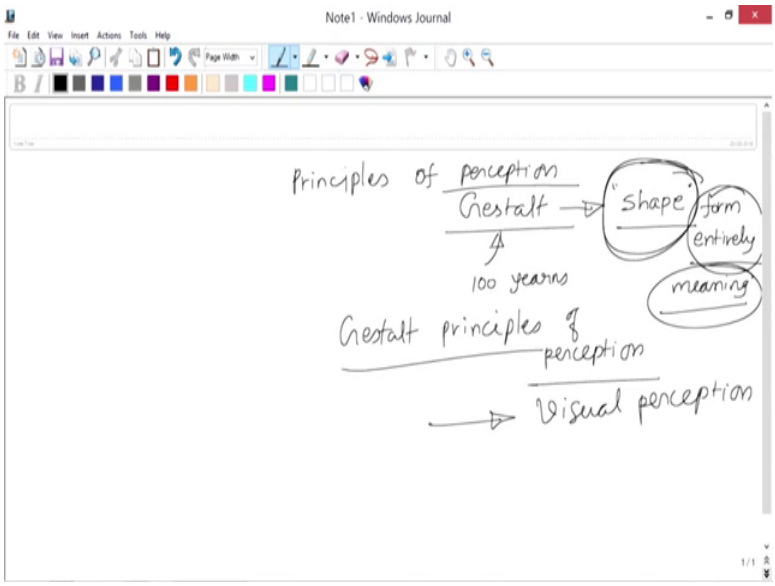
Virtual Reality Engineering
Dr. M. Manivanan
Department of Biomedical Engineering
Indian Institute of Technology, Madras

Lecture - 86
Principles of Perception

Welcome back. In a couple of classes, we are talking about the machine haptics, where we are looking at how to design the kinesthetic devices and tactile devices. Today, we are going to slightly take a off route, we are going to talk about a relative topic which is related to the haptic design. But again coming from the perceptual point of view, we are going to talk about this topic is relevant to the virtual reality.

So, this topic which are we are recording today it will be common for both the haptics as well as the, you know virtual reality. The topic we are going to talk about is how perceptual principles can be applied when we are looking at an a image or when we are touching an object or when we are hearing a sound. How are we perceiving things? Are there any principles? By understanding these principles probably, we can design better visual systems, better haptic systems, better you know auditory systems that is the idea of a listening to looking at today's principles.

(Refer Slide Time: 01:38)



So, principles of a perceptions, they are known as Gestalts principles. Gestalts is a term is a German term referring to shape. So, we are when we are perceiving things an image

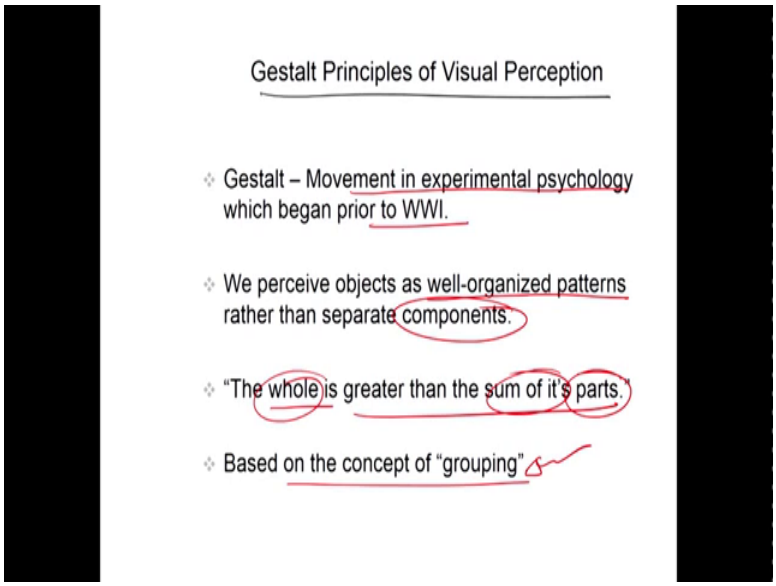
or a haptic object or sound, we are not looking at the components of a visual picture or the you know what we are touching ok. We are looking at the shape of it, essentially we are talking about the form of it, the entirety is what we are looking at it.

We are trying to you know again we saw in the earlier class what is the difference between this sensation and perception. Perception is adding meaning to it. We are relating to you know many things else; and essentially we are talking about the, you know meaning of it all right. So, are there any principles related to this perception, how we make shapes or how we you know form the entirety, how we perceive things, how we associate meaning, is there any principle that is what we are going to look at it.

So, these principles are coming from maybe about a 100 years old, essentially about you know after the First World War the scientists have extended their psychology into the perception of visual images and that is what as lead to something called a Gestalts principles of perception. So, in today's class, we will mostly look at the only visual perception, but the same principles can be extended to haptic perceptions as well, and also the auditory perception also.

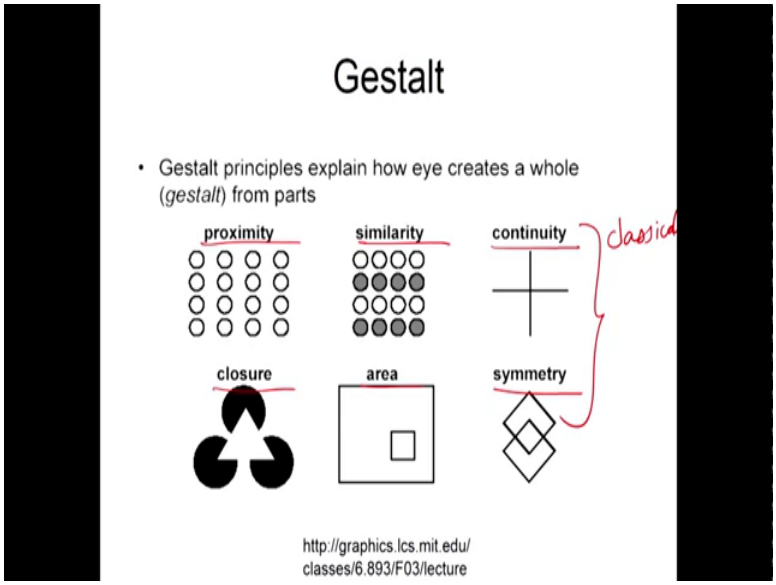
There are very few literatures as far as the, you know haptic perception applying the gestalts principles there, similarly auditory perception also, most of the literature or reading material is only for the visual perception. But be aware that whatever we are going to read or look at a today's principle can also be applied to you know haptic perception and the auditory perceptions ok.

(Refer Slide Time: 04:34)



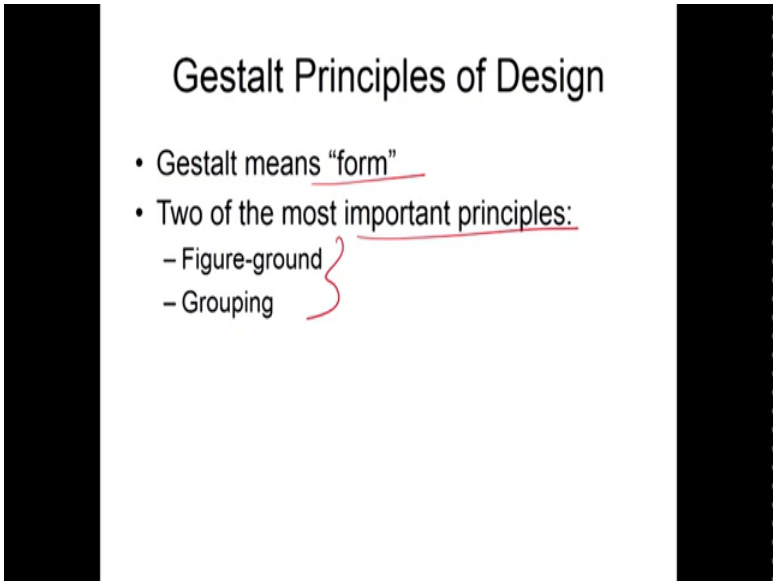
What are these principles? So, gestalts principles of visual perception essentially we are going to look at. So, gestalts in the experimental psychology it is you know which begin prior to World War I. We perceive object as well-organized patterns rather than separate components. We group them together; we do not look at the components, that is the first principles. The whole is greater than the sum of the parts. We do not look at the you know parts, but we observe the wholeness, the full shape the form that is the principle. Based on the concept of the grouping; grouping is only one concept at, concept one principle we are going to look at you know several other principles ok.

