Umm Al-Qura University

6001333-3 Human Computer Interaction

Lecture 2 (Week 1)

- Computer Systems
- Humans

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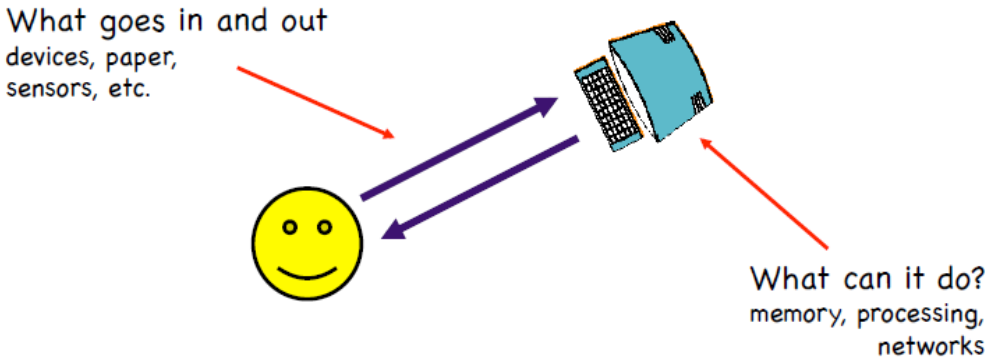
Computer systems

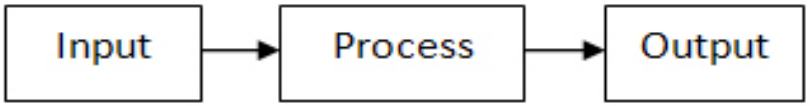
To understand human–computer interaction

… we need to understand computers



Computer systems

- Computer: is simply a programmable machine that receives input, stores data, processes data, and produces output.



input-process-output model

Computer systems

- The computer system are made up of various elements.
- Each of these elements *affects* the interaction:
  - input devices: text entry and pointing
  - output devices: screen, digital paper
  - memory: RAM, ROM
  - processing: speed of processing, networks

Computer systems

- A typical computer system
  - screen, or monitor
  - keyboard
  - mouse/trackpad
- Variations
  - desktop
  - laptop
  - Others

- If we use different devices, then the interface will support a different style of interaction

Interacting with computers

How do humans interact with computers?

What devices do they use to perform these interactions?

- Two primary forms of interaction:
  1. Text entry
  2. Pointing (target acquisition)

Text entry

Text entry devices :

- Keyboards
- Speech
- Handwriting recognition
- others

- **Keyboards**

  - Most common text input device
  - Allows rapid entry of text by experienced users
  - Cable or wireless

Text entry

Keyboard layout – QWERTY

- Standardised layout… created in the early 1870s… but …

  – differences between keyboards by country/language

  – non-alphanumeric keys are placed differently

Text entry

- QWERTY arrangement not optimal for typing

-The keyboard was designed to keep letters commonly used together away from each other to prevent jamming.

Alternative designs allow faster typing but large social base of QWERTY typists produces reluctance to change.

Alternative keyboard layouts

- Alphabetic
  - keys arranged in alphabetic order
  - not faster for trained typists
  - not faster for beginners either!

Text entry

Dvorak keyboard

- common letters under dominant fingers
- biased towards right hand
- common combinations of letters alternate between hands

Text entry

– 10-15% improvement in speed and reduction in fatigue

– But - large social base of QWERTY typists produce market pressures not to change

Special keyboards

- ergonomic designs
  – to reduce fatigue for RSI

- for one handed use
  – Malatron

Text entry

Virtual keyboards

Use touch screen or projection

https://www.youtube.com/watch?v=r50x1vc2B3w

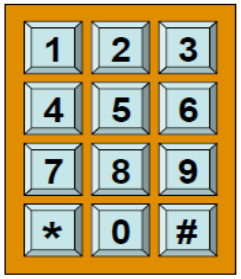
Text entry

Numeric keypads

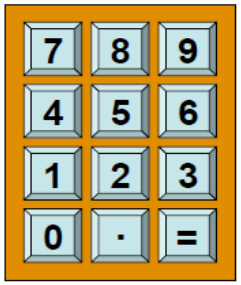
- for entering numbers quickly:
  – calculator, PC keyboard

- for telephones
  – not the same!!

