I am doing two tasks then I probably divide it 50/50.This case the parcels are doing both the tasks at 100% at the same time.

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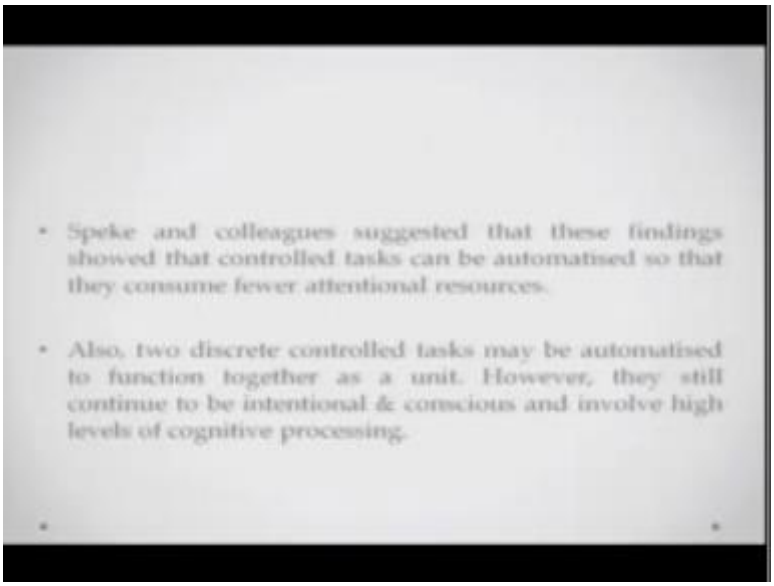

Now speaking colleagues who are doing this research of you know examining these two dual tasks this is said that these findings are showing that control tasks can also be automated so that they consume fewer intentional resources also to discrete control tasks may be optimized as a function together as a unit if you doing two tasks together say and you practice them in ER if you are good at them enough you can synthesize them you know some people study by repeating you know whatever they are reading.

So they Are speaking and reading at the same time and they it to them because both of them are working as a run unit task and is working pretty well so however they still continue to be intentional and conscious and involve high levels of cognitive processing it is not really taking away all their resources because they are doing two tasks they have evolved or practice the skills as much that they both of these tasks are functioning together and they're functioning as one unit of a task.

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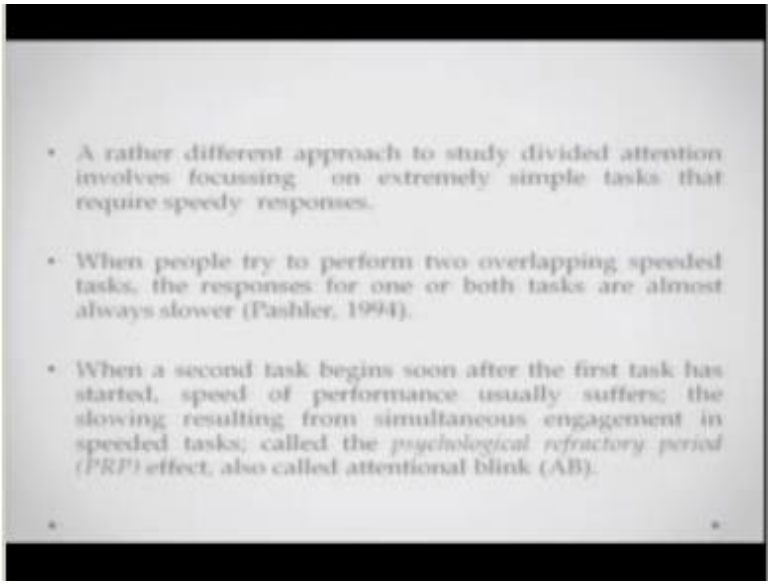

Now a slightly different approach to studying divided attention could be involving focusing on very simple tasks very you know a very simple tasks that require speedy responses an example could be say for example if people try to as you know perform an overlapping speeded recognition tasks like the one we do in our luvs the response for one or the both tasks are always slower so for example if you know if the second task begins soon after the first task started the speed of the performance usually starts to suffer the slowing is actually resulting from simultaneous engagement in these two speeded tasks this slowing is called the psychological refractory period also has been referred to as the attention blink phenomena in attention research.

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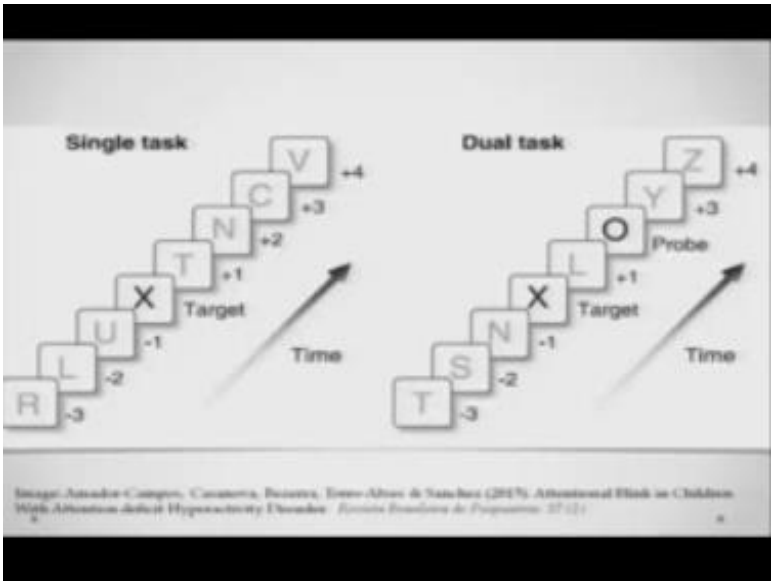

Now hearing is a good example in a single task scenario I can just ask you to spot a black X among these you know rapid serial visual presentation of grey alphabets so these grey alphabets will be presented one after another in quick succession generally with the presentation type of rounds seventy five or fifty milliseconds and then their tasks of the participant is to just recognize whether in that particular recipe sequence black X were presented or not so this one kind of performance particles generally do very well at it.

