

Lecture 6

chapter 1

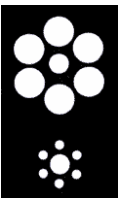
the human

1 of 3



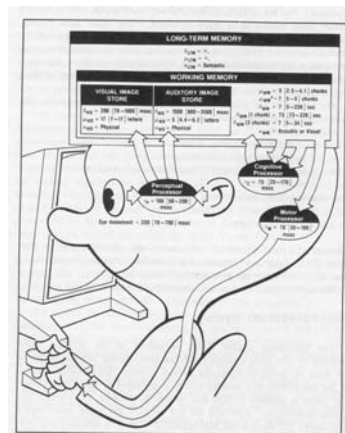
the human

- Lecture 6 (today)
 - Information i/o ...
 - visual, auditory, haptic, movement
- Lecture 7
 - Information stored in memory
 - sensory, short-term, long-term
- Lecture 8
 - Information processed and applied
 - reasoning, problem solving, skill, error
 - Emotion influences human capabilities
 - Each person is different



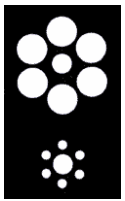
The human processor

- Input
 - senses
- Process
 - Cognition
 - Knowledge
 - Skills
 - Reasoning
- Output
 - Memory
 - Actions



Senses

- Vision
- Hearing
- Touch (haptics)
- Smell
- Taste



Vision

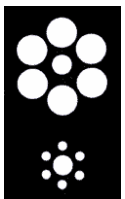
Two stages in vision

- 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
- Interesting web site
<http://www.hhmi.org/senses>



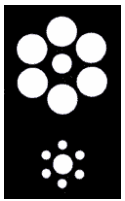
Interpreting the signal

- 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
- What does this mean for items on the screen periphery?



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

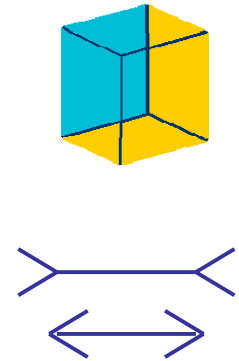
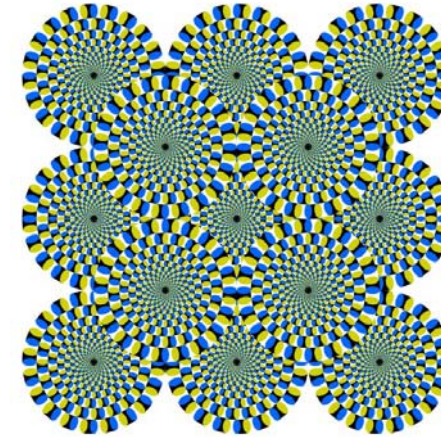


Interpreting the signal (cont)

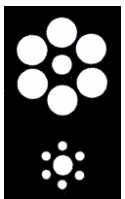
- The visual system compensates for:
 - movement
 - changes in luminance.
- Context is used to resolve ambiguity
- Optical illusions sometimes occur due to over compensation



Optical Illusions



http://www.planetarium-freiburg.de/optische_Taeuschungen.html

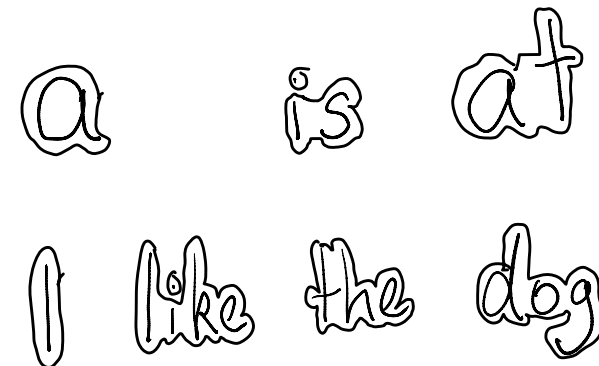


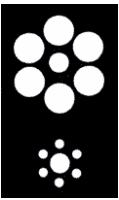
Reading

- 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



Word shapes





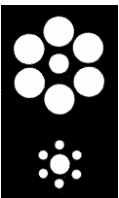
When you are surfing the web this week

- If you have trouble finding something you know must be on a page
- Look to see why that is
 - Is it right on an edge?
 - Is the colour wrong?
 - Is the font too small?
- Put some examples up on the class forum – link and your comment as to what was good/bad about the visual layout



What if

- Your visual attention is need for another activity
 - Driving & cell phone / gpa navigation....
- Were colour blind?
- Needed reading glasses?
- Had really poor eye sight that couldn't corrected by glasses?
- You were blind?



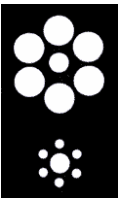
Hearing

- 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.
 - Higher frequencies disappear as you get older
- Auditory system filters sounds
 - can attend to sounds over background noise.
 - for example, the cocktail party phenomenon.
 - Hearing aids disrupt this filtering



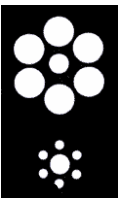
What if....

- You are in a noisy environment
 - Night clubbing
 - Phone call/ text message?
- Your hearing is below average
- You are deaf



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.
- Kinesthesia - awareness of body position
 - affects comfort and performance.
- Little experiment
 - Touch when reading



Touch devices

Interesting research in the areas of sound and touch

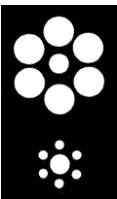


- Prof Stephen Brewster
<http://www.dcs.gla.ac.uk/~stephen/>
- UoA has a PHANTOM haptic device
 - I have some students working with it at the moment trying to emulate the feel of 'soft tissue'
 - It is very cool! (but hard ☹)



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.



What if...

- You can't keep your hand steady?
 - Keyboard, mouse
- You are a paraplegic?
- <http://www.abilityhub.com/mouse/eyegaze.htm>
- Eye tracking software/hardware also use for usability studies to track users focus points



Movement (cont)

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

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

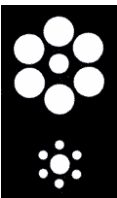
where: a and b are empirically determined constants

Mt is movement time

D is Distance

S is Size of target

⇒ targets as large as possible
distances as small as possible



Smell & Taste

- We have about 4000 types of different smell receptors
- Some primitive attempts to analyse and synthesise smell
- It is technically very difficult!
- Taste is closely associated – little work in this area



Summary

- Primary senses used for computers
 - Sight & Kinethics
- All senses have a reaction time
- Most senses degrade with age
- Many people have some disability
- Interactive environments for specific disabilities have often resulted in technological breakthroughs