# Week 8, Part 1: Cognitive Psychology for GUI design

### We're going to talk about:

Why we use cognitive psychology for GUI design, and 5 tools for understanding how people think:

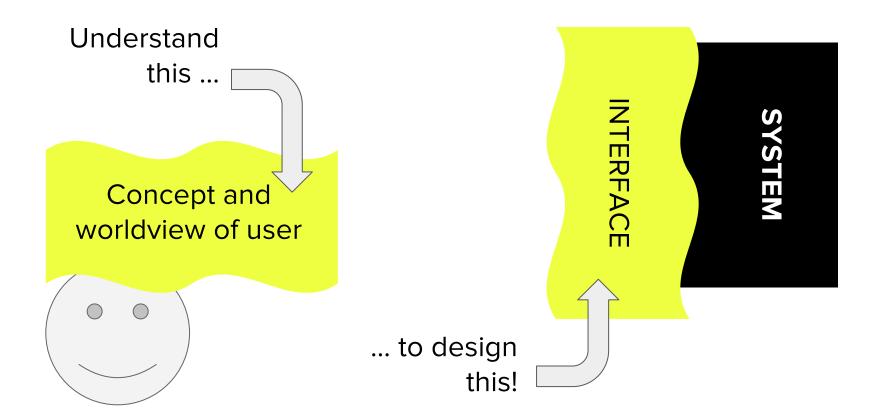
- 1. The Model Human Processor
- 2. Core aspects of cognition
- 3. Memory
- 4. Gestalt psychology
- 5. Human perception

Why use cognitive psychology for GUI design?

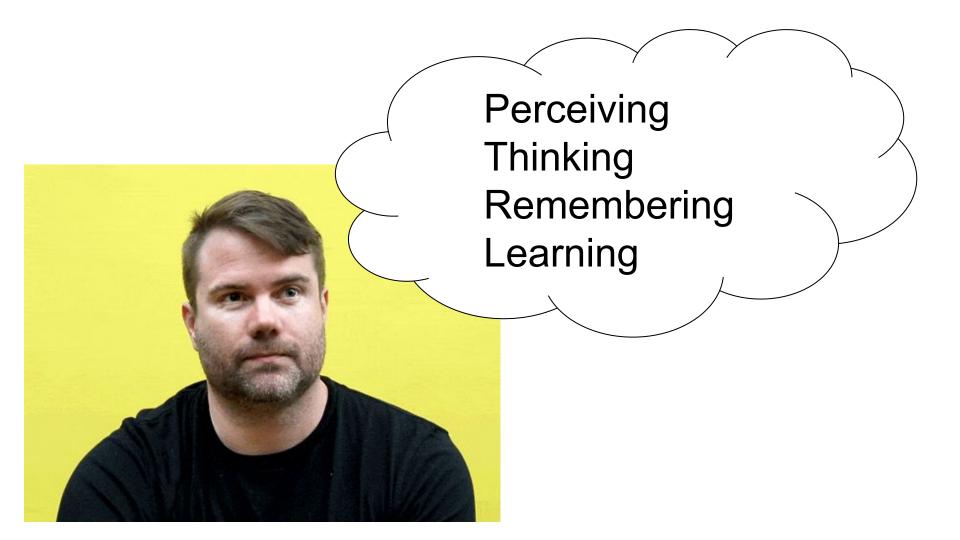
### Because we can't redesign people.

We need to understand how human beings understand things and design accordingly ... and users are human beings

We need to understand their abilities and limits



What goes on in the mind of the user?









Making decisions Solving problems Daydreaming

There might be many users, but can use models to understand how their minds generally tend to operate.









We have several tools to help us understand this.

### Tool 1: The Model Human Processor

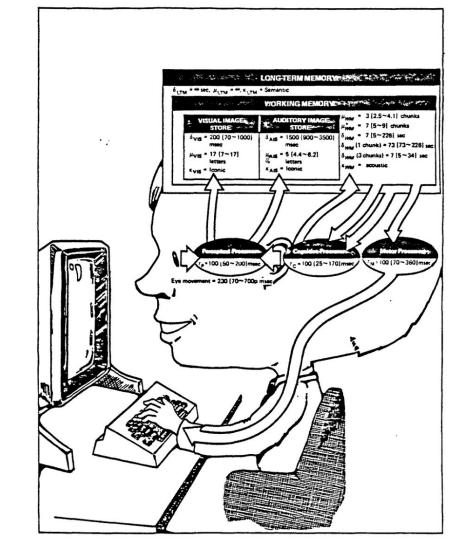
### The Model Human Processor consists of two parts:

