Ergonomics for Beginners Industrial design Perspective

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Module No. # 05

Behaviour and perception

Lecture No. # 26

Cognitive Aspects and Mental Workload

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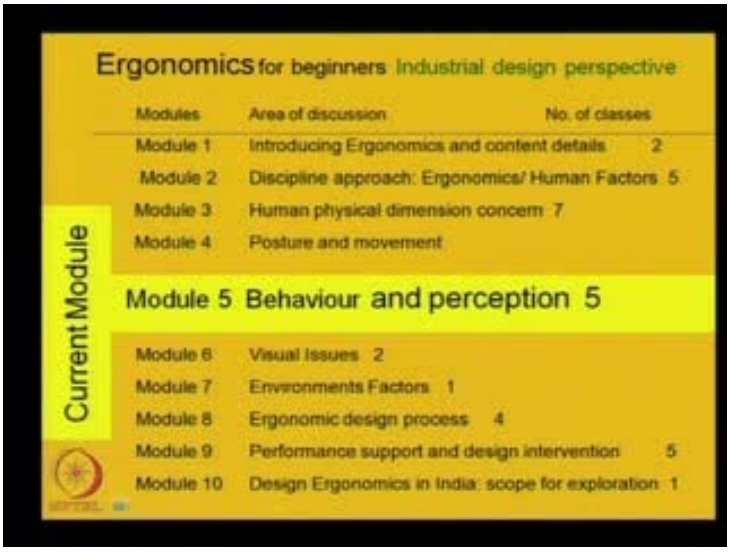

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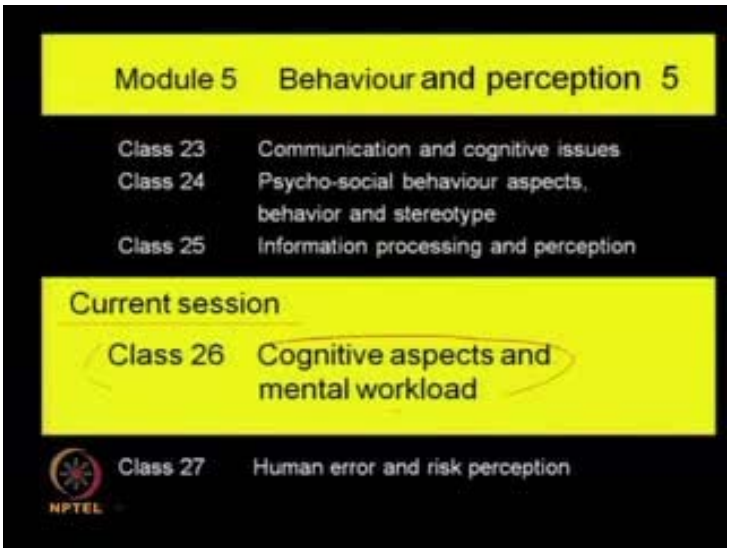

Welcome to this 26 session of ergonomics for beginners industrial design perspective, under module number 5, that is, behaviour and perception. The current session is the 26th class - cognitive aspects and mental workload, and its design relevances.

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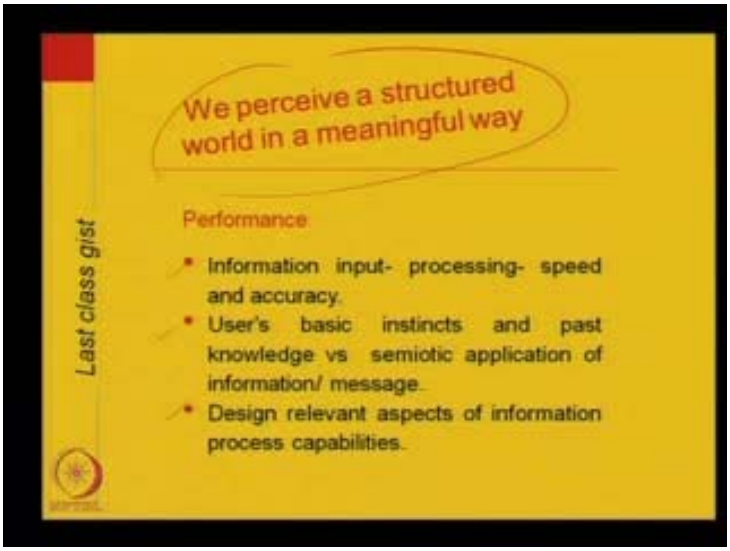

Now, last class gist, we perceive a structured world in a meaningful way - that we have discussed in last class. While talking about performance, we mentioned information input-processing, and speed, and accuracy. User's basic instincts and past knowledge versus semiotic application of information and message. The third point we discussed -

design relevant aspects of information process capabilities and accordingly design practice.

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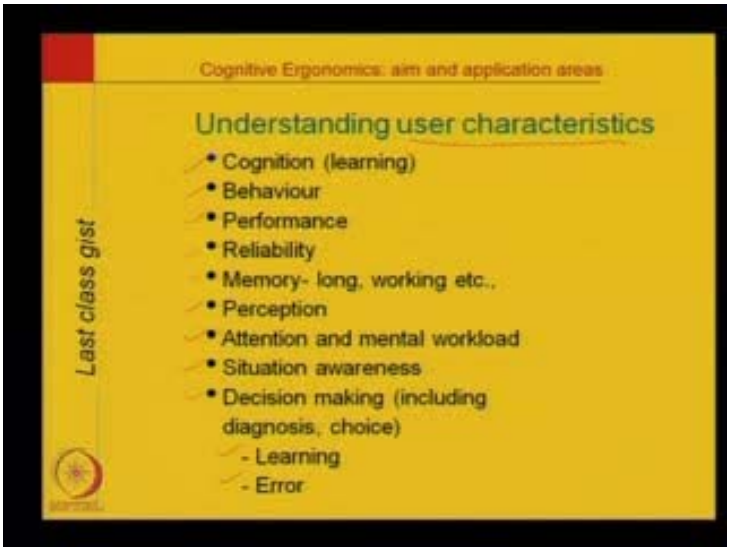

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Under the cognitive ergonomics aim and application areas, we mentioned about understanding user's characteristics and within that the specific points are: cognition - that is the learning, behaviour aspects, performance, reliability, memory - that is long time and working memory etcetera, the perception, attention and mental workload, situation awareness, decision making - that is including diagnosis, choice where learning

and error is an aspect that we need to consider. So, within this, some of the topics we have discussed in detail and some of the topics we would highlight in today's discussion. Within the cognitive ergonomics, today's session is cognitive aspects and mental workload and some of its design applications.

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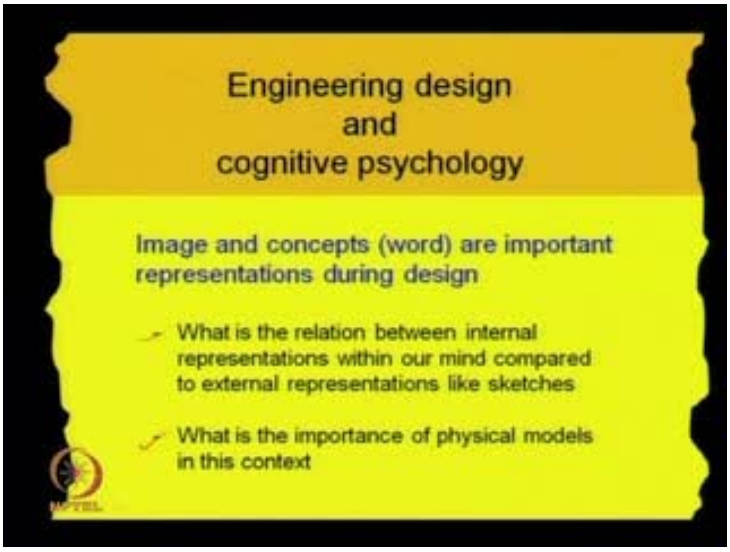

The engineering design and cognitive psychology - with that the image and concepts - that is word - are important representations during design. So, in this, some issues are coming up; that is - what is the relation between internal representations within our mind, compared to external representations like sketches and etcetera? It means how the links are maintained and how they behave with each other. What is the importance of physical models in this context? Whether it is only a sketch or its physical model, it is also required to perceive the inner meaning of the design.

