The Art and Science of Depiction
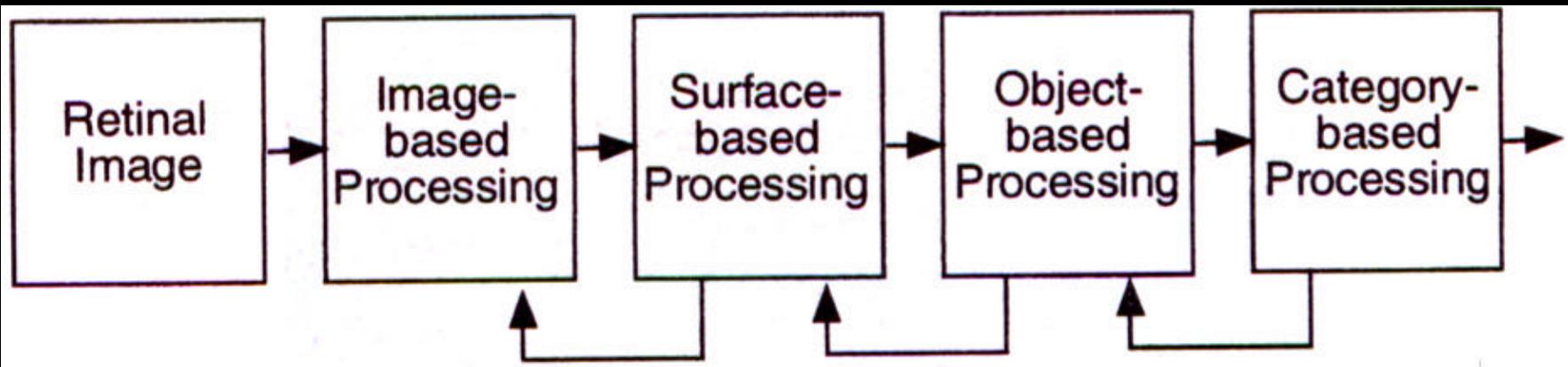
Picture Organization and Gestalt

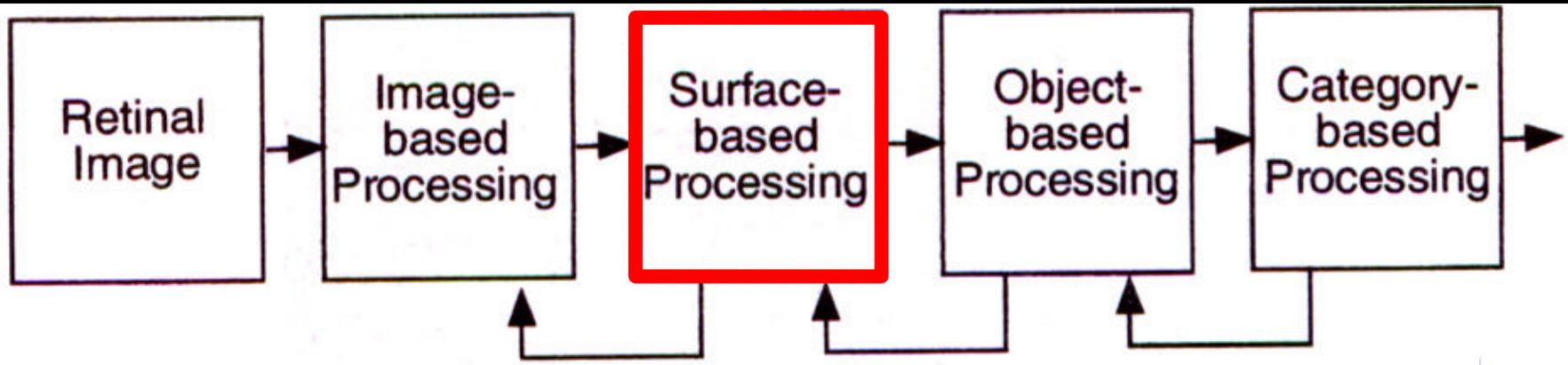*Fredo Durand*

MIT- Lab for Computer Science

Summary

- Contrast processing
- Different pathways
- Computational theory of vision
- Invariants

Overview

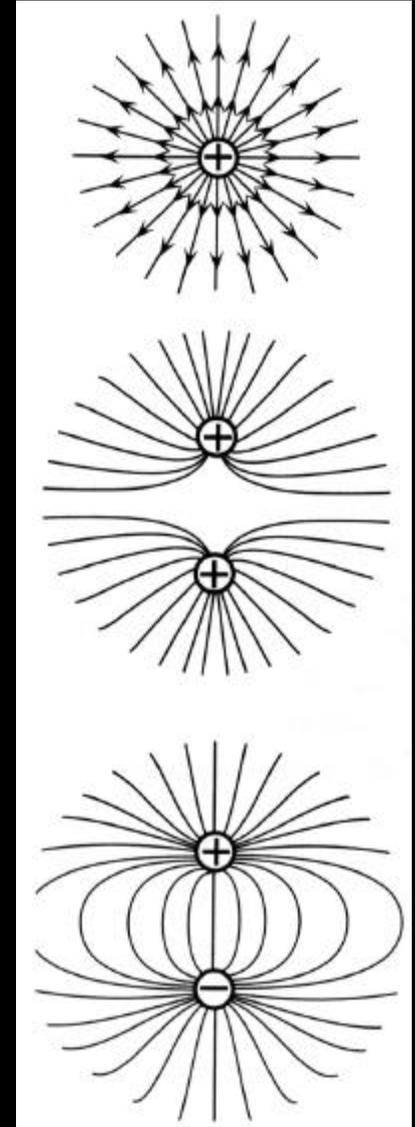- After image-based, we only know where edges are

- Need to organize the image
  - Segment by region, find structure

Context: Gestalt psychology

- Early 20th century

- Inspired by field theory in physics

- Holistic philosophy of vision
    - "spontaneous" organization
    - Opposed to unconscious inference

- Has been integrated recently into modern framework

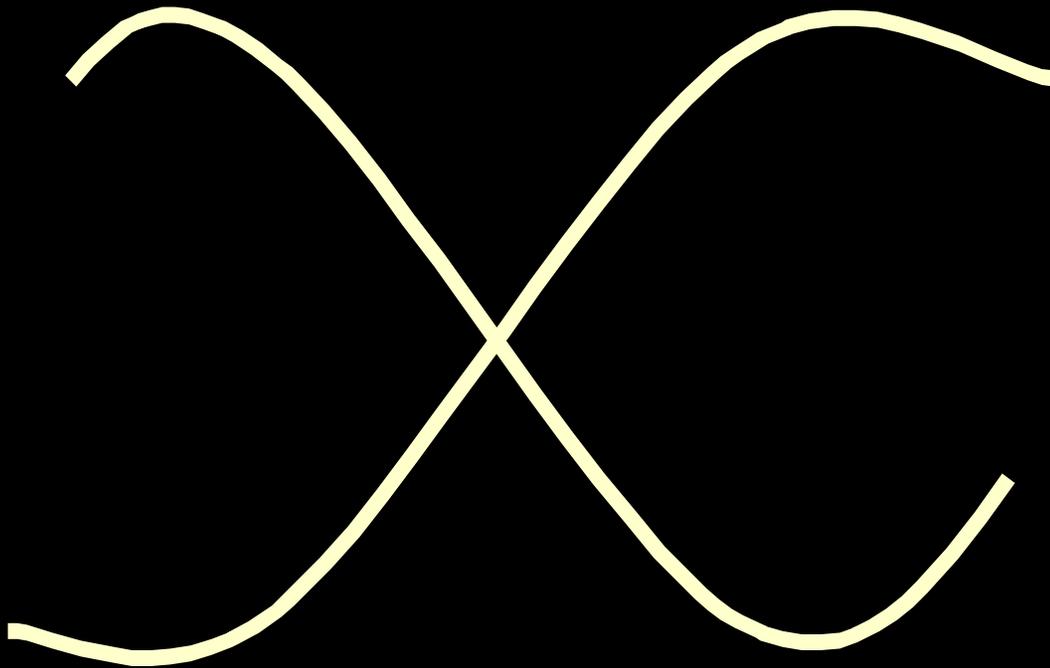- Very popular in design

Prägnanz

- "Goodness"

- "Simplest" possible figure or organization

- Has recently been related to information theory (simple in terms of amount of information required to encode it)
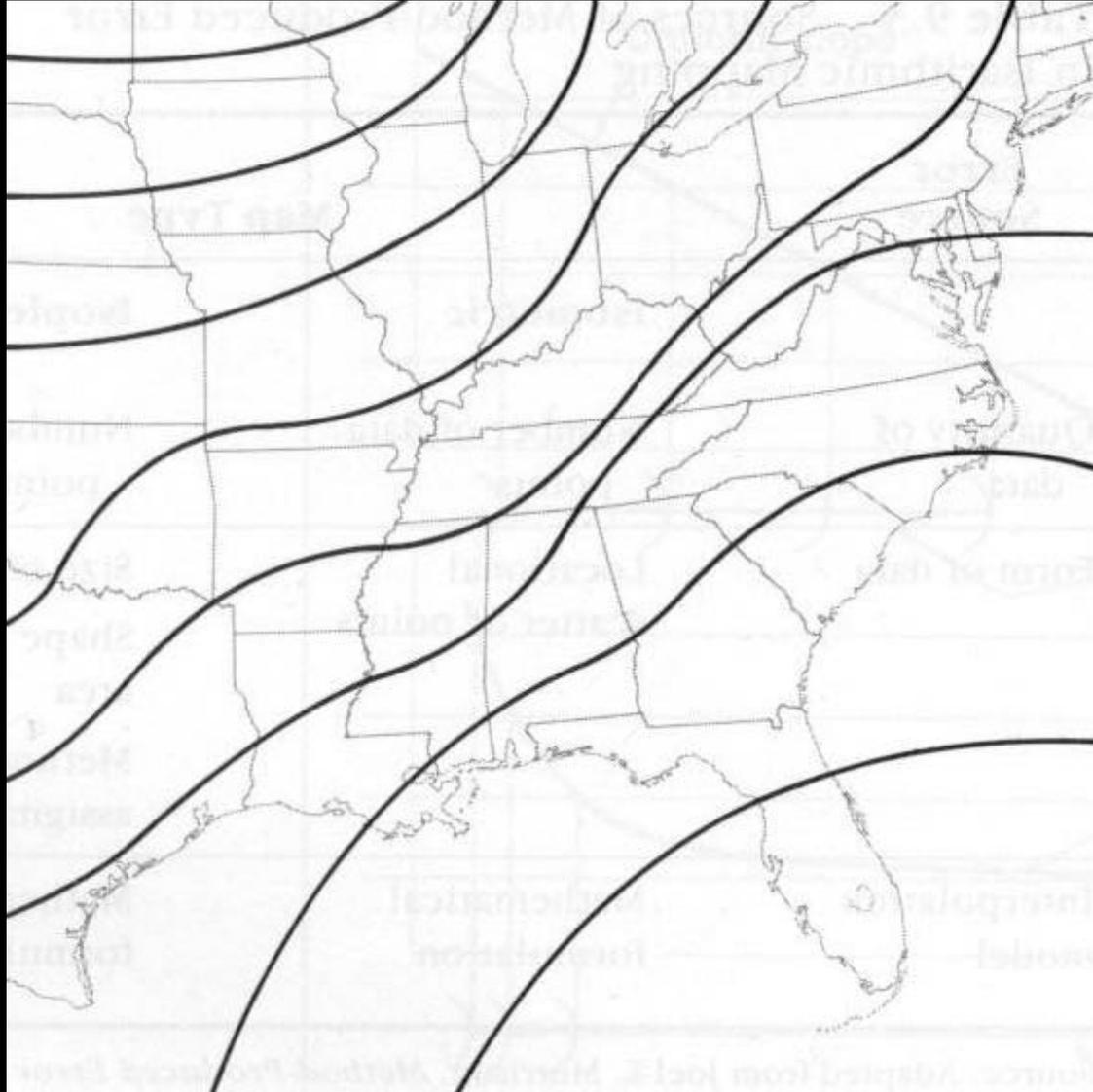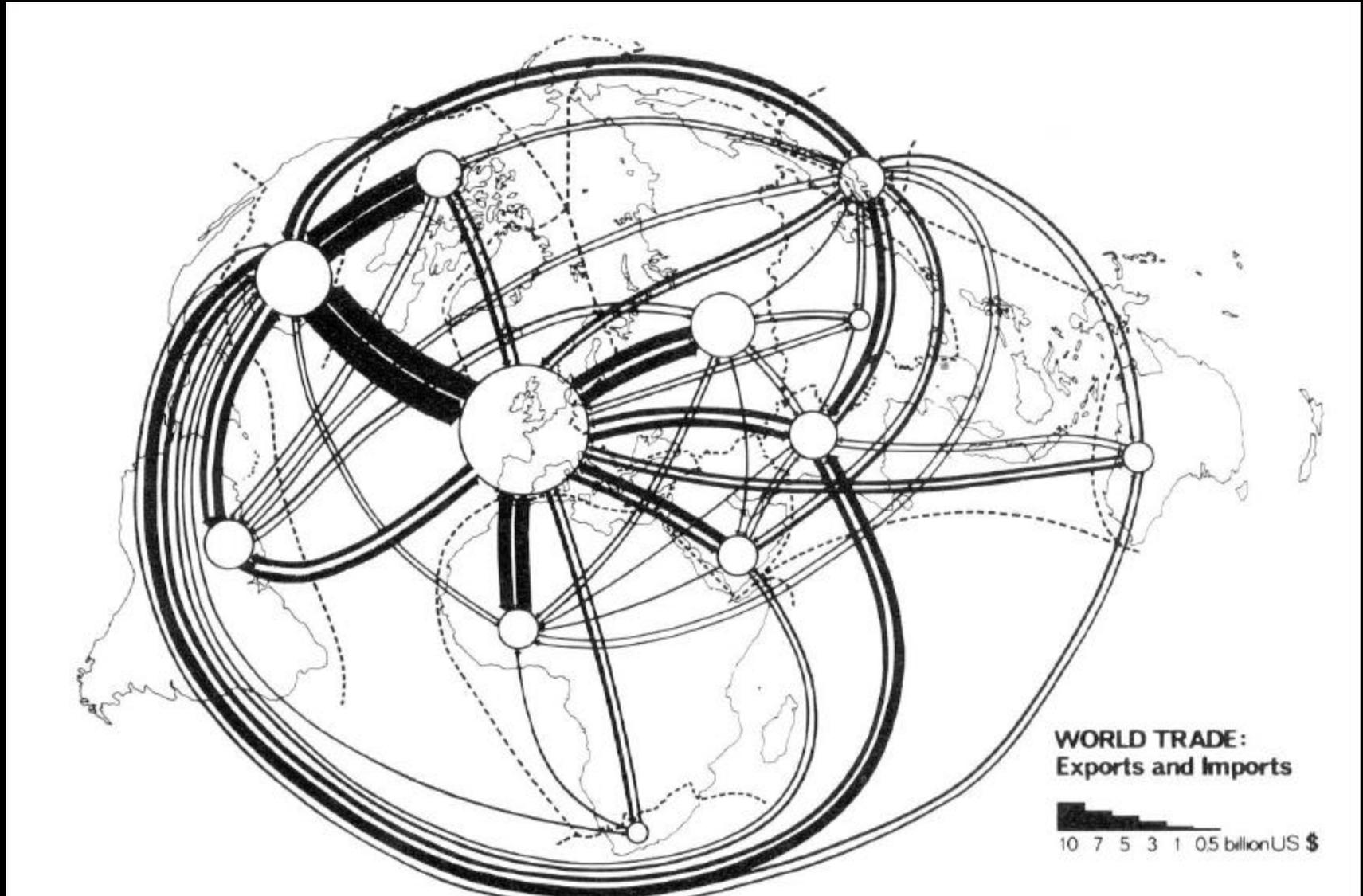
Some Gestalt principle

