

Vision in Human and Machine

Part 7 Gestalt Perception

Heiko Wersing

Honda Research Institute Europe GmbH

Gestalt Perception 1

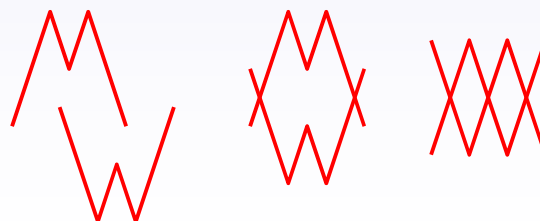
Gestalt theory of perception

- **Structuralism**

- Perception consists of association between sensory atoms
- Empiricistic approach: Associations are collected and stored

- **Gestaltism**

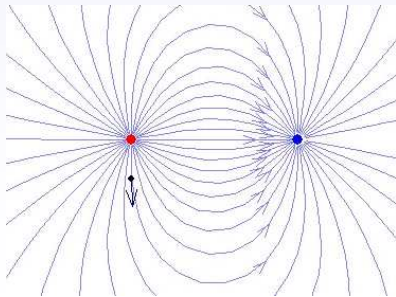
- "The whole is different from the sum of its parts"
- Emergent properties
- Nativistic approach: Phenomenological Gestalt laws are innate
- Perceptual organisation
- Proponents:
 - Max Wertheimer
 - Wolfgang Köhler
 - Kurt Koffka



Gestalt Perception 2

Important concepts

- Psychophysiological Isomorphism
 - Perceptual experience matches physiological brain events
- Physical Gestalt: A system searching a minimum energy state
 - Soap bubble analogy
 - Relaxation of electromagnetic fields in a continuum approximation of the neurons in the brain
 - This theory was refuted in the 1950s



Gestalt Perception 3

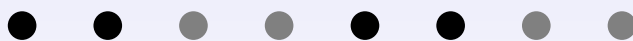
Classical principles of perceptual grouping



No grouping



Proximity



Similarity of Color



Similarity of Size



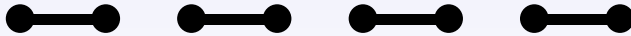
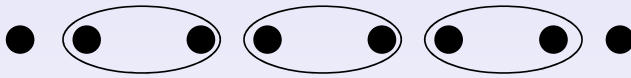
Similarity of Orientation

Common Fate

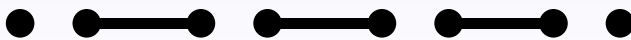
Other grouping laws



Common region



Connectedness

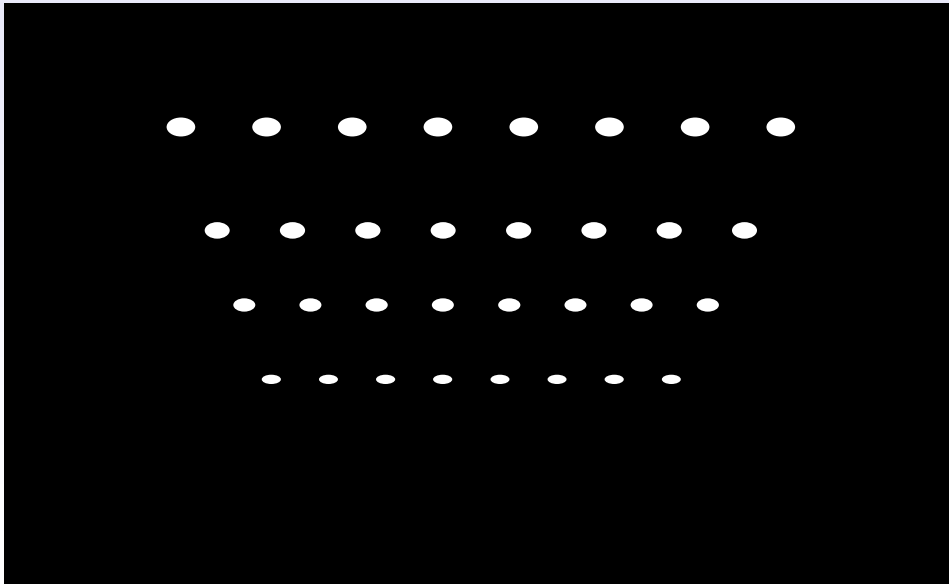


Gestalt laws

- Gestalt laws are a **phenomenological description** of highly agreed perceptual sensations
- Quantitative analysis can be performed
- Laws are **competing**
- “Ceteris paribus” rules
- Laws characterize a-priori assumptions about the visual physical world (relation distal-proximal stimulus)
 - Connected regions belong to the same object
 - Coherently moving regions belong to the same object
 - Nearby units are likely to belong together (unless being separated by a boundary)

