Indian Institute of technology Kanpur

National Programme on Technology Enhanced Learning (NPTEL)

Course Title
Basic Cognitive Processes

By: Dr. Ark Verma,
Assistant Professor of Psychology,
Department of Humanities & Social Science,
IIT Kanpur

Lecture 28: Attention - IV

Hello everyone welcome to the course basic cognitive processes I am dr. Ark Verma from Indian Institute of Technology Kanpur now we have been talking in the last three lectures about attention we have seen that there have been theories of attention which talked about attention as a selective strategy we also talked about filter theories and bottleneck theories of attention we were also talking in one of the lectures about how you use attention say for example the first lecture on attention that I took and I talked about theories of visual search that was one example wherein you use attention to navigate your environment.

Where in you are basically using aspects of attention to look for or to search for particular objects from the environment we saw that feature search it does basically involves looking for specific feature or let us say conjunction search involves looking for a specific set of features may be a combination of one or two features and how do you actually focus on one feature or two features and look for a particular object in your environment we have talked about that in the first lecture in the second lecture I talked to you about theories of selective attention how is it important to select the particular piece of information or object or a location from your environment and work on that.

And what are the different theories of selective attention in the third lecture we talked about divided attention and that given that it is a basic and it is a good a profitable ability that we have that we can sometimes if need arises focus on more than one stimulus or word more than one location at a time and we looked into some theories of that and also in the end of that lecture we

talked about how say for example this divided attention thing can be misused say for example for people you know trying to do two tasks at the same time when the task is something as demanding as driving.

In this lecture today I will basically take you to forming a link between attention and perception now if you think of what an individual does while interacting and navigating with the environment and if you remember some of the earlier discussions we have had we have constantly been talking about the need for selecting some information from the environment and working on it and in that sense you would see that attention does not only help us do that but attention because it is helping a silica and you know single out some particular you know region or location or event in time and to attend on that.

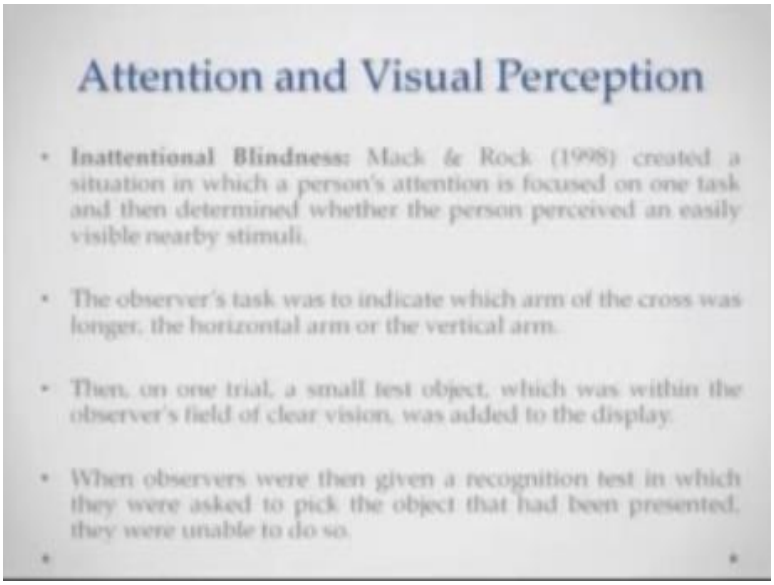
It is doing something with our perception as well what happens when you select something when you attain something and what happens when you do not attain the you know a object in question today we will try and make this link between attention and visual perception by the help of some experimental study some very famous studies that have been done in attention over the past decades we will try and make this connection and we will try.

And see how this connection can help us better understand the process of potential just to you know again remind you for the overall scope of the course we have been doing specific cognitive functions but we have also looked into how these cognitive functions interact with themselves because that is what the story of cognition has to be about this is a course on basic cognitive processes and I am trying to tell you that how these basic cognitive functions interact with each other sometimes start working together to give you a more holistic experience to give you more control.

And to give you a better handle over interacting with the environment we have talked about sensation we talked about perception if you remember the last section on perception was about perception and action so how do you perceive environment around and how do you act the second this chapter was basically about attention and today I am going to try and help you to connect attention and perception together.

So if you kind of following all of these lectures in a vertical sequence if you try and integrate them into a particular conceptual structure you would want to make attention perception and action all linked up with each other and then try and understand how each of these you know cognitive functions in their own right and in you know conjunction give an individual a better chance to interact and navigate with the environment. So with that background let us try and study one of the very famous phenomena in attentional research which has been around for quite some time called in attentional blindness.

(Refer Slide Time: 04:50)



So Mac and rock in 1998 they created a situation in which a person's attention is focused on one particular task and then they tried to determine whether the person can perceive another stimulus you know which is another visual stimulus easily or he has difficulty in doing that the observers task in this kind of set it was basically to indicate the setup I will just describe the set of how it looked like so there was a blank screen there was a fixation cross the fixation was is essentially a plus sign which is presented in the middle of the screen.

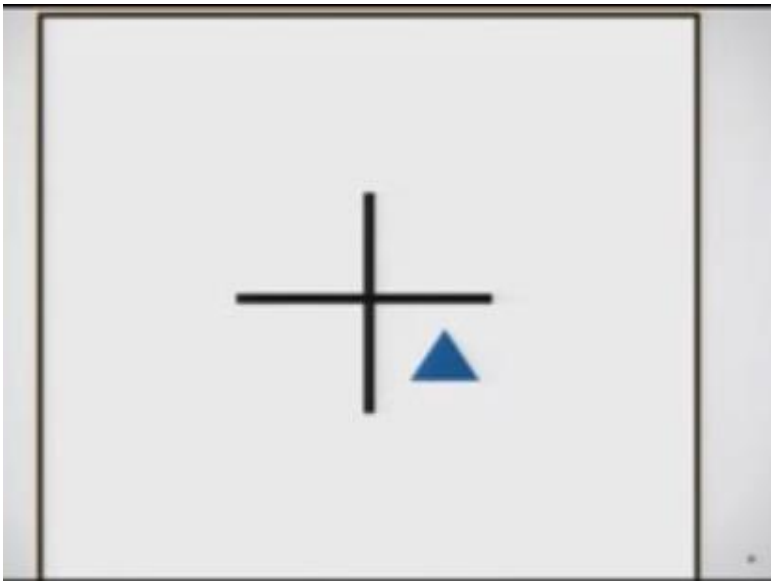
So the observers were given the task of determining which of the arms of this particular cross is longer so there is a plus sign one of these arms maybe the vertical or the horizontal will be longer

than the other and this is what the participants were told that you have to figure out Intel and they were told that you have to do it as quickly and as accurately as possible one of these trials while the participants were doing this a small test object it could be of any particular geometric shape which was also within the you know clear line of vision of these participants was presented.

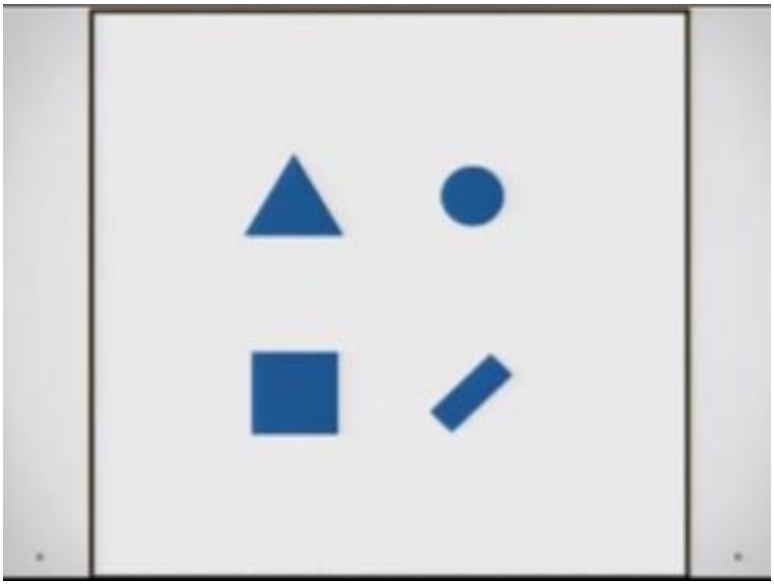
Observers were basically then given a recognition test after this in which they were asked to pick up the object that was presented along with the fixation cross so if you see the set up the set up is there are two tasks here the first task is to determine the length of the arm which of the arm is longer of this succession cross and the hidden task or the other task is to actually determine which of the shapes will be presented randomly at some point in time along with this fixation cross.

So this was the set up let me give you a demonstration of this right here right now say for example this is a fixation cross.

