Hello and welcome to the co-series and basic cognitive processes I am.

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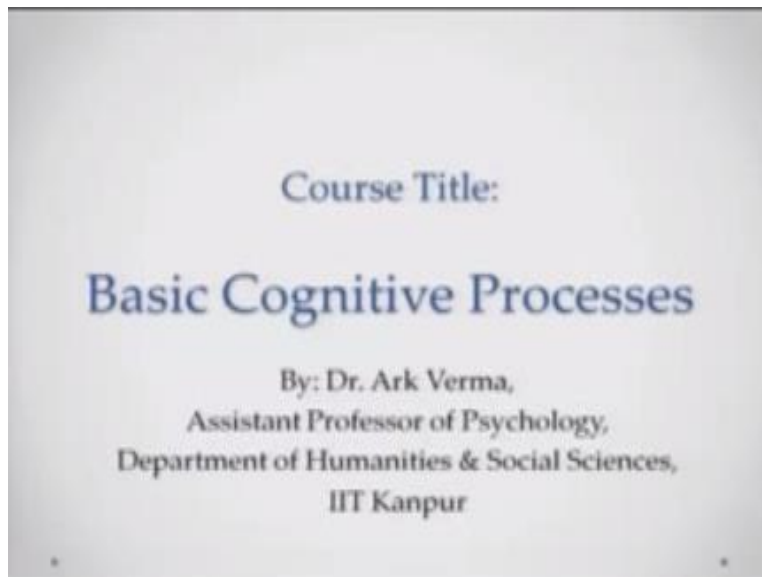
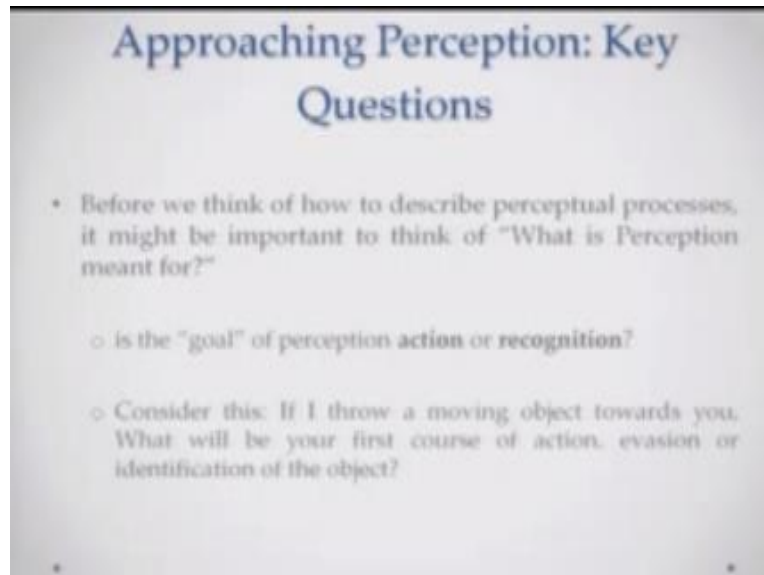

Dr. Ark Verma from IIT Kanpur, today we will be talking about we will begin to talk about various approaches to visual perception in particular.
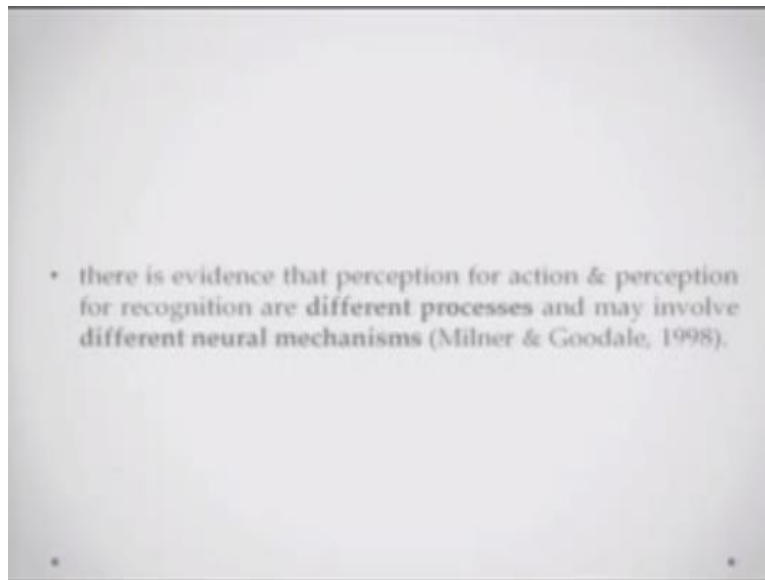
I will talk about JJ gives us a promotional perception but before we begin with that, let us talk about why do we need to discuss these approaches to perception in the first place? the key question in perception basically is the what is perception really meant for, why do we need to perceive the world? And what you know benefits does it give us and what is our perspective you know towards perception as a cognitive function.

The question one might ask is what the goal of perception is is it for action or is it for recognition. I can actually elicit eight the difference between action in the collection by just throwing a ball at you and you probably first take evasive action you try and you know save yourself from it by the ball, then really recognizing that what was this object that I threw towards you.

This kind of tells us that you know we looked at the world we are interacting with this world or you are perceiving this world more importantly to interact with this, not really merely just to get a you know visual description of the environment variable, that is also useful and that is also something which are you know perception is there for but there is this debate between what is the actual use of perception? Is it for interacting with this world or is it for just having a visual

description of this world okay. We are talking about visual perception more specifically but such a question can also be asked for other modalities of perception like auditory perception, tactile perception and other kinds of perception.

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- there is evidence that perception for action & perception for recognition are **different processes** and may involve **different neural mechanisms** (Milner & Goodale, 1998).

There is always there is already evidence for the fact that perception for action and perception for recognition are actually different processes and they basically involve different regions of the brain, this was the research done by Milner and Goodale in around 1998 and a lot of people a lot of experiments after that have actually confirmed this idea. So if you have this in background you know.
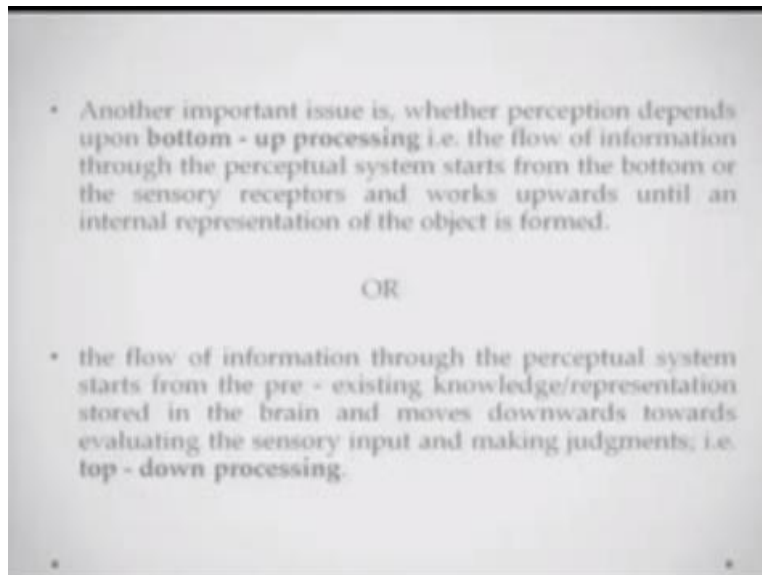
And if you really try and look at the last lecture in this series, we were talking about the presentation and what is a representation meant for and by do we construct representations basically, how do we construct representations? Then you will come to a actual difference between you know the very perception can be constructed, say for example better perception depends on bottom-up processing that is basically the flow of information through the perception system starts from the bottom of sensory receptors and works upwards until an internal representation of the objective is formed or the flow of information through the perceptual system starts from pre-existing knowledge image. You know like your memory stored in the brain and then it moves downwards towards evaluating whatever century in which you are getting.