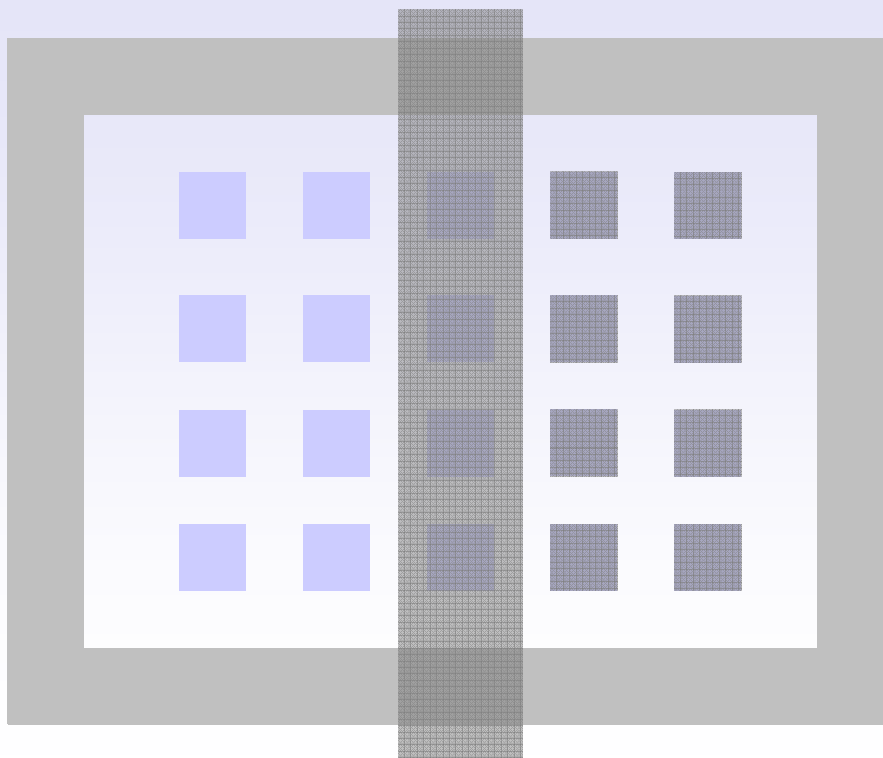
Grouping: Late or early in visual processing ?

- Wertheimer's proposal: Grouping appears prior to meaningful processing of the visual stimulus