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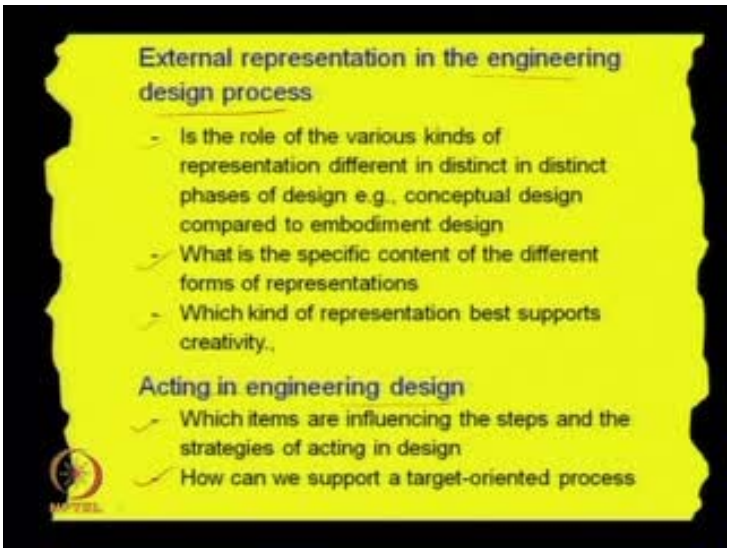

External representation in engineering design process: it is the role of the various kinds of representation different in distinct phases of design. For example, conceptual design compared to embodiment design; what is the specific content of the different forms of representations? Which kind of representation best supports the creativity? These issues are the external representation in the engineering design process.

Acting in engineering design: which items are influencing the steps and the strategies acting in design? How can we support a target-oriented process?

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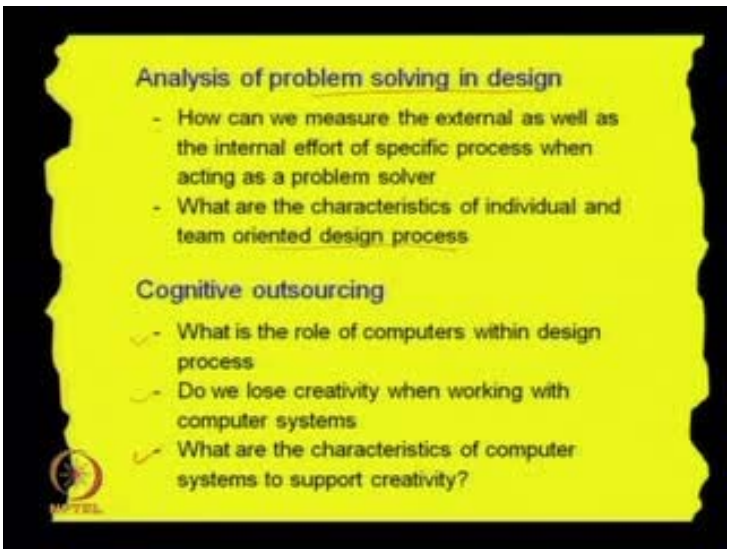

Analysis of problem solving in design: how can we measure the external as well as the internal effort of specific process, when acting as a problem solver? What are the characteristics of individual and team oriented design process?

Cognitive outsourcing, within this cognitive outsourcing what is the role of computers within design process? Do we lose creativity when working with computer systems? It means our thought process and etcetera, is guided by limitations of a system for thinking ability of ours. What are the characteristics of computer system to support our creativity? So, these issues we need to sort it out then our design thinking ideas and etcetera, it will be proper.

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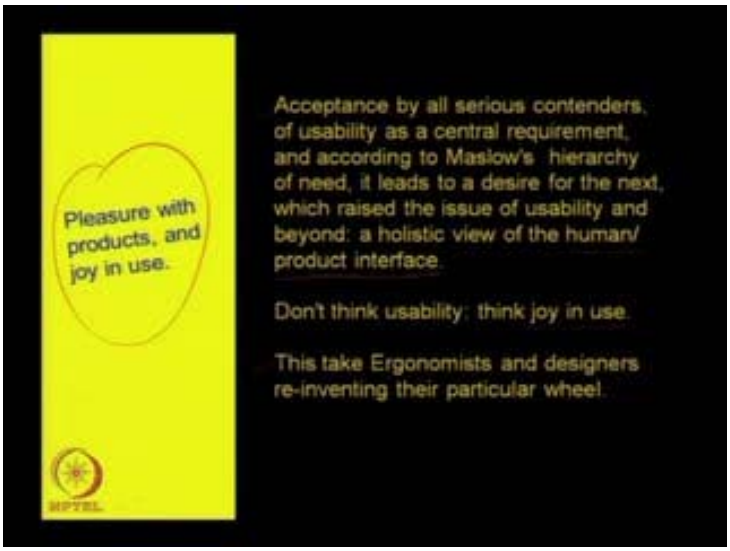

Now, we can say that pleasure with product, and joy in use to establish. This is we need - the acceptance by all serious contenders of usability as a central measurement. According to Maslow's hierarchy of need, it leads to a desire for the next, which raised the issue of usability and beyond a holistic view of the human product interface. Do not think of usability alone, think of joy in use. If we just found a product usable, but if we do not find joy while using it, then we may not feel good about it. A pen can write, but if I do not like to write with this pen, that is that joy, and then the usability, means it can write; the functional reliability is perfect, but still we will not be satisfied with this product.

This takes ergonomists and designers re-inventing their particular wheel, their rules. Ergonomics plays roles to establishing the need - what is need based on human information and designers can apply those things in an applicable product, so that the product will be well accepted by the users, and it will be compatible with the user's capabilities, limitations and requirement.

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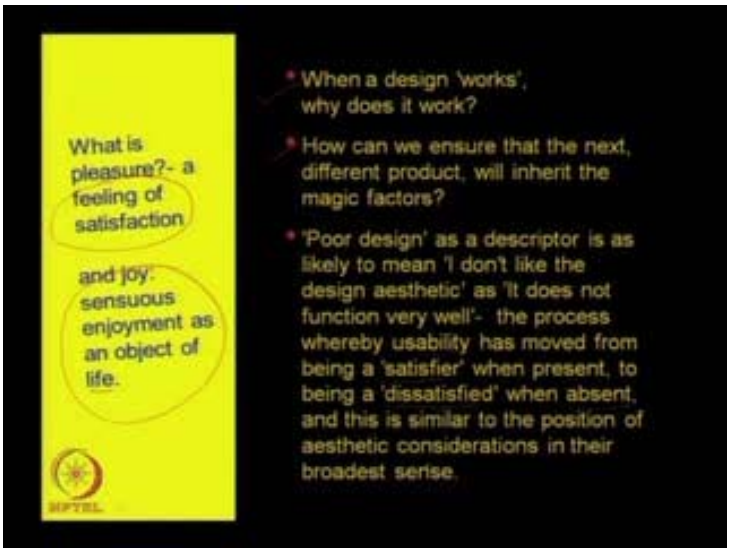

Now, what is pleasure? The pleasure is a feeling of satisfaction, and joy - the sensuous enjoyment as an object of life. Now for some queries: if we can satisfy them, then design would be good. Like, when a design works, why does it work? What are the factors relevant for this? How can we ensure that the next different product will inherit the magic factors?

Poor design as a descriptor is as likely to mean: I do not like this design aesthetic as it does not function very well - the process whereby usability has moved from being a satisfier when present, to being a dissatisfied when absent, and this is similar to the position of aesthetic considerations in their broadest sense.

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In this image, it says that everybody is happy or motivated to see this paper; this paper means media image should be positive to motivate. It means there should be some facts, some factors that people should feel to use it, should feel to possess it and also at the same time feel to share the pleasure among others; so, that would be the fact. Now, how to develop that thing? How to make this? A set of psychological features we need to satisfy while deciding design features.