#### 1. Processors

- Perceptual
- Cognitive
- Motor

#### 2. Memory

- Sensory Image Store
- Long-term memory
- Short-term (working) memory

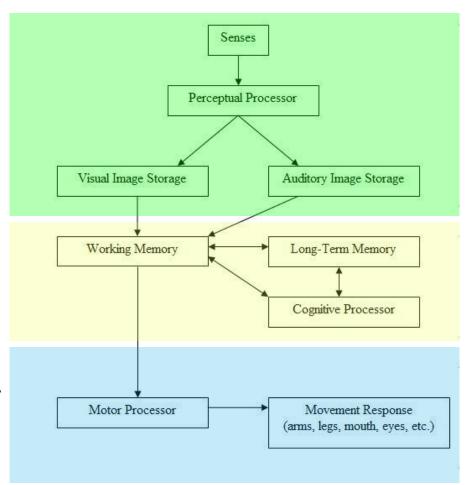


#### **Three Subsystems:**

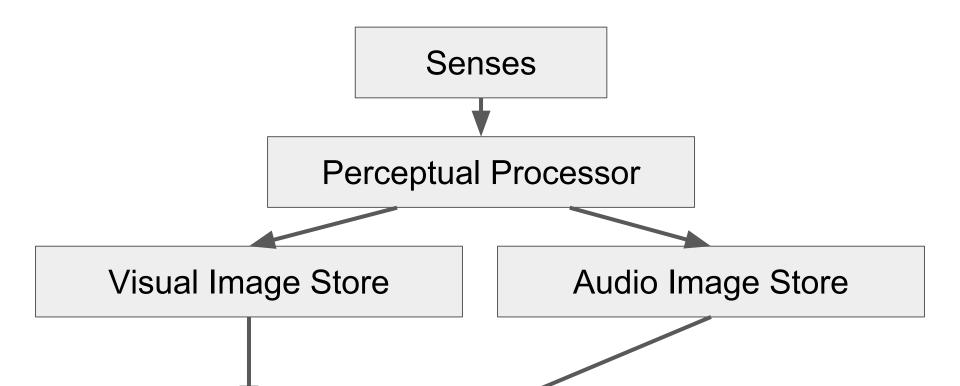
Perceptual (data goes in)

Cognitive (data processed)

Motor (data comes out)

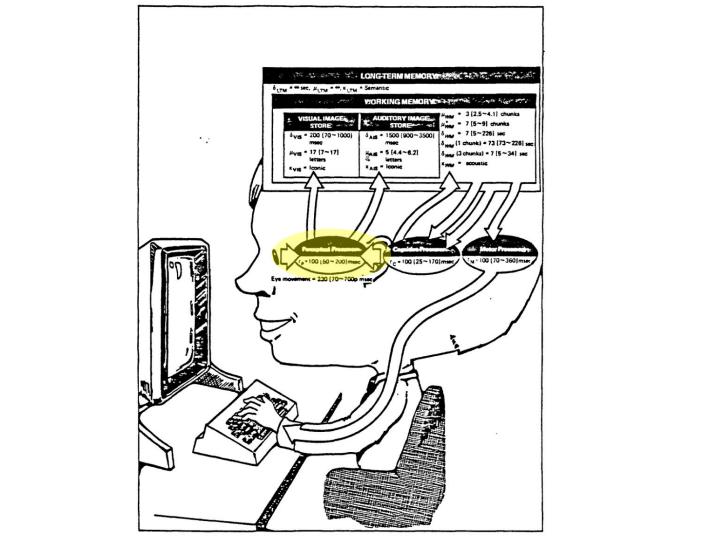


### Perceptual Subsystem:



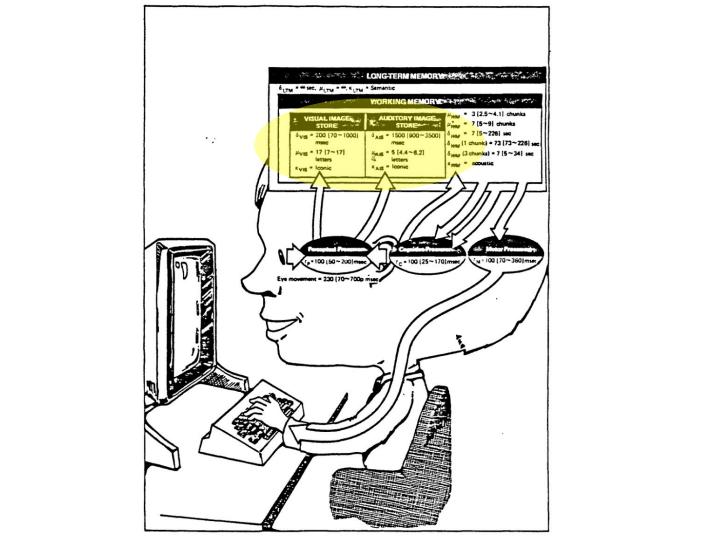
## What happens in the **perceptual** subsystem?

