Advanced Cognitive Processes

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Lecture – 08
Visual imagery – II

Hello and welcome to the course advanced cognitive processes; I am Ark Verma from the Indian institute of technology Kanpur. In this week we have been talking about mental imagery or I have used the term visual imagery also interchangeably, mainly because we have been predominantly talking about imagery happening in the visual domain. So, hence visual imagery, we have in one of the last classes we have talked about what visual imagery is as a concept, where do we use visual imagery and we also talked about one of the major debates between the analog code versus the propositional code representation of visual images.

Today I would like to take the concept a bit forward; we will review some of the experimental evidences which have basically dwelt about the relationship between imagery and perception, and also these experimental evidences. Basically play a very important role trying to resolve the debate between the analog code representation or the propositional code representation; again the former given by Kosslyn and worked upon by Kosslyn and other colleagues and the latter basically proposed vehemently almost by xenon philsin and so we will see what is the experimental evidence about the 2 representations. So, as I was already saying we will talk about some of these experiments.

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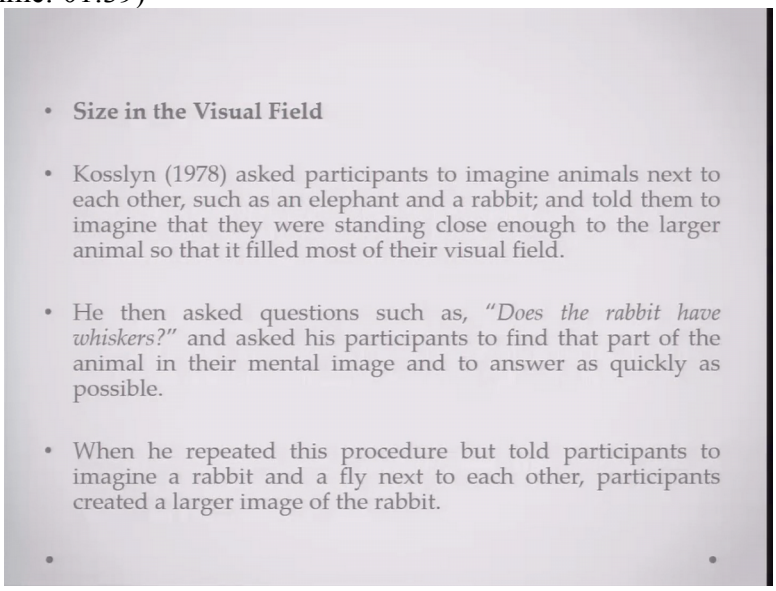

Let us begin with talking about perception of size individual feel. Now size of objects or size of different elements, in the visual world is a very important aspect of visual perception. People have actually tried to look at how size perception really changes when you are actually perceiving something or it works exactly the same in your imagining some of it. Suppose I ask you to imagine how big an elephant is relative to a hen, when you are actually seeing it is pretty apparent.

But is it exactly the same size when you are imagining it, are you really translating this map exactly into your mental image these were some of the questions. So, Kosslyn basically in set of experiments as participants to imagine such kind of animals to each other set, such as an elephant and an rabbit and then who told these participants to imagine that they were standing close enough to the larger one.

So, they suppose as I give the example elephant and hen, you can take an example of an elephant and a rabbit and imagine that you are standing so close to the elephant, that it is filling entire filling up your entire visual field. So, it is almost like you cannot see more any else other than the elephant. Also he asked his participant questions like you know does the rabbit have this curse, because you so close you might be able to see and he asked participants to find out that part of the animal in their mental image and try and answer these questions. So, these animals are nowhere near to be seen in actual perception, but again they are imagined and on the basis of the or mental imagery of

these animals, we have to answer these kind of questions; questions like does the and does the rat rabbit have whiskers things like which will require some detailed attention.

Now, when he repeated this procedure, but told participants to imagine a rabbit and a fly next to each other, instead of an elephant and a rabbit participant created this time a larger image of the rabbit; earlier the larger image was of the elephant this time the larger image was of the rabbit.

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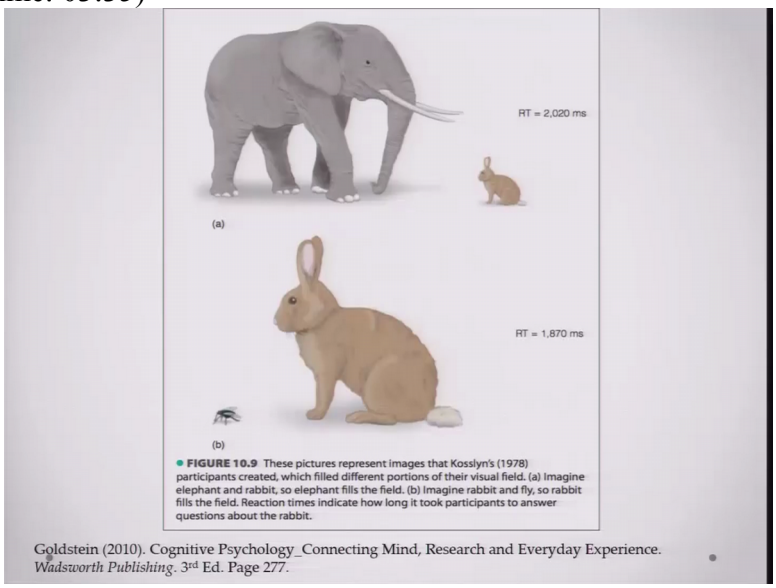

You can see here this is the kind of scenarios that the participants were asked to remember. Notice the reaction times here they are part of the results and we will talk about them very quickly.

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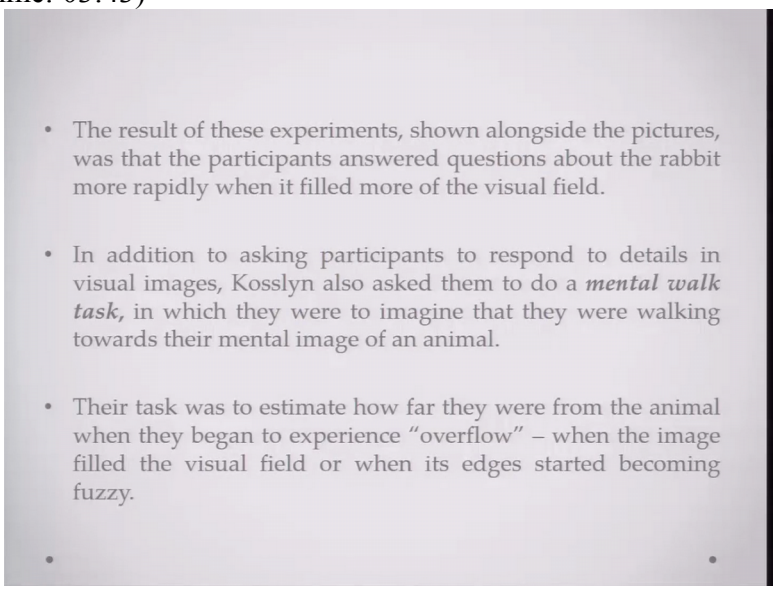

And the results of these experiments again as I showed you right here, basically show that the participants answered questions about the rabbit much more rapidly when it

filled more of the visual field. So, if you seen a the figure here, the reaction time here is 1870 milliseconds, when the question is about the rabbit and the rabbit is the bigger animal as compared to again, the question is about the rabbit in the first instance as well, but the rabbit is a smaller animal here.

So, technically you do not have that much detail of the rabbit in your visual field to answer the question, and hence you are slower in the first scenario and but you are faster in the second scenario where a rabbit is almost filling up your entire visual field. So, you see this is pretty much what you would expect when people actually perceive these animals. So, in addition to this kind of task Kosslyn also asked their participant's clue some other task, the task like the mental work tasks. The mental work task is basically your participants imagine themselves walking towards a particular animal and they have to report whenever this animal is feeling of the entire which will feel or there is this overflow of the visual field. And their task was to estimate how far were they from the animal, when this overflow of visual field is happening.

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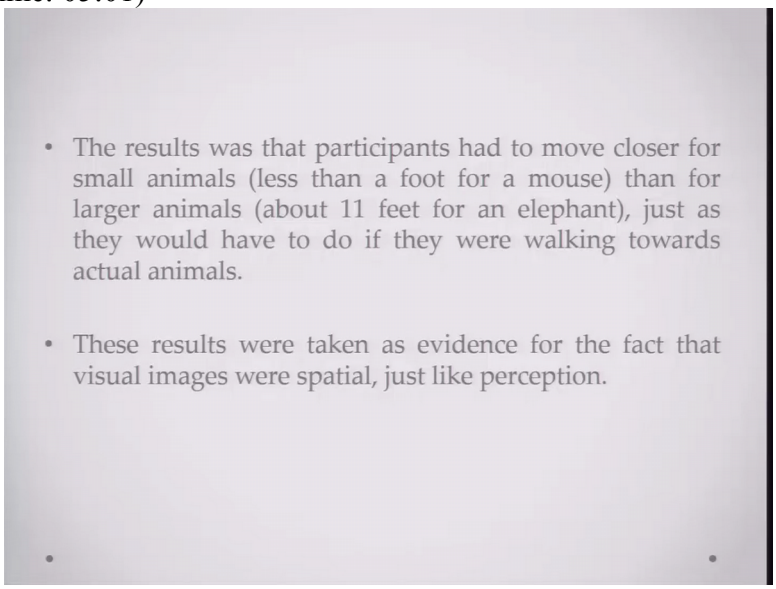

Now as would happen in visual perception, the results were that and persons had to move closer for smaller animals, while they had to come as close as just less than a foot for small animals like a mouse, than for larger animals about which is about 11 feet for an elephant; just as they would do if they were walking or actually seeing these animals.

Now, these results were taken as an evidence for the fact that visual images are spatial in nature, they follow the analog representation code and hence you know you can see that Kosslyn is already building up upon his proposal, by coming up with experiments like this which are actually supporting his account.