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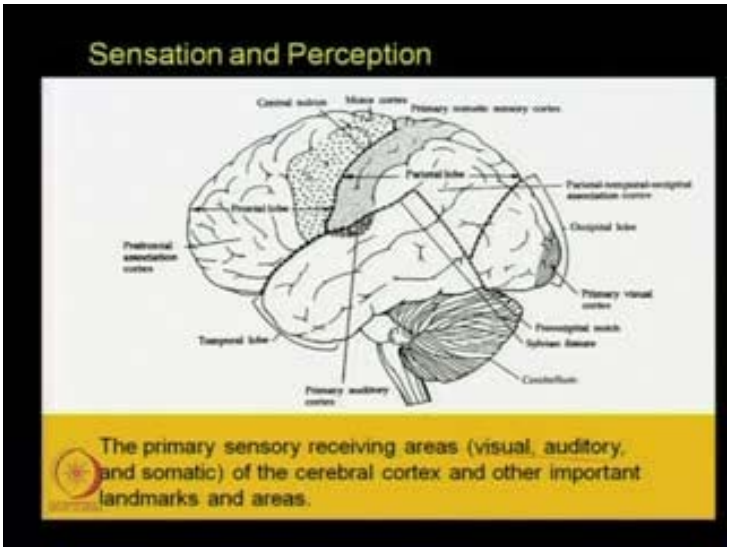

Now, sensation and perception, if we see how it actually does take place, then we should see that human brain, it has some specific space for specific purposes. The primary sensory receiving areas like visual, auditory and somatic, etcetera of the cerebral cortex and other important landmarks and areas are like this.

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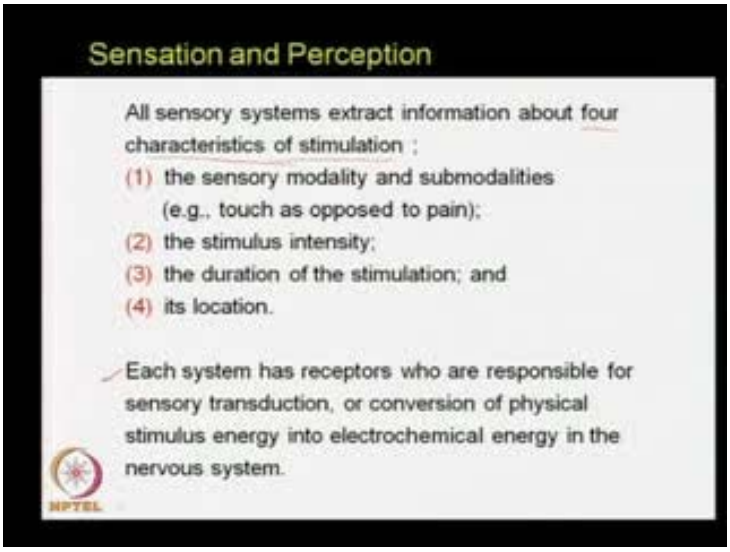

Sensation and perception - that all sensory systems extract information about four characteristics of stimulations; what are the four characteristics of stimulation? Number one: the sensory modality and sub modalities as for example, touch as opposed to pain; number two: the stimulus intensity, if the stimulus is more, its effect will be accordingly; number three: the duration of the stimulation, if it is short span stimulation, we may ignore it and its isolation, whether different stimulations are presented together in isolation, how can we have selective selection of those stimulus? That specific input we need to know and practice accordingly.

Each system has receptors that are responsible for sensory transductions, or conversion of physical stimulus energy into electromechanical energy in the nervous system. So, a specific threshold of input is necessary come out from the product itself.

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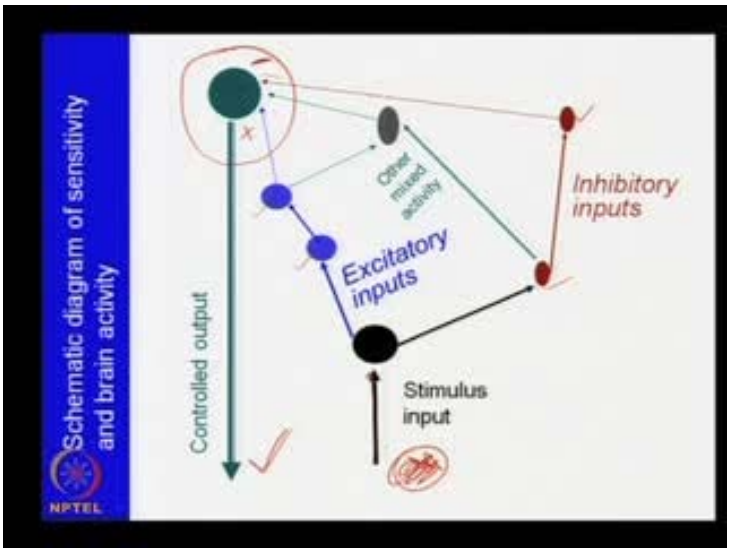

Like say, if we see the schematic diagram of sensitivity and brain activity, like this is a schematic diagram; suppose a stimulus input is going, may be through the eye, nose as smell, ear or other some touch kind of thing like that and may be some taste. So, a group of grey cells in our brain, it takes fast, then it distributes to certain cells; just see that these red colored cells are for inhibitory purpose, the blue are the positive, and this one for other different purposes. If the stimulus is given, means, if it rises through a certain limit, it triggers this one, then if this red one gets stimulated, then the total intensity get reduces to the second one and finally it acts as a negative effect on a final active cell.

If this thing is in a certain limit, then it should trigger this one, that is, excitatory inputs then its aggregates and then finally it acts as a positive input like this way, or sometimes what has happened, other mixed activities, some cells group it controls the negative and positive way. Likely a resultant effect that is balanced judgment it comes out as a controlled output and accordingly a controlled action takes place.

This stimulus input, the intensity and etcetera, it depends on what would be the output amount. If it is a very small amount, then it may have a judgment of neglecting its presence. If the stimulus is in such a manner that it needs to draw your attention, then that type of controlled output also will be like this (Refer Slide Time: 13:07).

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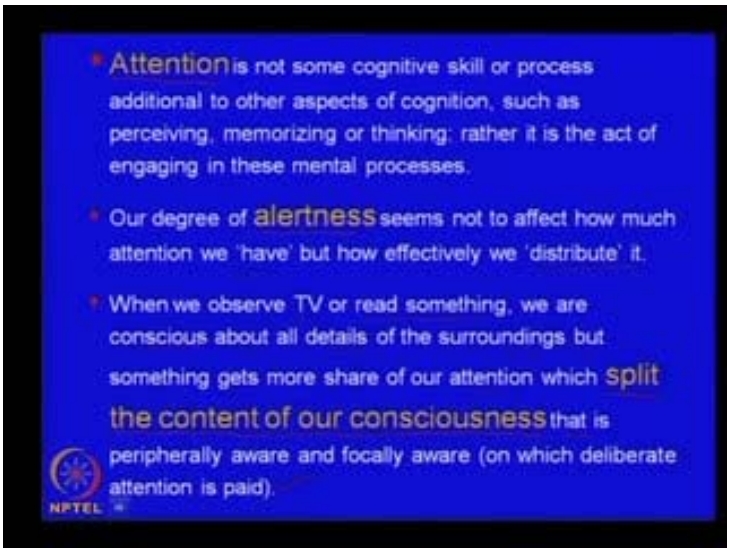

With this type of feeling we can say that attention is not some cognitive skill or process additional to other aspect of cognition such as perceiving, memorizing or thinking; rather it is the act of engaging in these mental processes. Our degree of alertness seems not to affect how much attention we have, but how effectively we distribute it.

When we observe TV or read something, we are conscious about all details of the surroundings, but something gets more share of our attention, which splits the content of our consciousness that is peripherally aware and focally aware - on which deliberate attention is paid.

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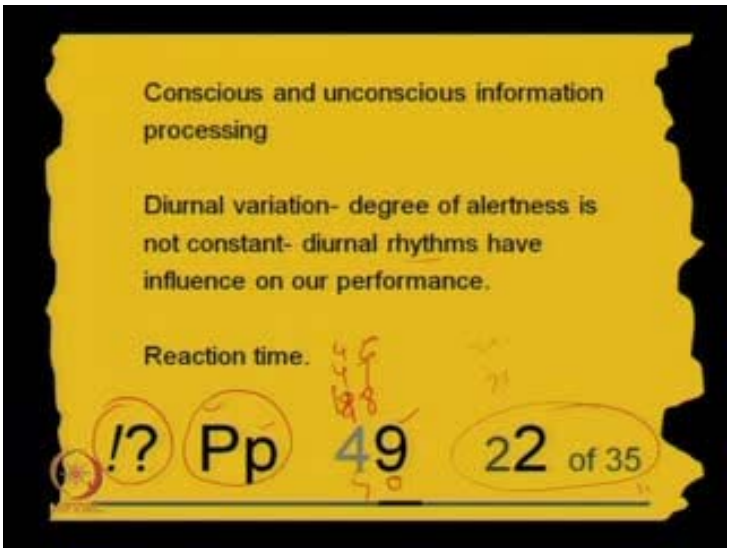

The conscious and unconscious information processing about this, we must consider the diurnal variation - this degree of alertness is not constant - diurnal rhythm have influence on our performance. In the morning, if I see something, the way I would react and evening I see the same thing with my tiredness and etcetera, I may react in different way and in the day something like that. So, the design - why do we use it that context specific time and duration? It does matter. Now, the reaction time after seeing something, that stimulus goes in judgment and the final outcome as an activity. What is the time taken? That is the reaction time. If we can reduce this time, it is to see the material thing and to react upon it; that design dependence or design acceptance or better acceptance lies on this aspect.