- Continuation

Continuation and Map-Making

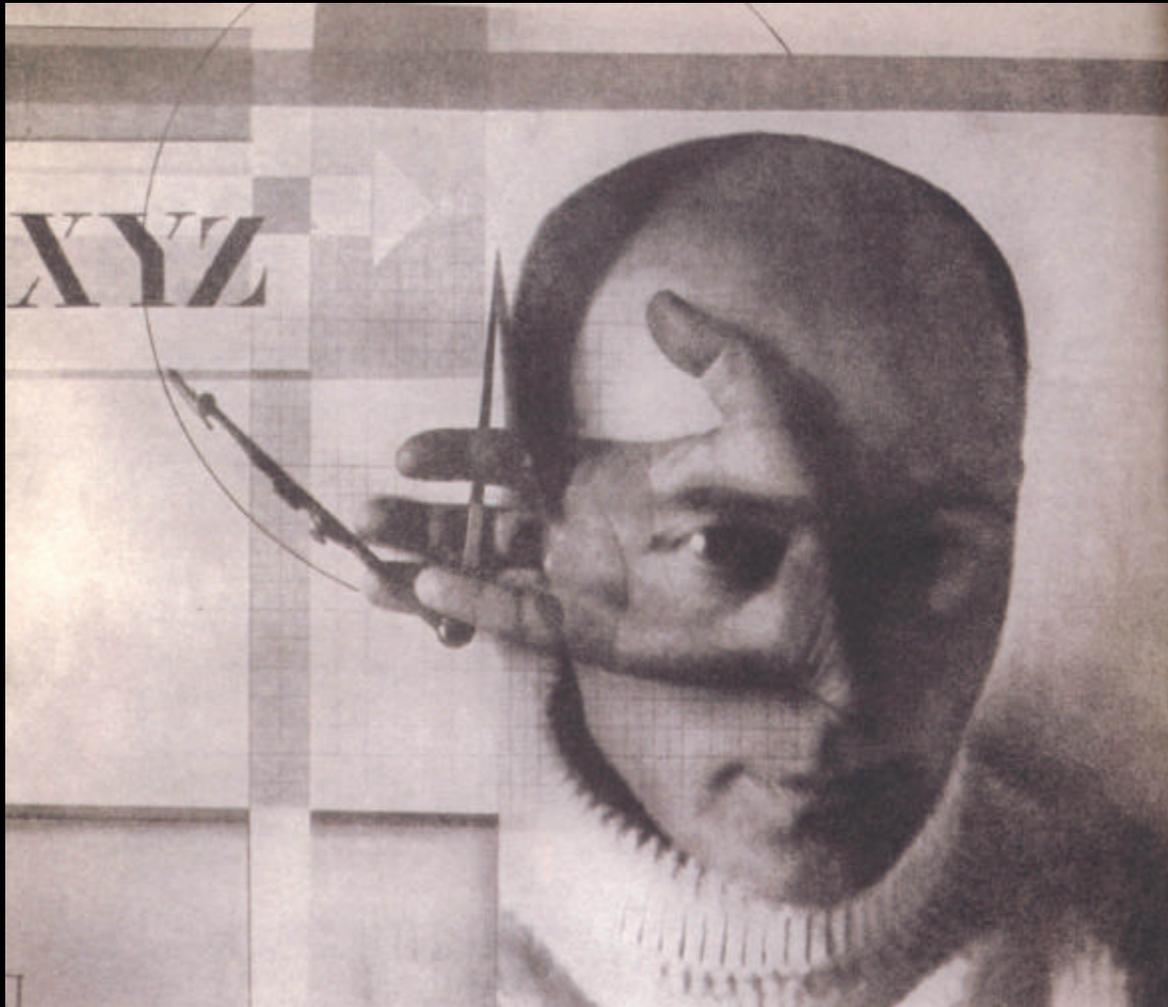# *Continuation and Map-Making*

WORLD TRADE:
Exports and Imports

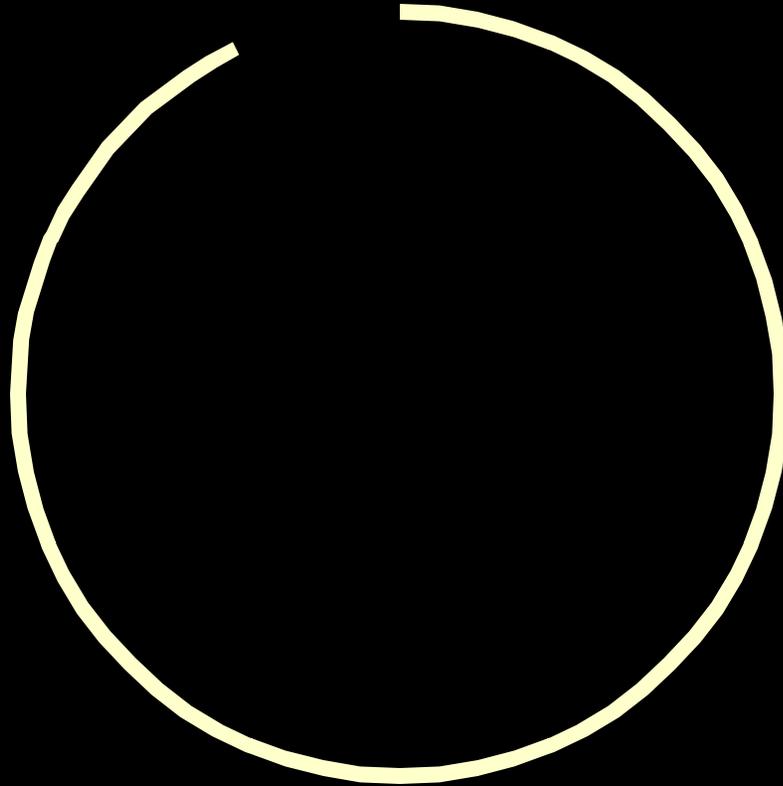10 7 5 3 1 0.5 billion US $

Continuation and design

- El Lissitzky, *Self Portrait: The Constructor* 1924

Some Gestalt principle

- Continuation
- Closure
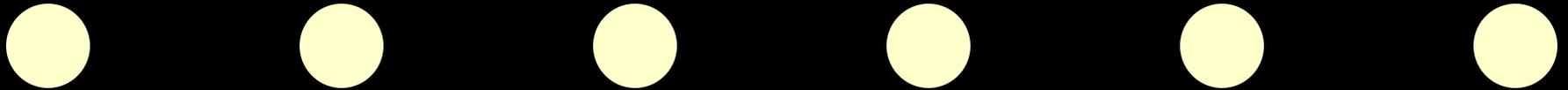
Plan

- Grouping

- Figure-ground
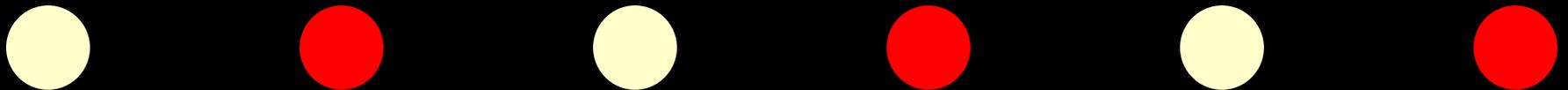
- Completion and illusory contours

No Grouping
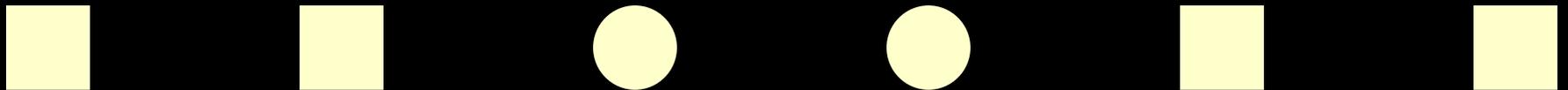
Grouping by proximity

Grouping by color

Grouping by size

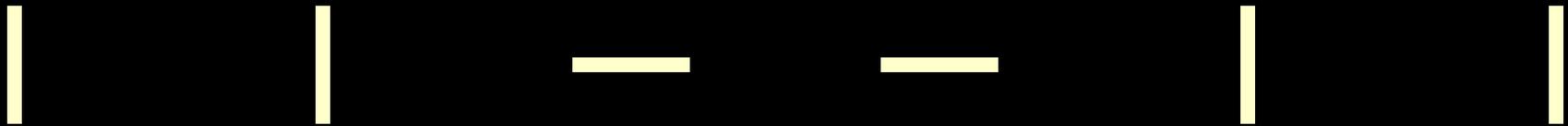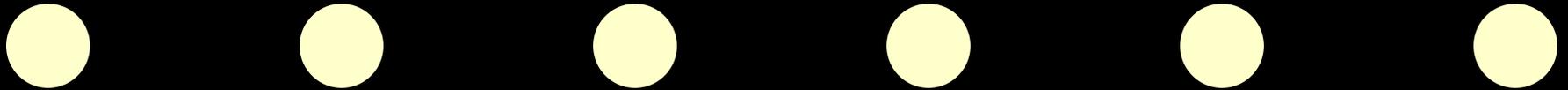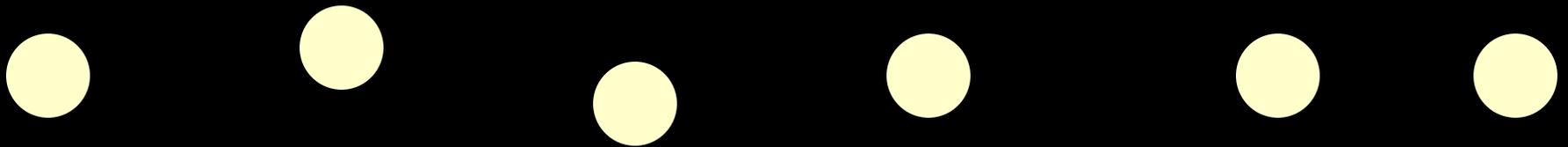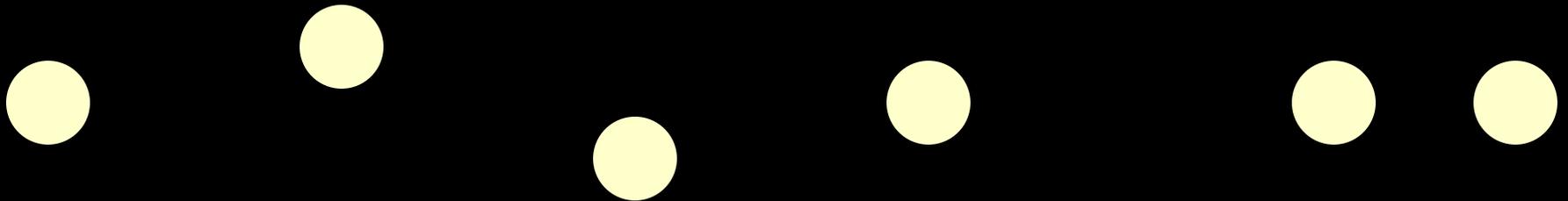# *Grouping by shape*

Grouping by orientation
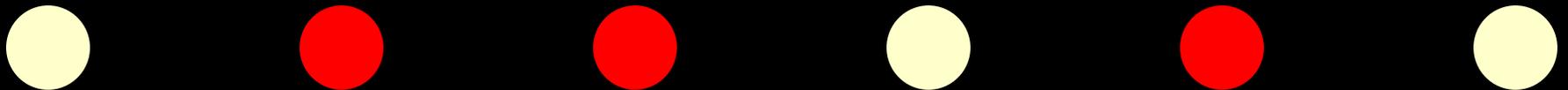
Grouping by synchronicity
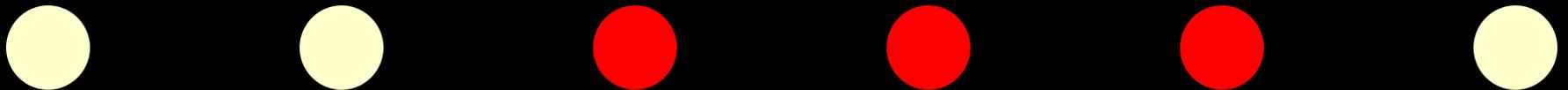
Grouping by synchronicity

Grouping by synchronicity

Grouping by synchronicity II
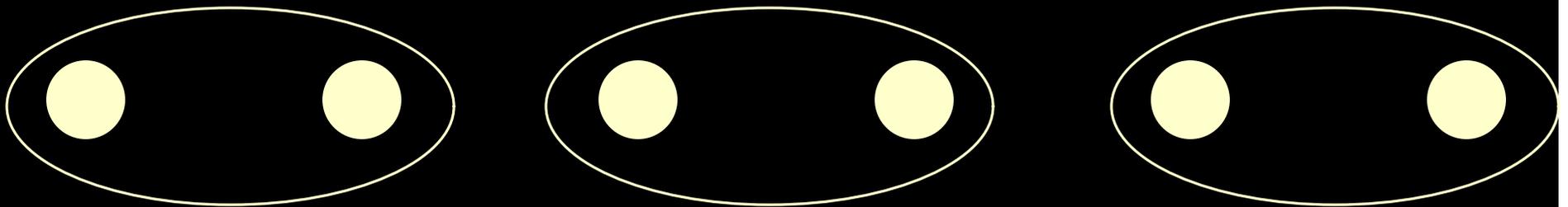
Grouping by synchronicity II

Grouping by region

Grouping by connectedness

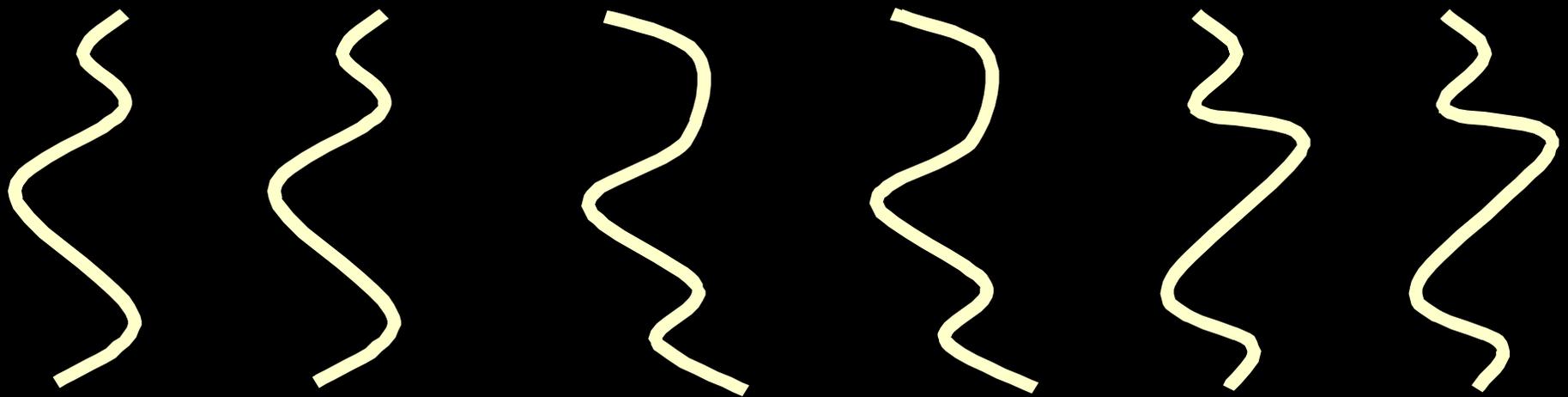# Grouping by symmetry
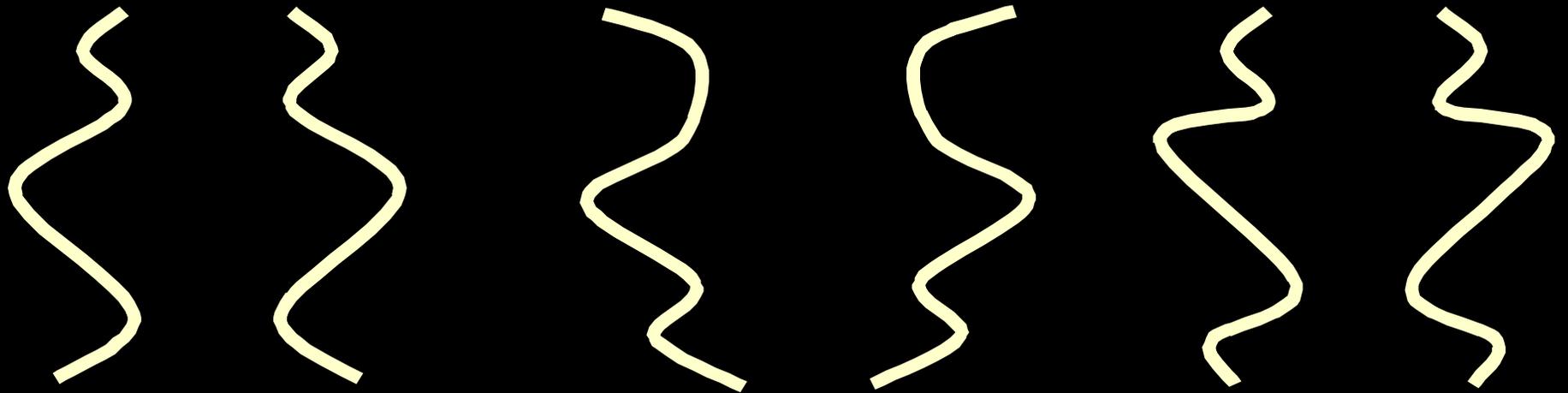
Grouping by parallelism