ATM is like phone



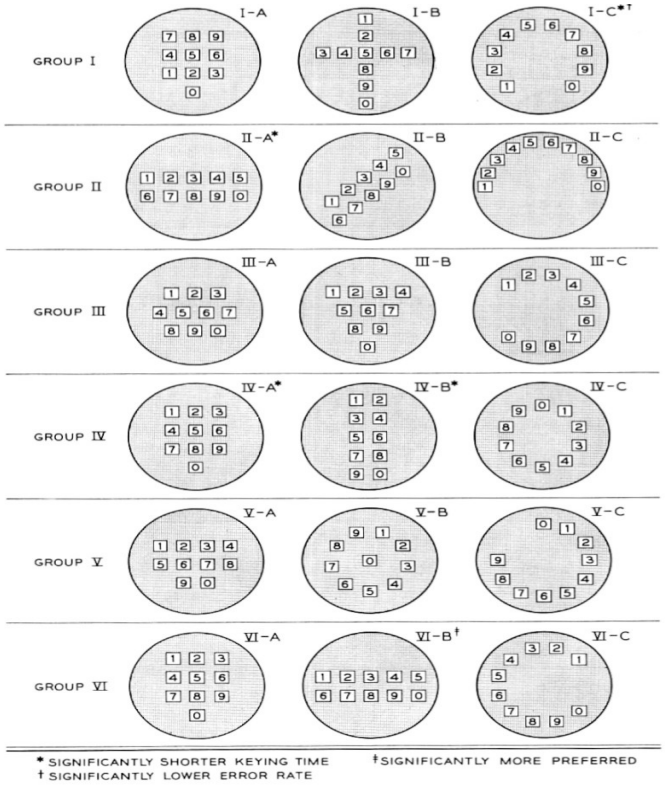
Telephone



Calculator

Text entry

Phone dials



- Bell Labs looked at layouts for phone keypads in the 1950s

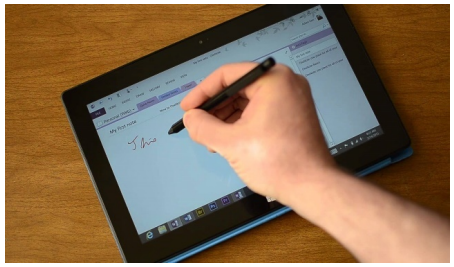
http://www.youtube.com/watch?v=kCSzjExvbTQ#t=54

Text entry

Handwriting recognition

- Text can be input into the computer, using a pen and a digitising tablet.. natural interaction

- Technical problems:
  – capturing all useful information - stroke path, pressure, etc. in a natural manner
  – coping with different styles of handwriting



Text entry

Speech recognition

- Improved rapidly in the last few years
- Most successful when:
  - single user: initial training and learns peculiarities
  - limited vocabulary systems

- Problems with
  - external noise interfering
  - large vocabularies
  - different speakers

Try it yourself: https://talktyper.com/ar/

Pointing

Pointing, positioning and drawing

- Mouse
- Touch screen
- Joystick
- Digitizing tablet

There are different types of pointing: Direct and indirect, absolute and relative pointing.