(Refer Slide Time: 05:22)



There are actually essentially six principles of a gestalts proximity, similarity, continuity, closure, area and symmetry, these are called the you know classical, we can see it as a classical gestalts principles. There are also recently more principles have been added, we look at a couple of them as well. We will see each of this in detail with a quite a few of examples. At the end of this lecture, I am going to give you a you know worksheet where you will be looking at certain pictures and then find out write down what are the principles gestalts principles used in this particular design. So, I would like to you know focus on the principles you know try to remember the names of these principles, so that you can write it in the worksheet ok.

(Refer Slide Time: 06:20)



As I mentioned gestalts means form. Two of the most important principles; there are many principle, six principles; among the six principles, these are the most important principles. We will see each of them.

(Refer Slide Time: 06:32)

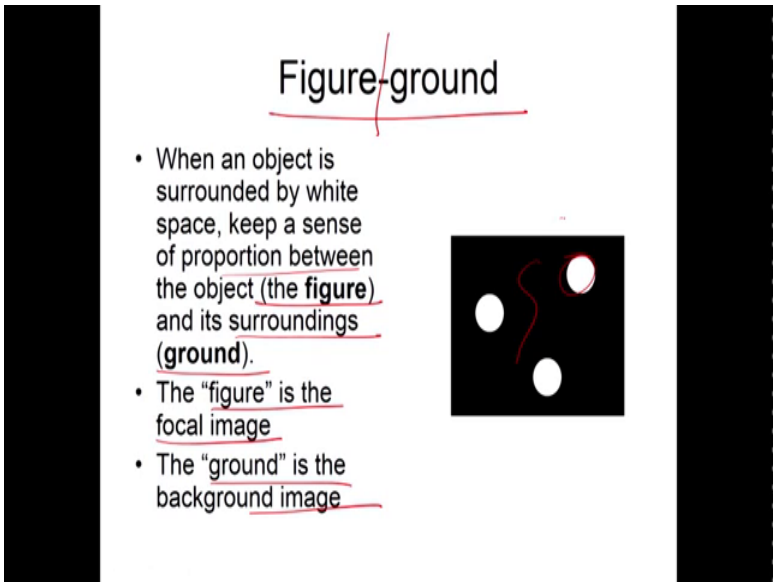
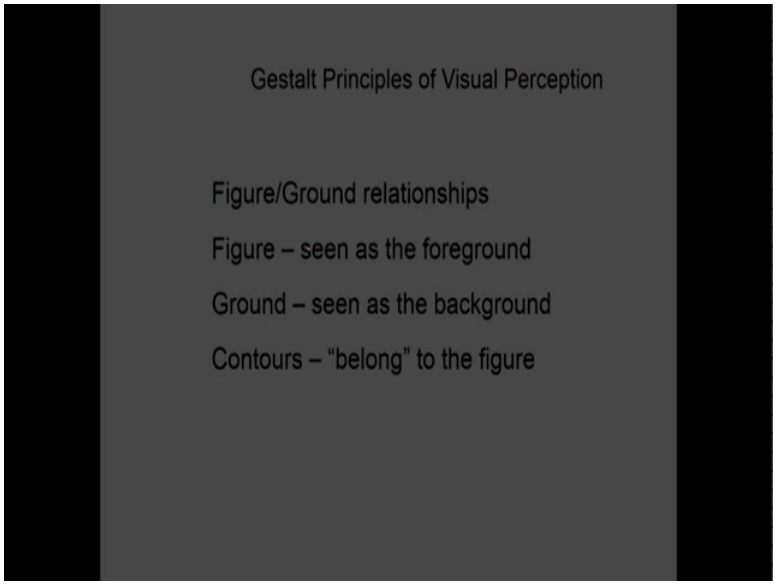


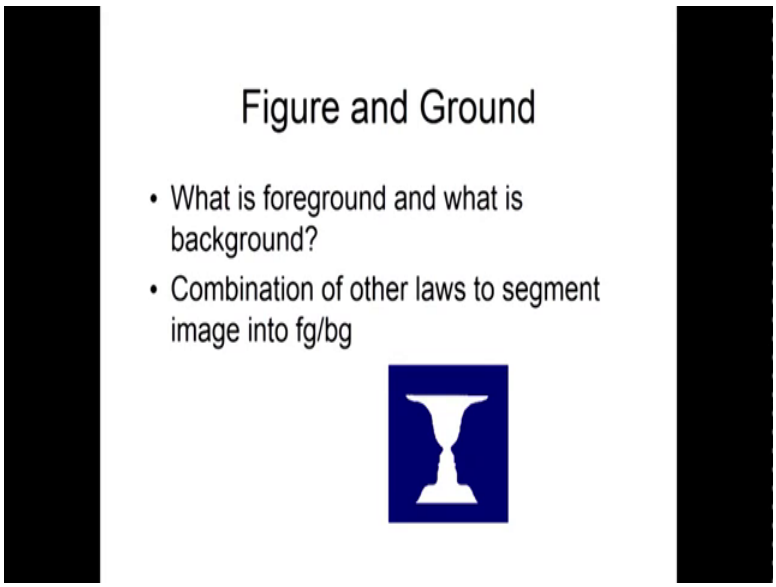
Figure-ground. Once we see a image, we always separate the image into what is a figure, what is a background ok. So, when an object is surrounded by white space, keep a sense of proportion between the object and its surroundings. The objects form the foreground, the figure. The surroundings become the background or the ground. The figure is the focal image. We focus on the foreground, on the figure; we do not focus on the background right. So, the ground is a background army of the image which we do not actually you know focus on it. In this example, if you look at it the black is the background, the white circles are the foreground. We focus on the foreground right.

(Refer Slide Time: 07:26)



So, the figure ground relation the in that relation, and sometimes there will be some contours ok. The contours belong to the figure.

(Refer Slide Time: 07:45)



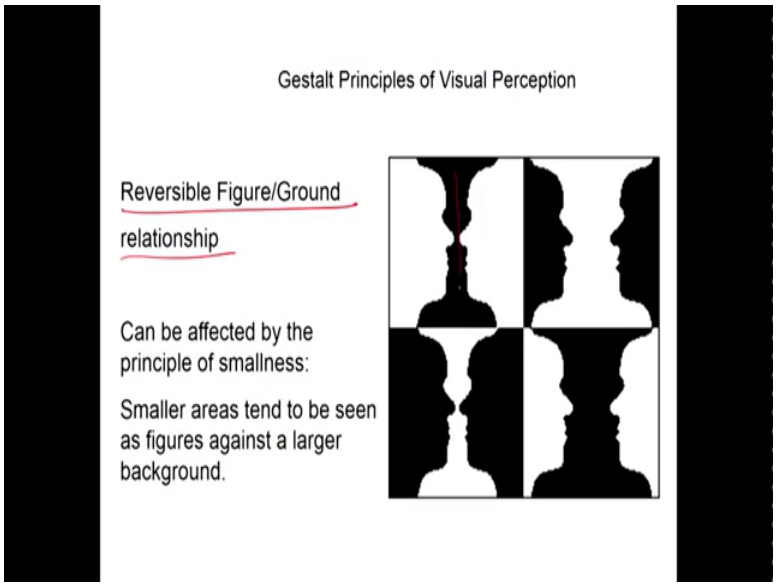
For example, look at this example. What is the foreground? What is the background? Here the foreground is the let us say the white, and the blue one is the background. The contour belongs to the foreground right. So, now;

Student: What is meant by contours the differentiate?