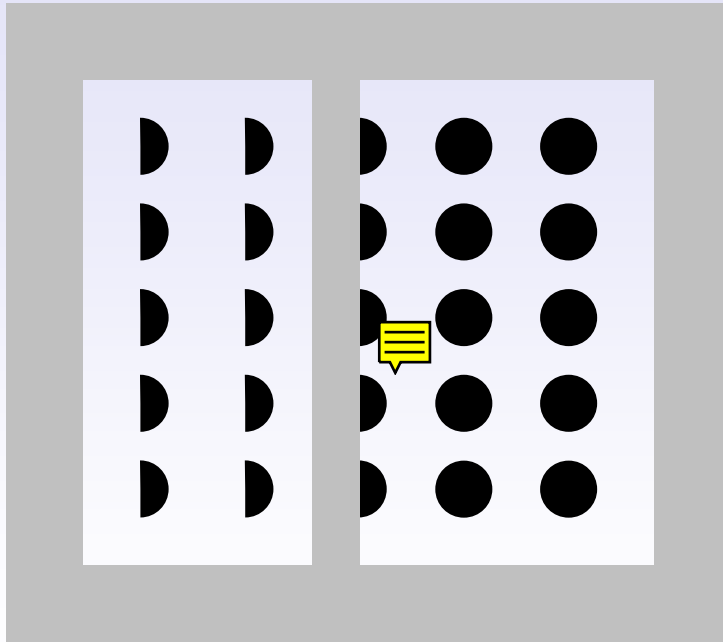
Gestalt Perception 7

Grouping and lightness constancy



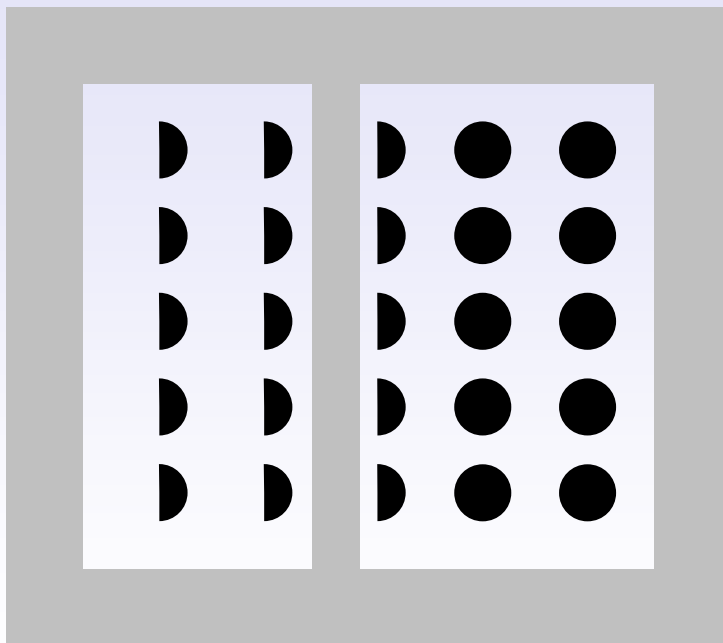
Gestalt Perception 8

Grouping and completion

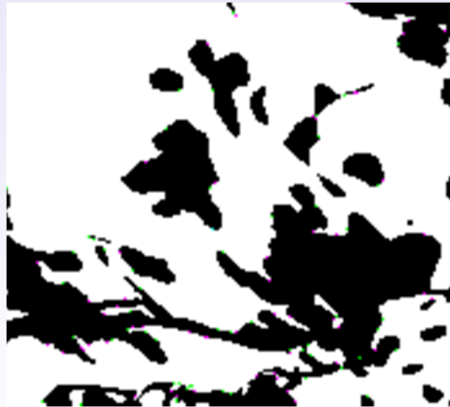


Gestalt Perception 9

Grouping and completion



Gestalt Perception 10



Top-down influences: Past experience

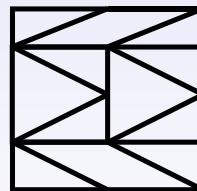
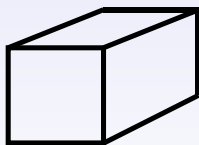


Top-down influences: Past experience



Gestalt Perception 13

Overwriting past experience