Grouping conflict

- Proximity is overweighed by region
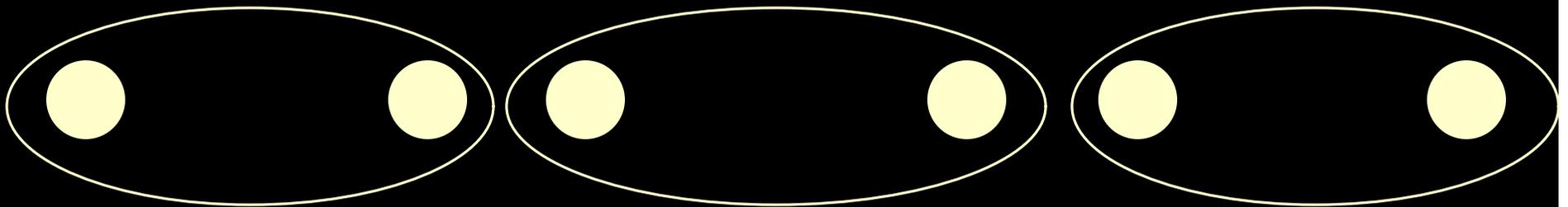
Grouping conflict

- Proximity is overweighed by connectedness

Grouping conflict

- Detect repetition
- Slower when between groups (0.7 vs. 1.1s)
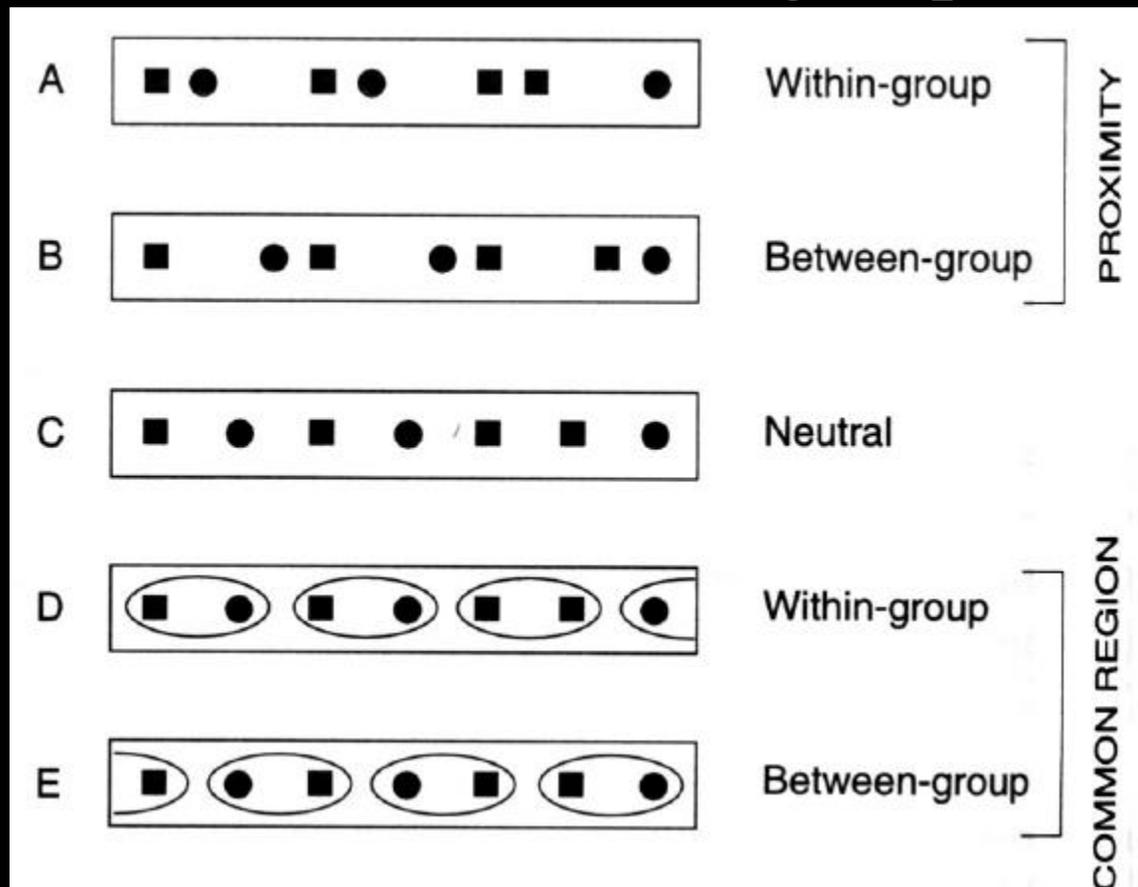
Grouping conflict

- Detect repetition
- Faster when within small oval
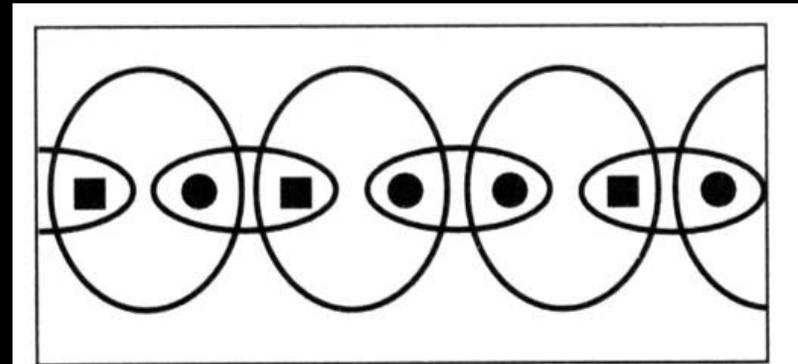
A. Pair within Small Ovals
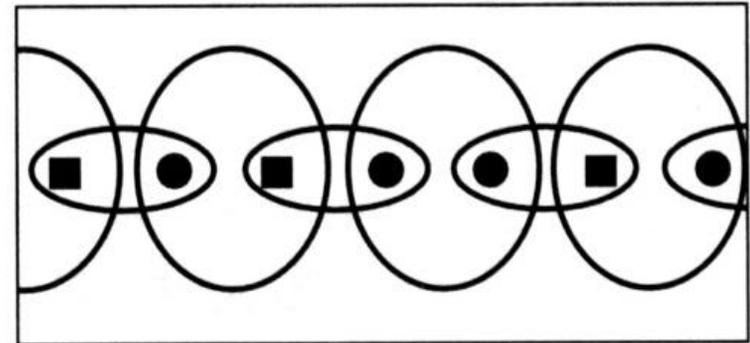
B. Pair within Large Ovals

Grouping after lightness constancy

- If the shadow is visible as a shadow

- Grouped by lightness

Cast Shadow

Reflectance Matched

Luminance Matched
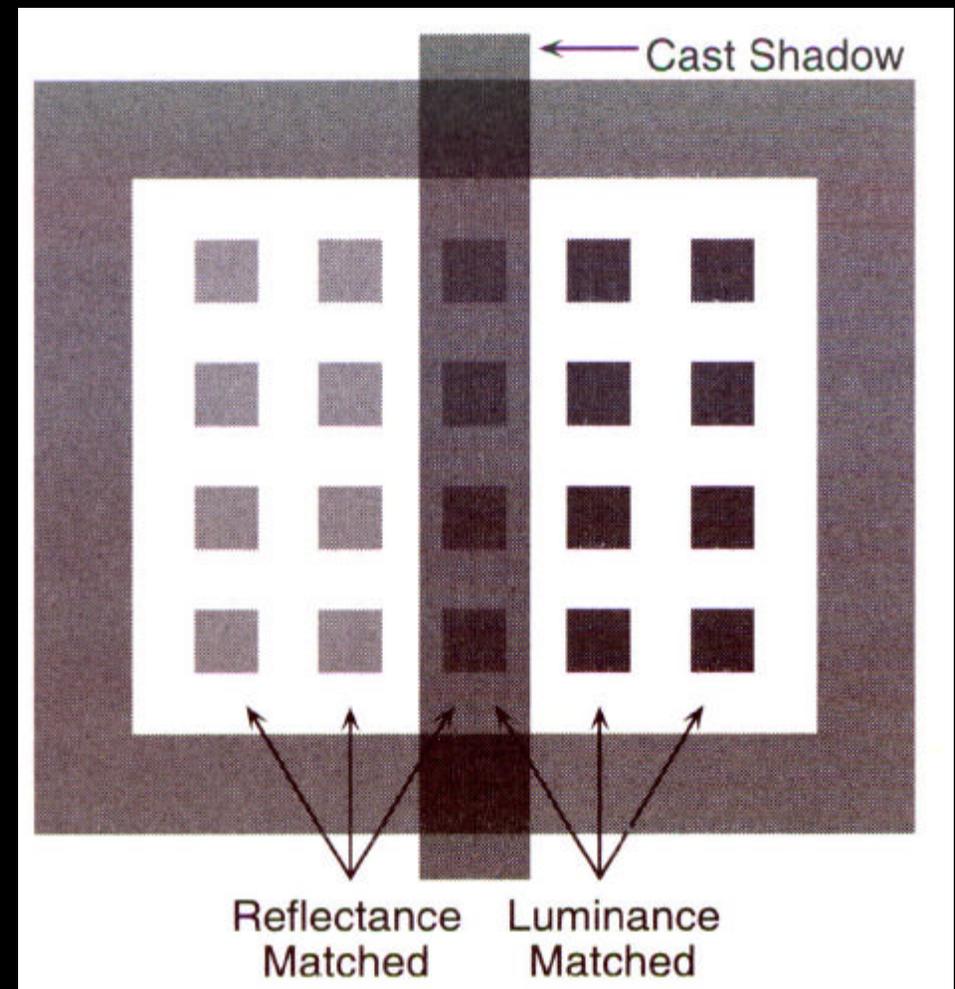
Grouping after size constancy

- Grouped by 3D –proximity, not by retinal image proximity
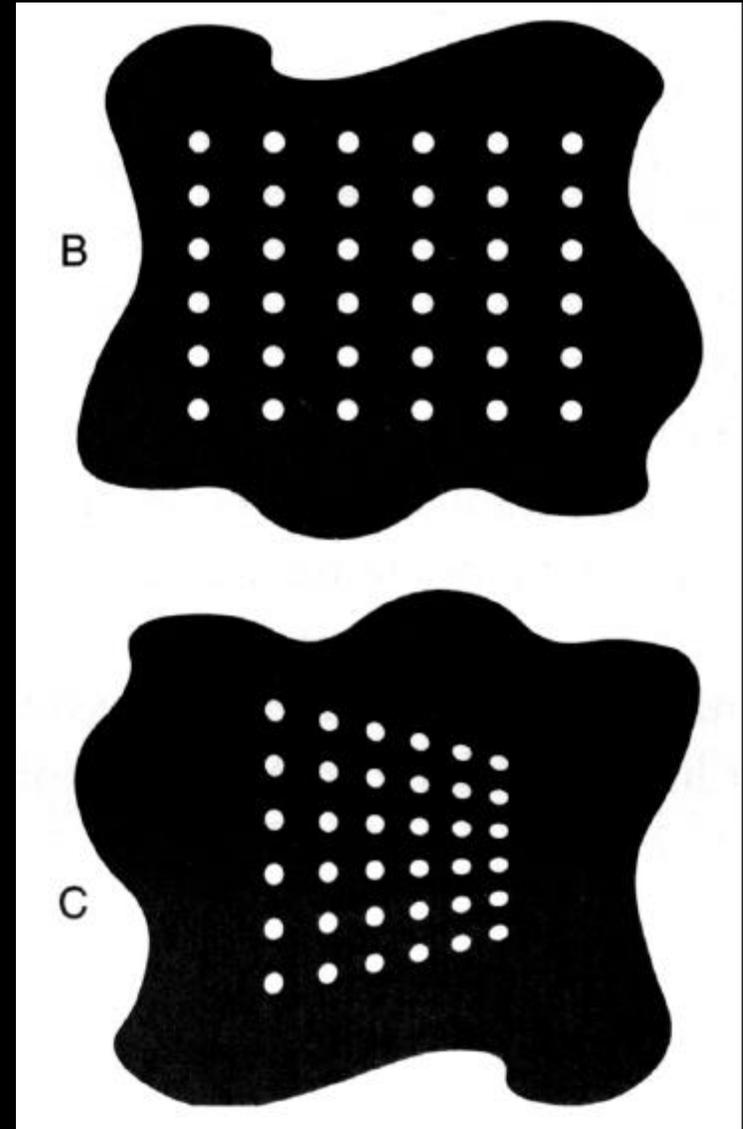
Grouping in complex situations

- No quantitative rule yet!

Grouping in photos

Arthus-Bertrand

Grouping in photos

Arthus-Bertrand

Grouping and photo

Edward

Weston

Grouping and photo

Jean-Pierre Sudre

Grouping

Frank Horvat

Grouping and photo

- Grouping reinforces contrast

Grouping by color

Georgia O'Keeffe

Grouping

- Grouping by proximity tells story

Grouping

- Abbas
  South African Police in Training, 1978

- Grouping by proximity and similarity tells story
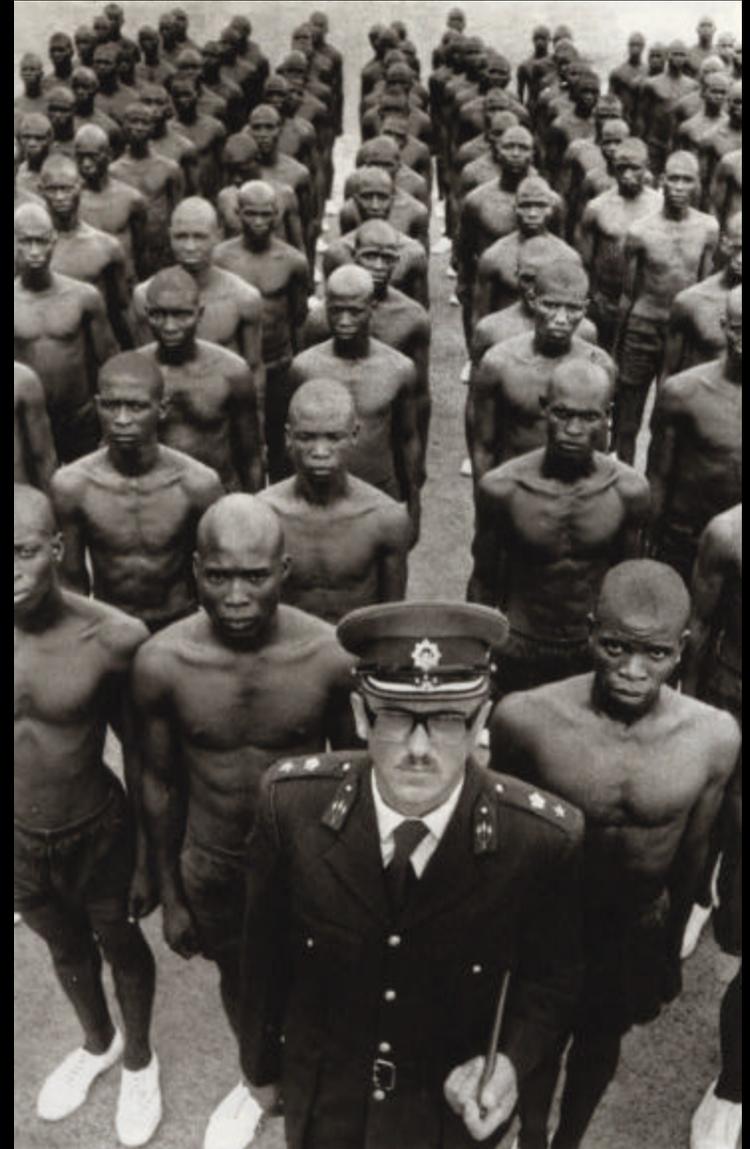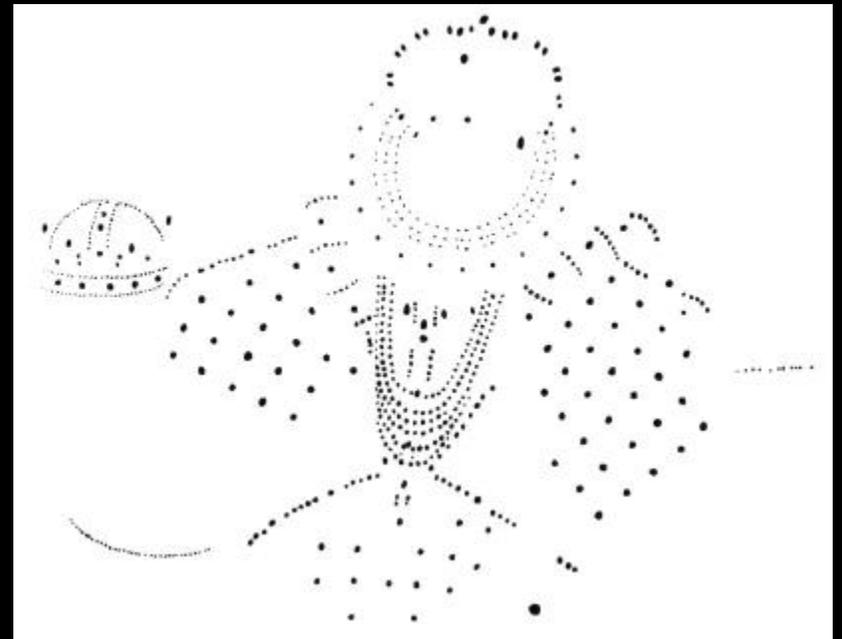
Grouping

- Grouping by similarity

Grouping & Map Making

- Grouping provides efficient analysis

Psychological Well-Being of Inhabitants in Selected Cities United States

◯ The 25 lowest stress cities

● The 25 highest stress cities

The city with the overall least stress is State College, PA., and that with most stress is Reno, NV.

