

# **Visual Perception: Objects and Scenes**

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## Visual Interpolation

In order to cope with occlusion which is intrinsic property of 3D world, the visual system has evolved mechanism called **visual interpolation**. This process enables us to infer the nature of hidden parts given visible ones. By nature, however, this mechanism is not perfect because it is only based on "guess" at most. However, as one can notice if one imagines the world without that conjecture, it is essential part of our visual system that make our visual system much more powerful than the one without it. Visual interpolation does not include visual experiences of completed surface, but only perceptual knowledge about its properties. Here we will investigate three kinds of visual interpolation; visual completion, illusory contours and perceived transparency.

### Visual Completion

**Visual completion** is the phenomenon that the visual system automatically perceives partly occluded surface and objects as whole and complete. The property it can guess includes shape, texture and color. Figure 1 shows an example of shape completion. While it is completely random that how we complete 3-quarter circle occlude by the square, most people naturally perceive that the actual configuration is B, rather than C or D. There are three main explanations about how this is possible.

The first one is figural familiarity theory, which many people can almost intuitively come up with. People complete partly occluded figures according to the most frequently encountered shape that is compatible with the visible stimulus information. A problem with this theory is

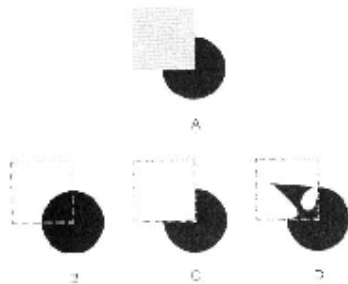


Figure 1

that we also can complete the objects that we have never seen before quite well. This is shown in first image of Figure. However, this counterexample does not falsify the theory because it can nicely explain many case of visual completion. The most obvious example is shown at second image of Figure 2. Although it is equally possible to complete the occluded letter to make it P, B or R, most people perceive it as R since WORD is the most familiar English word rather than WOBD or WOPD. Therefore we can assume that this theory

is roughly correct, but need some complementary theory to explain exceptional cases. This is done by the next theory.



Figure 2

According to the **figural simplicity theory**, visual completion is done in the way that results in the "simplest" perceived figures. This theory successfully explains the first case of Figure 2; the arbitrary shape occluded by the black square is completed just by smoothly connecting two points at the edges. The problem with this theory, however, is that it is ambiguous to define what is "simple" (or "good"). For example, let's try to complete the image A in Figure 3. If we define goodness just by finding the one with maximum number of bilateral symmetry, image C will be the best completion because it has two axis of symmetry. However, we are likely to complete the figure to be image B. If we assume that minimum number of sides means the "best" completion, the common completion of B can be explained. This means that figural simplicity theory is very hard to be falsified. But this does not mean that it is also as meaningful as it is powerful, because the theory can hardly predict arbitrary visual completion.

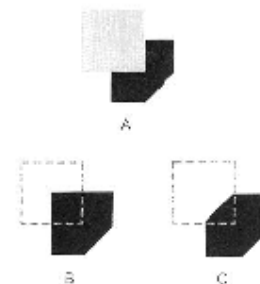
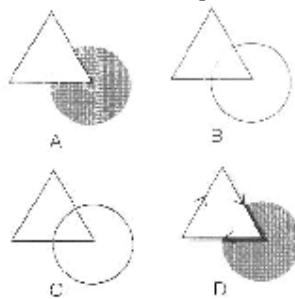


Figure 3

The last theory is **ecological constraint theory**. This theory tries to explain visual completion by directly focusing on ecological evidence of occluded contours. For example, occlusion take place, the involved objects typically form intersections known as T-junction. In addition, the continuous contour is interpreted as the closer edge. The assumption for this theory to explain visual

completion is that occluded edge is always connected to another occluded edge. One of the theories based on ecological constraint theory is **relatability theory**. It is formulated by following four steps, along with Figure 4.

1. Edge discontinuities are necessary, but not sufficient condition for visual completion.
2. Completed contours are perceived when the edges leading into discontinuities are relatable to others.
3. A new perceptual unit is formed when completed edges form an enclosed area.
4. Units are assigned positions in depth based on available depth information.



**Figure 4**

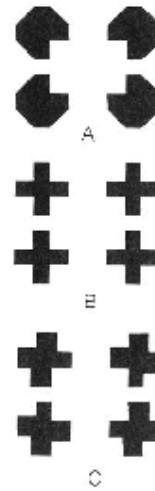
The next form of visual interpolation we consider is **illusory contours**. This is easily observed in Figure 5, where we perceive an illusory equilateral triangle occluding three lines and circles. Notice that this illusory is not something we consciously conjecture as it exists there, but perceived as a visual stimulus; white triangle seems to be brighter than background white.



**Figure 5**

One interesting property of illusory contours is that it is generally accompanied by visual completion of the inducing element. For example, in Figure 5, we can also perceive visual completion of three circles that are partially occluded by white triangle.