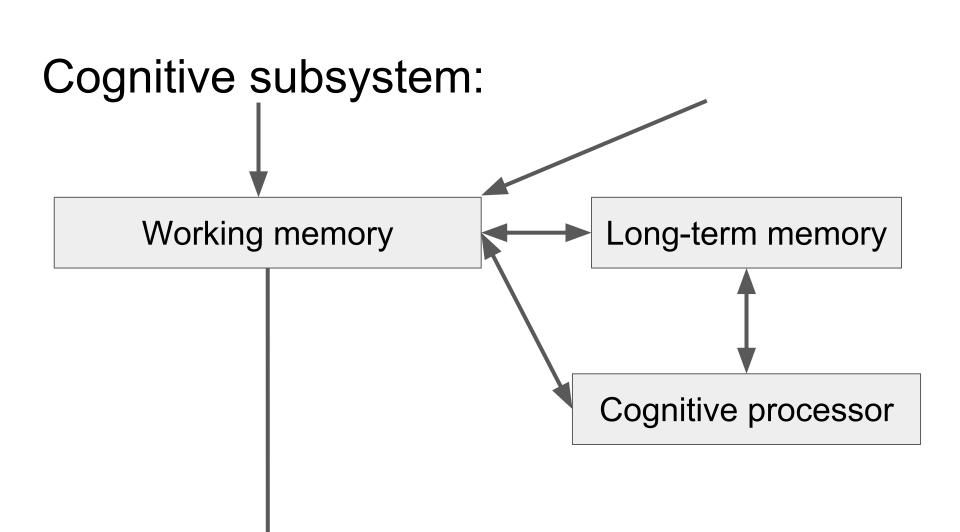
 Information comes in via visual, auditory, haptic, or movement channels



## What happens in the **perceptual** subsystem?

- Information is stored in memory:
  - sensory,
  - working, or
  - long-term memory

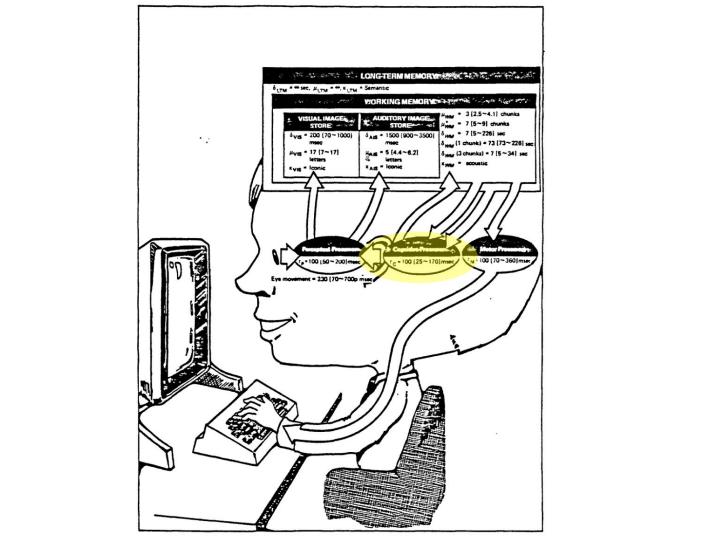




## What happens in the **cognitive** subsystem?

Information is processed and reasoning applied:

- Problem solving
- Skill acquisition
- Error feedback
- Meaning making

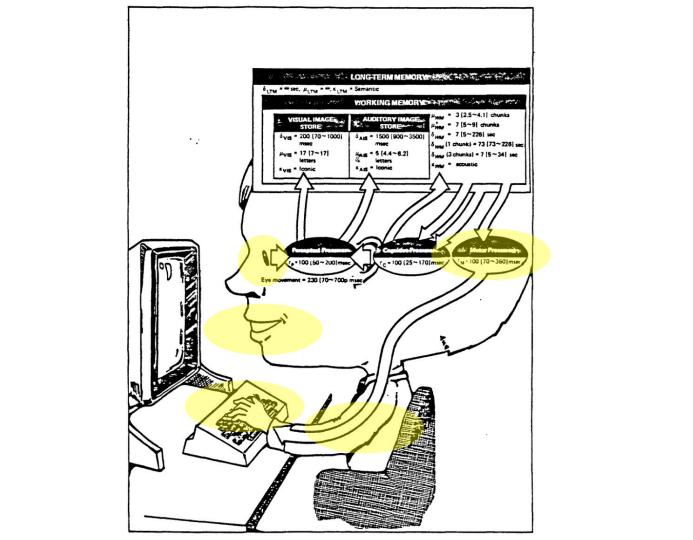


## Movement subsystem: Motor processor Movement response

Can be arms, legs, mouth, eyes ...

## What happens in the **motor** subsystem?

A reaction is produced using the motor skills (eyes, limbs, mouth, and so on) as a result of cognitive processing.



### Each processor requires an amount of time.

Perceptual: ~100ms (less for intense stimuli)

Cognitive: ~70ms

**Motor:** ~70ms (movement is not continuous, but is a sequence of separate movements.)



This model allows the designer to predict the time it will take a person to complete a task, by determining the time of each operation.