Now I can make this slightly twisted and I can tell you that ok you have to perform your know spot a black X but you also have to spot a black Oh after that X that might appear not appear might be closer to the X layer further from the X all of those things I would be able to manipulate but I am giving you two tasks Here I am giving you to identify two targets T 1 and T 2 again in the same recipe stream it has been found and research has shown that the performance in identifying the second target generally suffers.

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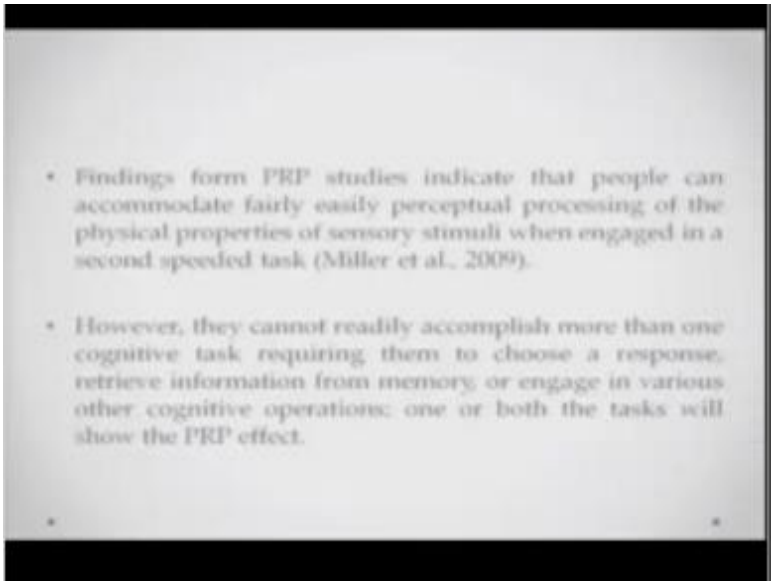

Now findings from these PRP studies these kind of studies indicate that people can accommodate fairly easy perceptual processing of physical properties or sensory surely when engaged in a second speeded task so they can with practice do that as well however they cannot readily accomplish more than one cognitive task requiring them to choose a response to a you know or retrieve information from memory or engage in various other cognitive operations at the same time. So one or both the tasks will generally show the PRB effect it will show the characteristics slowing down it will it might show the characteristics you know a characteristic fall in accuracy as well.

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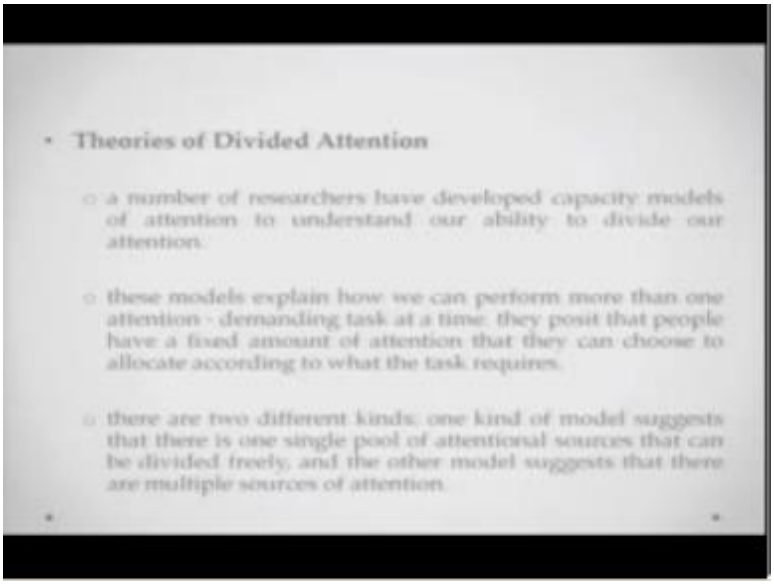

Now let us talk about theories of divided nation let us talk about what kind of theories do you know talk about divided attention now a number of researchers have developed capacity models of attention to understand our ability to divide out a so the whole point of being able to divide attention is that you have a limited attention capacity and you kind of divide this into two tasks which you are doing or which you intend to do at the same time now these kind of capacity models explain how we can perform more than one attention demanding tasks at the same time these post-it people have a fixed amount of attention that they can choose to allocate according to whatever task requirement.

So if you are doing an easier task and a difficult task it might be slightly easier to do it if you are doing two equally highly demanding terms then it might be slightly difficult to allocate attention and manage that now there two different kinds of models that have been proposed one kind of model suggests that there is only one single pool of potential resources so all that sensory information that you need to negotiate with there is only one pool of potential resources that you would have.

And resources can be divided according to the needs of the two tasks at hand the other model suggests that there are multiple sources of attention and there might not be a problem in negotiating you know the two tasks or three tasks at the same time because you can say for example and ask different pools of attention to be allocated to different tasks at the same time so these are the two kind of funds here.