(Refer Slide Time: 06:32)

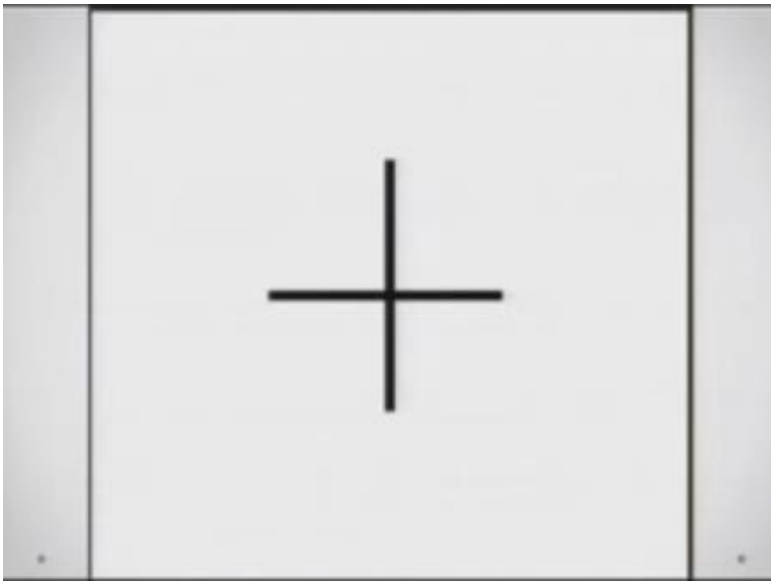


(Refer Slide Time: 06:33)



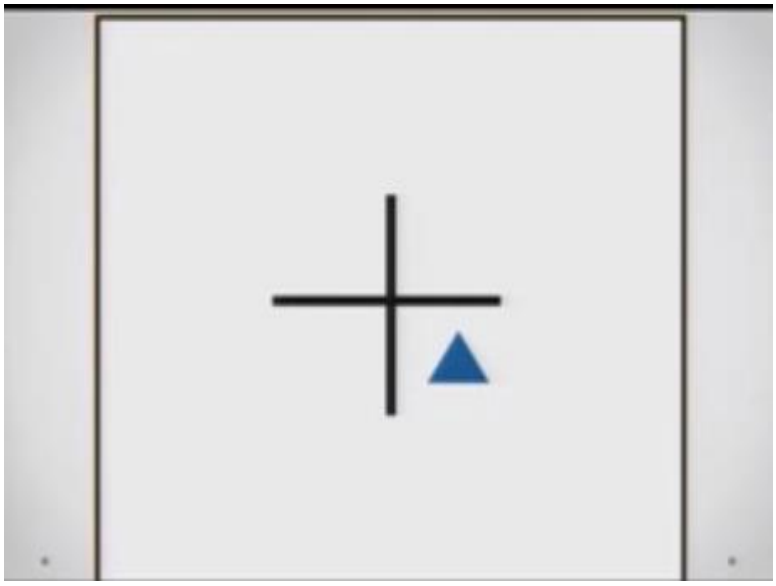
This is the object and now can you tell me which was the object present it I think it kind of went much slower than it would have gone in the typical experiment but I hope you got the idea.

(Refer Slide Time: 06:44)



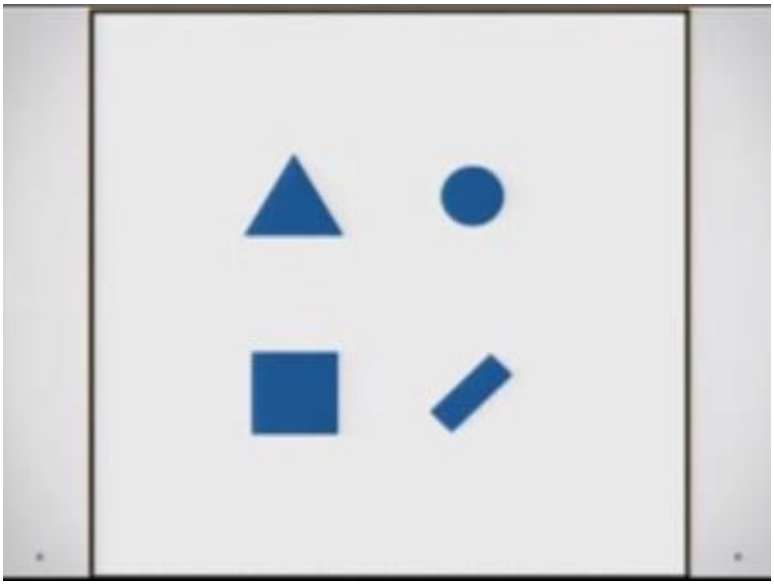
So if you are actually focusing on you know determining the length of one of these arms of the fixation cross you will have to look at it in a very focused manner it will probably not appear as big in the center of the screen the situation might be slightly different but the task is just determine which of these arms is longer and it is slightly a demanding task.

(Refer Slide Time: 07:04)



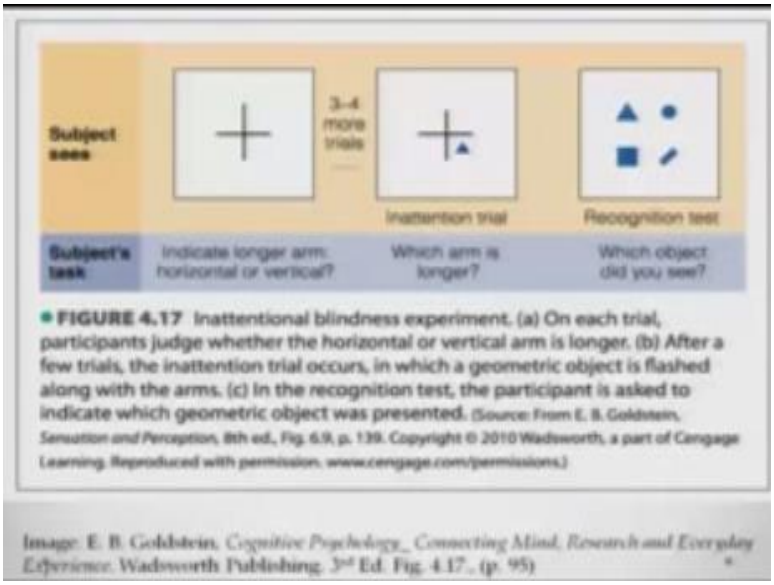
And then while you just focus on the arms length you will see some of these kinds of figures from these geometry shapes appearing right in front of your eyes right where this you know a target in question that is the plus sign is there.

(Refer Slide Time: 07:20)



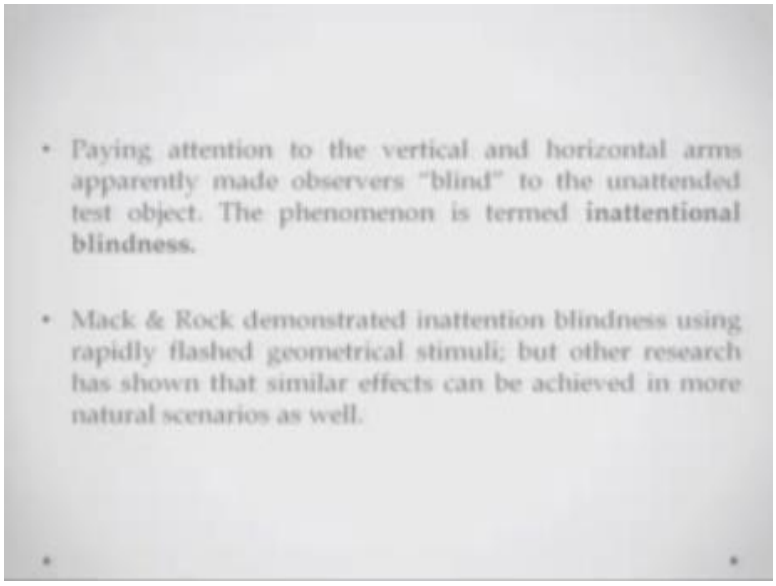
And then later after asking you which of the arms was no longer or which of the ones was shorter I will present you they presented an array of geometry to say like wearing one of these objects which were presented earlier may also be this you have to recognize which one the objects really appeared with the fixation cross and suppose if you were completely engrossed in the task of judging the arms length you will more you know probably not be very good at recognizing this particular visual object.

(Refer Slide Time: 07:53)



Now this basically this phenomena has been termed as in attentional blindness if you are not paying attention to something you are blind to that so if you are not really being able to attend to a particular stimulus now this is the entire setup which was again presented in gold stein spoke of cognitive psychology figure 4.17 this is the whole set up.