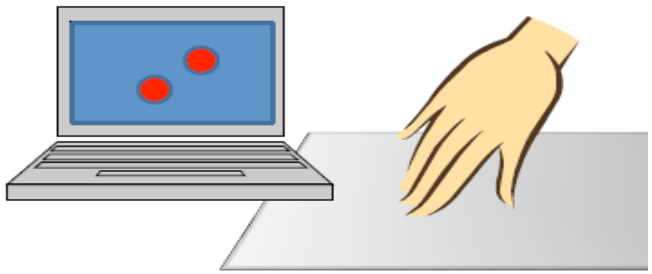
Pointing

Direct *vs.* indirect pointing

direct: input occurs co-located with output

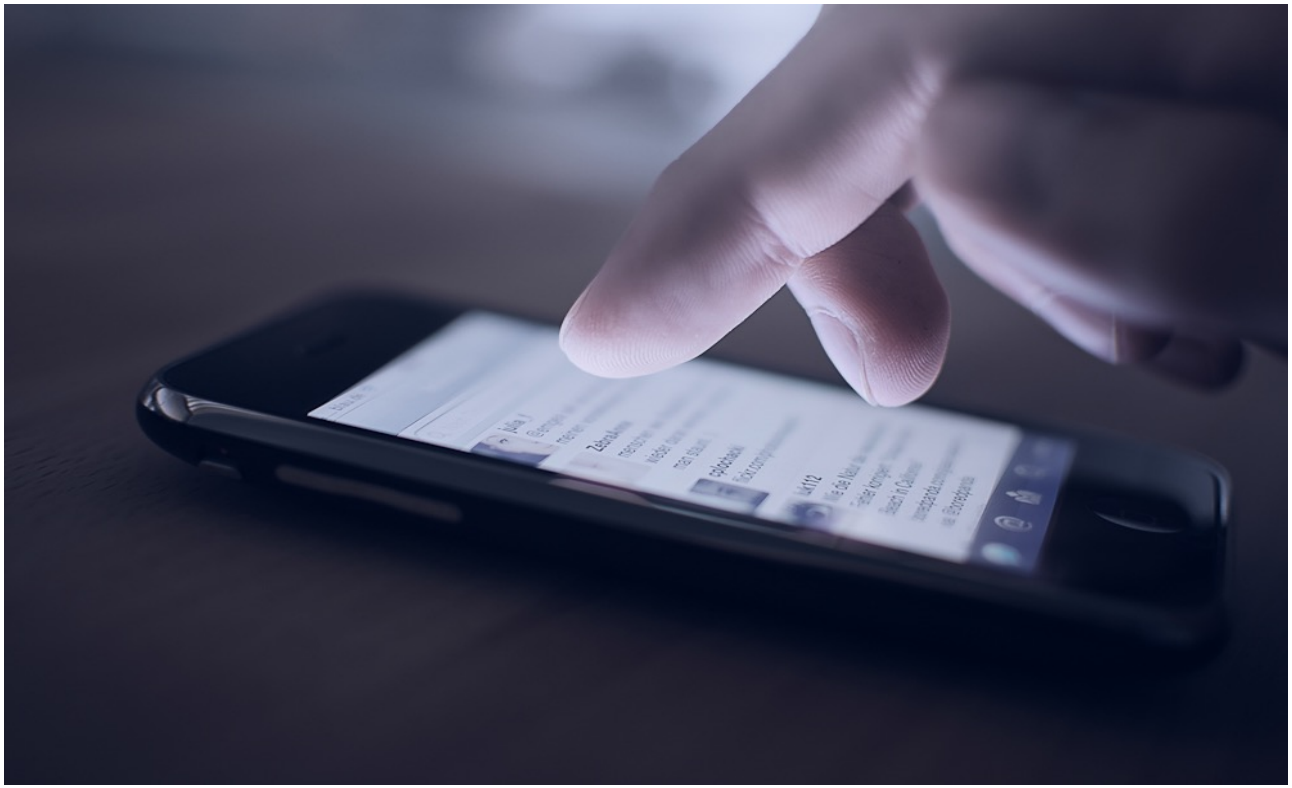
issue: hand occlusion

indirect: input occurs separated from output

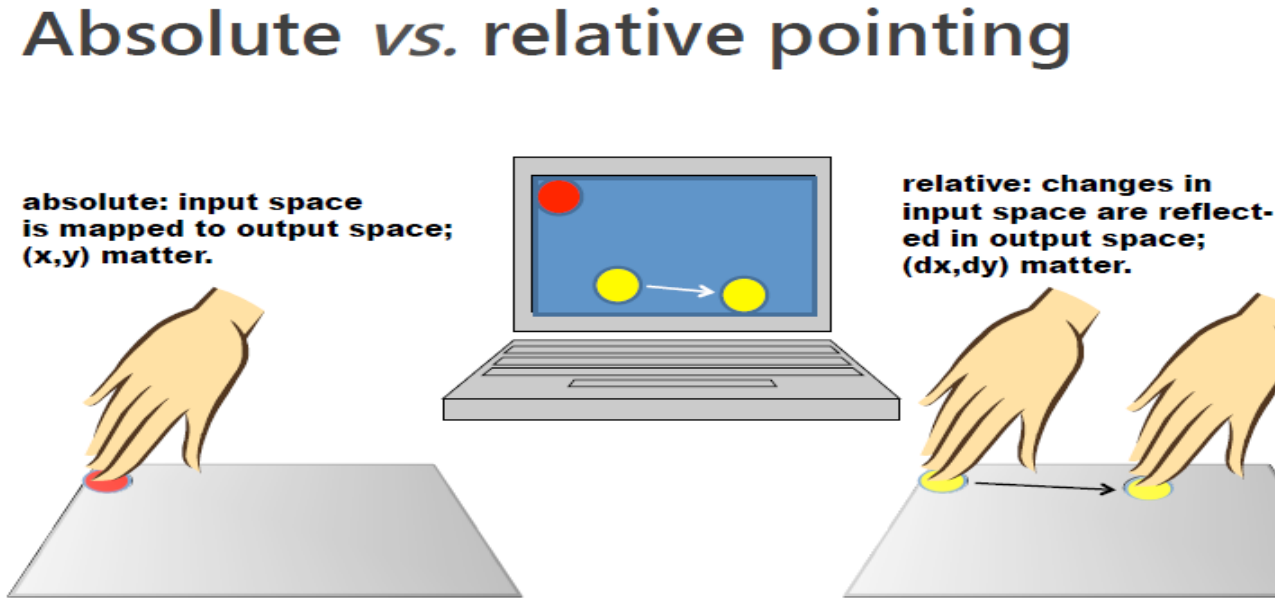


issue: 2 possible foci-of-attention

Pointing



Pointing


Absolute *vs.* relative pointing
absolute: input space
is mapped to output space;
(x,y) matter.
relative: changes in
input space are reflect-
ed in output space;
(dx,dy) matter.

Pointing

Pointing

The mouse

- Handheld pointing device
  - very common
  - easy to use

- Two characteristics
  - buttons:1, 2 or 3 buttons
  - Can only detect relative movement. Mover mouse moves screen cursor.

Pointing

Touch screen

- Detect the presence of finger or stylus on the screen.
- direct pointing device

- Advantages:
  – fast, and requires no specialised pointer
  – good for menu selection
  – suitable for use in hostile environment
  – clean and safe from damage.

Pointing

- Disadvantages:
  – finger can mark screen
  – can be imprecise (finger is a fairly blunt instrument!)
  – difficult to select small regions or perform accurate drawing.

Pointing

Joystick

- Indirect

  pressure of stick = velocity of movement

- buttons for selection

  on top or on front like a trigger

- often used for computer games and aircraft controls and 3D navigation

Pointing

Digitizing tablet

- used for maps, precision drawings
- surface with stylus or cross-hair pointer
- very accurate

Humans

Humans: Input–output Channels

- A person's interaction with the outside world occurs through information being received and sent: input and output.