In fact, this is intrinsic property of illusory contours and visual completion in a sense that each phenomenon can be interpreted as two different representation of same visual mechanism. Figure 6 illustrates the close relationship of these two phenomena. When we look at A, normally we perceive an illusory white rectangle and for octagons that is completed by the partially occluded portions.



**Figure 6**

However, when we move to B, even there are the same local contours that induced the illusion in A, we do not naturally perceive the rectangle. This is because that, in A, it is natural to perceive the four inducing objects as visual completion of octagons, while, in B, it is not owing to the symmetry of crosses. However, it is not only about symmetry because, when we see C, even though the inducing objects have symmetry, it is still hard to perceive illusory contours.

The distinction of illusory contours and visual completion becomes more blurry when we observe Figure 7. Image A is usually perceived to include central white triangle with illusory contours and three black circles with visual completion. However, although it is quite hard to perceive, it is possible to interpret the image in a way that there is a white triangle on black background and white paper with three holes on the top of it.



**Figure 7**

The last type of visual interpolation we consider is **perceived transparency**; the perception of an object as being viewed through a closer translucent object. The translucent condition means that observer can acquire information about two or more surfaces with single visual stimulus in the same direction from observer's viewpoint.

There are two conditions that must be satisfied for perceived transparency to be detected; spatial and color conditions. This is shown in Figure 8. In A, the reflectance edge on the opaque surface coincides with translucent surface. Moreover, the

portion of rectangle that is overlapped with (supposed) opaque surface have the same color of one that is produced by mixing original color and translucent one. Other images, which are B, C, D and E, violate one of these conditions and do not induce perceived transparency.

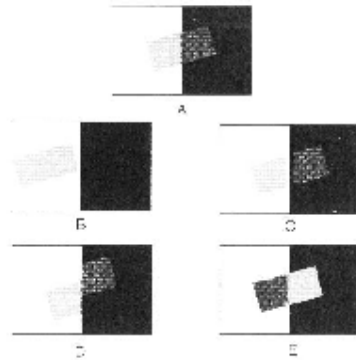


Figure 8

### Multistability

Most of natural scenes are perceived as a single well-determined perception. However, for certain carefully chosen examples, two or more organizations of a single stimulus alternatively take place. One of such examples is given in Figure 9, which is known as Necker cube. The famous vase/faces image is also one of them. They are examples of **multistable perception**: perceptions that spontaneously alternate among two or three different interpretation. Here we consider one of most widely accepted theory to explain multistability; **neural fatigue hypothesis**. Prior to that, we introduced neural network model that is used as a framework of the theory.

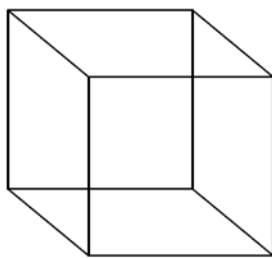


Figure 9

### Network Model

Throughout the exploration on multistability, we work with one grand running example; Necker cube. Figure 10 illustrates the neural network model of Necker cube. The network consists of two subnetworks, each of which corresponds to two different interpretation of Necker cube. One interpretation is top-right view and the other is bottom-left view. Each subnetwork consists of eight neurons (or group of neurons) that have a single function in regard of perception of Necker

cube, and are represented as nodes in Figure 10. Labels in the node represent 3-D interpretation of the corresponding node: front or back (F or B), upper or lower (U or L), and left or right (L or R). For example, "BUL" indicates the back upper-left corner of the cube.

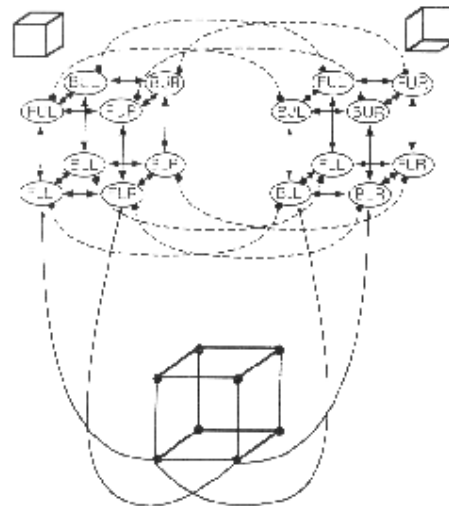


Figure 10

The eight vertices are connected to two nodes, each of which belongs to different subnetwork: the nodes that represent the 3-D locations. The solid line means this connection is excitatory input to the node it points. One assumption of this model (and of network fatigue theory) is that different interpretations are represented by different patterns of neural activity. That is, in this case, two different interpretations of Necker cube according to the depth interpretation are caused when different subnetwork is activated.

Besides the solid line between nodes and vertices, we can also find mutual excitatory links between pairs of node in the same subnetworks. This is when **cooperation** arises. As a result of these connections, activation in one node tends to increase activation in the other. That is, if one node of given interpretation is activated, this activation spreads first to its nearest neighbors and eventually to all the nodes within its subnetwork. This mechanism therefore makes each subnetwork function as a single cohesive unit; the final states will saturate into a state in which either all its units are active or none of them are.