Maybe the yeah the edge, edge is belong. In here the edge is, obviously part of the figure; but in some pictures, it may not be you know evident and wherever this contours are there, it will be part of this figure ok. Now, once we have this one of the unique property of this particular example is that you can switch between the foreground and the background. If you focus on the blue then that becomes the foreground; the white becomes the background.

So, when you focus on the background, you have different image emerges; when you focus on the white foreground, you have different image in emerge right. So, it depends upon what is your foreground, what is your background. Reversible figure and a foreground background relationship. There are many examples are there where we can switch between the background and a foreground. And therefore, it will lead to different, different images.

(Refer Slide Time: 09:25)

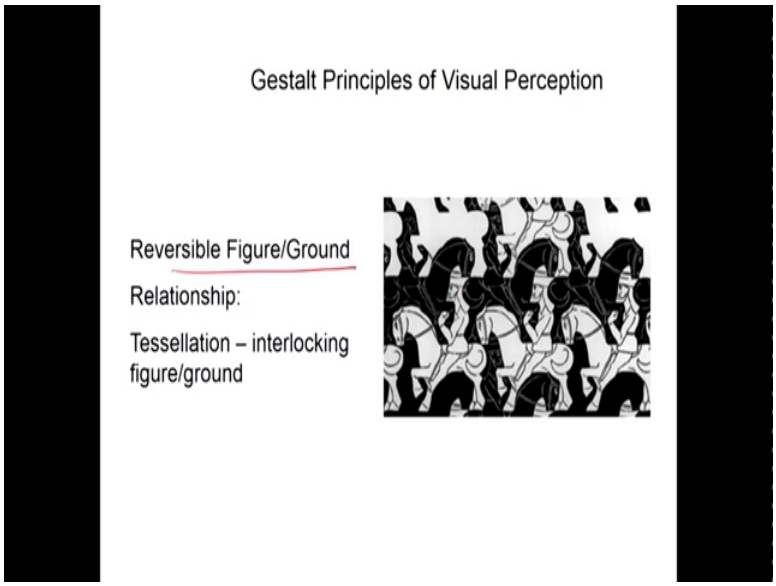


In this example, [vocalized-noise if you focus on the black you can see a light lamp; if you focus on the white as a foreground, then you can see that two faces right. So, here also it is white as the lamp and black as the two faces correct. You can actually switch or reverse this background and foreground. There are we are going to combine this principle of background and foreground and with a another principle of a smallness which will give you much more meaning smaller areas tend to be seen as a figures against a larger background; smaller areas will be considered as the foreground.

Student: (Refer Time: 10:15).

How much small, again it is a relative with respect to the background. So, in this case, in the first image, if you look at it, the black shade is a smaller one, the white shade is a bigger one. So, the black shade is considered as the as the foreground.

(Refer Slide Time: 10:44)



The e shade diagrams are one of the very good examples of thisreversible figure or ground relationships. For example, here you can see if you focus on the white, you can see the horse riding man the same thing if you focus on the black, you can see the reverse man riding the horse ok.

(Refer Slide Time: 11:00)

This is again one of the very good examples of the virtual diagram. Foreground, if you take white as the foreground, you can see the fish; the black if you take black as a foreground you can see their black fish. But one of the important thing is that the

background and the foreground are not seen simultaneously, we can see only one at a time.

Student: (Refer Time: 11:38).

Can you see simultaneously together?

Student: Yes, yes.

We can focus either on the.

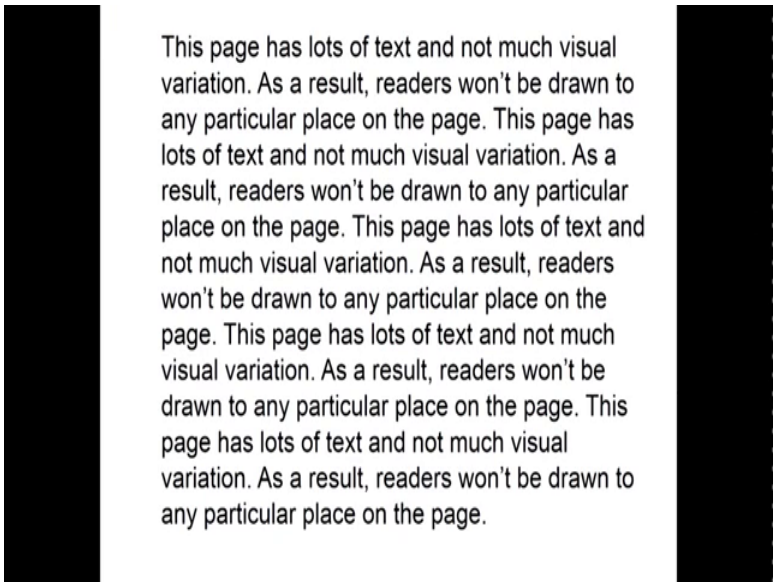
Student: Rapidly switch.

Yeah, we can rapidly fix it, but a at any time any one point of time, you can either focus on the foreground or the background.

(Refer Slide Time: 11:58)

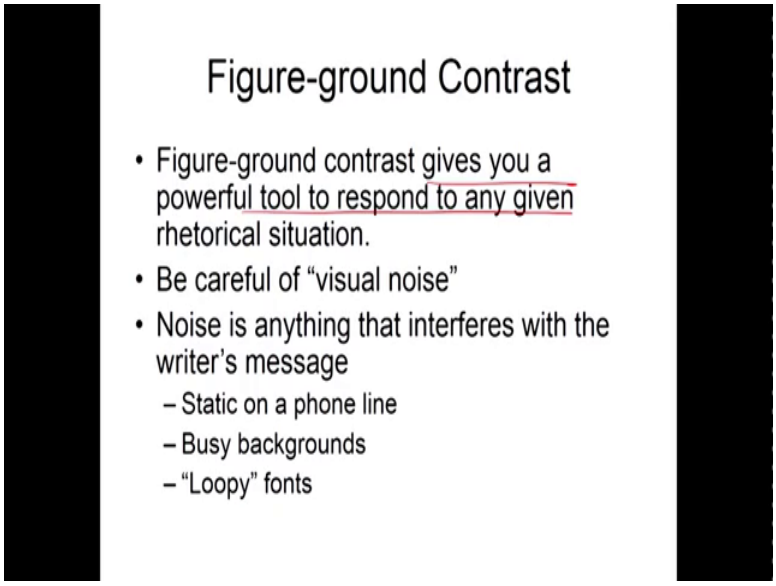
So, in this image, now first we focus on the ground, if that is the, you know where the dogs emerge ok. If you focus on this white, then you can see a small spaceship is emerging.