- In an interaction with a computer the user receives information that is output by the computer, and responds by providing input to the computer. The user's output becomes the computer's input and vice versa.

Input–output Channels

- Input in the human occurs mainly through the senses and output through the motor control of the effectors.
- There are five major senses: sight, hearing, touch, taste

and smell. Of these, the first three are the most important to HCI.

- Taste and smell do not currently play a significant role in HCI

Input–output Channels

1. **Vision** :

- Human vision is a highly complex activity with a range of physical and perceptual limitations, yet it is the primary source of information for the average person.
- Vision begins with light.
- Light is reflected from objects in the world and their image is focused upside down on the back of the eye.
- The receptors in the eye transform it into electrical signals which are passed to the brain.

Input–output Channels

- **Importance of Vision to HCI**
- Presenting information visually makes sense for a number of reasons:

– Vision is perhaps the most important of the 5 senses (which of your senses would you least like to lose?)

– Our thinking has strong visual elements (think about how you solve problems, and the language you use to describe thinking)

– All of these contribute to making visual interaction the most common form of HCI

Input–output Channels

- Humans can read 200 words per minute on paper, and 180 words per minute on the screen.). Reading is slower on the screen.

- We have a tendency to see:
  - what we have seen before
  - what we want to see
  - what we think should be there
- We frequently misremember visual information

