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5COSC025W
Human Computer Interaction & User Experience

Lecture 2: Design Principles - Mapping - Cognitive Aspects and Design Implications

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Academic Year 2024/25

Overview

- Usability and UX goals
- Design principles
- Mapping
- Cognition and cognitive aspects
- UX in healthcare
- Attention and design implications
- Memory and design implications
- Information processing model
- Cognitive load
- Perception and design implications

Usability Goals

1. Effective to use
2. Efficient to use
3. Safe to use
4. Have good utility
5. Easy to learn
6. Easy to remember how to use

User Experience Goals

- satisfying
- enjoyable
- engaging
- pleasurable
- exciting
- entertaining
- helpful
- motivating
- emotionally fulfilling
- aesthetically pleasing
- supportive of creativity
- cognitively stimulating
- rewarding
- fun
- provocative
- surprising
- enhancing sociability
- challenging

Usability Goals

1. Effective to use
   - It refers to how good a product/system is at doing what it is supposed to do

Identifying & Specifying Usability Goals (questions to ask)

- Effective to use:

  Is the product/system capable of allowing people to learn, carry out their work efficiently, access information they need, or buy the good they want?

Usability Goals

2. Efficient to use
   - It refers to the way a product supports users in carrying out their tasks

Identifying & Specifying Usability Goals (questions to ask)

- Efficient to use:

  Once users have learned how to use a product/system to carry out their tasks, can they sustain a high level of productivity?

Usability Goals

3. Safe to use

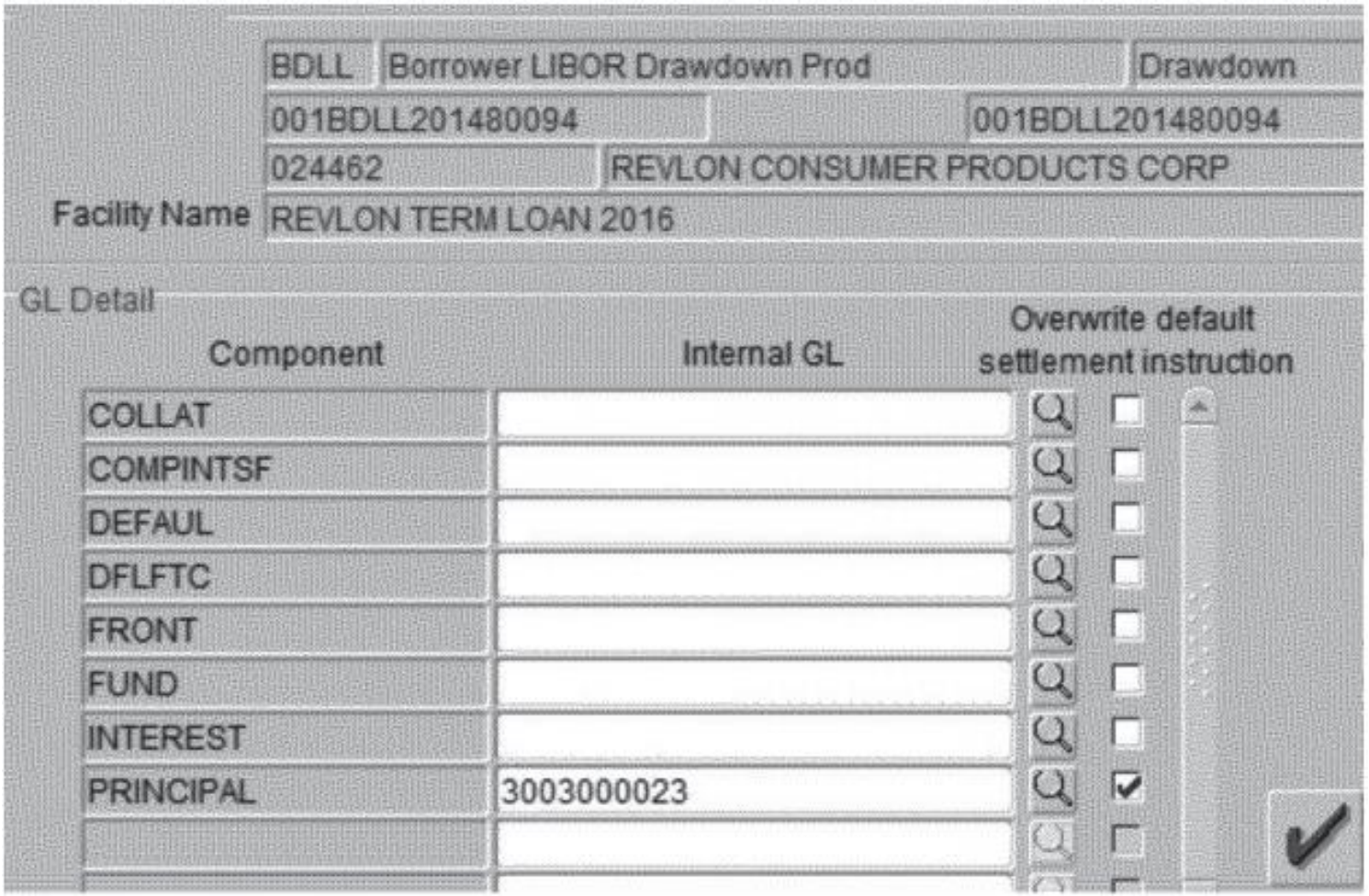
- It involves protecting the user from dangerous conditions and undesirable situations
  - The first aspect (i.e. "dangerous conditions" refers to the external conditions where people work.
  - The second aspect (i.e. "undesirable situations" refers to helping any kind of user in any kind of situation avoid the dangers of carrying out unwanted actions by accident. It also refers to the perceived fears users might have of the consequences of making errors and how this affects their behaviour.

Identifying & Specifying Usability Goals (questions to ask)

- Safe to use:

  What is the range of errors that are possible using the product/system and what measures are there to permit users to recover easily from them?

Citibank and confusing interface of financial software called Flexcube



Citibank accidentally sent $900 million to Revlon's lenders (2021)

1979 - The Three Mile Island accident - the user interface in the reactor control room had serious usability problems

Usability Goals

4. Have good utility
   - It refers to the extent to which the product provides the right kind of functionality so that users can do what they need or want to do.

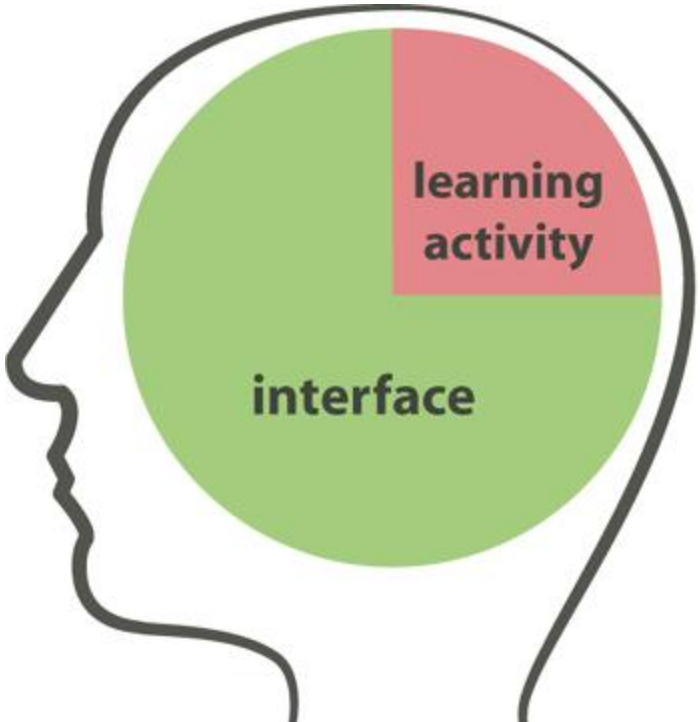
Identifying & Specifying Usability Goals (questions to ask)

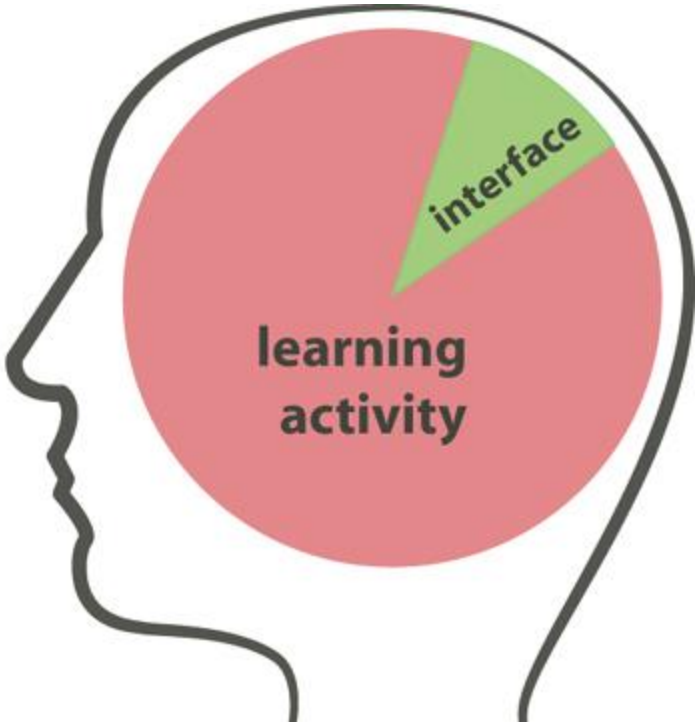
- Having good utility:

  Does the product/system provide an appropriate set of functions that will enable users to carry out their tasks in the way they want to do them?

