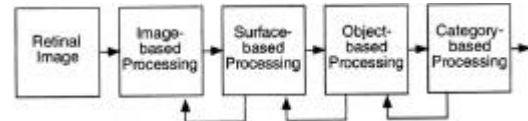


*The Art and Science of Depiction*  
**Picture Organization  
and Gestalt**

Fredo Durand  
MIT- Lab for Computer Science

*Summary*

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

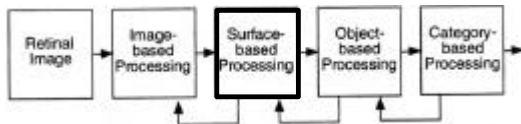


Picture Organization & Gestalt

2

*Overview*

- After image-based, we only know where edges are
- Need to organize the image
  - Segment by region, find structure

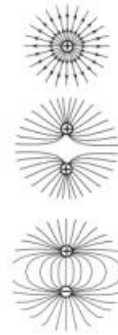


Picture Organization & Gestalt

3

*Context: Gestalt psychology*

- Early 20<sup>th</sup> 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



Picture Organization & Gestalt

4

*Prägnanz*

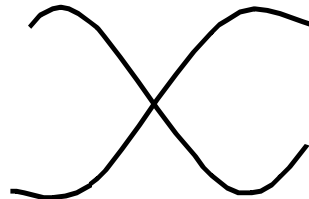
- “Goodness”
- “Simplest” possible figure or organization
- Has recently been related to information theory (simple in terms of amount of information required to encode it)