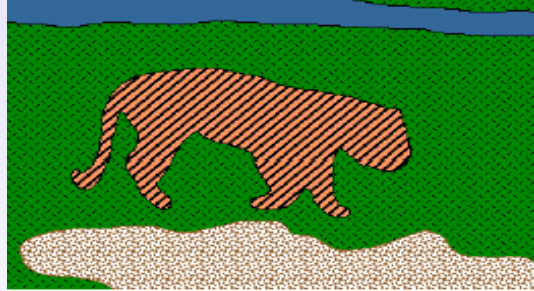


Gestalt Perception 14

Region segmentation



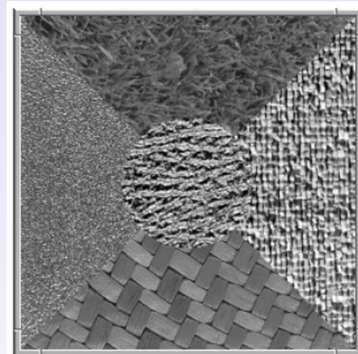
Original Image



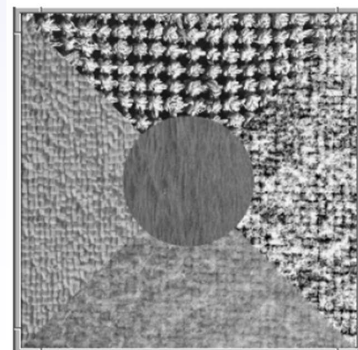
Region Segmented Image

Texture segregation

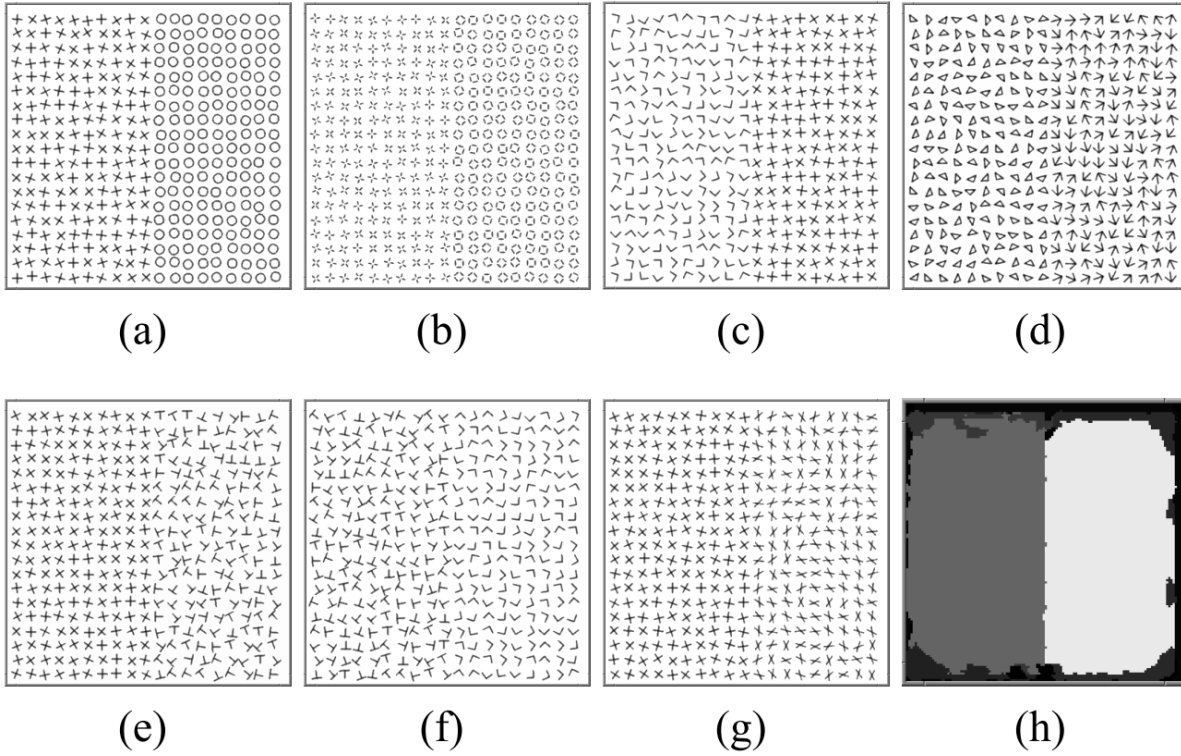
- Texture: Local pixel, color, and orientation statistics
- Important for connectedness and later processing (e.g. depth)
- Julesz's early proposal: 2nd order statistics explains effects (1975)
- Later many deviating effects were described