**Competition** arises when two nodes are connected by mutually inhibitory links, which are represented by dashed connections. This connection is plays the key role in multistability. We can see in the Necker cube example that these links are present between corresponding nodes in different subnetworks. This means that the more active node of such a pair reduces the activation of the other node of the pair more than the other inhibits it. Finally, as a result,

only the more active unit is firing and the other becomes virtually inactive. Because of this property mutually inhibitory link is also known as winner-take-all network.

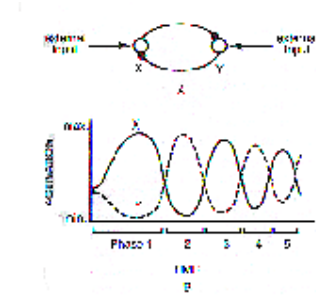
Given the network model in Figure 10 and the semantics of links, we can infer that Necker cube can give rise to two different and mutually exclusive interpretations. When one subnetwork is activated, the other must be inactive due to the mutual inhibitory links: that's why we do not perceive two interpretations at the same time.

Neural Fatigue theory

The point of **neural fatigue theory** is simple: after some period of stimulation, neurons tend to fire less vigorously. Physiologically, this happens because the biochemical resources that the cell needs to continue firing become depleted after certain time. This theory, when combined with the network model we introduced, explains for the multistability.

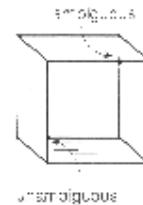
Let's say one of two interpretations dominates the visual system at a certain moment. By some minutes elapse, the neurons in the dominating subnetwork will grow tired and begin to fire less. The fact that these nodes are connected by mutual inhibitory links causes that the neurons in the other subnetwork will fire more than before. This successively inhibits the firing of the dominating neurons, resulting in acceleration of decrease and increase of firing in each subnetwork. Finally, at some point, the firing of the non-dominating neurons exceeds the dominating ones and the perception change to the other one. Same phenomenon happens after some period of time, resulting in another switch of dominance. This alternation continues indefinitely, at least in theory.

Data from experiments on the perception of ambiguous figures supports several predictions derived from neural fatigue theory. For example, the rate of alternation between the two interpretations accelerates over time, as shown in Figure 11. This acceleration should occur if the fatigue that has built up during extended perception of one interpretation is not fully recovered during the perception of the other interpretation. Then, after another switch takes place, the level of activation of dominating neurons decrease more quickly than it did on the previous dominating period.



**Figure 11**

Although the neural fatigue theory seems to be well formulated one and successfully explains important experimental facts, it is not perfect. In another experiment on multistable perception, the reversals are caused by eye movements to different fixation point. Figure 12 illustrates one example. When the subjects are asked to consciously fix the focus on certain vertex, only one interpretation is mostly reported. Moreover, even when the other perception dominates, when the subject tries to focus on the vertex, interpretation could be easily shifted. Such experiments on eye fixation and the role of instructions imply that there is something more than neural fatigue theory.



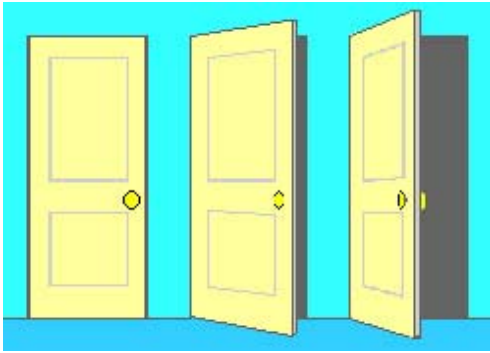
**Figure 12**

## Visual Perceivable Properties

The global properties of object that we perceive when we see object are size, shape, orientation, and position. In everyday experiences, the visual system is able to achieve veridical perception of object properties under many, but by no means all, viewing conditions. This section will describe these properties, how visual system can perceive and in what condition can cause illusions.

### Shape

Shape is the most complex of all visually perceivable properties. It includes all other spatial properties such as size, orientation, and position. There is no accepted theory of what shape is or how shape perception occurs. This section will provide shape perception from the restricted viewpoint of shape constancy.



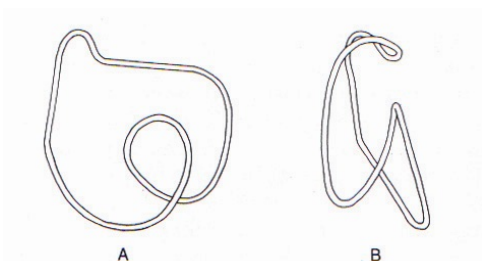
**Figure 13** Doors at different slant look the same as door in the frontal plane.

### Shape Constancy

Shape Constancy is that we perceive the same object as having the same shape when observed from different viewpoints. When viewing perspective changes, projected image on retina is changed.