Tool 2:
Core cognitive aspects

### What are the core cognitive aspects?

- 1. Attention
- 2. Perception and recognition
- 3. Memory
- 4. (and a few others, like reading)

#### **Attention**

What is attention?

The process of selecting things to concentrate on from the mass around us, at a single point in time.

### Design implications of attention:

- Structured information to capture attention
- Make important points salient
- Make important information stand out (colour, ordering, grouping, spacing, underlining)
- Avoid clutter and competing information
- Don't add stuff just because you can exercise restraint

### Perception and recognition

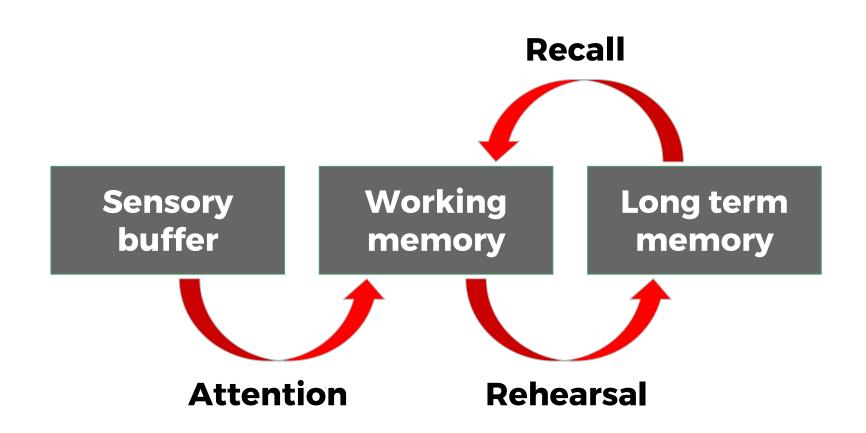
What are perception and recognition?

How information is acquired from the world and transformed into experiences

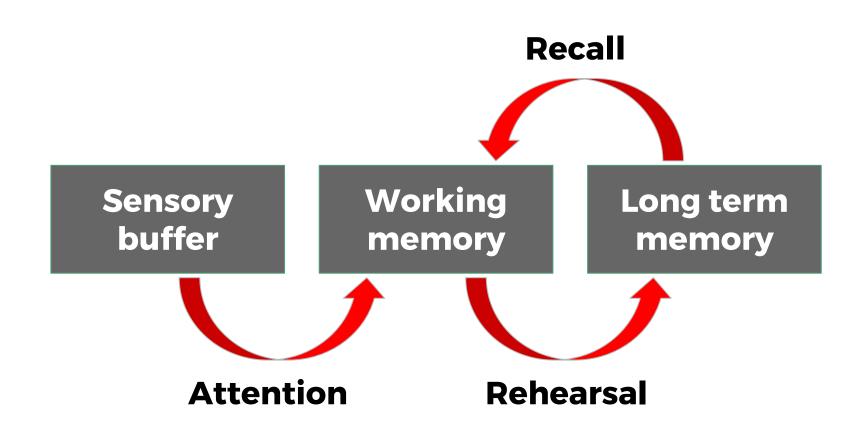
### **Memory**

Three types of memory:

- Sensory/perceptual
- Working/short-term
- Long-term



### Tool 3: Model of Memory



#### Sensory/perceptual memory

The sensory memories act as buffers for stimuli received through the senses:

- iconic memory for visual stimuli
- echoic memory for aural stimuli
- haptic memory for touch

### Sensory/perceptual memory

Storage here is **brief** and these memories are constantly **overwritten** by new information.

Storage lasts about 0.5 seconds!

### Sensory/perceptual memory

Information received by sensory memories is quickly passed to a more permanent memory store ... or overwritten and lost.

## The role of attention

Information is passed from sensory memory to working memory via **attention**.

Attention is the **concentration** on one stimuli out of a number of competing stimuli.

# Design implications of sensory memory

We can't expect anyone to remember anything (that happened more than 0.5s ago)

The information must be **applied immediately**, or **displayed** until it's no longer needed

As the information **moves** to working memory, it will persist for as long as 10 seconds.

#### Working/short-term memory

- Can be accessed rapidly (70ms)
- Transient in nature
- Has a limit of **7 +/- 2** chunks of information
- Information subject to interference
- Information is lost if not rehearsed



"The rule of 7, plus or minus two."