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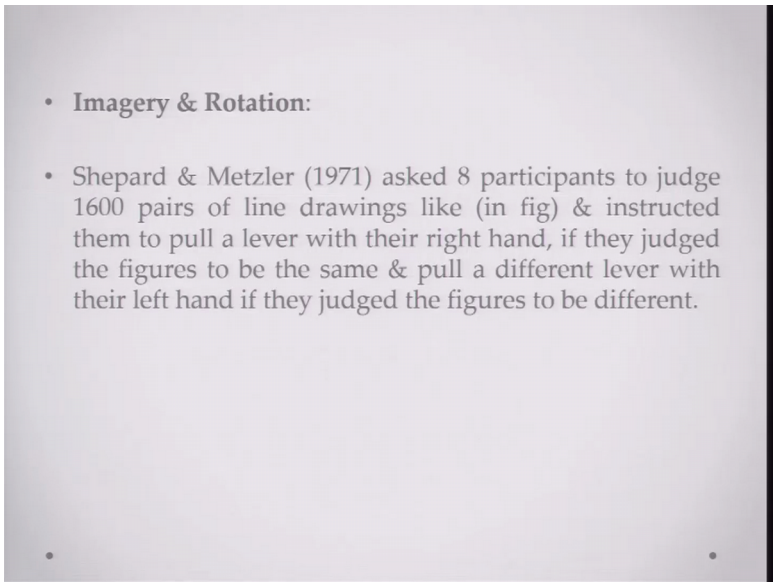

Moving on to a different phenomena let us talk about imagery and mental rotation. We have talked about mental rotation tasks earlier as well; but the most important task or the most important mental rotation task was actually undertaken by shepherd and metzler in 1971. When they asked around 8 participants to judge of around 1600 pairs of line drawings, I will show you the line drawings were like these. So, you can see a is 1 pair, b is another c is and here the person basically has to evaluate these pairs and say are they identical or they are not things like this.

So, if they and the participants has to indicate whether they are judging these pairs to be the same and they have to pull one lever and if these pairs are different they have to pull another level.

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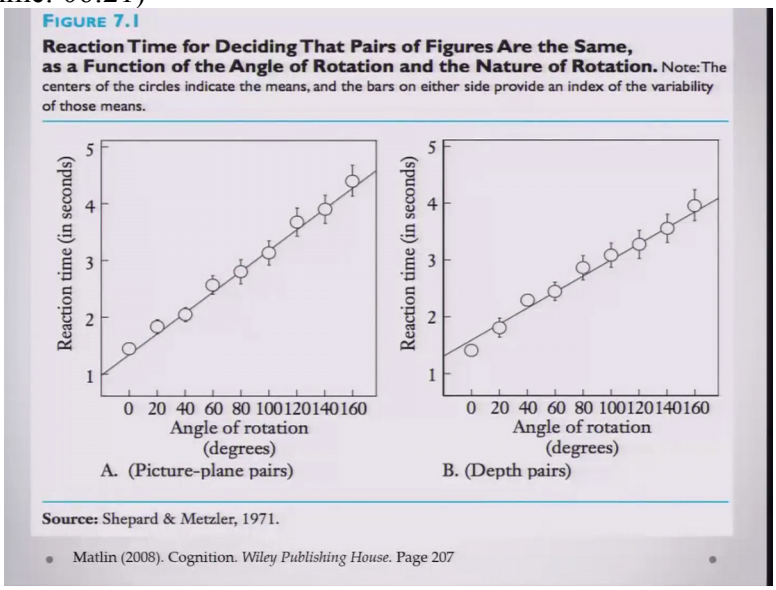

Now, what is happening? You can see here in the results, the amount of rotation that they have to do for one of these figures; let us say we take the left hand side figures on A B and C pairs the amount of rotation.

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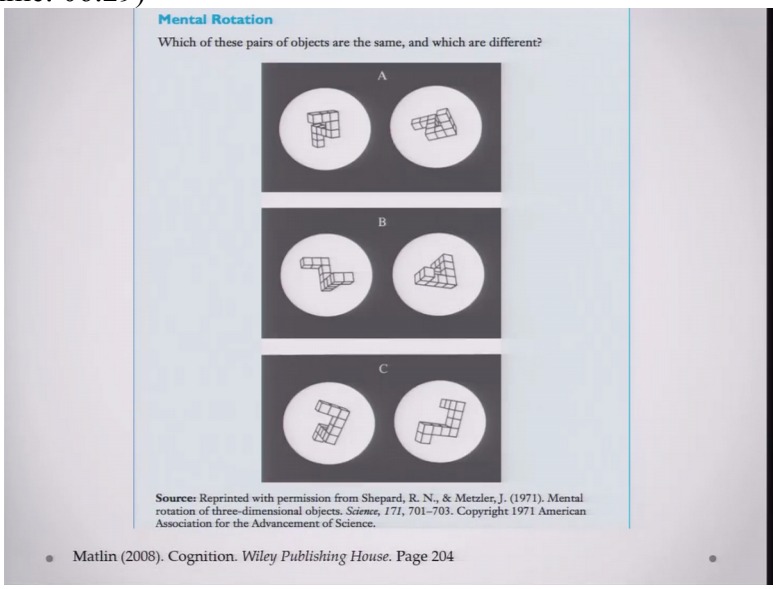

You would have to do on the left side figure of panel a to match it to the figure in panel b, is basically directly proportional to the amount of time you will take suppose you just rotate 10 degrees or 20 degrees and you take let us say and 40 milliseconds or 80 milliseconds you take 40 degrees you will take probably 160 milliseconds. So, this is the kind of a relationship that was observed you can see here this is pretty much what participants reported.

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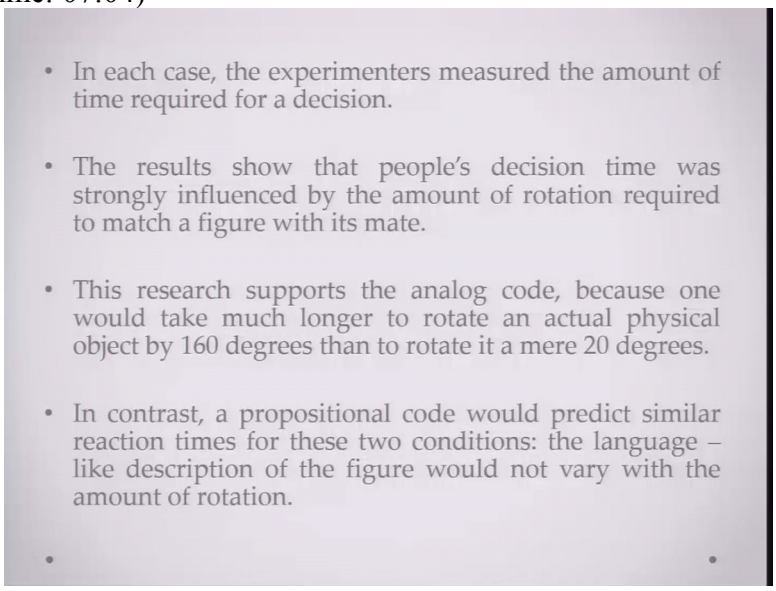

So, this research also supports the analog code because, one would actually take much longer to rotate an actual physical object by 160 degrees than to rotate it for a mere 20 degrees. So, because in actual time the rotation takes that much of your time, in imagery is also taking that much of your time, it seems that your mental imagery is actually based on the same code as your actual rotation is based upon.

So, again this is also kind of supporting the gosselins view of analog code for mental imagery, because if you see in contrast if you were following the propositional code; example the propositional code would actually predict similar amount of time for either, if you to rotate by a 20 degrees or 140 degrees or 160 degrees should not matter because, the idea is just to rotate.

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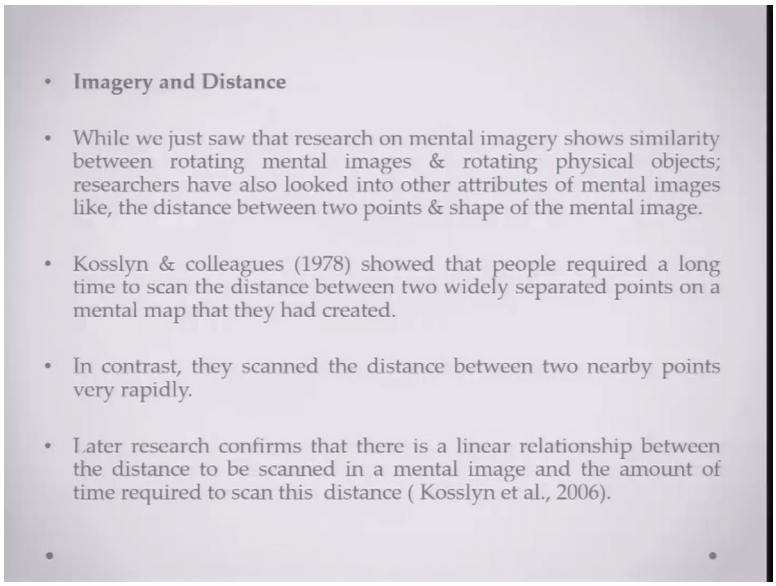

So this is again one of the experiments that kind of favours, the line that Kosslyn was trying to take in his experiments or in his understanding of how mental imagery works.

Let us move to a different phenomena let us talk about distance, now distance also very important aspect of you know perceiving and navigating through this world. So, why we have already seen that you know there is the research on mental imagery with it, kind of shows a similarity between rotating mental images and rotating physical objects.

So, the amount of effort you would take in rotating physical objects is rather equivalent to the amount of effort it is taking rotating these mental images. So, similar kinds of findings have also been reported and when researchers have tried to look into the attributes of mental imagery with respect to distance. So, Kosslyn and colleagues again have showed that people require a longer time to scan larger distances in the mental image or to widely separated points on a mental image as compared to shorter distances.

