Organizing Objects and Scenes

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The Forest Has Eyes： Can you find 13 faces in this picture?
Bev Doolittle (1984)

Introduction

- The world we perceive consciously is populated with large-scale objects such as people, trees, houses, and cars, not with the edges, bars.
- What is missing thus far is any discussion of large-scale perceptual organization:
  - How all the bits and pieces of visual information are structured into the larger units of perceived objects and their interrelations.
  - Perceptual organization depends on both innate mechanisms and subsequent learning.

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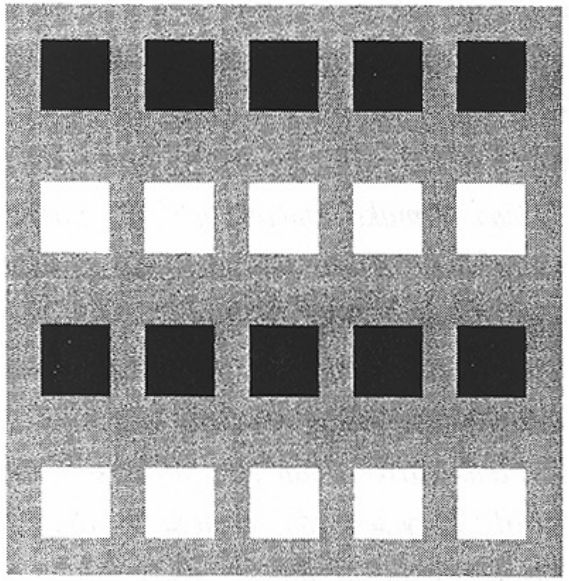
A



B

Why?

- The same information is present in both images.
- The human visual system has evolved to learn how to detect edges, regions, objects, groups, and patterns from the structure of luminance and color in optical images.

The experience error

- The visual system does not have direct access to facts about the environment; it has access only to facts about the image projected onto the retina.
- **The false assumption**: the structure of perceptual experience is somehow directly given in the array of light that falls on the retinal mosaic.
- The structure of the environment is more accurately regarded as the ***result*** of visual perception rather than ***its starting point***.

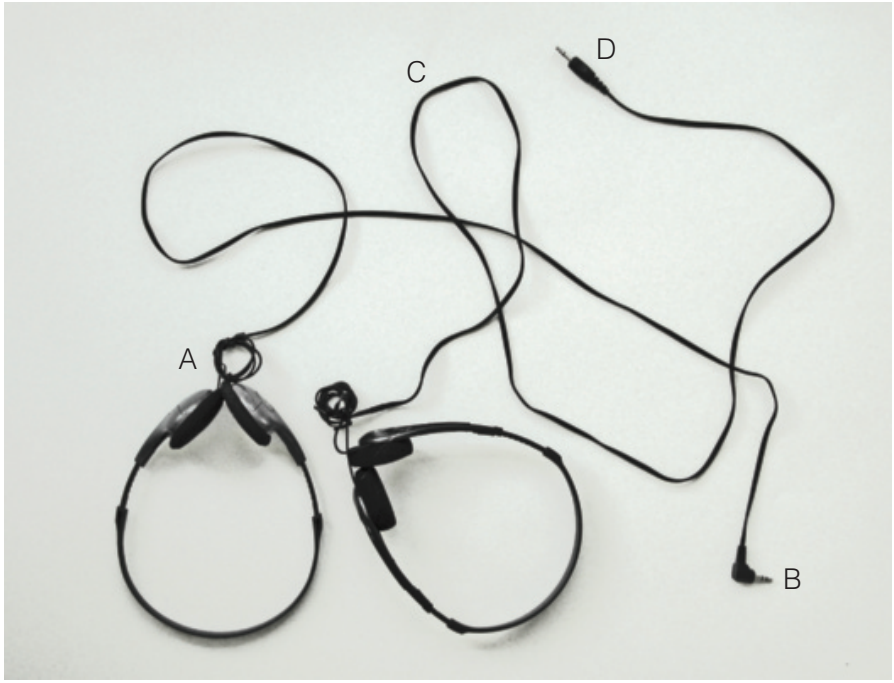
The problem of perceptual organization

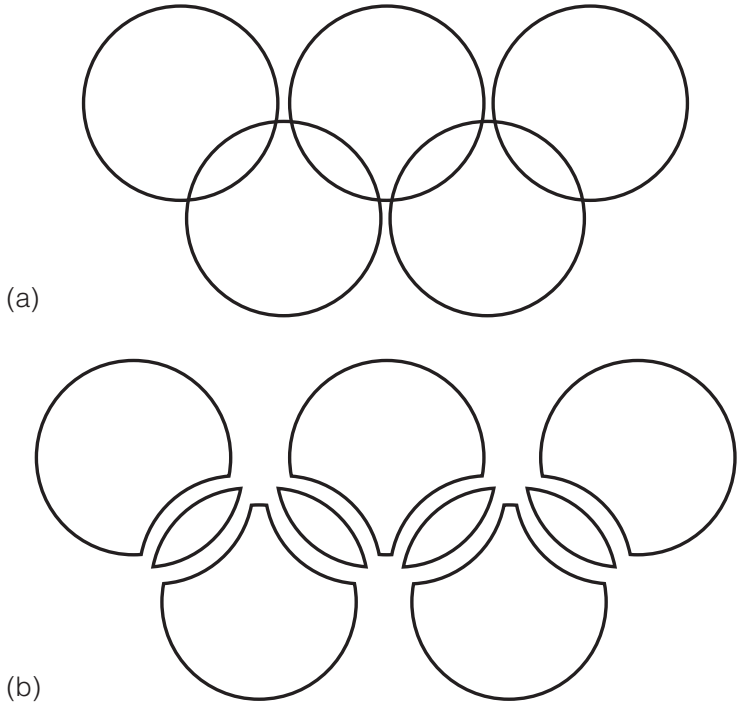
- Structuralism:
  - A simple concatenation of sensory atoms consisting of point-like color sensations.
  - Each atom was defined by a particular retinal position and thought to be independent of all other atoms
  - They were bound together into larger spatial complexes by the process of associative learning.
- Gestalt:
  - Global interactions within the visual nervous system and resulted from the overall structure of visual stimulation itself.

1. Perceptual Grouping

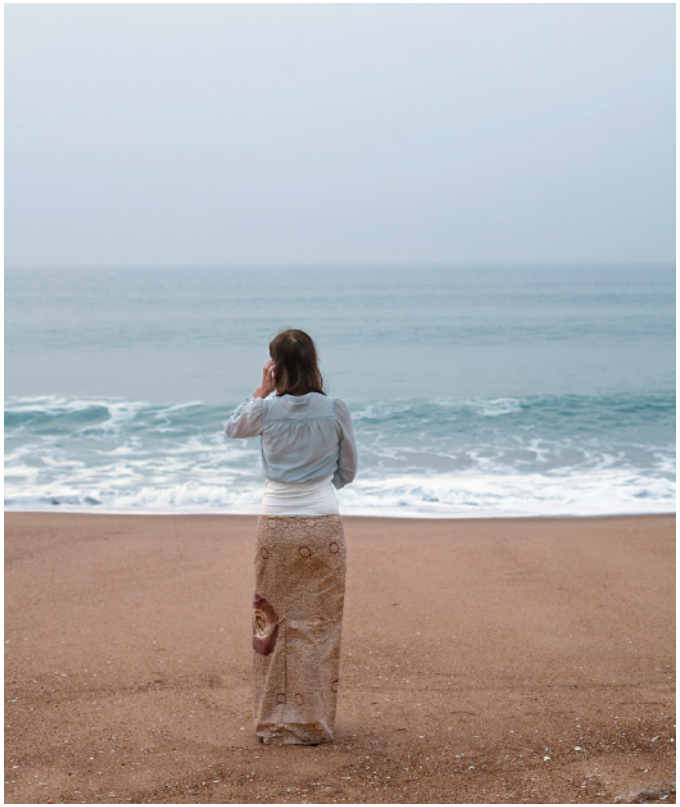
- The factors that affect perceptual grouping
  - How the various elements in a complex display are perceived as “going together” in one’s perceptual experience.
  - Constructing very simple arrays of geometric elements, and varying the stimulus relations among them to determine which ones caused certain elements to be grouped together perceptually.

Examples in life



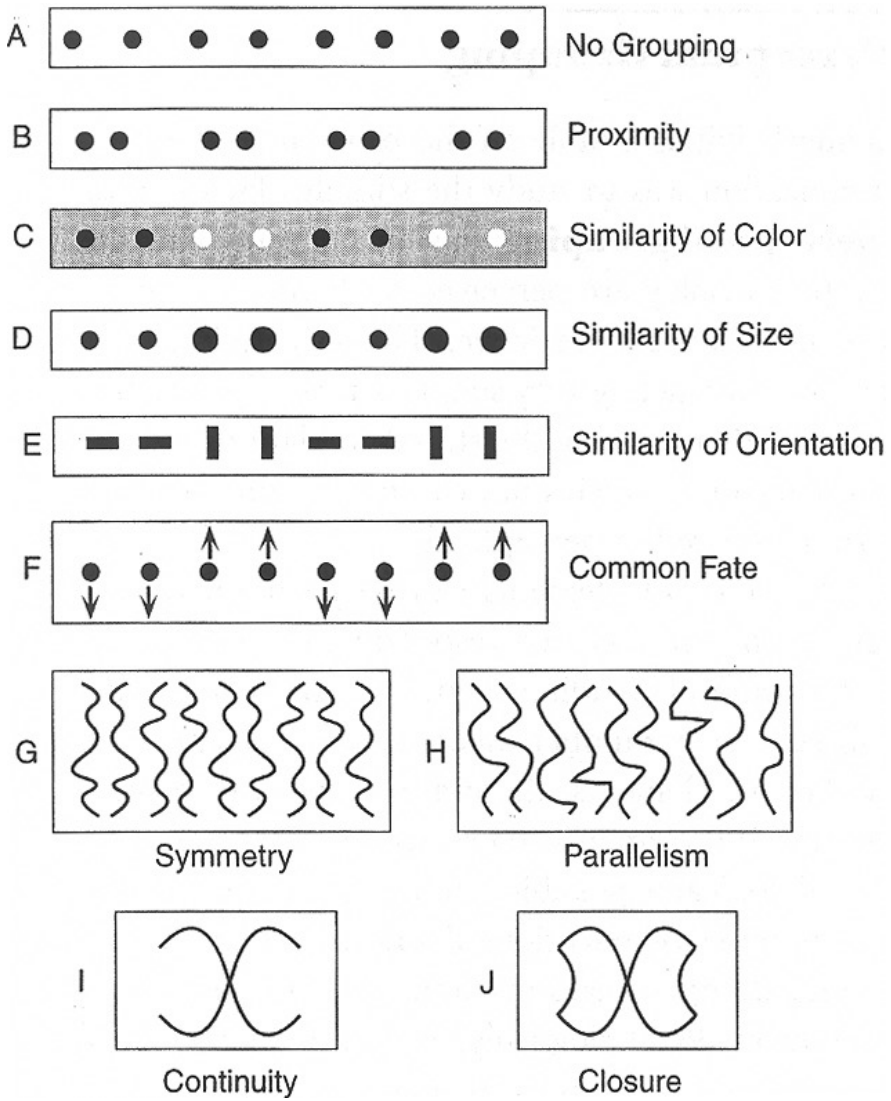


This is usually perceived as five circles, not as the nine shapes.



Similarity of color causes grouping: differently colored areas of the dress are perceptually grouped with the same colors in the scene.

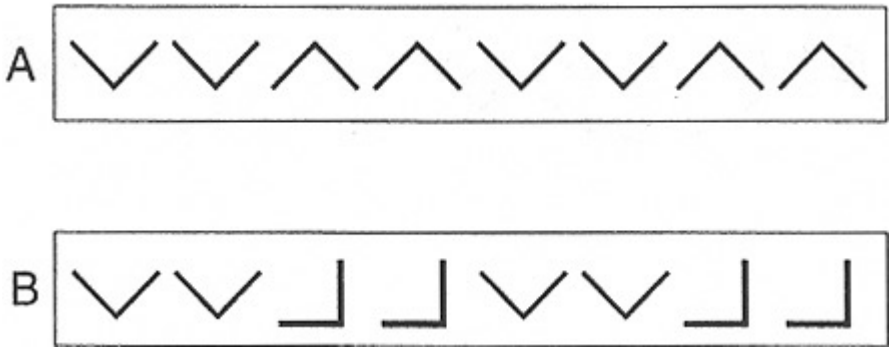
1.1 The Classical Principles of Grouping

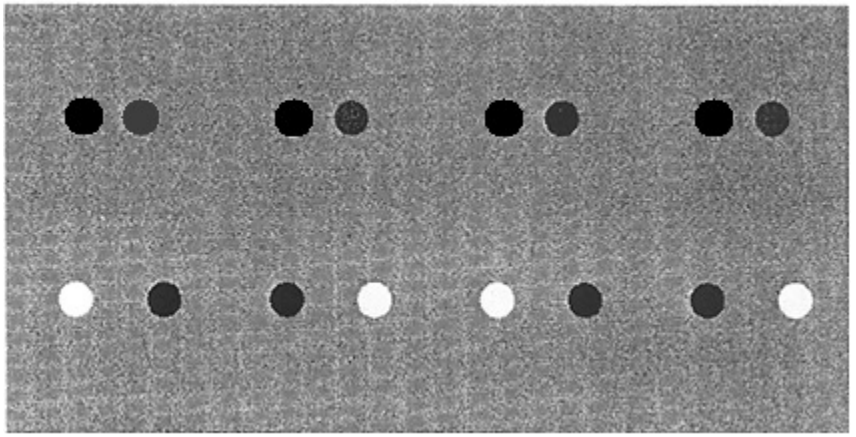


The phenomenological method.

- Proximity: relative closeness
- Similarity: the most similar element tend to be grouped together.
- Common fate: elements that move in the same way tend to be grouped together.
- Continuity: elements that can be seen as smooth continuations of each other tend to be grouped together.
- Closure: elements forming a closed figure tend to be grouped together.

Degrees of grouping

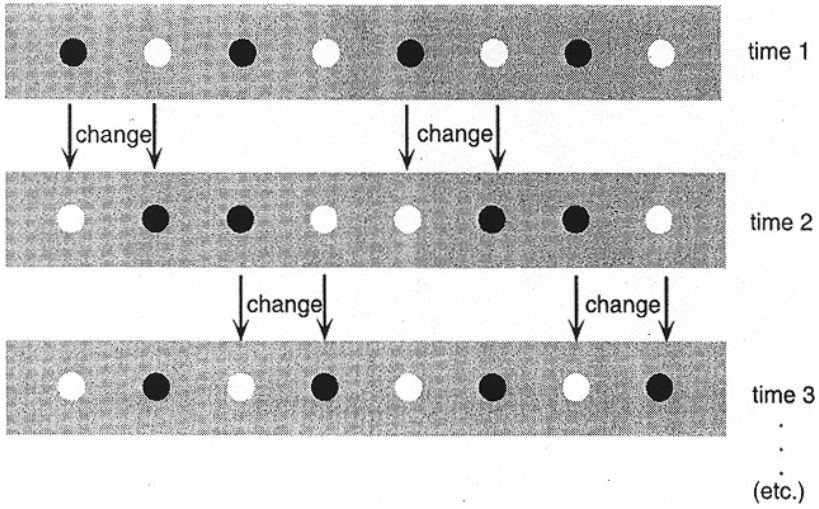




- Not all possible similarities are equally effective.
- The visual system clearly integrates over many grouping factors, but we do not yet understand how it does so.

1.2 New Principles of Grouping

- The principle of ***synchrony***:
  - all else being equal, visual events that occur at the same time will tend to be perceived as going together.