Picture Organization & Gestalt

5

*Some Gestalt principle*

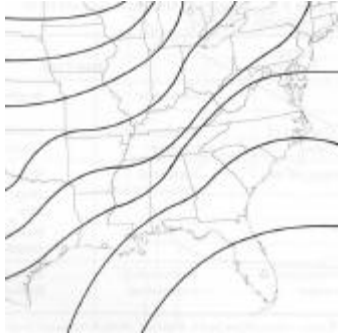
- Continuation



Picture Organization & Gestalt

6

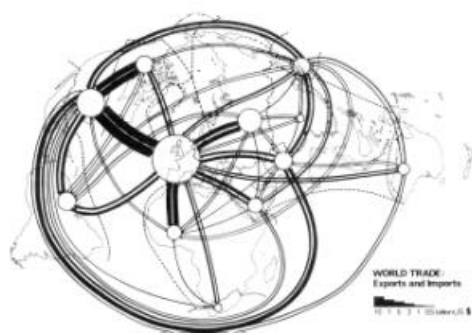
### Continuation and Map-Making



Picture Organization & Gestalt

7

### Continuation and Map-Making



Picture Organization & Gestalt

8

### Continuation and design

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

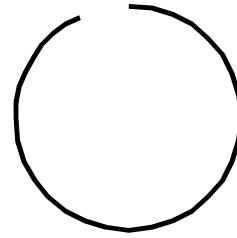


Picture Organization & Gestalt

9

### Some Gestalt principle

- Continuation
- Closure



Picture Organization & Gestalt

10

### Plan

- Grouping
- Figure-ground
- Completion and illusory contours

Picture Organization & Gestalt

11

### No Grouping



Picture Organization & Gestalt

12

*Grouping by proximity*

---



Picture Organization & Gestalt

13

*Grouping by color*

---



Picture Organization & Gestalt

14

*Grouping by size*

---

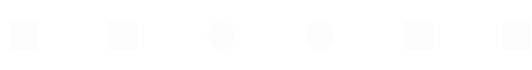


Picture Organization & Gestalt

15

*Grouping by shape*

---



Picture Organization & Gestalt

16

*Grouping by orientation*

---

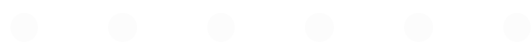


Picture Organization & Gestalt

17

*Grouping by synchronicity*

---




Picture Organization & Gestalt

18

*Grouping by synchronicity*


---



Picture Organization & Gestalt 19

*Grouping by synchronicity*


---



Picture Organization & Gestalt 20

*Grouping by synchronicity II*


---



Picture Organization & Gestalt 21

*Grouping by synchronicity II*

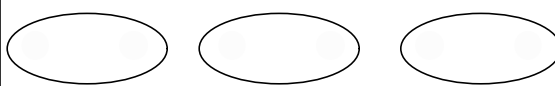
---



Picture Organization & Gestalt 22

*Grouping by region*


---



Picture Organization & Gestalt 23

*Grouping by connectedness*

---



Picture Organization & Gestalt 24

### Grouping by symmetry

Picture Organization & Gestalt 25

### Grouping by parallelism

Picture Organization & Gestalt 26

### Grouping conflict

- Proximity is overweighed by region

Picture Organization & Gestalt 27

### Grouping conflict

- Proximity is overweighed by connectedness

Picture Organization & Gestalt 28

### Grouping conflict

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

|   |           |               |               |
|---|-----------|---------------|---------------|
| A | ■ ■ ■ ■ ■ | Within-group  | PROXIMITY     |
| B | ■ ■ ■ ■ ■ | Between-group |               |
| C | ■ ■ ■ ■ ■ | Neutral       |               |
| D | ■ ■ ■ ■ ■ | Within-group  | COMMON REGION |
| E | ■ ■ ■ ■ ■ | Between-group |               |

Picture Organization & Gestalt 29

### Grouping conflict

- Detect repetition
- Faster when within small oval

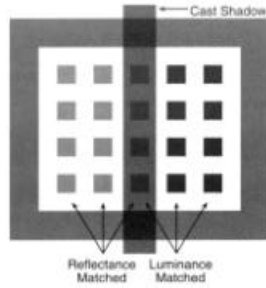
A. Pair within Small Ovals

B. Pair within Large Ovals

Picture Organization & Gestalt 30

### Grouping after lightness constancy

- If the shadow is visible as a shadow
- Grouped by lightness

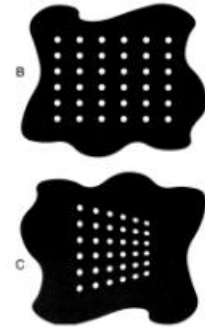


Picture Organization & Gestalt

31

### Grouping after size constancy

- Grouped by 3D-proximity, not by retinal image proximity



Picture Organization & Gestalt

32

### Grouping in complex situations

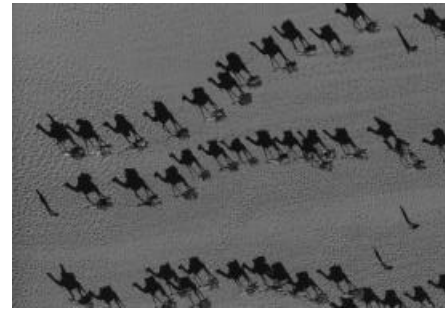
- No quantitative rule yet!

Picture Organization & Gestalt

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### Grouping in photos

Arthus-Bertrand



Picture Organization & Gestalt

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### Grouping in photos

Arthus-Bertrand



Picture Organization & Gestalt

35

### Grouping and photo

Edward Weston



Picture Organization & Gestalt

36

## Grouping and photo

Jean-Pierre Sudre



Picture Organization & Gestalt

37

## Grouping

Frank Horvat



Picture Organization & Gestalt

38

## Grouping and photo

- Grouping reinforces contrast



Picture Organization & Gestalt

39

## Grouping by color

Georgia O'Keeffe



Picture Organization & Gestalt

40

## Grouping

- Grouping by proximity tells story



Picture Organization & Gestalt

41

## Grouping

- Abbas  
*South African Police in Training, 1978*
- Grouping by proximity and similarity tells story



Picture Organization & Gestalt

42

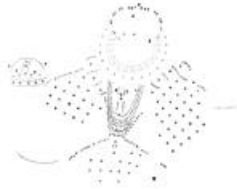
## Grouping

- Grouping by similarity



Picture Organization & Gestalt

43



## Grouping & Map Making

- Grouping provides efficient analysis



Picture Organization & Gestalt

44

## Grouping & Architecture

- Grouping by similarity

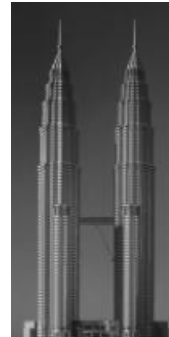


Picture Organization & Gestalt

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## Grouping & Architecture

- Grouping and symmetry
- Cesar Pelli  
Petronas Towers  
Kuala Lumpur, Malaysia  
1991-97