(Refer Slide Time: 12:12)



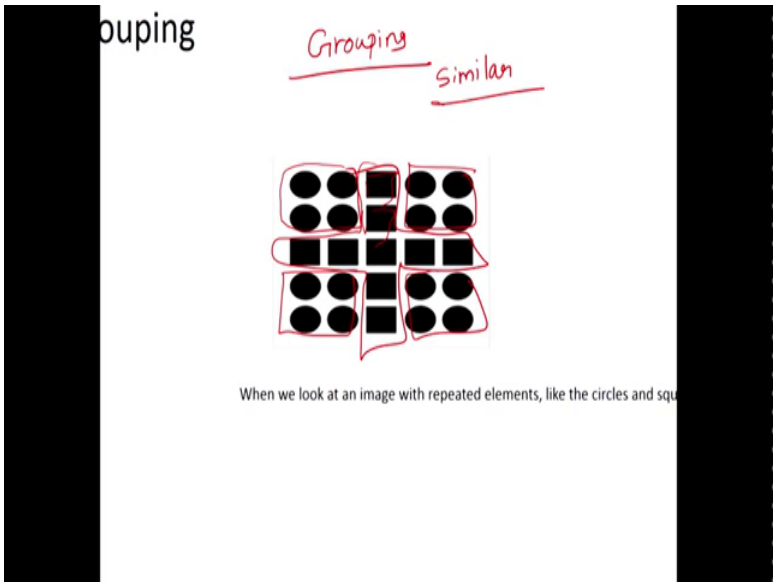
Again if whenever we look at the background or foreground, the noise is an important factor. What is the noise, this page for example has a lot of text and not much of visual variation. As a result, the readers would not be able to draw any particular place on the page. The whole thing is repeated ok. So, there is not much variation. So, the reader is not going to get anything out of it, nothing particular. If you want the reader to focus on something, then there has to be a, you know contrast right.

(Refer Slide Time: 12:50)



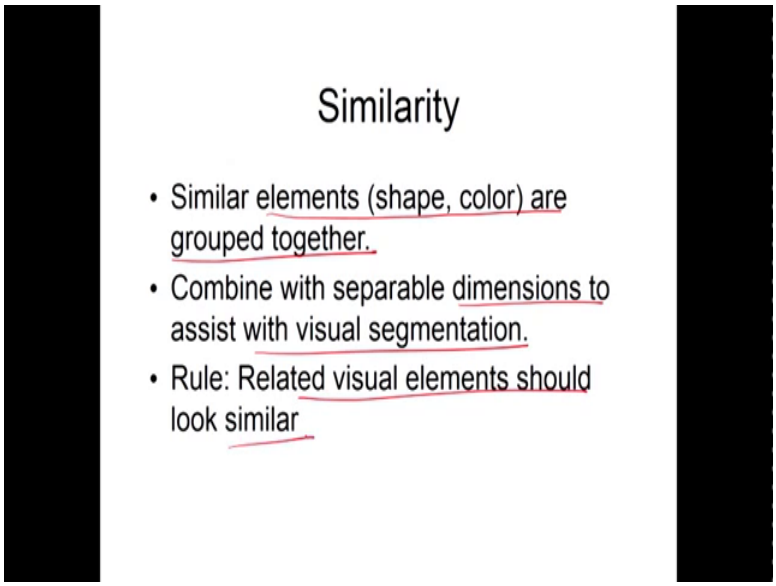
It gives you a very powerful tool to respond to any given rhetorical situations, but we need to be careful with the visual noise. Noise is anything that interferes with the writers message, static on a phone line or busy backgrounds or loopy fonts this all the this all the noises.

(Refer Slide Time: 13:04)



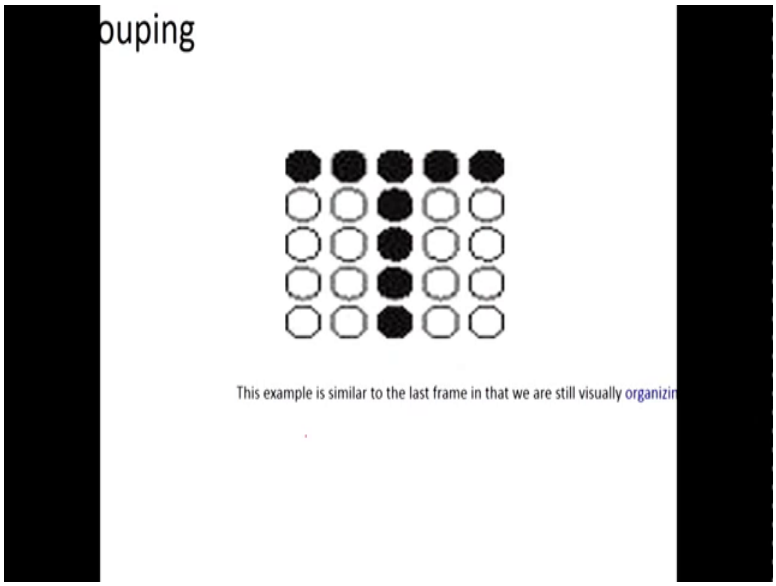
The second principle is called the grouping. One of the most important tool a principles of a gestalts is first see figure ground, the second one you see the grouping. We tend to group objects that are similar. Similar objects are grouped together. For example, here in the picture if you look at a all these rectangles are all grouped together, and then we form this plus sign. All these the circle things are grouped together as form a square. We tend to group things and objects that are similar ok.

(Refer Slide Time: 14:02)



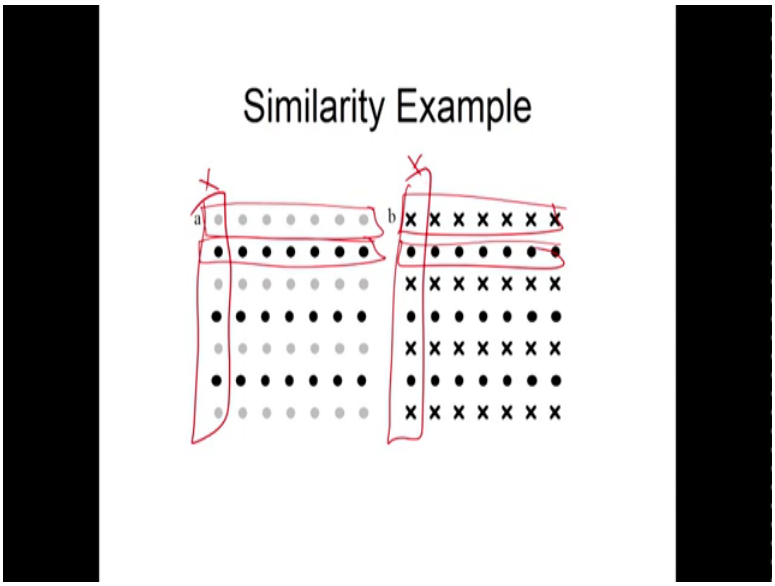
A grouping or similarity some literature called this is a similarity. Similar elements shape or color or group together combined with separable dimensions to assist with visual text segmentations. Related visual elements should look similar.

(Refer Slide Time: 14:19)



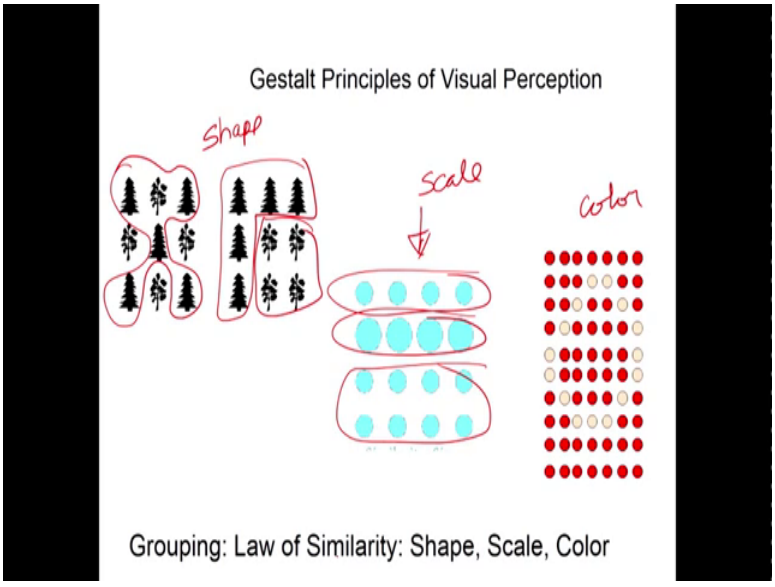
Again this is a another example where a black dogs are together grouped organizations.