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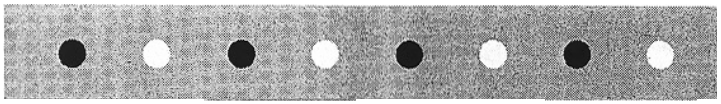
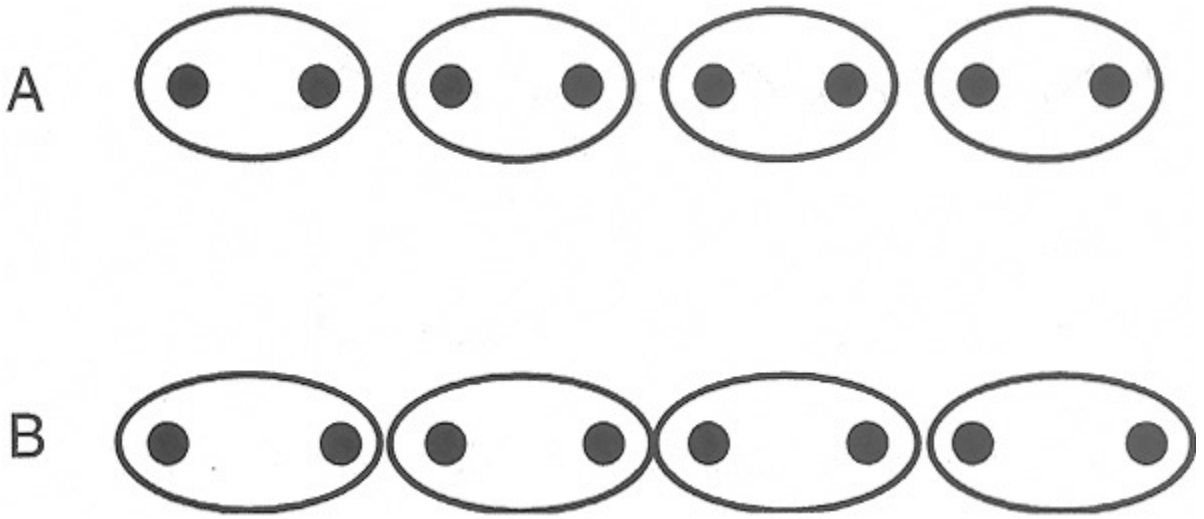
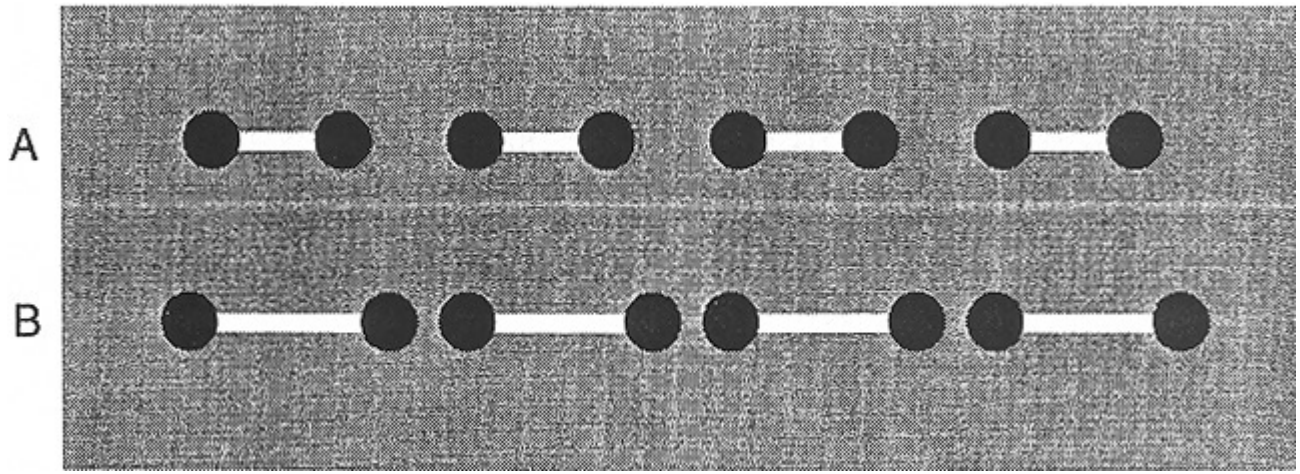


- When alternation rate is about 25 changes/s, strongly grouped into pairs.
- At faster rates, appears to be chaotic flickering of the dots.
- At very slow rates, there is momentary grouping into pairs at the moment of change, but it dissipates during the constant interval between flickers.

- The principle of ***Common region***
  - all else being equal, elements that are located within the same closed region of space will be grouped together.



- The principle of ***Element connectedness***:
  - all else being equal, elements that are connected by other elements tend to be grouped together.



- Parts of objects that are connected are much more closely coupled in their physical behavior than are two nearby objects, no matter how close they may be.
- Result in the perception of a single, unified object consisting of different parts.
- Proximity should be viewed as derivative from connectedness.

1.3 Element aggregations

- The principles of grouping may not be a homogeneous set.

- **Element aggregations**:
  - loose confederations of objects that result from perceptual grouping operations.
  - Proximity, similarity, common region, certain cases of common fate (synchrony)
  - The elements retain a high degree of perceptual independence despite their interrelation within the group.

Unit formation

- **Unit formation**:
  - Perception of a single, perceptually connected object from multiple underlying elements.
  - Element connectedness, good continuation, and other cases of common fate produce this more coherent organization into single unified objects.

Example: Camouflage

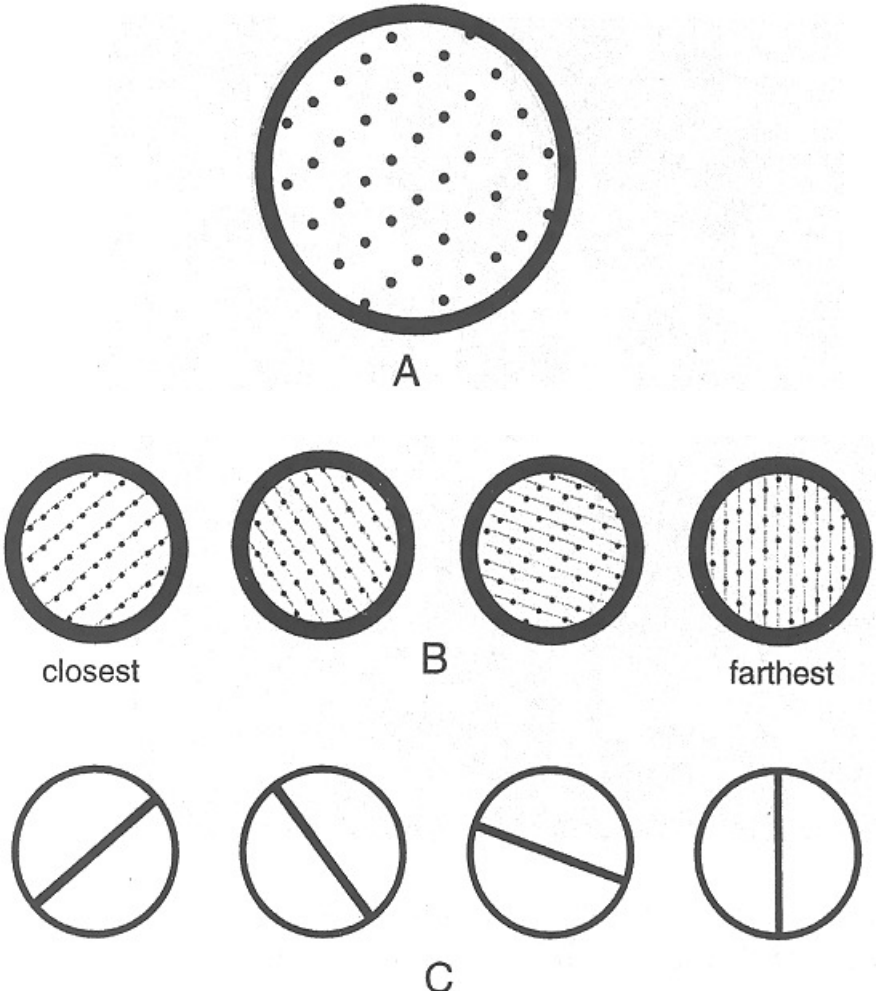
- The goal is to foil grouping processes that would normally make the creature stand out from its environment as a separate object.
  - If the animal's coloration and markings are sufficiently similar to its environment in color, orientation, size, and shape, it will be grouped with the background.
  - But even perfect camouflage is undone by the principle of common fate once it moves.

1.4 Measuring Grouping Effects of Quantitatively

- Gestalt demonstrations of grouping are not adequate to support quantitative theories that specify how multiple factors might be integrated.
- Quantitative methods are needed to enable measurement of the amount or degree of grouping.

Method 1

- **Experiment: relative strength of different groupings**

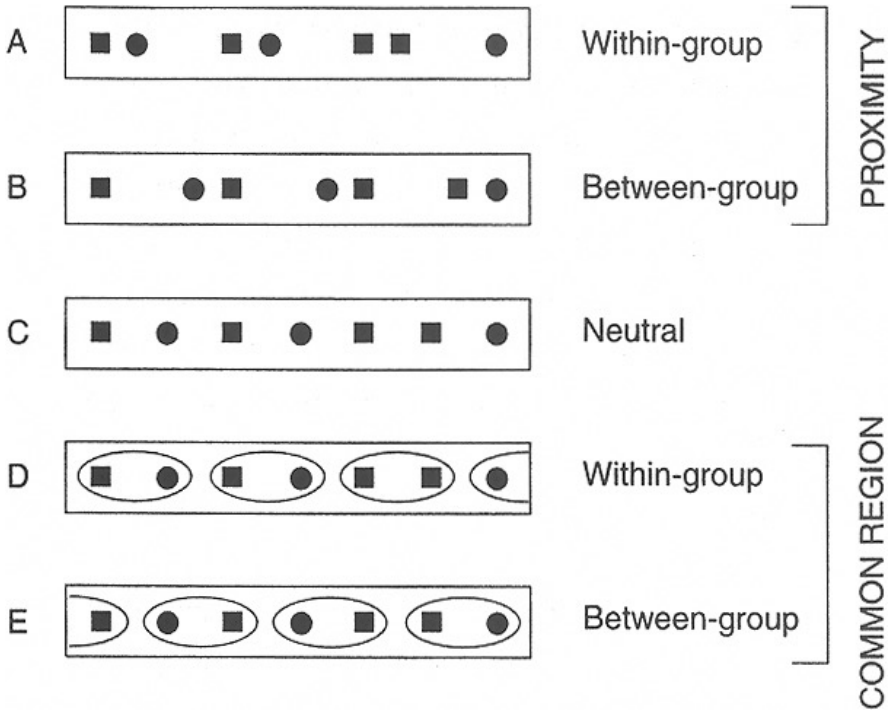


(Kubovy and Wagemans, 1995)

- Showed that the most likely organization is the one in which the dots are ***closest*** together, other organizations being less likely as the spacing between the dots in that orientation increased.
- The data were fit well by a ***model*** in which the attraction between dots decreases exponentially as a function of distance.

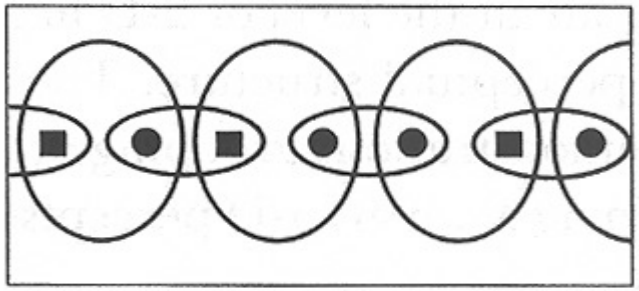
Method 2

- **Repetition discrimination task**:
  - to determine whether the adjacent repeated pair is composed of squares or circles.

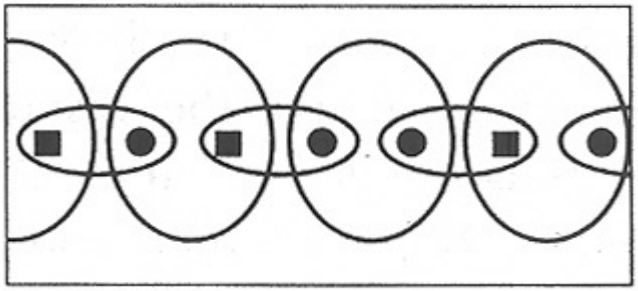


- ***Response times*** are measured in three different conditions:
  - proximity, neutral, common region.
- The results in reaction times.

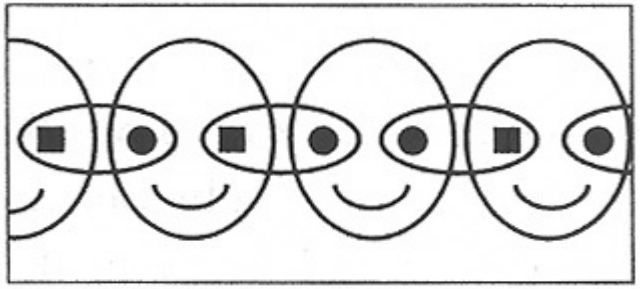
A<B; A=C; D<E



A. Pair within Small Ovals



B. Pair within Large Ovals

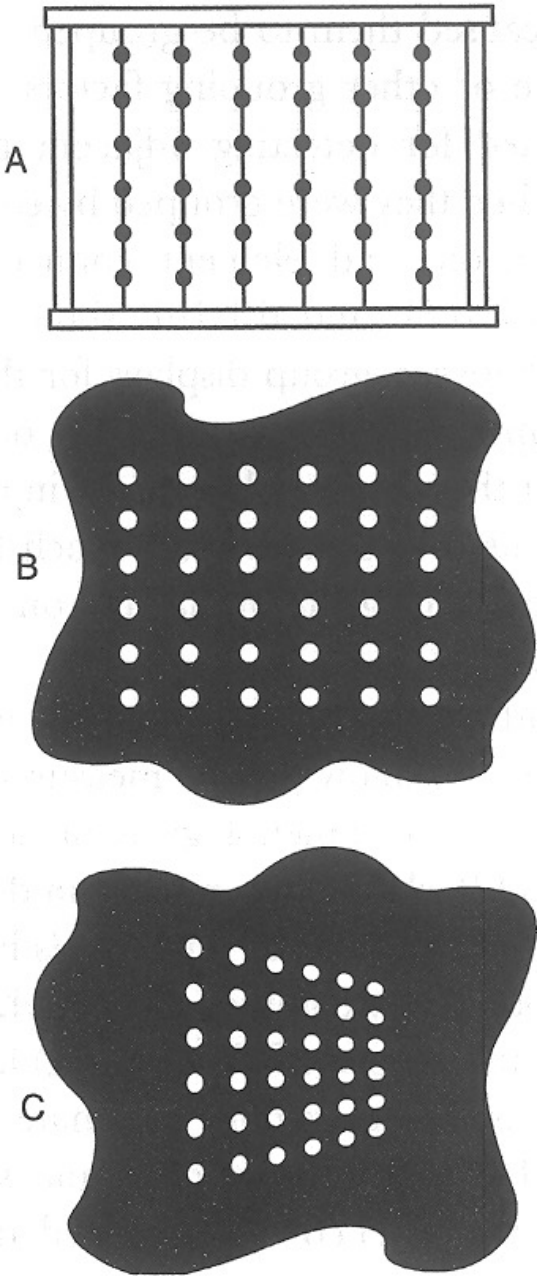


C. Pair within Smiling Faces

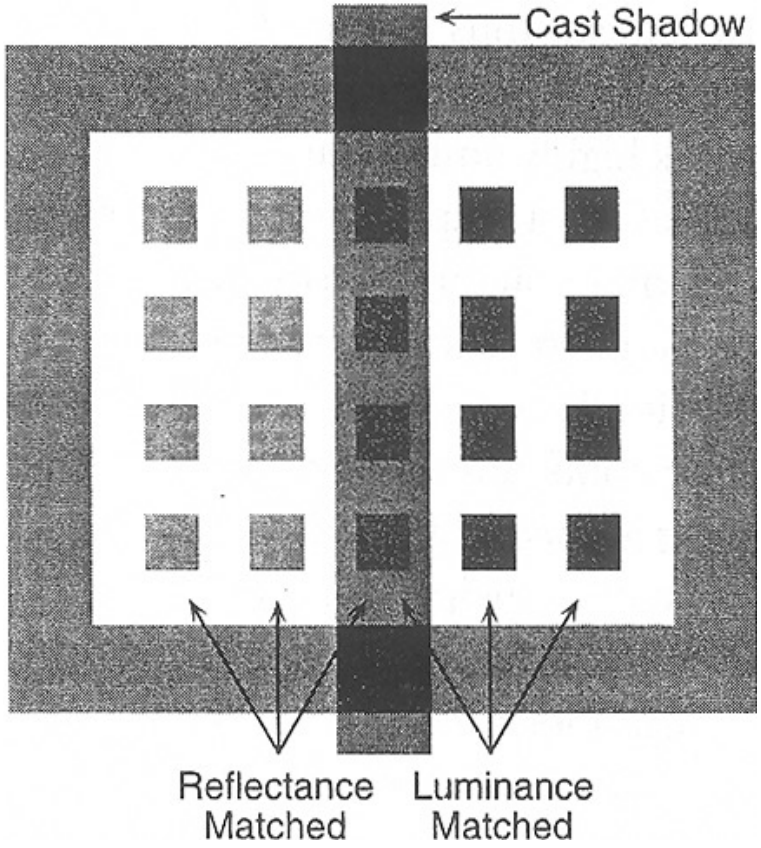
- Whether small or large ovals have the greater effect in grouping by common region when they conflict within the same display.
  - Show that small ovals have a much greater effect than large ovals on response times in this task.
- The dominance of the small ovals persisted even when “smiles” were added to the large ovals to make them into faces.
  - Suggests that grouping is not influenced by the familiarity and meaningfulness of faces, which affect perception fairly late in visual processing.