So these are the two routes we discussed yesterday about how mental representations are constructed and this is in that sense actually you know one of the critical questions in how perception can be looked at.
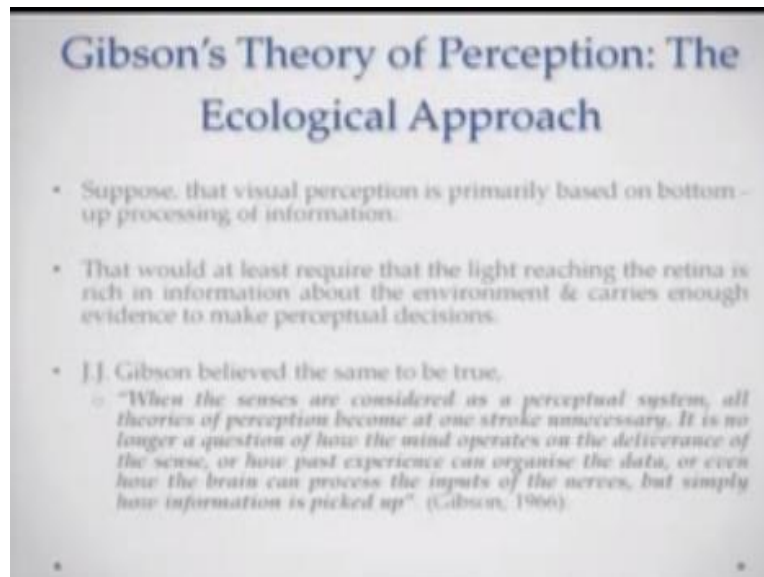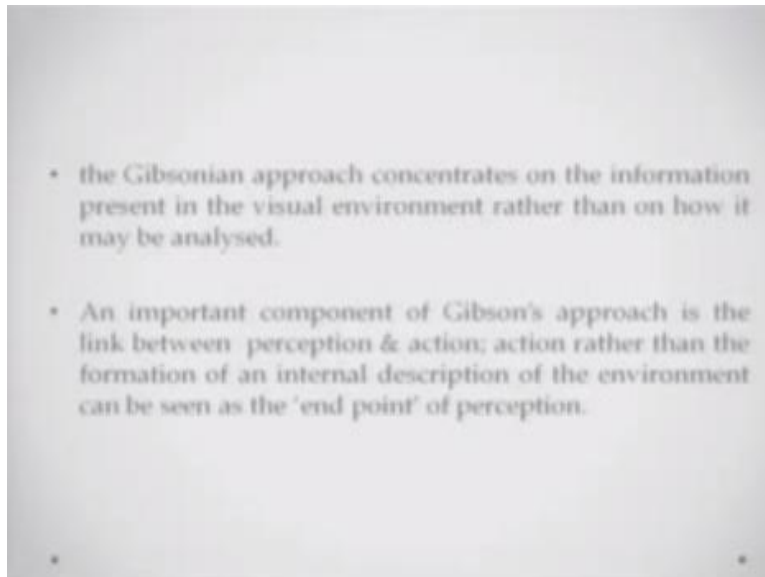
We will talk about one of these very important theories of perception put forward by Jeanne Gibson and the theory of perception is called the ecological approach. We talked about by ecological in a short while but let us say suppose that the visual perception is primarily based on bottom-up processing of information okay, so whatever mental representations of this world you are going to construct will be basically built out of whatever sensory you are getting. J.J. Gibson actually believed that this is how we perceive this internal world that is external world and he said something to the order of. When the senses are concerned are considered as a perceptual system all the theories of perception become at one stroke unnecessary, we do not really need to specify the in analytic processes.

It is no longer a question of how the mind operates on the deliveries of the sense or how fast experience can organize this data or even how the it can process the inputs of the nerves but simply how is information picked up from this external world via these senses. So JJ Gibson basically believes that the mental representations that we construct in perception are entirely made out of the sensory experience that is delivered by each of our senses. We are talking more specifically in the sense about visual perception. The give so many approaches concentrates on the information present individual environment.

- the Gibsonian approach concentrates on the information present in the visual environment rather than on how it may be analysed.

- An important component of Gibson's approach is the link between perception & action; action rather than the formation of an internal description of the environment can be seen as the 'end point' of perception.

Rather than how the brain or the mind operates upon it, an important component of Gibson's approach is the link between perception and action he believed that action rather than the formation of internal description of this environment should be seen as the end point of perception.
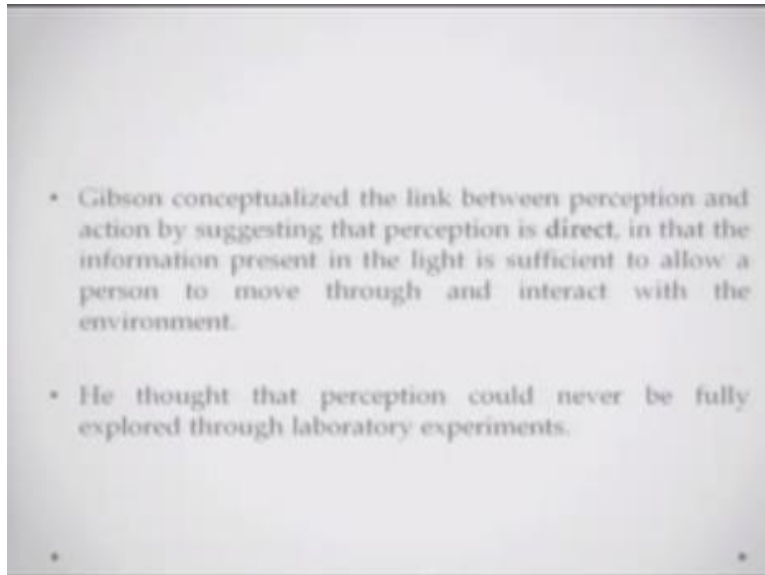
This should also conceptualize the link between perception and action by suggesting that perception is direct, in that the information present in the light is enough it's sufficient to allow a person to move through and interact with the environment, so it is it does not really need any kinds of intermediary processes or transformations to happen, it's just that the light that actually falls on the retina is sufficient to give you enough information to do both either get the X and description of the world and to be able to interact with it. He thought that perception could never be fully explored through laboratory experiments and one of the reasons was that if you see a picture like this.

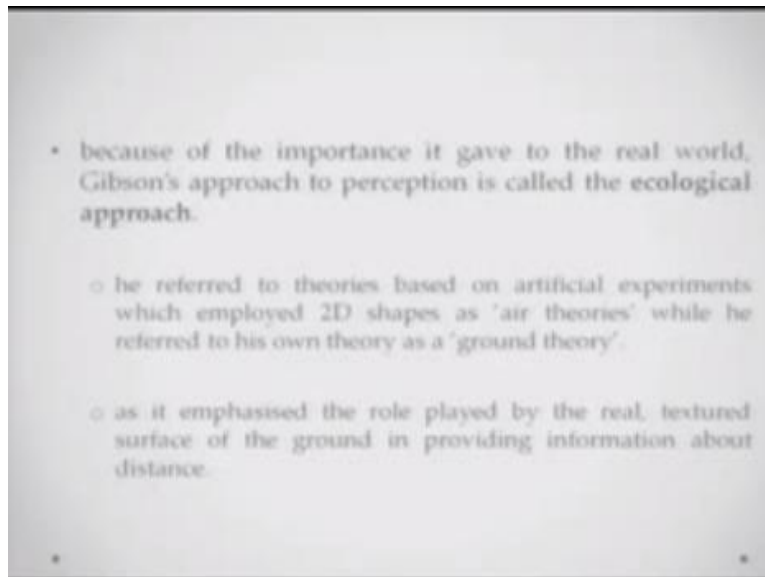(Refer Slide Time: 05:55)



Figure 3.7 Ceci n'est pas une pipe, 1928, by René Magritte

It is still at the end of the day a picture it does not carry all the information that if you have kept the real object would carry okay. So he kind of you know emphasized on this difference and he said further that you know.

- because of the importance it gave to the real world, Gibson's approach to perception is called the **ecological approach**.

  o he referred to theories based on artificial experiments which employed 2D shapes as 'air theories' while he referred to his own theory as a 'ground theory'.

  o as it emphasised the role played by the real, textured surface of the ground in providing information about distance.

And because of this importance that he gave to the real world and you know and because of the emphasis he placed on conducting real experiments his approach was called the ecological approach, he referred to theories that were based on artificial experiments employing these two-dimensional shapes as theories in the air while he referred to his own theory as the ground here because he is actually conducting experiments in the real scenario and interacting with real objects and looking at real scenes etc.
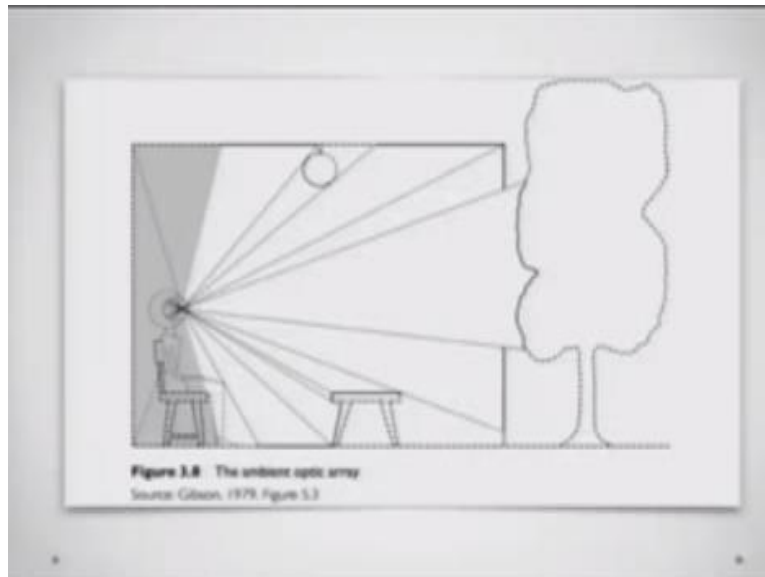
As it emphasizes the role by the real and textured surface of the ground in providing the information about the distance that is one of the reasons why his theory was called the ground theory. The most important concept in Gibson is approach to perception is this concept of the optic array.
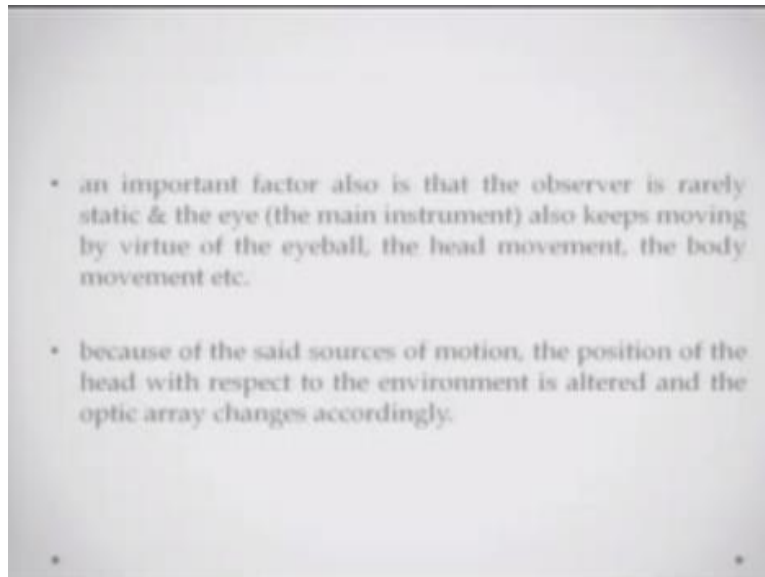
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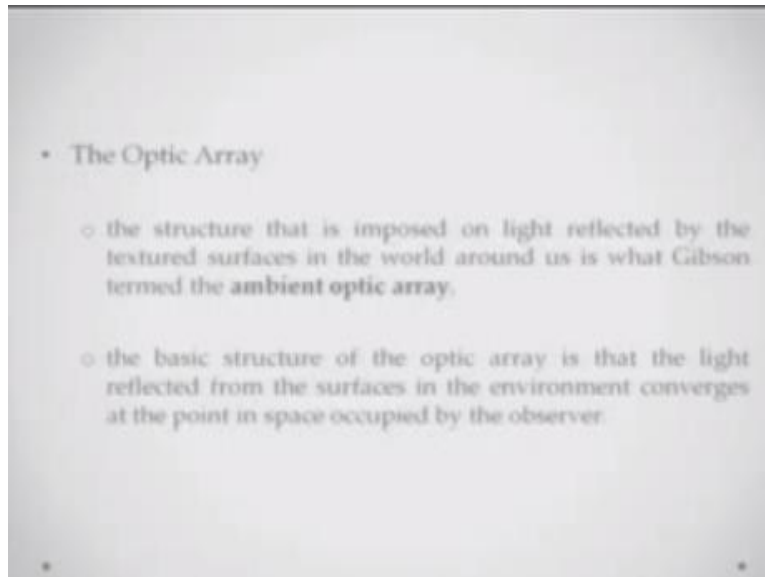