We can consider how we expect changes in perspective to affect shape constancy by looking at case of 2-D planer figures and objects made of thin wire. With different source of depth information, we can perceive shape and size differently. If accurate depth information is available from absolute sources, such as accommodation and convergence, we can completely recover both object's shape and its size. If accurate depth information is available from quantitative source, such as binocular disparity, its shape can be recovered but not size. If only qualitative depth information, such as edge interpretation, is available, we can recover neither shape nor size without invoking additional assumptions.

In experiment from Rock and DiVita, they observe shape perception on wire objects and solid 3-D clay objects and result show that shape constancy for wire objects and 3-D objects are poor. Perception of shape is strongly influenced by the quantitative changes in the projected shape on retina. Shape constancy in distant viewing conditions should be worse than in near viewing conditions.



**Figure 14** Wire objects in Rock and DiVita's experiment.



**Figure 15** A solid 3-D objects in Rock and DiVita's experiment.

However, from everyday experience, we have reasonably well shape constancy of objects in different perspectives and recognize them. There are some possibilities that make it different than Rock's experiment. First, we continuously moving perspective from one view to another view instead of drastically change in Rock's experiment. Second, we correlated shape constancy with object's identity which we can recognize familiar object very well but not a novel object. Last, objects with axes of symmetry or elongation make it easier for shape constancy since we can distinguish some features such as front or back side.

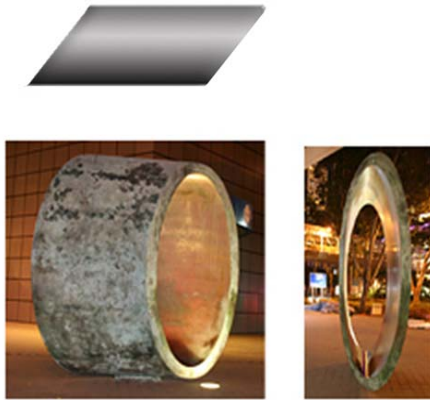


**Figure 16** A familiar object in multiple perspective. We can perform shape constancy well.

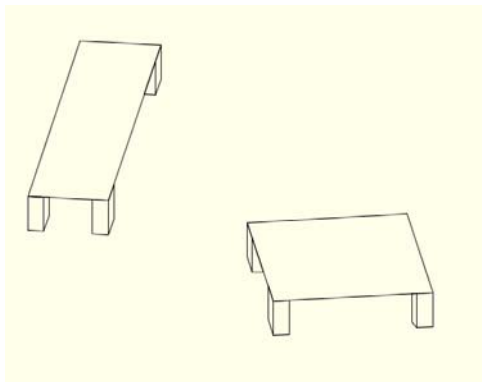
### Shape Illusions

There are some viewing conditions that we cannot perceive accurately on shape constancy.

- **Ellipse / circle illusion:** when there is not enough good depth information, we tend to perceive object as symmetry. For example, we perceive an ellipse as circle or trapezoid as square.
- **Ames room:** a trapezoidal room that appears rectangular when it is viewed from a particular station point.
- **The Shepard illusion:** results from the same mechanisms that normally produce shape constancy from pictorial depth information.
- **The Ponzo illusion:** also related to depth interpretation and shape constancy mechanisms.



**Figure 17** This object shows Ellipse / circle illusion.



**Figure 18** The Shepard illusion. Table on left appears to be longer while both tables have same shapes on retina images

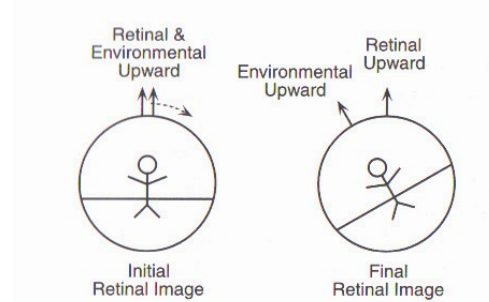
### Orientation

Orientation with respect to the environment is an important property of objects that we generally perceive constant despite changes in viewing conditions. We perceive objects that aligned with gravity as vertical while objects that parallel to the horizon as horizontal.

### Orientation Constancy

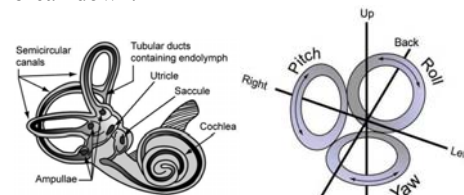
The perceived orientation of objects in the environment does not appear to change when we tilt our heads, even though their retinal images rotate in the opposite direction. To perceive orientation constancy, the visual system takes head orientation and the object's retinal orientation into account. The relation between object's environmental orientation ( $O_{\text{object}}$ ), its image orientation with respect to the long axis of the head ( $O_{\text{image}}$ ), and the observer's head orientation with respect to gravity ( $O_{\text{head}}$ ) can be expressed by the equation

$$O_{\text{object}} = O_{\text{image}} + O_{\text{head}}$$



**Figure 19** The objects' projected image on retina rotate in opposite direction when we tilt our heads, but we perceive orientation constancy.