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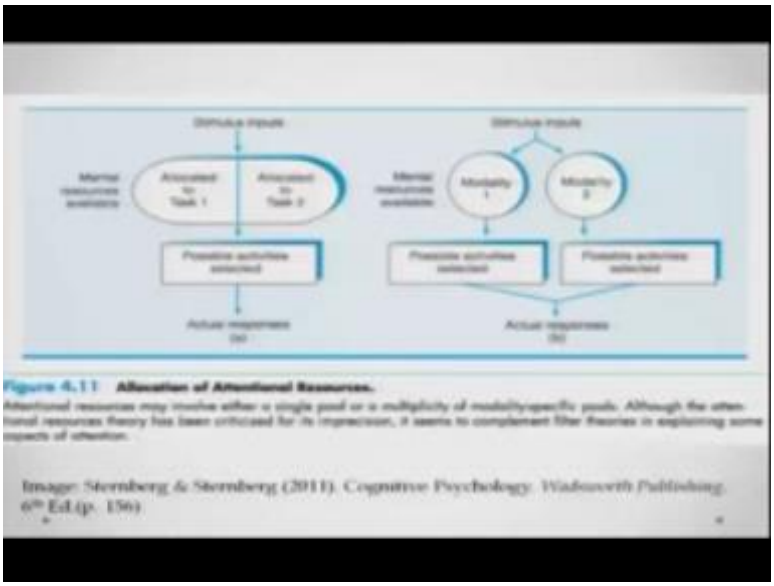

You see a graphic of that borrowed from Sternberg and stern books the text book on cognitive psychology now in the panel as you can see that there is one single attention pool whatever stimuli input are coming in part of that attention pool is allocated to task one part of that is allocated to task two and then you select whatever activities here to do may be press a key given verbal response whatever you want to do this is called a single resource model of attention or something like that the second model if you see which is your panel B you can find that whatever stimulus inputs are coming in they are actually entering in via two different modalities.

So there is modality one and there is modality two and what you are basically doing is there are separate mental resources allocated to modality one and modality two and so your selection of possible activities that you have to do directly follows from these two different modalities and in

that sense there will be less conflict and actual responses could be had later now these are the two metaphors these are the two hypothetical you know assumption see these are not really hard facts that intention really operates in this manner these are two hypothetical approaches to study attention and both of these kind of theories have been tested they have been a lot of experiments and those experiments have said a few things we will you know now talk about.

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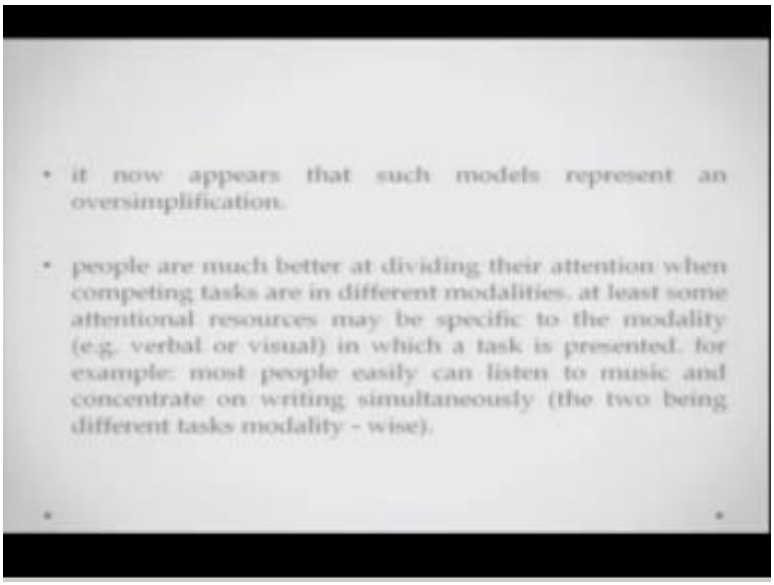

Now even if you look back at these models and say for example if you are wondering that obviously these models do represent the oversimplification these models are much better and it has been found that people are much better at dividing attention when completing tasks are in different modalities say for example if one task is in the visual modality the other task in the auditory modality people have been able to do that people have been found to do that almost effortlessly without really you know slowing down or without really being too inaccurate okay.

So it can be said that at least some attention resources might be specific to a particular modality verbal or visual in which a task is presented so for example you might also have done it a lot of times that you see most people can you know cannot you know listen to music and concentrate on writing simultaneously a lot of people do listen to music and drive they cannot even in some

sense you know drive if there is no music around in the car so people are doing two things at the same time in a lot of instances.

And so that this whole concept of different modalities having different kinds of additional resources still you know does start making some sense now it is no harder to listen to the new station and concentrate right on writing about this air you know at the same time because the information coming from a particular new station.

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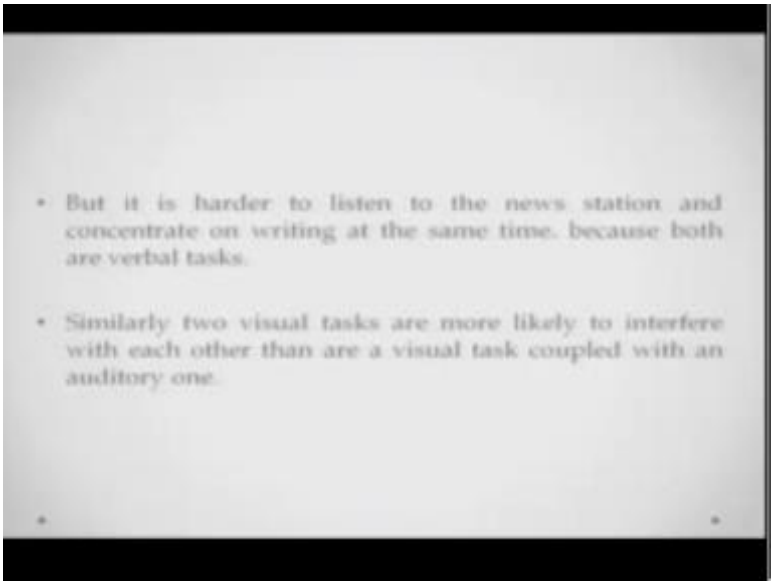