So, they scan the distance if they scanning the distance between 2 nearby points, they will take less time in the scanning the distance between 2 very you know points that are too far apart they will take more time; later research also confirms the same finding that there is a linear relationship between the distance to be scanned in the mental, suppose I ask you to imagine let us say you know if I ask you to imagine the layout of the academic area of your campus or say for example, if you visited to IIT and what if I asked you to imagine you know the academic layout of the academic area of IIT Kanpur

and I asked you to make you know, tell me how long it would take for you to reach from the faculty building to the library or say for example, from the faculty building to the lecture hall complexes.

The research would support the fact that, if I ask you to do a task or let us say mentally walk from the faculty building to the lecture hall complexes, which is the further distance you take more time there as compared to walking from the faculty building to the library which is anyways much shorter; this is the kind of results that we are getting in mental imagery research as well and Kosslyn has been coming up with these with these findings.

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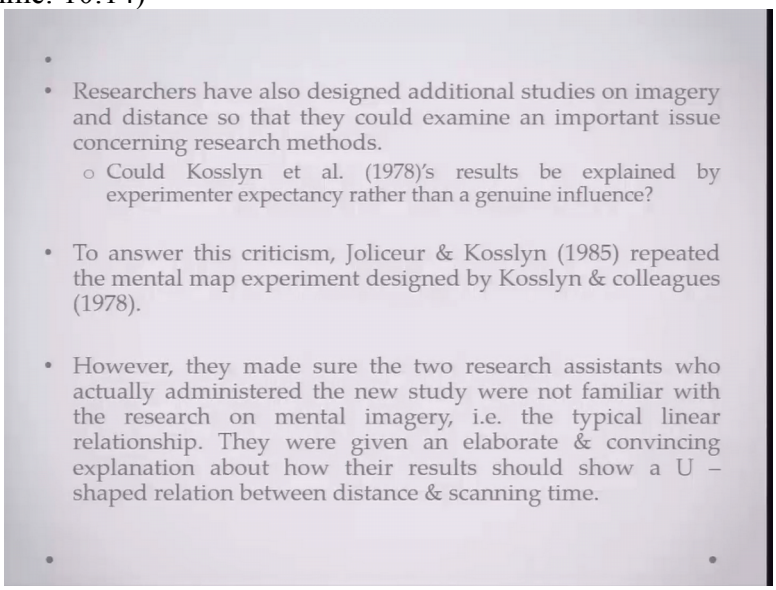

So, people have researchers have also designed other studies, they have designed additional studies to investigate the relationship between imagery and distance. So, that they could you know basically address the issues about experimental designed (Refer Time: 10:31)

So, when you know a lot of these findings started coming in one side of researchers also argued that these could be a result of faulty experimental designs and maybe because the experimenters are themselves expecting something, that they could these results could just be an outcome of an you know experimenter bias.

So, what they did was joliceur and Kosslyn in 1985, they repeated this mental map experimental design which was earlier done by Kosslyn and colleagues in 1978; this time they may show that the 2 research assistants that were actually helping set up the experiment, they did not know anything about the research on mentally imagery, rather

they were actually told that there is a typical you know a u curve u shape relationship between the distance and the scan time.

So, rather I mean the actual part is that there is a linear relationship, but these people were these research assistants were convinced that there should be a u shaped relationship, they were not egg expecting the linear relationship at all.

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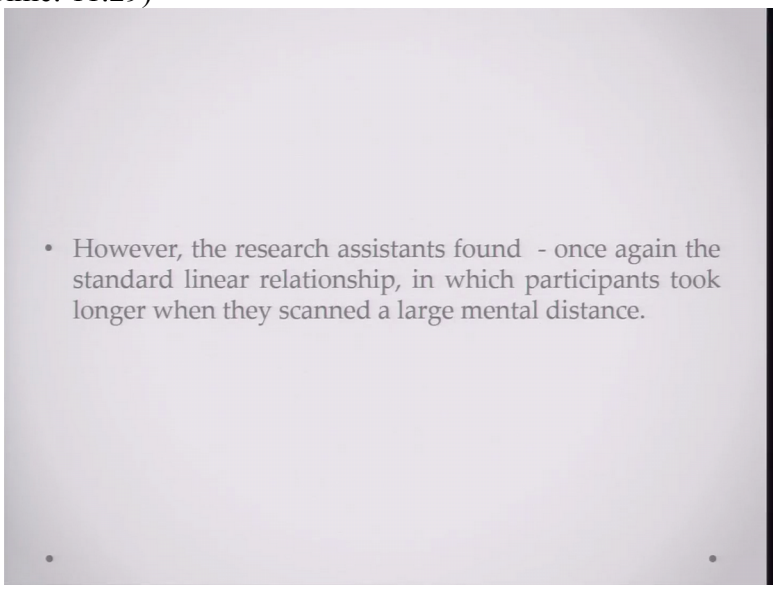

But when they conducted the experiment again the same experiment I was talking about, if a research assistant once again found that there is this standard linear relationship in which, participants generally take much longer when they are scanning a large mental distance; this is again confirming what Kosslyn has been talking about. Now we have talked about the rotation we talk about distance we talked about size; let us now talk about shape.

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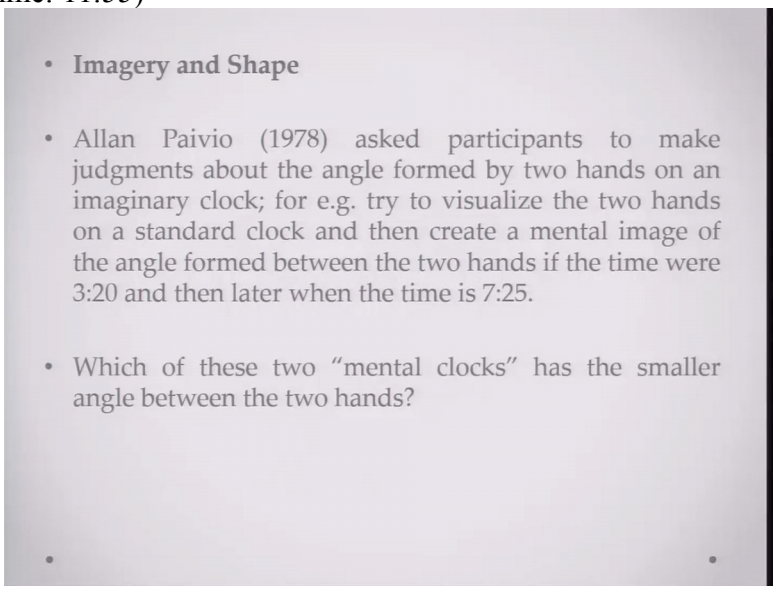

So, there is also been research investigating the perception of shape in actuality and perception of shape in mental imagery and Alan pioneer, we know the pioneer researchers working in this area shall in my view in 1978, asked participants to make judgments about the angriest found by 2 hands on an imaginary clock.

Suppose I ask you to imagine how you know the analog clock in your house and I ask you to visualize the 2 hands the minute hand and the hour hand of the standard clock that and create a mental image of the angle found when the time is let us say 3:20 pm and compare this with when the time is 7:25 pm and the idea is that you compare how far or how similar or how different are these angles to each other.

So, I guess you have to imagine both of these angles rather discretely and also be able to compare them only then you will be able to give the correct answers in this task.

Now, which of these 2 mineral clocks, so the question was to the participants which of these 2 mental clocks has the smaller angle between the 2 hands; you know so you have to really be aware of the 2, so that you can make this comparison.

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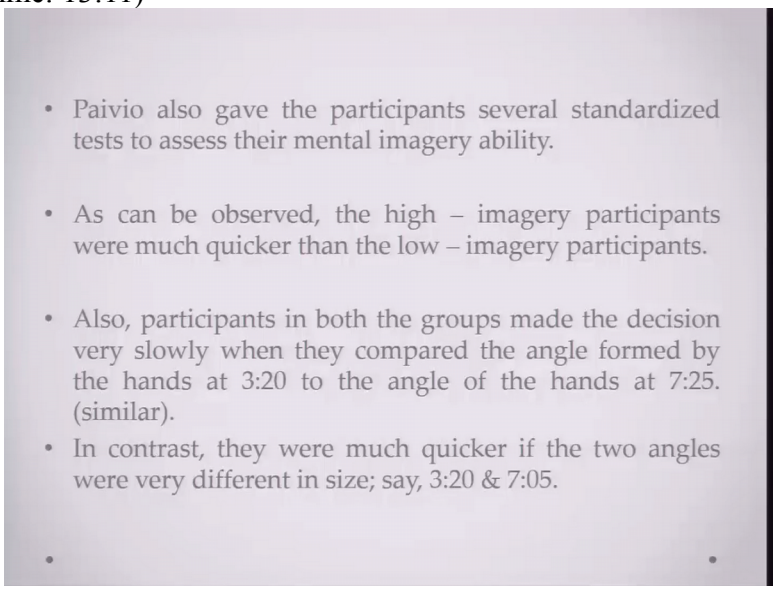

Paivio also gave the participants several other standardized tests along with this task, to assess their mental imagery or mental imagery ability as can be observed and I will probably show you the results here.

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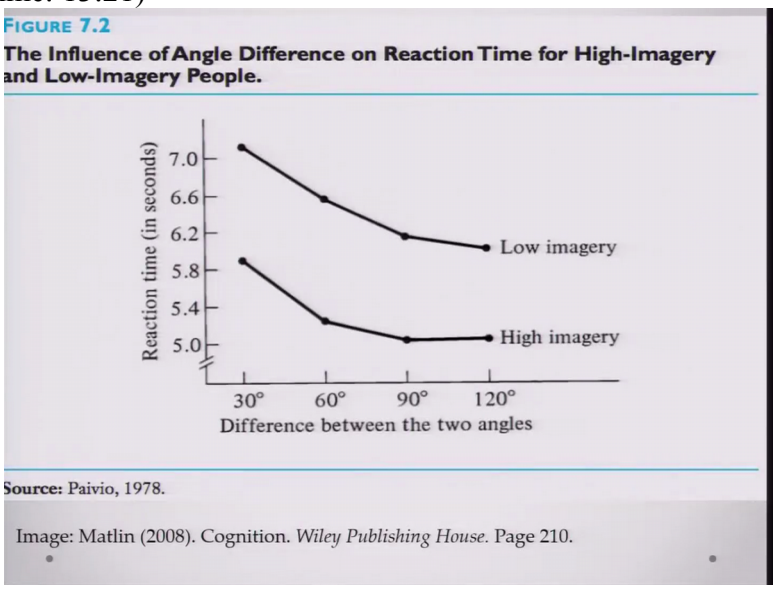

The high imagery participants were much faster you can see the participants who performed, who came out to be having high mental imagery ability, were faster across the different conditions as compared to participants, who were actually the low imagery participants and they were slower across all the conditions.