The primary source of head orientation comes from the **proprioceptive system** or the **vestibular system** which is the principle organ of balance. The vestibular system contains three semi-circular canals and two fluid-filled sacs that provide kinesthetic feedback. If the vestibular system worked perfectly and its output were perfectly integrated with retinal orientations, the position constancy would also be perfect. However if the angle of head tilts is too great and no visual surrounding context reference, such as an orientation of  $90^\circ$  in a dark room in a dark room, the position constancy will break down.



**Figure 20** The Vestibular System - semicircular canals and otolith organs

**Figure 20** The Vestibular System with three semi-circular canals.

### Orientation Illusions

- **Frames of Reference:** Tilted room is not structure horizontally. Your visual perception is reference by the of visual structure of the room not the gravitational.
- **Rod-and-frame effect:** the contextual effect due to a surrounding rectangular frame can effect your perception of object inside frame. In the dark room subjects made systematic errors of setting a luminous rod inside a luminous rectangle frame.
- **Geometric Illusions:** Zollner illusion is the illusion that perceive the parallel vertical lines converge and diverge because we perceive vertical lines as relational contrast to the orientation of the many shot oblique lines. The contrast illusions are another example of geometric illusions. We perceive the middle grating of two circle as slightly oblique and non



parallel because of the context influence of the surrounding background grating.

### Position

Position can be perceived at relative to the observer's body or relative to various objects in the environment. This section will cover on perception of an object's position relative to the observers, called its **egocentric position**. The egocentric position is specified in terms of its **polar coordinates** which are the radial direction and the distance from observer to object.

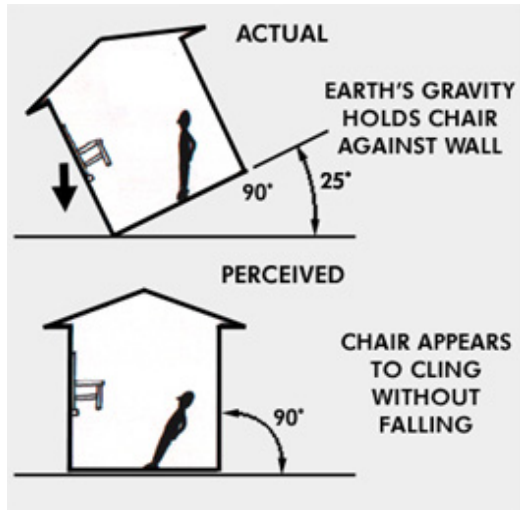


Figure 21 Frames of Reference: tilted room.

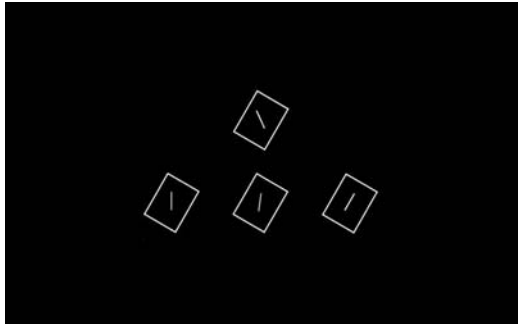


Figure 22 Rod-and-frame effect.

The direction of an object depends on its retinal position and the direction in which the observer's eye are pointed. These quantities can be expressed as a vector: the environmental position of the object with respect to egocentric "straight ahead" ( $P_{\text{object}}$ ), the image position to the object's projection with respect to the center of the retina ( $P_{\text{image}}$ ), and the position of the eye with respect to the egocentric straight ahead ( $P_{\text{eye}}$ ), which can be expressed as the following vector equation:

$$P_{\text{object}} = P_{\text{image}} + P_{\text{eye}}$$

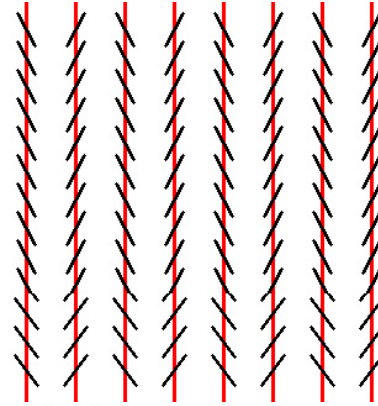


Figure 23 Zollner illusion.

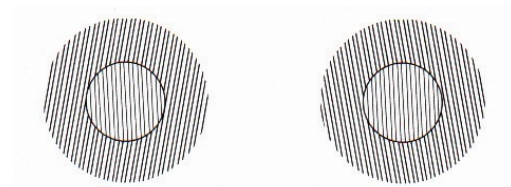


Figure 24 The contrast illusions.

### Position Constancy

Position Constancy is the visual system ability to perceive unmoving objects as stationary. The visual system can perceive position constancy by computing vector addition of displacements of each vector:  $\Delta P_{\text{image}}$  and  $\Delta P_{\text{eye}}$ . We present  $\Delta$  as the change in position of object in environmental direction.

$$\Delta P_{\text{object}} = \Delta P_{\text{image}} + \Delta P_{\text{eye}}$$

**Indirect Theories of Position Constancy:** the visual system uses information of eye direction to correct object position by adding displacement vectors. There are two possibilities.