(Refer Slide Time: 08:14)

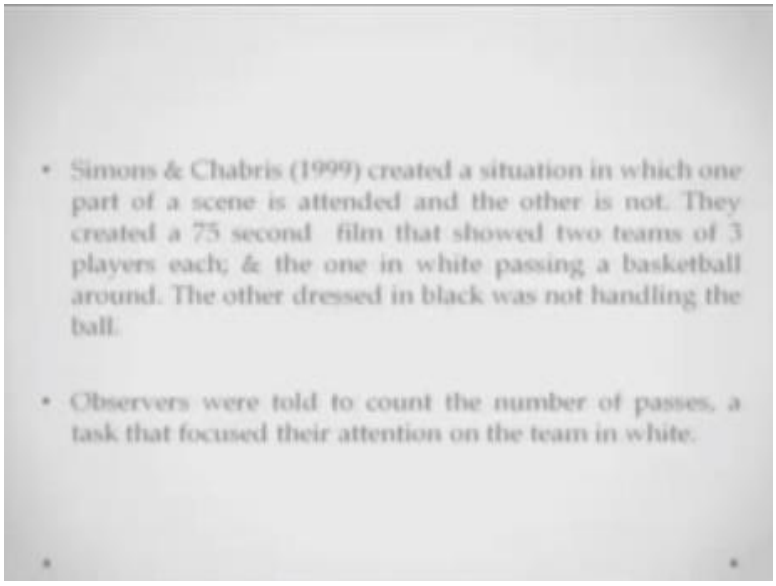


So the description of the phenomena is such that if you are not really paying attention to a visual stimulus or an auditory stimulus as it may in your environment you are almost blind to it blind basically means you are not really attending to it now remember we have talked about selective attention and we talked about divided attention and one of the theories you said that maybe we are still attending that but for most practical purposes we might still be we might be blind to everything that we have not done it and we not attended.

So to just define this in a more concise way paying attention to all of these at the vertical and horizontal arms of this fixation cross apparently is making the observers blind to the unattended test object this phenomena has been termed as in attentional blindness, now Mac and Rock demonstrated in attentional blindness using rapidly flashed geometric similar but there have also been other kinds of researches that have shown that similar effects can be achieved in more natural scenarios as well okay.

So let me destroy one of the other kinds of experiment here again to do within attentional blindness.

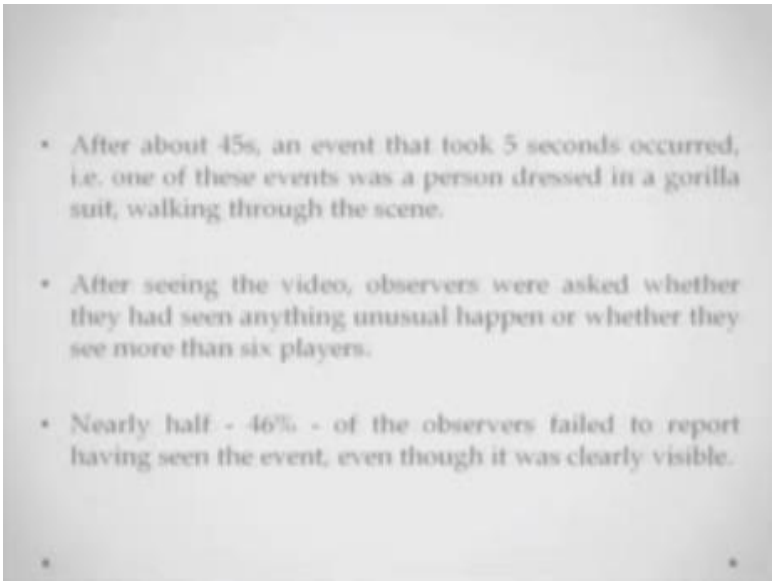
(Refer Slide Time: 09:23)



So Simons and Chabris basically in1999 they created a situation in which one part of the scene is attended and the other part is not so it is a more natural scenario they created a 75second film and they basically showed two teams of three players each playing basketball you know in a more natural kind of a setting and in the one in white passing the basketball around, so there is the two teams playing this one team which is white varying by the other team might be wearing a colored jersey.

And this team is basically following a you know passing the basketball around now observers who are made to watch these movies were asked to count the number of passes so a task let us focus you know their attention to this ball passing a key activity very well okay so they are basically attending to this team in white which is actually passing the ball around.

(Refer Slide Time: 10:19)



Now what happens was that after about 45 milliseconds an event that took around 5 seconds occurs, so one of these events was say for example a person dressed in a gorilla suit walks right through the middle of this you know a movie and right through the middle of these players so after seeing the video observers after they actually you know attended the video they saw the video and they were not really told that there will be a gorilla or something like that happening they were just told to count the passes that have happened.

Now after this you know nothing was going on the observers were asked whether they have seen anything unusual happen or whether they have seen any more than 6 players or something like that nearly half of the observers who saw the movie around 46% of the observers and they failed to report having seen the event even though it was clearly visible even though it was happening right in front of their eyes but they could not report it why they could have missed it is probably because they were too intense.

(Refer Slide Time: 11:16)

Too much caught in counting the all passes that way this is again a figure of that particular movie just a snap shot from this represented in Goldstein so this basically shows you that here there is a gorilla sending right in the middle and kind of I have seen that movie so kinds of does a few activities tries to gain attention but if there is somebody who is completely intent on just counting the wall passes and it is really varying gross or concentrated in that task I say miss noticing the gorilla and in that sense being blind to whatever is happening.

(Refer Slide Time: 11:51)

This is another example of in attentional blindness that which shows us that this is a real phenomena and we happen quite a few times it might also mean you might recall say for example if you are in a party or somewhere you are talking to somebody if somebody who are there is this other person who passes around kind of waves at you and you do not you know notice because you are too engrossed in a particular conversation.

(Refer Slide Time: 12:54)

FIGURE 4.19 Look at this picture for about a second, cover it, and look at Figure 4.20 (at the top of the next page).

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience*, Wadsworth Publishing, 3rd Ed. Fig. 4.17., (p. 96)

Now moving further and let me just give you another task you see in this picture here and now you can tell me whether there is a change in the picture.

(Refer Slide Time: 12:25)

So again I am not really sure what the video called be like.

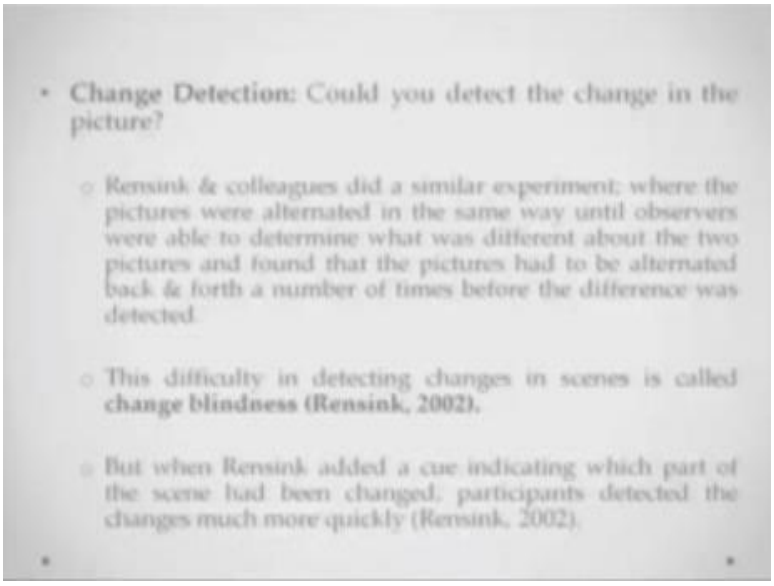
(Refer Slide Time: 12:26)

FIGURE 4.19 Look at this picture for about a second, cover it, and look at Figure 4.20 (at the top of the next page).

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience*, Wadsworth Publishing, 3rd Ed. Fig. 4.17., (p. 96)

But you can see here and here if you notice any change now what happens here is again if I try and do this slightly more closely you will see that right next to the women there is a yellow colored poster pasted on that placard and that yellow poster is not really a pleasant is not aware it is not available in this picture. So this is what is happening this is basically called a change scenario so something in the demonstration changes in a blink of a second and a lot of times because you are not attending to the whole picture at once you might miss this change this particular phenomenon is called change detection.

(Refer Slide Time: 13:14)



Now Rensink and colleagues they basically did a very similar experiment in which pictures were alternated in the same way until observers were able to determine what was different about the two pictures so they actually presented a whole lot of pictures and they actually asked the participants to keep track of whether they are there is any change or if there is any change report that participants basically represented this with this kind of sequence of pictures again and again and it continued until they were able to determine what was different about the two pictures and found that the pictures had to be alternated back and forth a number of times before the difference was detected.

The experiment had to do it quite a few times to really you know get that change detected by the participants now this difficulty in detecting changes in scenes is basically called change blindness proposed by tensing in 2002, now this is again one phenomena that is you know very demonstrative of the fact that attention is so much more important to select relevant information to select relevant stimuli from our environment and do you know and say for example if there is important information you would want to know that.