1.5 Is Grouping an Early or Late Process?

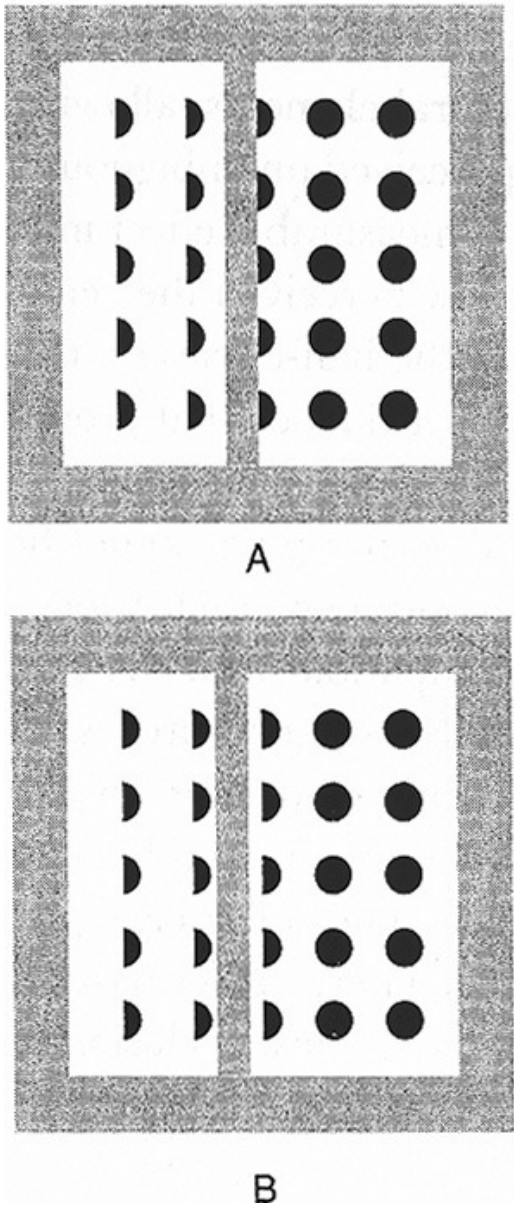
- Where in visual processing grouping occurs?
  - Is it an ***early*** process that works at the level of image structure, or does it work ***later***, after depth information has been extracted and perceptual constancy has been achieved?
- ***The generally accepted view*** has been that organization must occur early to provide higher-level processes with the perceptual units they require as input.
  - The usual Gestalt demonstrations of grouping: ***2-D displays viewed in the frontal plane with homogeneous illumination***.
  - It cannot be determined whether the critical grouping factors operate at the level of ***2-D image structure*** or that of ***3-D perceptual structure***.



- The question was whether the ***distances that govern proximity grouping*** are defined in the 2-D image plane or in perceived 3-D space.
  - When the lattice was slanted in depth, the beads were closer together horizontally.
  - When observers viewed this slanted display with just one eye, they reported the beads to be organized into rows as predicted by retinal proximity.
  - Observers reported the slanted array as organized into vertical columns binocularly.
- **The results supports the *hypothesis* that grouping occurs after stereoscopic depth perception.**



- Whether the central column of elements grouped with the ones on the left or on the right?
  - If grouping were based on relatively early processing of image structure, the central squares would be grouped with the luminance-matched ones on the right.
  - If it were based on relatively late processing after perception of shadows had been achieved, they would group with the reflectance-matched ones on the left.
- The results showed that similarity grouping was governed by the ***perceived lightness*** of the squares rather than by their retinal luminance.



- Whether grouping by shape similarity was determined by the retinal shape of the incomplete elements or by the ***perceived shape*** of completed elements?
- The results showed that grouping is based on similarity of completed shape rather than on retinal shape.

- The effect of Past Experience: if elements have been previously associated in prior viewings, they will tend to be seen as grouped in present situations.
- Suggests that
  - Grouping effects occur as ***late*** as object recognition. The stored ***representation*** of the object itself includes information about how its various parts are grouped and related.
  - If part of the object is identified first, prior knowledge of the shapes of object can be exploited in ***reorganizing*** the rest of the image.

Those results show that……

- Grouping cannot be attributed entirely to early, preconstancy visual processing.
  - A provisional grouping might be determined at an early, preconstancy stage of image processing but might be overridden if later, object-based information requires it.
  - Grouping is a temporally extended process that includes components at ***both early and later levels of processing*** (image-based, surface-based, and object-based stages).

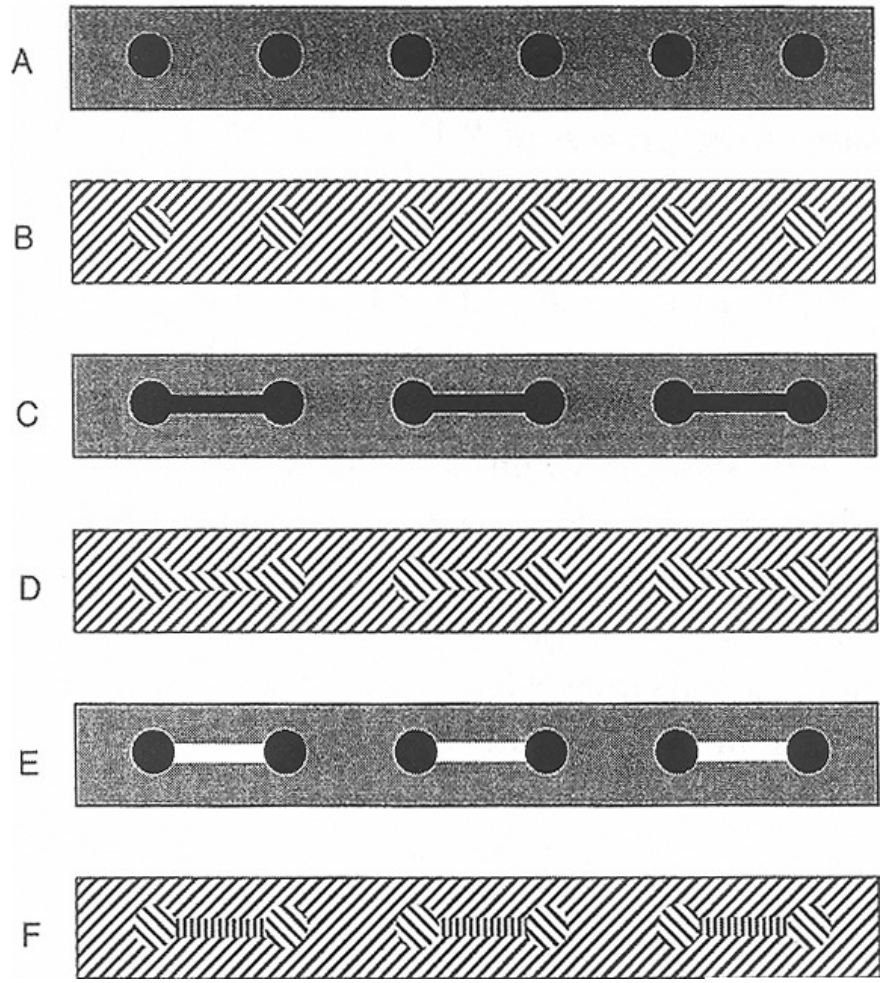
2. Region Analysis

- The Gestaltists neglected to explain how the "elements" of their analysis arise.
- **Regions**: bounded, 2-D areas that constitute spatial subsets of the image.
  - Another important aspect of ***edge's*** perceptual function, as boundaries that define 2-D regions.
  - Bounded regions are ***central*** to perceptual organization because they may well define the first level of fully 2-D units on which subsequent visual processing is based.

2.1 Uniform Connectedness

- The principle of **Uniform connectedness**:
  - The tendency to perceive connected regions of uniform image properties (e.g., luminance, color, texture, motion, and disparity) as the initial units of perceptual organization.
- This forms **a *crucial link* between the edge detection and perceptual organization and grouping.**
  - an ***excellent heuristic*** for finding image regions corresponding to parts of connected objects in the environment.

- The powerful effect of uniform connectedness on perceptual organization can be demonstrated.



  - C and D show that such regions merge into larger, more complex unitary elements when they are connected by regions defined by the same property.
  - E and F show that when they are connected by regions of different properties, they are no longer perceived as fully unitary elements.

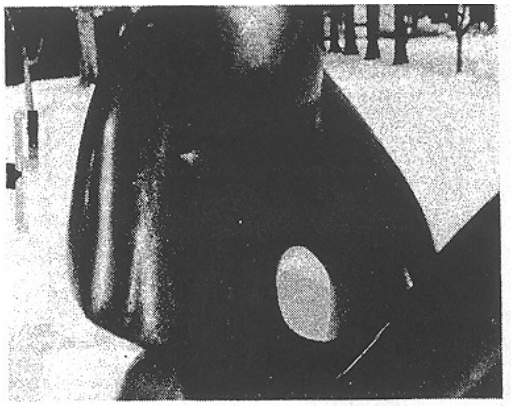
- ***The uniform connectedness cannot be reduced to any principle of grouping***.
  - The grouping principles presuppose the existence of independent elements that are to be grouped together
  - Whereas uniform connectedness is defined on an unsegregated image.
- Uniform connectedness is the ***first principle of 2-D perceptual organization*** to operate and the foundation on which all later organization rests.

2.2 Region Segmentation

- **Region segmentation:** the process of dividing an image into mutually exclusive areas based on uniformity of an image-based property, such as luminance, chromatic color, texture, motion, or binocular disparity
- Two ways for the task:
  - The visual system actually detects ***differences*** (or gradients) in local visual properties that divide one region from another.
  - Detect the ***sameness*** (or similarity) of adjacent portions of the image.

Boundary-based approaches

- 1-D edge detection may be used to find regions of roughly uniform connected areas in the image.
  - In the ***Marr-Hildreth algorithm***, it was accomplished by convolving the image with a set of second-order edge operators and detecting zero-crossings in the output.
  - The edges defined by zero-crossings necessarily form closed contours.
  - Some of spurious regions can be eliminated simply by merging adjacent regions between which there is a sufficiently low-contrast edge.
  - Some regions resulting from the interaction of lighting and surface conditions must eventually be unified by lightness constancy processes.



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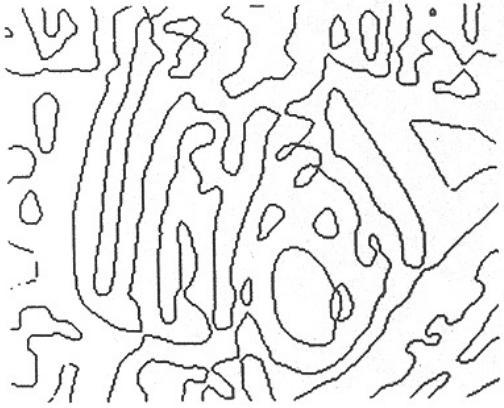
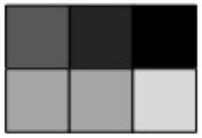
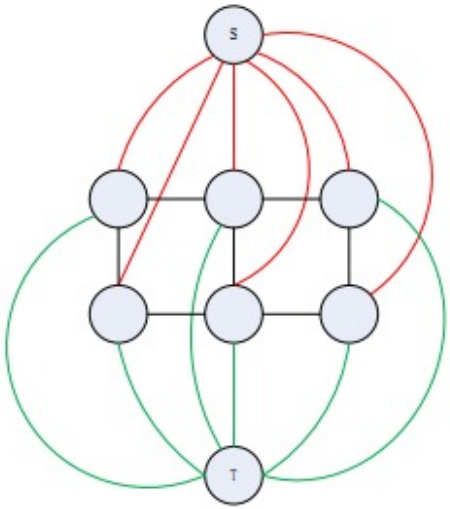


B

Region-based approaches

- Gestalt ideas suggest that there may be other approaches to region segmentation that do not depend on a prior process of local edge detection but find regions much more directly.