Brodatz textures

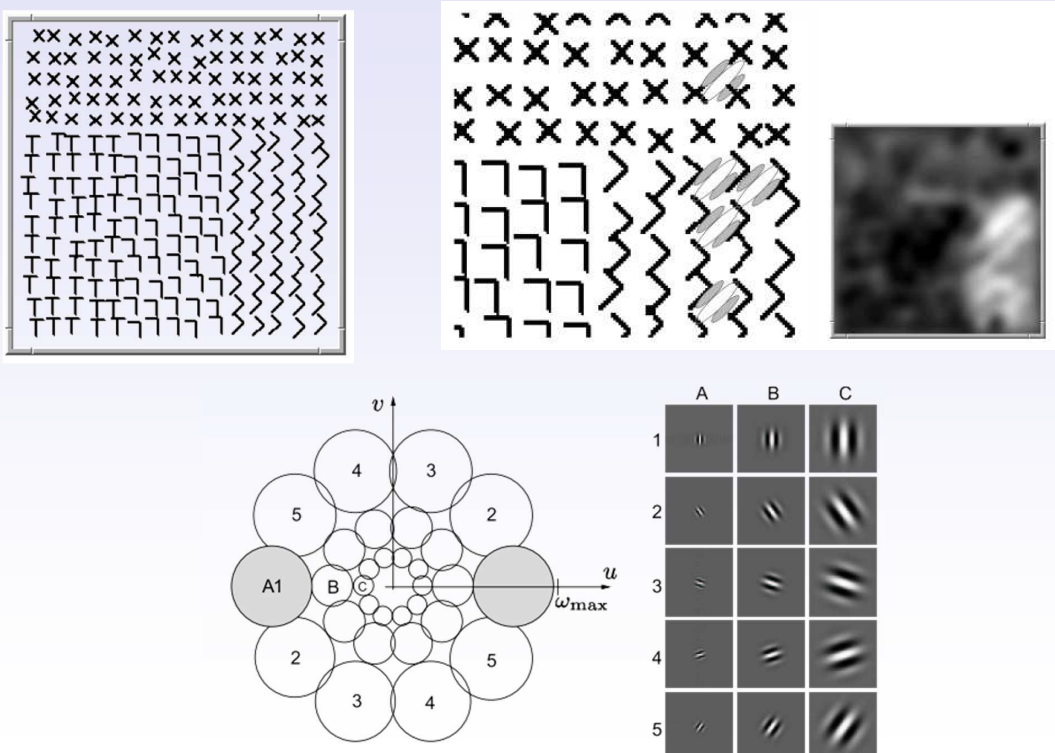


Texture segregation



Gestalt Perception 17

Gabor features for texture description



Gestalt Perception 18

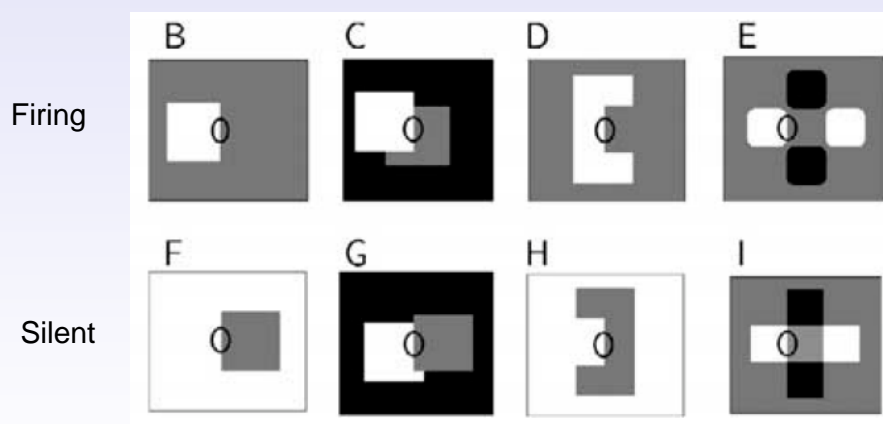
Figure-ground organization



Gestalt Perception 19

Neural correspondences

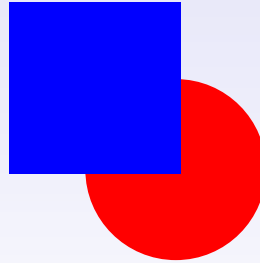
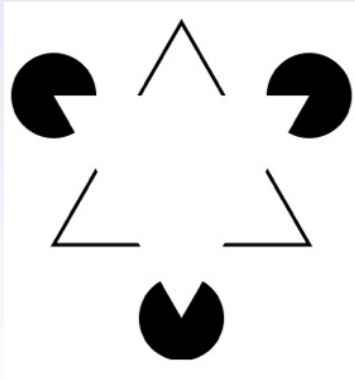
- Border ownership coding neurons in V2



Von der Heydt et al (2000)

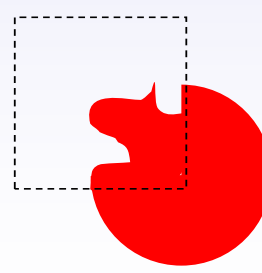
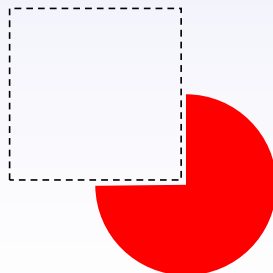
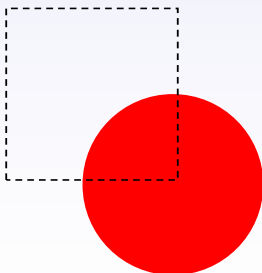
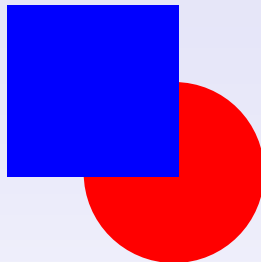
Gestalt Perception 20