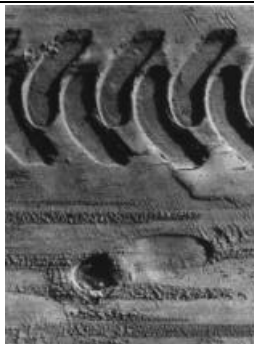


Picture Organization & Gestalt

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## Grouping

- Lucien Clergue  
*Camargue*, 1940



Picture Organization & Gestalt

47

## Grouping and repetition

- Andy Warhol  
*30 Are Better than One*  
1963



Picture Organization & Gestalt

48



### Grouping and ornament

- Repetition, rhythm



Picture Organization & Gestalt

49

### Closure & grouping



Picture Organization & Gestalt

50

### Plan

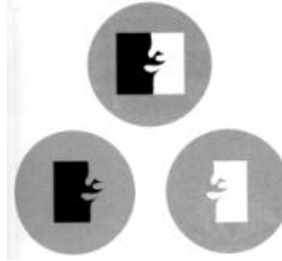
- Grouping
- Figure-ground
- Completion and illusory contours

Picture Organization & Gestalt

51

### Figure-ground

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

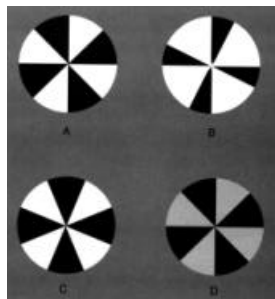


Picture Organization & Gestalt

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### Figure-ground

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

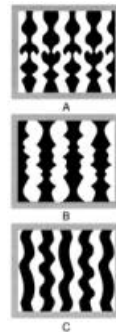


Picture Organization & Gestalt

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### Figure-ground

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



Picture Organization & Gestalt

54

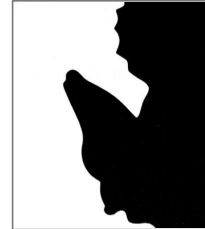
*Figure-ground & familiarity*



Picture Organization & Gestalt

55

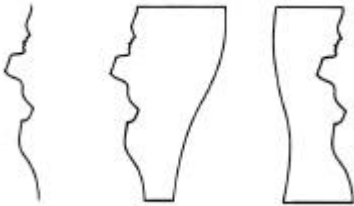
*Figure-ground & familiarity*



Picture Organization & Gestalt

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*Closure & figure-ground*



Picture Organization & Gestalt

57

*Figure-ground & signal-noise ratio*

- Information theory (Shannon)
- Figure-ground separation is simpler when high signal-noise ratio



Picture Organization & Gestalt

58

*Figure-ground painting*



Picture Organization & Gestalt

59

*Figure-ground pun*

- Rubin vase

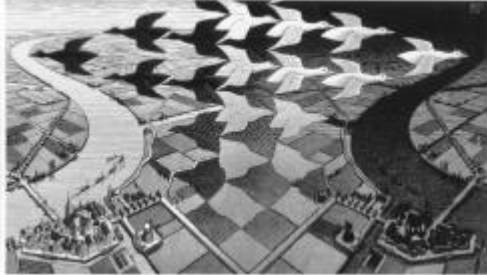


Picture Organization & Gestalt

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### *Figure-ground transition*

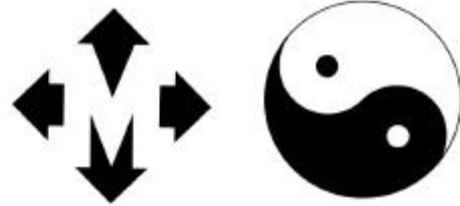
- +grouping



Picture Organization & Gestalt

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### *Figure-ground logos*



Picture Organization & Gestalt

62

### *Figure-ground logos*



Picture Organization & Gestalt

63

### *Figure Ground in design*

- Sharon Gresh,  
Michael Mc Ginn



Picture Organization & Gestalt

64

### *Figure ground: empty ground*



Hopper

Picture Organization & Gestalt

65

### *Figure ground simplification*



Picture Organization & Gestalt

66

### Figure-ground simplification

- Egon Schiele
- Contrast enhancement



Picture Organization & Gestalt

67

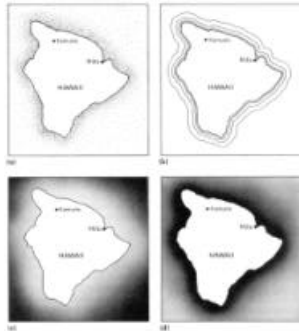
### Figure-ground simplification



Picture Organization & Gestalt

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### Figure-ground and map-making