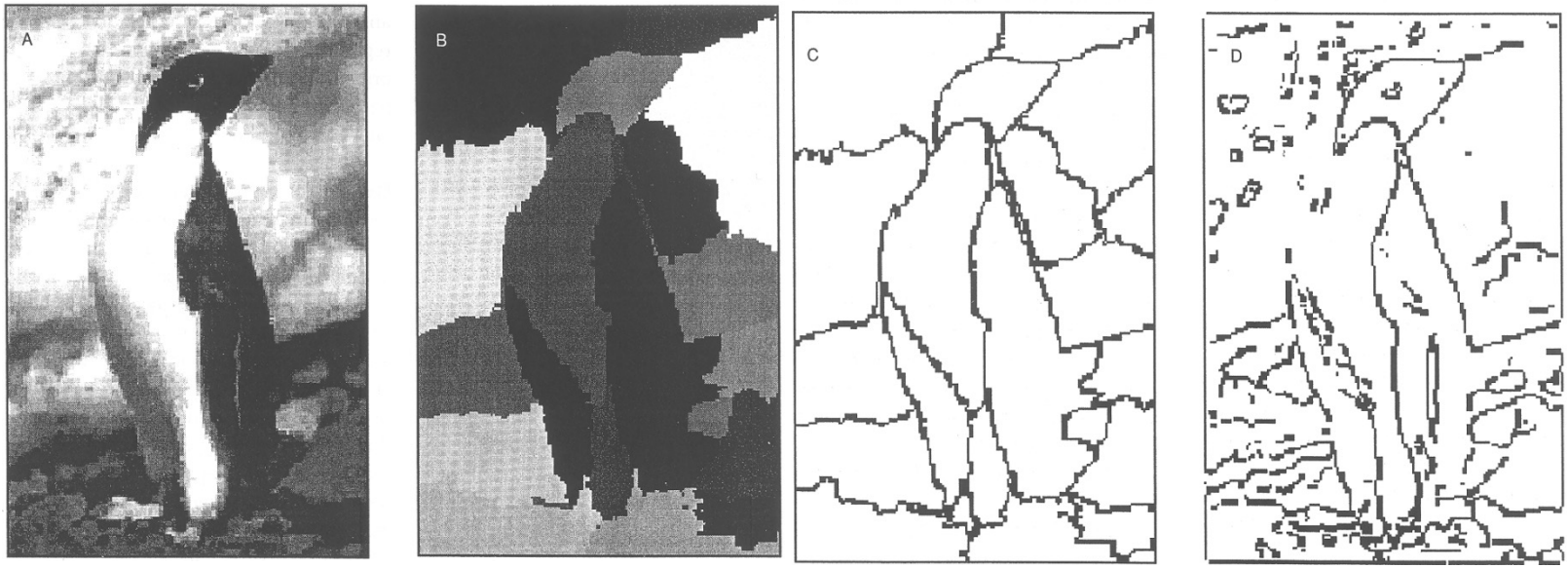




Graph-cut Algorithms

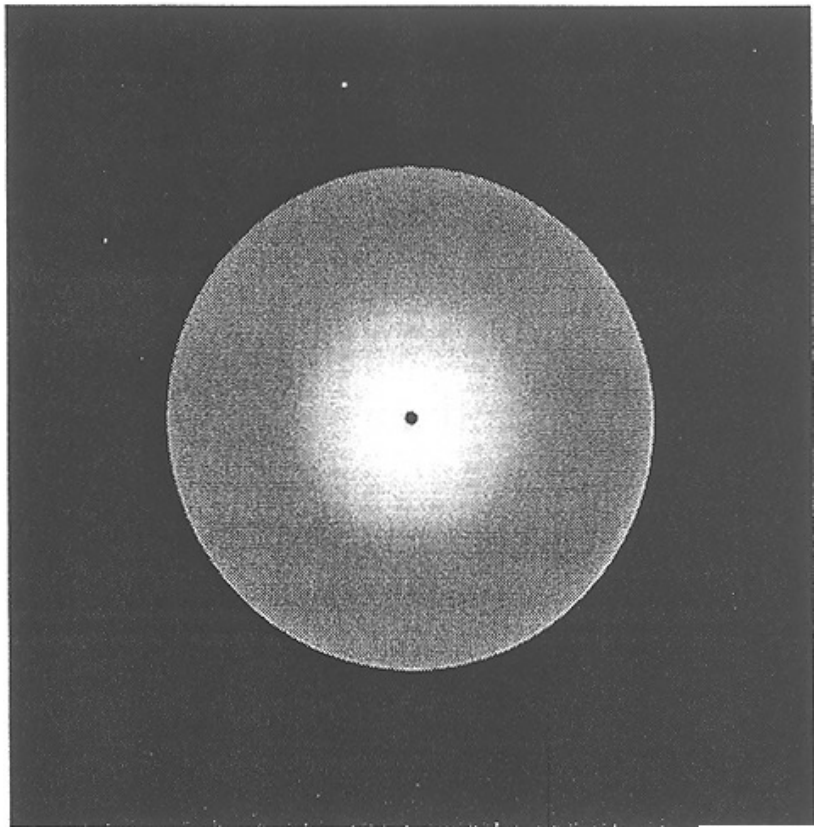
- It is even possible that edge detection is a result of region segmentation rather than its cause.
- **The graph theoretic approach** (Malik, 1998) partitions the image into regions by finding the set of pixels that are simultaneously most similar within a given region and most dissimilar between regions.

The results of Image Segmentation



(B) Malik's normalized cuts algorithm identifies plausible uniformly connected regions
(C) Shows the boundaries of the regions in B.
(D) The output of Canny edge detector.

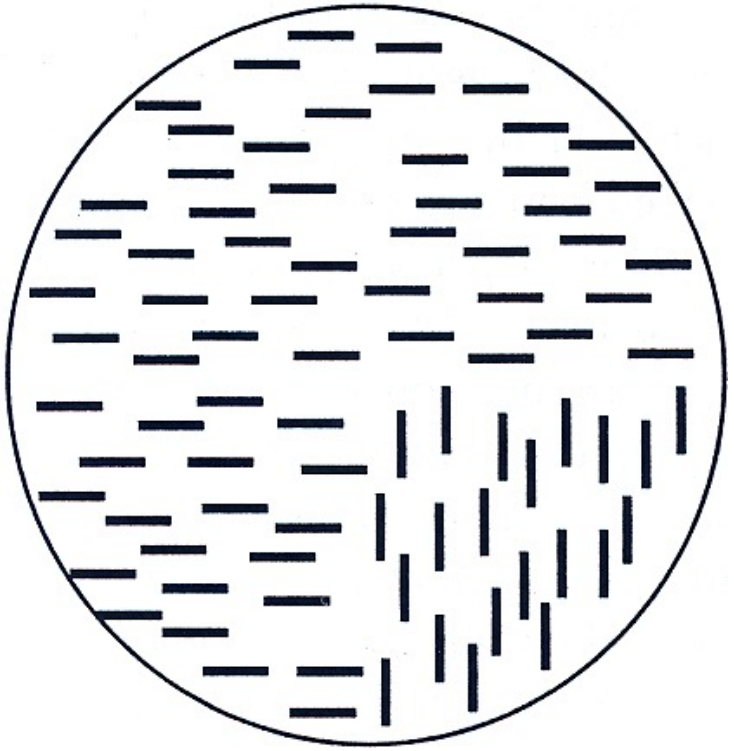
Evidence from stabilized images



- Stabilized images: images presented so that they are completely stationary on the retina.
- Once adaptation to the inner edge is complete, only the outer edge has any effect on the visual system.
- It supports the ***conclusion*** that people experience the shape and color of regions solely on the basis of edge information.

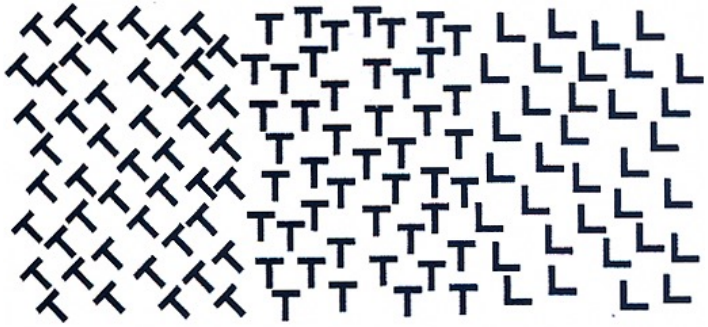
2.3 Texture Segregation

- Uniform connected regions could be defined by higher-order properties than luminance and color.
- Texture segregation: regions can be perceived solely on the basis of texture information.
- ***Texture segregation seems closely related to classical grouping,*** the Gestalt principle of similarity.



Discovering the features of texture

- The factors governing texture segregation are not necessarily the same as those that determine ***the shape similarity of the very same elements*** when they are perceived as individual figures.
- Texture segregation resulted from detecting differences in the **feature density** (the number of features per unit of area) of certain simple attributes, such as line orientation, overall brightness, color, size, and movement.



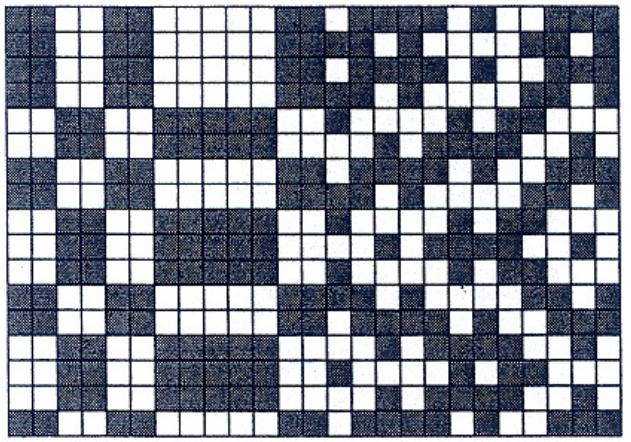
A. Texture Segregation

B. Shape Similarity

Texture segregation as a parallel process

- The textures could be discriminated in either of two ways
  - conscious scrutiny (A).
  - Normal texture segregation: effortlessly and simultaneously over the whole visual field, a preattentive process.(B)

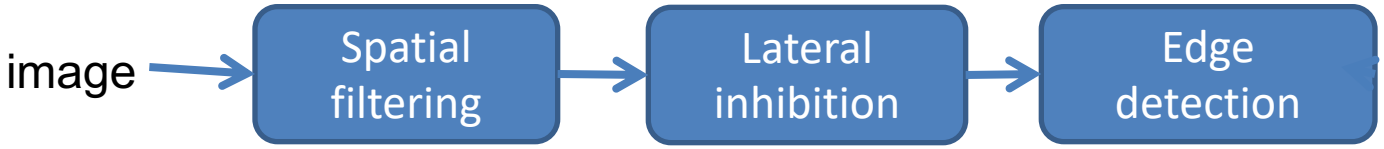
A



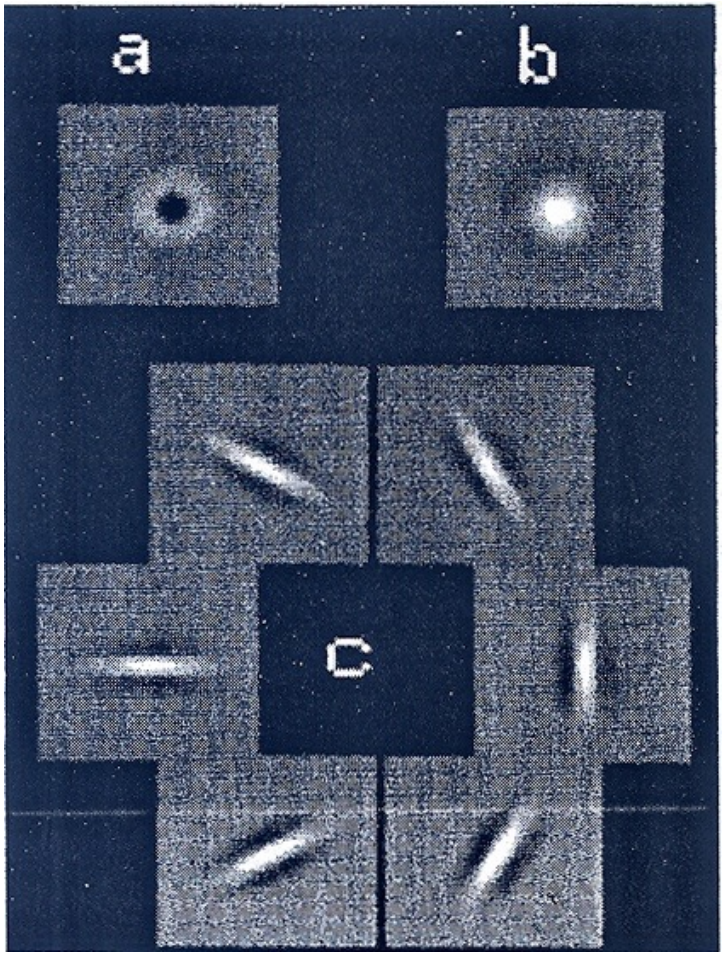
B

A theory of texture segregation

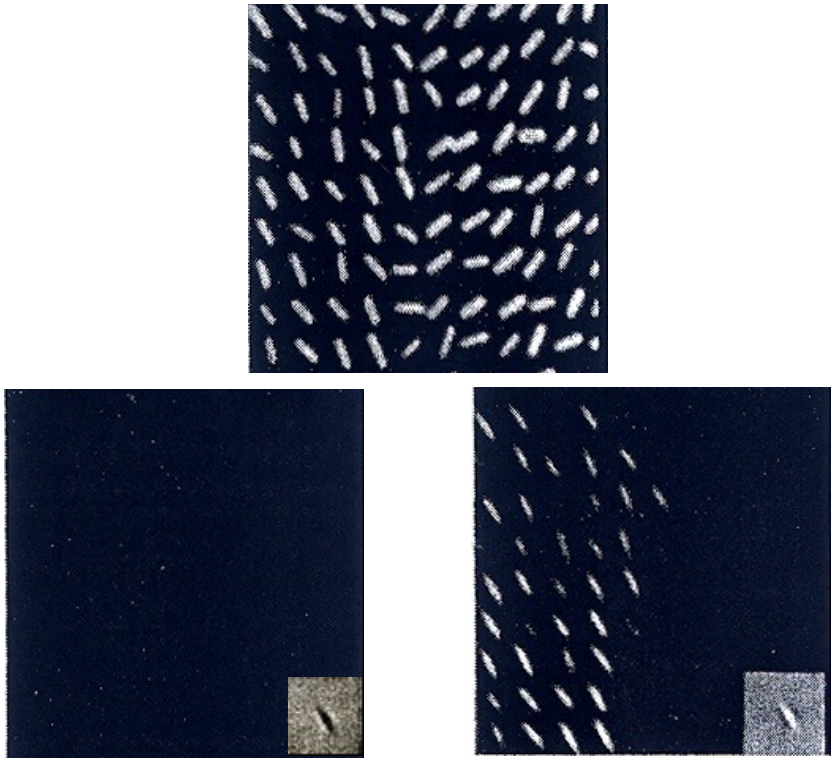
- A biologically plausible, computational theory of texture segregation based on detecting edges in the output of known cortical cell types.
  - Most successful theories of texture segregation to date.
  - A good example of the value of an interdisciplinary approach to vision.



The initial filtering stage:



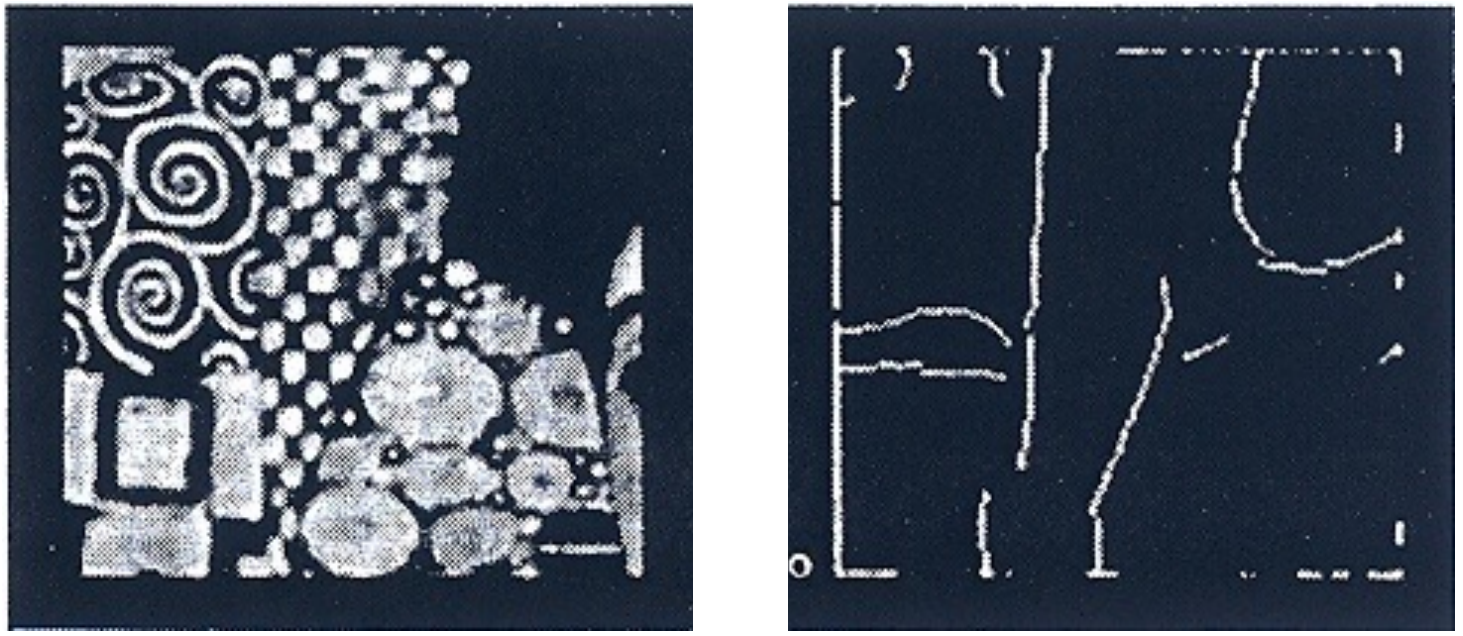
a/b: symmetric center/surround receptive fields
c: oriented bar detector



Left: shows the output for dark-bar filters at the left-oblique orientation
Right: shows the output for a similar set of light-bar filters.