So, again you can see that the participants who generally have a better ability to perform mental imagery are doing this task better, as compare to the participants who have a slightly lower ability to do perform mental imagery; also these participants were quicker

when the 2 angles are very different from each other, say for example if you have to distinguish between 3:20 pm and 7:05 pm.

Now these angles are actually very different you can see physically there and you can see them physically as well. So, again the pattern of the tasks when you are actually doing something when you are actually perceiving the physical object, is much rather similar to when you are actually you know performing these comparisons in the mental image, again evidence of the fact that mental imagery and visual perception work very similarly in work in very similar ways.

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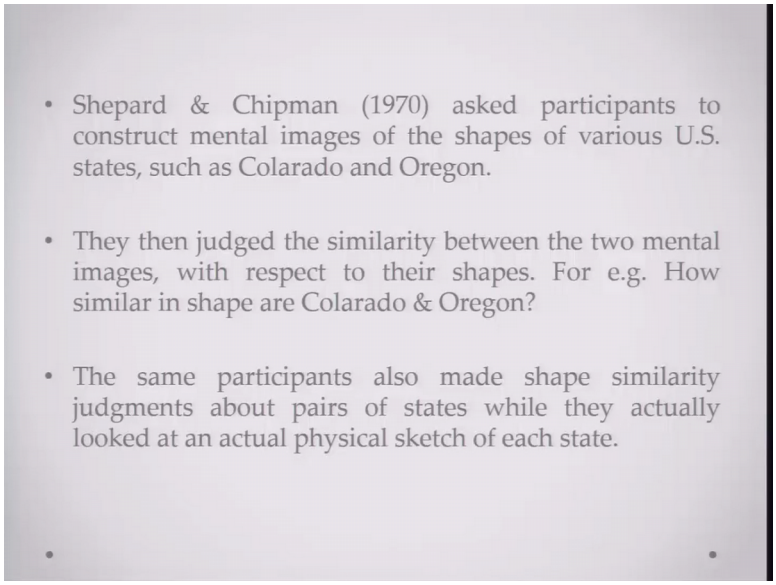

Another kind of studies we can talk about so shepard and chipman in 1970, they asked participants to construct mental images of the shapes of various states in the united states of America; such as for example Colorado or Oregon or things like that. Now the participants had to then judge the similarity between the shapes of between the, you know 2 mental images that were of these shapes, for example they could be asked equation how similar in shape are the states of Colorado and Oregon.

Now the same participants were in a separate setting asked to make shape similarity judgments about pairs of states, when they are actually seeing them on a physical map. So, in one hand they are actually making these decisions while seeing these things physically, on the other hand they are actually making the same decisions while they are imagining these different states.

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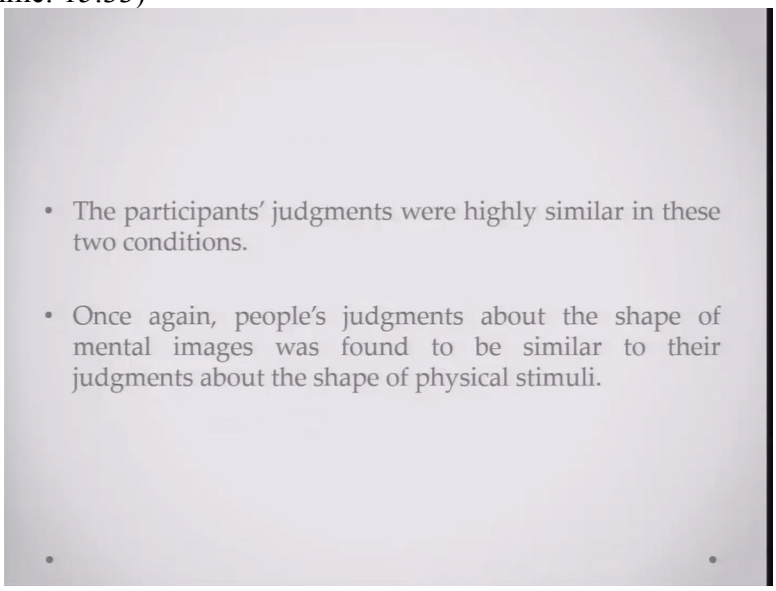

Again it was found that the participant's judgments were highly similar in both of these conditions. So, once again people's judgment about the shape of mental images was found to be very similar to their judgments of shapes of physical stimuli; again you could say this is evidence for the fact that mental imagery and visual perception are working in a very similar way to each other.

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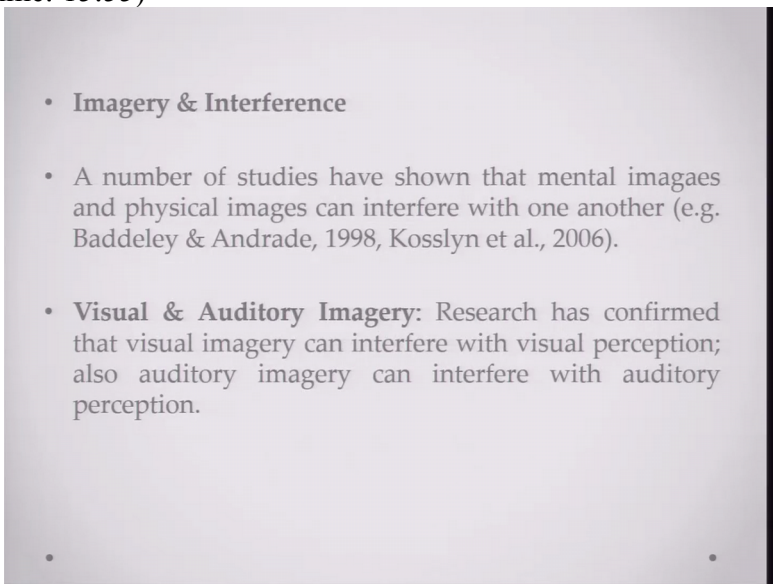

Now we have talked about various aspects, various ways about how mentally imagery might work, but they have also been instances people have also found out that mental imagery and a visual perception can interfere with each other. So, we people have actually come across with these effects as well. So, it has been shown that a number of studies have been conducted and people have shown that mental images and physical images and you know physical perception can actually interfere with each other, you will pick up some of the examples. So, research confirmed that visual imagery certainly can

interfere with visual perception and also similarly auditory imagery can interfere with auditory perception.

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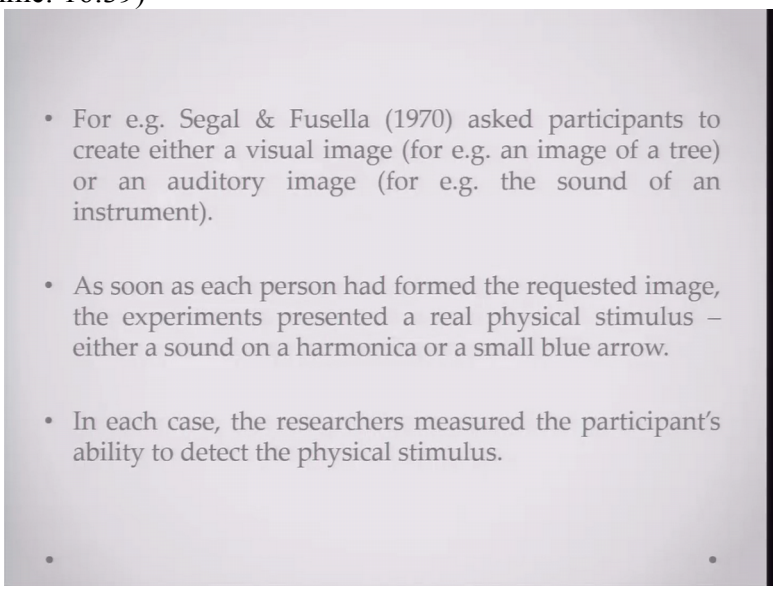

Let us take some examples, so Segal and Fusella in 1970 as participants to create either a visual image, for example if I asked you to create a visual image of a tree or an auditory image. So, suppose I ask you to imagine that a particular instrument let us say a guitar is being played; now as soon as each person has performed this requested imagery tasks, the experimenters present a real physical stimulus either a sound on a harmonica or a small blue arrow.

So, either I am asking you to make a visual image or a mint or an audio image and I am either presenting you with a visual stimulus or an auditory surface it is a classic 2 by 2 Latin square design.

Now, in each case the researchers are measuring the participants ability to detect the physical stimulus, while you perform the visual and the mental imagery tasks the physical stimulus is being presented and your ability to detect these physical stimulus is being tested. So, this is pretty much what the task is about.