City stress is based on combined overall rates of alcoholism, crime, suicide, and divorce

Source of data: Robert Levine, "City Stress Index," Psychology Today, November, 1988, pp. 53-58.

Grouping & Architecture

- Grouping by similarity

Grouping & Architecture

- Grouping and symmetry

- Cesar Pelli
  Petronas Towers
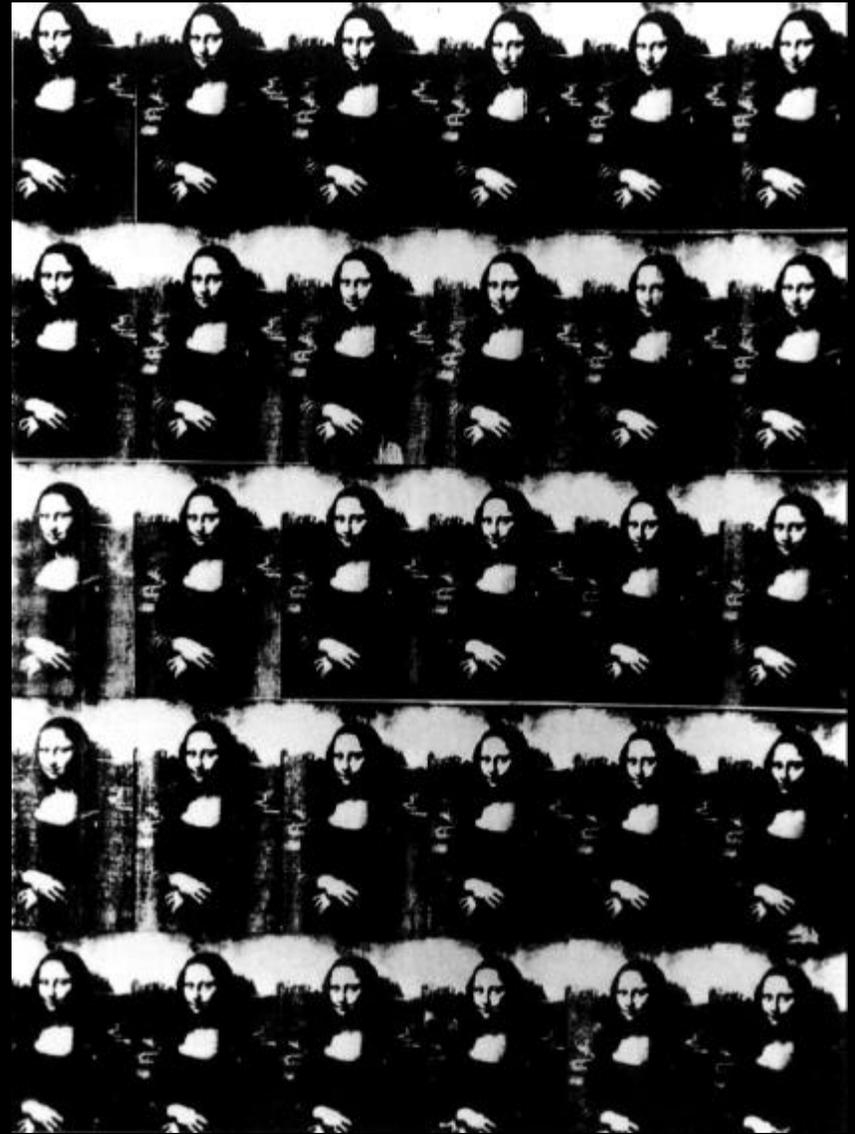 Kuala Lumpur, Malaysia
  1991-97

Grouping

- Lucien Clergue
  Camargue, 1940

Grouping and repetition

- Andy Warhol
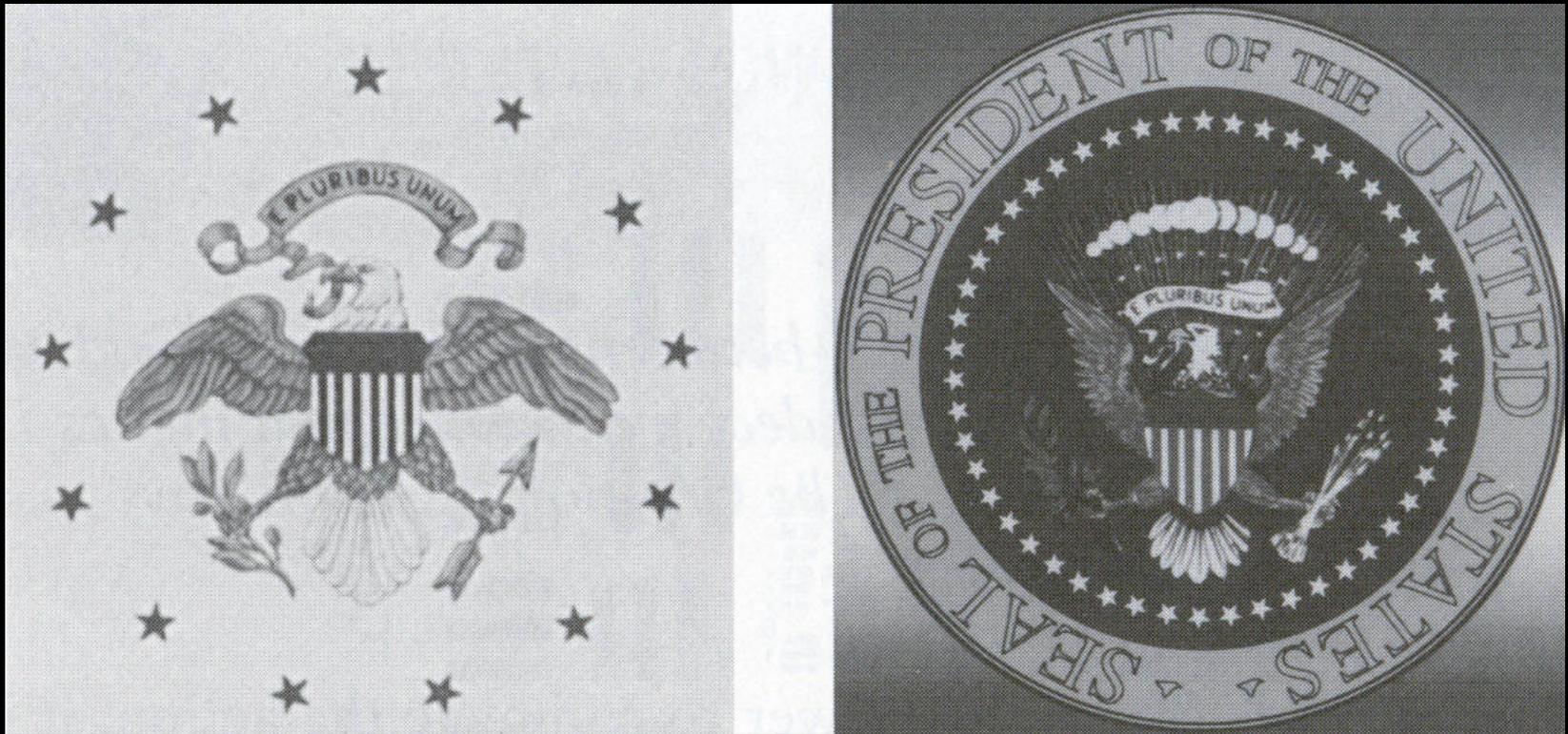 *30 Are Better than One*
  1963

Grouping and ornament
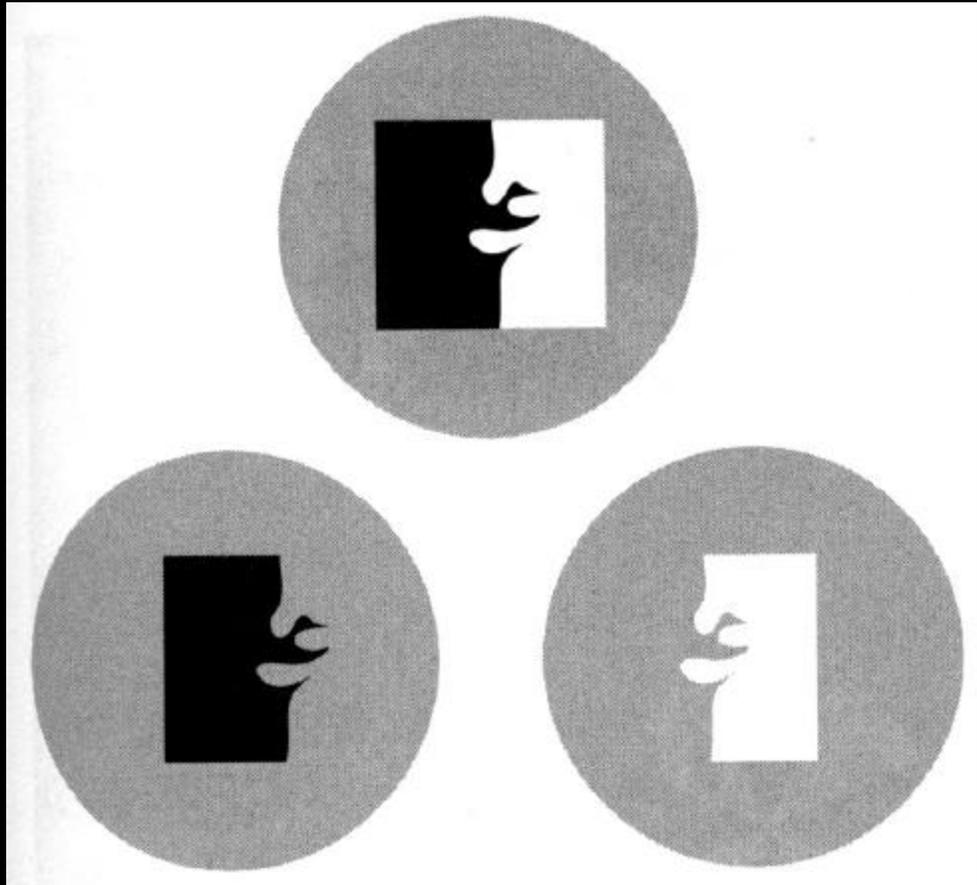
- Repetition, rhythm

Closure & grouping

Plan

- Grouping

- **Figure-ground**
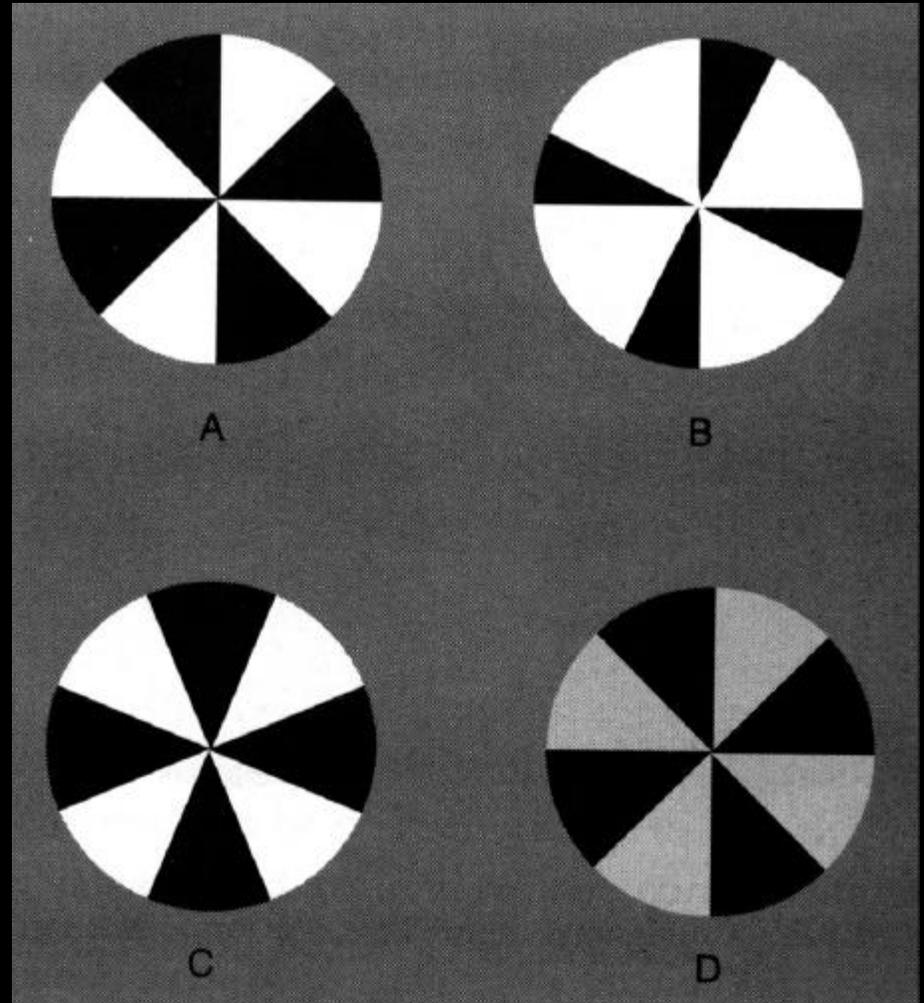
- Completion and illusory contours

Figure-ground

- There has to be one figure and one ground
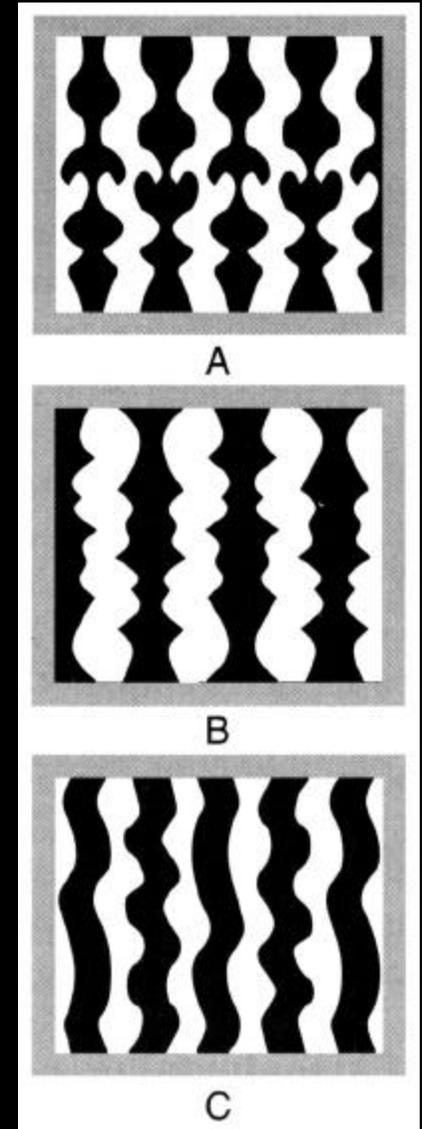- Related to occlusion and thus to depth