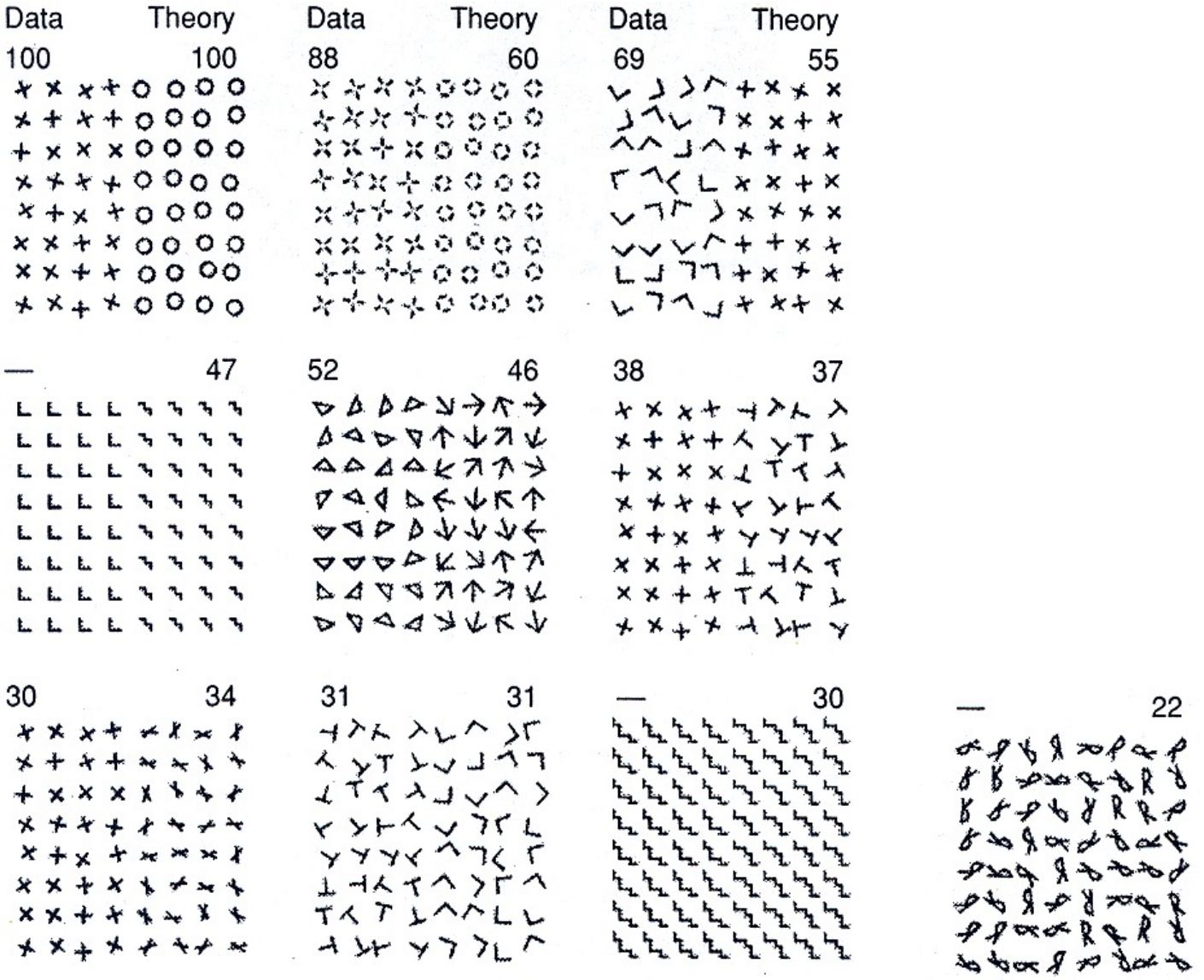
The second and final stages

- The second stage:
  - The ***lateral inhibition*** is to suppress or reduce spurious weak responses.
- The final stage:
  - analyzes through a set of very coarse edge detection operators at different orientation and positions.
  - It averages over the output of many individual filters with the same receptive fields.
  - *The final texture gradient is defined as the maximum gradient over all filter types*.



Texture boundaries in part of a painting.

Correspondence between data and theory



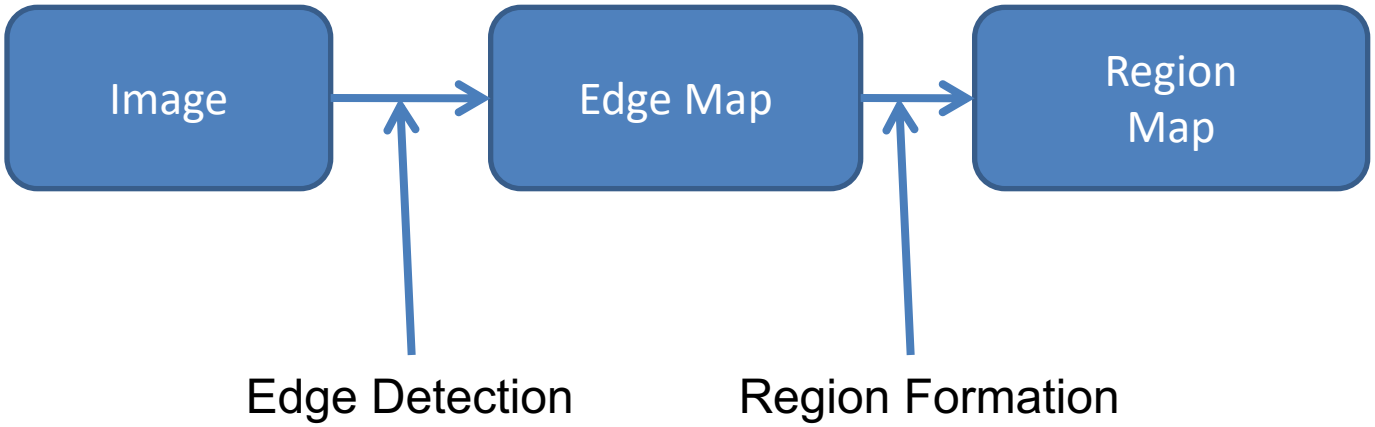
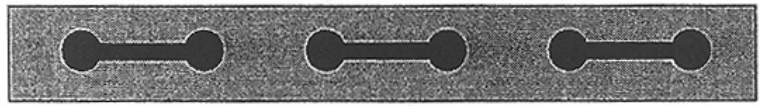
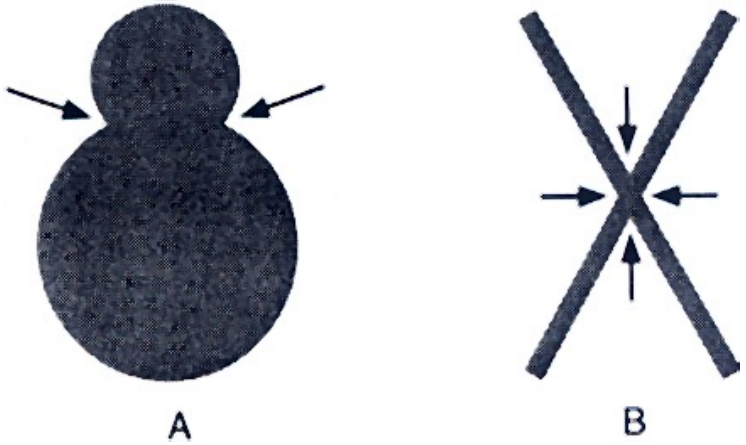


Image
Edge Map
Region Map
Edge Detection
Region Formation

Parts and parsing

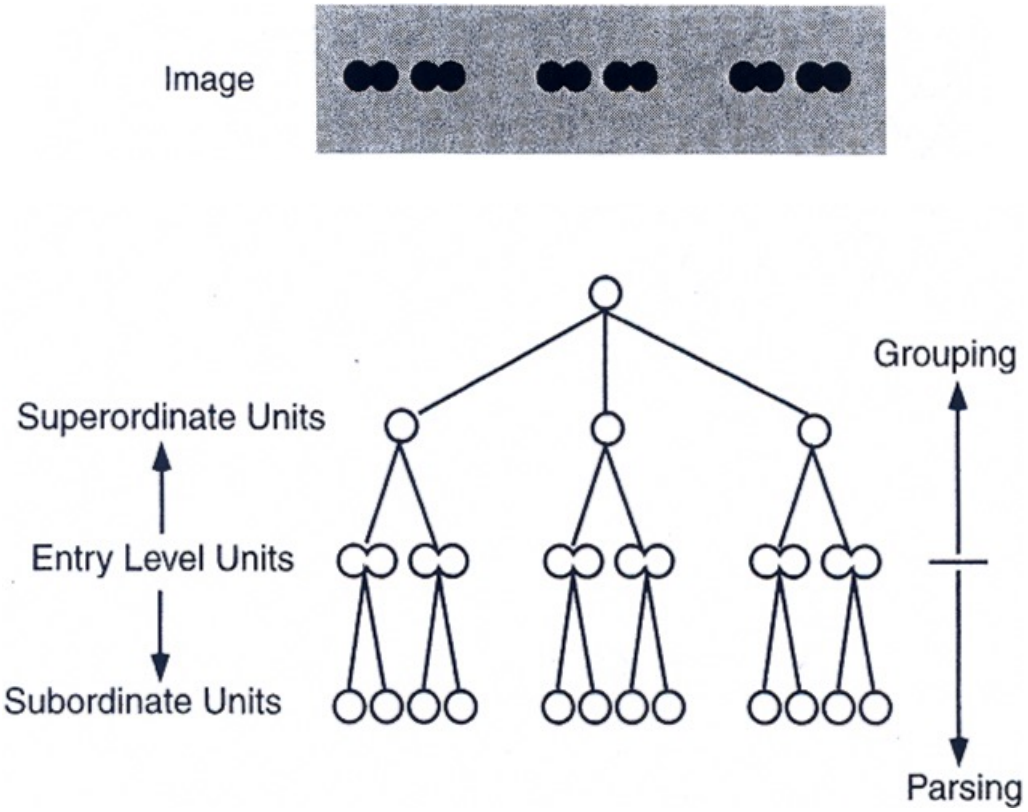
- **Parsing**: dividing a single element into parts.
  - It determines what subregions of a perceptual unit are perceived as “going together ” most coherently.
  - Parsing occurs where there are pairs of such discontinuities.
  - Parsing is the opposite of **grouping**.





- Grouping and parsing taking place at the same time after regions have been defined.

The Processes of Perceptual Organization



- Figure/ground organization
- Entry-level units: first units of perceptual organization
- Grouping and Parsing: to extend the part-whole hierarchy in both directions.

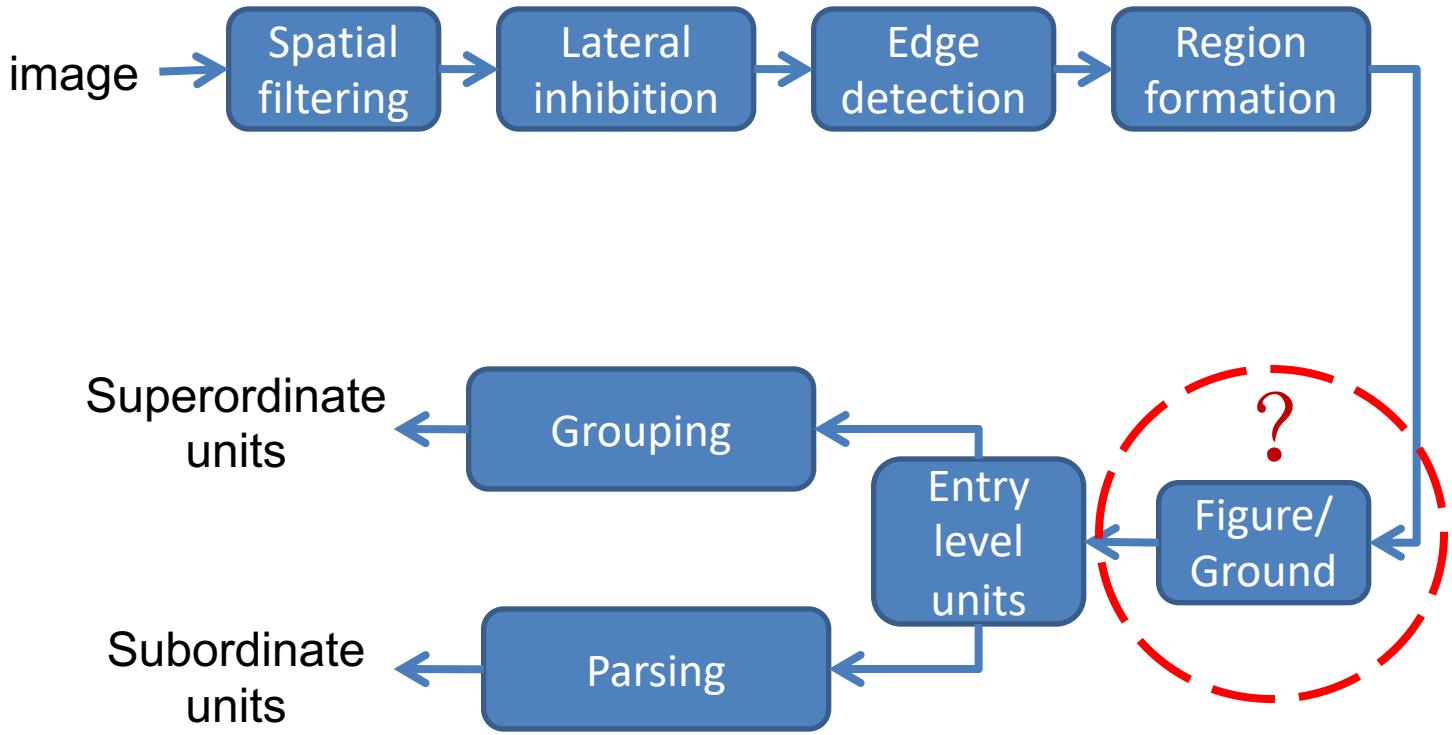


image
Spatial filtering
Lateral inhibition
Edge detection
Region formation
Superordinate units
Grouping
Entry level units
?
Figure/ Ground
Subordinate units
Parsing

3. Figure/Ground Organization

Ambiguous figure/ground organization

- **Figure / ground organization**: The “thing-like” region is referred to as the ***figure***, and the “back-groundlike” region as the ***ground***.