One example: normally, when we write or we do some symbolic thing in an italics way, in a normal font it is written and suddenly if something is in italics, it draws our attention; it is said that capital letters and small letters - small letter it is easier to go through, because it has links one after another.

If we write some numerical like 46, 47, 48, 49, 50, like this way. So, in this case, if it is a series and suppose we are presenting so many slides and slide numbers are like this (Refer Slide Time: 16:45); so, then what has happened? This 4, 4, 4, 4, we may have little low value and high value is this one. So that I can concentrate on this and then 51, 52, like this way or if it is like this, that 22 number of slides out of 35, total slides

number, then the previous slide may be 21 of 35, then previous one 20 of 35 and the next one would be 23 of 35 like this where this 20, 20, 20; this we do not need to know but this 0, 1, 2, 3, 4 these are more important at this moment then this would be more highlighted (()).

Another thing for a slide presentation, if we have a bar running bar and then suppose in this presentation there are total 35 slides; suppose in these 35 slides, if this is the 1 and this is 35, we can say that where at this current moment the presentation is on. So, this moving bar, it can give you a relative time, by this way, the understanding of the fact matter going on that depends; so, now how cleverly we can use this, so that the specific attention to be given to a topic is our excellence.

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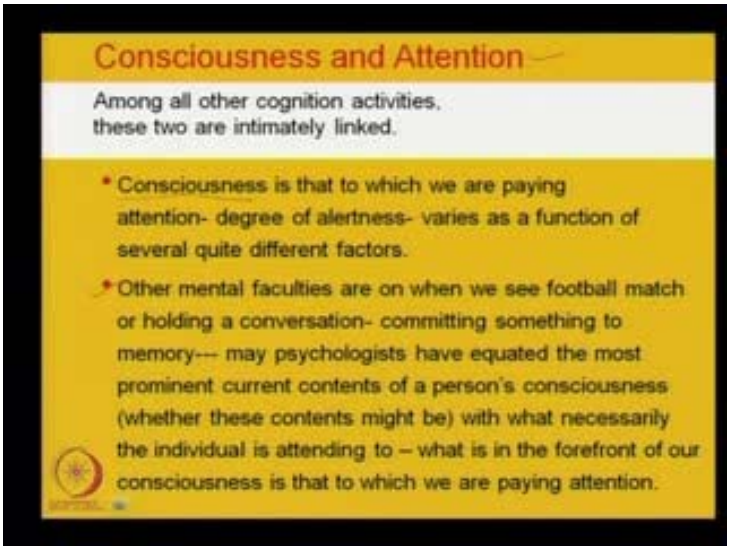

Consciousness and attention - among all other cognition activities, these two are intimately linked. The consciousness is that to which we are paying attention - degree of alertness - varies as a function of several quite different factors. Other mental faculties are on when we see football match or holding a conversation, committing something to memory; many psychologists have equated the most prominent current contents of a person's consciousness - whether these contents might be - with what necessarily the individual is attending to - what is in the forefront of our consciousness is that to which we are paying attention.

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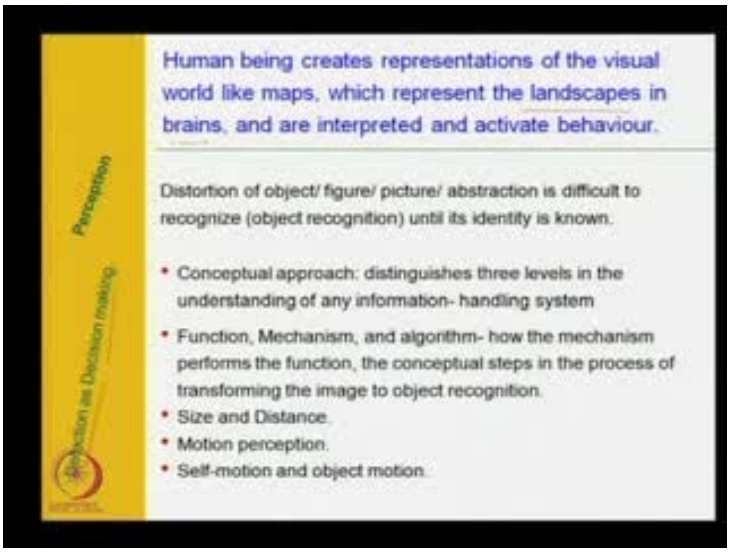

Perception and detection as decision making - human being creates representations of the visual world like maps, which represent the landscapes in brains, and are interpreted and activate behavior. Like the perception, distortion of object or figure or picture or abstraction is difficult to recognize - that is object recognition - until its identity is known about perception.

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Now, detection as decision making like conceptual approach, that is distinguishes three levels in the understanding of any information handling system that is a function,

mechanism and algorithm. How the mechanism performs the function, the conceptual steps in the process of transforming the image to object recognition, size and distance motion perception, self-motion and object motion - these are the issues of detection as decision making. Like this figure, it says that it gives a pleasure feeling while using this computer face book and etcetera, by somebody else, whereas for a different person it has different meaning.

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Now, we must see the design and trust factors, how to establish it. In earlier classes also, we have mentioned that this type of mixer cum grinder, people hold the lid feeling that it may fly off, to give a psychological while feeling this type of clips may be used it will give you a safety feeling; so, the physical presence of something, is it gives a meaning. Now, the trust building is that through semiotic inbuilt message, ensuring safe operations.

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In this figure, it sees that a bathroom is seen from inside, where the different types of control knobs are used. Now, how to use it? There is a small notice, here the instruction is written. Now, if this is at your home we may not require this, but when it is in a hotel where you do not know who will be the intended user of this, there we may require this type of information. So, easy encoded information inbuilt in this product itself or additional like this information sheet, proper instruction on how to use it, is necessary. Trust building - towards preventing anticipated problems, design must fulfill a set of context specific human compatibility factors and gain total trust.

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Another example in design and trust factor; this is a drinking water dispenser, this is like this one; water dispenser, water bottle, it is covered with a blue cap and here so that these caps can be thrown here; it may be through physical appearance or psychological well feeling. When this is covered, it will feel that it is safe, because it has been taken care. So, with that care, people will drink water; means, it is a care feeling; so, this physical presence it gives a psychological wellbeing feeling.

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Another item for an active function; now this is a small tea dispenser on a tea cup or somewhere; now, this is the cap having a small pipe and here the sugar is there. So, now the action is that now; if we see like this way, the activities. It is placed, then this is placed, then we tilt it so this much amount of sugar will be filled in here and then this much sugar will come out from this. So, every time we handle upside down one tea spoon full sugar will come out like this; so, the inbuilt message - ensuring reliable operations. In this bi-design, the reliable operation is maintained, so it is a trust factor, so by mistake more sugar will not spill out. This is it.

