MONASH University

MONASH
INFORMATION
TECHNOLOGY

Lecture 2

Design Theories, Models and Principles

FIT5152 - User Interface Design and Usability

GROUP OF EIGHT AUSTRALIA

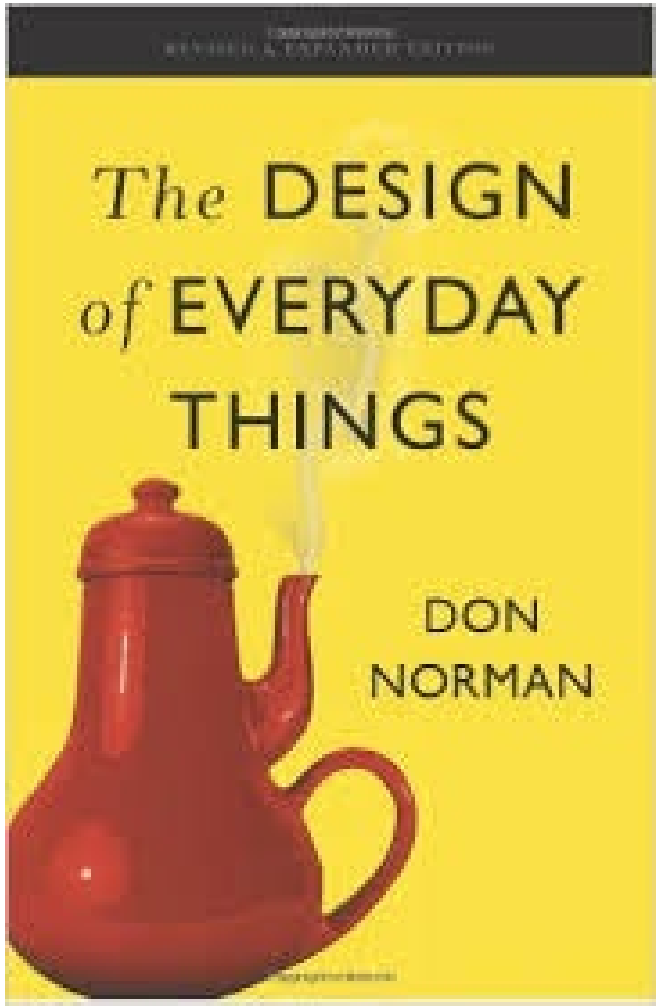
Learning objectives

MONASH University

- To learn about principles of discoverability
  - Affordance
  - Signifiers
  - Feedback
  - Constraints
  - Mapping
- To understand importance of cognition theories in good interface design
  - Knowledge in the world and knowledge in the head
  - Conceptual models and Mental Models
  - External cognitive and cognitive aids
  - To learn about cognition theories related to memory

Chapters 3 and 4 from Donald Norman, The Design of Everyday Things

Donald Norman (source Twitter)



Don Norman, 2013, The Design of Everyday Things

Design

- "…**how things work**, how they are **controlled**, and the nature of the **interaction** between people and technology."
- Interaction design aims "to enhance people's understanding of **what can be done**, **what is happening**, and **what has just occurred**."
- "When done well, the results are brilliant, pleasurable products. When done badly, the products are unusable, leading to great frustration and irritation."

(Norman, 2013, pg 5)