George Miller, 1956

## **Grouping/chunking**

A strategy of grouping items, about seven items per group

Think of how you remember your phone number - patterns can be useful memory aids

Short term memory is constrained by the number of **chunks**, not the number of items









Call log

Contacts

Favorites

## 555-555







Pepperoni, green peppers, black olives, anchovies, pineapple, sausage, tomatoes, fresh garlic, onions, ham, gorgonzola cheese, chilli peppers, mozzarella cheese, chicken, pesto, fresh herbs, mushrooms, ground beef, cheddar cheese, sweet corn, green olives, red peppers

## Pizza toppings:

#### MEAT

Pepperoni, anchovies, sausage, ham, chicken, ground beef

#### CHEESE

Gorgonzola cheese, mozzarella cheese, cheddar cheese

#### **VEGETABLES**

Chilli peppers, pesto, fresh herbs, mushrooms, sweet corn, green olives, red peppers, green peppers, black olives, pineapple, tomatoes, fresh garlic, onions

## Regency and Primacy effects

Items at the end of the list are remembered for **short periods** (regency effect)

Earlier items are remembered **better throughout** (primacy effect)

Items in the middle tend to be poorly recalled

#### **Long-term memory**

- We store meaning and knowledge here
- Recalling information means that information is moved from the long-term memory to an active state in the working memory

### Long-term memory: Storage

Rehearsal: Moves information from short-term to long-term

**Total time hypothesis:** The amount of time info is retained (proportional to rehearsal time)

**Distribution of practice effect:** Optimised by spreading learning over time

**Structure, meaning, familiarity:** Makes information easier to remember

## Long-term memory: Forgetting

**Decay:** Information is lost gradually and slowly

Interference: New information replaces old

**Memory is selective:** Affected by emotion ... we can subconsciously choose to forget!

## Long-term memory: Retrieval

**Recall:** When you remember something, like a login or password

**Recognition:** Happens when you are presented with the item you are trying to remember

## How we perceive things

Think about the IBM logo.

How many lines are in it?

## Who cares?

## How we perceive things

People filter out the irrelevant factors, and save the ones they consider to be important (the **salient** ones).

## How we perceive things

Context also plays a major role in perception.

Factors we already know and recognise can have a profound effect on the usability of an interface.

## Implications of long-term memory for GUI design

#### Grouping

If grouping isn't used, the user's perception will try to impose structure!

## Implications of long-term memory for GUI design

#### Context

What a user already understands and knows affects their perception

## Implications of long-term memory for GUI design

#### **Salience**

People filter out what they consider irrelevant, and remember what they consider important.

## Tool 4: **Gestalt Psychology**



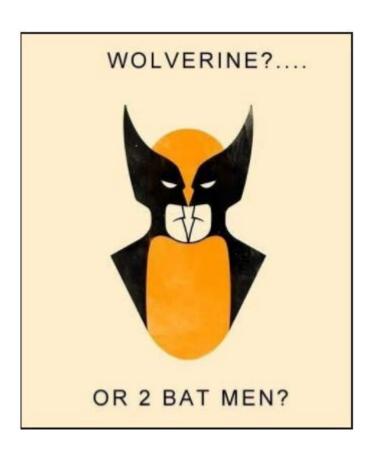
Noun; something that is made of many parts and yet is somehow more than or different from the combination of its parts

From the German, "shape"

## The 6 Principles of Gestalt Psychology:

## 1. Figure/Ground Relationship

We group elements either as **figures** (distinct elements of focus) or **ground** (the background/landscape on which the figures act)