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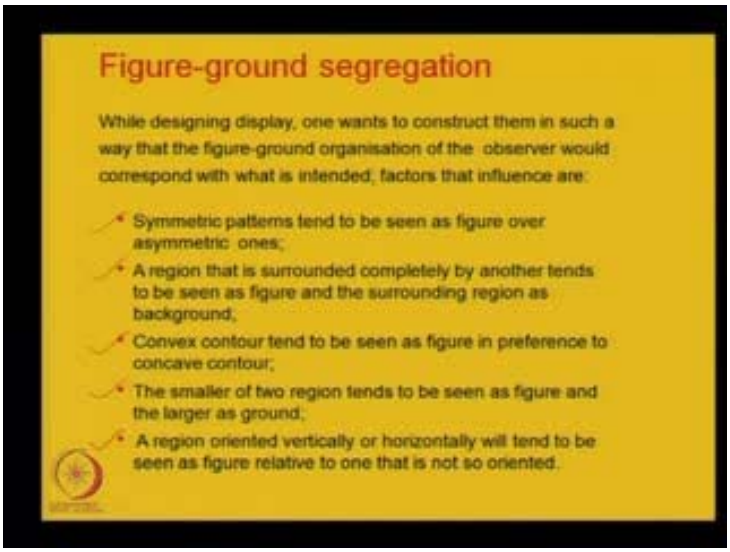

Another aspect is called a figure-ground segregation. While designing display, one wants to construct them in such a way that the figure-ground organization of the observer would correspond with what is intended; factors that influence are: symmetric patterns tend to be seen as figure over asymmetric ones; a region that is surrounded completely by another tends to be seen as figure and the surrounding region as background; convex contour tend to be seen as figure in preference to concave contour; the smaller of two region tends to be seen as figure and the larger as ground; a region oriented vertically or horizontally will tend to be seen as figure relative to one that is not so oriented; these aspect we will see now through some figures.

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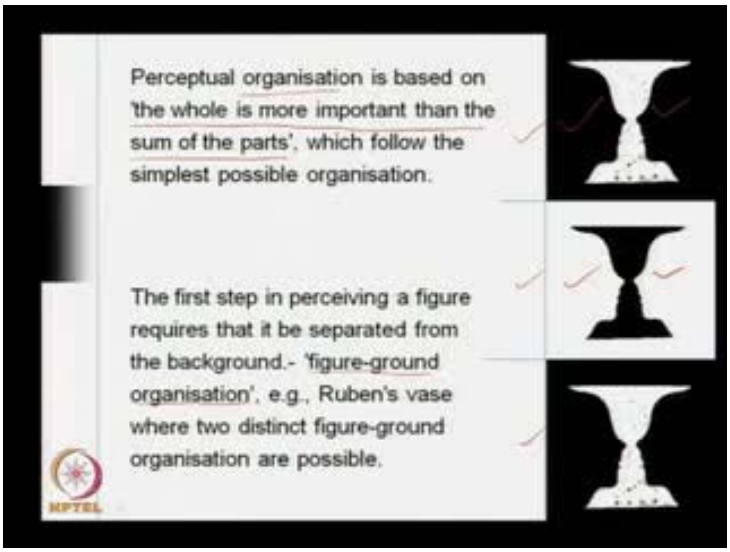

In this case, what are these figures? Perceptual organization is based on the whole is more important than the sum of the parts, which follow the simplest possible organization. In this, the first step in perceiving a figure requires that it be separated from the background - that is the figure-ground organization - that is in this Ruben's vase where two distinct figures - these two are the distinct figures - in black and in between the white space, in this case, white figures with the black space in between, whether in a first glance it appears as a flower vase or it appears two faces where two distinct figure-ground organization are possible.

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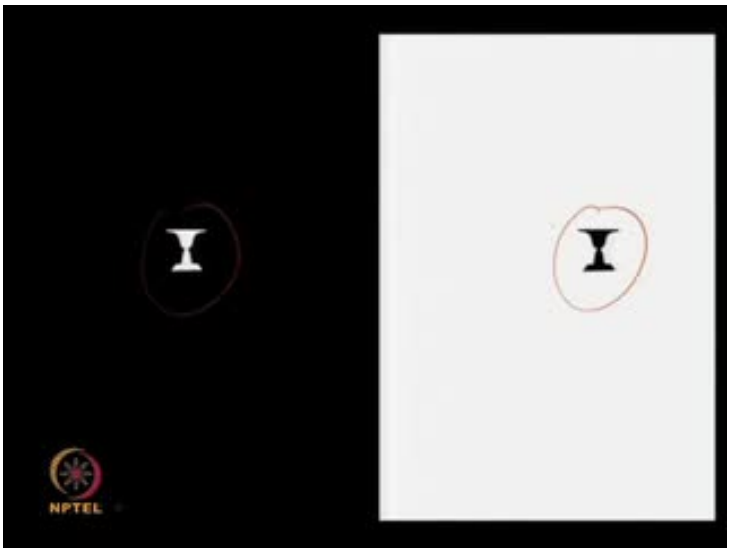

In this aspect, it can be said that, now in this black background this symbol, in white background this symbol; what it appears? The smaller one is the object and the larger space is the ground.

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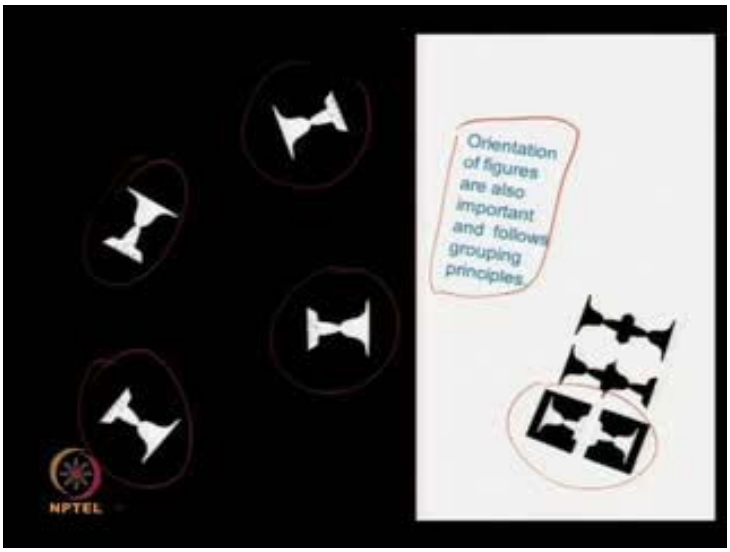

Now, orientation of figures is also important and follows grouping principles; now, the same thing, same figure is oriented in such a way; here it is very difficult to recognize the two faces. In this case also it is very difficult to recognize the faces, it gives all the black spots as a pore, in this case the white spot is the pore.

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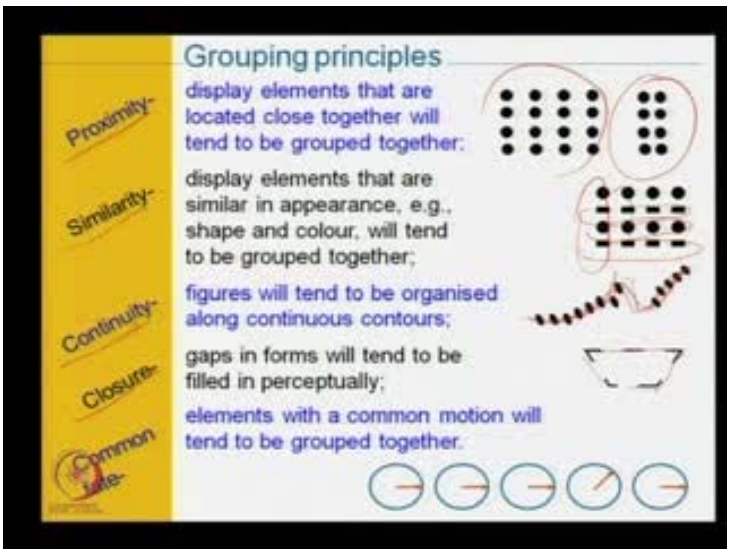

Now we are coming to grouping principles. How can we group some of the components to have a meaning? There are total five items; we can say that is proximity, similarity, continuity, closure and common fact. In this the proximity is that, proximity display elements that are located close together will tend to be grouped together. Suppose these dots, so this is the closed look, this is one group, these are another group, so like this (Refer Slide Time: 31:12).

Similarity - display elements that are similar in appearance, as for example, shape and color, will tend to be grouped together. In this case, either this one makes a group or these ones make a group; so, again it will depend on the space in between.

The continuity - figures will tend to be organized along continuous contours; like these beads, it is placed like this with a small string kind of thing or the string may not be there. Here, in this area there is no bead but only some small marking is there; so, apparently it is one line and this is another line, but it will appear as a single continuity line like this way. So, this is the continuity though these beads are not here, still it will give you a continuity feeling; so, then the space closeness and etcetera, it has a meaning in this.