The optic array basically is the structure that is imposed on the light reflected by the textured surfaces in the world around us that is basically what this optic array contains off. The basic structure of the optic array basically is the light reflected from the surfaces in the environment and that light converging at a point in space that is occupied by the observer. So imagine myself sitting in this room and I am actually you know there is a lot of light in this room the less light is reflecting from the screens from the cameras from these walls, so all of this light converging you know towards my eyes is basically what the ambient optic array.

Figure 3.8 The ambient optic array
Source: Gibson, 1979, Figure 5.3

Is about you can see this figure this kind of demonstrates and observer sitting in a particular room and light reflecting from various surfaces in the room and then converging on the point in space where this observers eyes are located.

- an important factor also is that the observer is rarely static & the eye (the main instrument) also keeps moving by virtue of the eyeball, the head movement, the body movement etc.

- because of the said sources of motion, the position of the head with respect to the environment is altered and the optic array changes accordingly.

But the observer is really static you know we are not really always sitting we are actually moving we are moving our head we moving arise, so this is also something that gives him took account of and he said that because of these sources of motion the position of the head with respect to the eyes always altered and the optic array also changes accordingly.

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Figure 3.9 Change in the optic array caused by movement of the observer
Source: Gibson, 1979, Figure 5.4
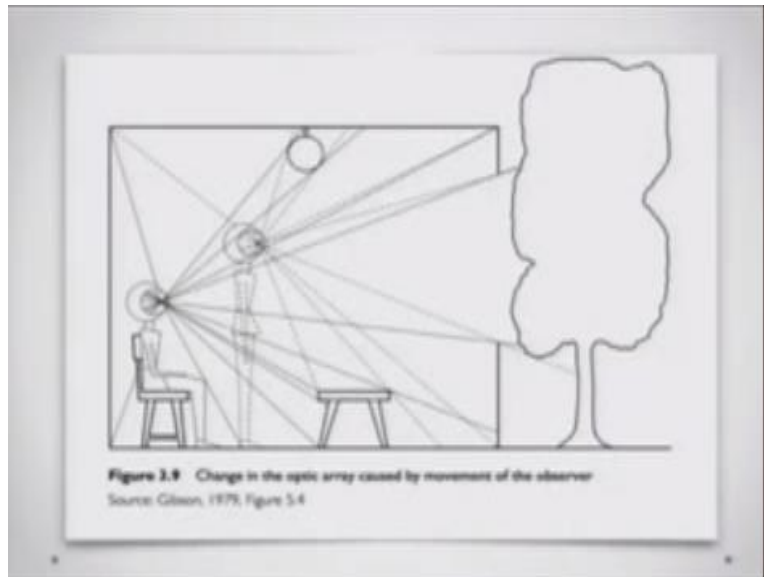
So here is the difference ratio of the fact that see for example, if this you know individual is now standing all say for example if this individual is walking in the room the structure of the ambient optic array would change accordingly.
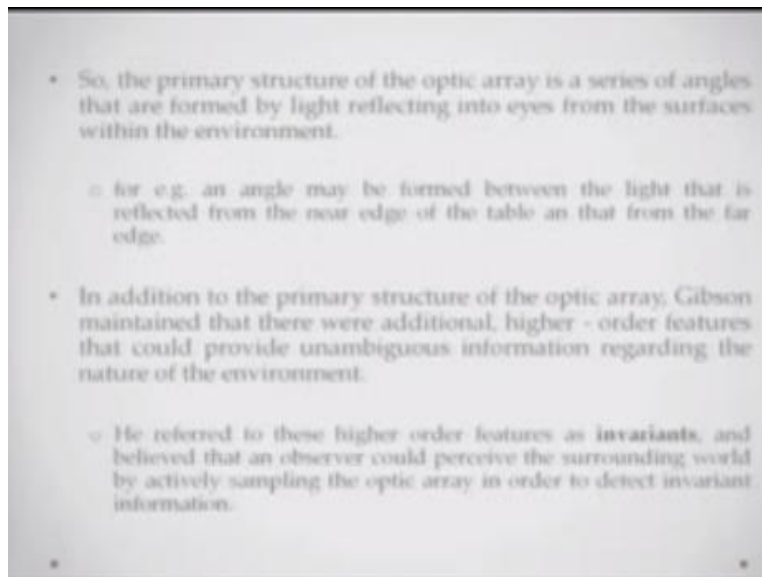
Now the primary structure of this optic array what is this primary structure of the optic array is basically a series of angular is that are formed by the light reflecting from various surfaces in the environment towards your eyes. So for example an angle may be formed between the light that is affected from the near edge of a table, or from the far edge or from the, you know the top of the wall or from bottom of the world different you know ways. In addition to this primary structure of the optic area gives maintain they were additional higher-order features that could also provide information unambiguous information basically regarding the nature of the environment.

So all of these different structures also tell you and give you rich information about the environment in which you are moving around, he refer to these higher-order features as invariance things that do not really change because those could be things that are static and he believed that an observer could perceive the surrounding world by an actively sampling this optic array in order to detect invariant information, so if you are actually you know at a place in the you know anta place in the room you would get particularly information about the surroundings about the objects in the room from examining, these invading features as well.

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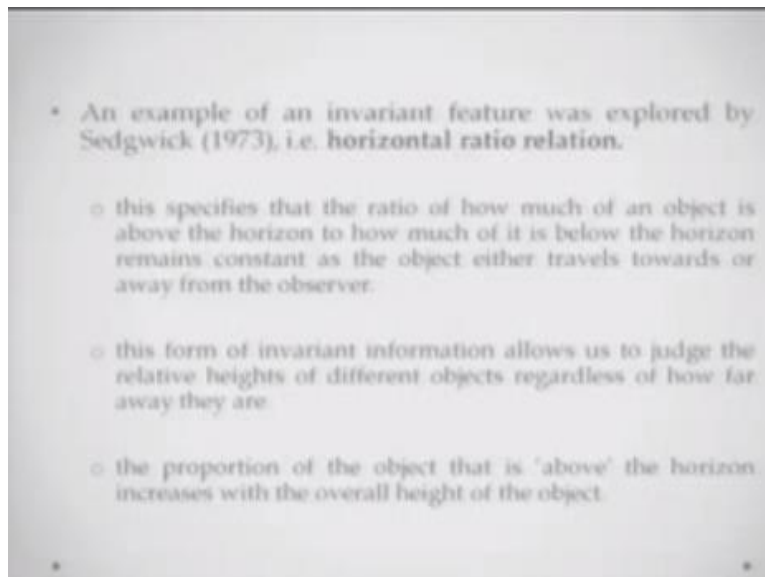


An example of an invariant feature was explored by a Sedgwick in 1973 and this invading feature was a horizontal racial relation what is horizontal relation. Horizontal relation basically it specifies that the ratio of how much of an object is above the horizon to how much of an object is below the horizon is always constant as the object either travels towards or away from the source, I suppose you know I am standing at this end of the room there's somebody standing at the far end and the person is moving towards me or the person is moving away from me. This ratio of how much of this person is above the horizon versus how much of this process below the horizon is going to be constant.

This form of invariant information allows us to judge the relative Heights of different objects and people regardless of how far away from us they are. This proportion of the object above the horizon increases with the overall height of the object, let us see a picture will explain you this.