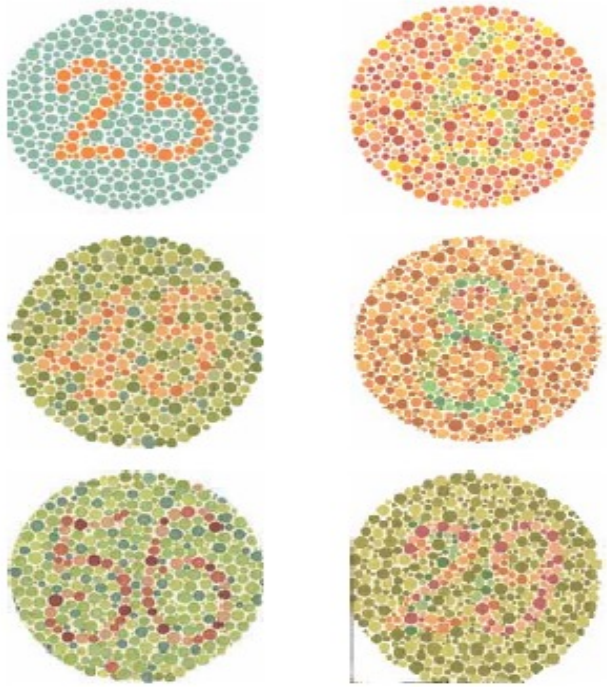
https://www.youtube.com/watch?v=FWSxSQsspiQ&feature=player_embedded

Input–output Channels

- **Colour blindness**

If you cannot read the number in one or more of the mosaic patterns, then it is likely you suffer from some kind of colour deficiency.

Colour deficiency more prevalent in men than women



Input–output Channels

How can we help users?

- Make information stand out when it needs attention at a particular stage in a task
- Use graphics, colour, underlining, ordering of items and sequencing/grouping of information
- Avoid cluttering interface with too much information
- PLAIN interfaces are easier to use (e.g., Google)…
- Large font size

Input–output Channels

2. **Hearing**:

- The sense of hearing is often considered secondary to sight, but we tend to underestimate the amount of information that we receive through our ears.
- The auditory system can convey a lot of information about our environment. It begins with vibrations in the air or sound waves. The ear receives these vibrations and transmits them, through various stages, to the auditory nerves.

Input–output Channels

How can we help users?

- Keep the length of speech-based menus and instructions to a minimum.

  – Research has shown that people find it hard to follow more than 3 or 4 options.

  – They will not remember more than a few directions at once.

Input–output Channels

3. Touch :

- The third and last of the senses that we will consider is touch.
- In the interaction with the computer, the fingers play the primary role, through typing or mouse control, with some use of voice, and eye, head and body position.

Input–output Channels

What about multiple senses being stimulated at the same time?

The McGurk Effect

http://youtu.be/G-lN8vWm3m0

Human Memory

"Memory refers to the processes that are used to acquire, store, retain and later retrieve information."

- There are three major processes involved in memory: encoding, storage, and retrieval.

- In order to form new memories, information must be changed into a usable form, which occurs through the process known as encoding.

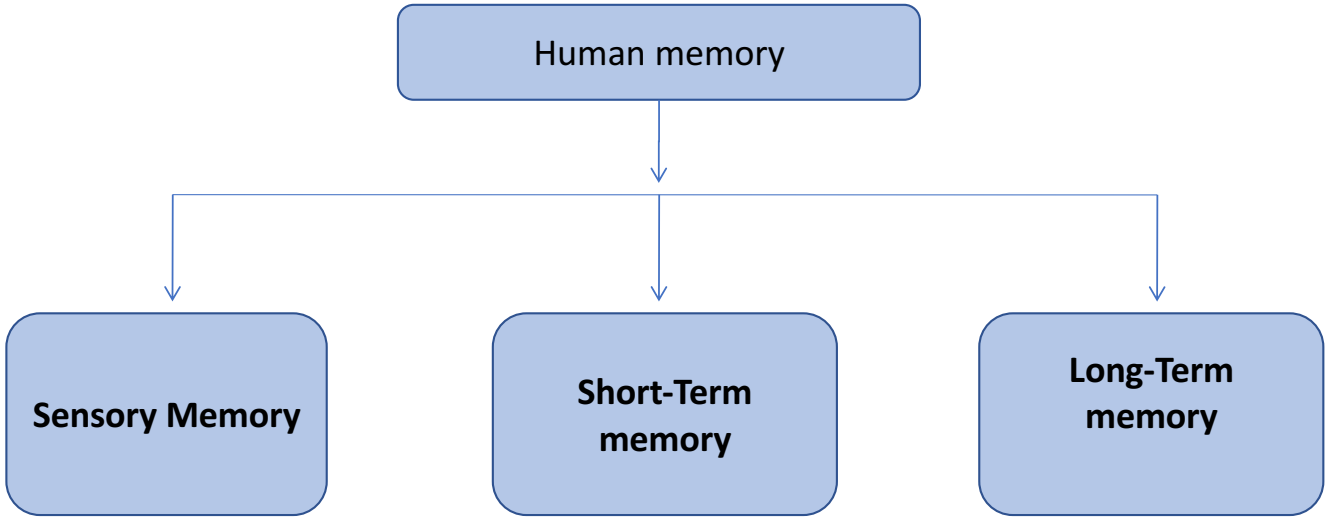
Human Memory

- Once information has been successfully encoded, it must be stored in memory for later use.