(Refer Slide Time: 14:27)



This is an again another example, where we group all the black dots and all the grey dots together. We do not group this way; we do not do that right. It is very you know a straight. Similarly, we group this way row wise we do not do the grouping and the column wise that is because the objects are similar similarity right.

(Refer Slide Time: 14:55)



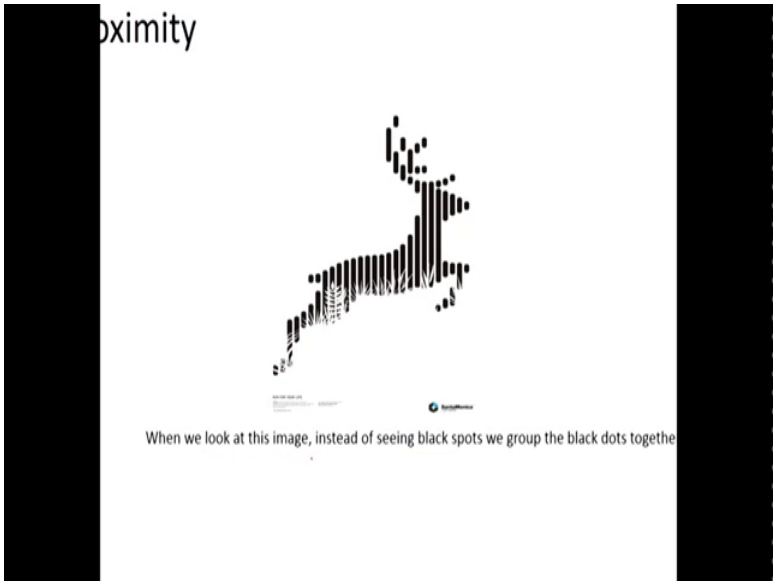
Again law of similarity we group things together where here we group things together. Here we group things together right. Here we group things together, and it can be color also. So, this is an example where we can group things based on this scale. Here we can

group things depending upon the shape. This is based on the color; we group things based on the color.

(Refer Slide Time: 15:34)

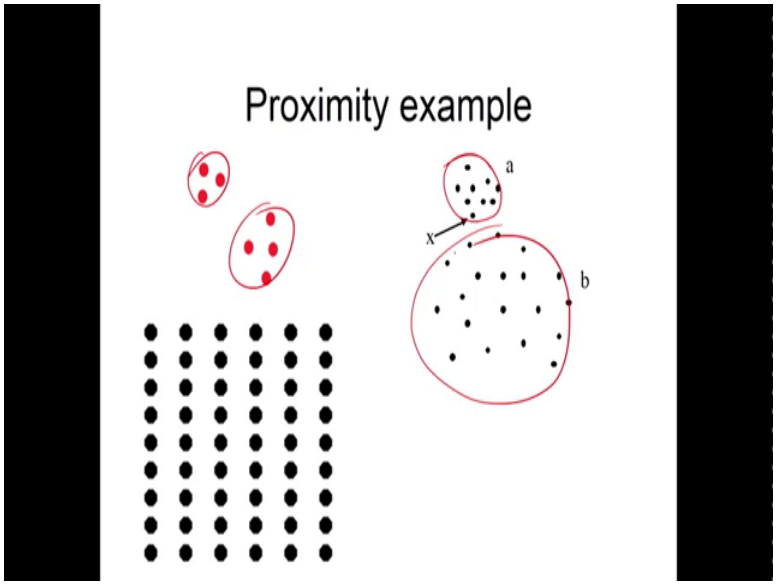
The third law is called the proximity. When we look at things the closer objects are you know perceived together, for example, instead of looking at a black dots and then yellow circle, they are all small small yellow circles ok. Now, all the black dots are grouped together, they are all put them together ok. And it emerges a full dog right. Can you see the dog over here? It emerges a you know full dog, they are all grouped together.

(Refer Slide Time: 16:18)



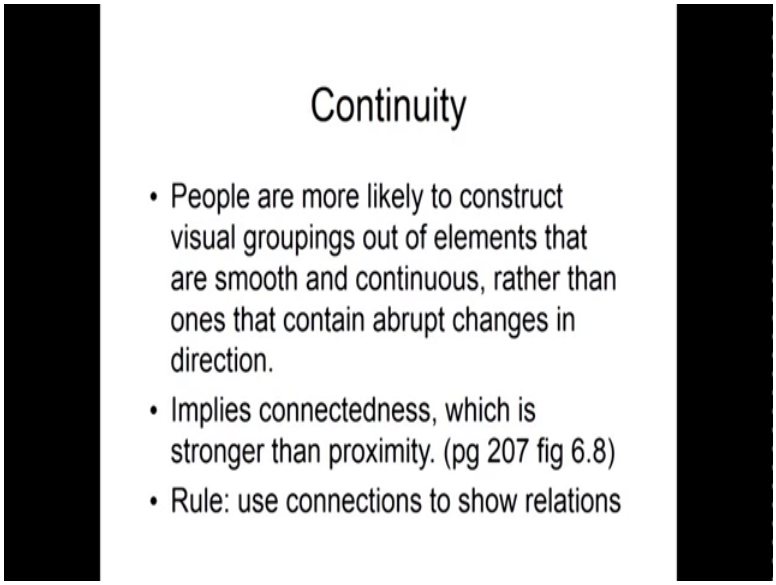
When we look at this image instead of seeing black spots, we group the block talks together, and we see the deer.

(Refer Slide Time: 16:29)



Again based on the color or the shape or the, you know separation right proximity examples.

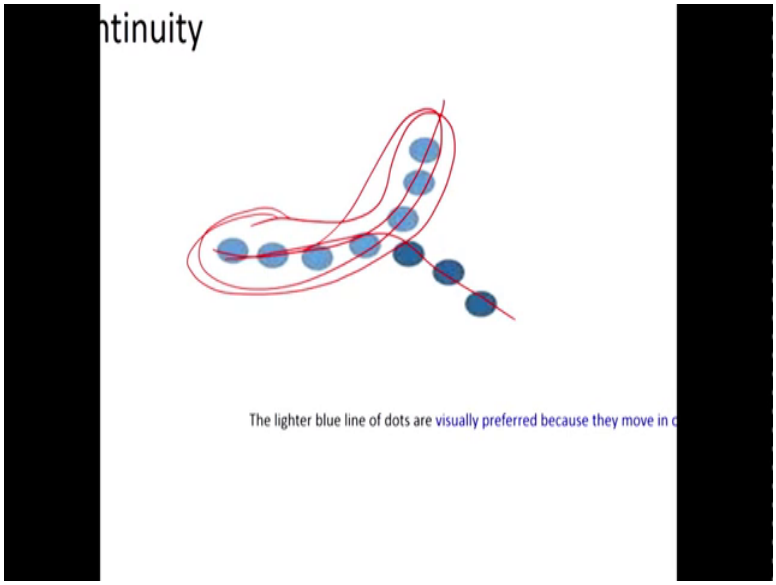
(Refer Slide Time: 16:43)



The fourth law is the continuity law. People are more likely to construct visual grouping out of elements that are as smooth as possible and it is continuous, rather than that one

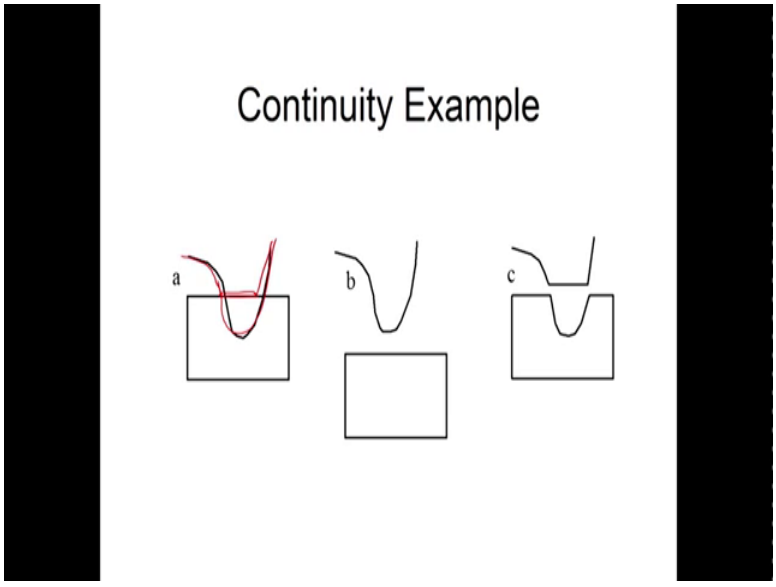
contains the abrupt changes in the direction ok. Implies connectedness which is stronger than the proximity use connections to show their relations.