Figure-ground

- A: ambiguous
- B: relative size
- C: symmetry
   & main axis
- D: contrast

Figure-ground

- A: symmetry
- B: convexity
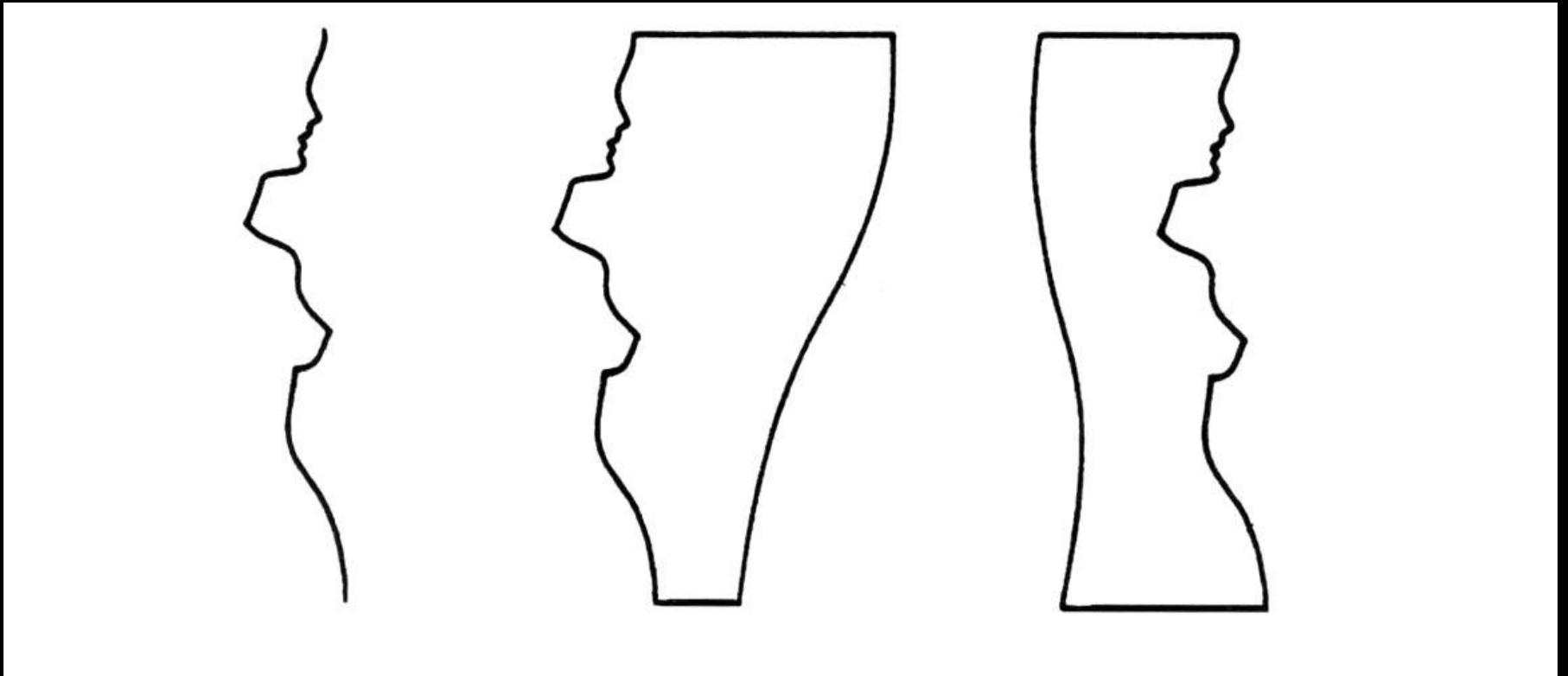- C: parallelism

Figure-ground & familiarity
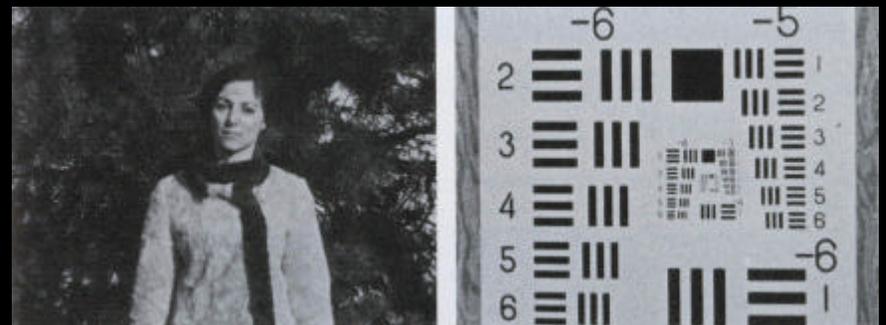
Figure-ground & familiarity

Closure & figure-ground

Figure-ground & signal-noise ratio

- Information theory (Shannon)

- Figure-ground separation is simpler when high signal-noise ratio

Figure-ground painting

Figure-ground pun

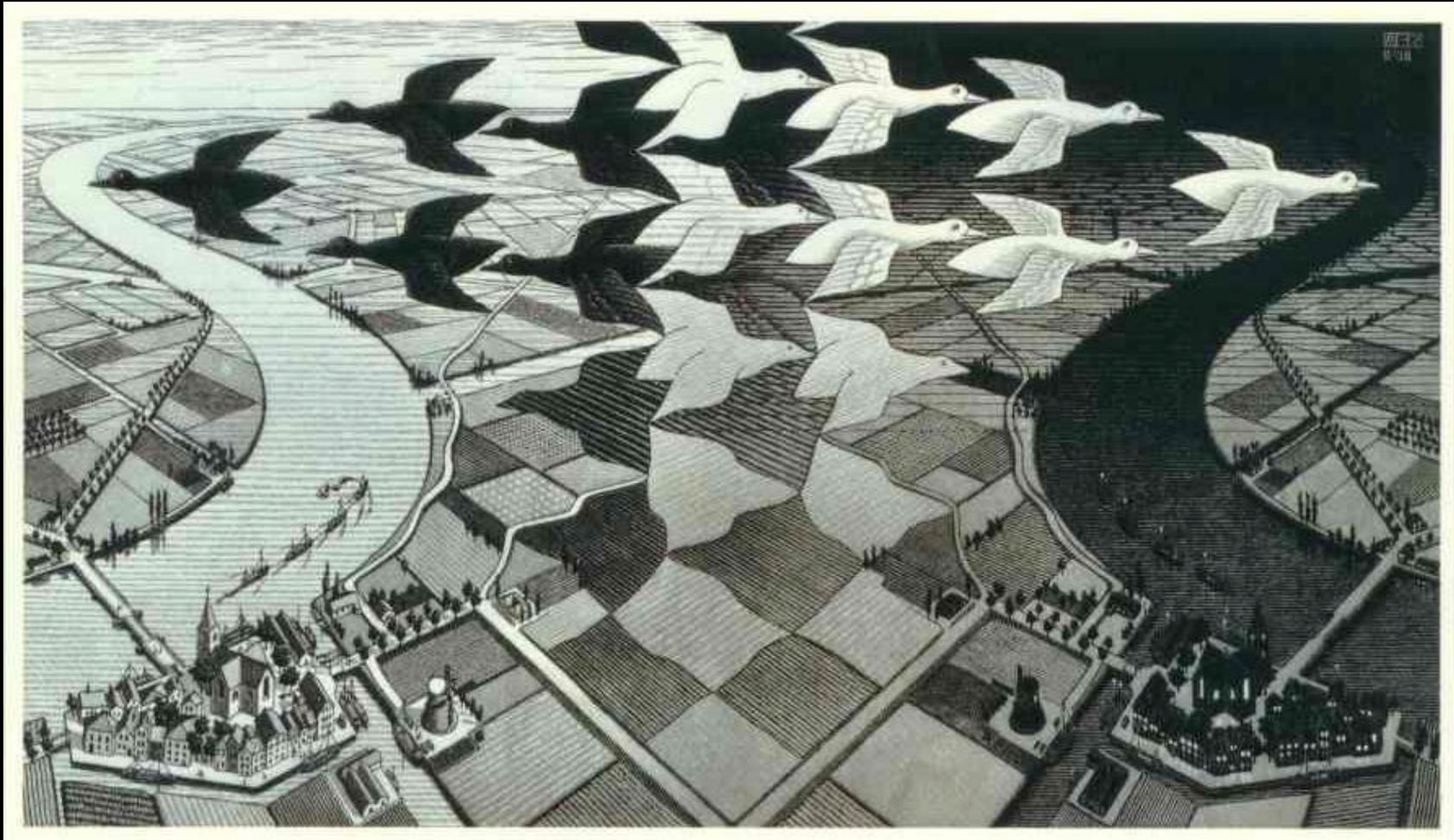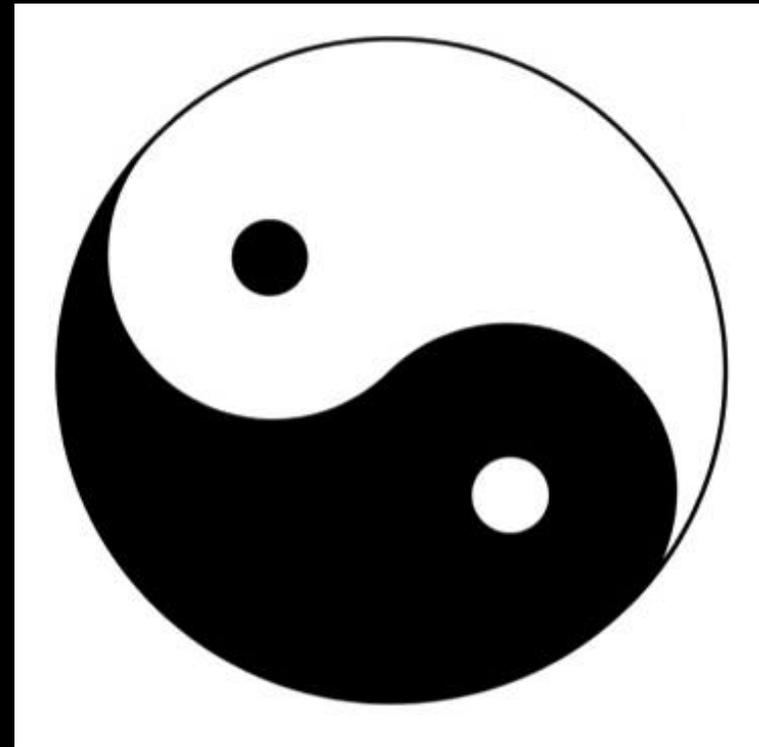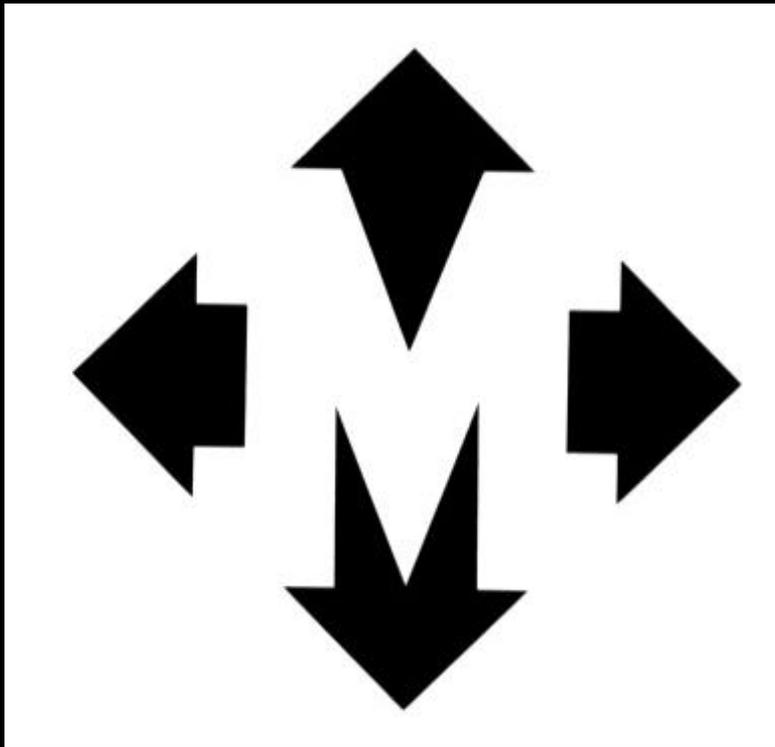- Rubin vase

Figure-ground transition

- +grouping

Figure-ground logos

Figure-ground logos

Figure Ground in design

- ## Sharon Gresh, Michael Mc Ginn

Figure ground: empty ground

Hopper

Figure ground simplification

Figure-ground simplification

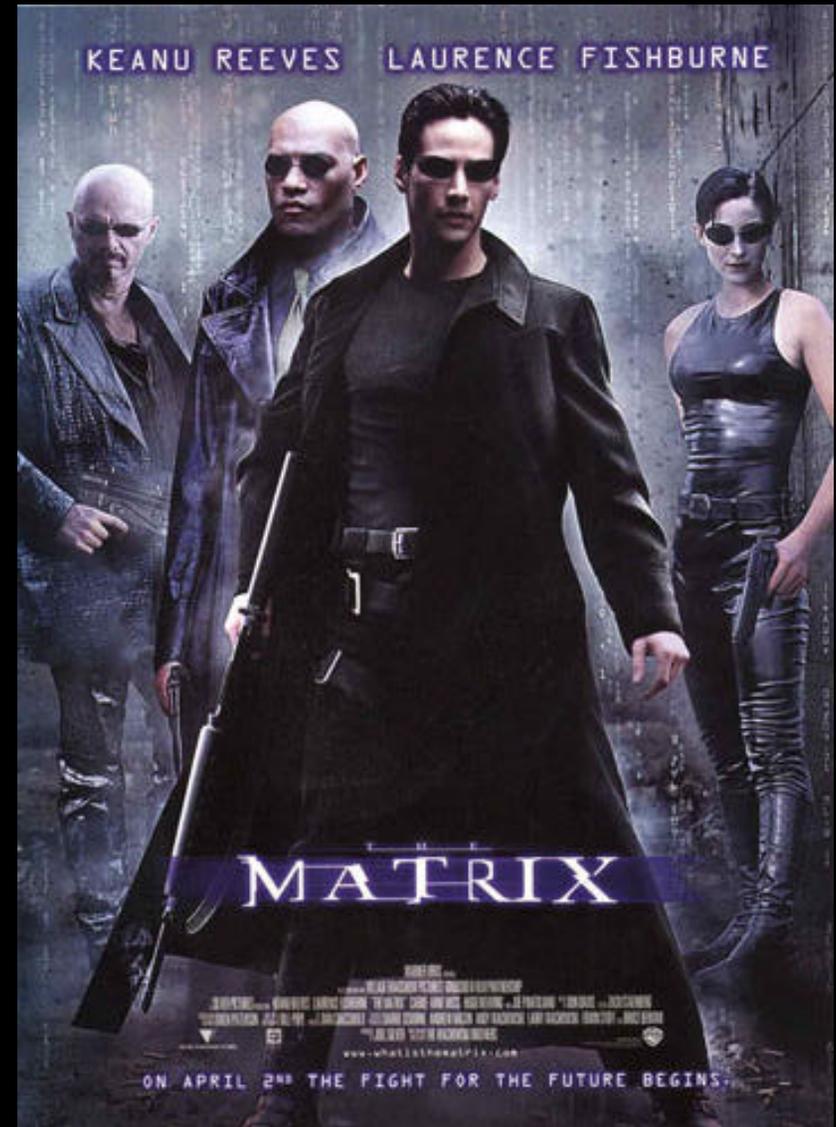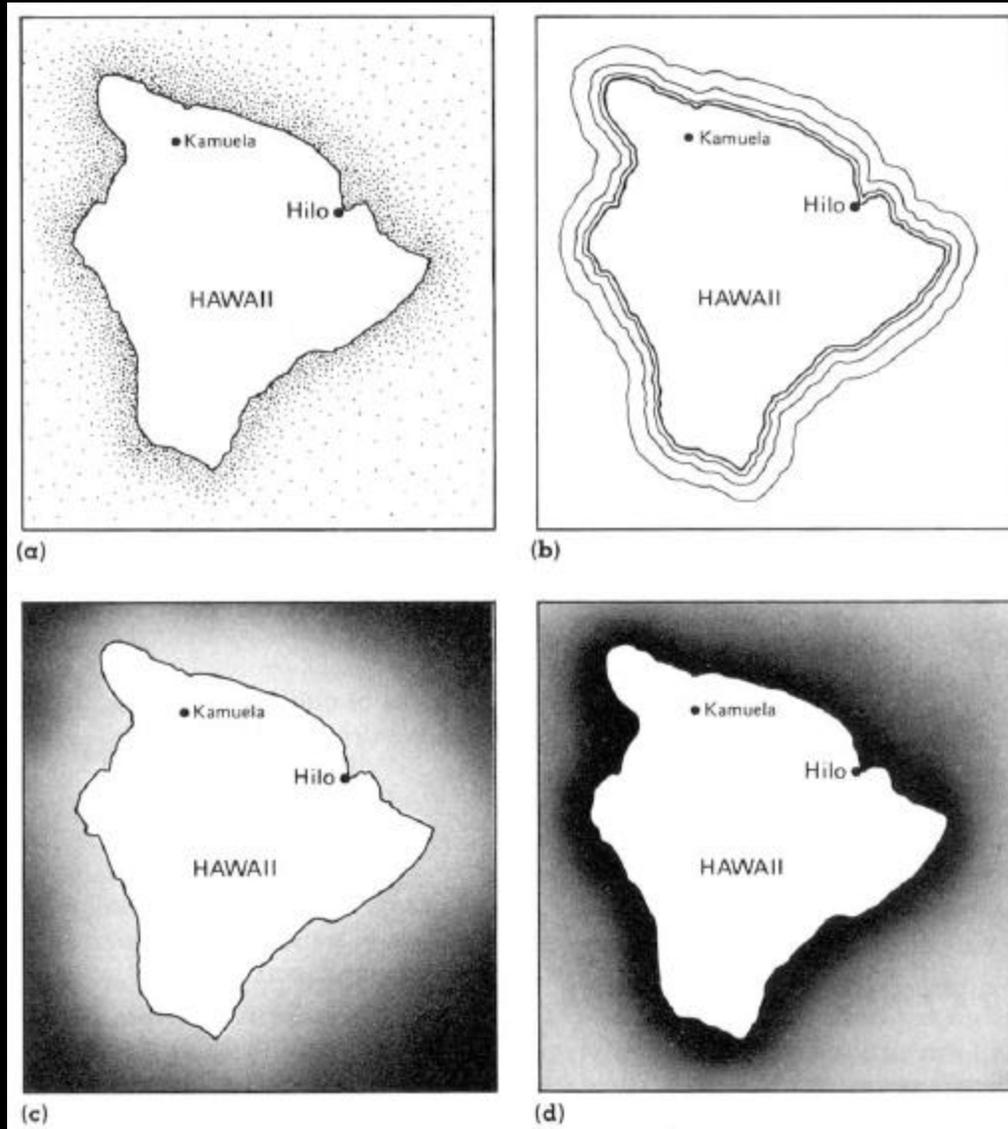- Egon Schiele