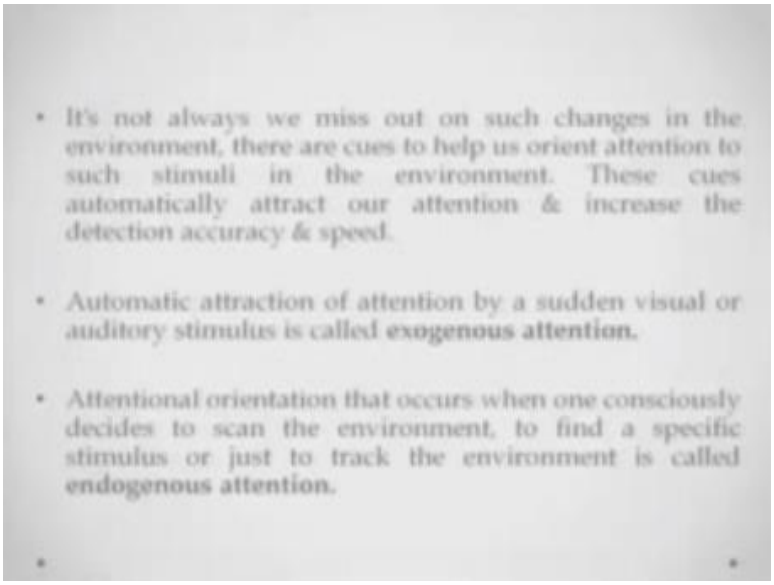
You can say for example liken this to a scenario when you are going you know somebody's asked you to look for a particular landmarks and you are kind of going and you do not notice that particular maybe it is a poster on the road and you kind of miss it because you know are talking or you are kind of you know attending something else okay so when rinsing added the cue indicating which part of the scene had change participants quickly detected the change.

So this can help if there is a cue which can grab attention and which can orient your attentions towards the site where the change has to be made, so rinsing in that sense they add he added a cue indicating which part of the scenes which facial location in the scene is going to be change and that kind of change is going to happen then the bargeman certainly could detect these changes much more quickly moving ahead it is not really often that you know we may it is not always that we miss out on such kind of changes in the environment.

Because there are obviously cues that help us to orient our attention towards such stimuli in the environment, so there is an importance of these cues these cues automatically grab our attention they automatically attract our attention and they increase there for the detection accuracy and the speed with which we will respond to these kind of stimuli automatic attraction of attention by a sudden visual or auditory stimulus is called orienting of exogenous attention exogenous.

Exogenous because the locus of the attention is outside the individual there are you know obviously a lot of time if you are doing something very interesting you kind of you know or maybe driving or something you are doing if there is a flash of light or if there is a particular kind for someone which is distinct from all other sounds you will certainly get oriented towards it that is basically called orienting of exogenous attention.

(Refer Slide Time: 16:06)

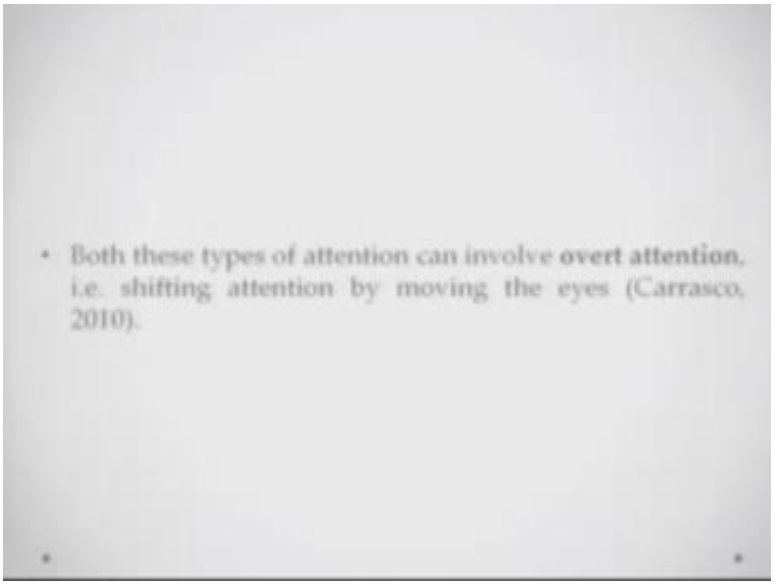


Now attentional orientation that occurs when is one consciously decides to scan the environment to find the specific stillness or just to track the environment it is called endogenous attentions, so the first part I was describing was exogenous attention where the stimuli themselves attract your attention they themselves grab your attention you get oriented toward step it is not happen always sometimes as if you remember in the visual search phenomenon you are looking for something say.

For example on a railway station or say for example on an airport you have gone to receive somebody and there are too many people coming out all of their faces you are scanning when you are actually looking for a particular face you are looking for a particular person that you have gone there to pick up that orienting of your attention which is basically decided by you which you're consciously controlling and manipulating is called endogenous attention.

So how you orient your attention in the environment can be of two ways either the stimulus is grabbing your attention or you looking for that kind of similar say for example in a visual search kind of a phenomena.

(Refer Slide Time: 17:10)



Now both these types of attention are can and cannot involve overt attention so we talked about the case where they involve over detention what is over to tension if you remember in the beginning of the attentional chapter I was talking about overt and covert attention over to tension is attention that is manipulated that is controlled by shifting of your eyes or by moving of your eyes the definition is taken from carrasco work in 2010.

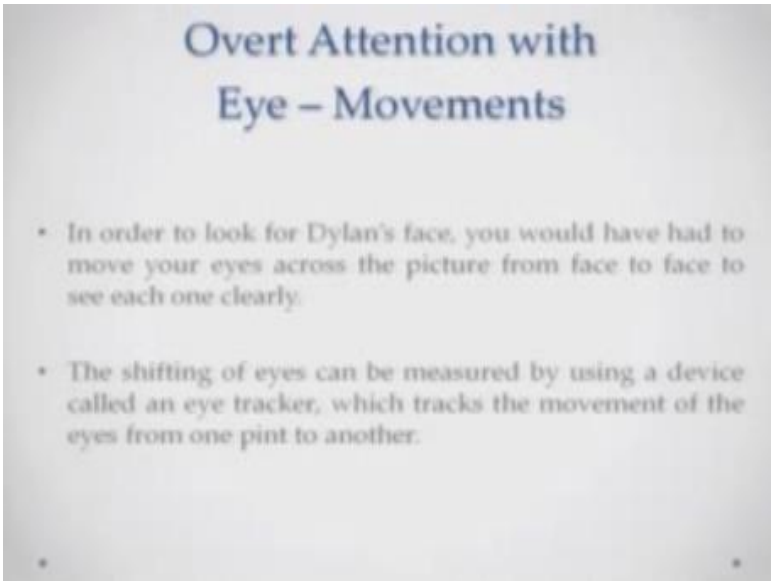
(Refer Slide Time: 17:39)

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience*. Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 99)

Now suppose I am showing you this particular picture and I ask you to find the face of Bob Dylan in this particular picture. So I am kind of again taking it off and I am bringing it on and now I am asking you that out of all these people here in this picture what you have to do is you have to look for and find the face of Bob Dylan what are doing here you are consciously directing your attention probably scanning each of these faces each of these pictures present you are going sequentially may be or maybe you are kind of have a sense and something pops out.

You are doing all of that on this picture and how are you doing? This you are basically moving your eyes.

(Refer Slide Time: 18:18)



In an eye tracking study you could actually also find out how do you move your eye over the tension with eye movements if I is there basically can we attract using a particular device called the eye tracker what does an eye tracker eye tracker is a very simple device basically a camera and a light source the light source kind of throws a light ray in your eyes and that light ray is reflected in the camera tracks the reflection of the side light ray and it in that sense it can track the movement of your eyes it can track where your eyes are looking at any point in time.

So it tracks the movement of eye from point one to point two or four from one point to another now suppose there is this thing.

(Refer Slide Time: 18:59)

If you are kind of looking at a particular fountain and there is this study which was done if you are looking at this picture of the fountain in Bordeaux France this is the pattern of eye movements that was observed, so the first point where in your eye is land and then they start moving all over the picture the first point is called first fixation, so wherein your eyes landed at the first.

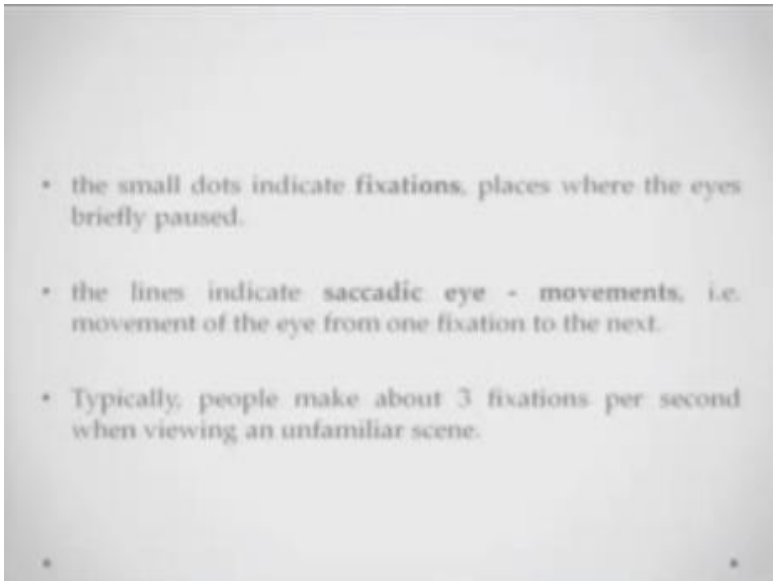
(Refer Slide Time: 19:21)

FIGURE 4.23 Scan path of a person viewing a fountain in Bordeaux, France.