Figure 3.10 The horizon ratio relation: same height objects at different distances.
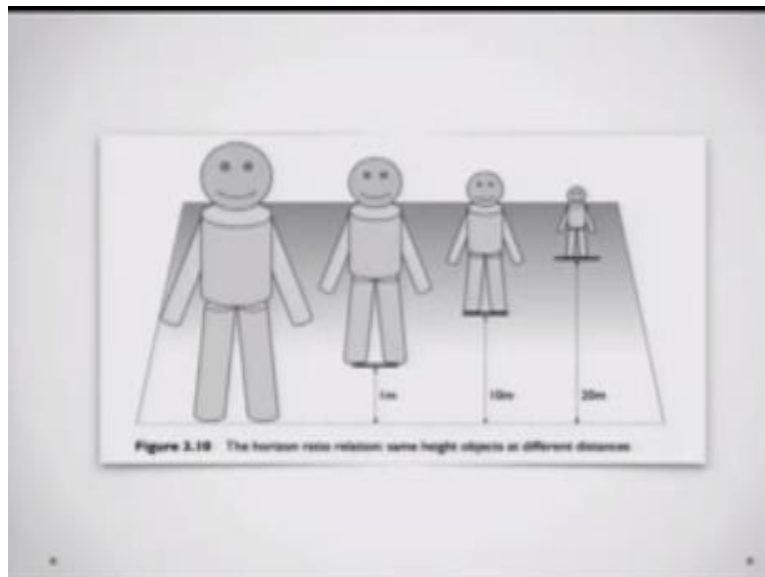
So here you can see people of same height and you know as they are actually from the Attic diff at different distances from us, so they are in the first viewer is just a mirror then and the second figure is someone meters away from us, and the third it is ten meters away from us and the photon is around 20 meters away from us. You see that this relationship is changing but the ratio is constant.

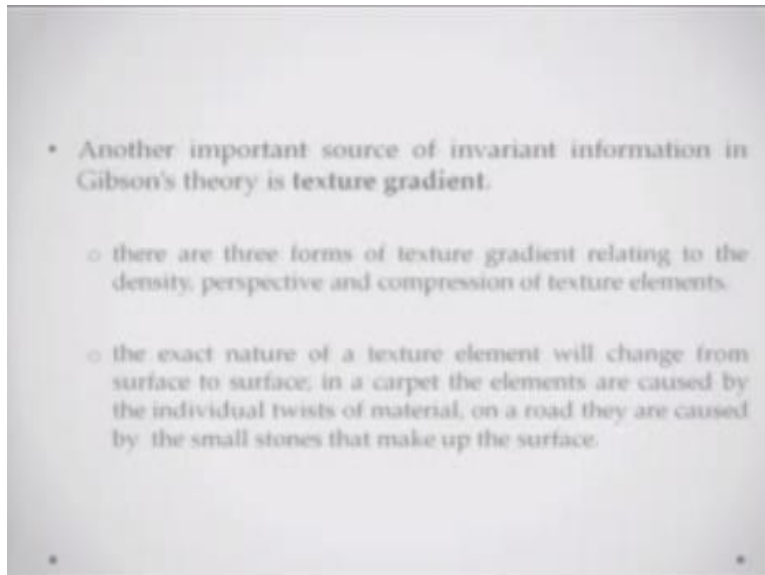(Refer Slide Time: 11:03)



Figure 3.11 The horizon ratio relation different height objects at same distance
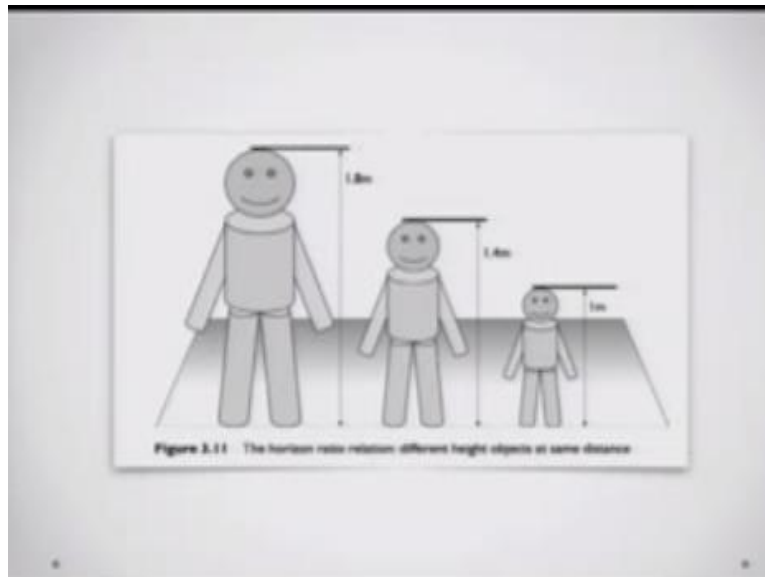
Here you can see people of different heights at the same distance and you can again see that this is a horizontal ratio relation is constant.

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Now another important source of invariant information in Gibson's theory is the texture bleeding what is the texture bleeding? There are three forms of texture gradient relating to density perspective and compression of these textured elements, texture is supposed to be the exact nature of you know say for example of different surfaces, how does one surface you know differ from another?

See for example in a carpet the elements are caused by individual piece of the material you know the threats there mediation a carpet is made above on a road these the texture is basically formed by these small stones, that you know are combined to make up that surface. So that is basically what you know surface is about and that is the idea of what textured means here you can.

See super easily you can see a you know in the bottom you can see a pebbles on the beach in the middle, you can see probably a tarred road, in the top you can see how a carpet is made or maybe a shawl or something like that.

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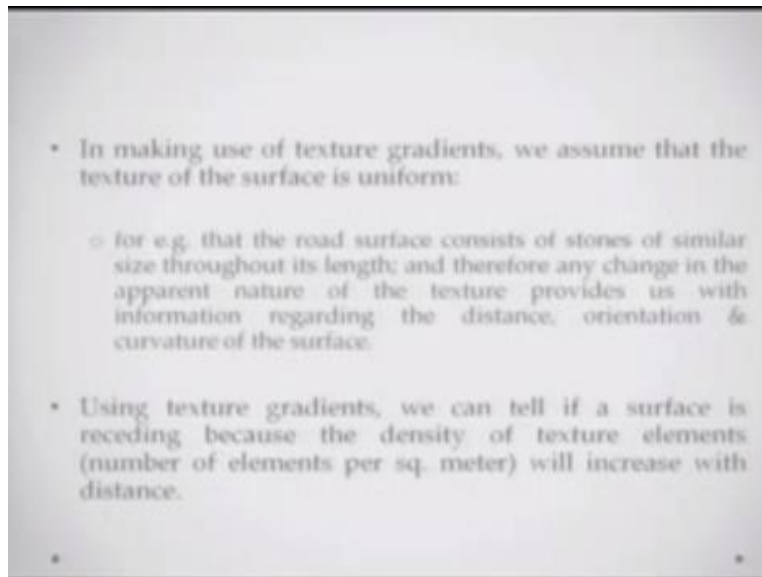


In making use of these texture gradients we assume that the texture of the surface is uniform, so you make this assumption that the entire surface will have the same kind of texture and then you use this information to make judgments about what you know may be you know judge about different things from the surface. Let us take an example the road surface of the road consists of stones similar in size throughout its length, and therefore any change in the apparent nature of the texture provides us with information about recording the distance orientation and the curvature of the surface that is the route.

Imagine say for example you are riding a bike and you're actually on a very you know nice road made with you know similar sized stones and in a long distance you might notice that sometimes the road appears to be converging or it appears to be diverging and this information about distance if there are no other cues available can actually be really important for you to you know guess how far you are from a particular milestone and those kind of things.
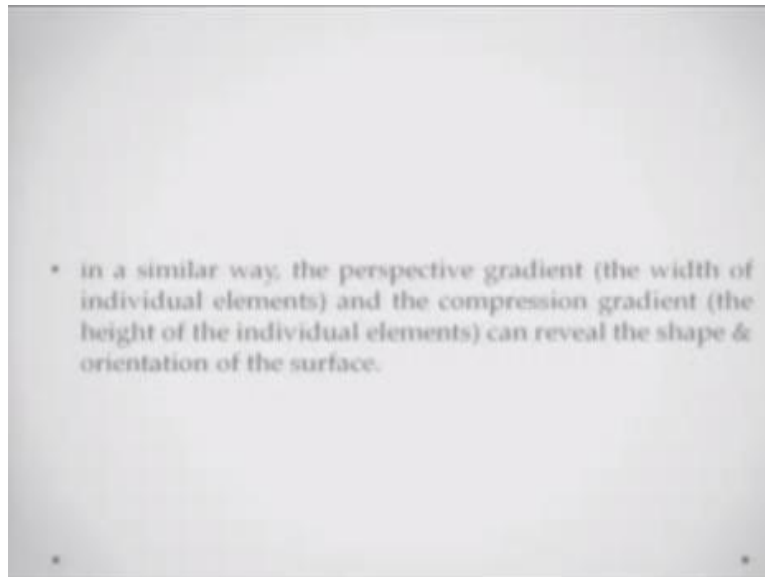
We will talk about this in more detail as we go ahead, so what we do using these texture gradients we can actually tell if a surface is preceding that is moving away from us or if it is actually you know coming closer. Let us take this example.
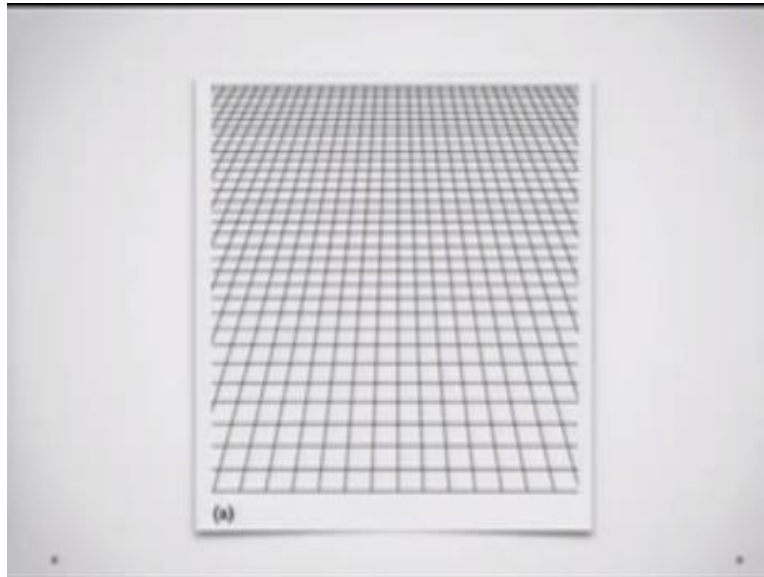
If you see the texture of these tiles here you can see that you know the tiles closer to us say, for example appear much bigger this tiles which are further from us appear slightly smaller. We know for a fact that all of these tiles all of these square boxes are actually of the same size, so we using this information about the size of the tiles to actually make a judgment about whether you know which part of the tile is closer to us or which part of the tile is farther it was. These kinds of things are used very cleverly by painters to create illusions of distance etc.