(Refer Slide Time: 17:11)



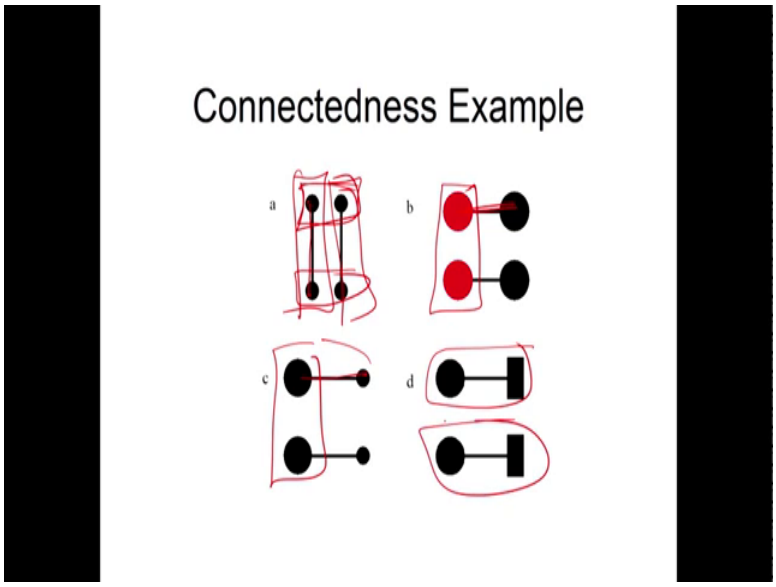
For example, here we tend to group this objects together, because there is a smooth flow. If you look at this one there is a abrupt flow, therefore we do not connect it and also you know there are colors also same there is one more reason. And any given picture there may be one or more than one law of gestalts can be applied to in order to perceive things right.

(Refer Slide Time: 17:43)



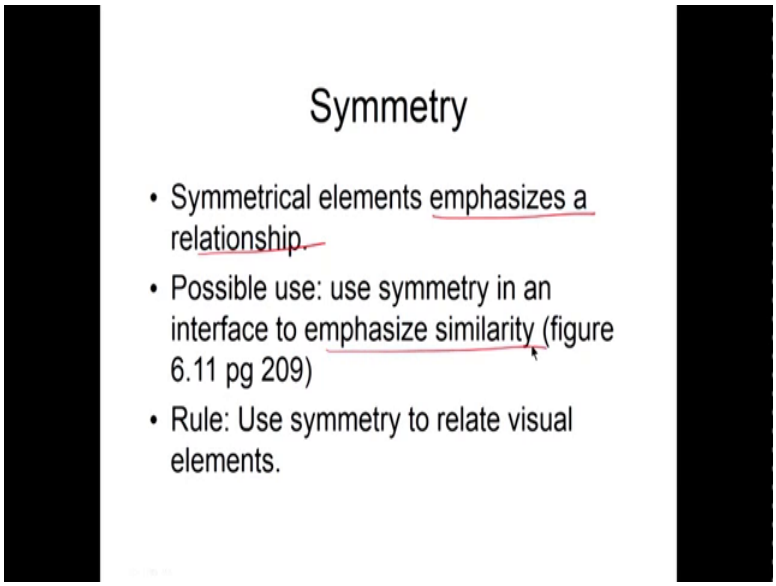
Continuity examples again, and even though there seems to be a break over here, but we continue we perceive this as continuity right. These are one good examples of a continuity.

(Refer Slide Time: 18:01)



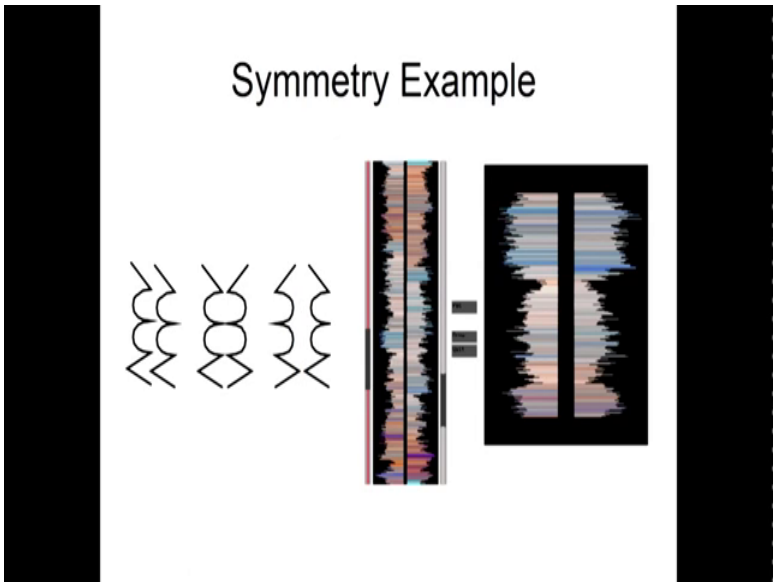
Connectedness. Can we connected this together or how do we connected this way? It is very difficult. If you if you if the lines were not there we would connect them to list like this ok. In order to make the perceiver connect these two dots, we need to explicitly connect by a line ok. Similarly, if the lines were not there, we would group this together in order to make it explicit we need to do this. Similarly, here the shape, we will connect it by default; otherwise if you want you have to connect it this way; similarly this also right.

(Refer Slide Time: 18:50)



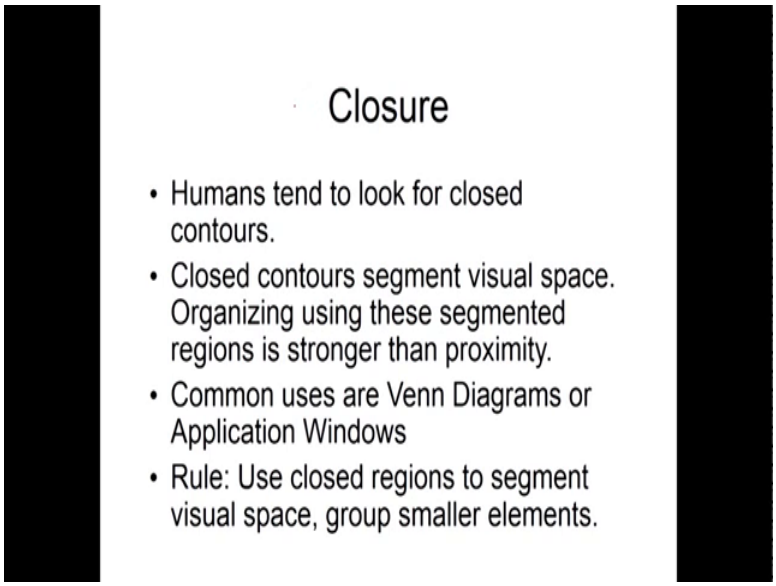
And then fifth principle is the symmetry. Symmetrical elements emphasize a relationship. Possible use of the symmetry is an interface to emphasize the symmetry. We are going to see some examples ok.