- **Afferent theory** (input theory) which eyes send signal from eye muscles to brain for computing object position.
- **Efferent copy theory** (output theory) brain send a duplicate copy of command of eye movement to visual system.

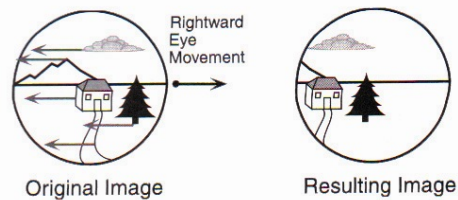


Figure 25 Images on retina rotate opposite direction as our heads.

Experiments from Helmholtz that move the eye passively supported the efferent copy theory by



showing position illusion when eye was moved without signal sending from brain.

**Direct Theories of Position Constancy:** the position constancy is based entirely on the structure of optical flow. Optic flow in position constancy is performed by subtracting the common motion vector field from the whole optical flow to review the true position of object.

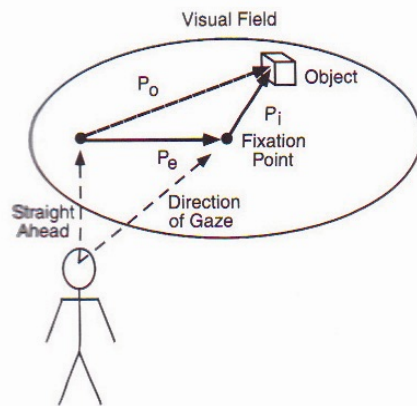


Figure 26 Position as an addition of vectors.

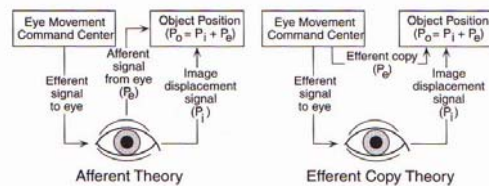


Figure 27 Afferent Theory and Efferent Copy Theory.

### Position Illusions

We can perceive relative position of object very well. However in some situation position constancy has some error.

- **Roelofs' effect:** Roelofs showed subjects a luminous rectangular frame in a dark environment and asked them to tell the straight ahead direction. He found that if frame was placed directly in front of subjects, they can tell correctly direction, but if it was shifted to one side of straight ahead, subjects was induced by center of frame and told few degree toward center of a frame. This effect is similar to rod-and-frame illusions but the effect degree is less.

### Perceptual adaptation

Our visual systems compute object's properties such as shape, orientation, and position by using retina images with extra information, such as distance information and head orientation as described above. In this section, we have a question that what will happen if we change retina images such as shifting image on retina in some degrees or

inverting image projected into retina to make it uninverting.

The different between perceptual adaptation and sensory adaptation is that sensory adaptation is a short term change in perception that occurs automatically from normal but prolonged stimulation in a single sensory modality, but perceptual adaptation is a semi-permanent change in perception that reduce sensory discrepancies that have been caused by stimulus transformations.

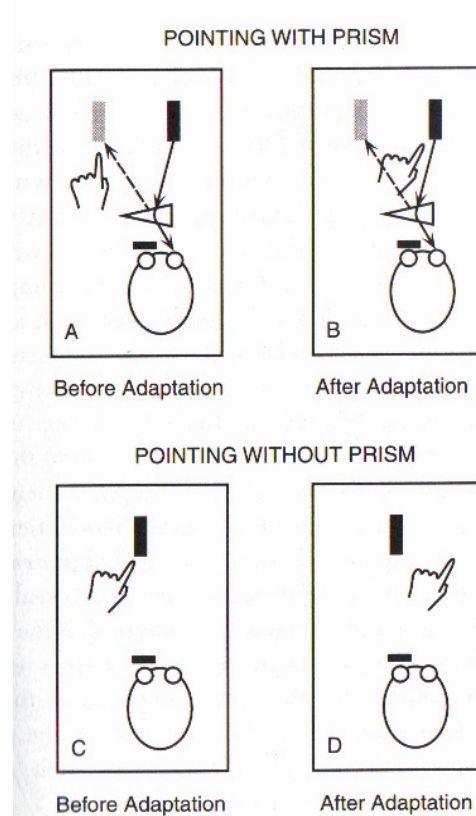


Figure 28

Helmholtz investigated perceptual adaptation by wearing spectacles containing prisms that shifted the image of the visible world about 11° to the side. He found that the world visualization did not look different but when he tried to reach object, he missed it. The reaching error could quickly overcome by practicing with feedback by seeing his hands as well as the objects. He also found that when perceptual adaptation took place then removed spectacle, it caused the negative aftereffect, which he could not reach object correctly. It appears to rule out the possibility that adaptation is the result of a conscious correction by the observer.