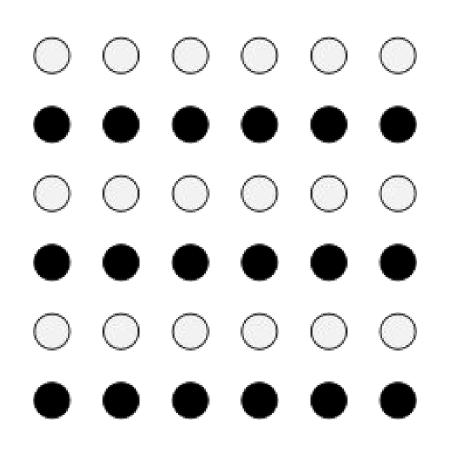
## 2. Proximity

We group by distance or location



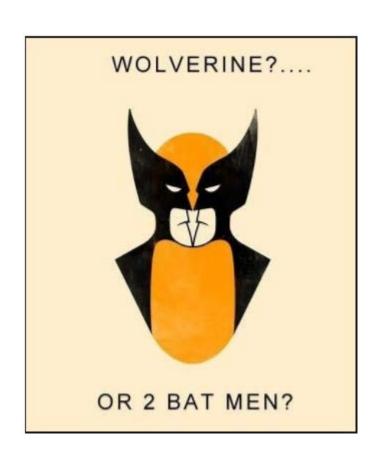
## 3. Similarity

We group by type



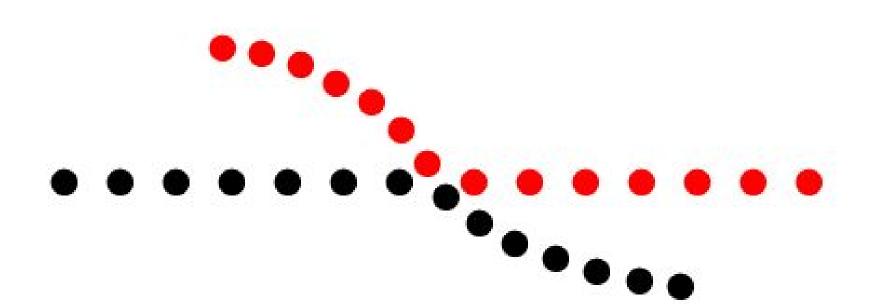
## 4. Symmetry

We group by meaning



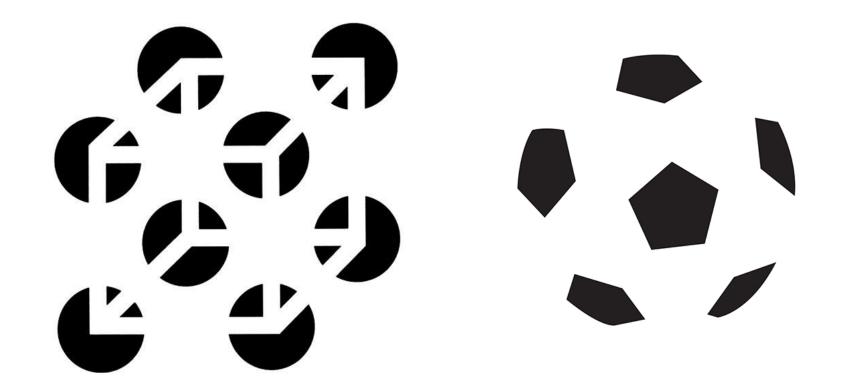
### 5. Continuity

We group by flow or alignment



#### 6. Closure

We perceive things as whole that are not completely there



#### **TOP TIP:**

Really evaluate and understand how the Gestalt rules are being **applied** or **violated** in the design of your weather app!

# Tool 5: **Human Perception**

#### Visual perception

Highly complex activity with a range of limitations. There are some things we can't see, but we can infer images from incomplete information

Perception is active, and vision is no exception.

It blends knowledge and sensation, and we have selective attention and perceptual expectations

### **Perception: Reading**

#### **Consists of several stages:**

- 1. We perceive the word's visual pattern
- 2. We decode it with reference to what we understand the language to look like
- 3. Syntactic and semantic analysis makes meaning

### **Perception: Reading**

If we CAPITALISE or mess with fonts or change around the colours, this can impact stage 2 (where we recognise the word by its appearance)

#### **Perception: Expectation**

What we expect to see affects what we perceive reality to be.

### PARIS IN THE THE SPRING

#### **Perception: Colour**

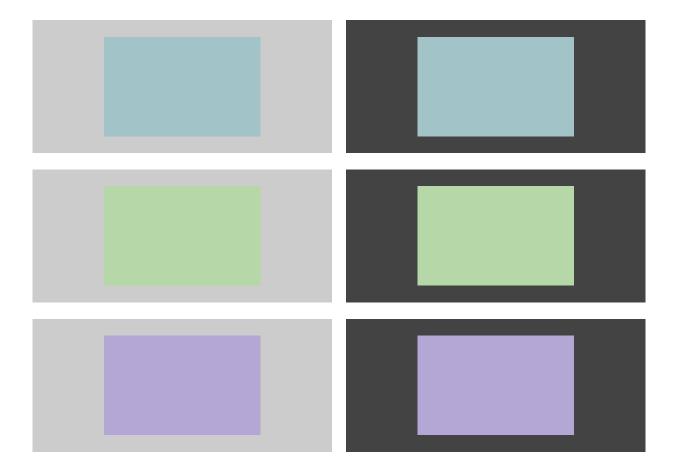
Colour is a powerful tool to improve user interfaces, but inappropriate use can severely reduce the performance of design

Welcome to my presentation about endangered animals

I hope that you will enjoy it and learn a lot about this subject.

#### **Perception: Colour**

Context is crucial - a colour is completely different beside other colours than it is on its own.



### An incredible amount of attention is paid to colour ... for good reason!



Colours have deeply ingrained cultural meanings, and should suit the content.



energetic

strength of character wisdom authority spirituality maturity WHITE freshness hope goodness light purity cleanliness simplicity coolness BLUE life peace stability calmness confidence tranquility sincerity affection integrity

**GRAY** 

stability

passion vision magic PINK romance compassion faithfulness beauty love friendship sensitivity GREEN growth environment healing money safety relaxation freshness