Usability Goals

5. Easy to learn
   - It refers to how easy a system is to learn to use.





Identifying & Specifying Usability Goals (questions to ask)

- Easy to learn:

  Is it possible for the user to work out how to use a product/system by exploring the interface and trying out certain actions? How hard will it be to learn the whole set of functions in this way?

Usability Goals

6. Easy to remember how to use
   - It refers to how easy a product/system is to remember how to use once it is learned.

Identifying & Specifying Usability Goals (questions to ask)

- Easy to remember how to use:

  What kinds of interface support have been provided to help users remember how to carry out tasks, especially for products/systems and operations they use infrequently?

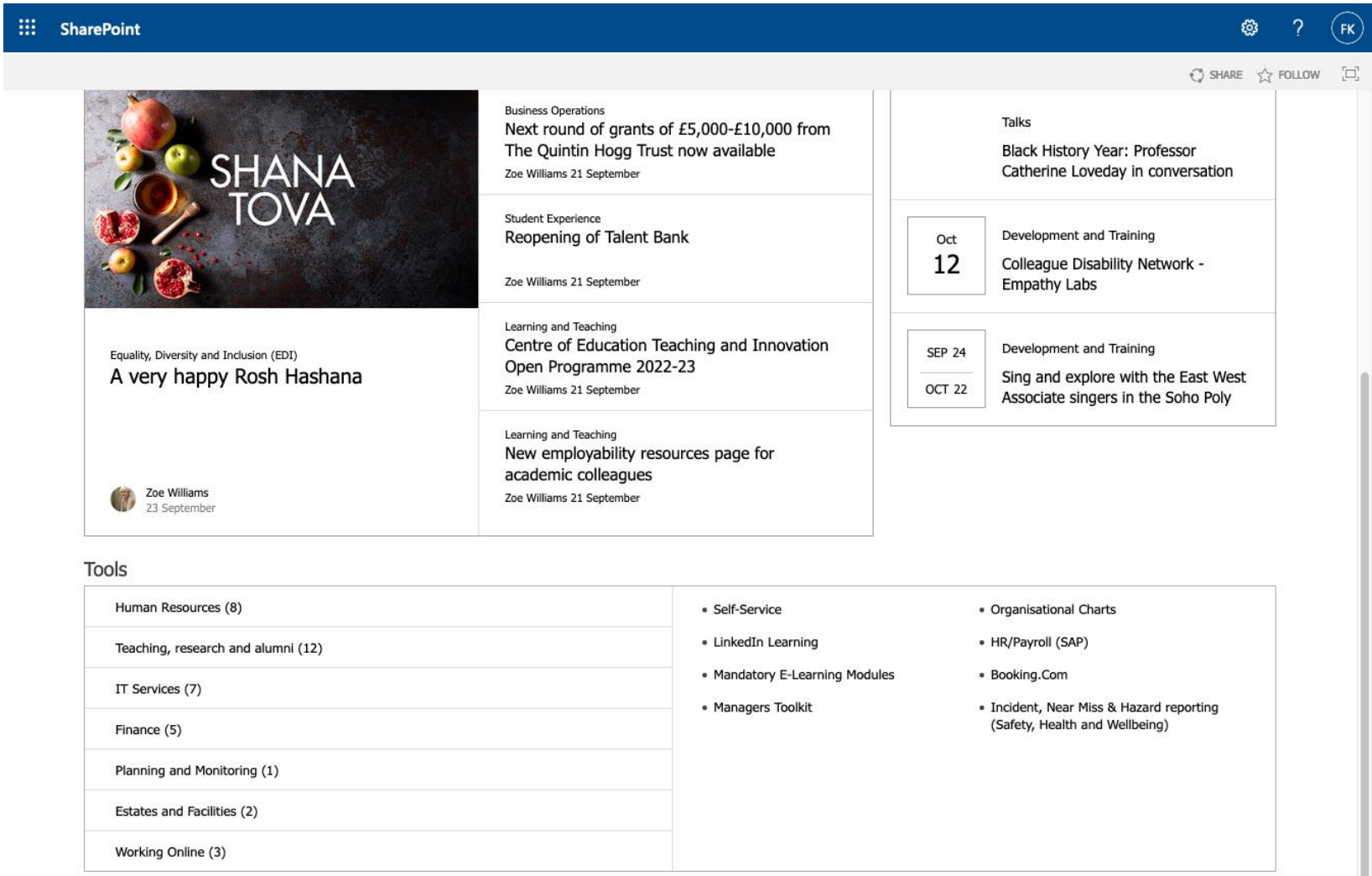
Design Principles

1. Visibility
2. Feedback
3. Constraints
4. Consistency
5. Affordance

Design Principles

1. Visibility
   - Elements should be visible so that the user can see what functions are available and what the system is currently doing
   - make relevant parts visible
   - make what has to be done obvious

Visibility


SharePoint
SHARE
FOLLOW
SHANA TOVA
Equality, Diversity and Inclusion (EDI)
A very happy Rosh Hashana
Zoe Williams
23 September
Business Operations
Next round of grants of £5,000-£10,000 from The Quintin Hogg Trust now available
Zoe Williams 21 September
Student Experience
Reopening of Talent Bank
Zoe Williams 21 September
Learning and Teaching
Centre of Education Teaching and Innovation Open Programme 2022-23
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Black History Year: Professor Catherine Loveday in conversation
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Colleague Disability Network - Empathy Labs
SEP 24 OCT 22
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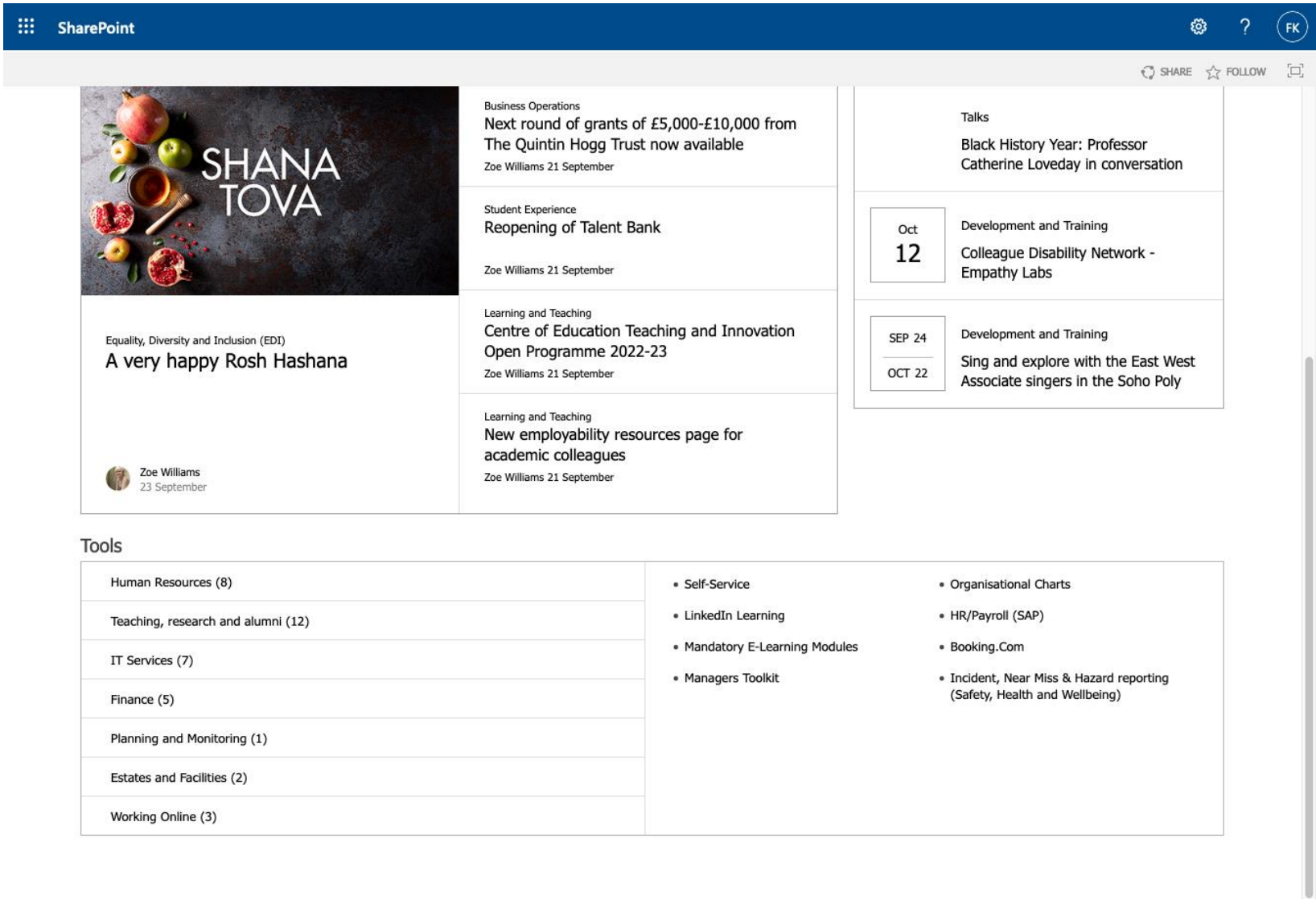
Sing and explore with the East West Associate singers in the Soho Poly
Tools
Human Resources (8)
Teaching, research and alumni (12)
IT Services (7)
Finance (5)
Planning and Monitoring (1)
Estates and Facilities (2)
Working Online (3)
Self-Service
LinkedIn Learning
Mandatory E-Learning Modules
Managers Toolkit
Organisational Charts
HR/Payroll (SAP)
Booking.Com
Incident, Near Miss & Hazard reporting (Safety, Health and Wellbeing)