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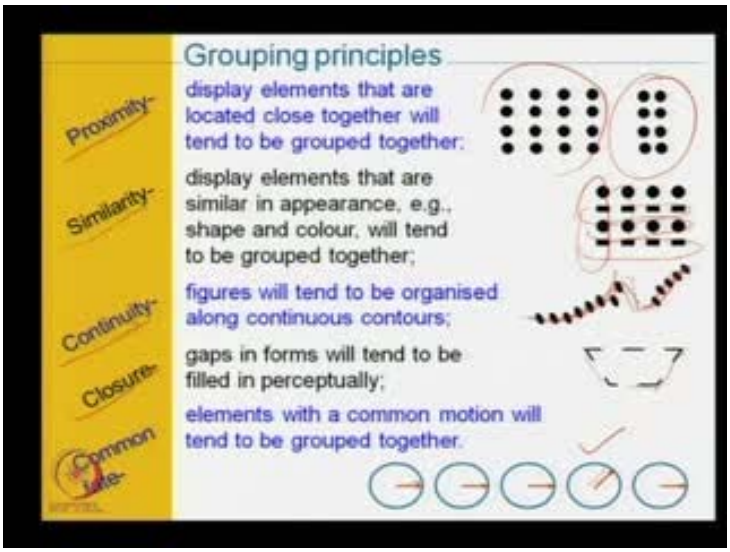

Closure gaps in forms will tend to be filled in perceptually, like this; this is a figure, this area, this area, this area, this area; so these are the open spaces, but it is arranged in such

a way that it gives total feeling. Here, in these cases, it may be there, it may not be there, but still it gives closed feeling. So, this type of appearances has to be used in design.

Then, common fate - elements with a common motion will tend to be grouped together. Suppose, in a machine there are some meters are provided, when each meter representing the functionality of a machine, in a machine array. When all the machines are in a good running condition, the needle will be in a 3 o'clock position, but if there is a change, means it says that the machine has problem that is related to this symbol; so, by this, means, the common fate - the elements with a common motion will tend to be grouped together. So, these are all grouped together but this is different, so people will attend to this.

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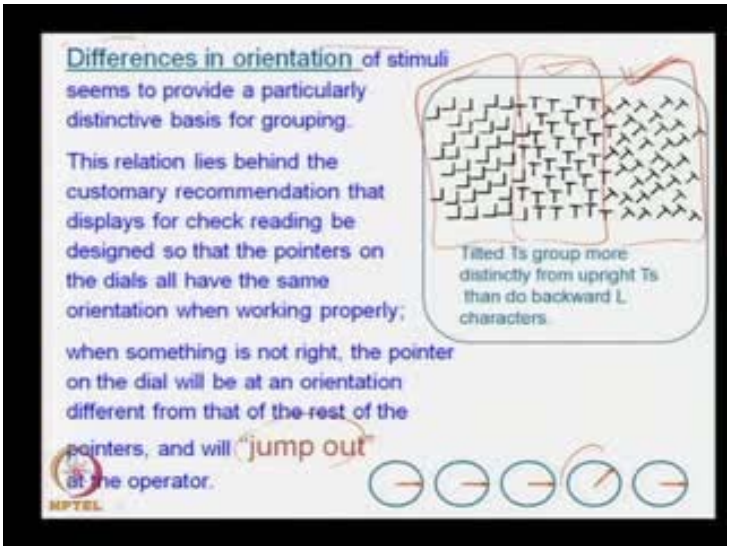

Now, differences in orientation - differences in orientation of stimuli seems to provide a particularly distinctive basis of grouping; like, in this case, there are Ts and Ls; so, this one has a group, this has a group and this tilted T this also a group, but in this group which one draws your first attention when we see this. Tilted Ts group more distinctly from upright Ts, then do backward L characters. It means, first it draws our attention here, then this, then this because this is unused here.

So, to draw some attention, this type of unused self-presentation is necessary to be presented, that breaks the harmony. Now, this relation lies behind the customary recommendation that displays for check reading be designed, so that the pointers on the

dials all have the same orientation when working properly; when something is not right, the pointer on the dial will be at an orientation, different from that of the rest of the pointers and will jump out at the operator. So, these are the some basic elements we need to practice in our design, so that we can give out particular attention to the need and accordingly design features has to be decided and applied.

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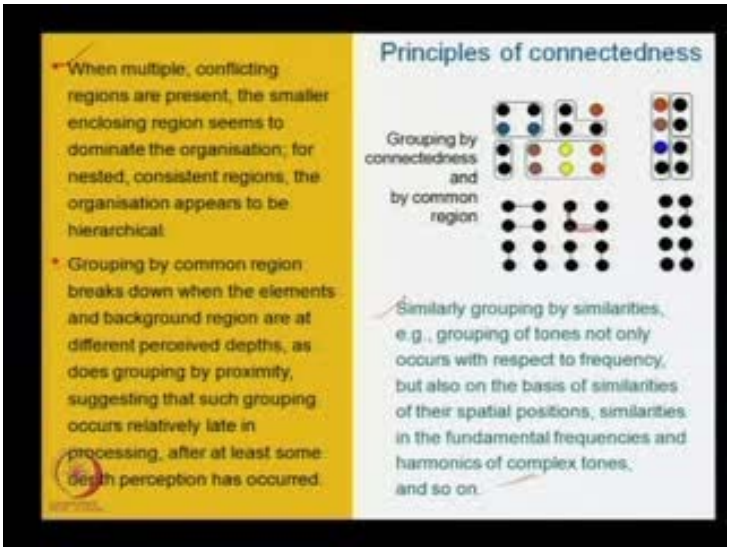

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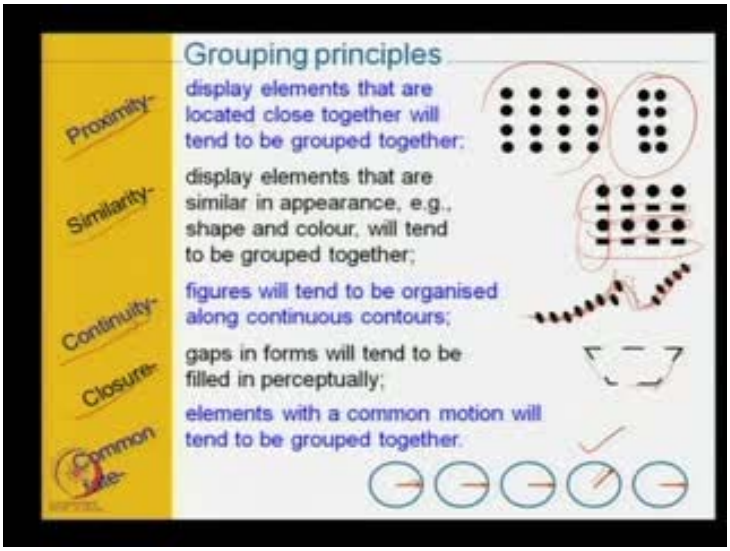

The principles of connectedness - when multiple, conflicting regions are present, the smaller enclosing region seems to dominate the organization; for nested, consistent

regions the organization appears to be hierarchical. Grouping by common region breaks down when the elements and background region are at different perceived depths, as does grouping by proximity, suggesting that such grouping occurs relatively late in processing, after at least some depth perception has occurred.

In this figure, we can say that grouping by connectedness and by common region. Now, if we see the earlier slide, where we have shown the same 1, 2, 3, 4, 1, 2, 3, 4 like this groups are there; you see groups are there, but now with the color application - black and blue, like this way either color application or a special mark around this, it makes a specific group within that group region, so like that or if no color or no marking is there, still we see different connectivity lines maintaining this lines; it gives a connectivity or groupings of the components.

Similarly, grouping by similarities, as for example, grouping of tones not only occurs with respect to frequency but also on the basis of similarities of their spatial positions, similarities in the fundamental frequencies and harmonics of complex tones and so on. So, these are the principles of connectedness and its application visibly.

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Another example, this is a ponds cold cream; now, here the thing is that if we see all the products from this angle, from this point it is closed; so, the shape remains same no change, when we tilt the lid or open it then the form discontinues, again the discontinuity of the form like this way and when we are closing it, it again comes to a specific thing;

now, we can ensure that the lid is closed or secured enough. So, like this continuity and discontinuity of form it gives a safety feeling as well; so in a machine condition that may be practiced.

