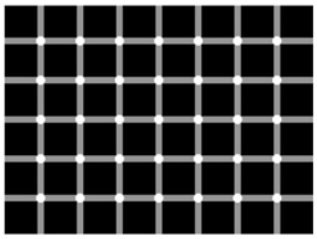
Lecture 3: Cognitive Psychology Overview II

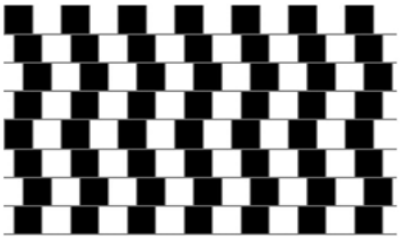
- Perception and Attention

Perception

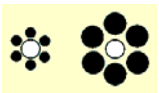
- Perception is not simple
  - The sensory systems do not simply take a “photograph”
  - Epicharmus (450 B.C.): “The mind sees and the mind hears. The rest is blind and deaf”
  - Illusions are important demonstrations: perceiving is not a copy of the physical world as can be measured by physics/engineering
  - Sensory illusions: illusions which can be traced, e.g., to the interaction patterns of nerve cell firings in the retina and brain
    - Dot illusion: lateral inhibition
  - Perceptual illusions: illusions which must be traced to higher level processing: depth perception from 2D drawings, ambiguous figures
    - Ambiguous drawings: cube, eskimo
    - Elephant

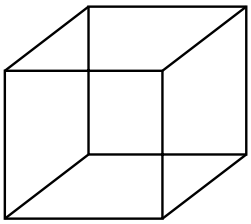


Count the black dots! :o)

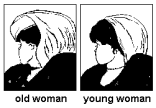


Are the horizontal lines parallel or do they slope?

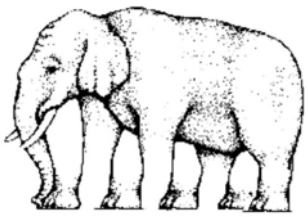




Do you see the face? Or an Eskimo?



old woman young woman



How many legs does this elephant have?

Theories of Perception

- Constructivist
  - Gregory (1970), *The Intelligent Eye*
  - Perception is constructed from a combination of sensory information and stored knowledge, inferences based upon memory
  - Constructive perception is adaptive: "see" people as the same size regardless of their distance (retinal size varies)
- Ecological
  - Gibson (1966) *The Senses Considered as Perceptual Systems*
  - Gibson 1979) *The Ecological Approach to Visual Perception*
  - "Direct perception"
  - Information is detected from environment, higher order relationships present in the stimulus can specify

Theories of Perception (2)

- Information in the visual field
  - emphasis on use of texture gradients, visual field in motion
  - Gibson spent some time in aviation human factors at Air Force
  - "Flow of the visual field" oft-used example of motion and size detection: Example, pilot landing plane on field
- Concepts of Ecological Approach imported into other domains
  - "Information processing" occasionally considered a compromise
  - Concepts of relationships in stimulus often discussed by information processing models
  - Affordance - concept borrowed by Norman to HCI design

Theories of Perception (3)

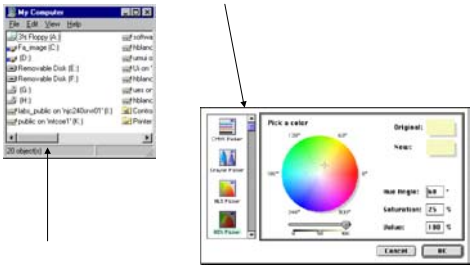
- Affordance
  - Theory (Ecological Approach)

Gibson, J. J. (1979) *The Ecological Approach to Visual Perception. (p.127)*

" The *affordances* of the environment are what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill. … [affordance] refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment. … "

" If a terrestrial surface is nearly horizontal .. nearly flat … and sufficiently extended … the it *affords support*. … It is stand-on-able … walk-on-able … run-over-able …"

The properties are physical, but as an affordance they have to be measured relative to the animal -- "They are unique for that animal."