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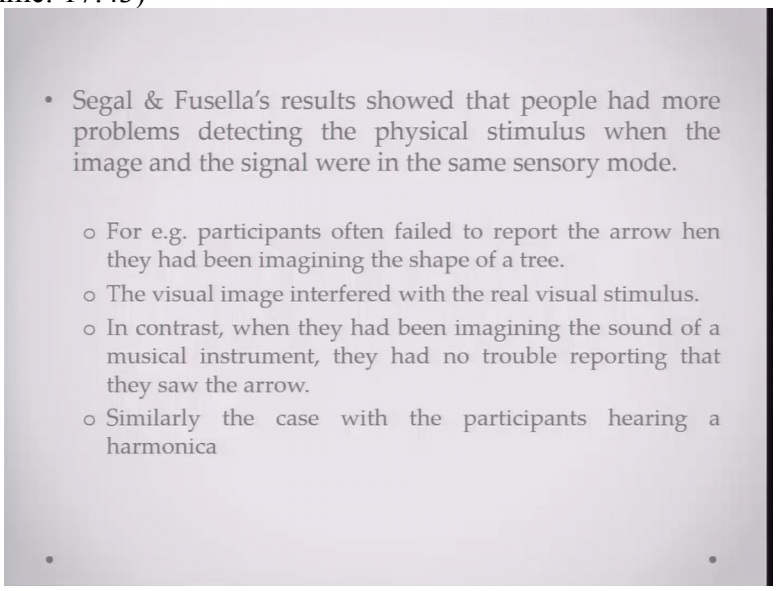

Now, Segal and Fusella's results show that people had problems detecting the physical stimulus, when the image and the signal were in the same century modality. So, the idea is participants often fails to report the arrow when they had been imagining a tree, the visual image in that sense is interfering with the perception of a real visual stimulus. In contrast when they had been imagining the sound of the musical instrument they had no problems in detecting the visual stimulus that is the arrow.

So, if the modality is different than mental imagery and actual perception, so visual perception or auditory perception they can power you know there is no interference at all, but if both of these things are happening in the same modality you are presenting a physical stimulus and the person is making some visual imagery, if it is happening in the same modality then you can see instances of interference.

So, it could be you know taken and understood as the fact that you know there is only so much memory or there is only. So, much cognitive resources for people to perform particular kinds of tasks and in that sense if you are kind of overloading one of these modalities; obviously, there will be some kind of cost there and you know the lower detection rate is probably one of the example of those costs.

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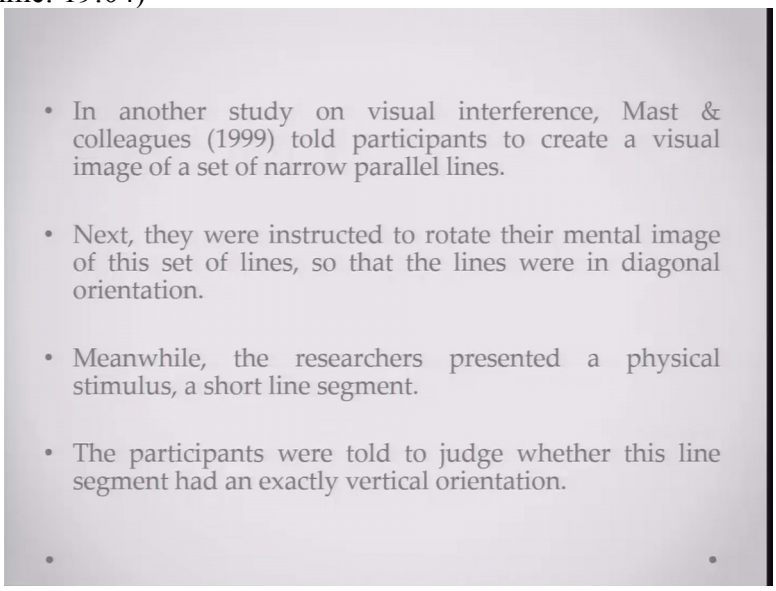

In another study on visual interference mast and colleagues in 1999, they told participants to create a visual image of a set of narrow parallel lines. So, the idea was that there are you know you imagine that there are 2 parallel lines and you kind of hold the image in your head; next they were instructed to rotate their mental image of these lines, so that the lines were in diagonal orientation.

So, I asked you to imagine a line and I asked you to imagine that this is now diagonally; meanwhile while this performance is being conducted the researchers also presented a physical stimulus, they sign a short line segment and the participants were told to judge whether this line had exactly the same vertical had done exactly vertical orientation. So, they have to judge whether this is vertical or not what it something like that

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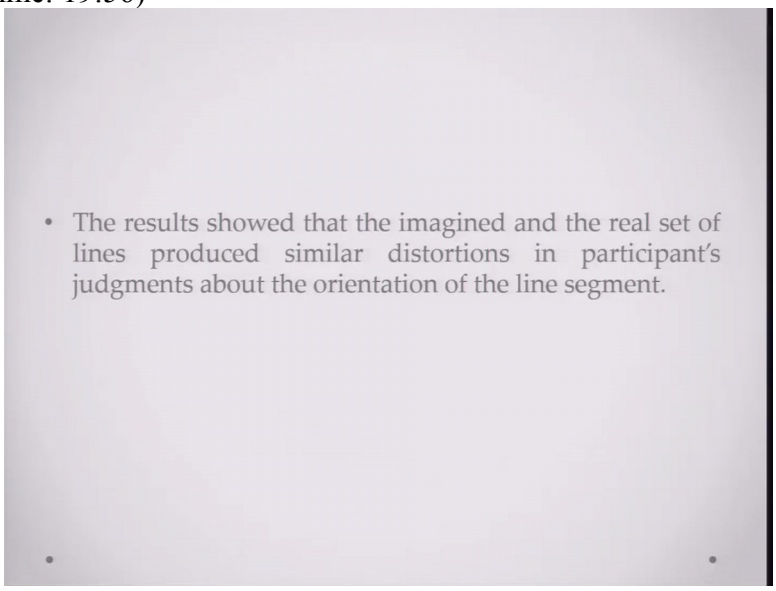

The results showed that I imagined and the real set of lines produce similar distortions in the participants judgments about the orientations of the line segments, if I am giving you an actual physical stimulus and I am asking you to check their orientation or check the orientation of this third stimulus, what if I am asking to imagine these parallel lines and again at the same time you know judge you know.

Whether these new symbols that I present it is vertically oriented or not same kind of distortions or the same amount of distortion or the same amount of error in judgment was experienced; again an example of the fact that in the same mod modality these interferences are operating.

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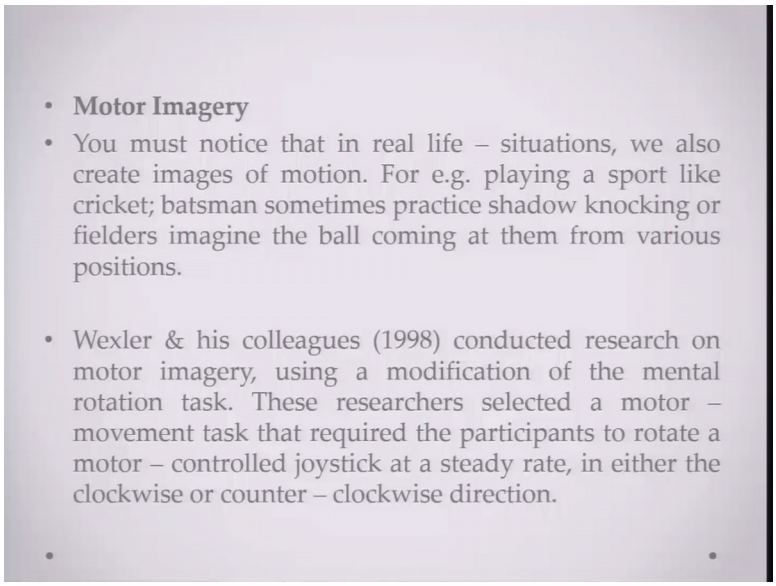

Now, not only in visual perception and visual imagery or not only in the auditory perception and auditory imagery, these interferences have also been reported in things like motor imagery; now what is motor imagery? We do not you know a lot of things we do imagine you know motion or moving objects, things like say for example, I know if you come across a lot of cricketers, you will see a lot of batsmen do something which is called shadow knocking.

So, they will imagine the ball coming from various areas and then will and they will you know now try to play shorts to these balls or a lot of times fielders you know imagine the ball coming from various areas and try and practice you know attempting to catch them.

So, this kind of mental imagery you know relate to the motion people have been talking about; now Wexler and colleagues they did a lot of research in this area. So, Wexler and colleagues basically conducted this research on motor imagery and they used a modification of the mental rotation task, the task which Shepard and Metzler had earlier used.

This time new set of researchers selected a motor movement tasks that required the participants to rotate a motor controlled joystick at a steady rate. So, they had to you known they you imagine a joystick and you have to keep rotating it in either the clockwise direction or the counter clockwise direction.

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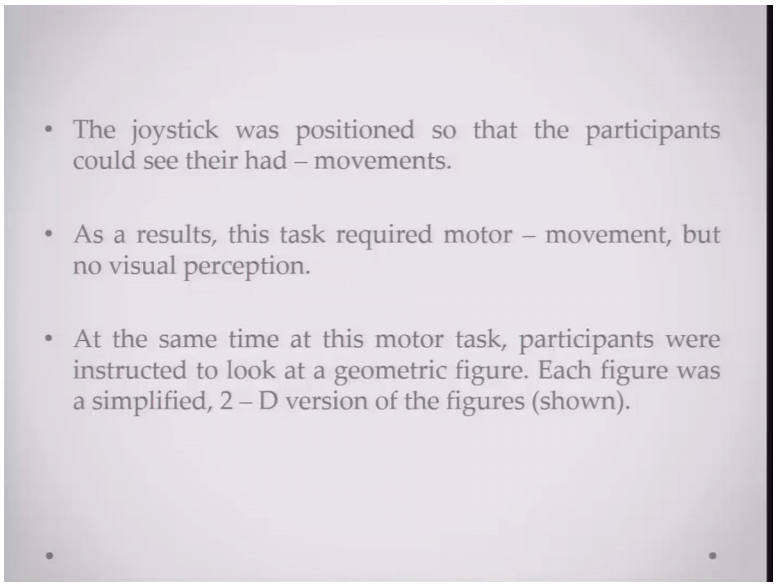

Now, the joystick was so positioned that the participants could see there could not see their hand movements. So, as a result this task required motive movement, but there was no visual perception of the hand happening, at the same time as this motor task was being done participants were instructed to look at a geometric figure and they were geometric figure presented, each figure was a simplified you know things like this and they had to you know actually again test, just do the same thing that Shepard Metzler had a to do.

