Gibson’s “Ecological View”

Direct Perception

• All information needed for perception is supplied by the stimulus
• Perceptual systems evolved to extract the stimulation relevant for perception
• Perception is Determined by the Stimulus
  – The whole pattern of proximal stimulus information available in the environment
Problems for Ecological Perception

• Conceptual Problem
  – Availability vs. Utilization

• Empirical Problems
  – Organization
  – Pattern Recognition
  – Perceptual Constancies
  – Ambiguous (Reversible) Figures
  – Perceptual Illusions
  – Cultural Differences
  – Perceptual Problem-Solving
Gestalt Principles of Perception
Max Wertheimer (1925); Wolfgang Kohler (1929) ; Kurt Koffka (1935)

• Critique of Structuralism
  – Atomism and the Chemical Analogy

• Holism
  – Emergent Properties

“The whole is something else than the sum of its parts”
Koffka (1935)
The Law of Prägnanz  
(The Minimum Principle)  
Hochberg (1974, 1978)  
Perception will be as good as stimulus conditions allow.  
We perceive the simplest or most homogeneous organization that will fit the sensory pattern
Classical
Gestalt Principles of Perception

• Proximity
• Similarity
  – Color, Size, Orientation
• Common Fate
• Symmetry
• Parallelism
• Good Continuation
• Closure
Proximity
Similarity
Common Fate
Symmetry
Parallelism
Closure
Good Continuation
New
Gestalt Principles of Perception
Palmer (1999)

• Synchrony
• Common Region
• Connectedness
Synchrony
Common Region
Connectedness
Subjective Contours
Kanizsa (1976)

A Kanizsa triangle
Information-Processing View of Perception
Selfridge (1957); Lindsay & Norman (1977)

• Feature Detection
  – Analyze Stimulus
  – Extract Elementary Features

• Pattern Recognition
  – Synthesize Mental Representation
  – Familiar, Meaningful Configurations
“What the Frog’s Eye Tells the Frog’s Brain”
Lettvin et al. (1959)

• Present Visual Stimulus
• Record Activity in Optic Nerve
  – Single Fiber (or Very Small Bundle)
• Detector Types
  – Sustained Contrast
  – Net Convexity
  – Moving Edge
  – Net Dimming
• “Grandmother Cells”?
Feature Detectors in Visual Cortex
Hubel & Wiesel (1959, 1962)

• Present Stimuli in Visual Field
• Record Activity in Visual Cortex
  – Single Neurons (or Small Bundle)
• Stimulus Features
  – Points of Light/Darkness
  – Edges
  – Bars
  – Angle of Orientation
  – Movement vs. Stability
  – Direction of Movement
Hierarchical Organization of Feature Detectors
Hubel & Wiesel (1959, 1962)

• Simple
  – Location of Feature

• Complex
  – Presence of Feature

• “Hypercomplex”
  – Combinations of Features
English Orthography

• Elementary Features
  – Vertical, Horizontal, Oblique *Lines*
  – Right, Acute *Angles*
  – Continuous, Discontinuous *Curves*
German Orthography

B

ß

(sisset)
Greek Orthography

Γ  “gamma”
Π  “pi”
Θ  “theta”
Φ  “phi”
Ψ  “psi”
Ω  “omega”
Russian Orthography

Ж “zhe”
Ц “tse”
Ш “sha”
Щ “shcha”
Ы “ee”
Я “ya”
Hebrew Orthography

א "alef"
ב "bet"
ג "nun"
ד "dalet"
ה "qof"
ו "shin"
Arabic Orthography

ا "alef"
ب "beh"
ت "teh"
ث "theh"
ش "seen"
ش "sheen"
Hierarchical Coding of Input in Reading

Graphemic Information

- Feature Detectors
- Letter Codes
- Spelling-Pattern Codes
- Word Codes
- Word-Group Codes

- Innate, Automatic
- Learned
  - Initially Effortful
  - Automatized via Practice
# Articulatory Features in English

**Types of Articulation**
- Plosives
- Nasals
- Fricatives
- Laterals
- Trills

**Positions of Articulation**
- Bilabial
- Labiodental
- Dental
- Alveolar
- Cacuminal
- Palatal
- Velar
- Glottal

**Examples:**
- PA vs. BA
- TA vs. DA
- MA vs. NA
- W vs. FA vs. VA
Sample Language Differences in Phonology

- English: 40 phonemes
- Hawaiian: 14 phonemes
  - “glottal stop”
    - *humuhumunukunukuapua’a*
    - Hawai’i, Kaua’i
- German: *ch* as in *Ach!* or *Bach*
- Russian: щ, *shcha*
- Khoisan: ! and ℃, “click”
“Bottom-Up” Processing in Perception
After Marr (1982)

- Bottom-Up Processing
  - Data-Driven
    - Perceptually Driven
  - Input: Low-Level Representation
  - Output: Higher-Level Representation

Category

Object

Visible Surface

Retinal Image
The Word-Letter Phenomenon

• Word Superiority Effect
  – COIN vs. JOIN > C vs. J

• Detect Letter in 4-Letter String
  – Words (COIN) vs. Random Strings (CPRD)

• Instructional Conditions
  – “Try to see the whole word”
  – “Fixate on particular letter position”
The Word-Letter Phenomenon
“Top-Down” vs. “Bottom-Up” Processing in Perception

After Marr (1982)

• **Bottom-Up Processing**
  – Data-Driven
    • Perceptually Driven
  – Input: Low-Level Representation
  – Output: Higher-Level Representation

• **Top-Down Processing**
  – Conceptually Driven
    • Hypothesis-Driven
    • Expectation Driven
  – Input: Higher-Level Representation
  – Output: Lower-Level Representation
Size Constancy
Shape Constancy
Perceptual Constancies

• Pattern of proximal stimulation changes
  – Retinal image gets larger

• Perception of distal stimulus is constant
  – Object perceived as getting closer
  – Perceived size stays the same
Figure and Ground in Size Constancy
Two Sources of Constancy

• Gibson: Ratios
  – Comparison of object with background
  – Consistent with ecological view
    • All information needed by stimulus

• Helmholtz: Unconscious Inferences
  – Unaware of Performing Calculations
  – Cannot Specify What They Are
    • Know operation only by inference