Is also new might be relevant to you might get interested in that so you kind of allocating and you know a sizable amount of resources to that also writing needs sizeable amount of resources and then it gets difficult another thing is that they are both verbal tasks they are both tasks about language so in the language modality it might be difficult then to divide the same kind of resources that the language modality has to two language tasks at the same time verbal tasks at the same time similarly if you give somebody two visual tasks they are also more likely to interfere with each other.

Now than are a visual tasks compared with the ordinary task or an auditory task compared with the hap tic task something like that so within modalities certainly there is this notion of capacity limitation within modality you try and put in too many tasks always see the finding of the PRP thing that there will be that characteristic slowing down then there will be those you know extra errors that will start coming in.

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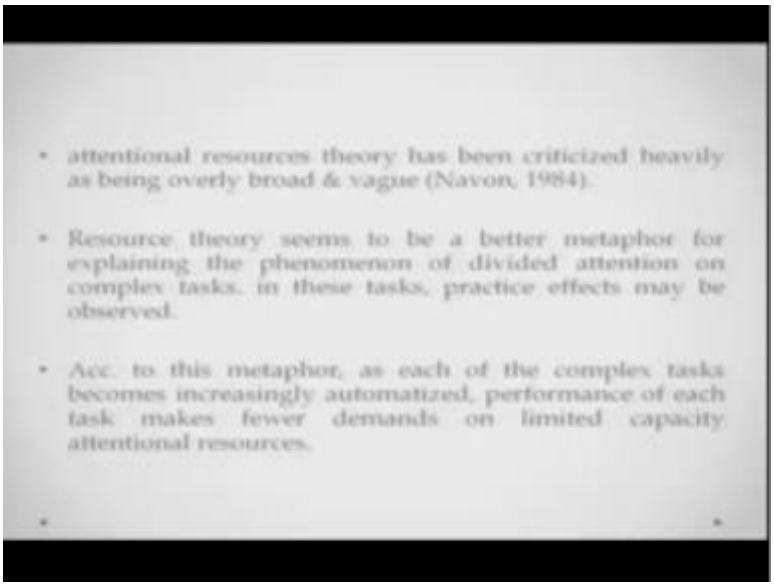

Attentional resource theory the ones which we have been talking about they have been criticized you know heavily as being slightly broad and vague resource theory then in essence seems to be a slightly better metaphor for explaining the phenomena of divided attention on complex tasks in these tasks practice effects may also be observed when the person gets you know used to it when the person gets highly skilled and in that particular task they do this become better now according to this metaphor of the resource theory each of these complex tasks become increasingly automat zed when you are getting good at driving.

And listening to music I can share one of these instances which happened with me when I started to learn driving I used to get really you know disturbed when somebody is playing the radio or in somebody's playing a radio on a higher volume as and when I practice over the you

know a course of a few months I got better at driving and in that sense now I do obviously listen to music while I'm driving it so as the task becomes increasingly automat zed as you scale on those for you let us get better the performance of each task is now going to make fewer demands on your attention resources.

And in that sense both of these tasks at the same time will become more and more manageable that is pretty much what this concept of divided attention and this whole concept of resource Theory tells you now let us talk a little bit about the factors that might influence our ability to pay attention to two or more things at the same time say for example if you are anxious anxiety is a very important factor if you are anxious either by nature some people are nervous by nature some people are slightly cautious by nature or say for example by situation.

If there is say for example as something really important going to happen in interviews there or some very difficult task is there or say for example you just had a very you know a bad fight with somebody but you still have to sit in a particular exam both kinds of anxiety do place constraints on attention you will find that your you know ability to concentrate on even one thing for that matter but on two things certainly becomes very difficult the second factor could be arousal so arousal is basically the concept of general activity.

And general of energy or relate RG in your body so once overall state of arousal obviously effects and for you know it kind of impacts attention so if you are drowsy or drugged - you are very sleepy say for example it's always said with drivers that they should be well-rested if you are going for a long trip especially at the time of the night so if you are very you know very drowsy or varies you know lethargic then your attention capacities will slightly be limited also for example if you are too excited even if you kind of you know very excited if you are very happy.

And you know sometimes it happens with friends your attention capacities will slightly be you know better and your overall attention will be slightly better if it is drowsy to be lower if it's your kind of optimally excited maybe you know better if you are too excited however then also it

might be a problem another important factor about how you can really govern your attention is that the task difficulty.