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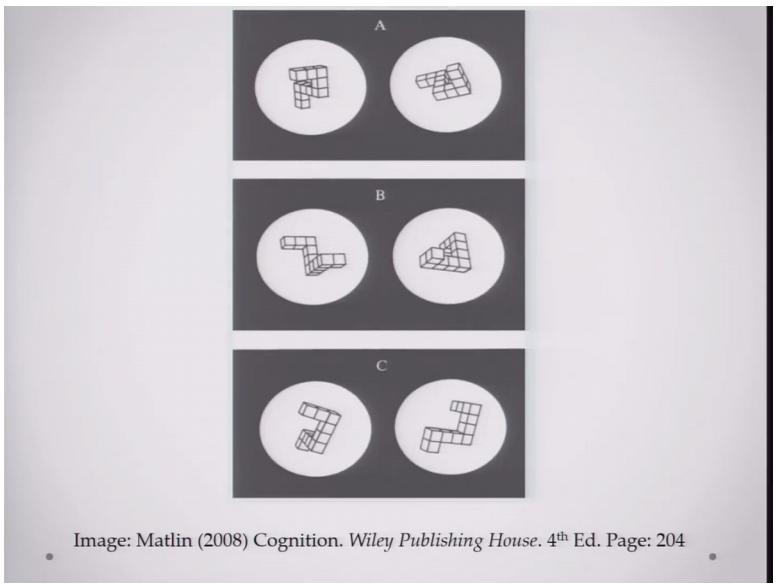

But in this study Wexler done by Wexler and colleagues participants first off one member of the pair. So, this time both of these pairs are not presented simultaneously they first saw one member of the pair.
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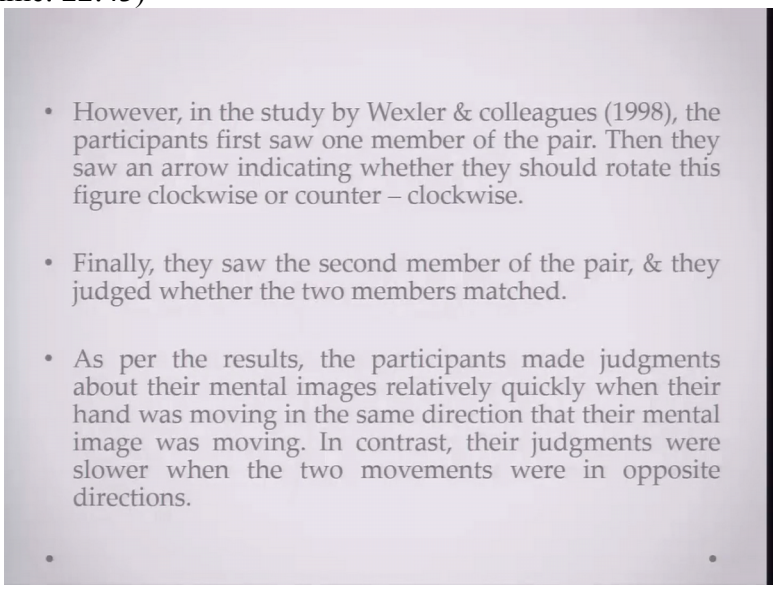

Then they saw an arrow indicating whether they should rotate this member of the pair counter clockwise or counter clockwise. So, actually they are moving their hand in the measure imagery task but the hand is not visible to them, also we are moving one of these figures that shepard and metzler had used and the arrow is going to tell them whether they have to move them counter clockwise or clockwise.

So, 2 similar things are happening one, they are actually moving this and when they are mentally you know mentally imagining this movement. So, they saw a finally at a later point, they saw the second member of the pair and they judge whether these 2 you know elements are going to match; as per the results the participants made judgments about mental images, relatively quickly when their hand was moving in the same direction and a rotation that was required.

So, in contrast their judgments were much slower when the movements 2 the imagined moment of the actual moment were in opposite direction, you can see there is again this sort of interference coming here in the motor imagery section as well. So, typically you could see that you know the resource that is allocated to perception or to mental imagery is probably shared in some way; we will talk in talk about these things in much more detail in one of the later lectures, but it seems here that both of these 2 things kind of you know are constraining each other at some level.

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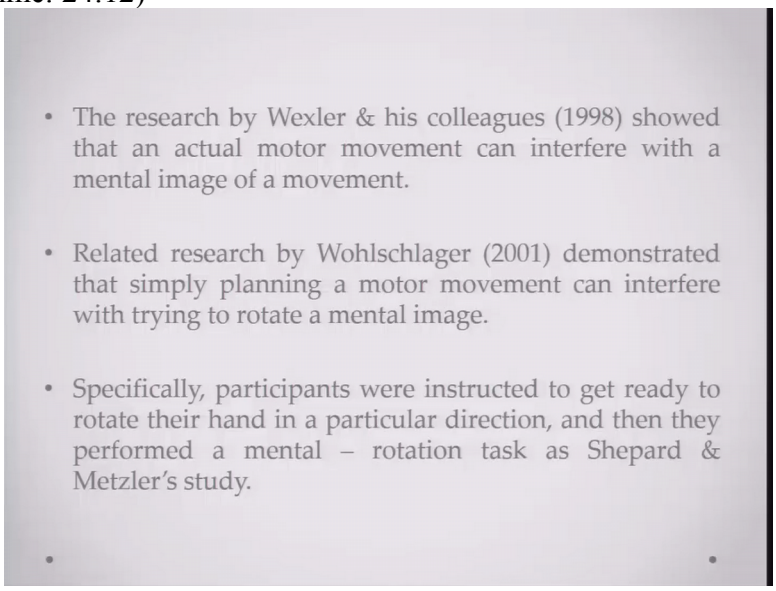

So, the research again by Wexler and colleagues showed that an actual motor movement can interfere with an imagined motor movement or mental image of a particular movement; other research by wohlschlager and have has demonstrated that simply planning a motor burn not only performing, but simply even planning a motor moment can interfere we trying to rotate a mental image.

So, had these people were not been making actual movements, had they just been planning a particular motor movement and they are doing the mental imagery movement; both of these things could also interfere religion let us see how that happens. So, participants were instructed to get ready to rotate their hand in a particular direction get ready. So, they have to plan this and then they performed a mental rotation task much.

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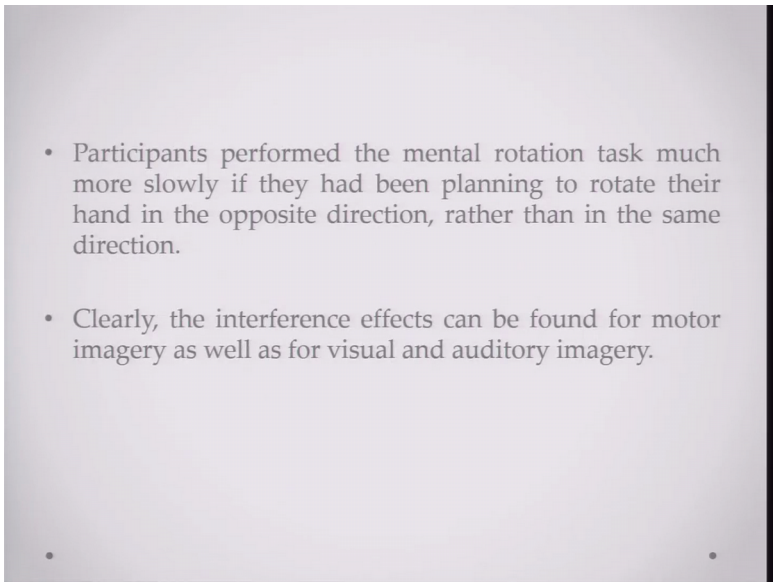

Similar to what Shepard and matzler had been doing participants found perform this. So, it was found that partisans performed a mental rotation task much more slowly, if they had been planning to rotate their hands in the opposite direction rather than in the same direction. So, clearly even plan at the planning level this interference can be observed and you know in motor imagery as well as auditory or visual imagery. Now let us move to a different aspect of research now let us talk about ambiguous figures.

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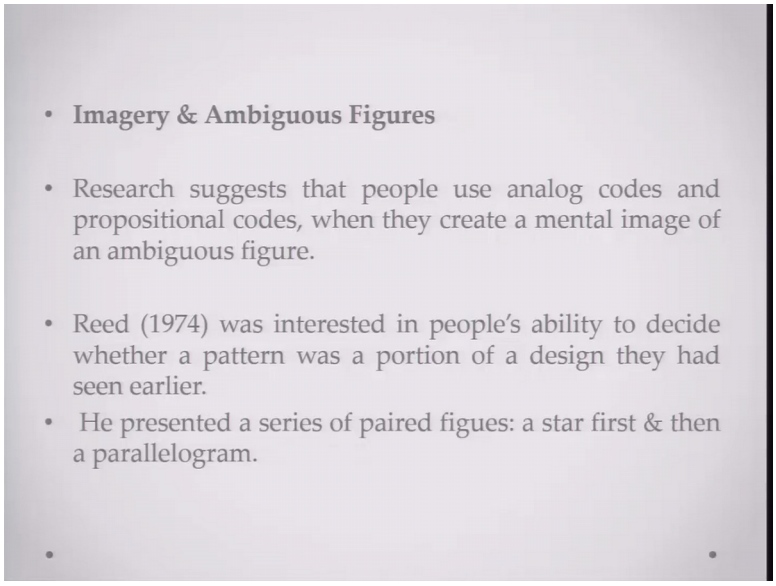

So, I am coming to a section of research that is very interesting and it is rather intriguing for a set of reasons that you will see; now research has suggested that people use analog codes and proposition codes, when they create a mental image of an ambiguous figure. So, I will talk about what ambiguous figures are, if you seen you know there are figures you come across once in a while that can be interpreted as 2 separate objects depending upon which you know folk which foreground or background that you choosing.

Now, read in 1974 was interested in people's ability to decide whether a particular pattern was a portion of a design that they had seen earlier. So, they had to you know look at something remember it and then see it something else and see that whether this is part of what they have seen earlier, something of this sort he presented to see a series of paired figures a star things like; you know the star of David something like that and then a parallelogram and you have to compare these 2 things.