Visual Interpolation



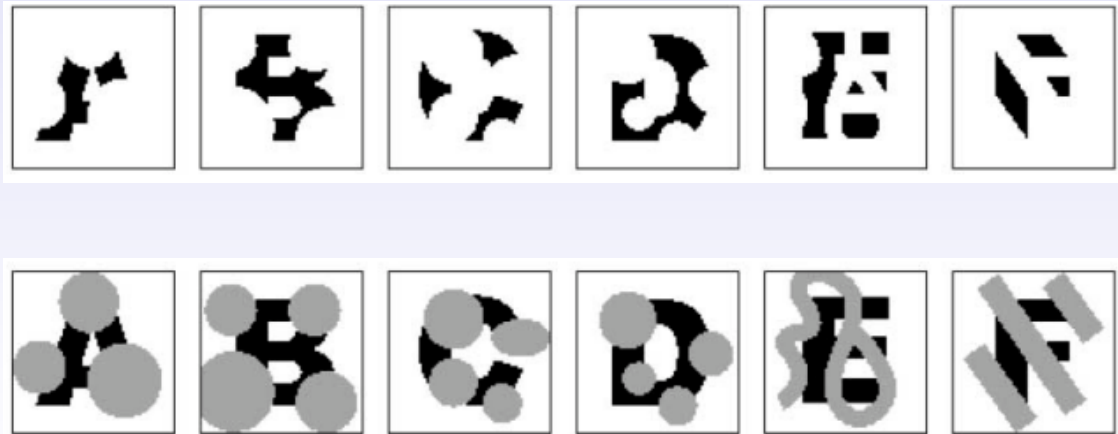
Gestalt Perception 21

Visual Interpolation



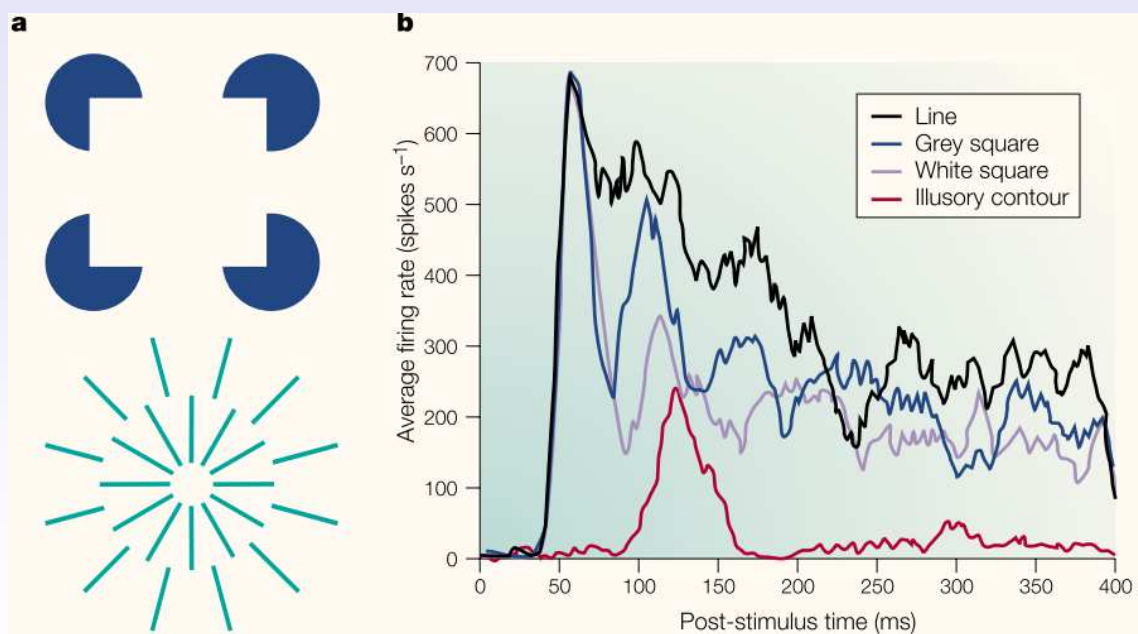
Gestalt Perception 22

Completion, occlusion, and recognition



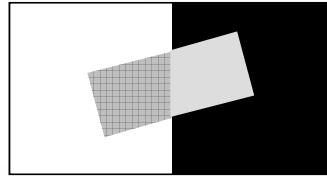
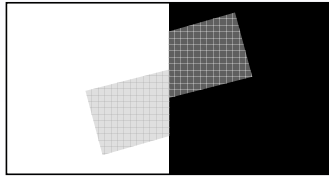
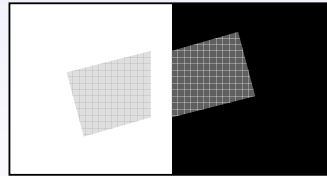
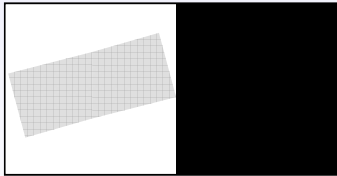
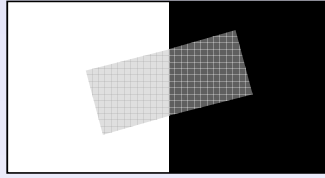
Gestalt Perception 23