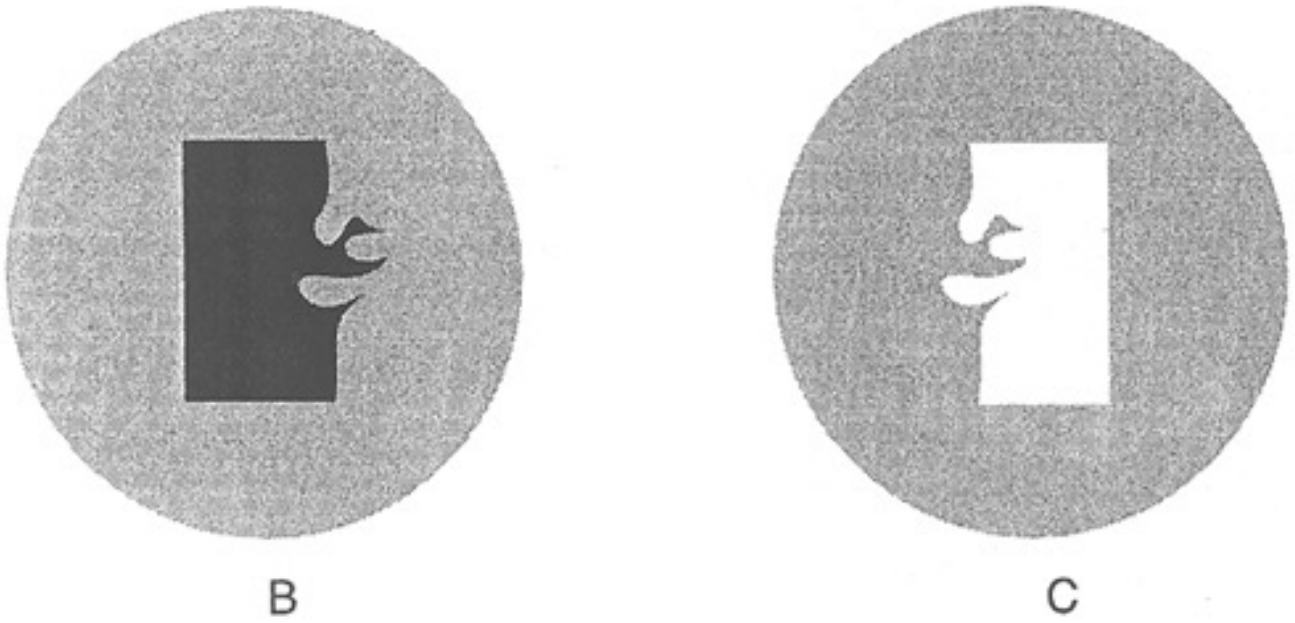
Properties of figures versus grounds

Figure	Ground
Thinglike	Not thinglike
Closer to observer	Farther from observer
Bounded by contour	Extends behind contour
Shape defined by contour	No shape at contour

Evidence from memory

A

Ambiguous figure/ground organization



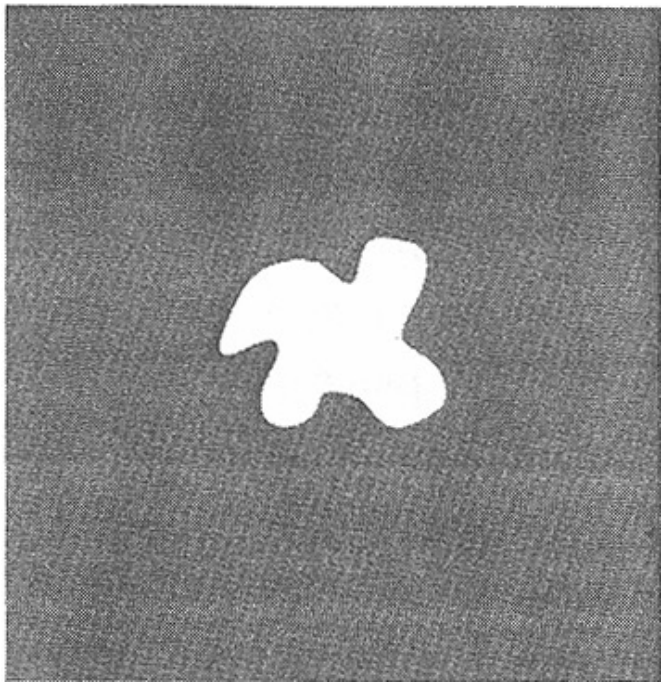
Ambiguous figure/ground organization

- People tend to perceive only one side of a contour as a thinglike figure.
- **Experiment (Recognition memory paradigm)**
  - Half of the subjects were asked to attend to the white figures, and the other half were asked to attend to the black figures.
  - After the whole series was presented, subjects were shown a series of unambiguous gray test figures consisting of just one region.
- The results showed that subjects remembered the figural test shapes quite well but remembered the ground test shapes no better than chance.

Evidence from Depth Perception

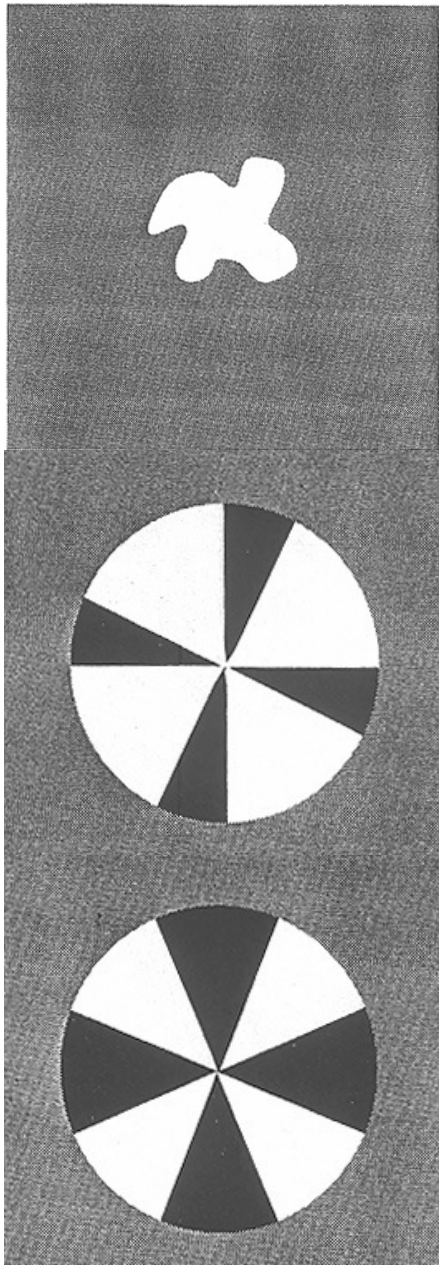
- The fact
  - the figure is always perceived as lying in front of the ground region.
  - The visual system has a strong preference to ascribe the contour to just one of its bordering regions and to perceive the other side as part of a surface extending behind it.
- Suggest
  - Figure/ground organization is intimately related to depth perception, particularly to pictorial information from occlusion.
  - Figure/ground organization can be interpreted ***as part of the edge interpretation processes***, particularly those involved in labeling depth edges.

- The visual system has distinct preferences for perceiving certain kinds of regions as figure.

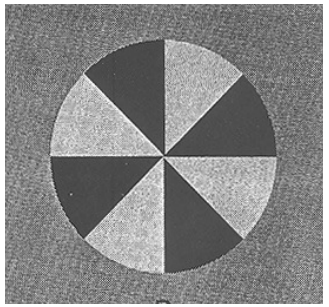


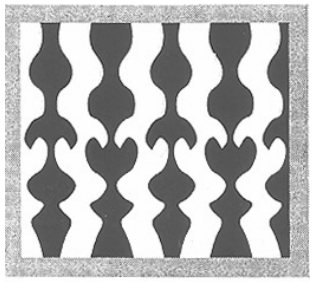
3.1 Principles of Figure/Ground Organization

- The most important factors:
  - **Surroundedness**: If one region is completely surrounded by another, the surrounded region is perceived as figure and the surrounding region as ground.
  - **Size**: All else being equal, the smaller region is perceived as the figure.
  - **Orientation**: the set that is vertical and horizontal tends to be perceived more frequently as figure than does the oblique set.

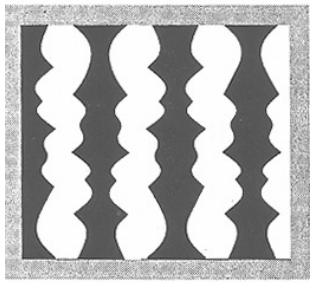


- **Contrast**: the regions with greatest contrast to the surrounding area are taken as figural.
- **Symmetry**: all else being equal, symmetrical regions tend to be perceived as figure.
- **Convexity**: All else being equal, convex regions tend to be perceived as figure and concave ones as ground.
- **Parallelism**: Yet another feature that favors figural status for a region is that its contours are parallel.

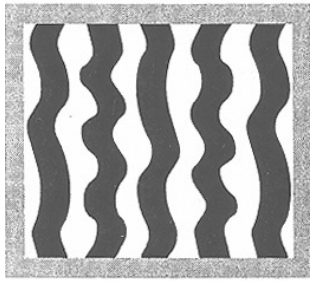




A



B

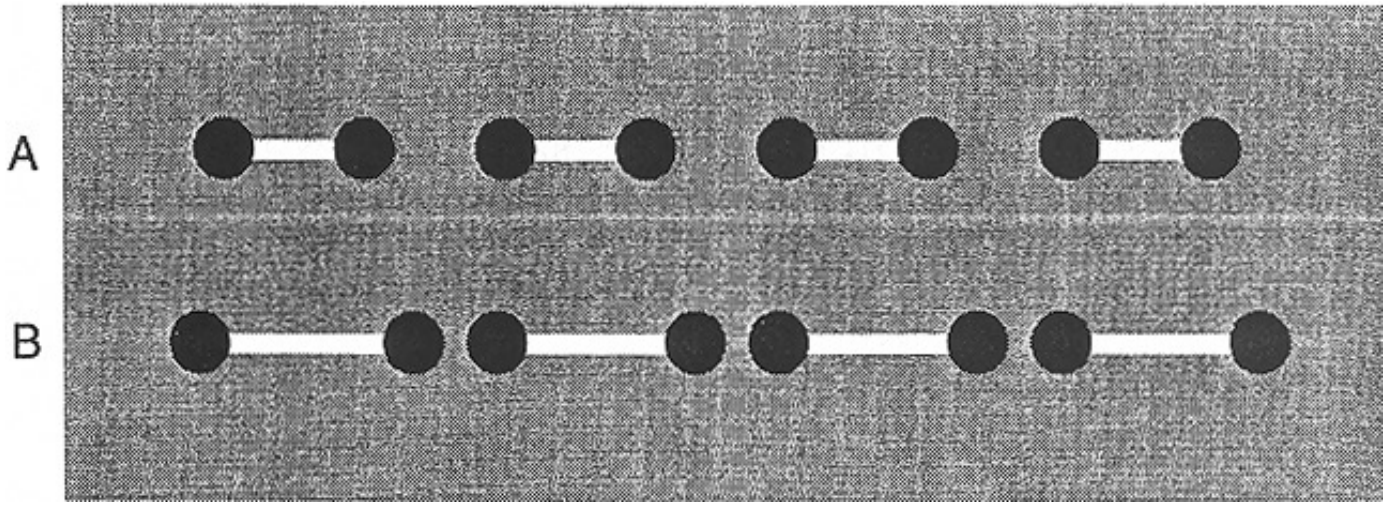


C

The **weaknesses** of the principles of grouping

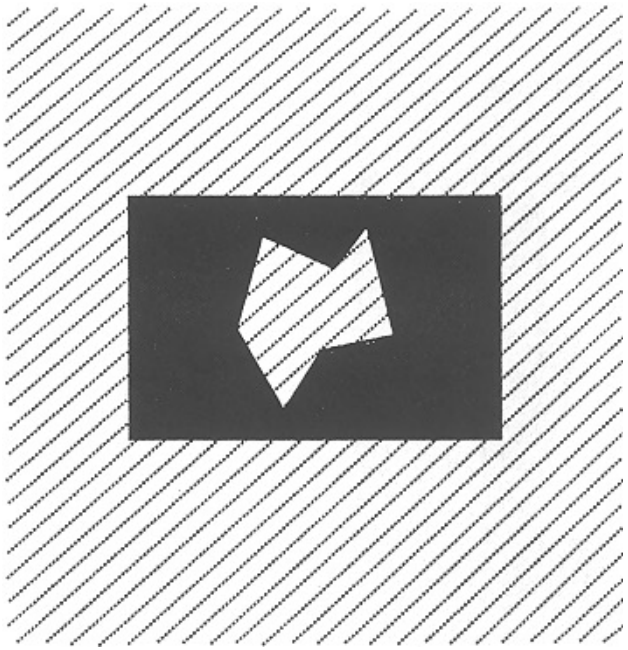
- As qualitative, these principles of figure/ground organization have the same weaknesses as the principles of grouping, including the inability to predict the outcome when ***several conflicting factors*** are at work in the same display.

- **Why** the figure/ground organization must operate before both grouping and parsing processes.
  - The entry-level elements on which grouping operates must already have been differentiated from **ground**
  - if they were not, *each region would be grouped with its immediately adjacent region by the principle of* ***element connectedness***.



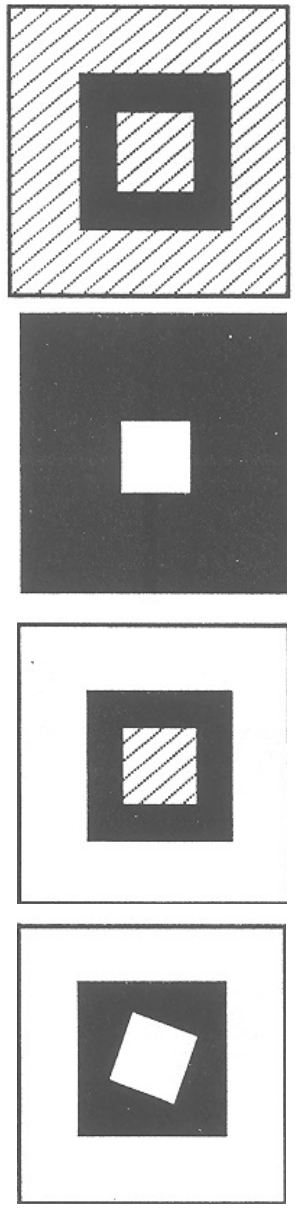
3.2 The Problem of Holes

- Definition: holes are interior regions of objects or surfaces that do not contain matter.



Hole's paradox

- The Inner contour seems to be doing ***double duty*** by imparting shape to regions on both sides.
- The fact that holes are perceived to have shape involves a **paradox**.
- Some of the factors support the perception that a hole is present:
  - **Surrounding figure**: For a hole to be perceived, the surrounding region must have an outer boundary that is perceived as figural.
  - **Ground continuity**: the region within the hole is the same surface as that behind the object's outer boundary.
  - **Nonaccidental relation to the outer boundary**: the inner boundary is nonaccidentally related to the outer boundary also supports the perception of the inner region as a hole.



3.3 Ecological Considerations

- Figure/ground organization might be determined simply by attending to one region rather than another.
- The ability to attend selectively to the perceptual ground suggests that figure/ground organization probably comes ***before attentional selection***.
  - ***The attention is drawn to the figure rather than that attention determines the figure***.
  - Attention can be flexibly allocated to either figure or ground, depending on the goals and intentions of the observer, but that there is **a strong bias** to attend to figures.