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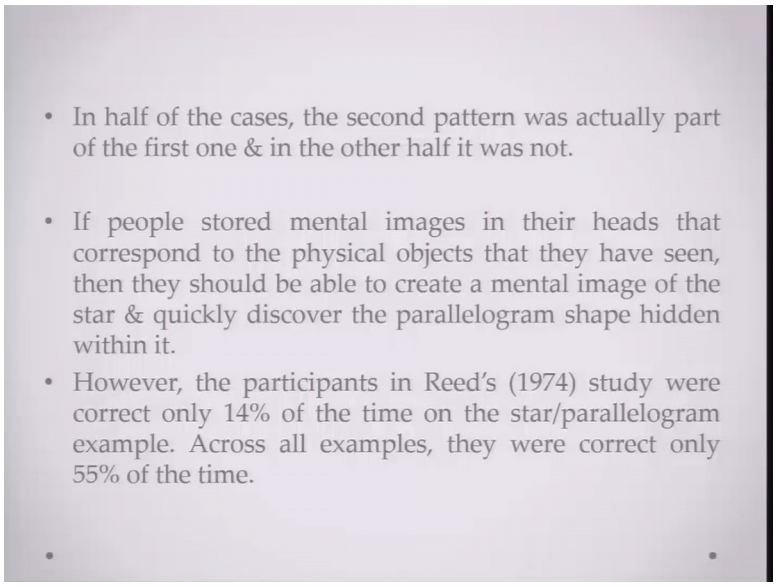

In half of these cases the second pattern was actually part of the first 1 and in other half this was not clear, the second figure was actually part of the first. So, if I am drawing a particular figure you might come across these kinds of stimuli or these kinds of presentations and many mental ability examinations, many you know aptitude examinations nowadays.

So, the idea is you see a slightly more complex figure then you see a part of that figure in a separate slide and you have to realise this whether this actually belongs with this 1 or

not. Now if people were storing mental images in their heads as Kosslyn has been arguing in an analog code, as they should have be able to create the mental image very quickly and discover that their fact that the second figure belongs to the first; so this parallelogram belongs to the star of David.

However, in this experiment what happened was that participants, you know only participants were could make correct judgments only about 14 percent of the time across all examples they were correct; only about 55 personal chains which is a 55 percent of the time which is very similar to you know at the chance level. So, it is not really that they are doing this task any better.

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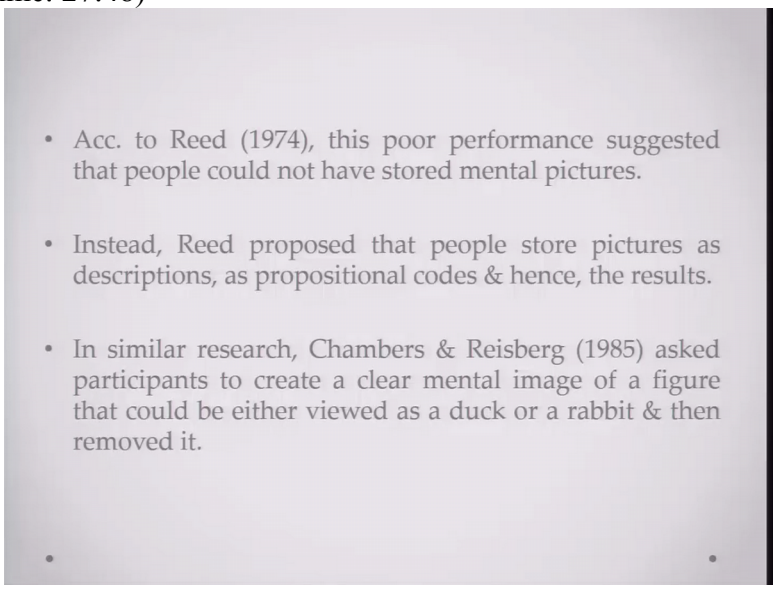

Now, reed tries to explain this, so reed says this poor performance suggests that people are not storing these mental images as pictures, it seems that people are storing these pictures as descriptions or as propositional course as patient has been arguing; in similar research chambers and Reisberg 1985 asked participants to create a clear mental image of a figure, that could either be viewed as a duck or a rabbit I think you can see this here.

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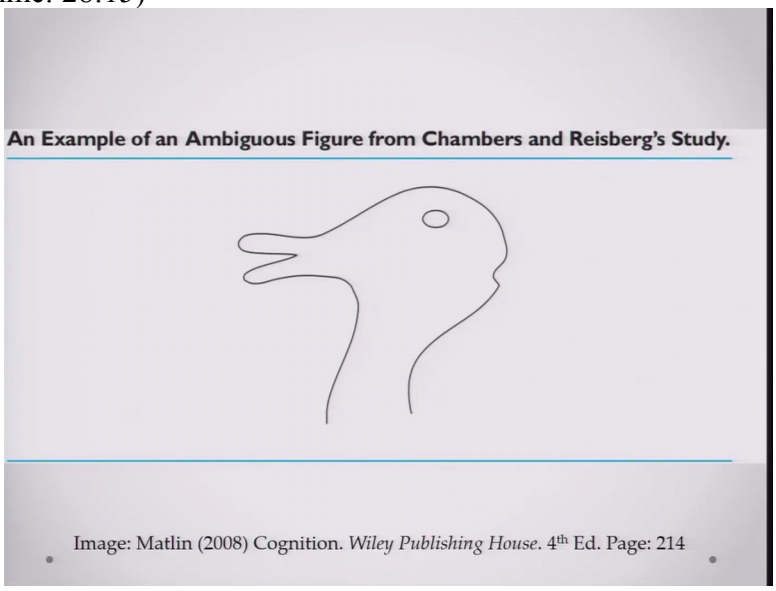

If you look at this ambiguous figure here, you can if you choose to look at this as a duck or you can if you choose to look at this one as a rabbit. So, chambers and Reisberg basically gave these participants you know the same kind of task and they were then. So, they have to just look at this and remember it memorize it and then this was taken away and then later what happened was the participants were then given the second different interpretation of the figure. So, the first time if I ask you and you tell me that this is a rabbit; I will show it to you I will remove it later, I will tell you no that was not a rabbit that was actually a duck.

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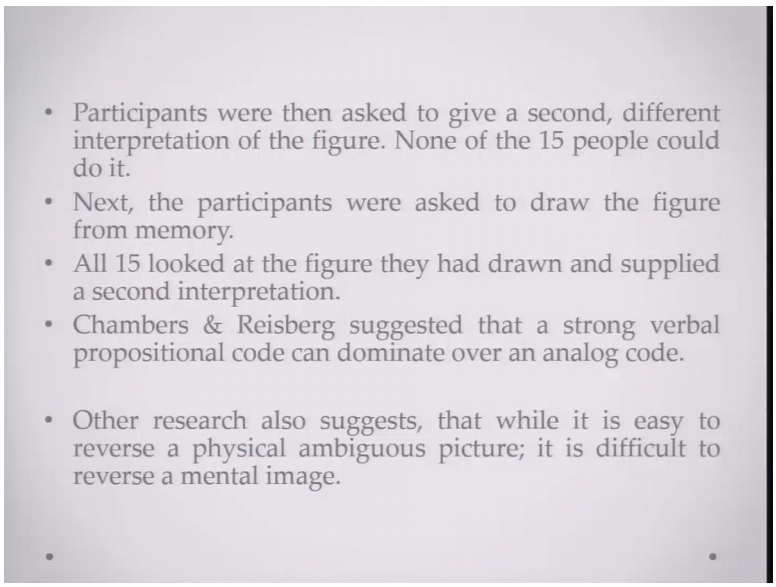

None of the fifteen people could actually you know tell that this was a correct interpretation. So, next what happened, the participants were basically the parchments were asked to give the second interpretation? So, they were asked that and you saw this hazard can you imagine this. So, I am correcting myself a bit here, so the participants were ask that you know you saw this as a duck in this instance.

Now this is removed how can you mentally imagine this figure and tell me whether there was a rabbit embedded here or not? None of the fifteen participants that were part of this experiment would actually do this task. So, the chamber and Reisberg move to another step what they had was this time they asked the participants to draw this image from their memory and once they draw this image from the memory all of the 15 of them could look at this figure and very easily rather quickly supply the second interpretation.

So, chambers and Reisberg on the basis of this evidence suggested that a strong verbal propositional code is basically dominating the analog code here; other research has also offered this. So, why is this domination of the propositional code because, if you had stored this as a mental image you could actually go back and look at this and decide, but you have to actually see it, you have to probably see how this figure is there and then decide this.

Now, there is other research as well other research also suggests that while it is easy to reverse a physical ambiguous picture, if it is right in front of you is very difficult to reverse a mental image.

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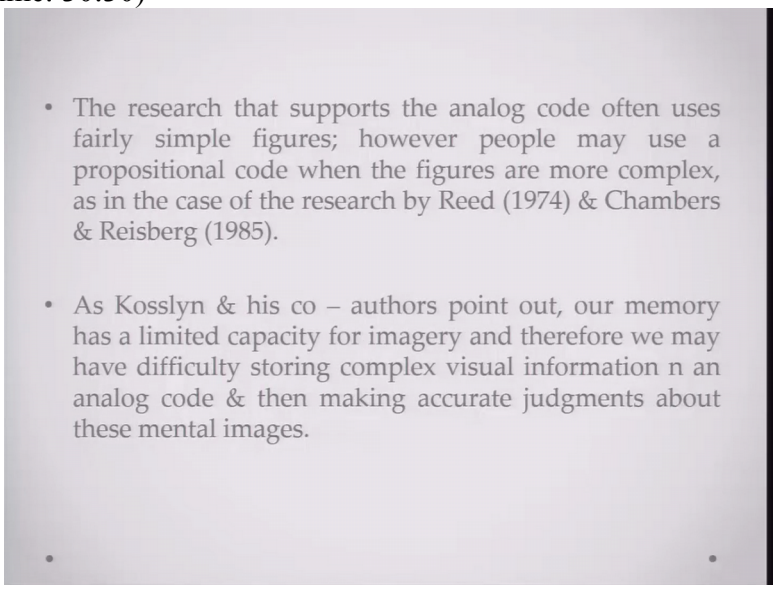

Now, the research that supports this kind of research that supports the analog code has often used fairly simple figures, you know however it is quite possible that in you know slightly more difficult tasks people may be using what is called a propositional code and when the figures are more complex and or you know as in the case of you know reed and chambers and Reisberg. As Kosslyn and his co authors have pointed out our memory has a limited capacity for imagery and perception and one of the reasons is that therefore, we might have a difficulty in storing these complex figures.