- Contrast enhancement

Figure-ground simplification

Figure-ground and map-making

Figure ground – not so easy

- Monet

Figure ground – not so easy

- Picasso

Figure ground – stage of vision

- Note that Impressionism and cubism where not classified surface-based

- In contrast, in this Raphael, figure-ground separation is easy
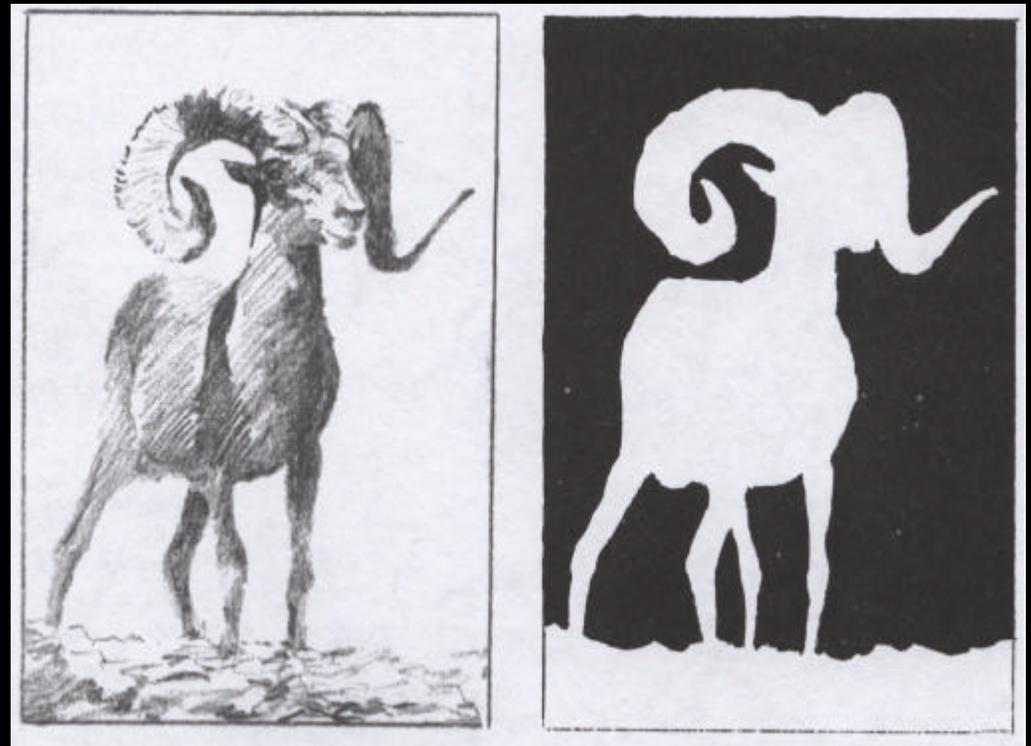
Figure ground – stage of vision

- Note that Impressionism and cubism where not classified surface-based

- But in this Picasso, figure-ground separation is easy

Negative space

- The ground defines the negative space
- Usually overlooked
- Fundamental for balance
  - Typography