- The retrieval process allows us to bring stored memories into conscious awareness.

Human Memory

- There are three types of memory or memory function:



Human Memory

1. **Sensory Memory :**

Sensory memory is the earliest stage of memory. During this stage, sensory information from the environment is stored for a very brief period of time, generally for no longer than a half-second for visual information and 3 or 4 seconds for auditory information.

Human Memory

2. Short-Time Memory :

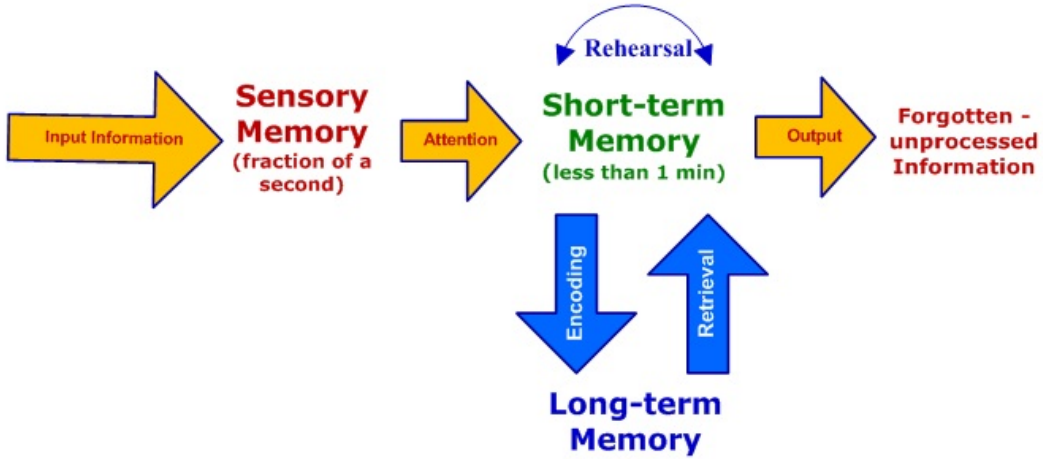
- Short-time memory, also known as active memory, is the information we are currently aware of or thinking about.
- Most of the information stored in active memory will be kept for approximately 20 to 30 seconds.
- Distraction erases short-term memory.
- Short-term memory capacity reduced 4% to 28% as people age. Especially for visually acquired information

Human Memory

3. **Long-Time Memory :**

- Long-time memory is intended for the long-term storage of information.
- Here we store factual information, experiential knowledge, procedural rules of behavior….
- Seemingly permanent and unlimited
- Access is harder and slower

Human Memory



Why we forgot?

- lack of use
- Interference.. similar things get in the way

Human Memory

- **Memory load**
  - Users perform tasks best when all required information fits in STM
  - accessing is fast
  - requires little work

- **How can we help users?**

1. Don't overload users memories with complicated procedures for carrying out tasks.

- Good interfaces promote recognition rather than recall by using menus, icons and consistently placed objects.

- **Recognition** is a response to a sensory cue. When you see something, you compare it to information stored in your memory, and if you find a match, you "recognize" it.

Human Memory

2. Help users stay concentrated by reducing distractors.

3. Good interfaces promote recognition rather than recall by using menus, icons and consistently placed objects

Human Memory

- **Recognition** is a response to a sensory cue. When you see something, you compare it to information stored in your memory, and if you find a match, you "recognize" it.
- A police line up is a classic exercise in recognition. You look at several people, and compare each to the person you saw commit the crime

- **Recall** is the retrieval of information from memory without a cue. There is a question, and you must search your memory for the answer. Say that instead of looking at a lineup, you have to describe the person you saw to a sketch artist. This is an exercise in recall.

Individual Differences

- All the points that we discussed apply to the majority of people.
- We should be aware of individual differences so that we can account for them as far as possible within our designs.
- These differences may be long term, such as sex, physical capabilities and intellectual capabilities. Others are shorter term and include the effect of stress or fatigue on the user.