- in a similar way, the perspective gradient (the width of individual elements) and the compression gradient (the height of the individual elements) can reveal the shape & orientation of the surface.

In a similar way the perspective gradient and the compression gradient, so perspective gradient is the width of the individual elements the compression gradient is the height of the individual elements, both of these can reveal about the shape and the orientation of the surface.
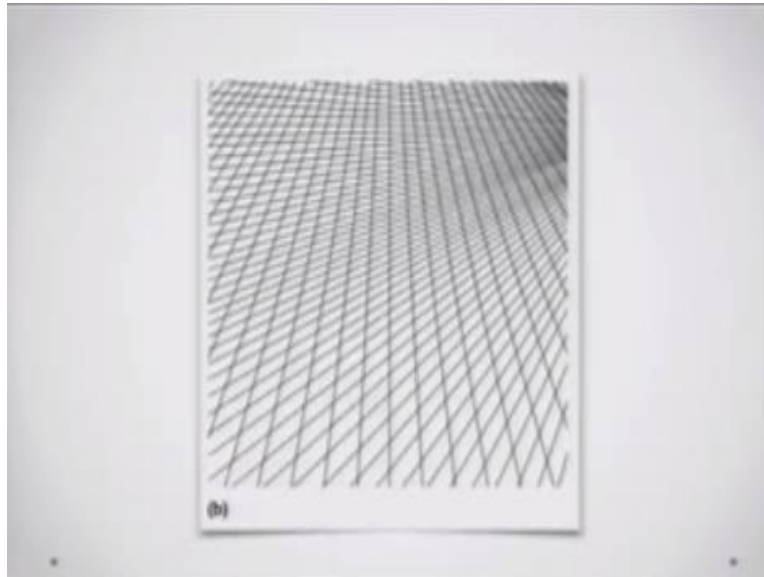
 I will take another similar example you can see towards the right side everything is slightly here compress the width is you know a reducing, so you get an information about you know the perspective and say for example you can get the information of the shape and if you see there you know in the left side of the image, you can get the best perspective about the orientation of the surface okay.

So you are using this information present in the surface to actually judge about the nature of the surface or actually more importantly about your position in relation to this particular surface. Now another important concept in Gibson's ecological.
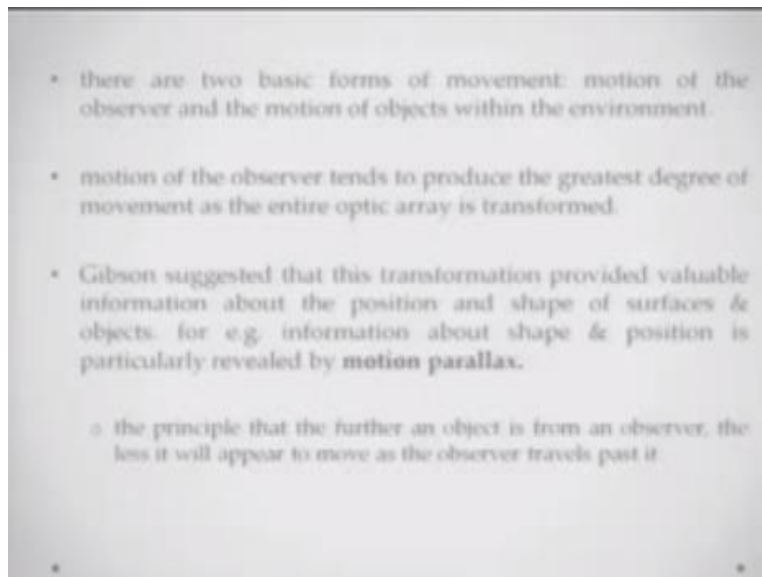
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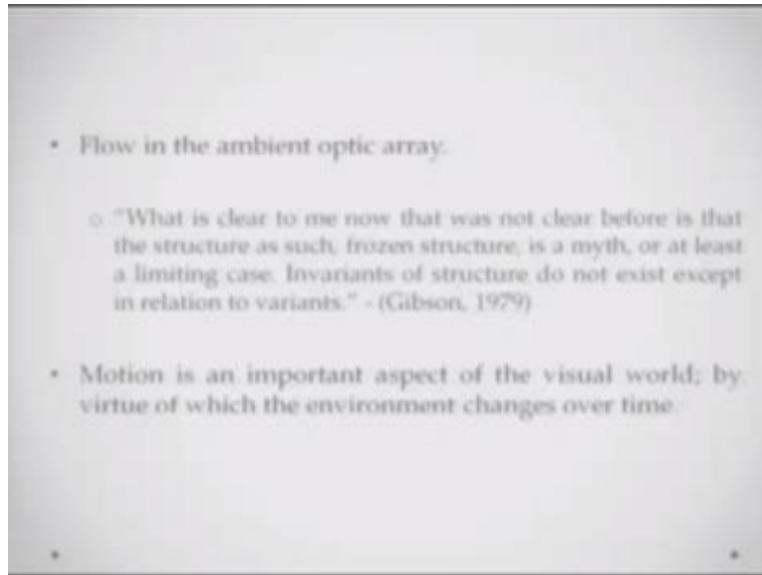


Approach is basically this concept of flow. Gibson says that what is clear to me now that was not clear before is that the structure, you know there as a frozen such it is just a mix you know or at least it is a limiting case, in variants of structure do not really exist except in relation to variance okay. Let us find understand what is trying to say here is saying frozen structure static structures are not really the thing you know we are always moving or objects in the environment are mostly moving and in that sense we have this concept of motion and how this motion changes you know your relationship to you know the different surfaces etc or objects in the environment.

So motion is an important aspect of the visual world by virtue which the environment changes over time or the way you see the environment changes over time. There are two basic forms of moving motion of the observer if you are moving around.
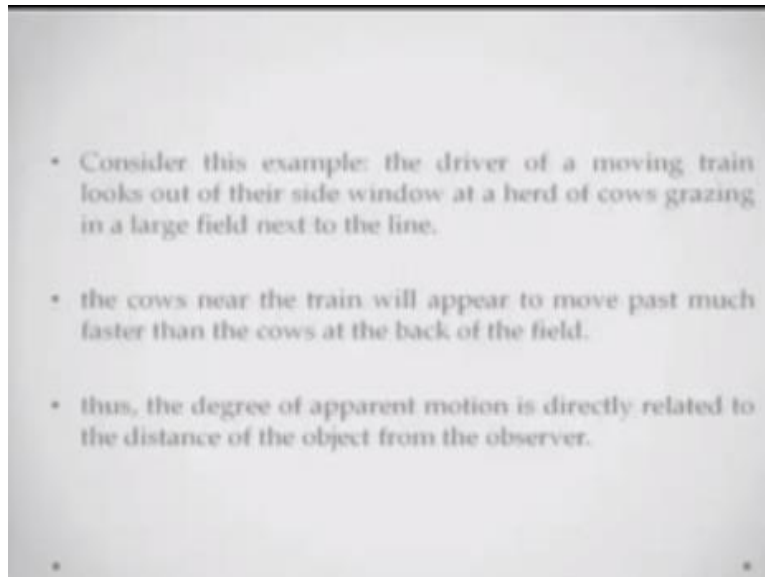
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- there are two basic forms of movement: motion of the observer and the motion of objects within the environment.

- motion of the observer tends to produce the greatest degree of movement as the entire optic array is transformed.