Visibility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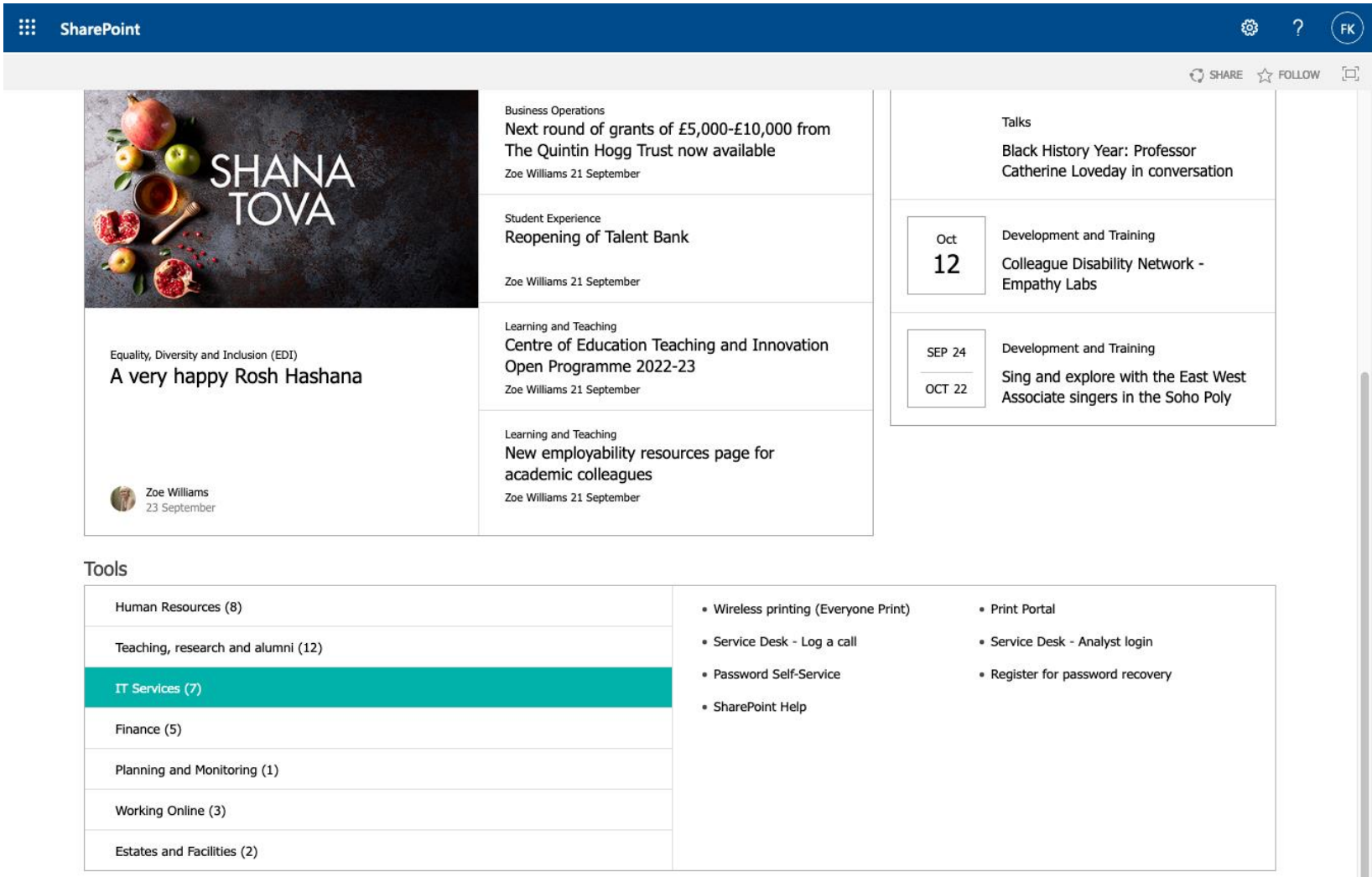
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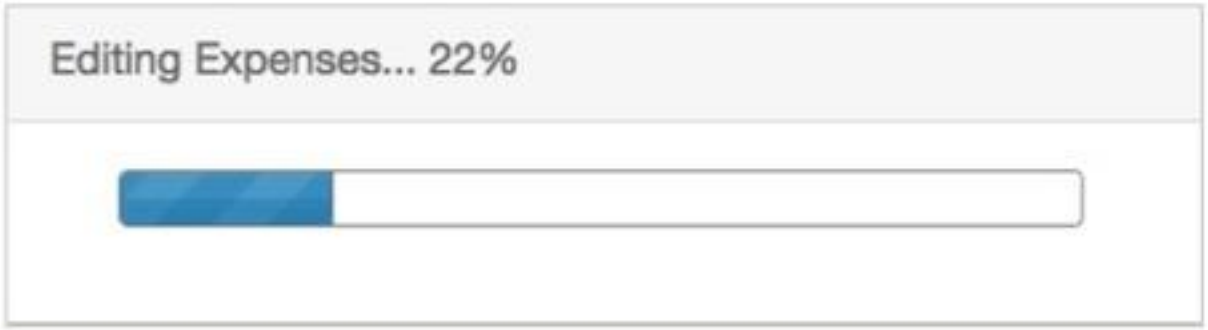
Estates and Facilities (2)
Wireless printing (Everyone Print)
Service Desk - Log a call
Password Self-Service
SharePoint Help
Print Portal
Service Desk - Analyst login
Register for password recovery