PURPLE

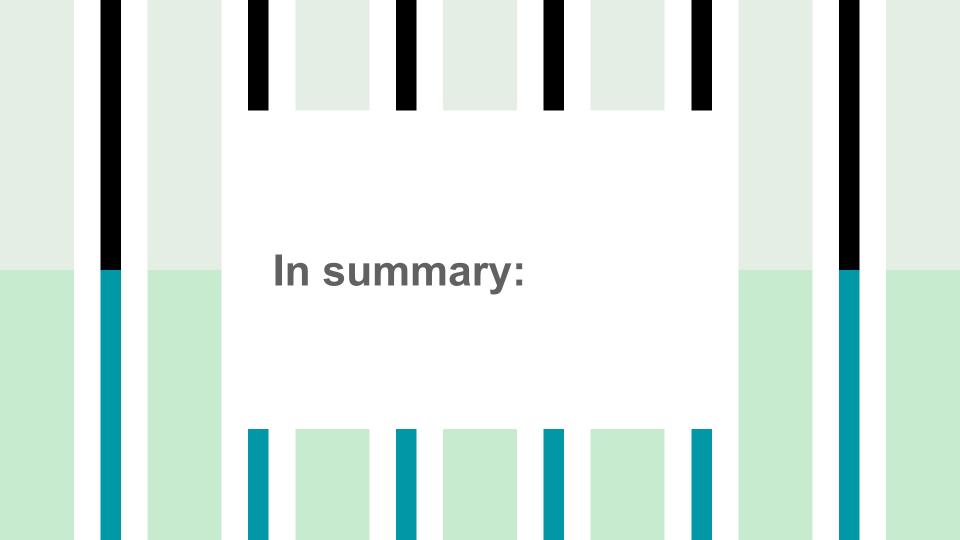
royalty

luxury dignity

## How do I find out about colour?

Pattern libraries: Google Material, Mail Chimp, Facebook, and so on are all good resources.

Google "colour scheme picker": There's hundreds and you can learn a lot!





Because though all people who use something are different, the workings of our minds have lots of things in common.

We need to understand these commonalities to make effective interfaces.

### The Human Processor Model

Describes three subsystems:

- Perceptual
- Cognitive
- Motor

Each requires an amount of time to execute its functions.

### The main aspects are: Attention Perception and recognition Memory

### Aspects of cognition



#### **Attention**

Very impactful on design!

A "simple" interface should be based on this, not various personal ideas of what "simple" means



Describe how information passes from the world into our working and long-term memories



### Memory

Three types:

- Perceptual/sensory
- Working/short-term
- Long-term



Design is profoundly impacted by the way memory works.

Attention and memory are closely linked.

Miller's "Seven plus or minus two" rule, and grouping/chunking

### Gestalt psychology

#### Six aspects:

- Figure/ground relationship
- Proximity
- Similarity
- Symmetry
- Continuity
- Closure



Also deeply impacts design, and understanding even how we read is important

Colour is crucial, and there are lots of ways to understand it

# Week 8, Part 2: **Affective Design**



Aspects of design that have to do with our emotions.

These are profoundly influential on usability.

A reliable, well engineered interface does not guarantee user satisfaction.

### User satisfaction is influenced by:

 Learning curve and retention rate (task-dependent)

### User satisfaction is influenced by:

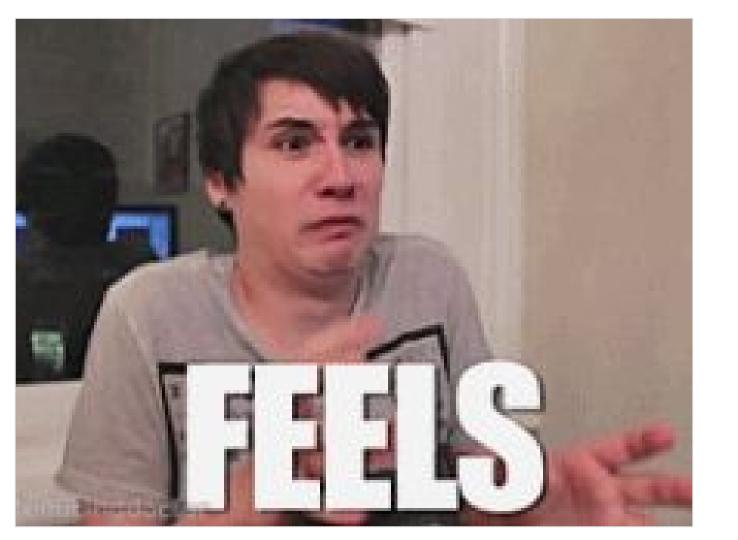
2. Performance factors, such as speed, error rate (user-dependent)

### User satisfaction is influenced by:

3. Subjective satisfaction (user-dependent)

# Successful interface design understands the following things:

- 1. Who the person using the system is
- 2. What this person's task is
- 3. Where this person is having the interaction
- 4. How the person using the system feels



### We have to understand the person's feelings.

## Emotional aspects of interface design

In an interaction context, this considers:

- How the user feels and reacts when interacting with technology
- What makes the user happy / frustrated / anxious / motivated

## Emotional aspects of interface design

In broader context, this considers:

- How human emotions affect human behaviour
- How people express themselves (face, body, voice)
- How people read each other's expressions and react accordingly

## Emotional aspects in GUI design

#### **Appearance and style:**

How "cool" or "cute" the person thinks think it is

## Emotional aspects in GUI design

#### **Appearance and style:**

Aesthetically pleasing devices and interfaces have a positive effect on people's **perception** of their usability.