Stable properties

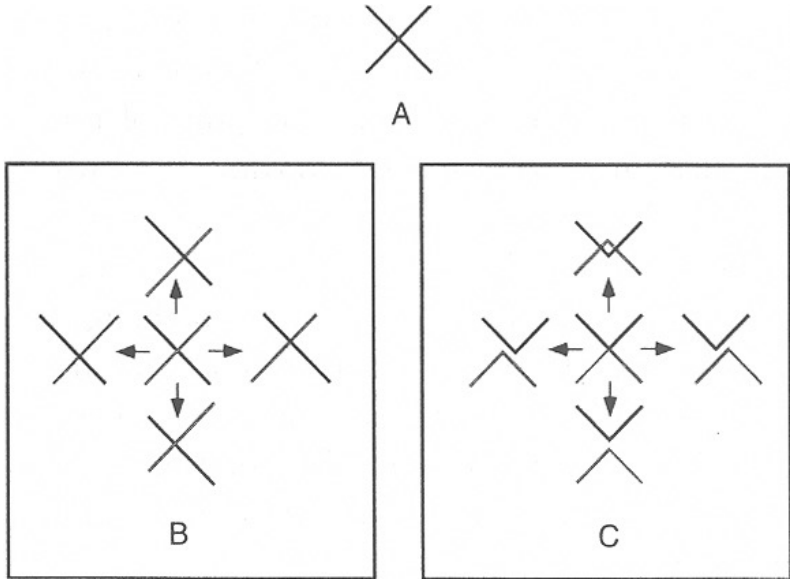
- Objects are also the entities that have stable properties either when the observer's viewpoint is changed or when one of the objects moves.
  - In attending to figures rather than ground, the perceiver is ***selectively*** processing the nonaccidental features of the visual field.
  - The contour seems to belong to the figure rather than the ground because, if the figure is closer, it actually does.

The Principle of Nonaccidentalness

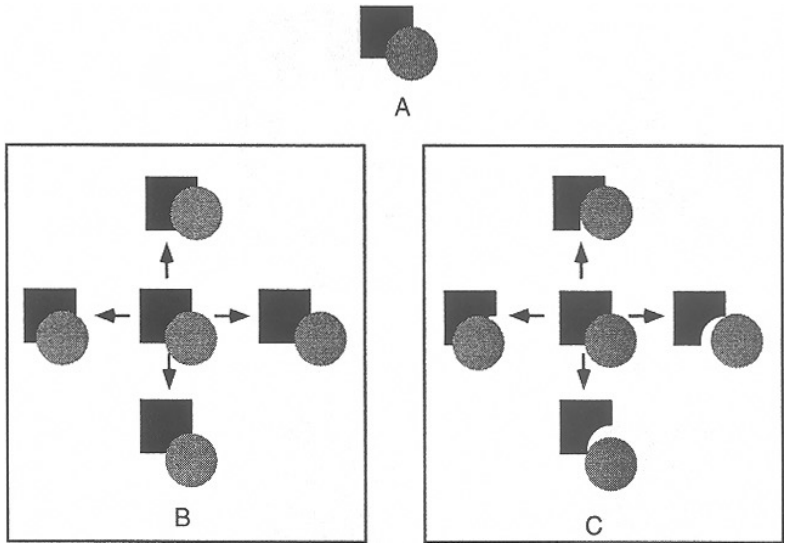
- Many of the phenomena of perceptual organization can be understood within a general framework of **nonaccidentalness**:
  - the hypothesis that the visual system avoids interpreting structural regularities as arising from unlikely accidents of viewing,
- In the psychology, **rejection-of-coincidence principle**.
  - Many phenomena of perceptual organization can be explained by assuming that the visual system rejects interpretations in which the properties of the retinal image arise from coincidences of any sort.

Examples of the principle of nonaccidentalness

- Good continuation:



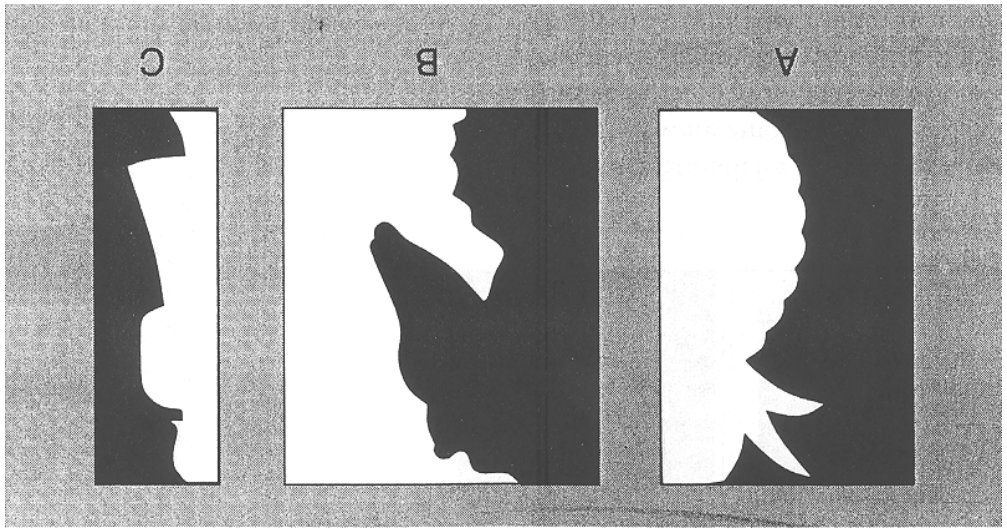
- Visual completion:



3.4 Effects of Meaningfulness

- The processes underlying figure/ground organization may be viewed as the way in which the visual system decides which regions correspond to objects and which ones are partly occluded surfaces of objects father away.
- Figure/ground processing might be influenced by whether the shape of a region corresponds to that of ***a known, meaningful object***, affected by this form of past experiences.

Experiments



Ambiguous figure/ground images

- The results showed that
  - The region corresponding to the meaningful object was perceived as figure substantially more of the time than the nonmeaningful region.
  - Subjects were also more likely to perceive the meaningful region as figure initially.
- upright figures vs. upside-down.

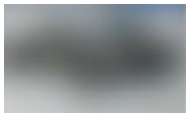
Relation to Object Recognition

- The classical view has always been that figure/ ground organization must precede object recognition because it requires a candidate object on which to work.
- The fact that figure/ground processes are influenced by object recognition processes
  - Explanation 1: The existence of a "prefigural" recognition process that operates on both sides of each contour before any figure/ground processing.
  - ***Explanation 2***: Ambiguous figure/ ground stimuli to be disambiguated by the feedback of the later recognition process rather than requiring that object recognition precede figure/ground processing.

Relation to Context

- People use their knowledge of physical and semantic regularities such as the ones we have been describing to *infer* what is present in a scene.

What we expect to see in different contexts influences our interpretation of the identity of the "blob" inside the circles.



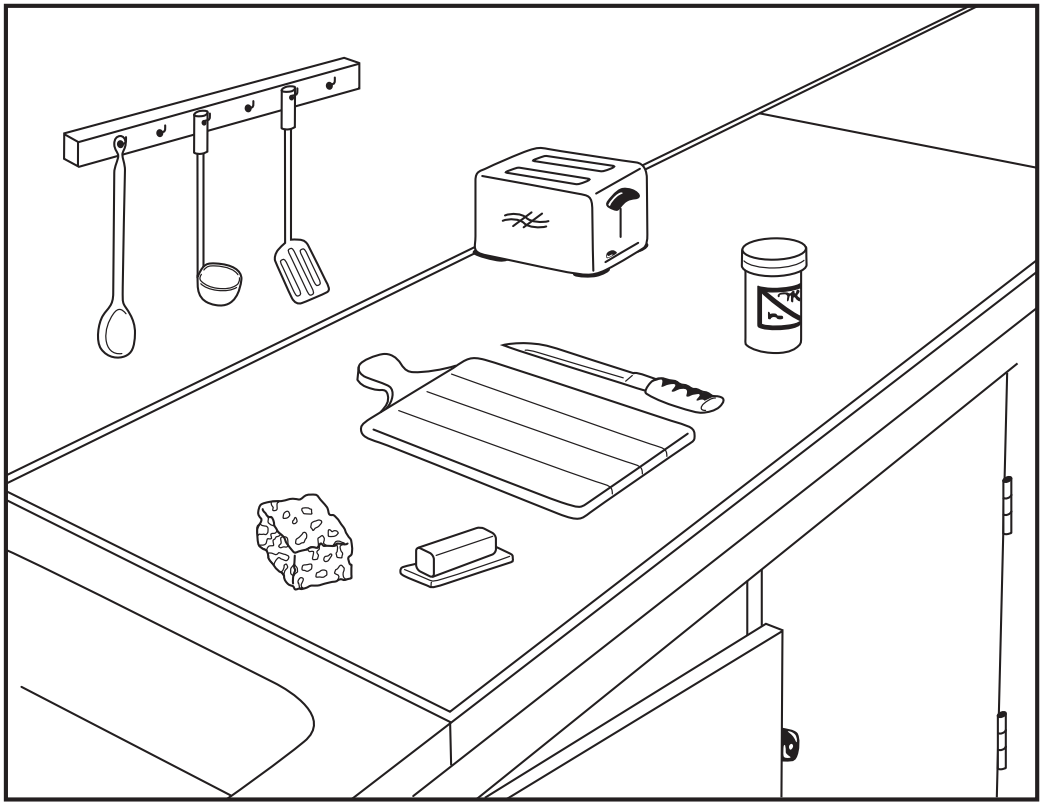
blob

(a)

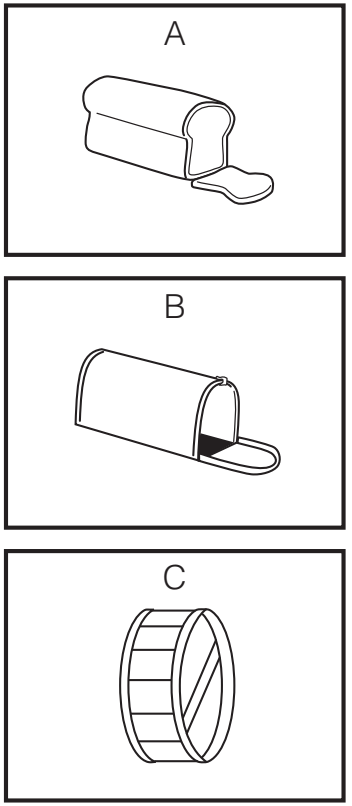
(b)

(c)

(d)



Context scene



Target object

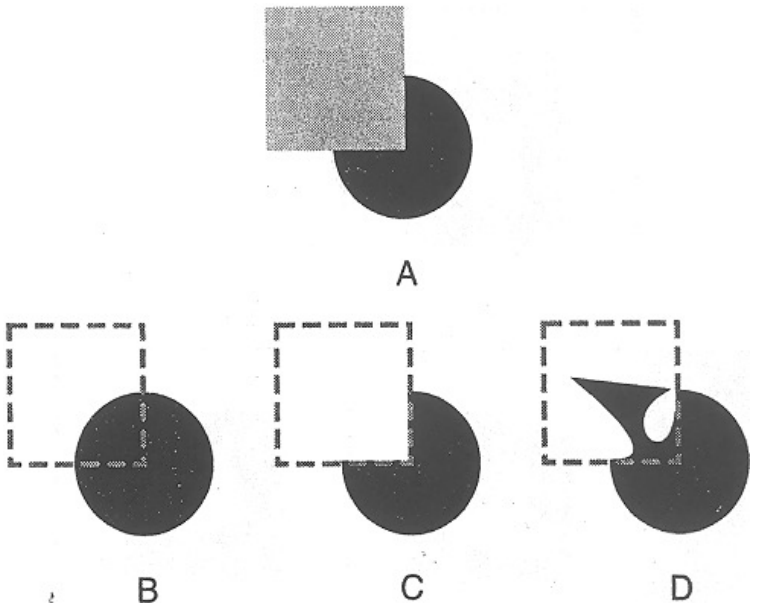
The loaf of bread percent of the time, but correctly identified the mailbox or the drum only 40 percent of the time.

Apparently, observers were using their knowledge about kitchens to help them perceive the briefly flashed loaf of bread.

Degree of naturalness:
Three scenes that have different global image properties.

4. Visual Interpolation

- One of the main complicating factors in achieving the proper organization is that most surfaces are opaque, routinely hiding portions of objects from view .
- The visual system has evolved mechanisms to do this, which we will call processes of **visual interpolation**.
  - *All they can do is make a best guess about something that cannot be seen*.



4.1 Visual Completion

- The visual system automatically perceives partly occluded surfaces and objects as whole and complete, usually including their shape, texture, and color.
  - **Amodal**: the completed portion is not supported by local stimulation or sensory experience in any modality.
- It is logically ***underdetermined***, and seems to fall midway between full sensory experience of visible objects and purely cognitive knowledge of the existence of completely unseen objects.

Three theories:

(1) Figural Familiarity Theories

- People complete partly occluded figures according to the most frequently encountered shape that is compatible with the visible stimulus information.
- Problem
  - We seem able to complete objects that we have never seen before just as easily as quite familiar ones.

B

A

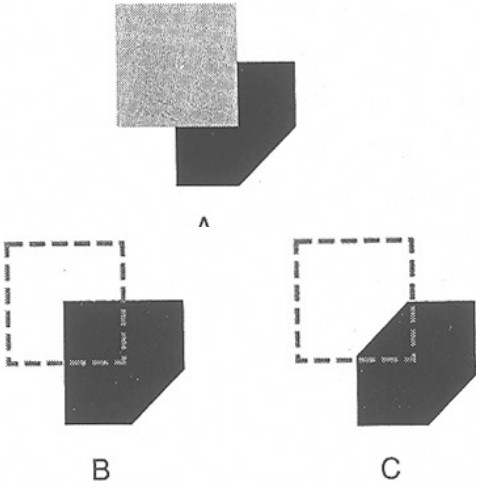
(2)Figural Simplicity Theories

- Second possibility is that partly occluded figures are completed in the way that results in *the "simplest" perceived figures*.
- **Minimum Principle**: It states that the percept will be as **good** as the prevailing conditions allow.
  - The term "**good**" refers to the degree of figural simplicity or regularity
  - The prevailing conditions refer to the structure of the current stimulus image.

How to define “goodness”?

- The goodness of a figure can be measured just by counting the number of axes of bilateral symmetry, such that ***more axes correspond to greater figural goodness***.

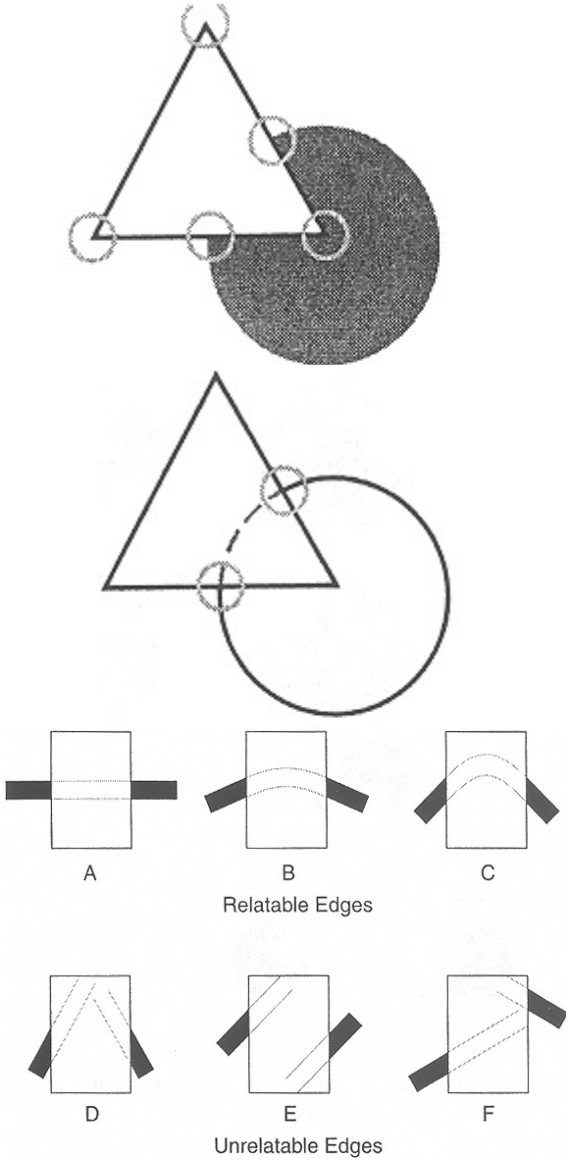
- ***The number of sides*** gives the correct answer in this case
  - ***The preferred cornerless square*** has only five sides, whereas the hexagon has six.