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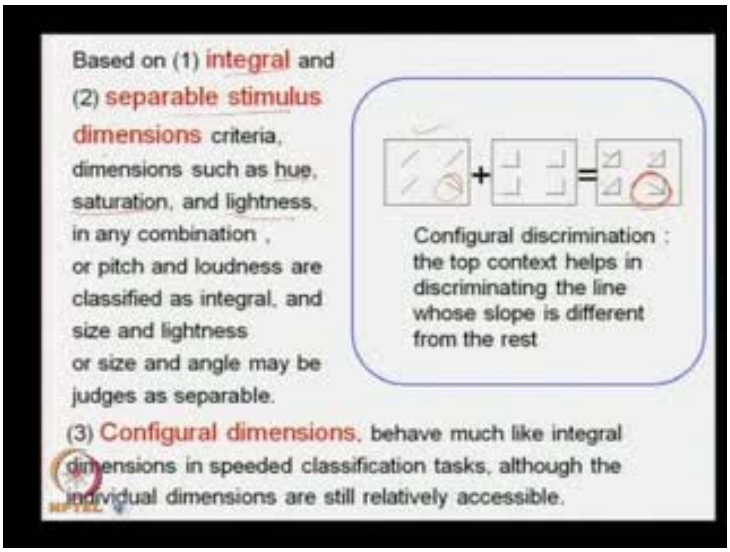

Based on this the integral and separable stimuli dimensions criteria, dimensions such as hue, saturation, and lightness in any combination, or pitch and loudness are classified as integral, and size and lightness or size and angle may be judged as separable.

Number three: the configural dimensions, behave much like integral dimensions in speeded classification tasks, although the individual dimensions are still relatively accessible. Like in this example, it can say that these are the lines plus this is the basic form if these two are connected then this one appears.

Configural discrimination: the top context helps in discriminating the line whose slope is different from the rest, this is the connection.

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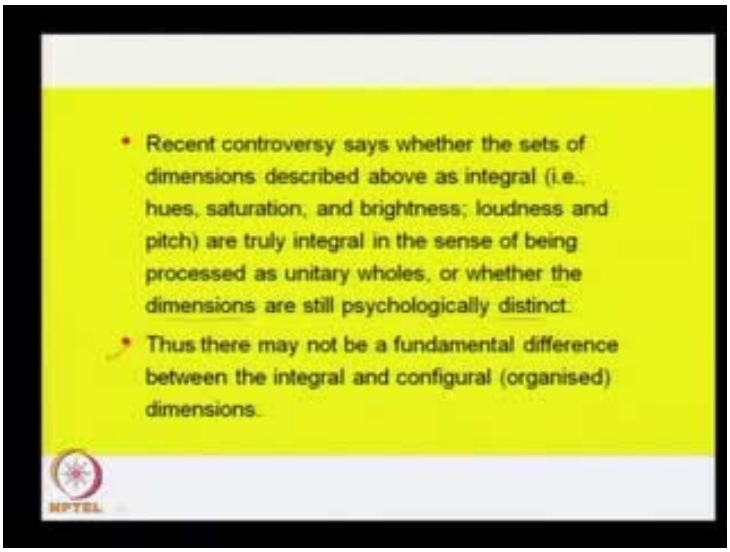

Recent controversy says whether the sets of dimensions described above as integral that is hues, saturation, and brightness; loudness and pitch are truly integral in the sense of being processed as a unitary wholes, or whether the dimensions are still psychologically distinct. Thus there may not be a fundamental difference between the integral and configural that is organized dimensions.

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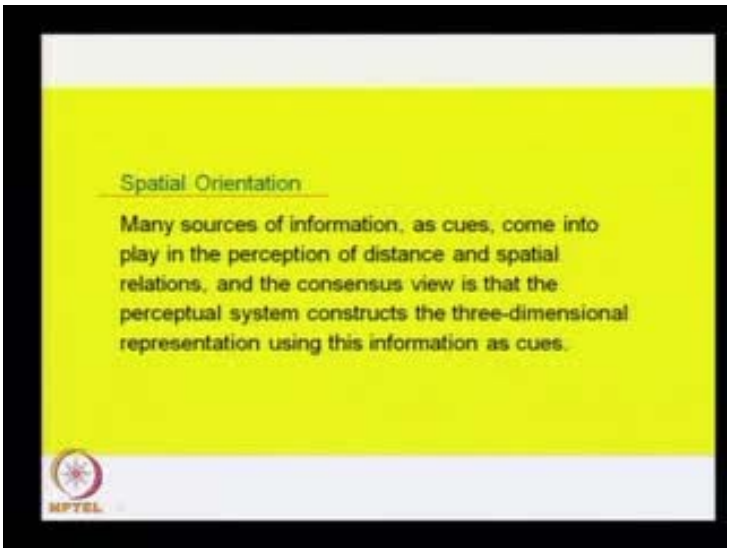

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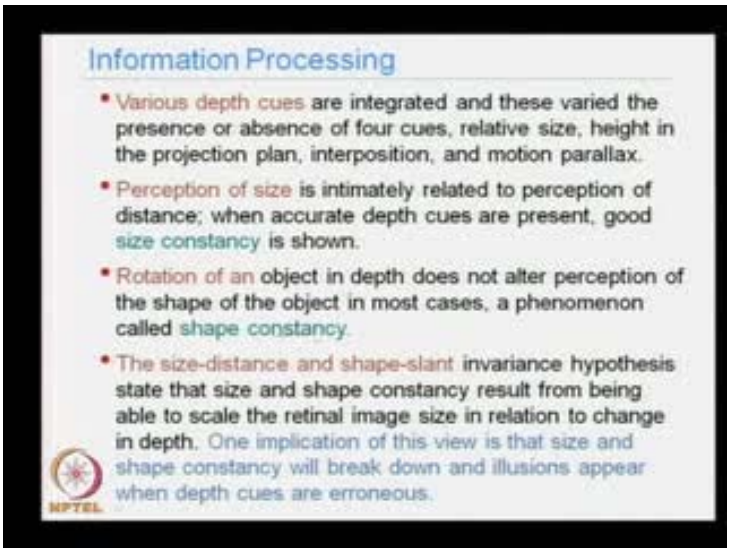

Spatial orientation: many sources of information, as cues comes into play in the perception of distance and spatial relations, and the consensus view is that the perceptual system constructs the three-dimensional representation using this information as cues. Like information processing, various depth cues are integrated and these varied the presence of or absence of four cues, relative size, height in the projection plan, interposition, and motion parallax. Perception of size is intimately related to perception of distance, when accurate depth cues are present, good size consistency is shown. Rotation of an object in depth does not alter perception of the shape of the object in most cases, a phenomenon called shape constancy.

The size-distance and shape-slant invariance hypothesis state that size and shape constancy results from being able to scale the retinal image size in relation to change in depth. So, one implication of this view is that size and shape constancy will break down and illusions appear when depth cues are erroneous.

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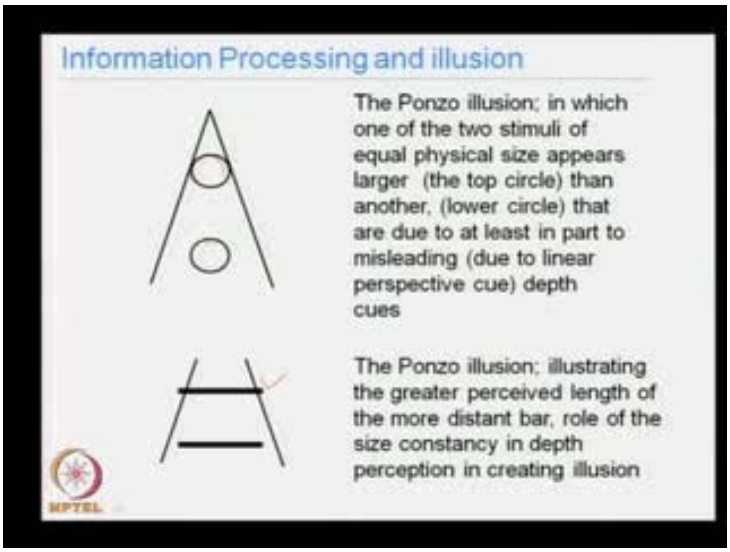

For example, information processing and illusion; here, in this conical line the two circles are same but appearance wise, one appears larger than other. The Ponzo illusion: in which one of the two stimuli of equal physical size appears larger-the top circle, than another, lower circle that are due to at least in part to misleading - due to linear perspective cue-depth cues. Another, the Ponzo illusion is like this (Refer Slide Time: 44:48); so, within these two parallel lines, intersected with different angle lines, here this line appears larger than this one, why? Though these two lines are the same size, the Ponzo illusion again illustrating the greater perceived length of the more distant bar, role of the size constancy in depth perception in creating illusion.