Feedback



Design Principles

2. Feedback

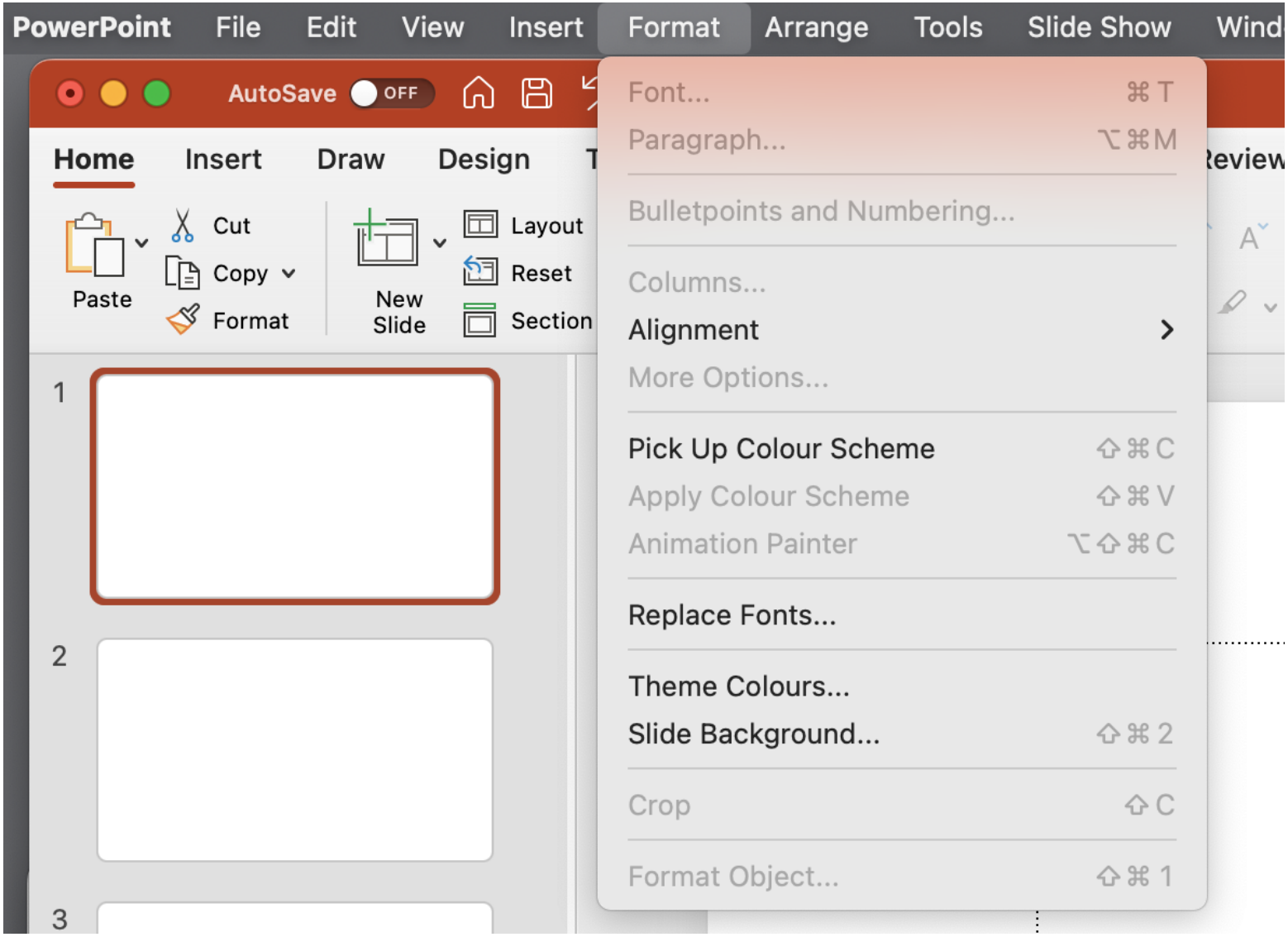
- Rapidly send back information from the system to the user so that they know what effect their actions have had.
- Constant and consistent feedback will enhance the feeling of control.

- **Understand what information the user needs to know and when. Successful feedback is based on this understanding.**

Design Principles

3. Constraints
   - Restricting the possible actions that can be performed
   - Helps prevent user from selecting incorrect options

Constraints



Design Principles

4. Consistency

- Design interfaces to have similar operations and use similar elements for similar tasks

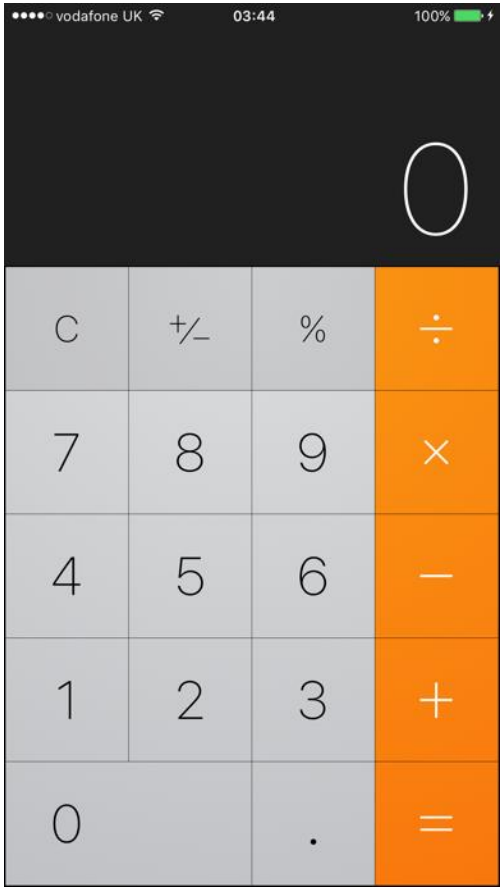
  For example:

  - always use ctrl key plus first initial of the command for an operation – ctrl+C, ctrl+S, ctrl+O
  - Apple iOS

- Main benefit is consistent interfaces are easier to learn and use

Example of inconsistency:

Keypad numbers layout

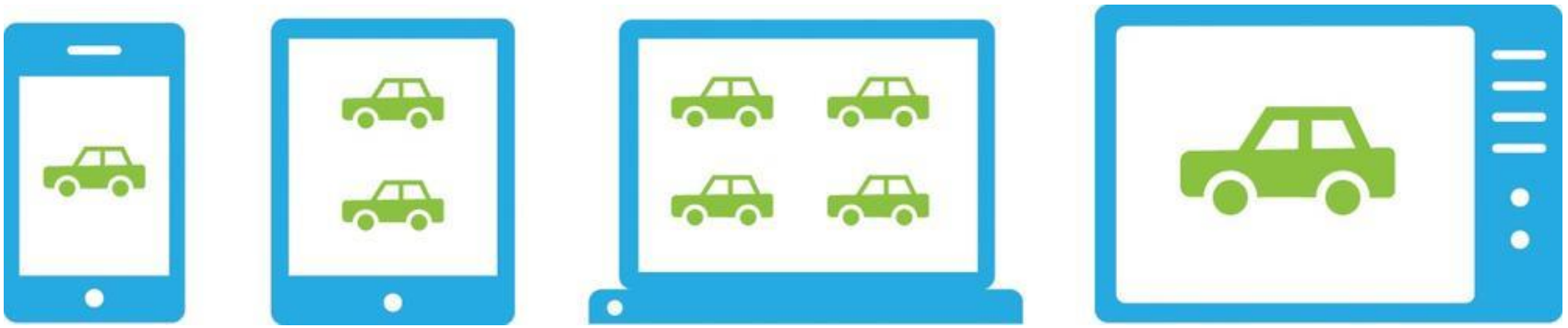


Calculators and computer pads

Phones and remote controls

What's Consistent Across Devices?

The consistent approach



SPORT
Man Utd better than last year - Van Gaal
Football Scores
Champions League
Fury stripped of IBF world title
'Respected, admired, a supreme competitor'
Advent calender: Epic ski jumps
England's Slade likely to miss Six Nations
gossip

Design Principles

5. Affordance + Perceived affordance

"...the term **affordance** refers to **the perceived and actual properties** of the thing, primarily those fundamental properties that determine just how the thing could possibly be used".

"Affordances provide strong clues to the operations of things"

(Norman 1988, p.9)

PUSH
PUSH

PULL
PULL

HSBC
Please select service required
by pressing the appropriate key
or press cancel to return card
MOBILE TOP-UP
BALANCE ENQUIRY
PIN SERVICES
CASH NO RECEIPT
CASH WITH RECEIPT

Mapping

- Good mapping is essential to ensure that the relationship between actions and results is apparent.

Where could this also be relevant?