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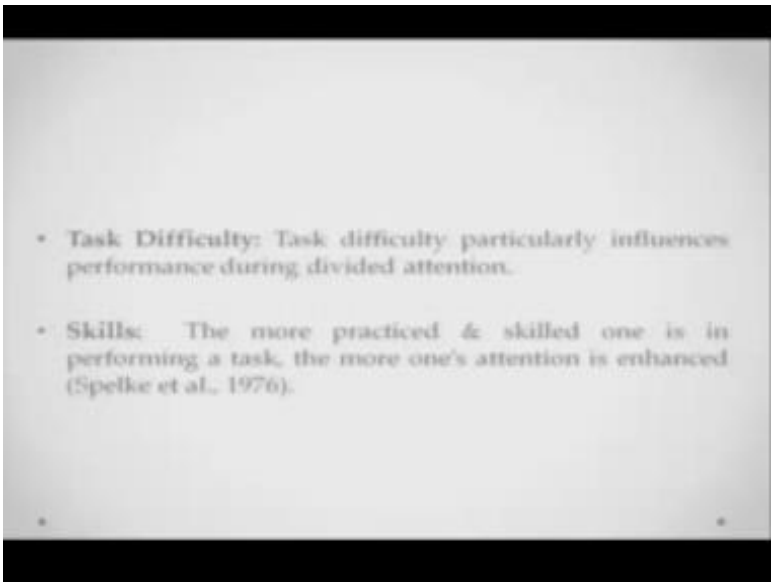

Now task difficulty particularly influences people's performance during divided if I was giving you two easy task to perform you will do it very well if I am giving you one easy and one difficult task to perform you I still do okay but if I am giving you two difficult tasks to be done at the same time under time pressure you will certainly find it very difficult to do it another aspect as we saw with the you know experiment of spec increase is that your skills play a very important role the more practiced and the more Skills you become in performing each of the task at hand the more you know better you will be in performing two tasks two of these tasks at the same time so your attention is enhanced your processing is enhanced and better if you are performing two tasks at the same time now let us talk a little bit again about the brain.

And what it has to do with attention so there is this gentleman a very important gentleman in theory of attention and attention research or in most of cognitive psychology Michael Posner he basically said that the attention system is in the brain is neither the property of a single brain area and it's not the property of the entire brain as well.

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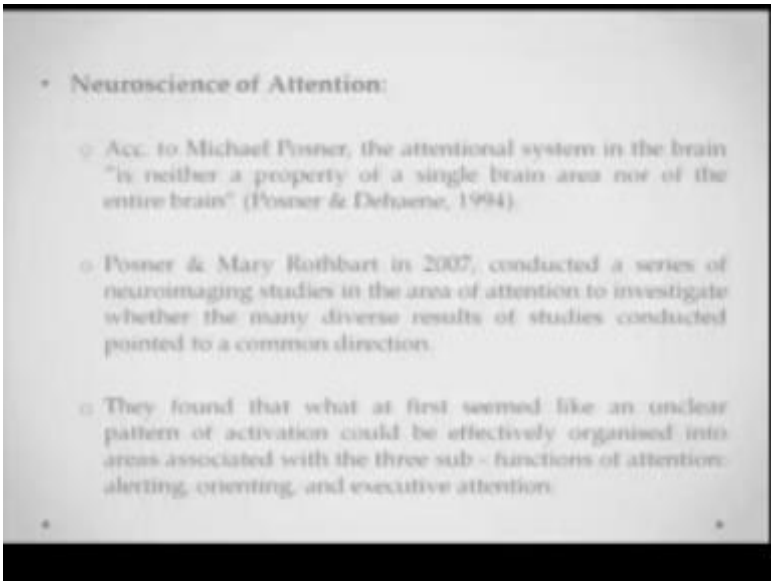

Posner and Mary wrote but in 2007 they conducted a series of neuro imaging studies in the area of attention to investigate whether the many diverse results of studies conducted points to a common direction they actually conducted a series of neuro imaging studies Fmri studies that are in the area of attention and they wanted to investigate whether the many diverse it's because there were a lot of research going on it and inattention in the past two or three decades and it actually wanted to you know try and integrate.

And combine all of the findings from all of these studies and to say whether is a you know a unique direction whether there is some commonalities and all of this literature that can be coming out so Posner and Roth were they found at worst that what at first seemed like an unclear pattern of you know results and findings could be effectively organized into areas you know associated with three sub functions of day.

So they were actually looking at the brain they were actually looking at how the brain is negotiating attention and what are the areas of the brain they are responding to various aspects and various facets of attention so they found that what actually looked like An unclear activation over you know a distributed area of the brain can actually be effectively organized into three sub

functions of attention these sub functions they said are alerting orienting and executive attention let us talk about all of these three things in more detail.

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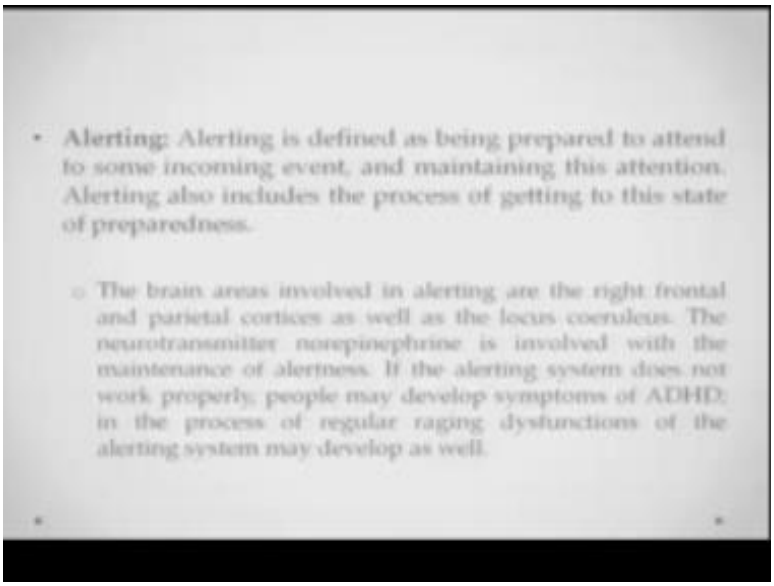

Now alerting is basically that a certification that there is about you know being prepared to attend to some incoming event and maintaining this attention so alerting also includes the process of getting into the state of preparedness if you know you are supple you know on television there is a number going to be announce and that number is of a particular lottery and you are also having a lottery ticket in your hand you are prepared that now this announcement will be coming up say for example if you know sitting at airport lounges.