- Gibson suggested that this transformation provided valuable information about the position and shape of surfaces & objects. for e.g. information about shape & position is particularly revealed by **motion parallax.**

  o the principle that the further an object is from an observer, the less it will appear to move as the observer travels past it

And motion of the objects within then I suppose your yellow sitting in a park and a lot of children are playing suppose you are actually standing in the balcony and you see lot of vehicles moving by. Motion of the observer tends to produce the greatest degree of movement as the entire optic array needs to be transformed, so if you are moving your head if you are moving yourself, then whatever the angles of you know that are contained in the slide with you know these light reflecting on, so many surfaces and so many objects in the environment all of this needs to change at once. If say for example the objects in the external world are moving minute adjustments with relation to those particular objects might be needed.

Now Gibson suggested that this transformation if you are moving you know provides valuable information about the position and shape of surfaces and objects in this external world, for example an interesting cue could be information or shape a shape and position that is revealed by something called motion parallax. Now watch what is motion parallax? Very simply motion parallax is basically the principle that the further the an object is from an observer the less it will appear to move as the object appear comes closer to us, it kind of the motion of the object becomes more pronounced.
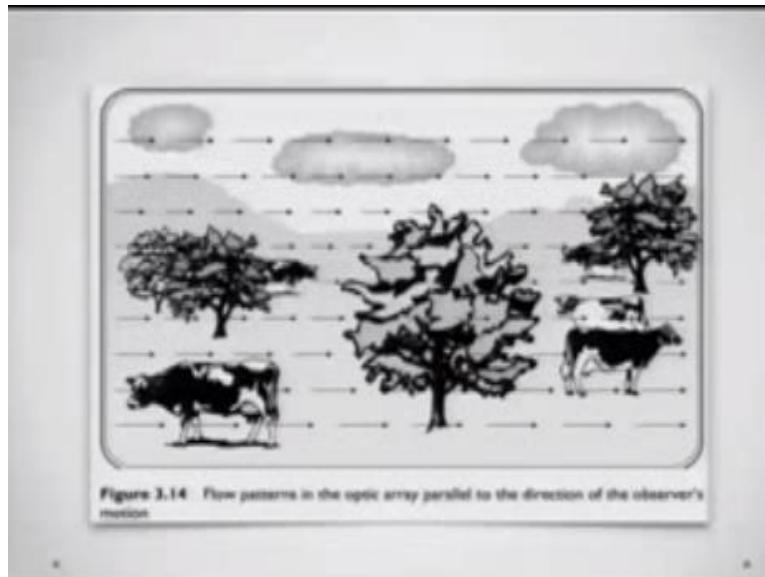
- Consider this example: the driver of a moving train looks out of their side window at a herd of cows grazing in a large field next to the line.

- the cows near the train will appear to move past much faster than the cows at the back of the field.

- thus, the degree of apparent motion is directly related to the distance of the object from the observer.

You put in charge of a moving train and you are looking outside of your window when you are trying to make sense of the environment around, you passing by afield and you look at a herd of cows blazing in a large field next to the railway lines, the cows near the track will appear to move fast much move fast much faster, than the cows at the back of the field okay.
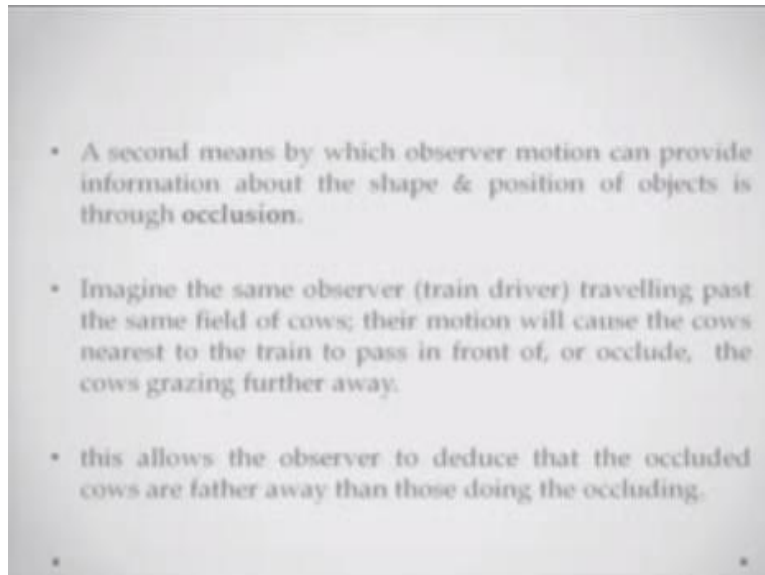
This is not really necessary that those cows are running and the other one, so static is basically because you moving faster and the cows you know which are nearer that is why they appear to move fast faster. Thus this degree of apparent motion is directly related you know to the distance of this object from the author of the cow from the driver.

**Figure 3.14** Flow patterns in the optic array parallel to the direction of the observer's motion

You can see this figure here you can see that if you are passing by and you are looking at your left, you think that this is the slow is from you know the left to the right and you are looking at the field you probably and you will find out that the food cow which is furthest, will appear to be not moving even irrespective whether it is moving a lot and the cow which is closest to the observer appears to be moving much faster.

- A second means by which observer motion can provide information about the shape & position of objects is through **occlusion**.

- Imagine the same observer (train driver) travelling past the same field of cows; their motion will cause the cows nearest to the train to pass in front of, or occlude, the cows grazing further away.

- this allows the observer to deduce that the occluded cows are father away than those doing the occluding.

A second means by which also emotion can provide information about the shape and position of objects is through occlusion is basically when something is hidden or occluded by something else okay, so imagine the same observer the train driver that is traveling past the same field of curves and the motion will cause the cows nearest to the nearest to pass in front of the cows blazing further.

If you go back to this figure you will see that the second and the third cows motor is the right the third cow is actually slightly occluded by the second cow. This aspect of occlusion gives you an estimate of that the third cow is slightly further away, from the second go you know this is something which you can actually make up very easily so they all this allows the observer to reduce that occluded cows are further away from those that are actually doing this occlusion okay.
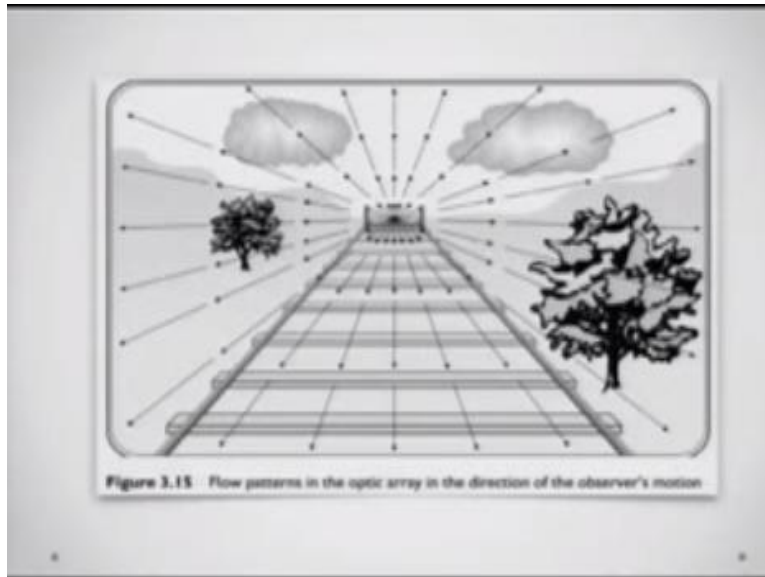
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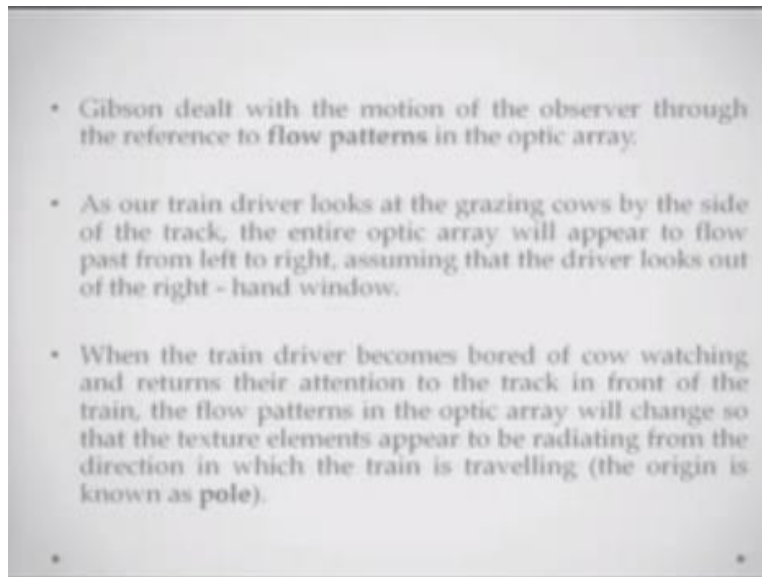


Now yes in dealt with this motion of the observer through the reference to flow patterns in the optical, so he says that there are patterns of flow in the optical a flow is basically just movement, now say for example again coming back to the strain guy for example suppose, the train driver is now bored at looking at by looking at the size he is now looking he comes in the front of the locomotive and he is just looking further in the direction to which they in the direction in which the train is moving.