Image: E. B. Goldstein, *Cognitive Psychology: Connecting Mind, Research and Everyday Experience*. Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 100)

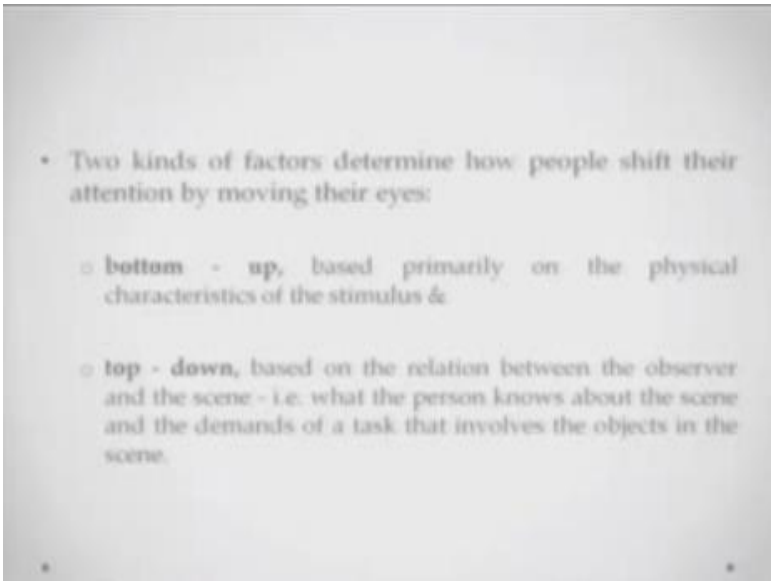
All these small dots you can see here all these yellow dots are called fixations because the eyes move from point A to point B and stayed there for some amount of time that amount could be say for example the minimum amount that the fixation could be is around eighty two hundred milliseconds your eyes are saying there and then I am moving towards other points, so those the small dots are called fixation points when you are moving your eyes along these lines from point A to point you are doing something called a saccadic eye movements.

(Refer Slide Time: 19:53)



What you are doing is you are moving the eye from one fixation to the next fixation that is saccadic eye movement typically people make about 3 fixations per second when you viewing and unfamiliar seeing something like this if I give you scene to scan and tell me and find out something in that particular scene you will be taking around three fixations per second, now two kinds of factors determine how people shift their attention by moving their eyes.

(Refer Slide Time: 20:20)



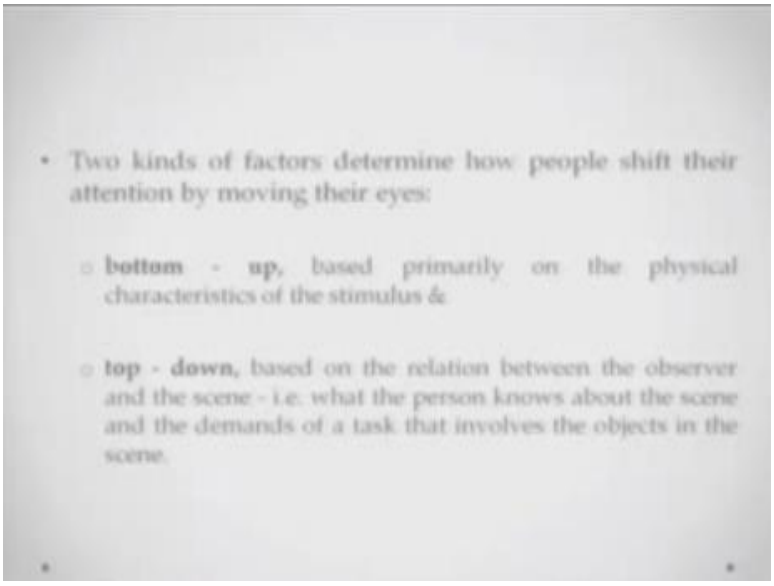
First is bottom of factors basically based on the primary physical characteristics of the stimulus if there is a bright color if there is an unusual shape that might attract your attention better than some other things, so these are bottom-up driven eye movements the other thing would be the top-down base eye movement based on the relationship between the observer and the scene you know when the person looks at the scene and the demands of the task involve the person to scan the scene say for example in the picture.

(Refer Slide Time: 20:51)

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience*. Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 99)

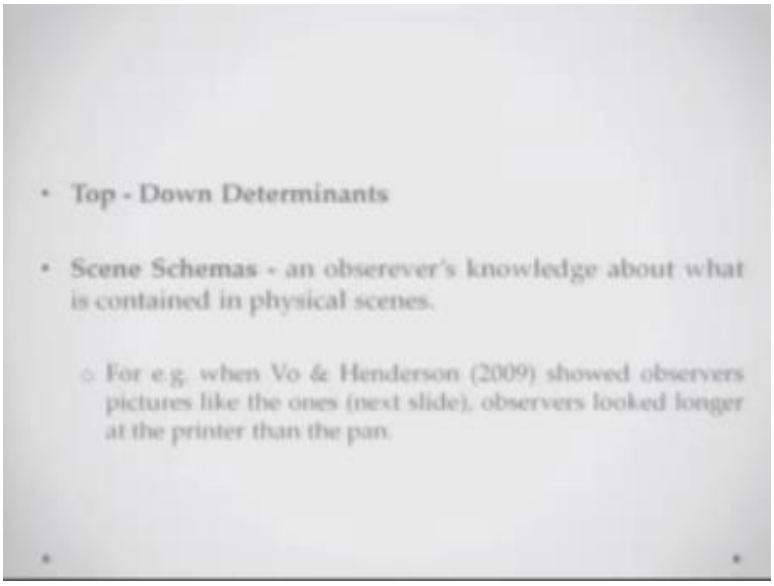
When I ask you to look for the Bob Dylan what you are doing here is you are basically doing top-down government eye moments you're basically decided that I have to look for something.

(Refer Slide Time: 20:58)



That is why you are moving your eyes over this picture again and again.

(Refer Slide Time: 21:01)



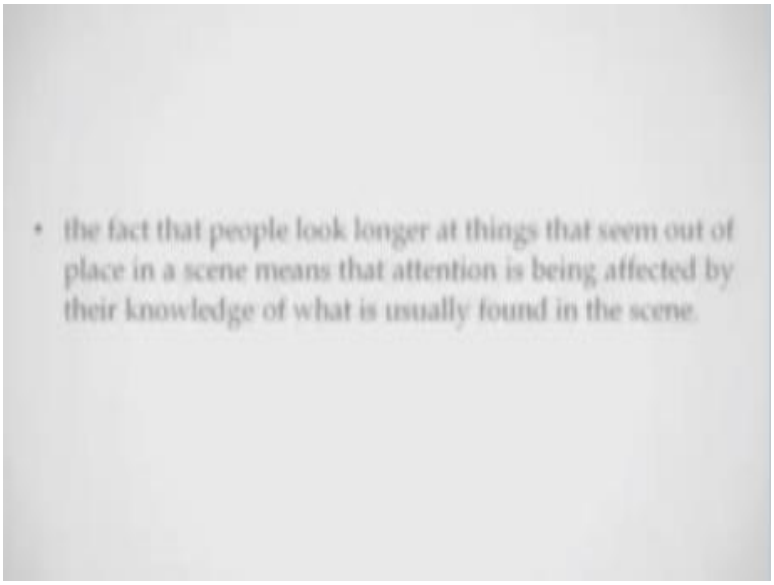
Some top-down determines we can talk about so seen schemas and observers knowledge about what is contained in the physical scenes if you are looking at a particular scene if you are looking at a particular scenario something about that scene and in that sense maybe you are looking for something from that scene and that is basically wherein you are doing your top-down kind of I move you are deciding I can take one example when Vo and Henderson in 2009 they showed observers pictures like the ones show you right away the observers looked longer at the printer than the pan. I will just show you this picture right away.

(Refer Slide Time: 21:39)

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience*. Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 100)

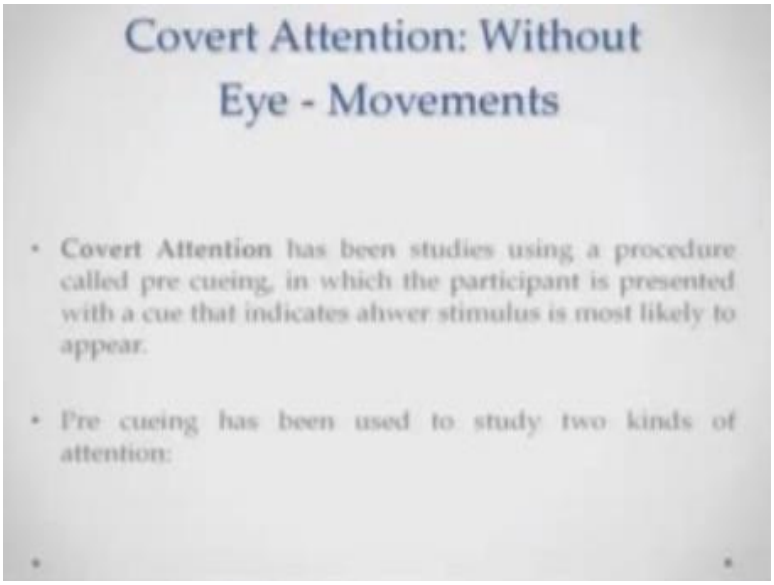
If you see these pictures again and again a scene of the kitchen but here you can see that there is a pan in the first picture but there is a printer on the second picture at the cook top now there is something interesting about that scene is not it you do not expect to find the printer in the kitchen especially over the cook top okay so because there is something very specific about that thing that actually made people look longer at that printer.