Picture Organization & Gestalt

69

### Figure ground – not so easy

- Monet



Picture Organization & Gestalt

70

### Figure ground – not so easy

- Picasso



Picture Organization & Gestalt

71

### Figure ground – stage of vision

- Note that Impressionism and cubism were not classified surface-based
- In contrast, in this Raphael, figure-ground separation is easy



Picture Organization & Gestalt

72

### *Figure ground – stage of vision*

- Note that Impressionism and cubism where not classified surface-based
- But in this Picasso, figure-ground separation is easy

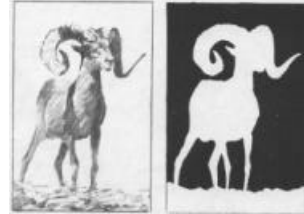


Picture Organization & Gestalt

73

### *Negative space*

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



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

Picture Organization & Gestalt

74

### *Negative space*

- George Seurat



Picture Organization & Gestalt

75

### *Negative space*

- George Seurat



Picture Organization & Gestalt

76

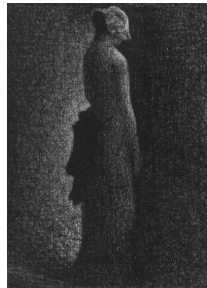
### *Closure & Negative space*

- Negative space are enclosed in the picture frame



Picture Organization & Gestalt

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### *Negative space in Architecture*

- Michael Graves, 1969



Picture Organization & Gestalt

78

## Plan

- Grouping
- Figure-ground
- Completion and illusory contours

Picture Organization & Gestalt

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## Illusory contours

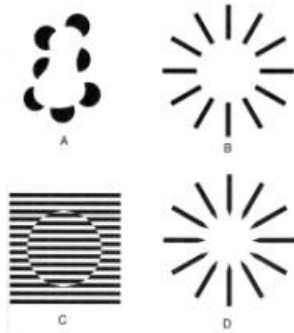
- Kanisza



Picture Organization & Gestalt

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## Illusory contours

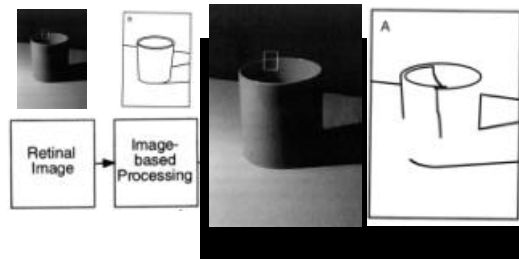


Picture Organization & Gestalt

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## Image-based (primary sketch)

- Contrast, edge detection
- Not so easy

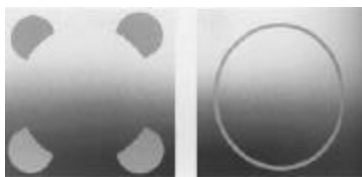


Picture Organization & Gestalt

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## Illusory contour

- Can be more effective



Picture Organization & Gestalt

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## Illusory contour



Picture Organization & Gestalt

84

*Illusory contour*

- Cocteau



Picture Organization & Gestalt

85

*Illusory contour*

- Matisse



Picture Organization & Gestalt

86

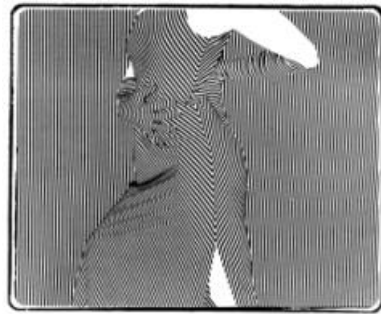
*Figure-ground and illusory contour*



Picture Organization & Gestalt

87

*Figure-ground puzzle*



Picture Organization & Gestalt

88

*Illusory contour*

- From [Ramachandran 1995]