And waiting for the flight announcement or in a railway station waiting for your train announcements you are actually prepared and alert to the possibility of that announcement being made so that you do not miss out on any important information so that is basically what alerting is about now the brain areas that might be involved in alerting on the right frontal and parietal cortices as well as what is called a locus coriol is now the neurotransmitter no epinephrine is also found to be involved with the maintenance of alertness also if the alerting system does not work properly people may develop symptoms of.

What is called the attention deficit hyperactivity disorder we can talk about this in a later section but this in the this is the process of regular aging days functions of learning systems and it kind of you know can make it very difficult for people to concentrate on specific things.

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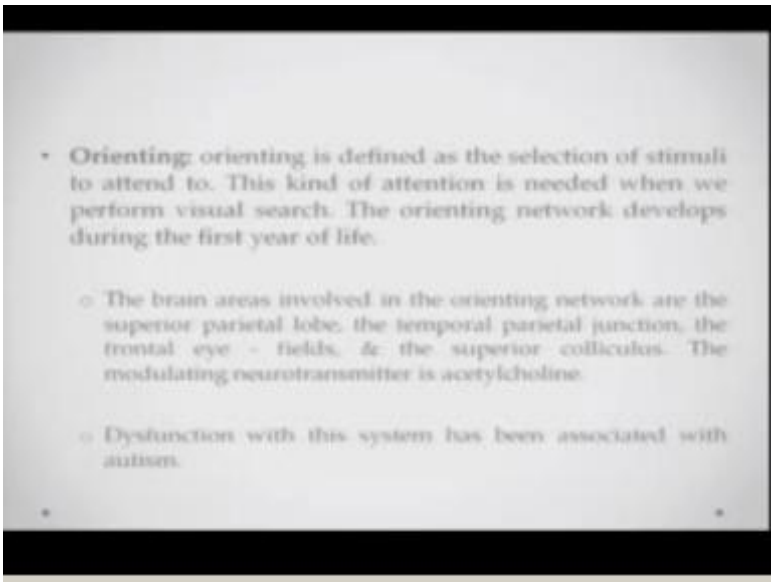

Orienting is defined as the selection of stimuli to attend to if there are too many things going on if there are too many announcements being made too many people talking around you might want to orient your attention to select something very specific and then listen and analyze and process that this kind of attention is needed when you are performing say for example visual search kind of tasks you are orienting network develops during the first year of you'll see the children even very young children are also able to orient towards particularly if you clap if you kind of you know give some kind of Foley they cancel it – that stimulates.

And look at that and then maybe you are their attention where fades off now the brain areas involved in the orienting Network are the superior parietal lobe the temporal parietal Junction the frontal eye fields and the superior colliculus the modulating transfer neurotransmitter the kind of modulation activity of this network is the acetylcholine now this function with this system has been associated with what is called autism is a cognitive disorder which has to do a lot with you

know that people afflicted with autism are not able to orient and attar into something or concentrate on things over periods of time again we can talk about autism in more detail.

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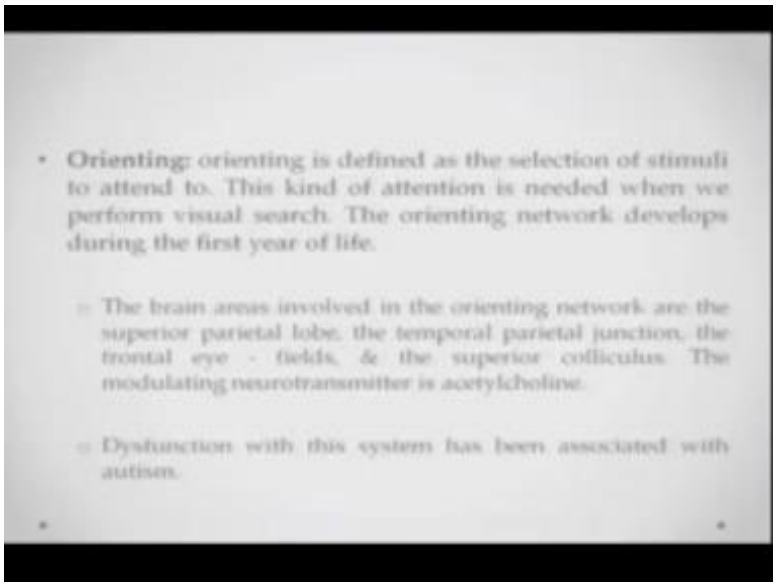

At a later point the other thing is executive attention executive attention includes the processes for monitoring and resolving conflicts that arise among internal say for example you are processing too many things at the same time too much information is coming you have to select to that I will select this and select that I will you know if there is a conflict or response all of those kinds of things feeling safe example if there's somebody saying something you are feeling very angry but you suppress your anger you see it you know continue talking peacefully those kind of you know social dilemmas are actually handled by this executive network the brain areas involved in this highest order of attention processing are the anterior cingulated cortex lateral ventral.