From *Drawing with the Right Side of the Brain*, Edwards

Negative space

- George Seurat

Negative space

- George Seurat

Closure & Negative space

- Negative space are enclosed in the picture frame

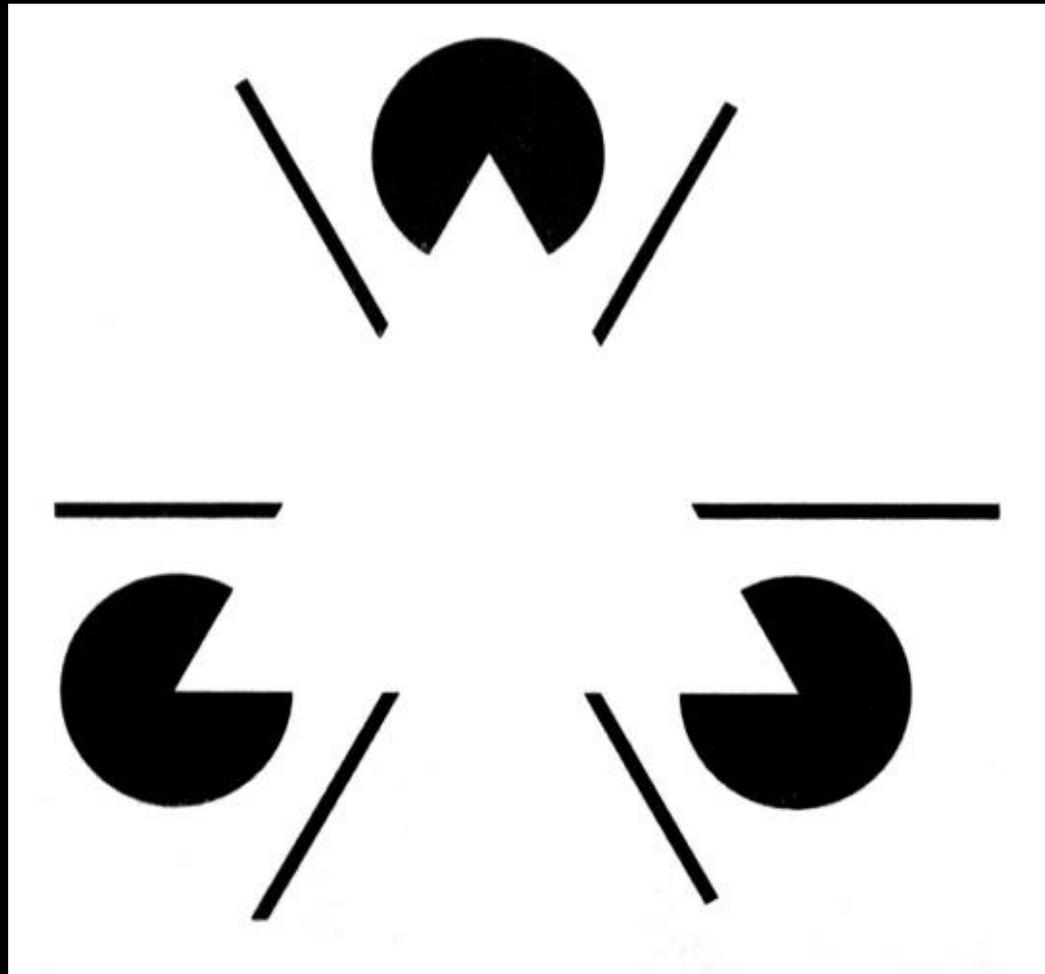# *Negative space in Architecture*

- Michael Graves, 1969

Plan

- Grouping
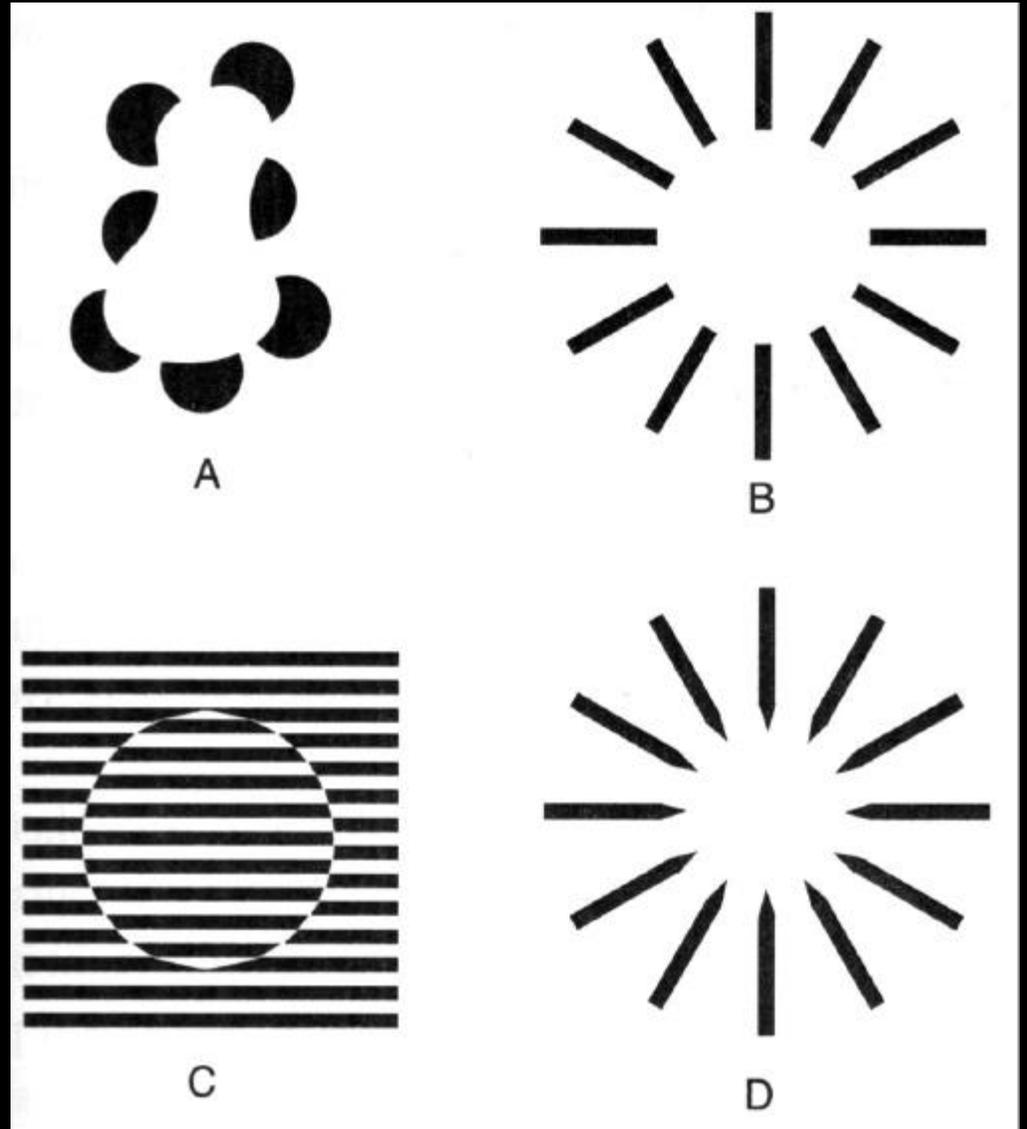
- Figure-ground

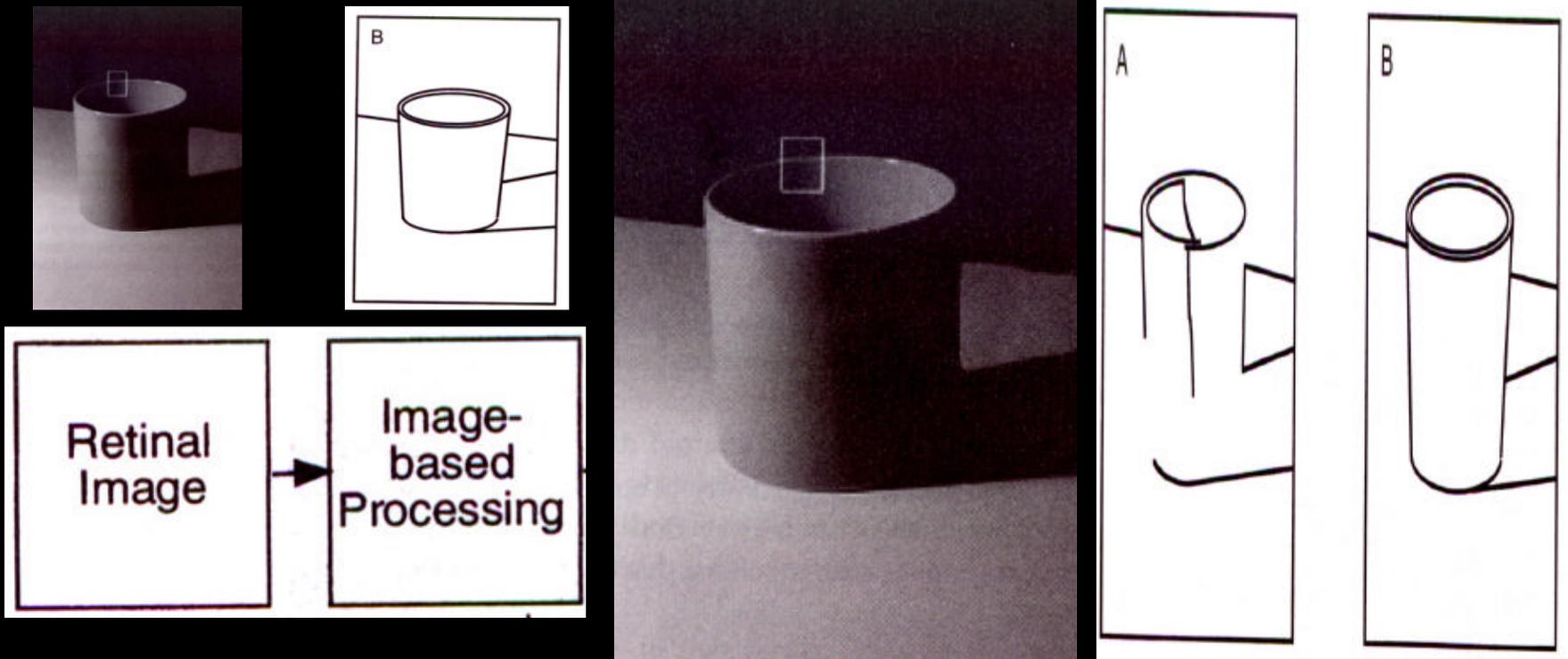- Completion and illusory contours

Illusory contours

- Kanisza

Illusory contours

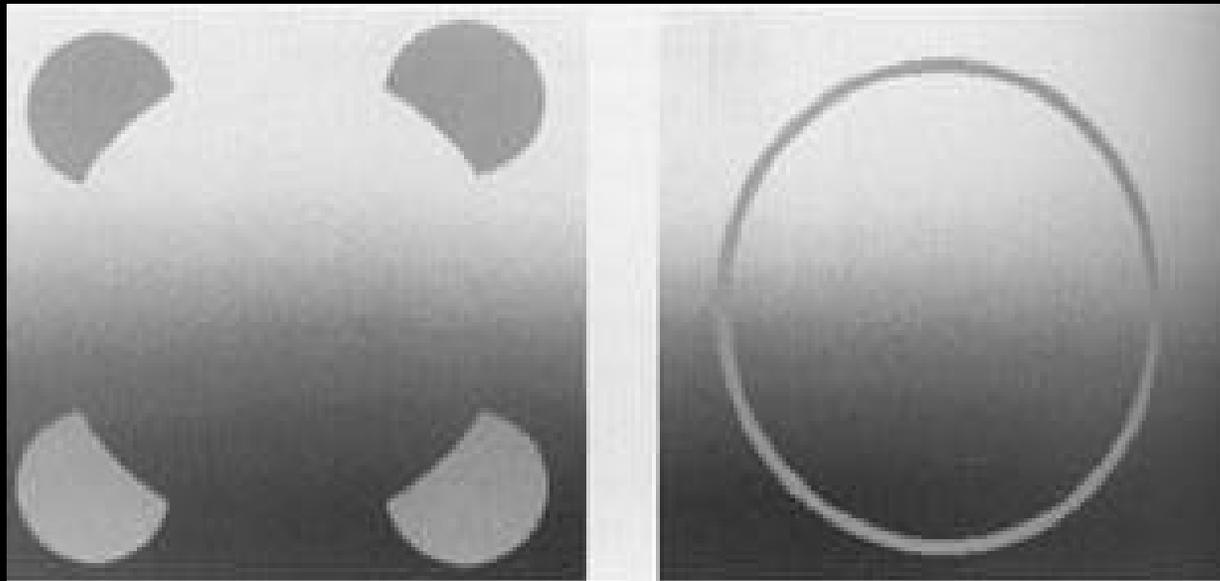# *Image-based (primary sketch)*

- Contrast, edge detection
- Not so easy

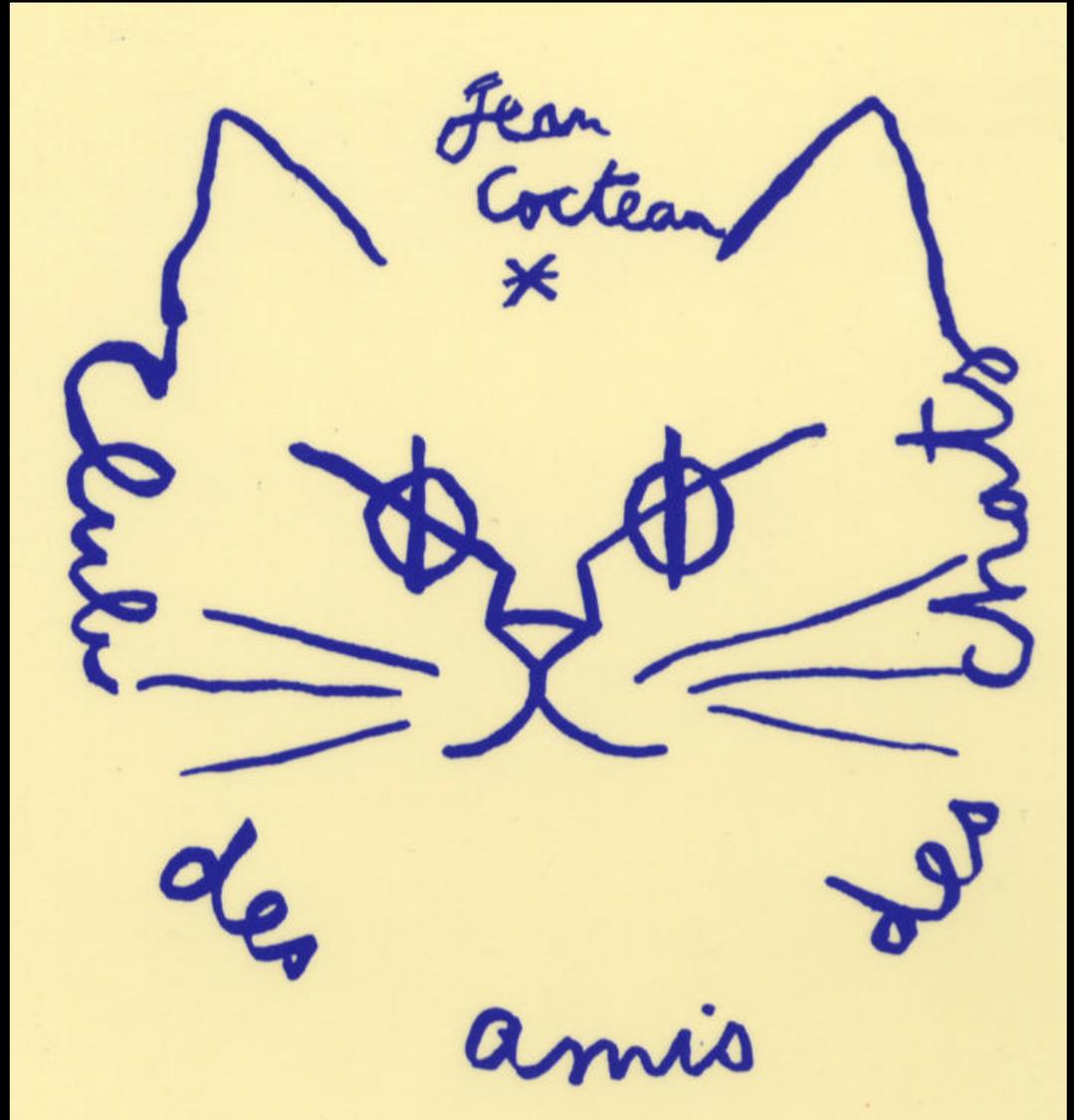Raw edge detection

Illusory contour

- Can be more effective

Illusory contour

The American Short Story

Illusory contour

- Cocteau

Illusory contour

- Matisse

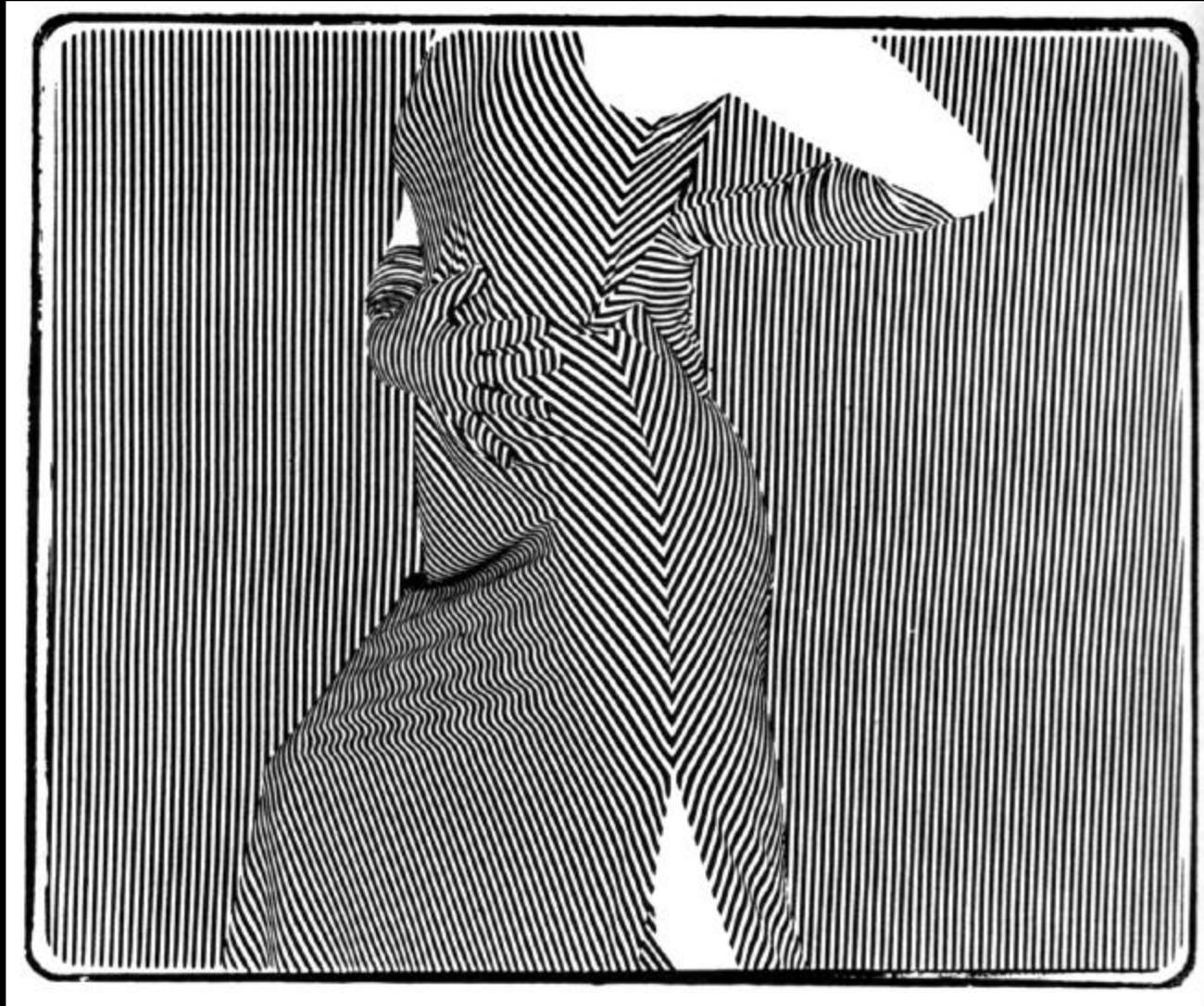# *Figure-ground and illusory contour*
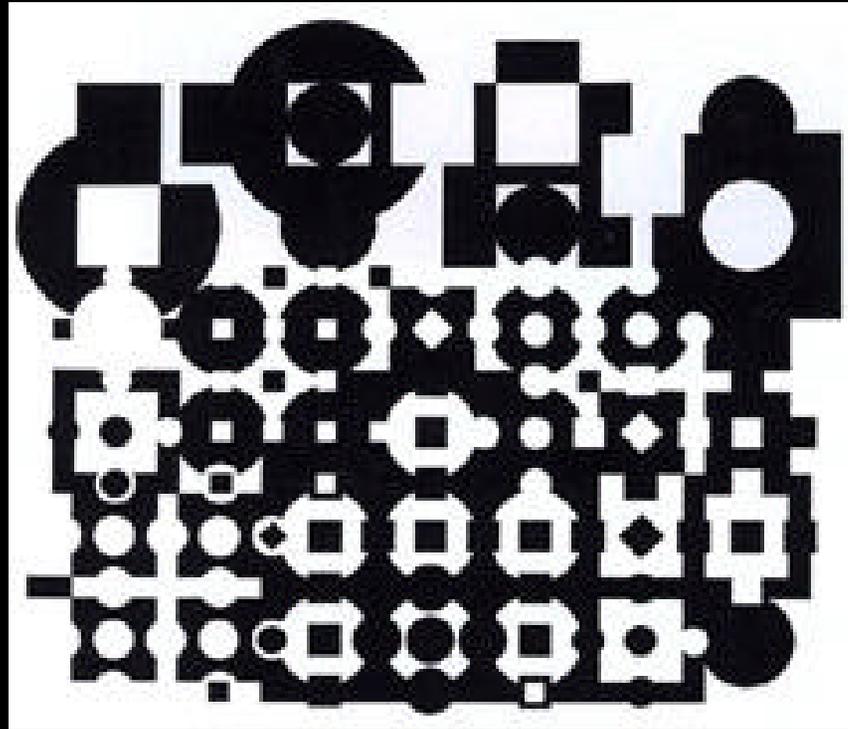
Figure-ground puzzle

Illusory contour

- From [Ramachandran 1995]

Illusory contours

Vasarely, *Helios*

Illusory contour

- William Anders
  Earthshine
  1969

- Prägnanz:
  a circle is
  "simpler"

Illusory contour
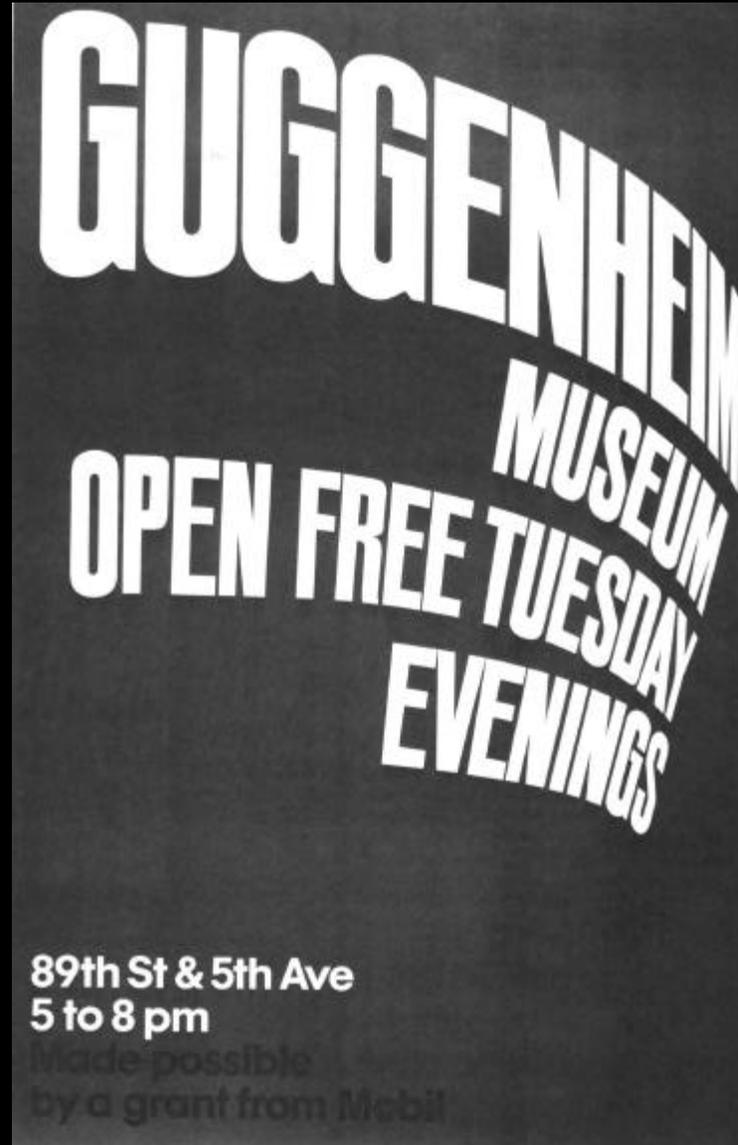
- Familiarity helps

Disappears rather quickly, doesn't it.

Illusory contour
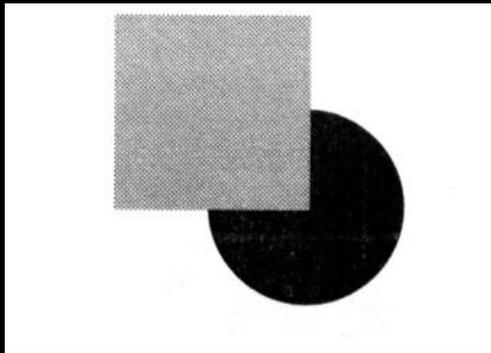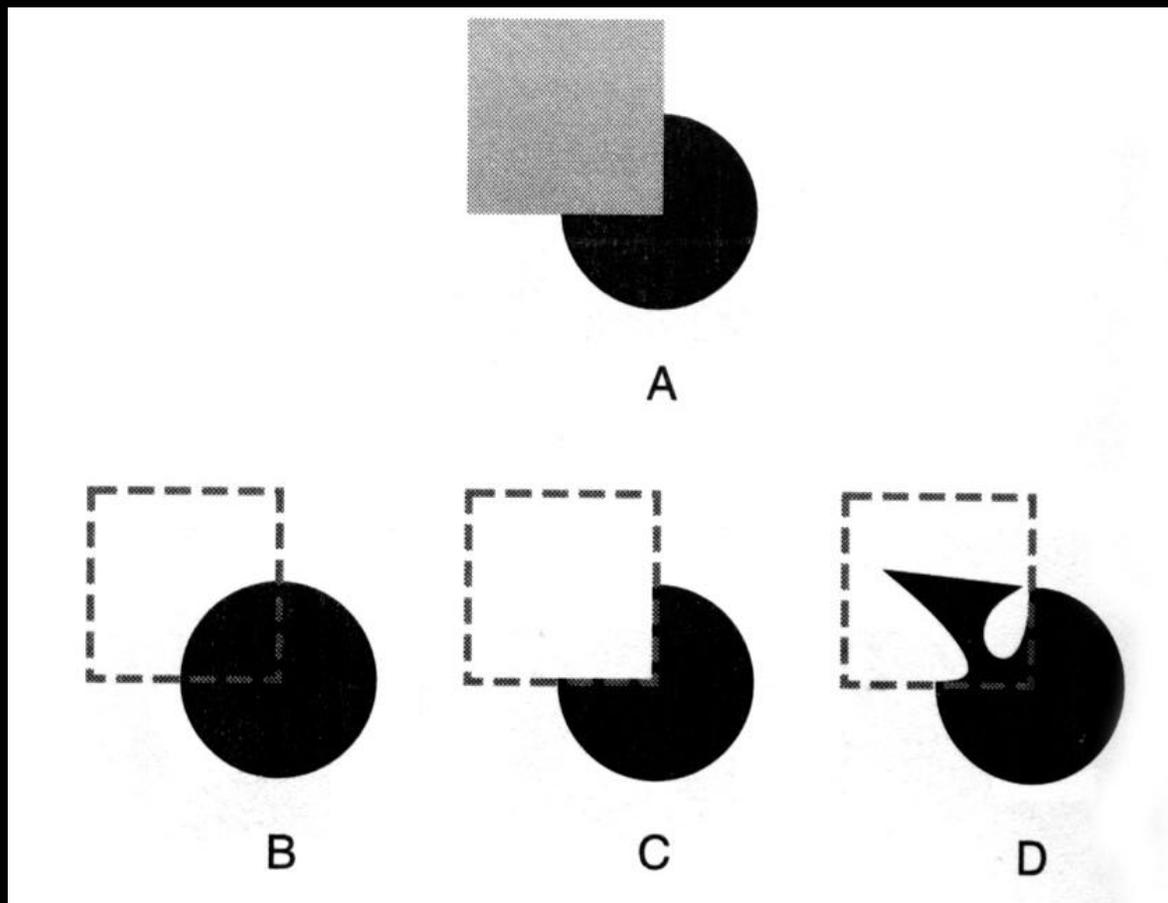
- Familiarity helps