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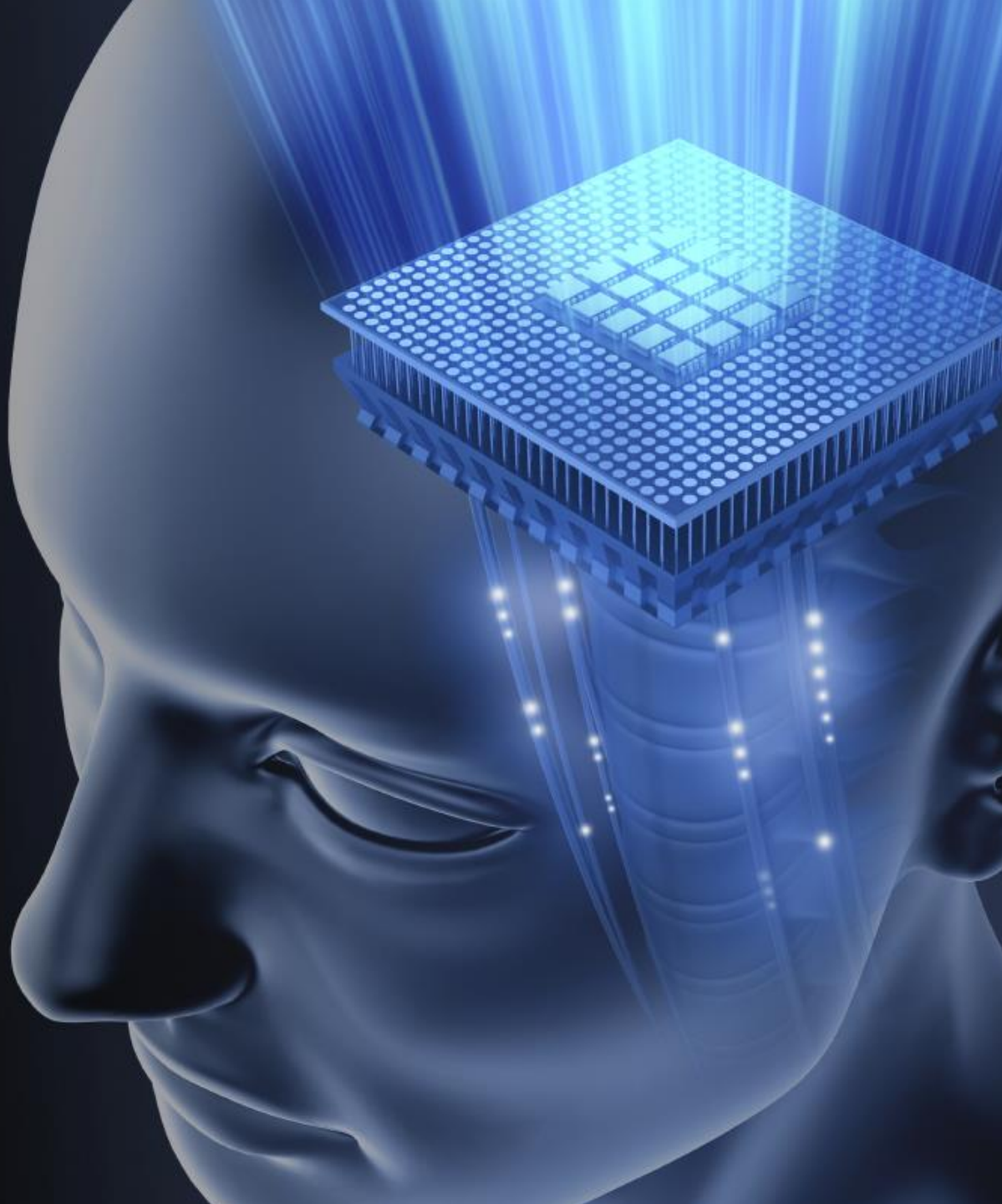
Understanding Users

Cognitive Aspects



Decline
Accept

“**Cognition** involves cognitive processes, such as attention, perception and recognition, memory, learning, reading, speaking and listening, problem solving, planning, reasoning and decision making”

Core cognitive aspects

- Attention
- Perception and recognition
- Memory

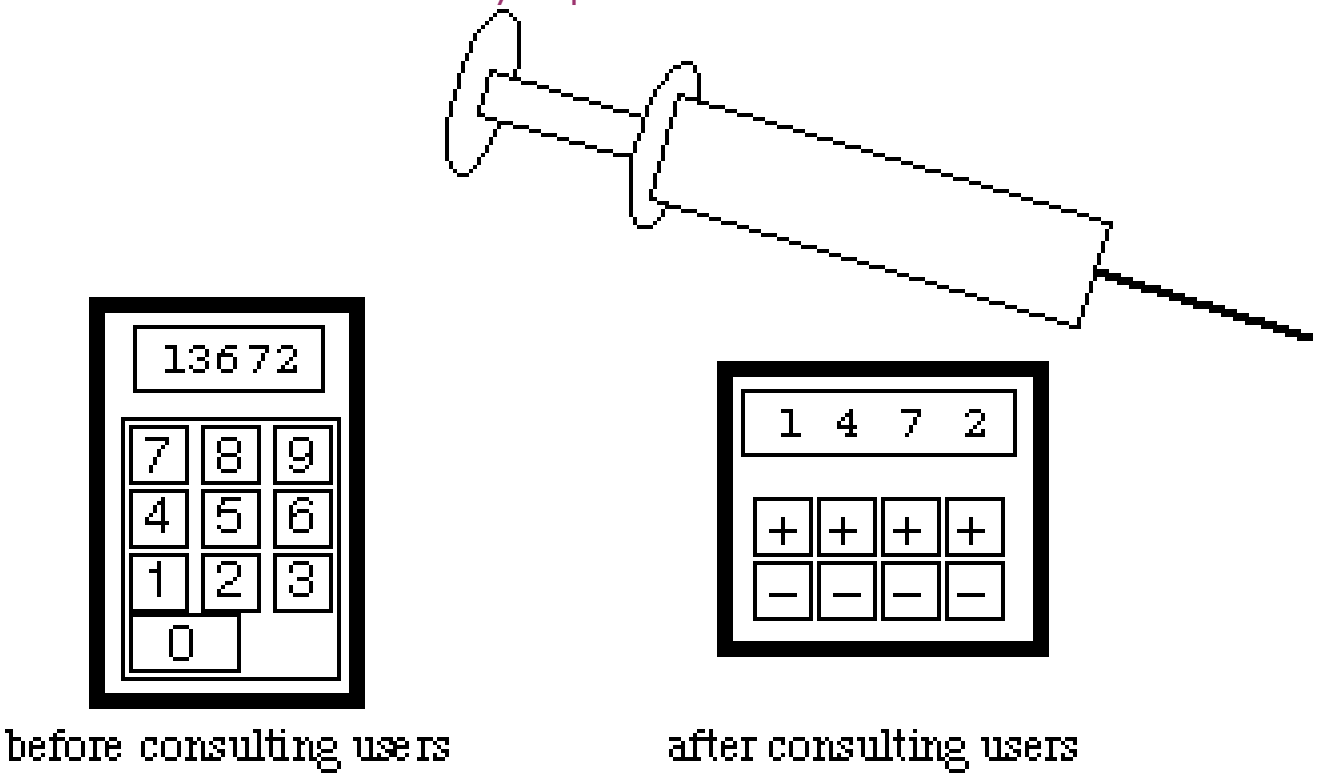
Most relevant to interaction design

- Learning
- Reading, speaking and listening
- Problem-solving, planning, reasoning and decision-making

Use Error

Automatic syringe: setting the dose to 1372.

The effect of one key slip before and after user involvement.



[HCI, Dix et all, 2004]

Automatic syringe

Healthcare UX

- The design of the user experience of any healthcare product or service

1. Attention

- Allows us to focus on information that is relevant to what we are doing
- The extent to which this process is easy or difficult depends on:
  1. Whether we have clear goals
  2. Whether the information we need is prominent in the environment

Find the price of a double room at the Holiday Inn in Columbia

Pennsylvania
Bedford Motel/Hotel: Crinaline Courts
(814) 623-9511 S: $118 D: $120
Bedford Motel/Hotel: Holiday Inn
(814) 623-9006 S: $129 D: $136
Bedford Motel/Hotel: Midway
(814) 623-8107 S: $121 D: $126
Bedford Motel/Hotel: Penn Manor
(814) 623-8177 S: $119 D: $125
Bedford Motel/Hotel: Quality Inn
(814) 623-5189 S: $123 D: $128
Bedford Motel/Hotel: Terrace
(814) 623-5111 S: $122 D: $124
Bradley Motel/Hotel: De Soto
(814) 362-3567 S: $120 D: $124
Bradley Motel/Hotel: Holiday House
(814) 362-4511 S: $122 D: $125
Bradley Motel/Hotel: Holiday Inn
(814) 362-4501 S: $132 D: $140
Breezewood Motel/Hotel: Best Western Plaza
(814) 735-4352 S: $120 D: $127
Breezewood Motel/Hotel: Motel 70
(814) 735-4385 S: $116 D: $118

Find the price for a double room at the Quality Inn in Pennsylvania

South Carolina

City	Motel/Hotel	Area code	Phone	Rates Single	Rates Double
Charleston	Best Western	803	747-0961	$126	$130
Charleston	Days Inn	803	881-1000	$118	$124
Charleston	Holiday Inn N	803	744-1621	$136	$146
Charleston	Holiday Inn SW	803	556-7100	$133	$147
Charleston	Howard Johnsons	803	524-4148	$131	$136
Charleston	Ramada Inn	803	774-8281	$133	$140
Charleston	Sheraton Inn	803	744-2401	$134	$142
Columbia	Best Western	803	796-9400	$129	$134
Columbia	Carolina Inn	803	799-8200	$142	$148
Columbia	Days Inn	803	736-0000	$123	$127
Columbia	Holiday Inn NW	803	794-9440	$132	$139
Columbia	Howard Johnsons	803	772-7200	$125	$127
Columbia	Quality Inn	803	772-0270	$134	$141
Columbia	Ramada Inn	803	796-2700	$136	$144
Columbia	Vagabond Inn	803	796-6240	$127	$130

- Tullis (1987) found that the two screens produced quite different results
  - 1st screen - took an average of 5.5 seconds to search
  - 2nd screen - took 3.2 seconds to search
- Why, since both displays have the same density of information (31%)?
- Spacing
  - 1st screen - the information is bunched up together, making it hard to search
  - 2nd screen - the characters are grouped into vertical categories of information making it easier

Design Implications: Attention

- Make information prominent when it is important (at a given stage of a task)
- Use techniques that make things stand out like colour, ordering, spacing, underlining, sequencing and animation
- Information at the interface should be structured to capture users' attention. For example use perceptual boundaries (windows), colour etc.
- Avoid cluttering the interface - follow the google.com example of crisp, simple design
- Forms t(and search engines) that have simple and neat interface are easier to use
- Avoid using too much because the software allows it

Design Implications:
Attention

- For immediate attention, use pulsing shadows
- For less-critical info, use an icon with a badge
- If something must pop up, make sure it integrates well with the page

Multitasking & attention

- It depends on the nature of the tasks and how much attention each demands
  - E.g. background gentle music while working can help tune out background noise and help people concentrate on their task.
  - While loud music (drum/bass) could be distracting.