(Refer Slide Time: 19:04)



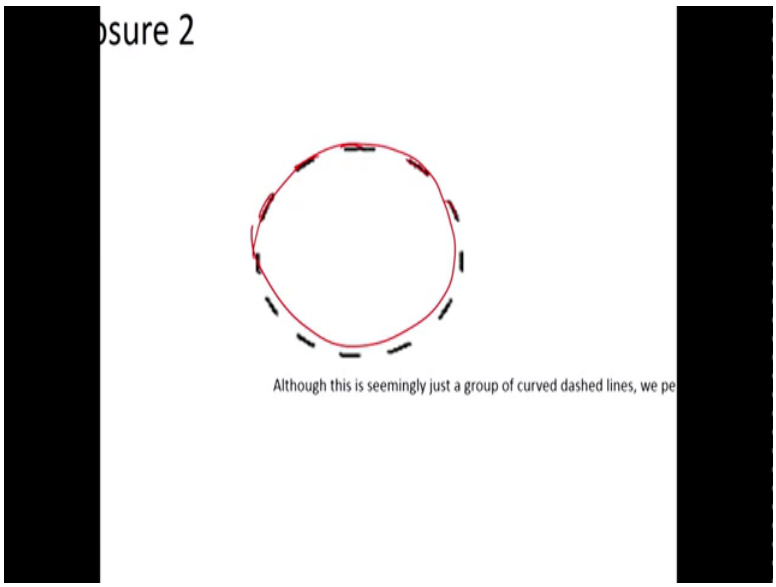
So, this there is no symmetry over here. Here we see the symmetry; here also we see the symmetry.

(Refer Slide Time: 19:16)



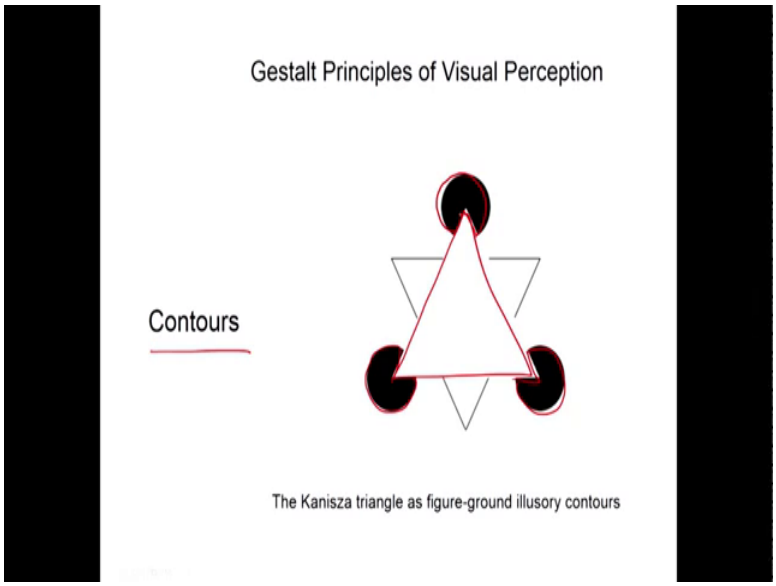
The 6th law is called the law of closure. Humans tends to look for close to contours; we perceive things in order to find out some closed contours ok.

(Refer Slide Time: 19:33)



For example, even though we see a segment of lines, we close them as a circle. We perceive this as a close closed form right.

(Refer Slide Time: 19:47)



Similarly, this also is a you know closed closure example or here also it is called the contours. You can see that even though this is like a packman kind of you know shape is there, we find we perceive an object here which is not there. We perceive the closure of the shape right. This is called the Kanisza triangle as shown in the figure-ground illusory contours.

(Refer Slide Time: 20:27)

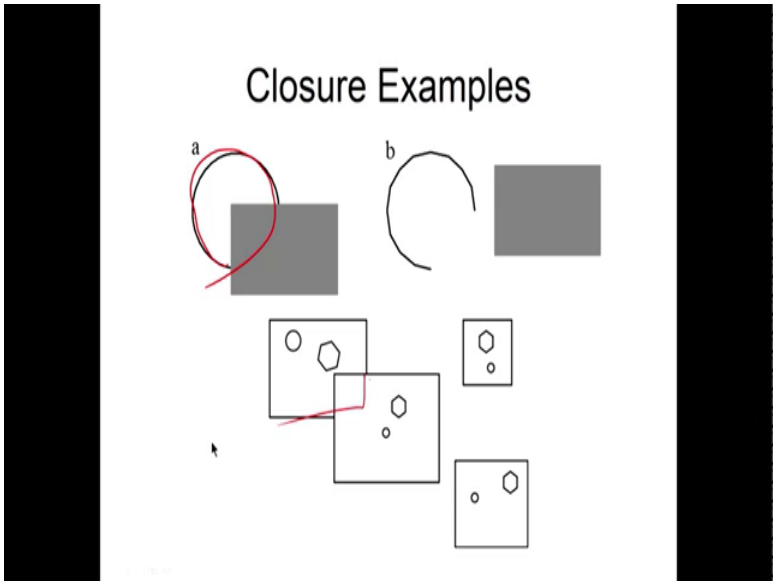
And this is one of the classical examples of a optical illusion ok. We tend to you know there is a negative space created in the FedEx logo, specifically whenever the logo

design designers they use, gestalts principles very much ok. Have you seen this FedEx image logo before and then can you find out yeah missing arrow over here?

Student: Yes.

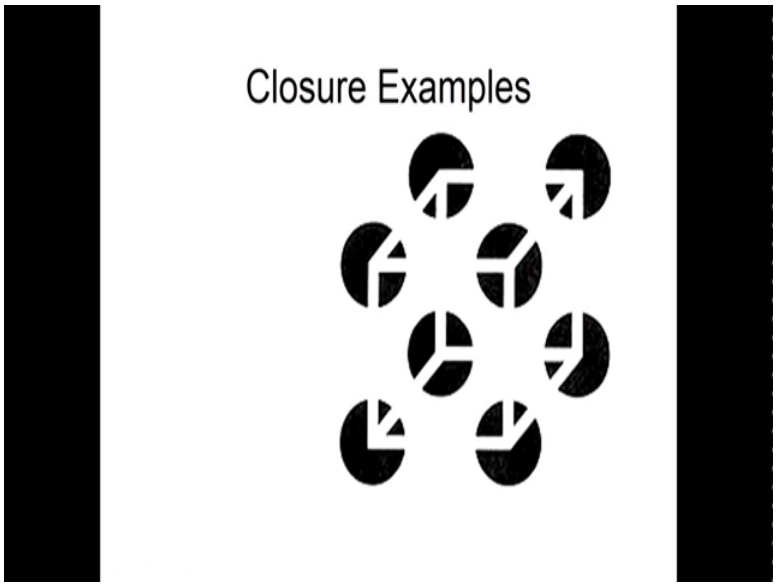
Yes. So, here is a missing arrow. We try to close things together. This is a classical example right. Even though, this is considered as separately, we tend to close this negative space and then pursue missing arrow.

(Refer Slide Time: 21:26)



Again this circle, we perceive this is closed; this rectangle we perceive as closed. These are all classical examples.