Now this entire optical optic array will now appear to flow pass from the left to right assuming that the driver looks out of the right-hand window, now when the driver is in the front the flow patterns in the optical a will change such that the texture elements that information listens will appear to be leading from the direction in which the train is traveling okay.
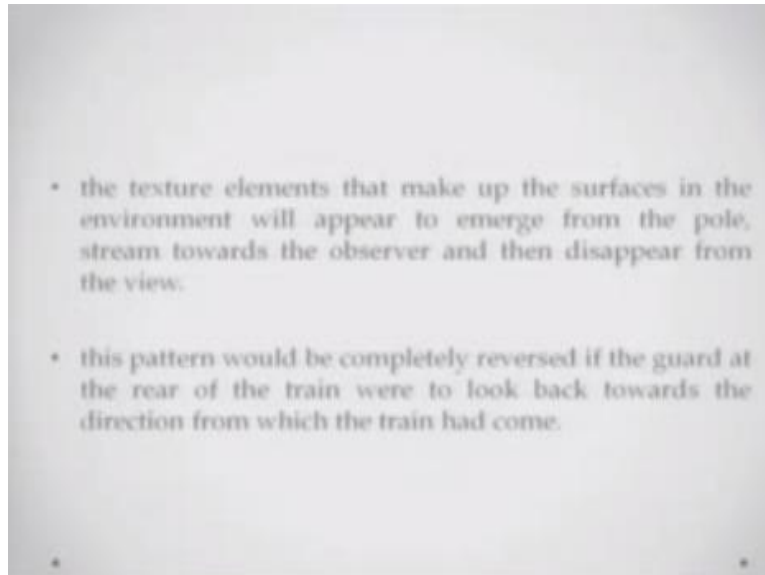
So it will appear like say for example you are moving in a particular direction and all the lights diverging from that direction this point, for this in the direction is referred to as the pole. So if you if you are actually moving ahead and you are looking at you know right in front of you, will see that this you know there is a point called the pool and all the light is kind of diverging from it.

Figure 3.15 Flow patterns in the optic array in the direction of the observer's motion

Here is a figure which is a winner it is just demonstrating this, now case way for example maybe the driver kind of comes.

- the texture elements that make up the surfaces in the environment will appear to emerge from the pole, stream towards the observer and then disappear from the view.

- this pattern would be completely reversed if the guard at the rear of the train were to look back towards the direction from which the train had come.

At the back of the Train now the textural elements that will you know that appear to make up the surface in the environment will kind of you know appear to, so this paddle me I talked about this already so this pattern we completely get reversed if the guard at the rear of the train you know the guard comes at the rear of the train and is trying to look backwards in the direction from which the train had come. That will basically lead to you know convergence of this light the convergence pattern of there.

**Figure 3.16** Flow patterns in the optic array in the opposite direction to the observer's motion
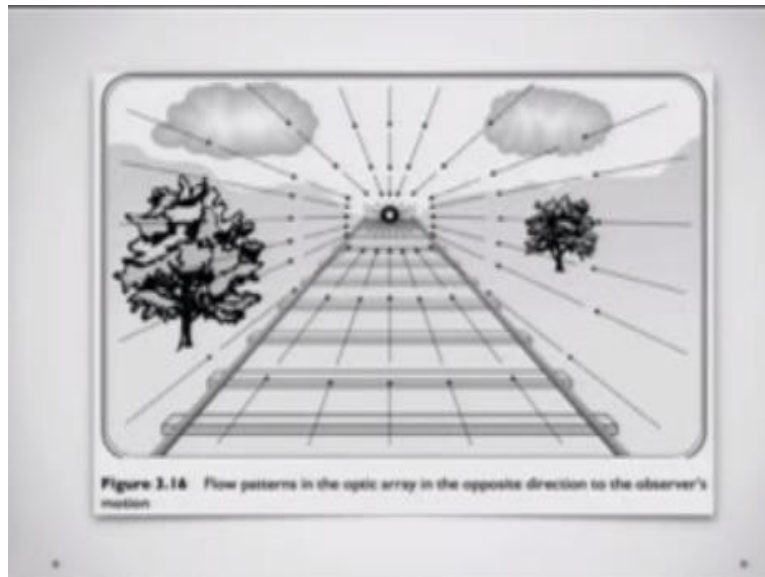
You will actually now in this figure you are moving away from this direction and you see everything is converging towards the pole okay, so if you just look at these figures this one is when you are actually moving towards the pole, this one here is when you are moving away from the pole is any point at the furthest distance to the direction in which you are moving.
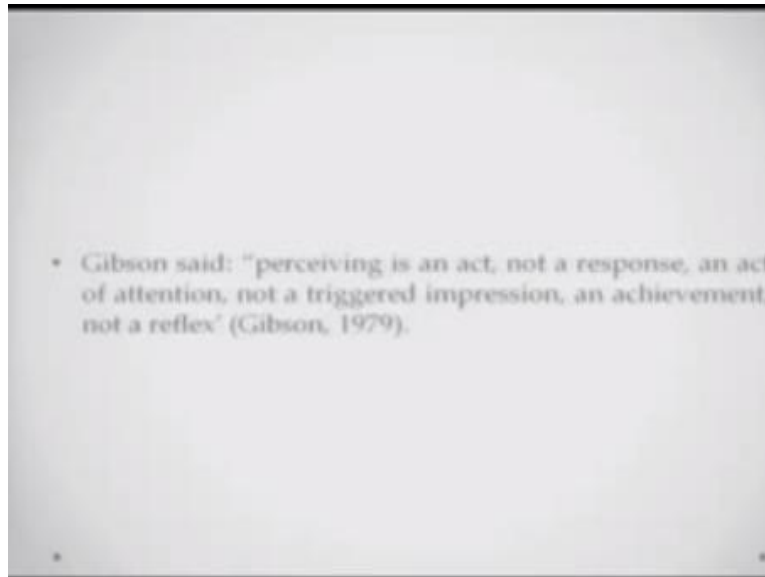
Now listen he proposed a set of rules that links flow in the optic array to the movement of the observer through this in memory the observer is moving through the environment, you can deduce a few things by observing the you know flow indoor optically, these rules are basically so if there is flow in the ambient optically the observer is moving if there is no flow the observer is not moving that is understood outflow of the optic array from the pool specifies, that you are approaching this point in flow to the pool specifies that you are moving away from a particular point.

The direction of the fall specifies where the direction in which the observer is moving, so if the direction is basically right in turn to feel your move in towards it is the directive the direction the poll is at the back then you are actually receding from it. A change in the direction of the pool specifies that the observer is now change direction okay.
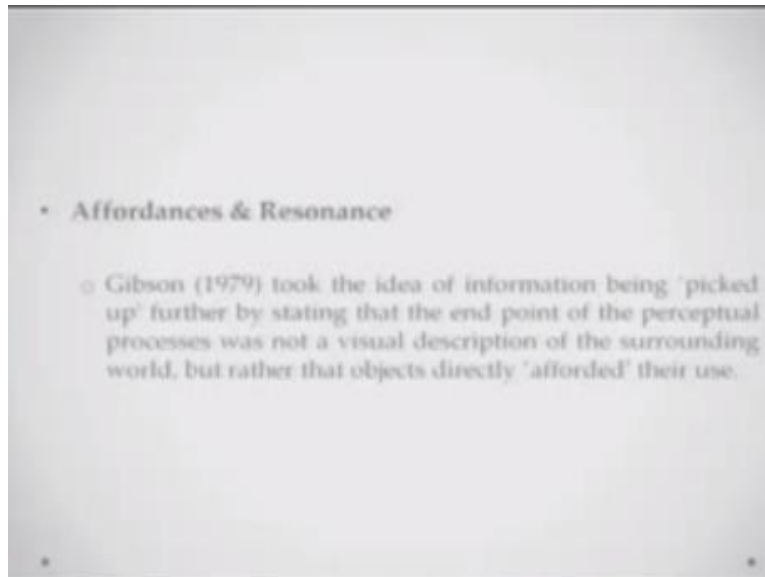
- Gibson said: "perceiving is an act, not a response, an act of attention, not a triggered impression, an achievement, not a reflex' (Gibson, 1979).

Now so this was about motion this was about earlier we talked about perspective horizontal ratio relation, so we have talked about how this ambient optically changes or how this ambient optic array basically is are structured in light of new information, you know with the in with respect to the environment. Now Gibson as I began saying Gibson believe that percept and a perception is an act, you know it is an action and it is not really a merely a passive response okay it is basically an act of attention you choose and you select to attend aspects of the environment while you are not really concerned about all the other parts okay.

So it is not really triggered impression it is an achievement and it is not really reflects, he is basically telling us that you are actively involved in perception that is you looking for information with which or on which you interact.

- **Affordances & Resonance**

  o Gibson (1979) took the idea of information being 'picked up' further by stating that the end point of the perceptual processes was not a visual description of the surrounding world, but rather that objects directly 'afforded' their use.