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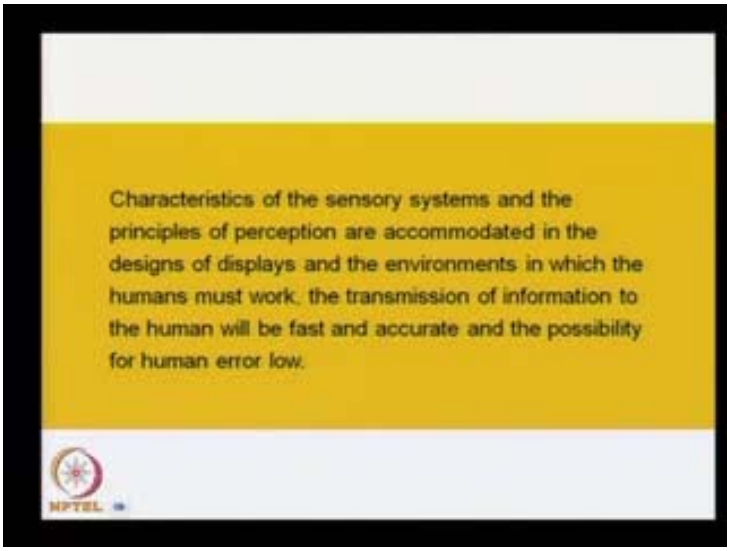

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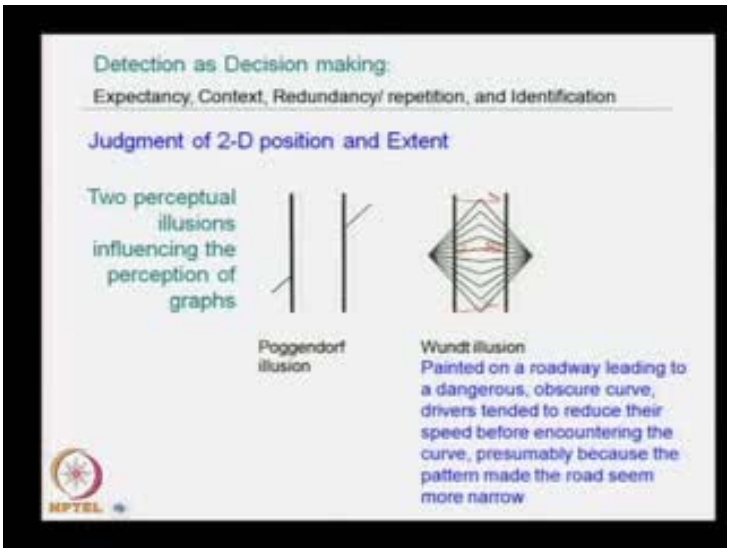

Characteristics of the sensory systems and the principles of perception are accommodated in the designs of displays and the environments in which the humans must work, the transmission of information to the human will be fast and accurate and the possibility of human error flow. In this the detection as decision making that is expectancy, context, redundancy, repetition and identification, the 3-D that is judgment of 2-D, and etcetera.

Let two parallel lines, the two perceptual illusions influencing the perception of graphs. Here, in this case, these two lines are appearing as narrower here, than these other sides but actually these two are the parallel lines.

Painted on the roadway leading to a dangerous, obscure curve, drivers tend to reduce their speed before encountering the curve, presumably because the pattern made the road seem narrower, this will be an application area.

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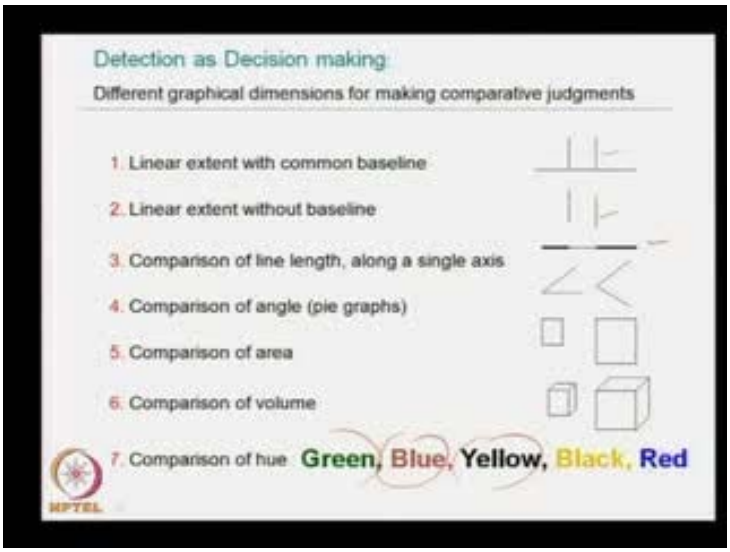

So, in this case different things, that linear context of common baseline it gives a continuity; linear context without baseline; comparison of line length, along a single axis; comparison of angle that is pie graphs and etcetera, then large, bigger and smaller; comparison of area; comparison of value and volume; comparison of the hue, like this way if we write green in green color, blue in different color, and yellow in different color like this way, then what impact it gives while reading this.

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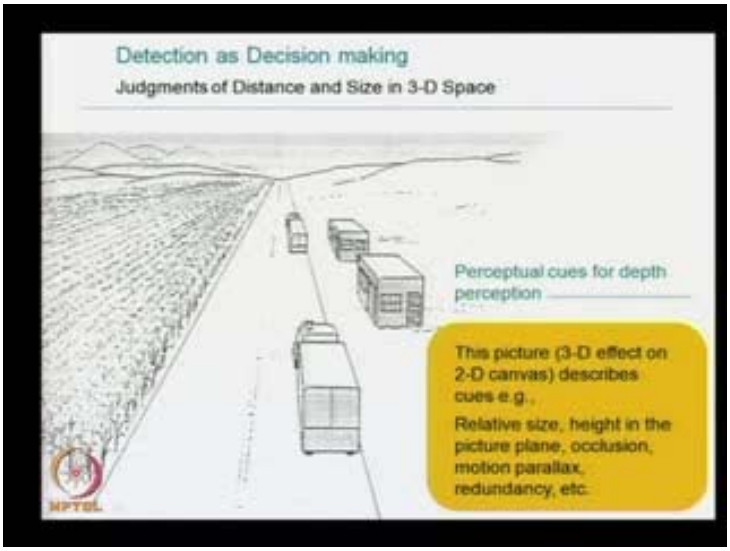

Like depth 3-D perception, like this way the perceptual cues of depth perception; this picture 3-D effect on 2-D canvas describes cues, as for example, relative size, height in the picture plane, occlusion, motion parallax, and redundancy, etcetera.

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Now, with this we can say that our role to use the above human information, how best we use in design activity, that is our role and so we need to understand this aspects and righteously we have to use it in our design dimensions.

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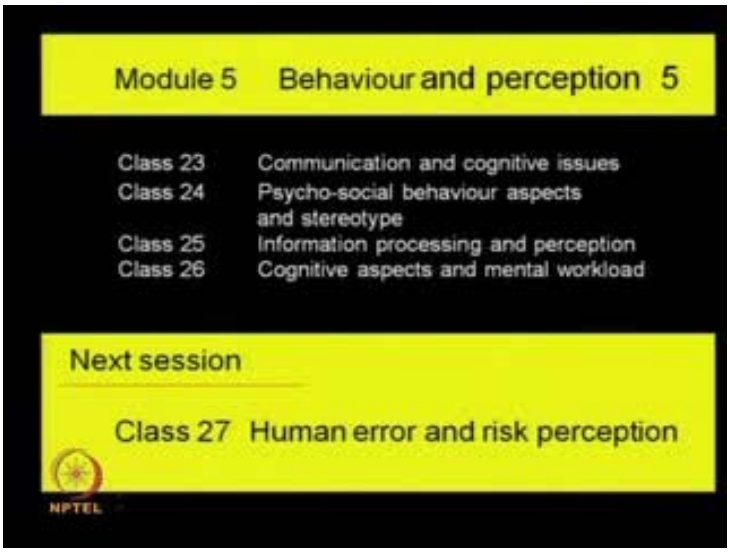

So, with this we are concluding today's session, that is, the cognitive aspect and mental workload and its design relevance's in the next session. The class number 27, we will discuss human error and risk perception and its design applications; so, with this we are concluding today's session, see you next.

Thank you.