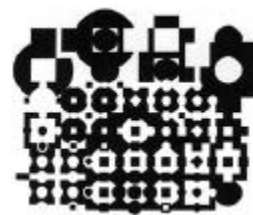


Picture Organization & Gestalt

89

*Illusory contours*

Vasarely, *Helios*



Picture Organization & Gestalt

90

### Illusory contour

- William Anders  
*Earthshine*  
1969
- Prägnanz:  
a circle is  
“simpler”



Picture Organization & Gestalt

91

### Illusory contour

- Familiarity helps



Disappears rather quickly, doesn't it.

Picture Organization & Gestalt

92

### Illusory contour

- Familiarity helps



Picture Organization & Gestalt

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### Visual completion

- We complete the occluded part

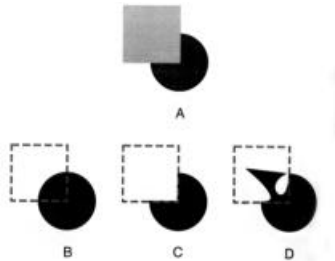


Picture Organization & Gestalt

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### Visual completion

- We complete the occluded part  
with the simplest shape



Picture Organization & Gestalt

95

### Visual completion

- With no context
- With context



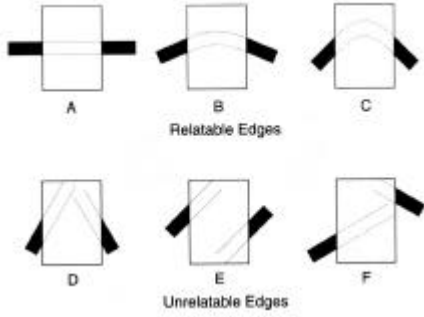
WORD

Picture Organization & Gestalt

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### Relatable edges

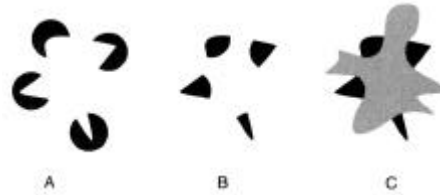


Picture Organization & Gestalt

97

### Illusory contour & completion

- Both “see” a figure from incomplete information



Picture Organization & Gestalt

98

### Visual completion

- Clarence Lee, 1977

ONE NINE SEVENTEEN DE V ELL

Picture Organization & Gestalt

99

### Visual completion

- Greg Brown (mural)



Picture Organization & Gestalt

100

### Completion

- Magritte



Picture Organization & Gestalt

101

### Completion

- Degas
- Framing



Picture Organization & Gestalt

102

## Completion

- Marc Riboud
- Completion is challenged



Picture Organization & Gestalt

103

## Summary

- Grouping
- Figure-ground
- Completion
  
- As usual pictures can
  - Simplify
  - Challenge

Picture Organization & Gestalt

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## Assignments

- Piranesi
  - Tutorial 1 to 4
- Reading
  - Art and Illusion, Gombrich
  - Summary 1 to 2 pages
  - 2 Discussion issues
- Feedback + 1 picture

Picture Organization & Gestalt

105

## Talks

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

Picture Organization & Gestalt

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## Discussion

- *The Man Who Mistook his Wife for a Hat*
- *The Colorblind Painter*
- Oliver Sacks



Picture Organization & Gestalt

107

## The Colorblind Painter



Picture Organization & Gestalt

108

## *The Colorblind Painter*



Picture Organization & Gestalt

109

## *Figure ground simplification*

- Isaac D. Fletcher

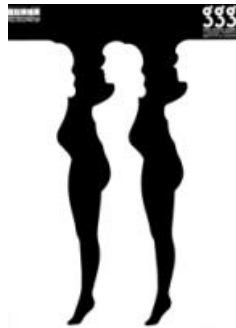


Picture Organization & Gestalt

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## *Figure-ground in design*

- Shigeo Fukuda  
1986
- Poster for a  
one-man  
exhibition



Picture Organization & Gestalt

111

## *Grouping*

Andy Warhol



Picture Organization & Gestalt

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