(Refer Slide Time: 22:06)



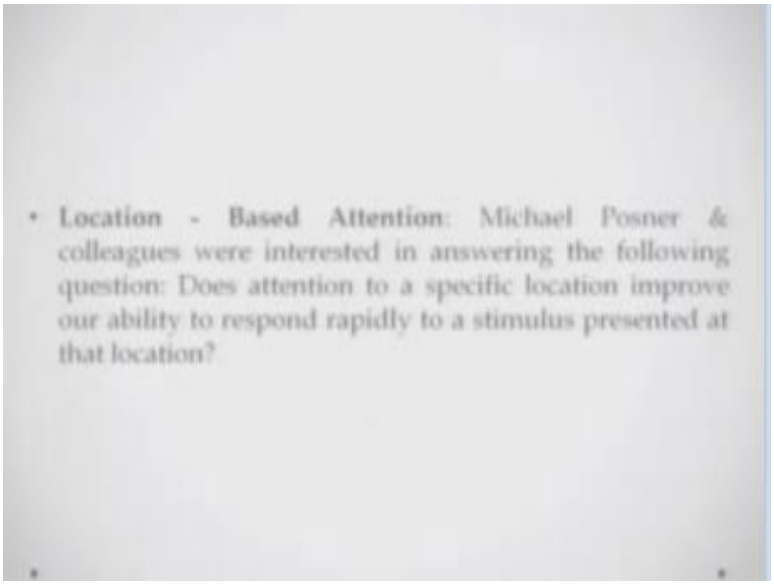
So the fact that people look longer at things that seem out of place in a particular scene kind of tells us that attention is being affected by their general knowledge about the scene their general knowledge of what is usually you know to be found in a particular scene eye movements can also happen or say for example attention can also you know move from one place to another without moving your eyes so I hinting about this sighting in one of the earlier classes as well the movement of attention where the without the movement of five is referred to as covert attention so shifting of attention without moving the files is called covert attention.

(Refer Slide Time: 22:42)



They are having a lot of studies in which covert attention has been investigated and they have used a procedure called Pre cueing so in which a participant is presented with the queue that indicates where the stimulus is most likely to appear so Per cueing has been used to study two kinds of attention.

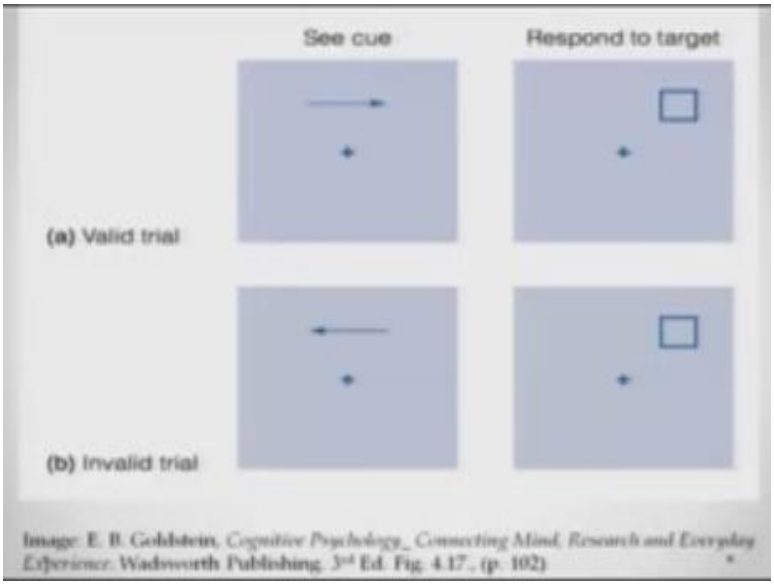
(Refer Slide Time: 22:58)



And just tell you so first is the location based attention Michael Posner did this kind of study so Michael Posner and colleagues were interested in answering the following question the question was does attention to a specific location improve our ability to respond rapidly to a stimulus presented at that let us say for example if there is a location and I have already told you that I am going to present a number here.

And then I quickly present some numbers and you know I ask you later that which were the numbers presented here because I have already told you the location because you have already oriented your attention towards that particular location your performance will be slightly better as compared to if I am not really telling you there you know the stimulus is going to appear and then I present a bundle a stimulus that will be called location based.

(Refer Slide Time: 23:47)



Say for example in this experiment which was again borrowed from Goldstein's book I think it is a typical post earnest paradigm you can say for example have the first things vary there is an arrow appearing over the fixation cross so arrow points was the right side and the stimulus appears on the right side okay so it kind of basically already Orient's your attention towards the right side on an invalid trial a kind of point source the left but the stimulus still appears on the right that is called a invalid trial.

So a valid trial is where the cue is successfully predicting the location where the object will appear invalid trial is when the cue is not successfully predicting where the object will appear.

(Refer Slide Time: 24:28)

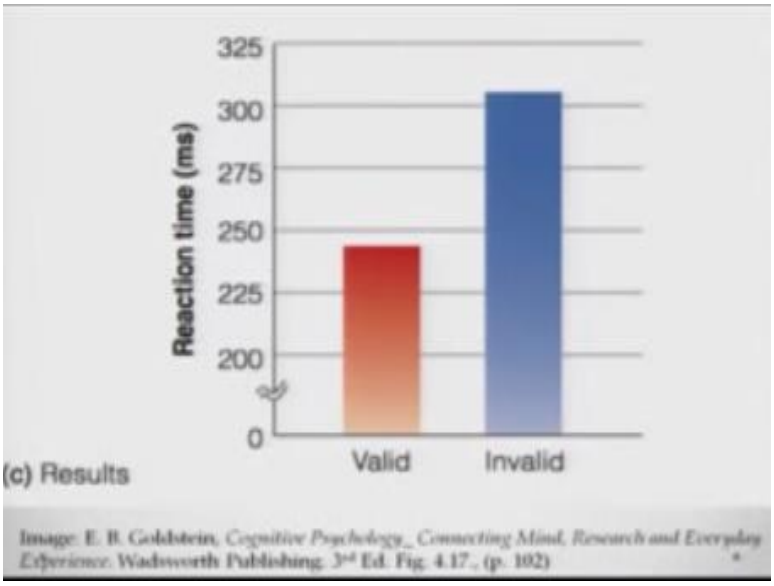
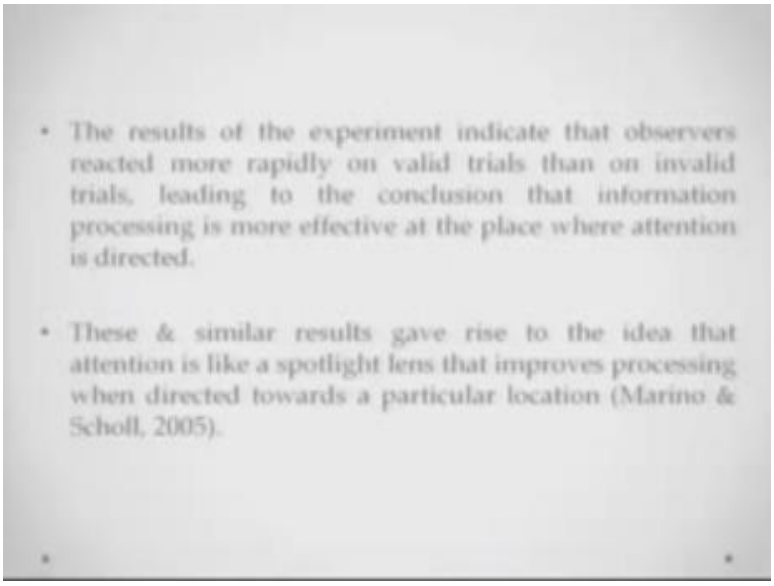


Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience*. Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 102)

So it has been seen that when participants are given tasks like this and there could be many variations valid cues are responded to much faster, so people will respond much faster targets presented on pre cued locations because what has happened is and oh you have not moved your eyes generally the time period is much lower as well our eye movements even though we have not moved your eyes you have shifted your attention to that pre cued location and that is why any stimuli are presented at those locations are attended to faster and more accurately.