There were few experiments for perceptual

adaptation by placing a prism that uninverted the retinal image. The first one was conducted by George Malcolm Stratton. He wore goggles that allow him to see the world only through a prism mounted inside a tube in front of his right eye, causing his retinal image to be upright with respect to the world. His left eye was completely covered. He wore this goggles for eight days except at night, which he covered his both eyes.

At first, he found severe difficulties about his daily activities such as walk, dress himself, eat, read and write. He found that when he closed his eyes he could do activities better. After continuous wearing goggles for several days, he began to adapt to visual transformation. He could do daily activities such as read and write. He reported that he came to unaware of the world's being upside-down. However, he appears never to have really achieved complete perceptual adaptation.

In addition, he found that after he removed the goggles, there was no negative aftereffect: the world did not appear upside-down. It can be objected that he did not wear the goggles for long enough.

Kohler repeated Stratton's experiment for longer periods of time with improved methods for inverting the image. He could have impressive motion adaptation. He could ride a bicycle and ski.

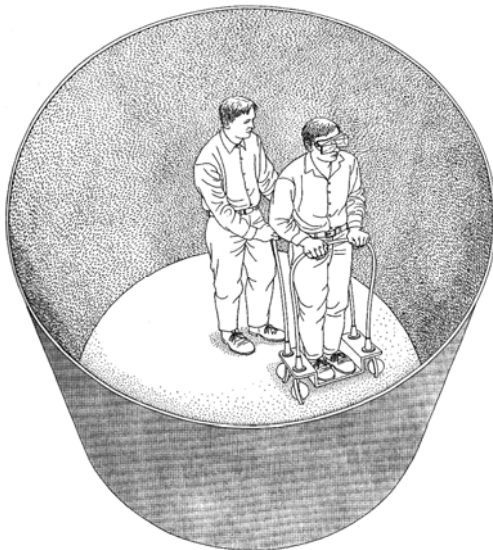


Figure 29

Psychologist Richard Held of M.I.T. investigated adaptation in active versus passive observers. He placed goggles to observers. Half of them were allowed to walk in a large cylinder, whereas other half were moved passively on a wheeled cart. He

found that active observers had adapted more fully to transforming effects on the goggles than the passive observers.

## Parts

Along with size, shape and orientation, perceiving parts is also very important aspect in regard of perceiving objects. In almost every single perception of objects, we give a natural partition to each of them; human consists of head and torso and limbs, tree consists of trunk and leaves and roots, and so on. Here we consider some evidence that we always perceive parts of objects and detail on how we perceive them.

Evidence for perception of parts

The evidence that people naturally perceive parts can be found in a wide range. Regardless of cultures and geological location, almost every language have similar vocabulary that means the same part of certain object; for example, palm, toe, shin, etc. Even when an object with arbitrary shape is given, people generally have a consensus about how they partition the object. This is illustrated in Figure 13.

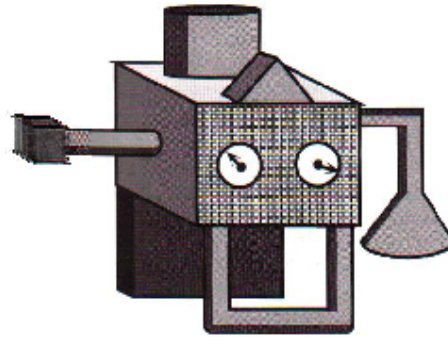


Figure 30

There are also phenomenological demonstrations of perceiving parts. One of them is shown in Figure 14. When we see the staircase with two dots, we usually say that these two dots belong to the same part called "step", even if it is completely possible to say they are not because there is no symmetry or other distinguishing feature.

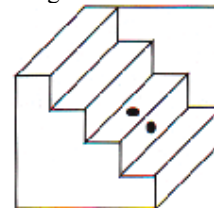


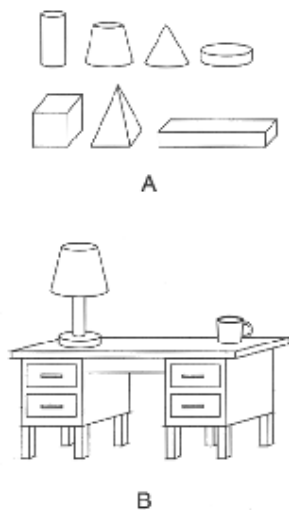
Figure 31

Part Segmentation

Here we pose a question of following: how does the visual system determine what the parts are? There are two ways to go about dividing an object into parts: using shape primitives or boundary rules. The **shape primitive** approach to part

segmentation requires a set of simple, indivisible shapes that compose the complete set of the most basic parts. An arbitrary object can be divided into the primitives. This idea is both attractive and familiar. But, when it comes to 3-D, this idea is not as clear as the one with 2-D. To apply shape primitives effectively to 3-D world, generalized cylinders were introduced by Marr and Binford. The idea was that shapes can be represented as constructions of appropriately sized and shaped cylinders, as illustrated in Figure 15. Provided the primitives are sufficiently general, part segmentation will be possible, even for novel objects.