- Individual differences
  - Ophir et al (2009) compared heavy vs light multi-taskers:
    - heavy (media) multi-taskers were more prone to being distracted than those who infrequently multitask
    - heavy multi-taskers are easily distracted and find it difficult to filter irrelevant information

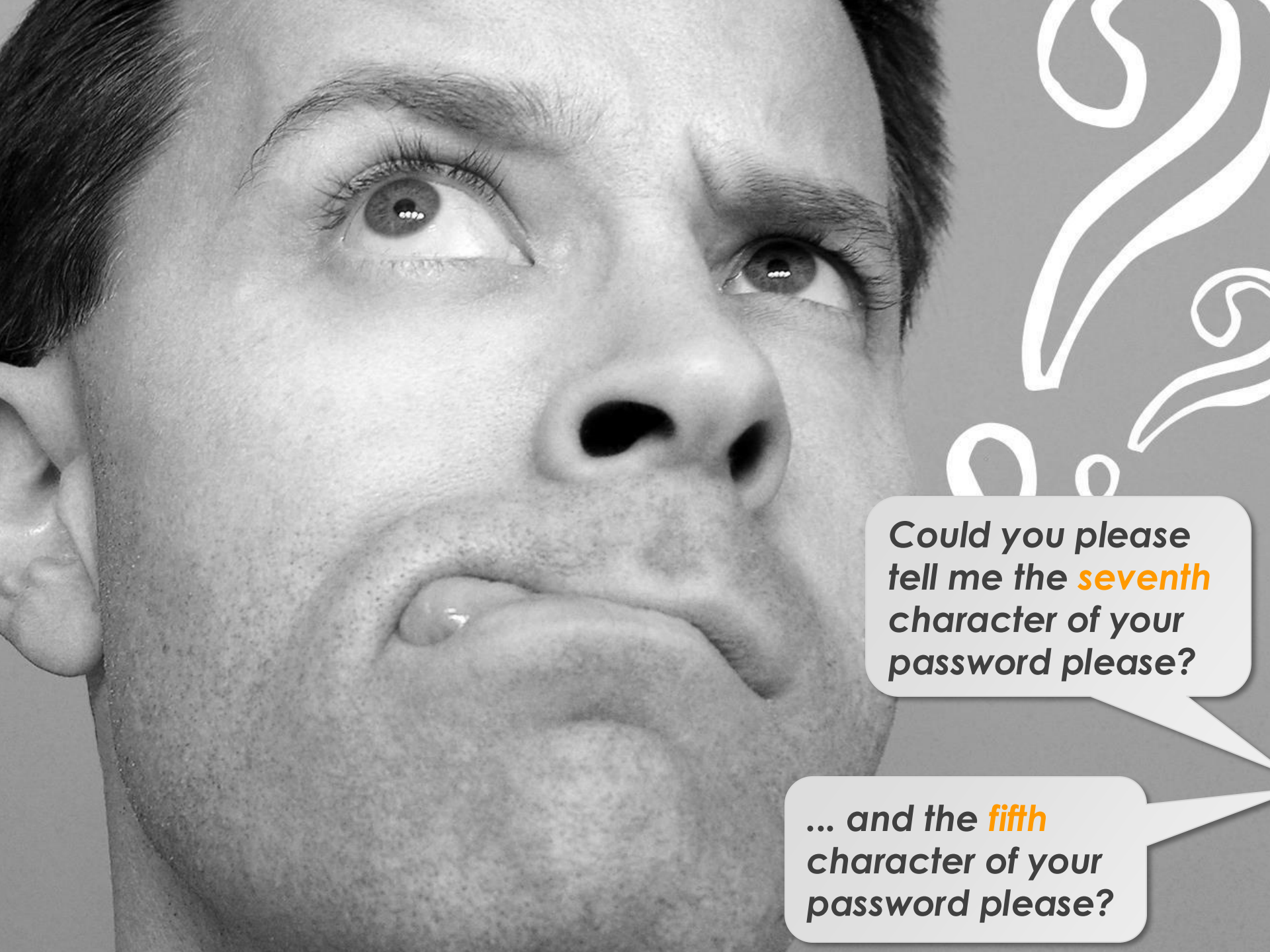
2. Memory

- Involves recalling various kinds of knowledge that allow us to act appropriately.
- It is usually considered in terms of our short memory and long-term memory.
- It involves first encoding and then retrieving knowledge.
  - We don't remember everything - involves filtering and processing
  - **Context** is important in affecting our memory (i.e. where, when)

[Sharp, Rogers and Preece,

Memory Load..

- Calling your mobile network provider..


Could you please tell me the seventh character of your password please?
... and the fifth character of your password please?

An alternative to passwords:
Eliminating the need to remember and type passwords could reduce security breaches and online crime.

Design Implications: Memory

- Don't overload users' memories with complicated procedures for carrying out tasks
- Design interfaces that promote recognition rather than recall
- Provide users with a variety of ways of encoding digital information to help them remember where they have stored them
  - e.g., categories, colour, flagging, time stamping

Change your security questions.

Select three security questions below. These questions will help us verify your identity should you forget your password.

Security Question: Who was your favorite singer or band in high school

Answer: ********

Security Question: What was the first album that you purchased?

Answer: ********

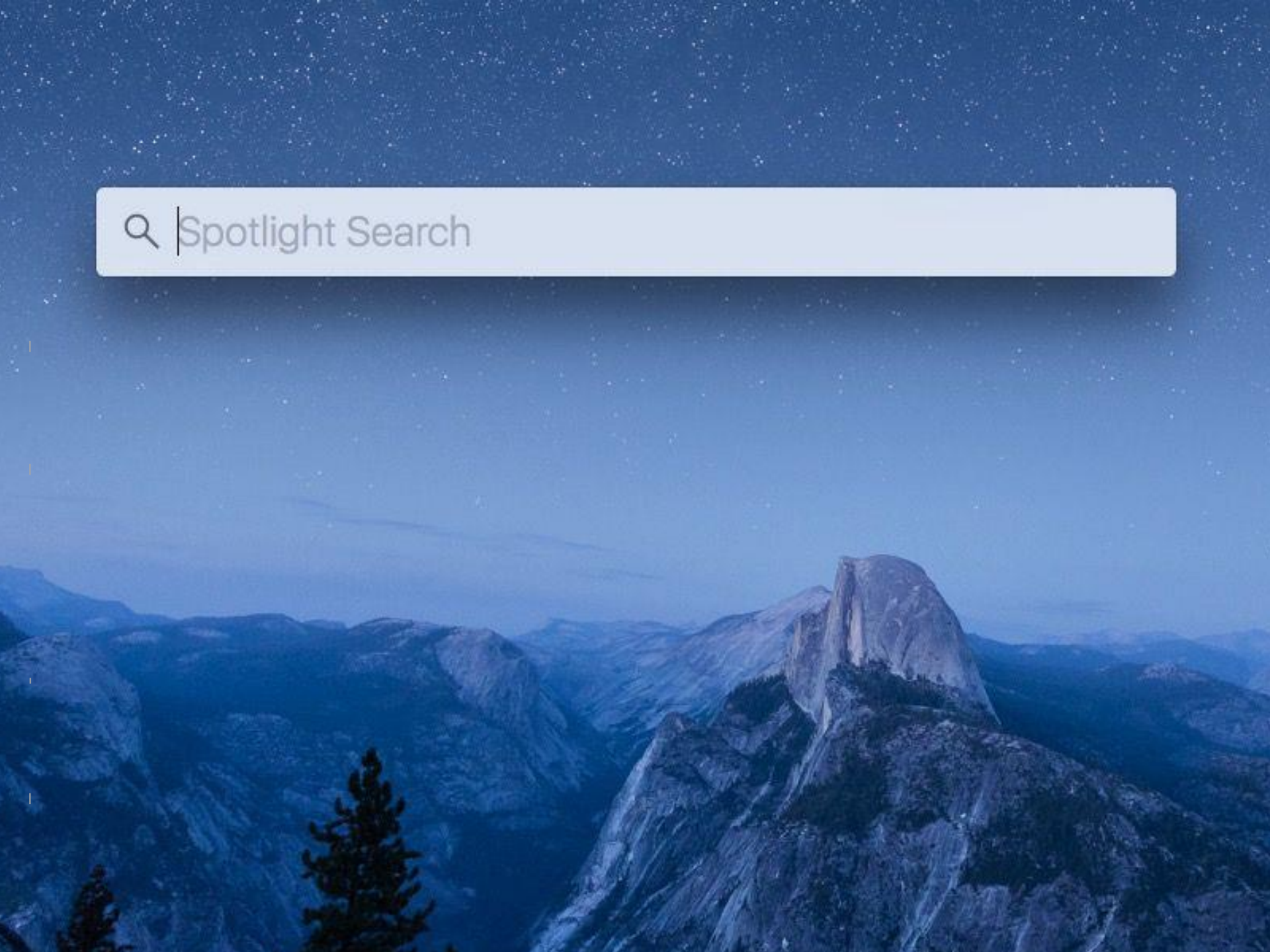
Security Question: What was the first film you saw in the theater?