Visual completion
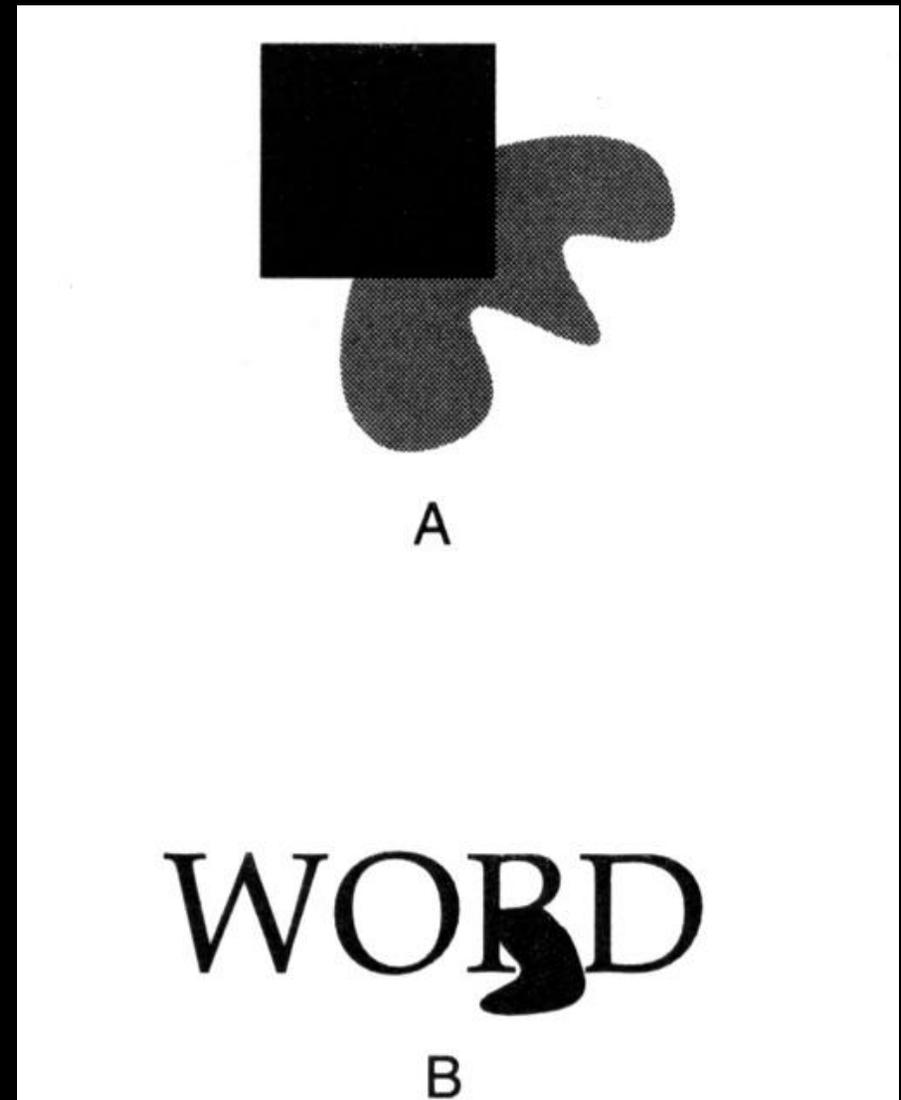
- We complete the occluded part

Visual completion

- We complete the occluded part with the simplest shape

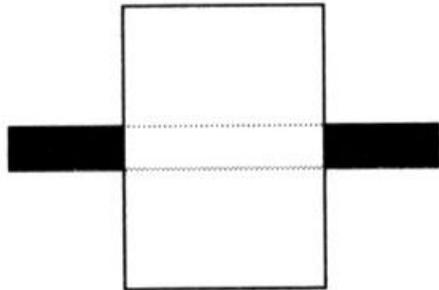# *Visual completion*

- With no context
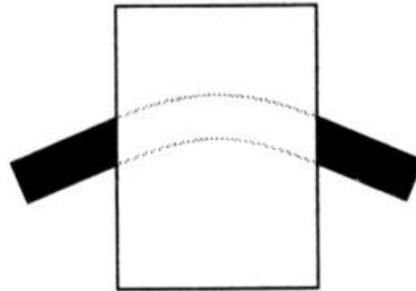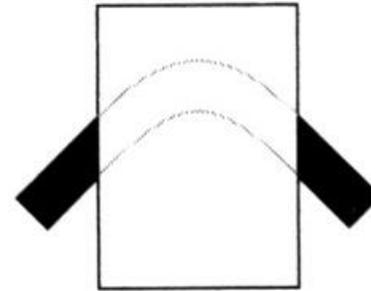
- With context
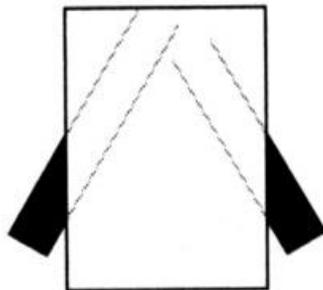

A

WORD

B

Relatable edges

A   B   C

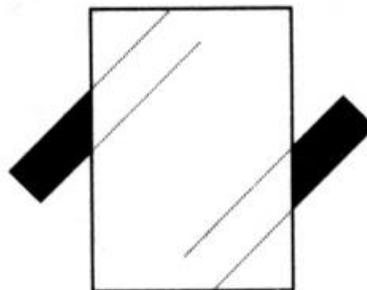Relatable Edges
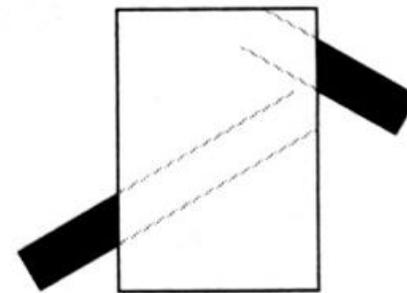
D   E   F

Unrelatable Edges

Illusory contour & completion

- Both "see" a figure from incomplete information

A   B   C
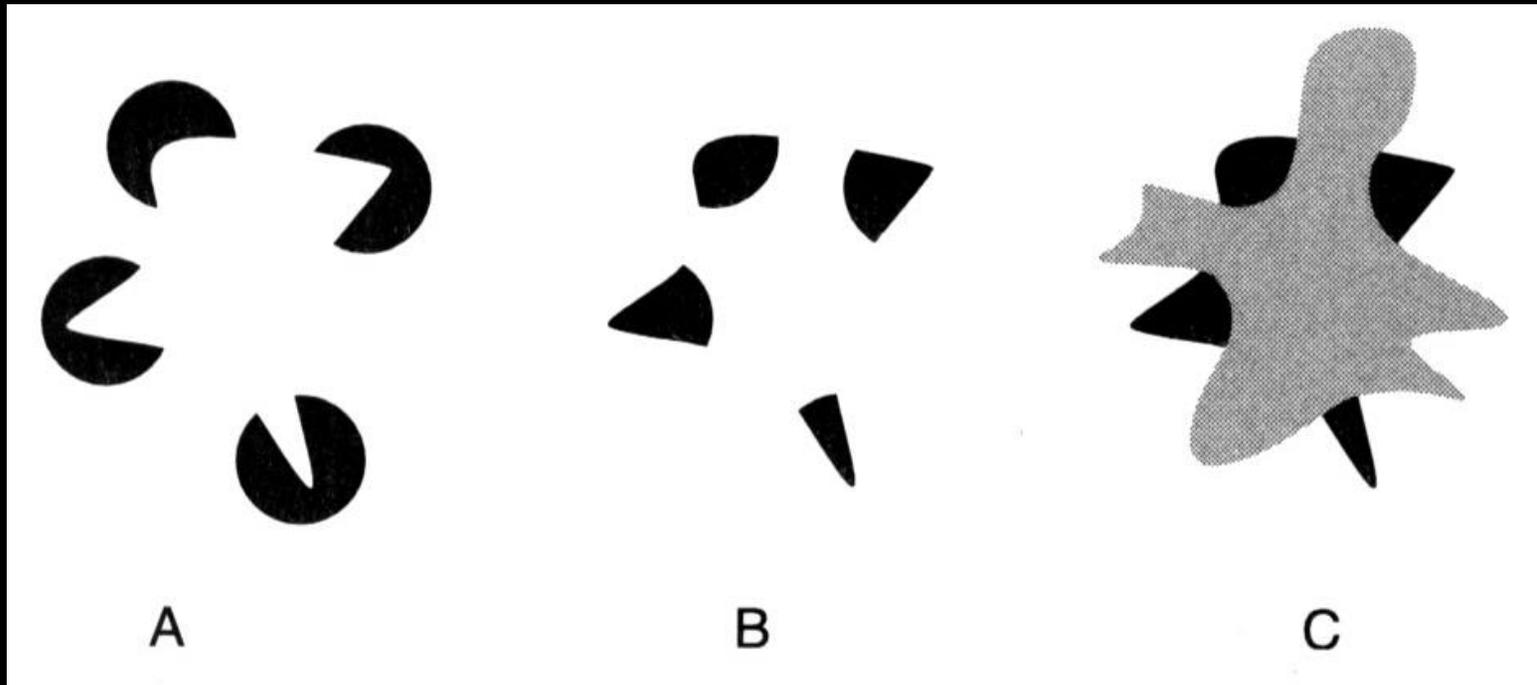
Visual completion

- Clarence Lee, 1977

ONE NINE SEVEN SEVEN

Visual completion

- Greg Brown (mural)

Completion

- Magritte

Completion

- Degas
- Framing

Completion

- Marc Riboud

- Completion is challenged

Summary

- Grouping

- Figure-ground

- Completion

- As usual pictures can
  - Simplify
  - Challenge

Assignments

- Piranesi
  - Tutorial 1 to 4

- Reading
  - Art and Illusion, Gombrich
  - Summary 1 to 2 pages
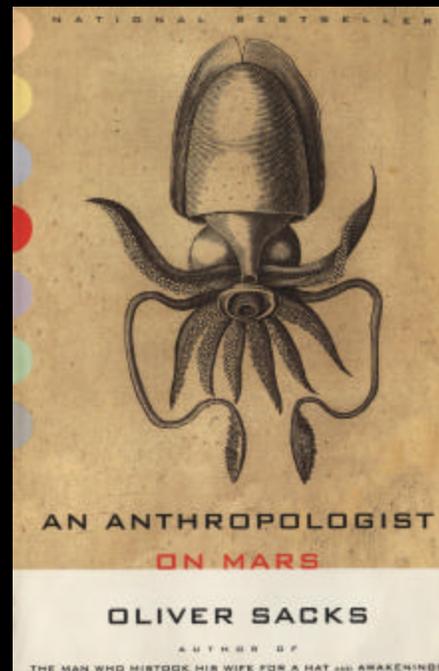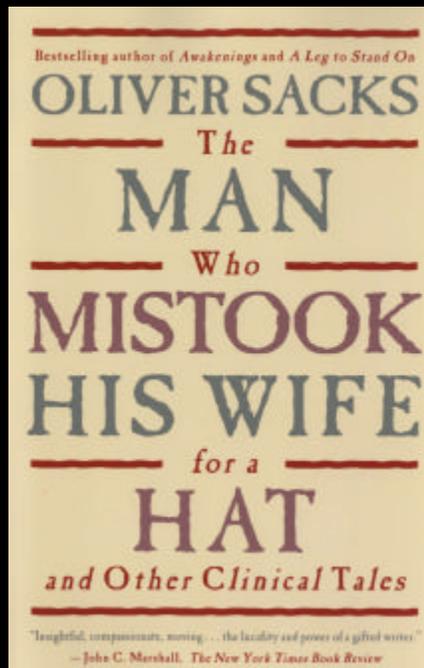 - 2 Discussion issues

- Feedback + 1 picture

Talks

- Start in 2 weeks
- 20-30 minutes
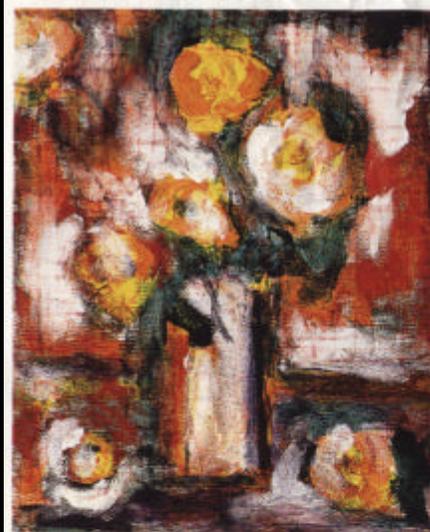- Discuss your subject with me if not done

Discussion

- *The Man Who Mistook his Wife for a Hat*

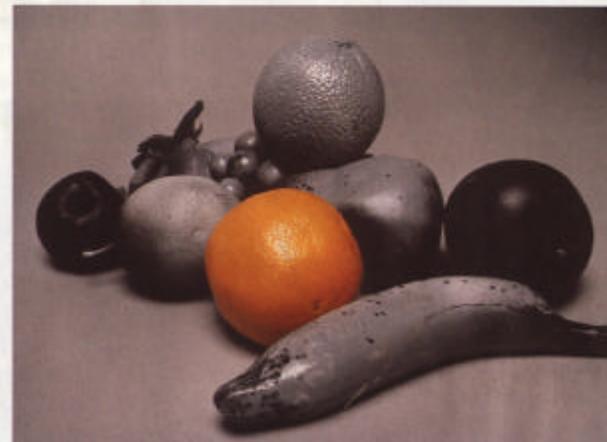- *The Colorblind Painter*

- Oliver Sacks

The Colorblind Painter

Two paintings done by Mr. I. shortly before his accident.

A painting of flowers done four weeks after Mr. I.'s accident. The underlying outlines are clear, but camouflaged by a random application of color.

Mr. I. painted pieces of grey fruit to show us the "leaden" universe into which he had fallen.

The Colorblind Painter

A test painting from Mary Collins's *Colour-Blindness* (left), as reproduced by someone with red-green colorblindness, and by Mr. I. (right).

The sunset scene of which Mr. I. could see virtually nothing—an effect simulated by a black-and-white photocopy of it.

A black-and-white painting done about two months after Mr. I.'s accident, and a painting done two years later—Mr. I. at this time was experimenting with adding single colors, even though he could not see them.
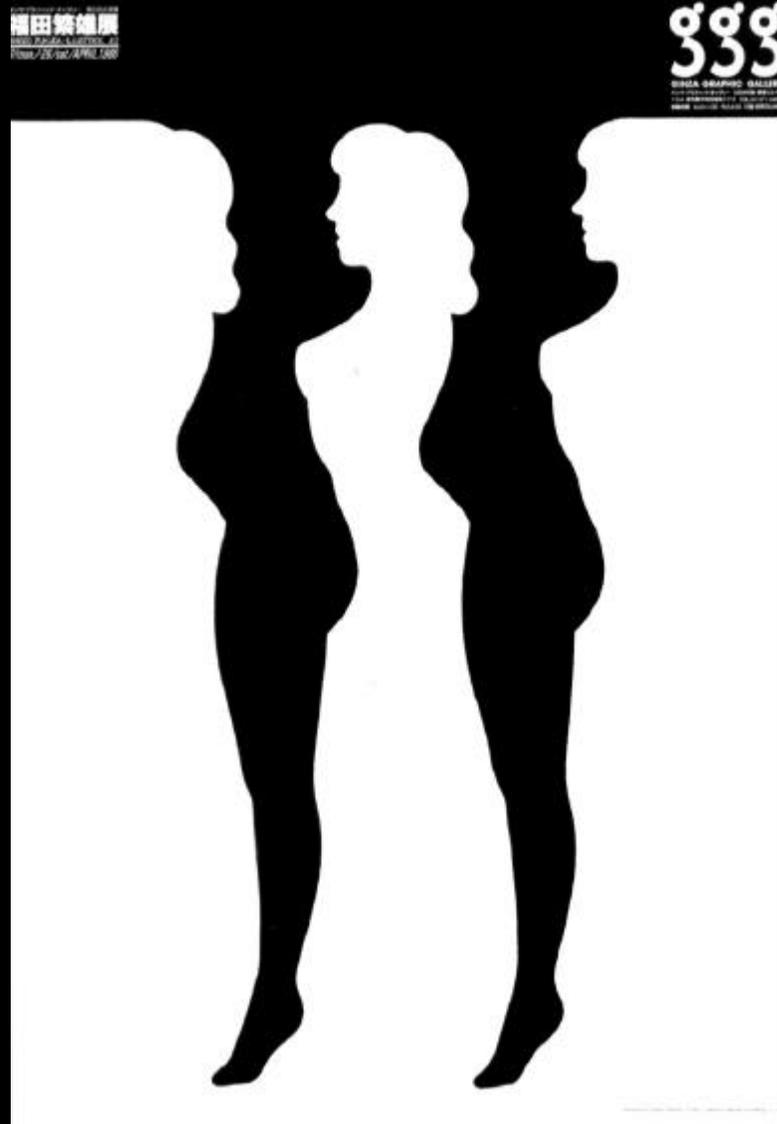
Figure ground simplification

- Isaac D. Fletcher

Figure-ground in design

- Shigeo Fukuda 1986

- Poster for a one-man exhibition

Grouping

Andy Warhol