This approach, however, has several potential problems. One is contextual effects of part segmentation. Experiments showed that the same part will be easily detected in one figural context and not in another. The fact that the same part is harder to be recognized in some cases than in others cannot be explained only with shape primitives.

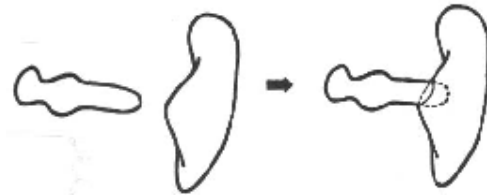


**Figure 32**

Another difficulty with shape primitive approach is that we not only perceive objects as containing parts, but also often perceive those parts as having subparts. For example, we perceive eyes, nose, ears as well as head. This means that the theory of part segmentation should incorporate possibly complex part/whole hierarchy. If there is only one set of primitives, it seems to define only one level of part structure.

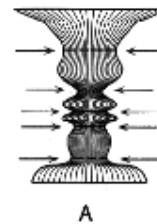
The other major approach to part segmentation is to define a set of general rules that specify where the boundaries lie between parts. In contrast to shape primitive approach, this does not require a set of primitive shapes; therefore it is not necessary to specify the precise nature of the resulting parts beforehand. In this approach, boundaries are primary and parts are by-product.

We introduce two types of **boundary rules**. One is **transversality regularity**, which means that when one object penetrates another, as illustrated in Figure 16, they meet in concave discontinuities: places where their composite surface is not smooth but angles sharply inward toward the interior of the composite object. However, this rule does not apply to many cases of segmentations that have smooth transitions between parts; like human body or wavy surface.

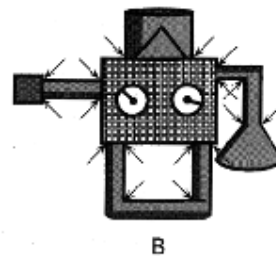


**Figure 33**

The other rule is **deep concavity rule**. It states that a surface should be divided at places where its surface is maximally curved inward (concave), even if these curves are smooth and continuous rather than smooth and continuous rather than discontinuous. An example is shown in Figure 17. A difficulty of this rule is that it merely identifies the points at which cuts should be made to divide an object into parts; it does not say which pairs of these points should be the endpoints of the cuts.



**A**



**B**

**Figure 34**

Global and Local processing

Another question we can pose about part segmentation is that which level has priority in perceptual processing. To put it in other words, are parts perceived before wholes or wholes before parts?

One brilliant experiment shows the **global precedence** in very clear way. Navon presented subjects with hierarchically constructed letters in two kinds of configurations.

In consistent configurations, the global and local

letters were the same, such as a large H made of small H's or a large S made of small S's. In inconsistent configurations, the global and local letters conflicted. Subjects were cued on each trial whether to report the identity of the letter represented at the global or the local level. Response times and accuracies were measured for the four conditions shown in Figure 18.

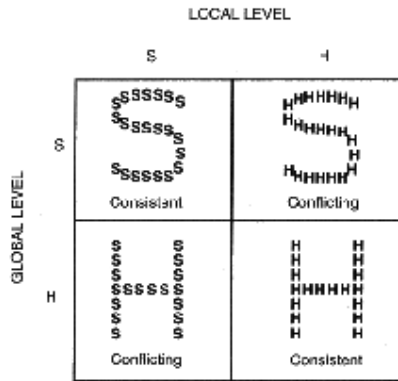


Figure 35

If the global precedence holds, three predictions follow:

1. Global advantage: Responses to global letters should be faster than those to local letters.
2. Global-to-local interferences: Inconsistent global letters should slow responses when subjects attend to the local level, because the local level is perceived only after the global one.
3. Lack of local-to-global interferences: Inconsistent local letters should not slow responses when subjects attend to the global level because level is perceived first.

If the local level is perceived first, the opposite results are predicted: (1) faster responses to the local level, (2) slower responses to inconsistent conditions in the global attention condition, and (3) no slower responses to inconsistent conditions in the local condition. The results of the experiment are shown in Figure 19. They support the predictions of global precedence on all three counts.

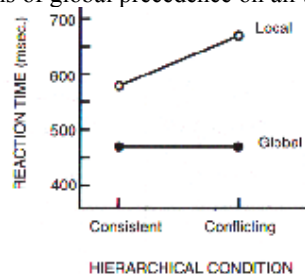


Figure 36

Another experiment is showing interesting physiological aspect of part/whole perception. The study on brain-damaged patients showed that

global and local information is processed differently in the two cerebral hemispheres. That is, there is an advantage for global processing in the right temporal-parietal lobe, whereas there is an advantage for local processing in the left temporal-parietal lobe.

Figure 20 illustrate how the patients copied the same hierarchical target stimulus shown on the left side. Patients with right hemisphere damage are able to reproduce the small letters making up the global letter but are unable to reproduce their global structure, and vice versa for patients with left hemisphere damage. This implies that global information is processed more effectively in the right hemisphere, and local information is processed more effectively in the left hemisphere.



Figure 37