Answer: ********

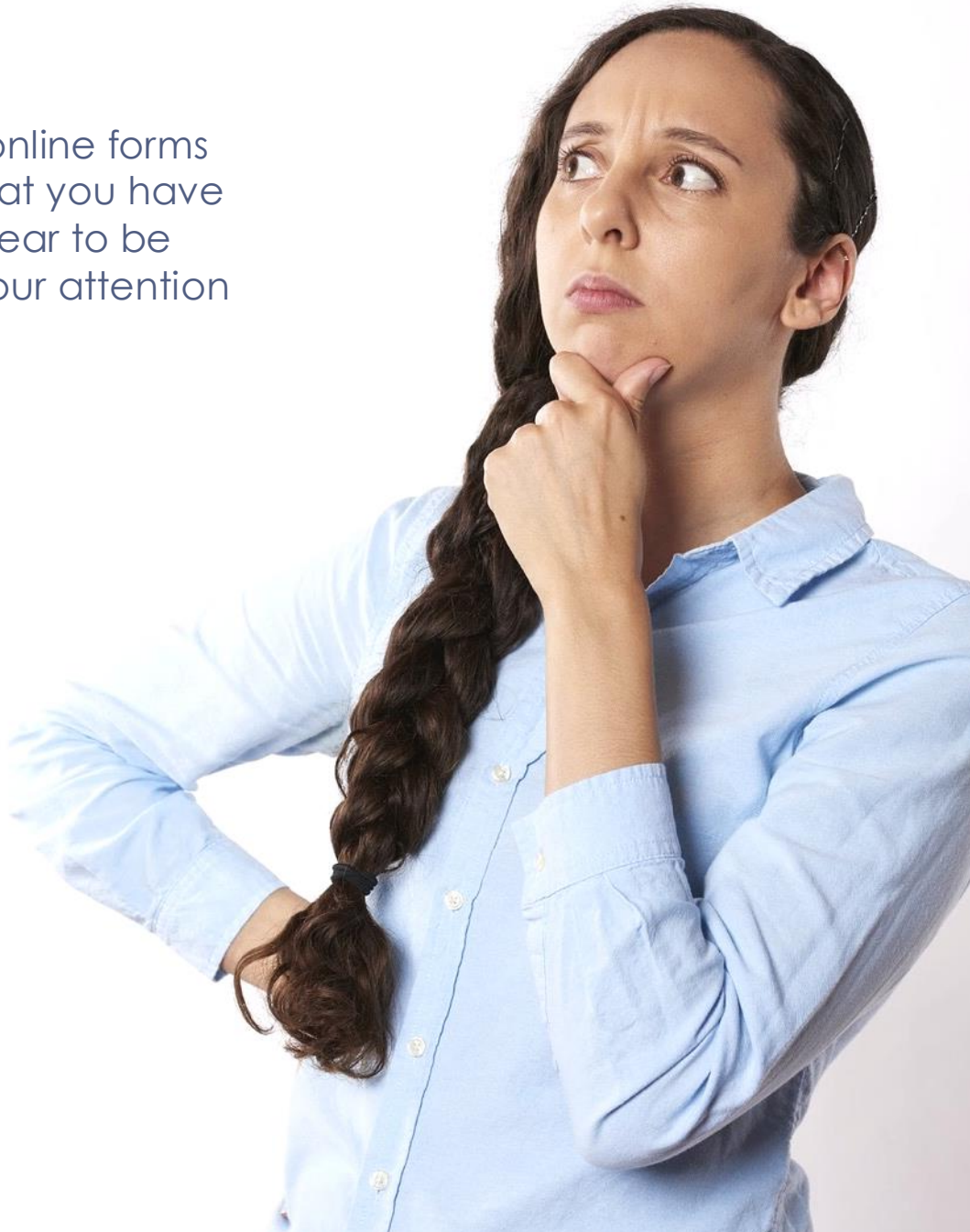
* Question 1

select one

- select one
- What is the name of the first school you attended?
- What is your paternal grandmother's given name?
- What is your father's middle name?
- What was your favorite place to visit as a child?
- What is the name of your first pet?
- Where did you meet your spouse/partner?
- What is the phone number you remember most from your childhood?
- What is the name of your childhood best friend?


Spotlight Search

Can you think of any online forms (or other examples) that you have used or seen that appear to be aligned with the way our attention and memory 'work'?



Recall & Recognition

- **Recall** is the process whereby individuals actively search their memories to retrieve a particular piece of information.

- **Recognition** involves searching your memory and then deciding whether the piece of information matches what you have in your memory store

[Benyon, 2010]

Recall & Recognition

- Command-based interfaces require users to recall from memory a name from a possible set of 100s
- GUIs provide visually-based options that users need only browse through until they recognize one
- Web browsers, MP3 players, etc., provide lists of visited URLs, song titles etc., that support recognition memory

Processing in memory

- Encoding is first stage of memory
  - determines which information is attended to in the environment and how it is interpreted
- The more attention paid to something, and the more it is processed in terms of thinking about it and comparing it with other knowledge, the more likely it is to be remembered
  - e.g., when learning about UX, it is much better to reflect upon it, carry out exercises, produce UX deliverables, have discussions with others about it, and write notes than just passively read a book, listen to a lecture or watch a video about it

Visual Cues

- People are very good at remembering visual cues about things
  - e.g., the colour of items, the location of objects and marks on an object
- They find it more difficult to learn and remember arbitrary material
  - e.g., birthdays and phone numbers

Context

- Context affects the extent to which information can be subsequently retrieved

- Sometimes it can be difficult for people to recall information that was encoded in a different context
  - e.g., You are on a train and someone comes up to you and says hello. You don't recognise him for a few moments but then realise it is one of your lecturers. You are only used to seeing your lecturer in the classroom at the university and seeing him out of context makes him difficult to recognise initially