Temporal response of a V1 neuron



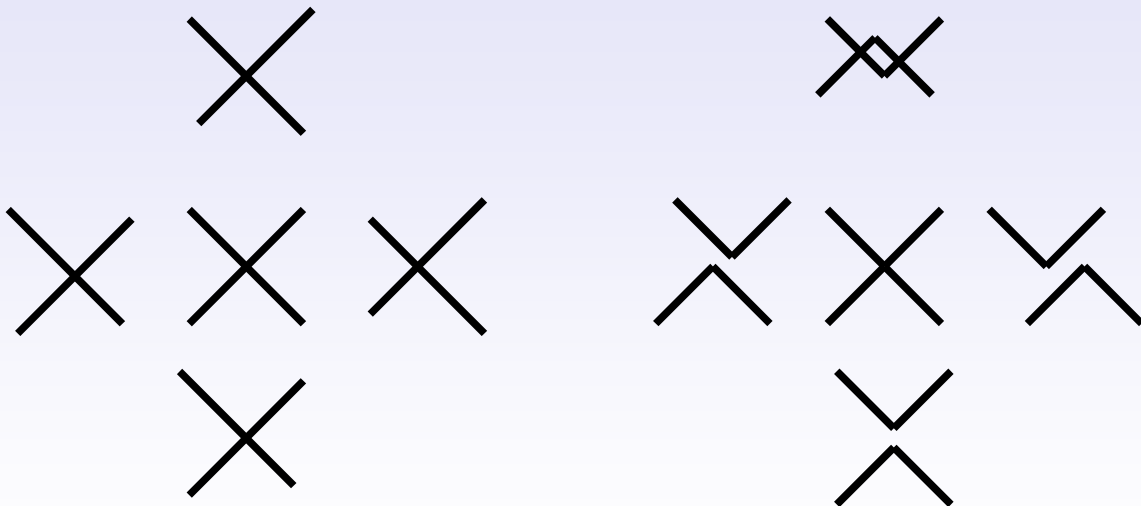
Gestalt Perception 24

Transparency perception



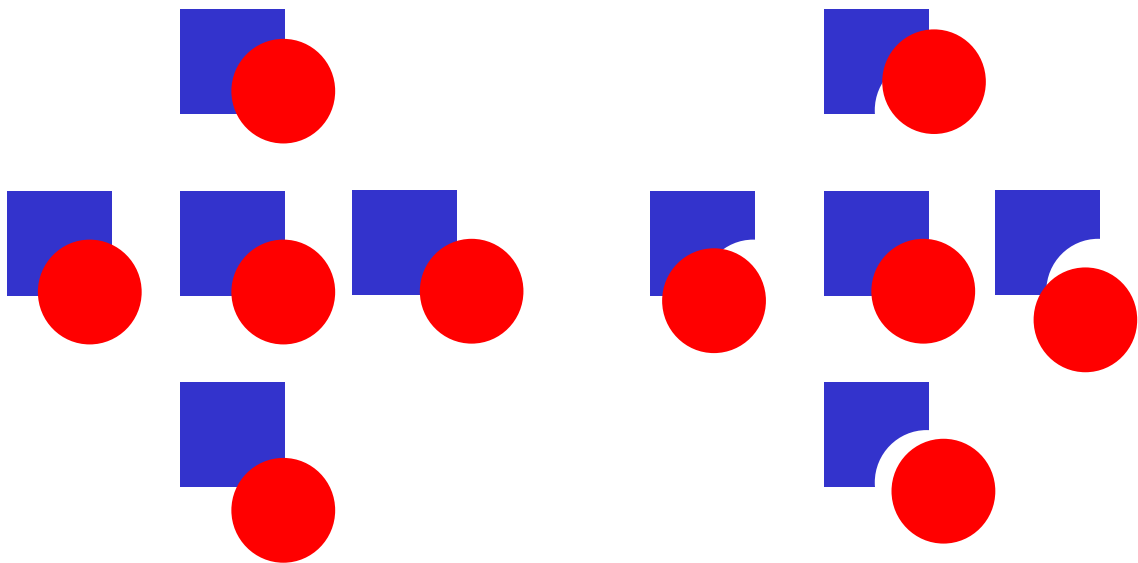
Gestalt Perception 25

Non-accidentalness



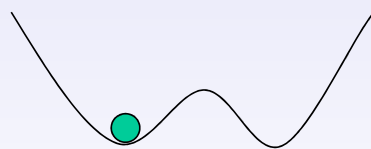
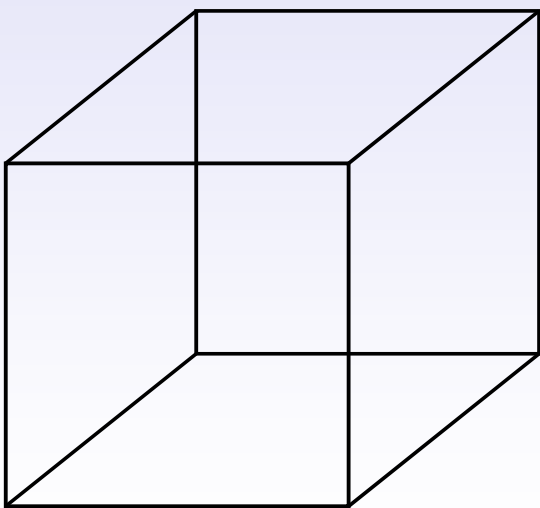
Gestalt Perception 26

Non-accidentalness



Gestalt Perception 27

Multistability – The Necker cube



Gestalt Perception 28

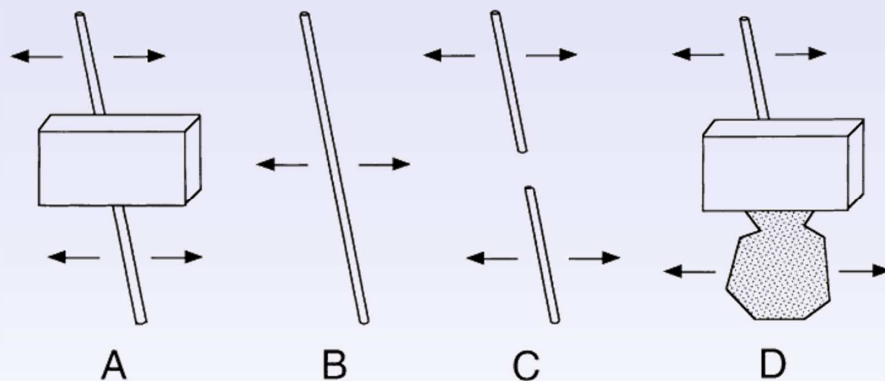
Development of perceptual organization

- Developmental approach to organization in vision
 - Nature versus nurture – nativism versus empiricism
 - Experimental setups for babies / small children
 - Habituation paradigm
 - Preferential looking
 - Attention