(3)Ecological Constraint Theories

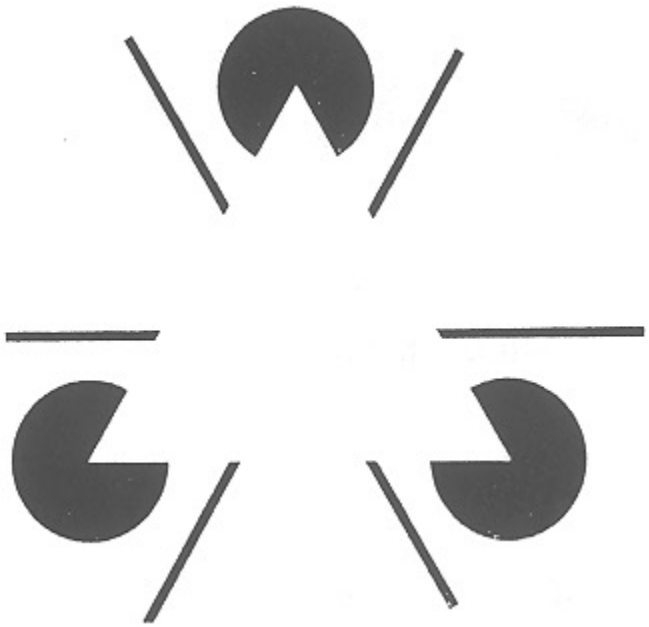
Relatability theory:

- ***Edge discontinuity (*type T*)*** is an abrupt change in the direction of a contour
  - **Edge discontinuities** are necessary, but not sufficient conditions for visual interpolation of amodal contours.
- Amodally completed contours are perceived when the edges leading into discontinuities are **relatable to others**.
  - Two edges are ***relatable*** if and only if (a) their extensions intersect at an angle of no less than 90^0 and (b) they can be smoothly connected to each other.



4.2 Illusory Contours

- The second form of visual interpolation produces a fascinating illusion in which contour are seen that do not actually exist in the stimulus image.

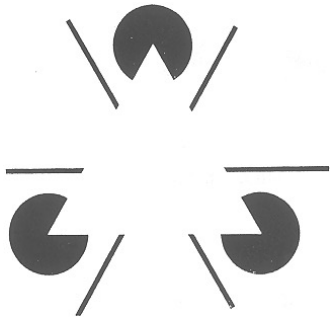


Kanizsa triangle

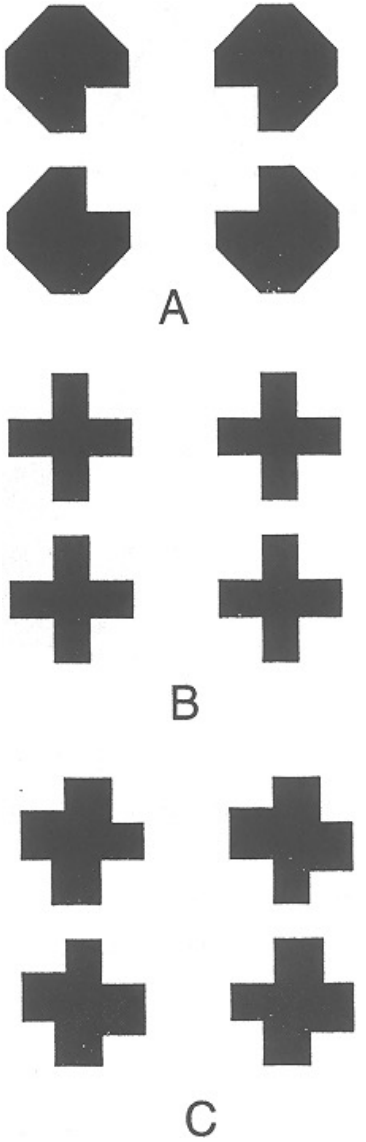
- Most observers report seeing well-defined **luminance edges** where the contours of the triangle should be, the interior region of the triangle appearing slightly **brighter** than the surrounding region.

Relation to visual completion

- The perception of illusory contours is generally accompanied by visual completion of the inducing elements.

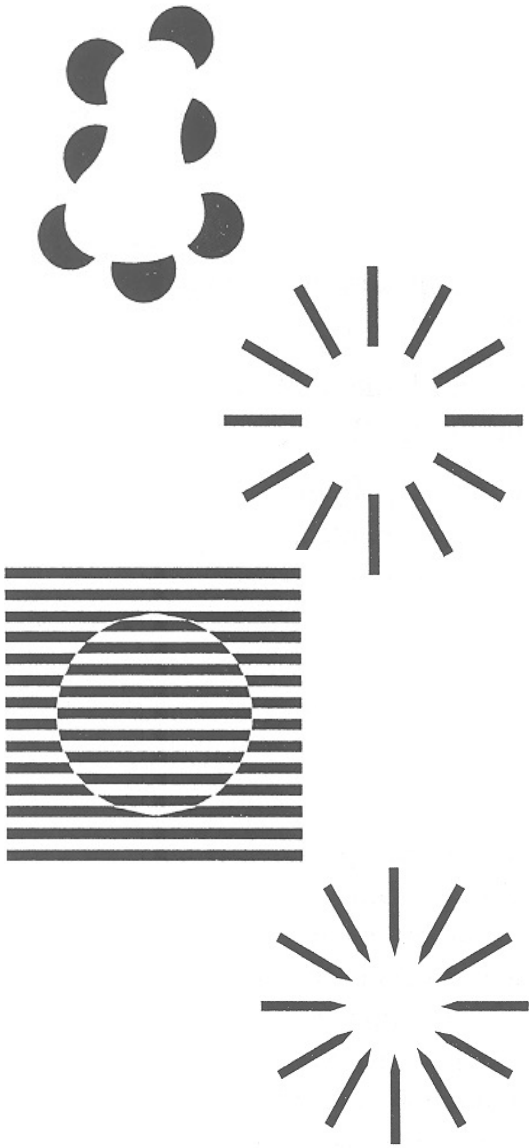


- In fact, *if <u>the inducing elements are not perceived as incomplete</u>*, no illusory contours or figures are seen.
  - The symmetry of the crosses
  - Parallel sides



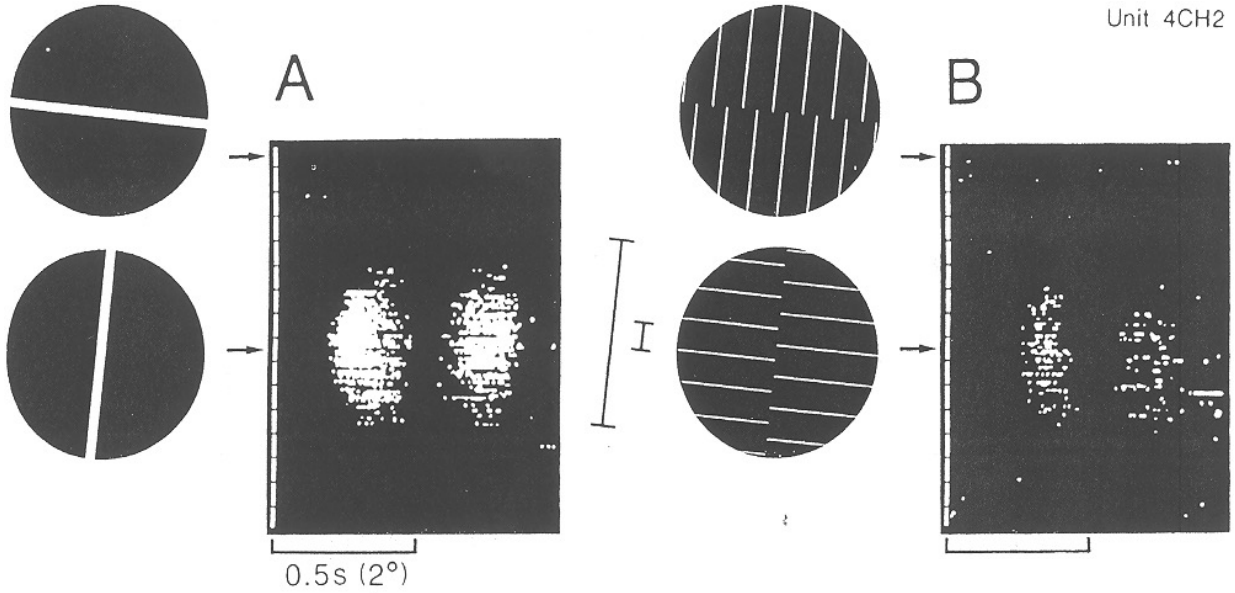
Further demonstration of illusory figures

- Illusory figures and contours are a relatively complex phenomenon that depends on more than local conditions of stimulation.
  - Illusory figures ***do not have to be familiar shapes*** such as triangles or circles, for novel shapes can be perceived just as easily
  - Illusory contours can ***be produced by line segments*** that terminate as though they were occluded.
  - Line segments are merely displaced inside and outside the illusory boundary so that their ends align along its contour.
  - Line-induced illusory contours depend on that lines that are occluded by a closer edge ***terminate abruptly*** along the occluding contour.



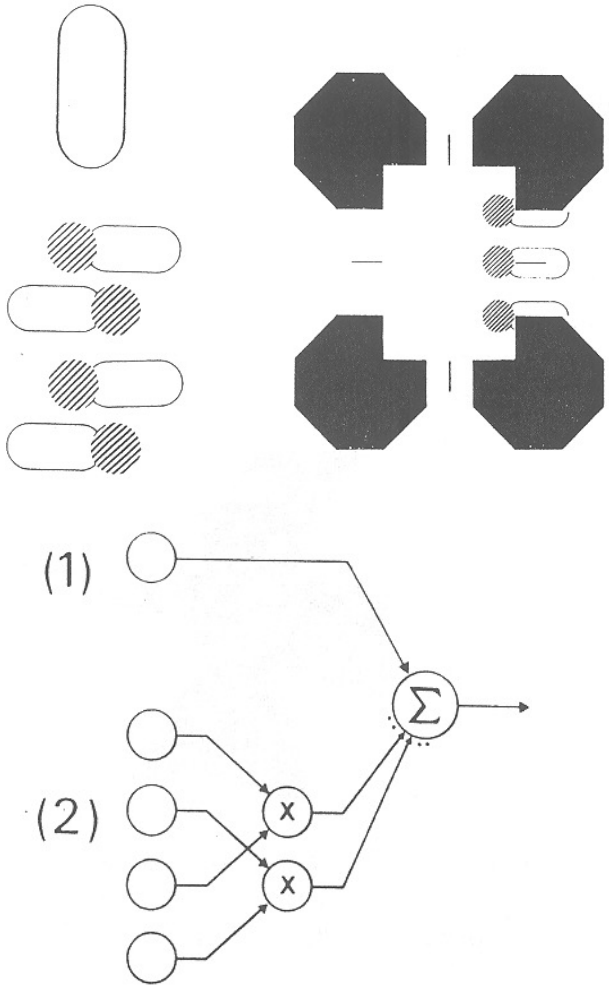
Physiological Basis of Illusory Contours

- Cells in area V2 that appear to respond to the presence of illusory contours.



How might these cells produce responses to such illusory contours?

- **Contour cells (Σ)** integrate the output of a number of oriented cells in V1.
  - One type of input (1) comes from simple or complex ***V1 cells*** that are aligned with the favored contour orientation of the V2 cell.
  - Other type of input (2) comes from a set of ***orthogonally oriented end stopped V1 cells*** whose inhibitory ends are aligned along the favored contour orientation.



Conclusion

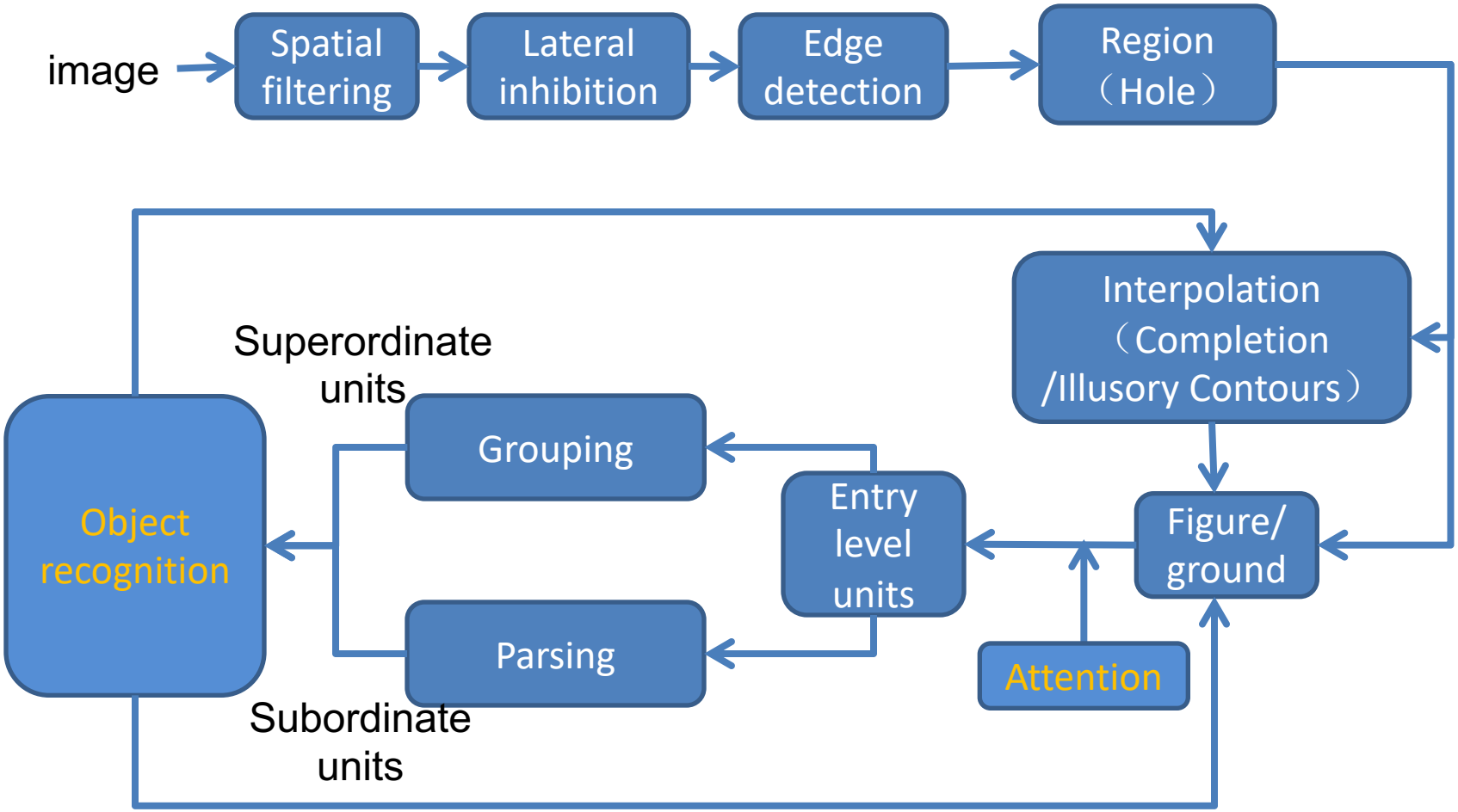


image
Spatial filtering
Lateral inhibition
Edge detection
Region （Hole）
Interpolation （Completion /Illusory Contours）
Figure/ ground
Attention
Entry level units
Grouping
Parsing
Superordinate units
Subordinate units
Object recognition

Question?