And prefrontal cortex as well as the basal ganglia the neurotransmitter that is involved in executive functioning is dopamine now this function with this kind of system the executive's attention system is associated with diseases like the Alzheimer's disease borderline personality disorder and schizophrenia.

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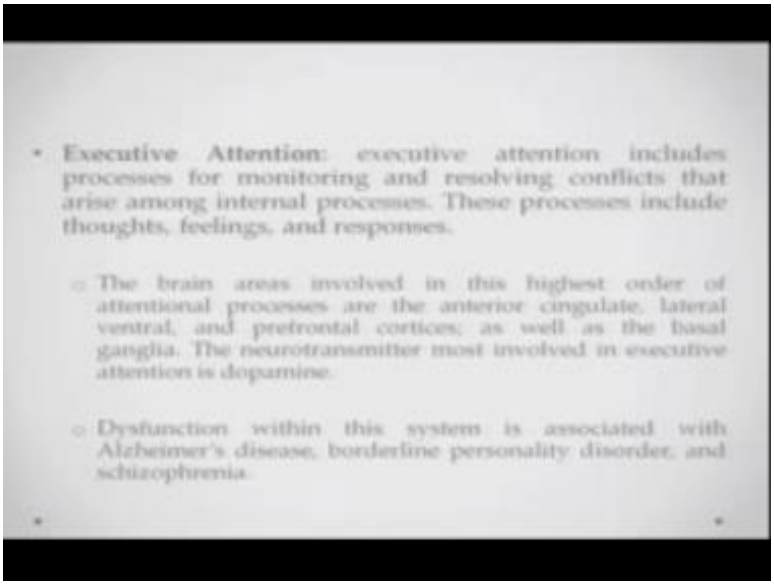

Now here is the figure of the brain again borrowed from Goldstein and his textbook of cognitive psychology you can see that what are these different networks of attention and how are they organized or scattered across the brain?

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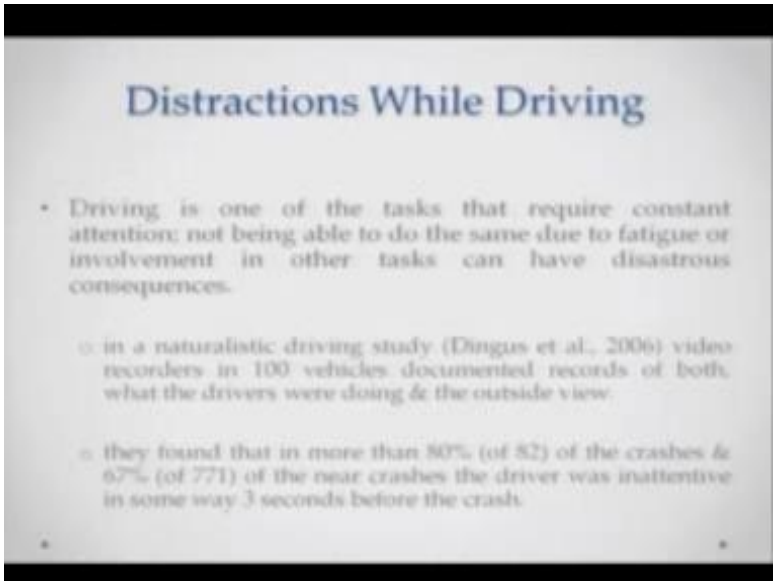

We have begin this you know this chapter on divided attention by giving this example of distractions while driving now driving is one of the you know I am just going to present a very important study to you so that it kind of impresses enough that you know doing something else while you are driving is a rather dangerous so driving is one of the tasks that actually require constant attention and not being able to do due to the same due to fatigue or involvement in other tasks can have and does have disastrous consequences in a naturalistic observation study of driving you know in the video recorders were placed in hundred vehicles.

And they documented records of both you know what the drivers were doing and also the outside view and this was done by dingus increase in 2006 they actually found out that in more than 80 percent of the crashes and a 67 percent of the near crashes the driver was actually inattentive in some way three seconds prior to the crash so I mean it is living proof it is experimental proof or the fact that it is very dangerous to do anything else while driving.

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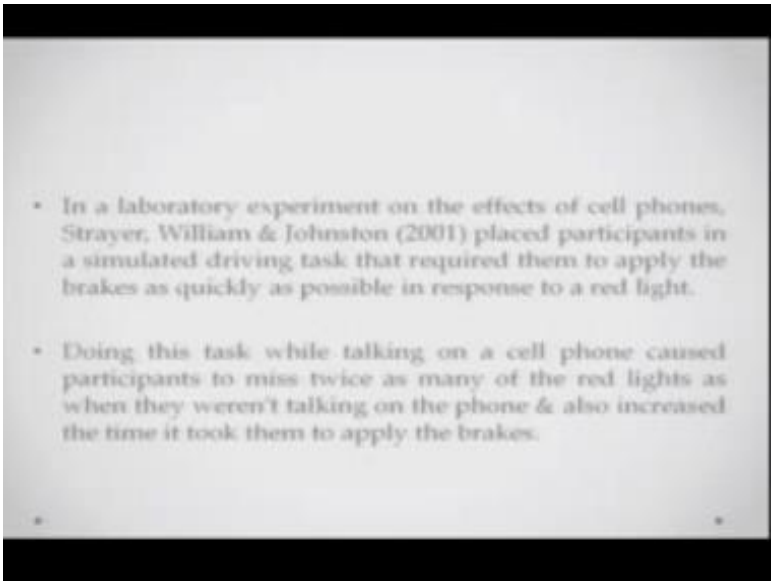

When a laboratory experiment on the effects of cell phones Strayed and colleague Strayer's Williams and Johnston place participants in a simulated driving task and that required them to apply brakes as quickly as possible as soon as a red light flashed now doing this task why talking on a cell phone cause participants to make twice as many of the red lights as when they weren't talking on the phone or they were not doing something.