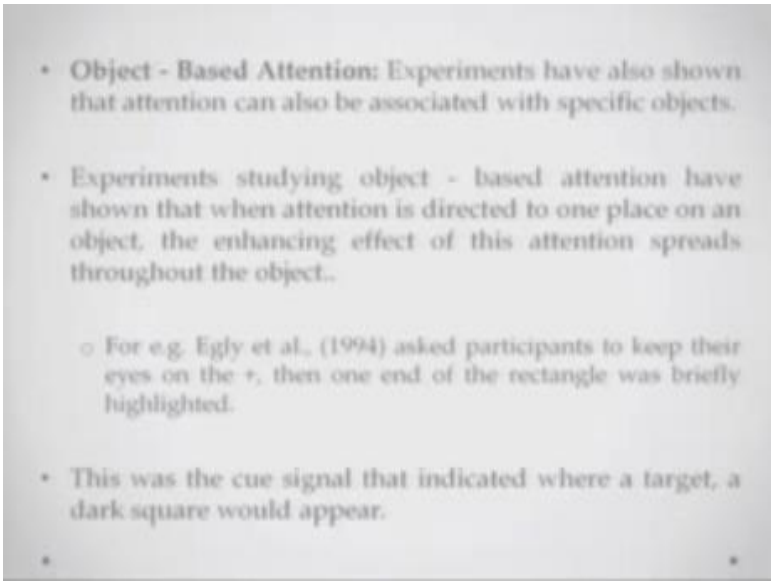
(Refer Slide Time: 25:03)



The results of these experiments indicate that also us were reacting more rapidly on valid trials than on invalid cells leading to the conclusion that information processing is more effective at the place where attention is directed these and other similar results have given rise to the idea that attention is like a spotlight it is like a lens that improves processing when directed toward a particular location you know I was giving that example of a torch if you are in a dark room.

Your attention is like a torch you put your attention somewhere that is the part you are getting most information out of now the other kind of attention when we talk about is object based attention now when you select a particular object experience have also shown that attention can also be associated with specific objects.

(Refer Slide Time: 25:41)



Experiment studying of the base attention have shown that when attention is directed to one place on an object the enhancing effect of this attention spreads throughout that dot you are looking at a particular span or if you are looking at a particular small object then the attention will kind of cover that entire object I will show you an example so Eglin colleagues they did this experiment the as participants to keep their eyes on the fixation cross then on one end of the rectangle was briefly highlight I will show you the figure right away.

(Refer Slide Time: 26:12)

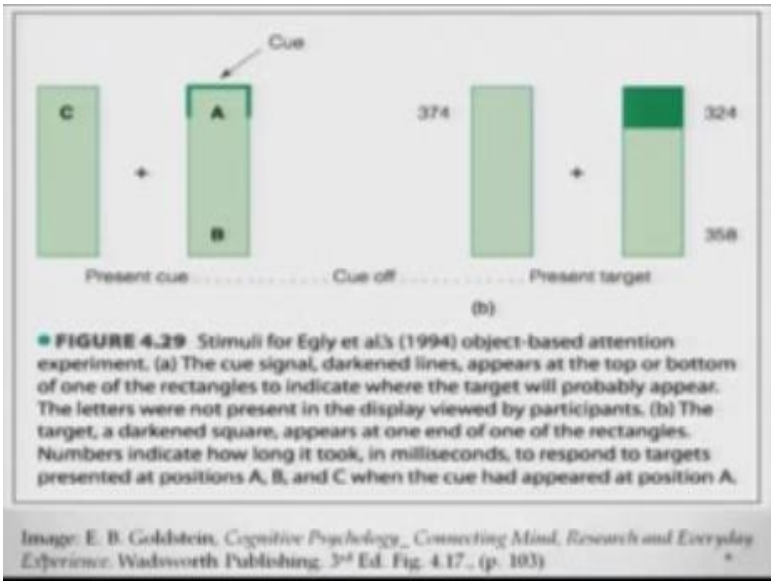
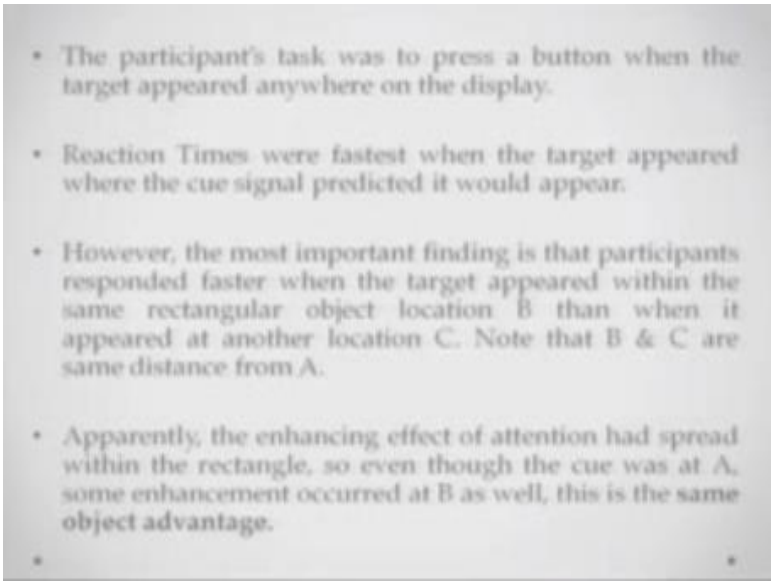


FIGURE 4.29 Stimuli for Egly et al.'s (1994) object-based attention experiment. (a) The cue signal, darkened lines, appears at the top or bottom of one of the rectangles to indicate where the target will probably appear. The letters were not present in the display viewed by participants. (b) The target, a darkened square, appears at one end of one of the rectangles. Numbers indicate how long it took, in milliseconds, to respond to targets presented at positions A, B, and C when the cue had appeared at position A.

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience*. Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 103)

This is the thing parcels will basically also keep their eyes on the fixation cross but one end of these rectangles is brightly highlighted and there is where the target could appear okay, so let us see let us see what happens I will just describe this in more detail so this basically is highlighting acts as a cue signal that indicates where a target or dark square that is could appear and that is what they have to detect.

(Refer Slide Time: 26:36)



Now the partisans task is here is to press a button when the target appeared anywhere on that display the reaction times were found much faster when the target appeared on where the cue signal predicted that it would appear so again something is similar to the last finding if you pre cue attention to a particular space or a particular object in this case your performance in terms of detection and accuracy is going to be much better however the most important finding higher in the sky a set of experiments is that partitions responded to much responded much faster in the target appeared within the same rectangular object location B. Then when it appeared at another location C now note that Band C is at the same distance.

(Refer Slide Time: 27:19)

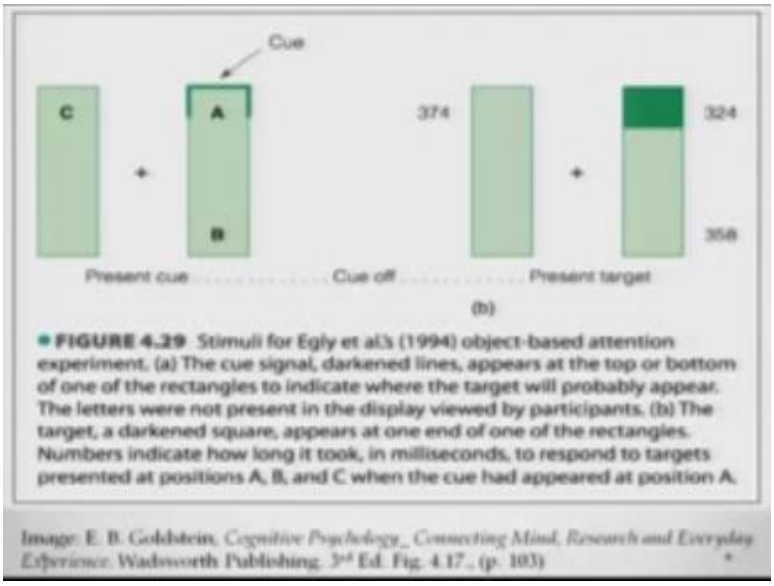
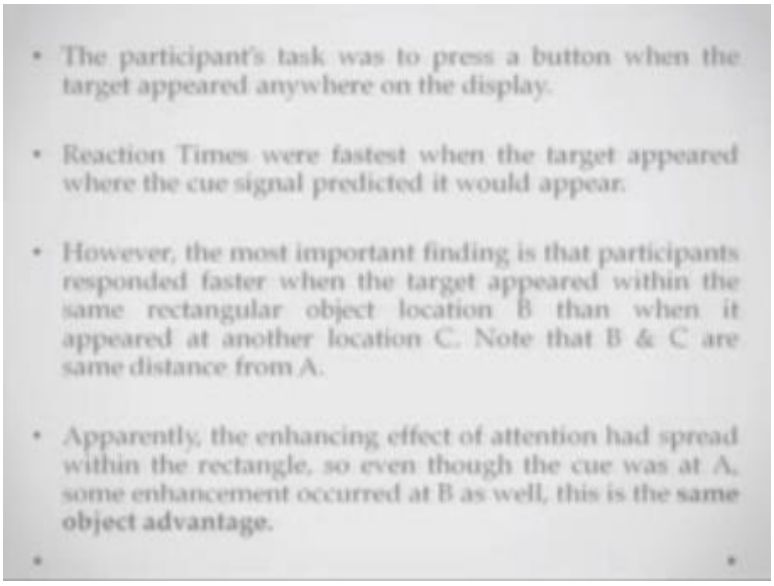


FIGURE 4.29 Stimuli for Egly et al.'s (1994) object-based attention experiment. (a) The cue signal, darkened lines, appears at the top or bottom of one of the rectangles to indicate where the target will probably appear. The letters were not present in the display viewed by participants. (b) The target, a darkened square, appears at one end of one of the rectangles. Numbers indicate how long it took, in milliseconds, to respond to targets presented at positions A, B, and C when the cue had appeared at position A.