(This can be fonts, colours, graphical elements, animations ...)

## Emotional aspects in GUI design

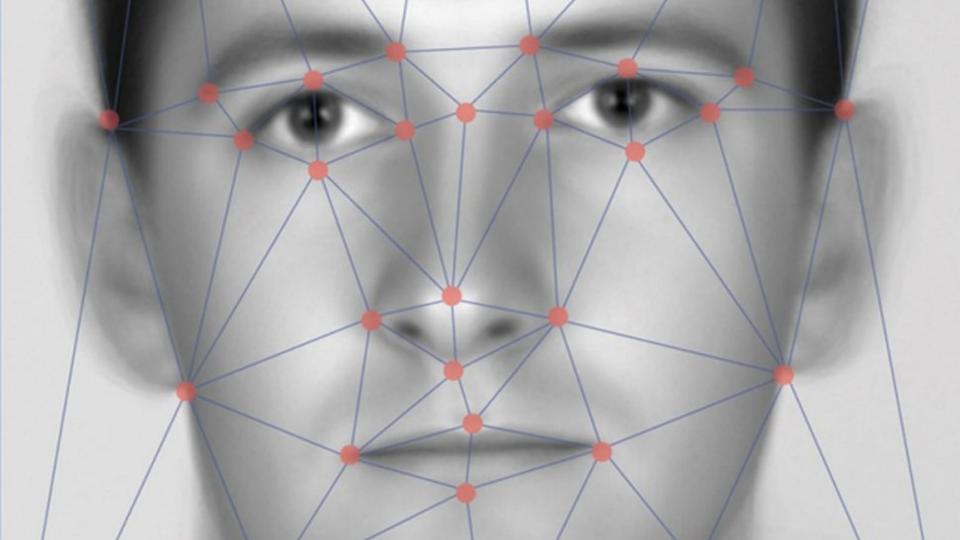
#### **Usability Characteristics:**

- Does it work properly?
- Are the user's **expectations** met?
- Are the error messages clear?
- Is the user in **control**?
- Is the design too: flashy / overloaded / noisy / patronising?
- Does the application do what the user wants it to do?

### Responding to emotions: Emotion-sensitive interfaces

These interfaces try to anticipate and respond to the person using them by sensing their emotions

Can be done through audio, facial recognition, infrared camera, bio feedback ....



## Affective computing questions

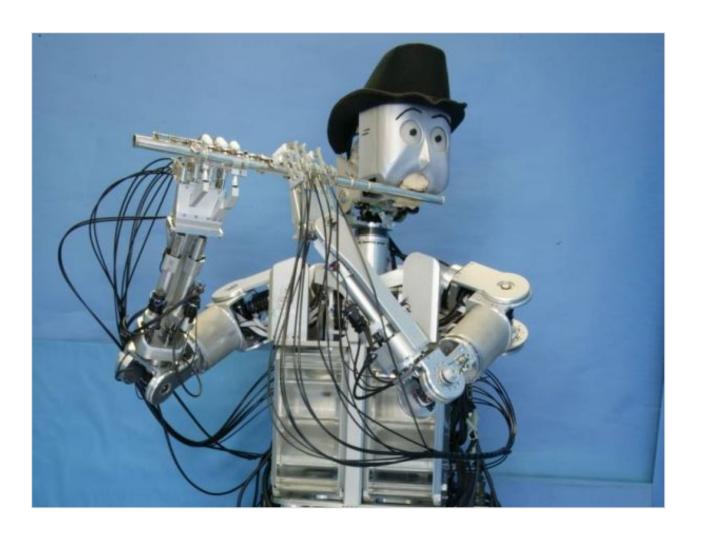
How accurate are these methods?

What are we using them for?

What are the ethical considerations?

#### **Anthropomorphism**

- Making interfaces human-like
- Giving interfaces personality









### **Anthropomorphism**

- People spend more time with these interfaces and respond positively to them
- But, their limited emotional intelligence can be misleading

## What does it mean to make a robot more "human"?

- Recognizing and responding to verbal and non-verbal input
- Generating verbal/non-verbal output
- Coping with breakdowns, turn-taking, etc
- Giving signals that indicate the state of the conversation as well as contributing new suggestions for the dialog

## What's in it for the person using the device?

- Companionship
- Feeling recognised/acknowledged
- Person using it doesn't have to learn a computer system

1. Feels are central to user satisfaction.

2. Appearance and style and usability are central considerations.

3. Affective computing (sensing emotions) is gaining popularity but there are some considerations here

4. Anthropomorphic (human-like) interface design is also gaining popularity.



### Friday, March 9

### 1400-1800

## Be on time. Be ready.

The schedule, rubric and guidelines will be available on the QMPlus page.

## Your viva will go like this:

# 10 minutes of presentation.

# 5 minutes of questions.

# If you don't show, you get 0.