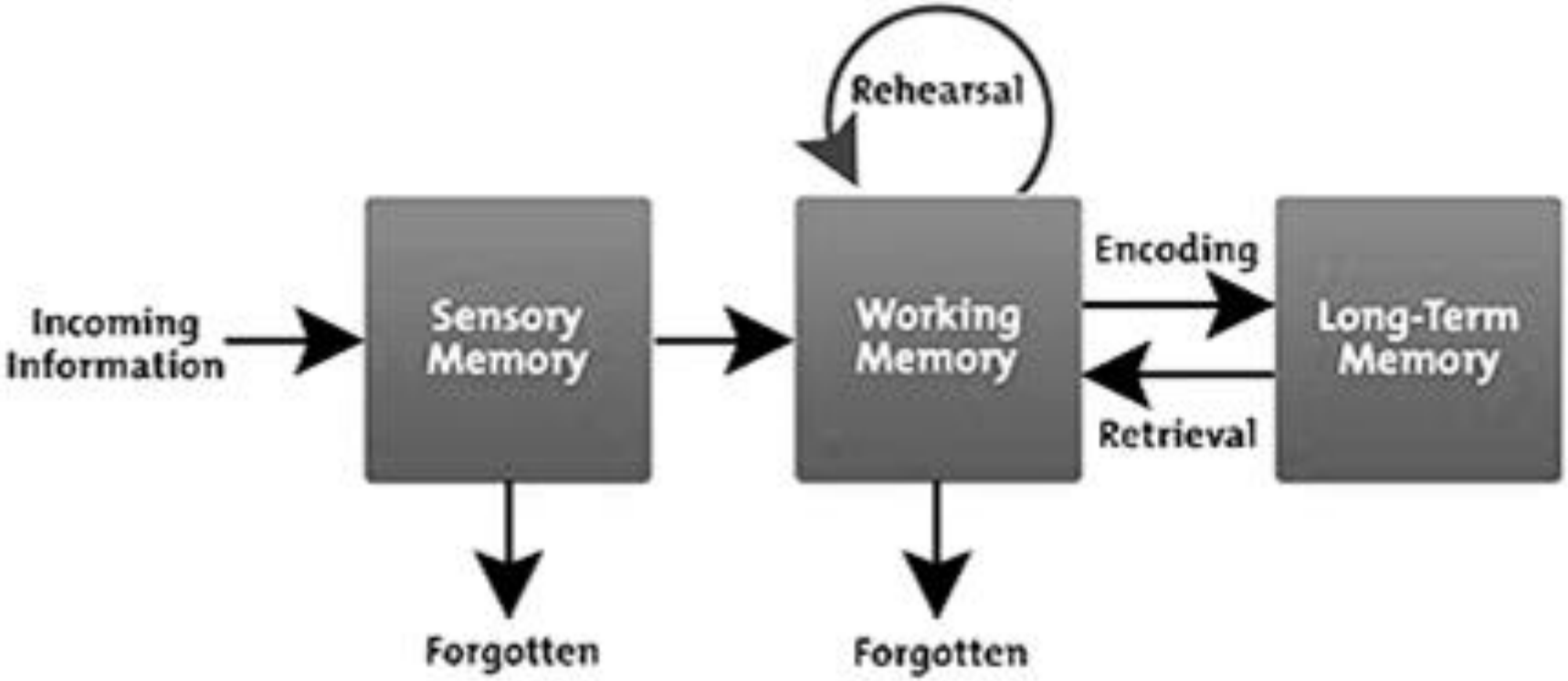
Personal Information Management

- Personal information management is a growing problem for most users
  - Vast numbers of documents, images, music files, video clips, emails, attachments, bookmarks, etc.
  - Major problem is choosing where and how to save them all, then remembering what they were called and where to find them again
  - Naming most common means of encoding them
  - Trying to remember a name of a file created some time back can be very difficult, especially when have 1000s and 1000s
- How might such a process be facilitated taking into account people's memory abilities?

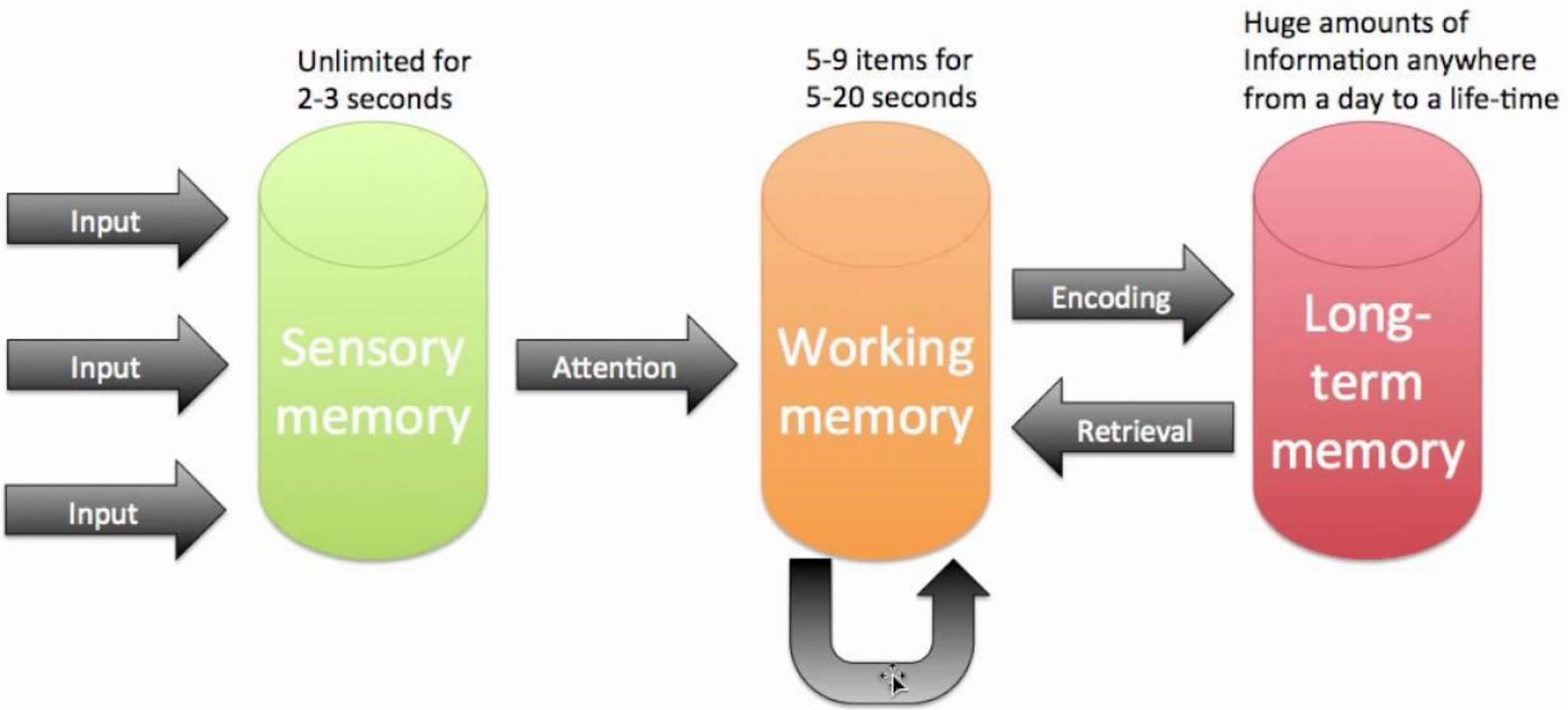
Personal Information Management

- Memory involves 2 processes
  - recall-directed and recognition-based scanning
- File management systems should be designed to optimise both kinds of memory processes
  - e.g., Search box and history list
- Help users encode files in richer ways
  - Provide them with ways of saving files using colour, flagging, image, flexible text, time stamping, etc

Information Processing Model



Information Processing Model



[Jered Borup]

Cognitive load

- The amount of information that working memory can hold at one time.

i.e.

- The amount of information that a person is trying to process (in working memory) at any one moment.
- How hard you are thinking.

Design Implications:
Cognitive Load

Minimise Cognitive Load by:

- Chunk content
- Optimise response times
- Avoid visual clutter
- Build on existing mental models
- Offload tasks

Split-Attention Effect

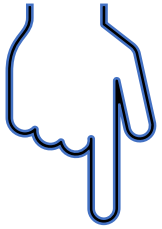
- Interface with multiple sources of visual information, such as diagrams, labels and explanatory text, causes our attention to be divided between them and therefore adding to the cognitive load.

3. Perception & Recognition

- How information is acquired from the world and transformed into experiences

- Obvious implication is to design representations that are readily perceivable e.g.
  - Text should be legible
  - Icons should be easy to distinguish and read

Take aways (Lecture 01)



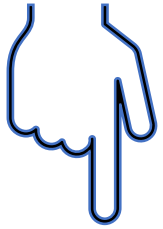
1. **Human Computer Interaction (HCI)** is about:
   - studying the way people interact with technology
   - understanding how to design systems for people, how to create that technology

2. **User Experience (UX):** person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service.

3. **User Interface (UI):** all components of an interactive system (software or hardware) that provide information and controls for the user to accomplish specific tasks with the interactive system.

4. **Human-centred design:** approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and applying human factors/ergonomics and usability knowledge and techniques.

Take aways (Lecture 02 – Part 1)



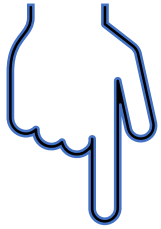
5. **Usability:** the extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.

6. **Context of use:**
   - the circumstances in which the product is (or will be) used.
   - Users, tasks, equipment (hardware, software and materials)and the physical and social environments in which a product is used.

7. **Design Principles:** Visibility - Feedback - Constraints - Consistency – Affordance

8. **Understanding users:** "*What people say, what people do, and what they say they do are entirely different things.*"

Take aways - (Lecture 02 – Part 2)



1. Usability and UX goals
2. Design principles
3. Mapping
4. Cognition and cognitive aspects
5. UX in healthcare
6. Attention and design implications
7. Memory and design implications
8. Information processing model
9. Cognitive load
10. Perception and design implications (to cover next week)

Further Reading

- Preece, J., Rogers, Y., & Sharp, H. (2023). *Interaction design: beyond human-computer interaction*. 6th Ed. John Wiley & Sons.
  - Or previous edition:
- Preece, J., Rogers, Y., & Sharp, H. (2019). *Interaction design: beyond human-computer interaction*. 5th Ed. John Wiley & Sons.
- Benyon, D. (2019). Designing User Experience: a guide to HCI. *UX and interaction design*.