(Refer Slide Time: 21:38)



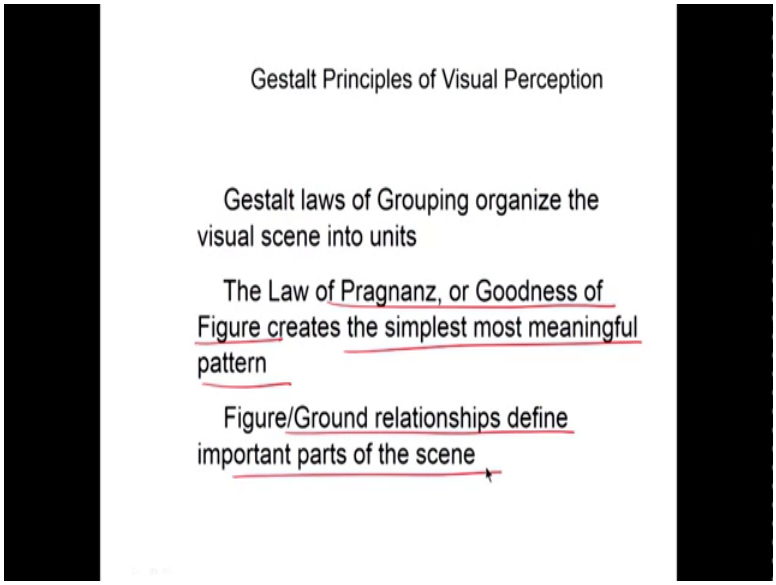
You can see again a 3D sphere which is missing as a closure example.

(Refer Slide Time: 21:45)

And then seventh principle is called the Law of Pragnanz. Pragnanz it appears to be a German term, but I m not sure what is the real meaning of it. It it sounds like a fragrance or you know Pragnanz, pregnancy right. But the real meaning is we try to simplify things. When we have a complex objects, we try to simplify it. We perceive simple objects. For example, if you look at this Olympics circles, there are you know segments of the circles right and there are you know smaller this objects, we do not divide the

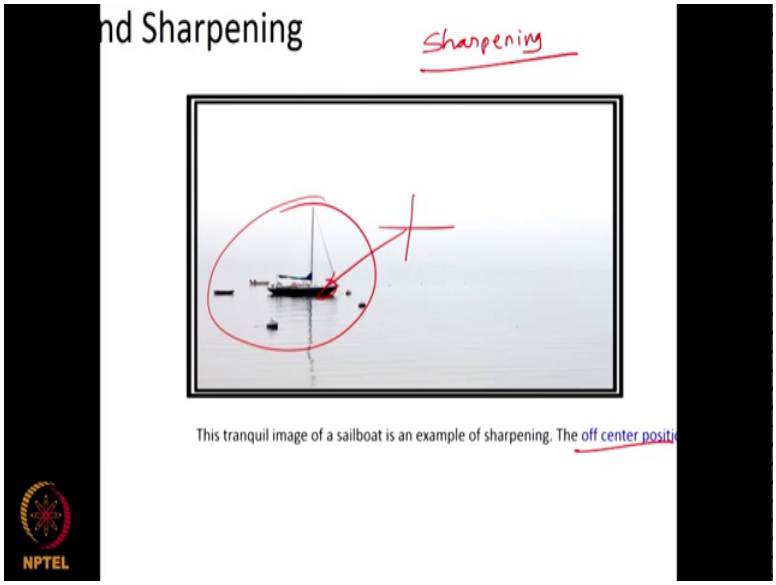
Olympics circle into smaller, smaller different objects. We perceive them as five different circles, so that is a simplest form instead of perceiving you know each object you know there are there are 1, 2, 3, 4 four such small smaller objects we do not perceive them ok. This is one good examples of the Pragnanz, we want to complex figures; we want to reduce into a simpler figure.

(Refer Slide Time: 23:12)



The Law of Pragnanz, or Goodness of the figure creates a simplest meaning out of the complex object. So, figure ground relationship define important parts of the scene ok.

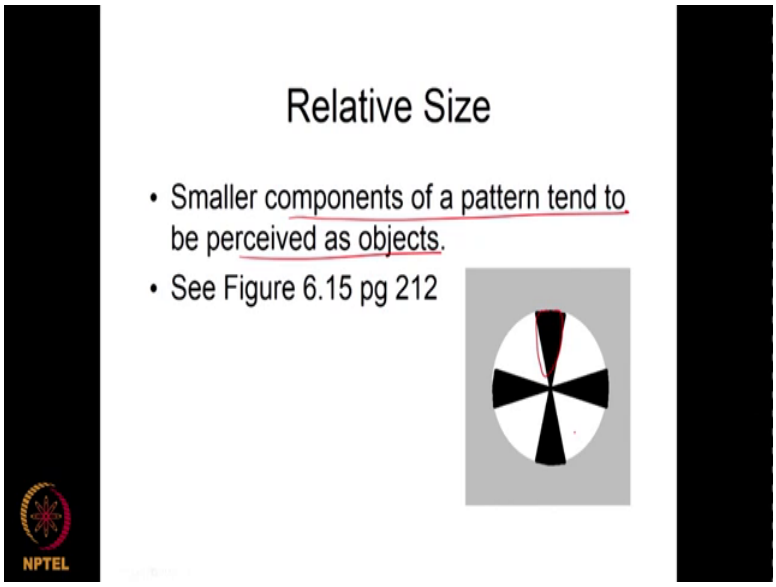
(Refer Slide Time: 23:29)



This is called the sharpening, sharpening of the image. So, this figure if it is see in the middle, then we will be focusing it properly, but because it is at the side, it creates a little bit of tension ok. So, always the centre of the image is attracting the focus. If it is a out of you know centre, then it is causing little tension over here ok. the off centered position is causing a little tension.

Student: Sir is it in other principle or this in (Refer Time: 24:23)?

(Refer Slide Time: 24:21)

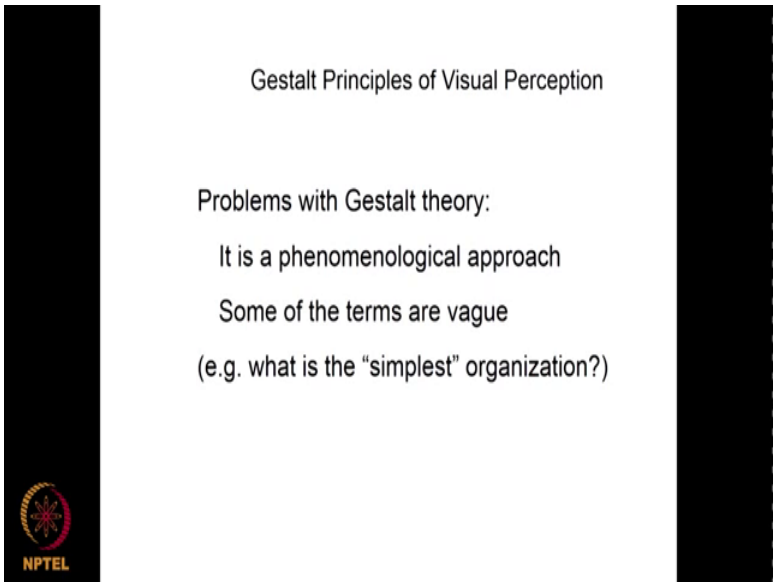


This is another principle we can say yes, this is one of the modern principles of the gestalts.

Student: (Refer Time: 24:31).

Classical are six or seven, yes. And then you know relative size also is one of the principles; again it can be a derivative or modern principles. Smaller components of the pattern tend to be perceived as objects. For example, here the black one or together is considered as objects ok.

(Refer Slide Time: 24:55)



We have seen some principles, but perception is not all the perceptions are explained by the gestalts principles ok. There are some problems with it ok. So, essentially some of the terms are very vague. When we say you know a simplest organization what is simplest, it is not very well defined ok, these are the problems with the gestalts principles. Now, what we have seen is only for the visual perception, can you imagine how these principles can be extended to haptic perception right. So, think about all the six classical principles of a gestalts can be extended to you know a haptics or even the sound right.

We will stop here. We will do a very small worksheet example.