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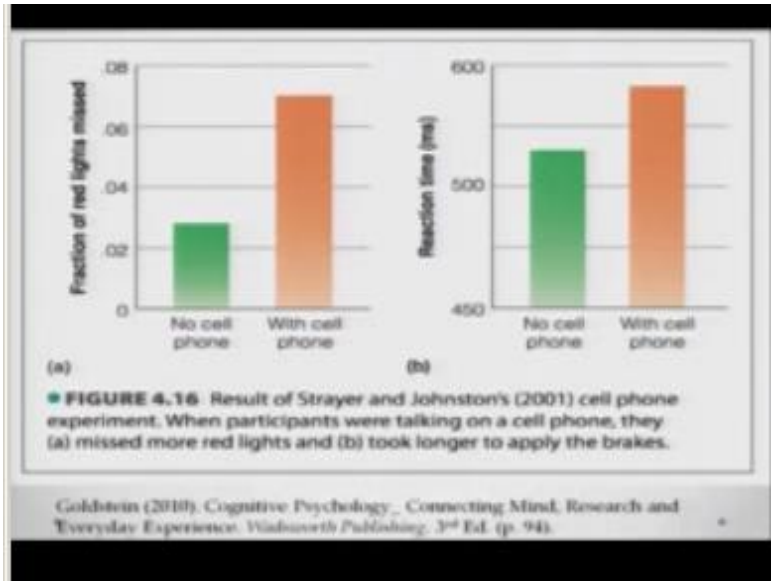

Here there is also if you can basically see the amount of red light Smith is much higher than when they were doing with cell phones and see for example the reaction time is also much higher when they were driving along with cell phones so this is you know again experimental proof of why it is very dangerous to do anything while you are driving.

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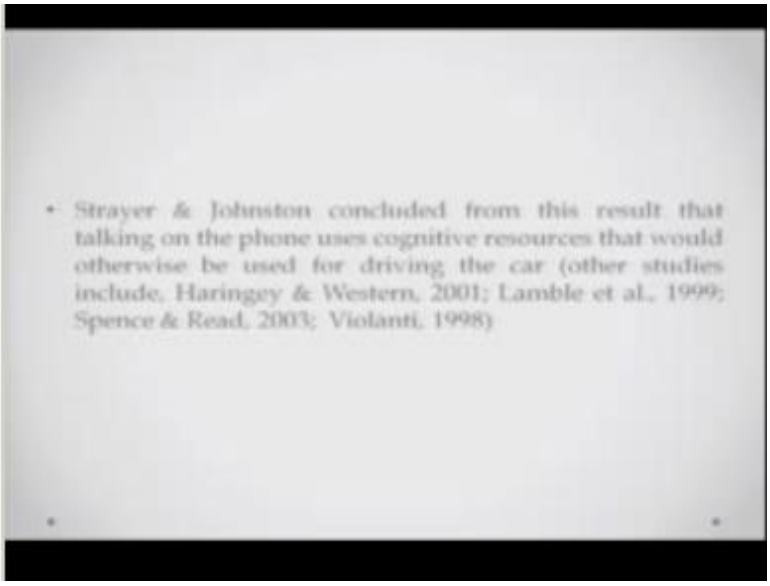

Sharon Johnston concluded from this result that talking on phone uses cognitively so obviously you listening to somebody you are attending to the voice on the phone over all the other voices of traffic haunts maybe somebody here from the back is a honking and one surpass all of those you know you are not selecting or selecting this voice on the phone and that would otherwise basically you know that will be the problem so you know it takes a cognitive resources that would have been actually being used while you are driving the car.

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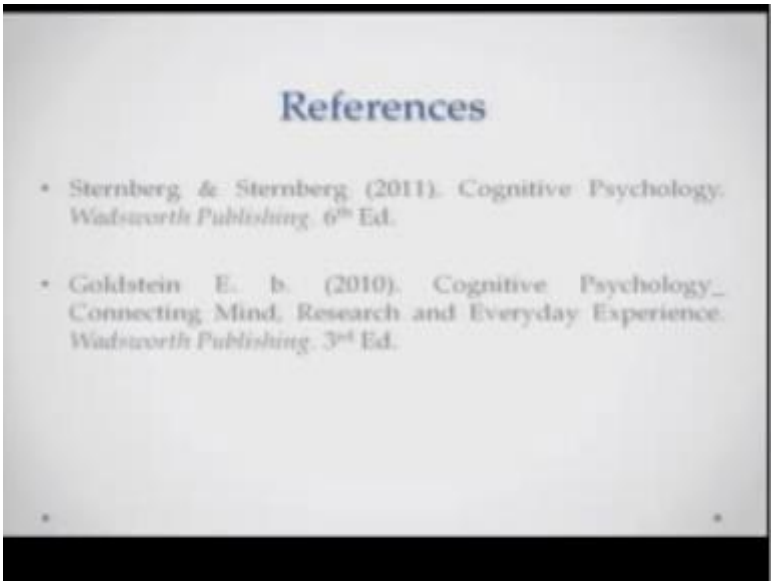

This is all I hope I have impressed you know enough about the good parts of divided attention and also while the end about what the you know unfortunate or misuse of divided donation would be thank you so much.

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