So, because we have difficulty in storing these complex figures let us say the file size is too big, what we might be doing is, we might not be storing them as images; we might start storing them as a propositional code and then making accurate judgment about these mental images. So, that is something which is possible and which is proposed.

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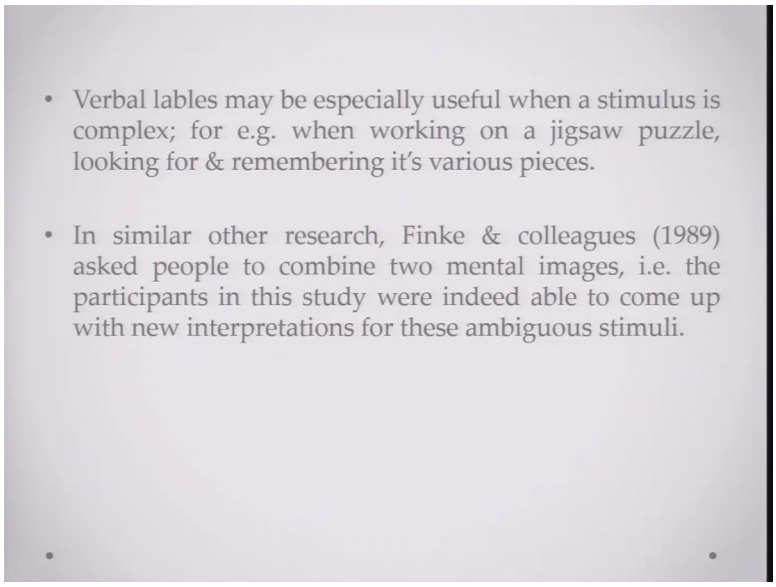

Now these verbal labels when you actually you know store them in a propositional code, may be especially useful when a stimulus is slightly complex; say for example when you are working on a putting together a jigsaw puzzle, you know a lot of times what people do is they name each of these parts as something you know, look at the tail or look at the you know I know face or look at something else.

The idea is because; they will probably not be able to hold that image for as long as they are going to search for the next matching piece. So, the idea is that they have to really

store them in a propositional manner, in a rather sort of a descriptive manner and that description is going to help them look for the other thing.

Now, in similar research again I am just trying to take this a bit forward, in similar research Finke and colleagues have asked participants to combine 2 mental image. So, this time we are actually combining the 2 mental images and so participants in the study were indeed they were able to come up with new interpretations for these ambiguous stimuli.

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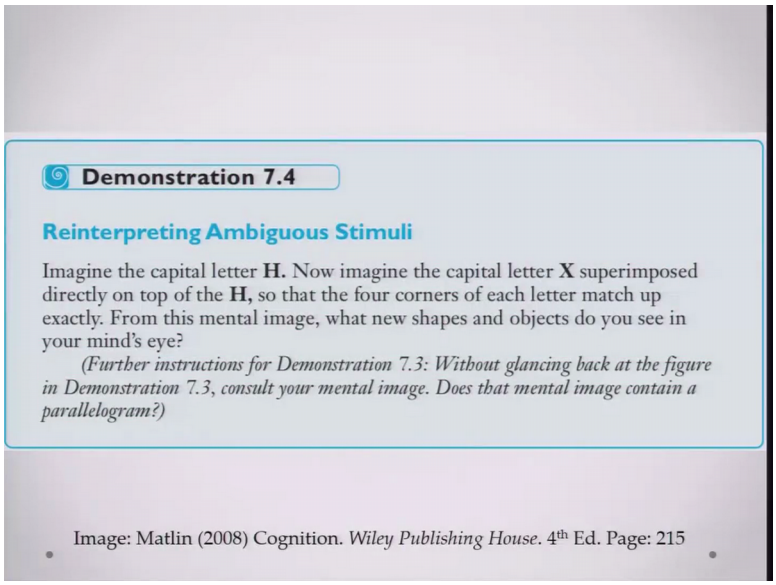

So, the idea was, the task was a little bit like this it is been borrowed from marlin. So, the task is imagine the letter H, now imagine the letter x superimposed on the top of H. So, that the 4 corners of all of these things match up from this mental image, what new shapes and objects you would see. So, you could probably see an m you can see in you know the n you could see different kind of things here.

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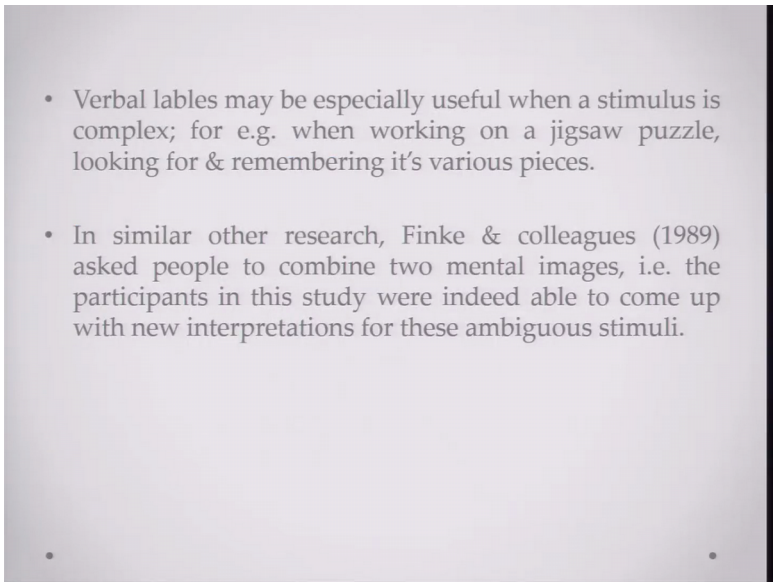

So, this is what the task is and it is there the participants were very easily able to come up with alternative interpretations for this ambiguous figures.

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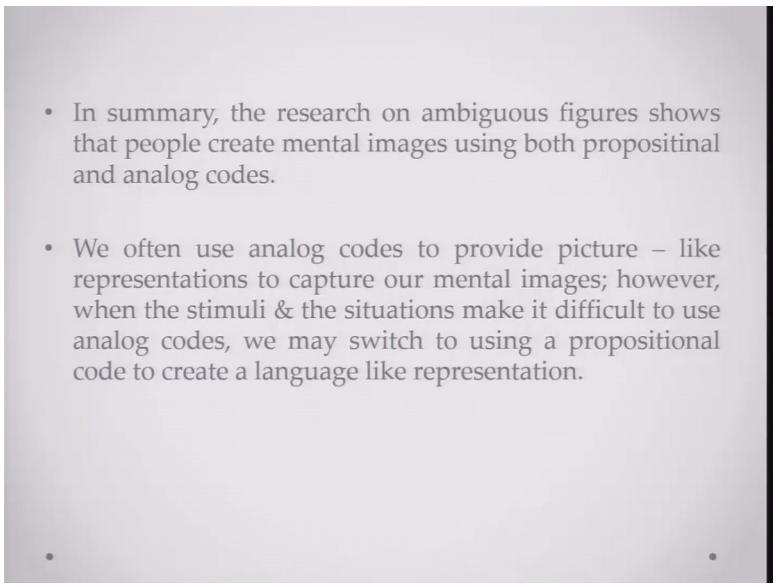

Now, I have at this point surveyed some of the earlier research which favours the analog code, very recently I was talking about some of the research that kind of favours the propositional code. So, again you will see that there is evidence on both sides. Now in summary the research on ambiguous figures again coming back to the topic at hand the

research on ambiguous figure shows that people do mental images using both propositional codes and analog codes.

We might often be using analog codes to provide picture like representations to capture our mental images. However, when the stimuli and in situations make it difficult for us to store inform of a mental image, we might switch to using a propositional code and we might switch to creating a more language like representation of the world around us.

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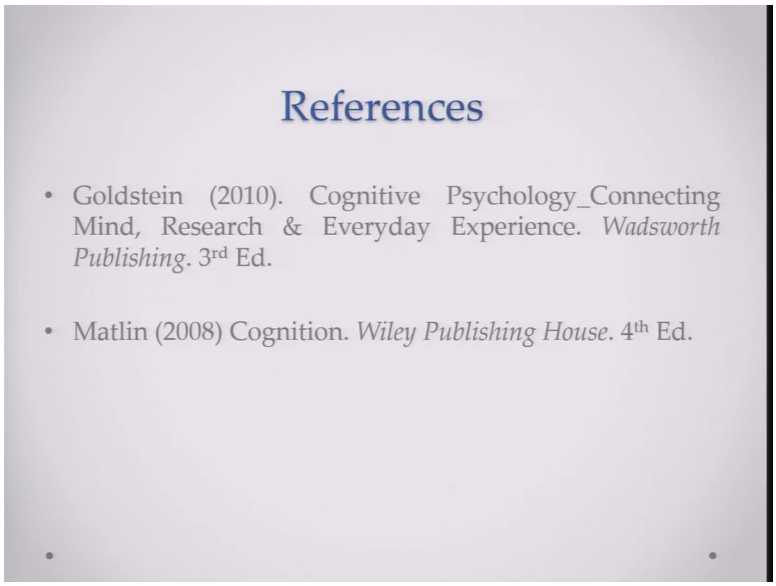

So, that was all from my part in this lecture, we talked about evidence supporting analog course and evidence supporting proposition code and he kind of probably came to the end that because there is evidence of both side, it is quite possible that we might be using both of these strategies.

Thank you and we will meet in the next lecture.