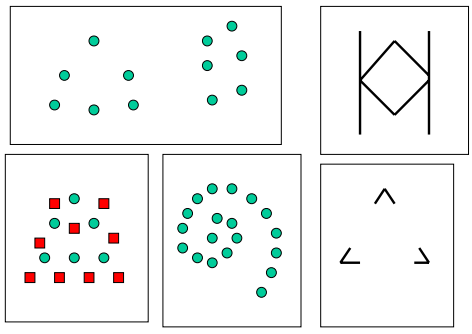


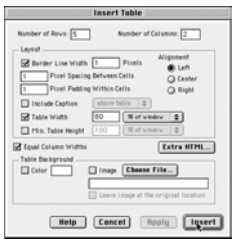
Affordance

- Torenvliet (2003): Drift of term in Human Factors
  - Gibson
    - Affordances 'have to be measured relative to the animal"
    - "-abilty" → sit-ablity, push-ability, etc.
    - Chair: sit-able for adult not for child
  - Norman (1988)
    - "The perceived and actual properties of the thing, primarily those fundamental properties that determine just how the thing could properly be used."
    - Norman (1999) "perceived" affordances
  - Cooper (1995)
    - Omit "and actual" from Norman's definition
    - " … Purely cognitive term … referring to what we think the object can do rather than what it can actually do …"
    - Reverses term
      Gibson → actual environment --- Cooper → perceptions

Gestalt Laws of Grouping

- Proximity
  - Objects that are close together are seen as grouped
- Similarity
  - Objects of same shape, color, etc.
- Closure
  - Missing parts of a figure are closed to perceive a complete shape
  - Space enclosed by a contour tends to be perceived as a figure
- Continuity (Good continuation)
  - Elements that appear to follow in the same direction tend to be grouped together
- Symmetry
  - Regions bounded by symmetrical borders tend to be perceived as coherent figures

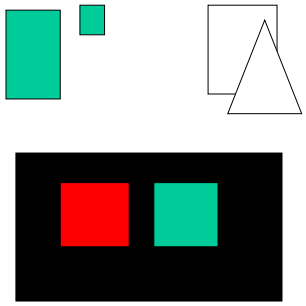




Depth Perception

Depth Cues

- Size
  - Closer objects are larger
- Interposition
  - Objects overlapping, blocked object seen as more distant
- Contrast, clarity, brightness
  - Sharper and more distinct objects are nearer
- Shadow
  - Shadows cue relative position
- Texture
  - Texture elements change with distance
- Motion parallax
  - In motion, objects of different distances are displaced at different rates (distant objects move more slowly
- Binocular disparity (stereoscopic cues)
  - Eyes receive different images, images are merge and depth is perceived



Color Perception: Applied Examples (1)

- Chromostereopsis
  - High saturation of spectrally extreme wave lengths, like red and blue, should not be used adjacently as texts or background in reading tasks
    - Unintended depth effects, size effects, or excessive accommodation
- Depth Effects
  - Spectrally extreme colors that produce depth effects should not be presented for images to be continuously viewed or read
    - Two objects differing in color and brightness appear to be at different distances

From ANSI/HFES 200 Human Computer Interaction Standards

Attention (1)

- Focused attention (Selective attention)
- Divided attention
  - Cocktail party phenomenon
  - Dichotic listening task
    - two audio channels with different content (typically linguistic)
    - some information from no-focused channel is processed
  - Models:
    - bottleneck models: early selection and late selection
    - limited capacity models
- Focusing attention (orienting)
  - Structuring information
  - Spatial and temporal cues
  - color
  - Alerting: flashing, reverse video, audio (other channel)

Attention (2)

- Dual and mulit-task situations
  - Switch between primary and secondary task
- Automatic and controlled processing theory
- Automatic cognitive processes
  - fast
  - require little or no attention capacity
  - unavailable to conscious inspection
  - difficult to relearn
- Controlled processes
  - require attention, have limited capacity
  - characterized by conscious control
- Example: learning control key sequences in GUI or touch-tone sequences in voice mail