This brings us to the concept of affordance Gibson risk took this took this idea of information being picked up further by stating that the endpoint of the perceptual processes was not the visual description of the surrounding world but rather that the objects would directly afford their use. So when you once you look at the object there is enough information in light emanating from the table jet that will tell you about how-to use, that particular object that is what gets in actually meant.
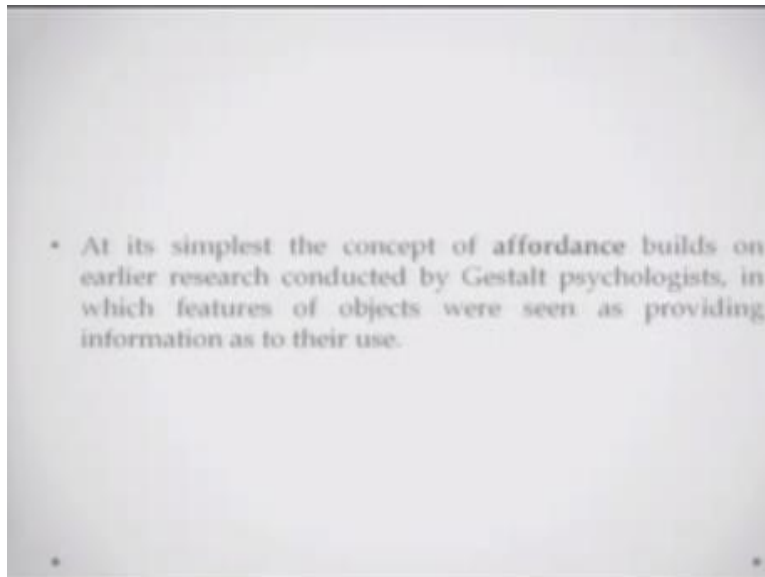
So at its simplest the concept of affordance builds on earlier research done by Gestalt psychologists will talk about them and your course basically says that features of objects actually provide information, as per regarding their use.
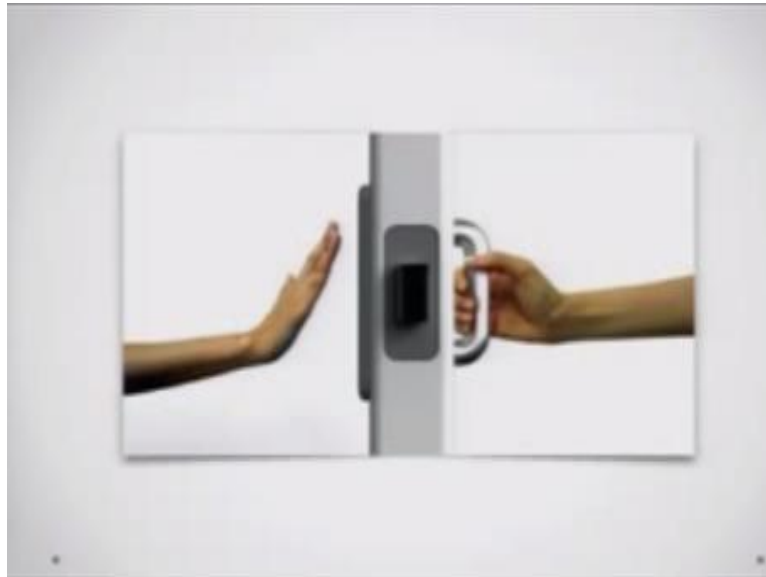
If you see the door the two surfaces of the door here, you know one of these surfaces has a handle it affords holding it at a force taking a grip of it while the other surface of the door does not have in handy, so kind of you know a force you pushing through it okay. So you look at the surface you realize what how do you interact with the surface and that is how you make out whether you only pull it or for example when we grip the handle or just push the root to the to your thumb.

Again different kinds of handles can afford different kinds of grip formation and again this is basically also you know derived from the light emanating from these objects, so you automatically you know modulate the aperture of your fingers a new trial hold these different figures.
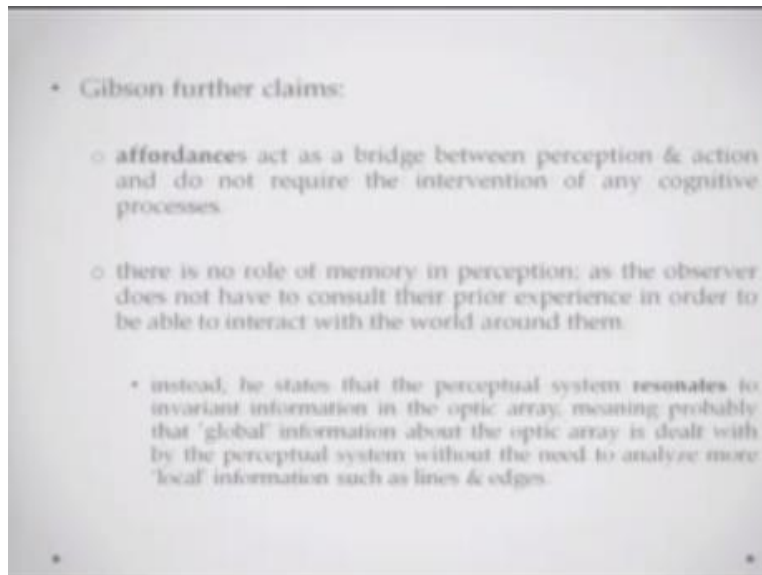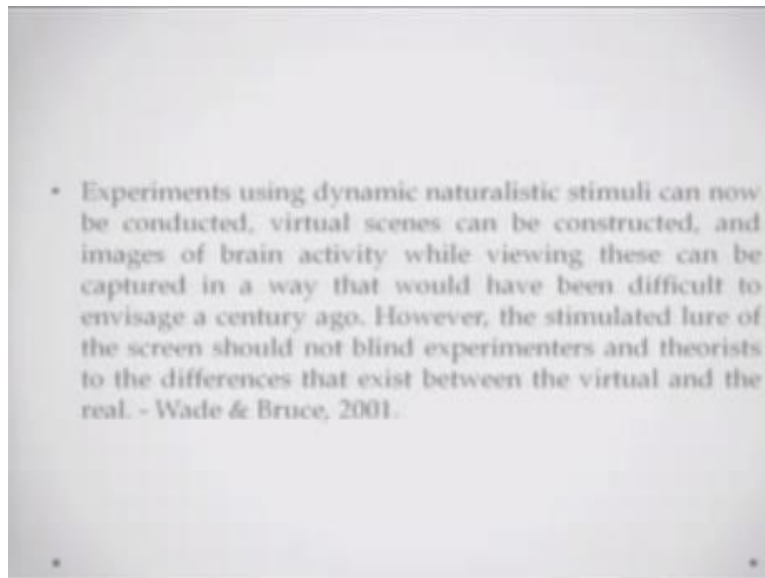
Gibson for the claims that affordance acts as a bridge between perception and action and that food is does not require the intervention of any cognitive processes, he say information or you know information or that is the light emanating from all of these surfaces is enough you know for a person to be able to act and interact with the object on these objects or interact with this environment. There is no rule of memory in perception according to Gibson and he says that the observer does not really need to consult prior experience in order to be able to interact with the world okay. He says there is already enough information in the world already enough information in the light that is being reflected from the world the light that he called the built optic array.

So he is strictly you know this approach is strictly bottom-up approach it is kind of building up from whatever the sensory experience is gained by your eyes. He says for example that the system resonates to the invariant information in the ambient optic array meaning probably that global information about the optic array is dealt with by the perceptual system without the need to analyze more local information, such as lines energy so he said this global information about this light and reflect from these edges and the surfaces is more than enough. Now that was

mostly what Gibson was saying nowadays experiments using dynamic naturalistic stimulation can be done.

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- Experiments using dynamic naturalistic stimuli can now be conducted, virtual scenes can be constructed, and images of brain activity while viewing these can be captured in a way that would have been difficult to envisage a century ago. However, the stimulated lure of the screen should not blind experimenters and theorists to the differences that exist between the virtual and the real. - Wade & Bruce, 2001.

Virtual scenes can be constructed and images of brain activity why people are viewing these scenes or viewing these objects have also been captured in a way that would have been difficult you know to even think of in the time that Gibson was around. However the stimulated year of the screening should not really blind experimenters and theorists to this difference between the real scenario and the scenic scenario, that you that we construct in our labs okay.

This is something you know you can take off from Gibson's analysis on perception, he says that there is much more information in the real world in when you are actually interacting with the environment, then if you trying to study this process of perception by conducting experiments in our lives, where we are basically projecting these stimuli on two-dimensional screens.

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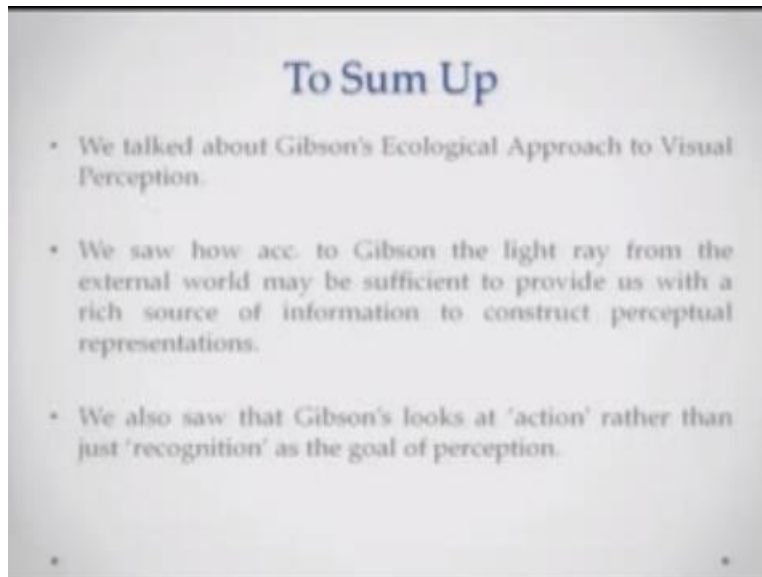


Now to sum up whatever we have talked about Gibson we basically talked about the ecological approach and we talked about how Gibson suggests that the light array from this external world may be sufficient to provide us with a rich source of information to really construct a very rich mental representations of, this external world we also saw that Gibson actually emphasize that perception is more for action rather than just the description or recognition of this visual world thank you in the next lecture we will talk about another approach on visual perception.

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