Gestalt Perception 29

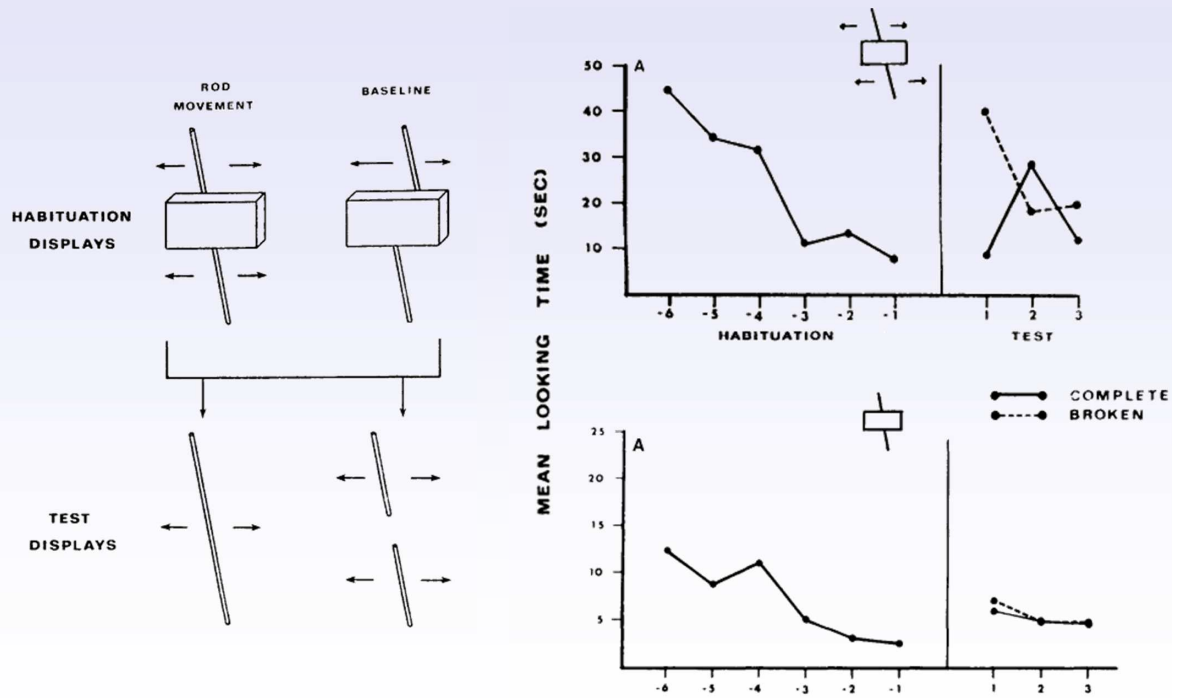
Kellman & Spelke experiments



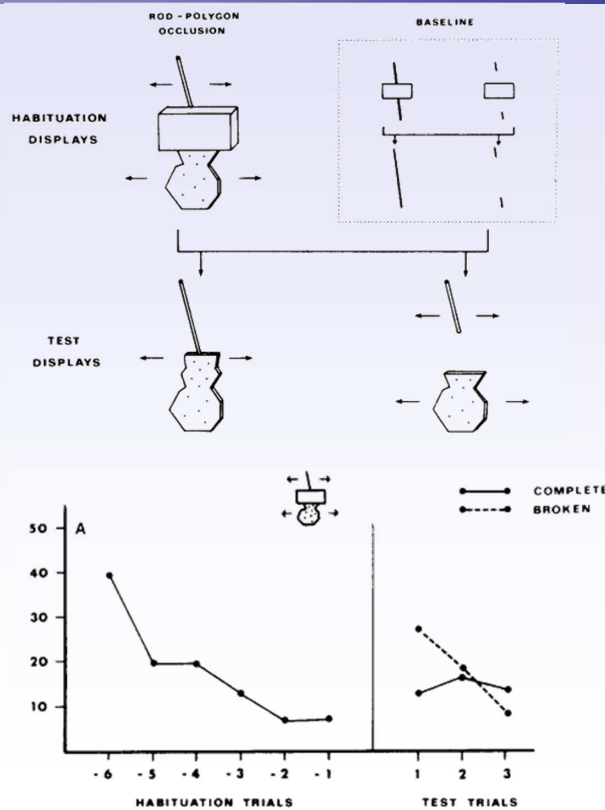
- Common fate overrides static grouping factors
- Static grouping can only be observed later in development

Gestalt Perception 30

Results



Gestalt Perception 31



Gestalt Perception 32