



# HUMAN-COMPUTER INTERACTION

THIRD  
EDITION

DIX  
FINLAY  
ABOWD  
BEALE

## chapter 1

# the human

# the human

- Information i/o ...
  - visual, auditory, haptic, movement
- Information stored in memory
  - sensory, short-term, long-term
- Each person is different

# Vision

## Two stages in vision

- physical reception of stimulus
- processing and interpretation of stimulus

# The Eye - physical reception

- mechanism for receiving light and transforming it into electrical energy
- light reflects from objects
- images are focused upside-down on retina
- retina contains rods for low light vision and cones for colour vision
- ganglion cells (brain!) detect pattern and movement

# Interpreting the signal

- Size and depth
  - visual angle indicates how much of view object occupies  
(relates to size and distance from eye)
  - visual acuity is ability to perceive detail  
(limited)
  - familiar objects perceived as constant size  
(in spite of changes in visual angle when far away)
  - cues like overlapping help perception of size and depth

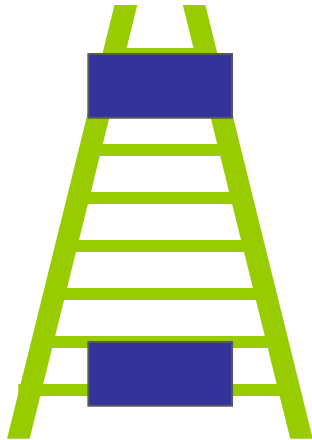
# Interpreting the signal (cont)

- Brightness
  - subjective reaction to levels of light
  - affected by luminance of object
  - measured by just noticeable difference
  - visual acuity increases with luminance as does flicker
- Colour
  - made up of hue, intensity, saturation
  - cones sensitive to colour wavelengths
  - blue acuity is lowest
  - 8% males and 1% females colour blind

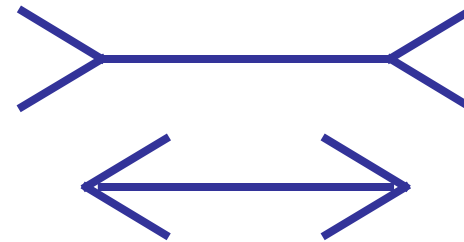
# Interpreting the signal (cont)

- The visual system compensates for:
  - movement
  - changes in luminance.
- Context is used to resolve ambiguity
- Optical illusions sometimes occur due to over compensation

# Optical Illusions



the Ponzo illusion



the Muller Lyer illusion



# Reading

- Several stages:
  - visual pattern perceived
  - decoded using internal representation of language
  - interpreted using knowledge of syntax, semantics, pragmatics
- Reading involves saccades and fixations
- Perception occurs during fixations
- Word shape is important to recognition
- Negative contrast improves reading from computer screen

# Hearing

- Provides information about environment:  
distances, directions, objects etc.
- Physical apparatus:
  - outer ear      – protects inner and amplifies sound
  - middle ear    – transmits sound waves as  
vibrations to inner ear
  - inner ear      – chemical transmitters are released  
and cause impulses in auditory nerve
- Sound
  - pitch            – sound frequency
  - loudness       – amplitude
  - timbre          – type or quality

# Hearing (cont)

- Humans can hear frequencies from 20Hz to 15kHz
  - less accurate distinguishing high frequencies than low.
- Auditory system filters sounds
  - can attend to sounds over background noise.
  - for example, the cocktail party phenomenon.

# Touch

- Provides important feedback about environment.
- May be key sense for someone who is visually impaired.
- Stimulus received via receptors in the skin:
  - thermoreceptors                      – heat and cold
  - nociceptors                              – pain
  - mechanoreceptors                      – pressure  
(some instant, some continuous)
- Some areas more sensitive than others e.g. fingers.
- Kinethesis - awareness of body position
  - affects comfort and performance.

# Movement

- Time taken to respond to stimulus:  
reaction time + movement time
- Movement time dependent on age, fitness etc.
- Reaction time - dependent on stimulus type:
  - visual ~ 200ms
  - auditory ~ 150 ms
  - pain ~ 700ms
- Increasing reaction time decreases accuracy in the unskilled operator but not in the skilled operator.

# Movement (cont)

- Fitts' Law describes the time taken to hit a screen target:

$$Mt = a + b \log_2(D/S + 1)$$

where: a and b are empirically determined constants

Mt is movement time

D is Distance

S is Size of target

⇒ targets as large as possible  
distances as small as possible

# Individual differences

- long term memory
  - sex, physical and intellectual abilities
- short term memory
  - effect of stress or fatigue
- changing
  - age