Image: E. B. Goldstein, *Cognitive Psychology_ Connecting Mind, Research and Everyday Experience*. Wadsworth Publishing. 3rd Ed. Fig. 4.17., (p. 103)

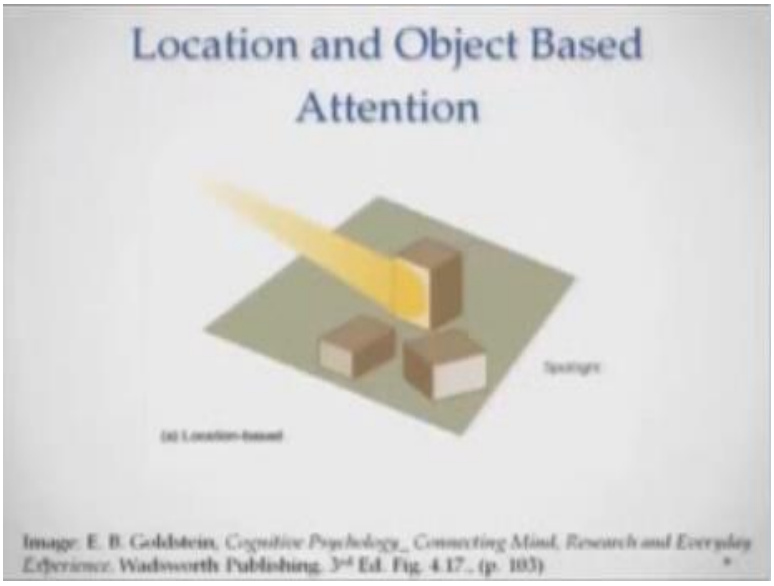
From a so this is the thing if the object appeared in B versus the object appeared in C parts were much faster at B even though the distance from B from A to B and A to C is exactly identical what is the difference the difference is that B is lying on the same object as a or as the queued location but C is on a different object so this is you know the apparently enhancing effect of attention.

(Refer Slide Time: 27:49)



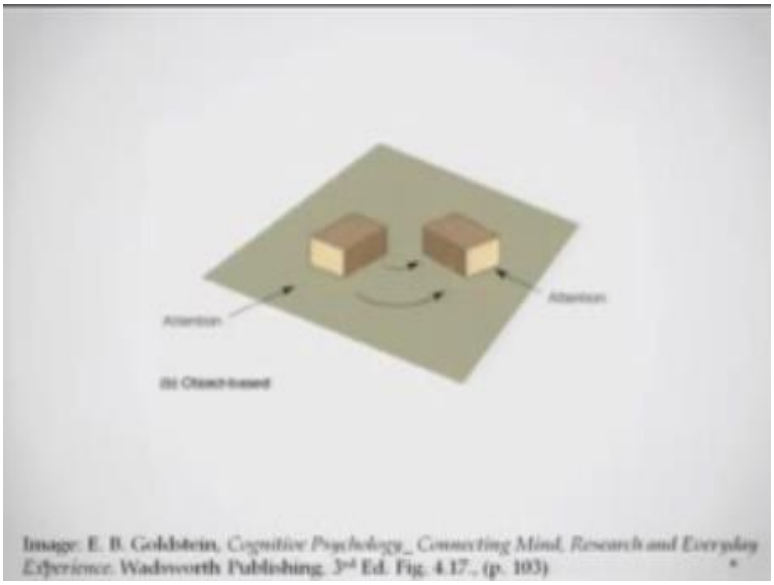
And that has spread within the entire rectangle so even though the Q is at as partial location or let us say on that particular object there is some enhancement occurring at B as well because B forms part of the same object this is basically called the same object advantage.

(Refer Slide Time: 28:04)



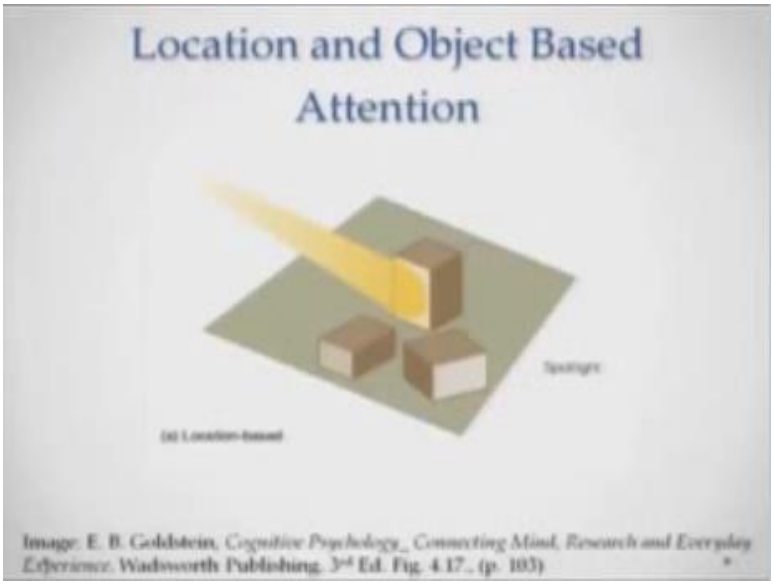
Location and object basis so this is basically typically an example of location based and object based attention put together for you so location is just like you are putting as pot light at a particular location.

(Refer Slide Time: 28:16)



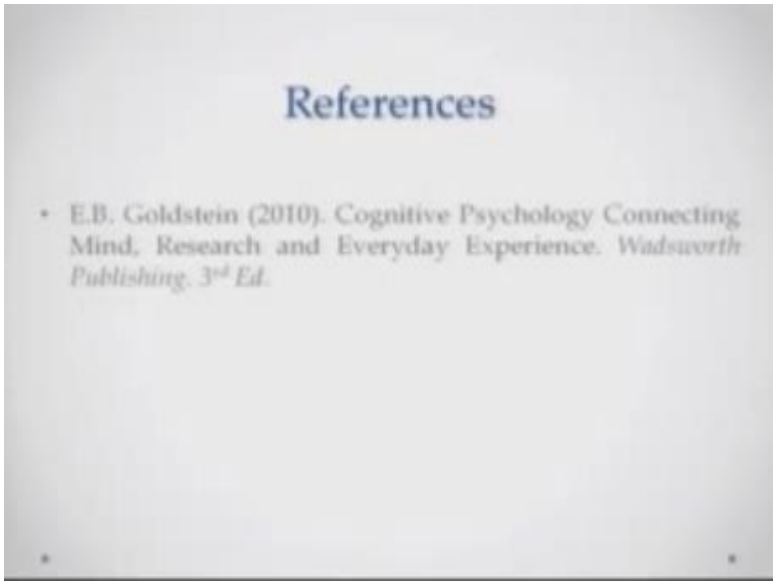
Object basis when you are looking at a particular object and your attention is enhance throughout that particular object so if you move the object your attention moves along with the object.

(Refer Slide Time: 28:27)



In the location based if you change the location the attention there is not really ship it is a very specific location that you have selected to attend, so I hope these demonstrations and kind of going to end here.

Refer Slide Time: 28:36)



These demonstrations about how attention interacts and affects your visual perception might have been useful for you to realize how attention is an important process and how attention affects your abilities of perception as well similar examples would have also been taken with attention and auditory perception this is well but I am not really talking about them because they are kind of not in the scope of the course thank you.

Acknowledgement

Ministry of Human Resources & Development

Prof. Satyaki Roy
Co – ordinator, NPTEL IIT Kanpur

NPTEL Team
Sanjay Pal
Ashish Singh
Badal Pradhan

Tapobrata Das

Ram Chandra

Dilip Tripathi

Manoj Shrivastava

Padam Shukla

Sanjay Mishra

Shubham Rawat

Shikha Gupta

K.K Mishra

Aradhana Singh

Sweta

Ashutosh Gairola

Dilip Katiyar

Sharwan

Hari Ram

Bhadra Rao

Puneet Kumar Bajpai

Lalty Dutta

Ajay Kanaujia

Shivendra Kumar Tiwari

an IIT Kanpur Production