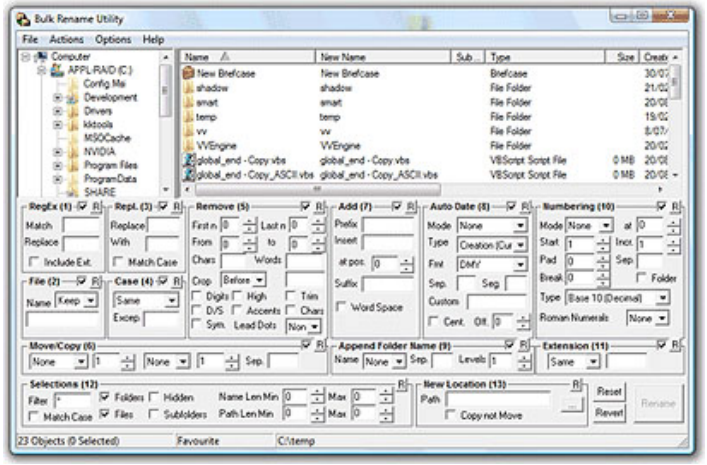
Discoverability

MONASH University

- To interact with a product, we need to discover:
  - **What actions are possible**?
  - **Where and how should actions be done?**
  - **What can we interact with?**

- "The relevant components must be **visible**, and **communicate the correct message**", otherwise discoverability fails
- When there are many functions and controls it becomes very difficult to understand the product

(Norman, 2013, pg 10)



Source http://www.digi-link.com/one-simple-rule-for-a-good-user-interface/

Visibility

- “to indicate what parts operate and how, to indicate how the user is to interact with the device.”

(Norman 1998, pg 8)

- **Visibility is not just about what you can see** but it is about whether what you see tells you about how to interact with it

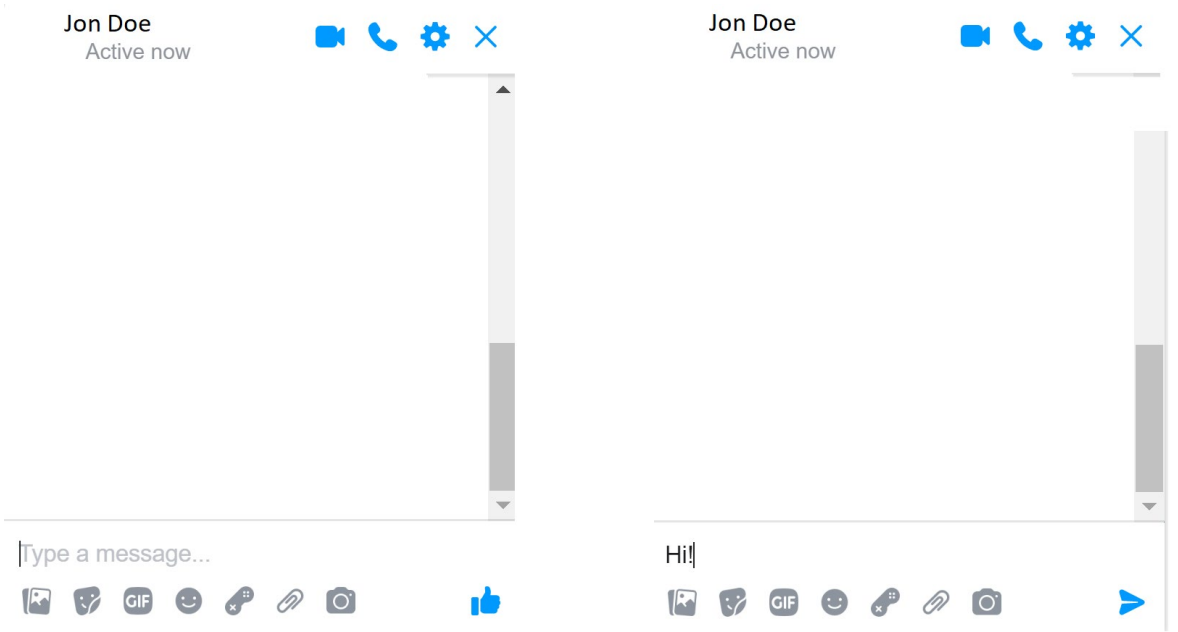
‘Discoverability’ is mainly used instead of ‘visibility’ in The Design of Everyday Things (Norman, 2013)

UI Example

MONASH University

Discoverability questions:

- What actions are possible?
- Where and how should actions be done? What can we interact with?



Principles of Discoverability

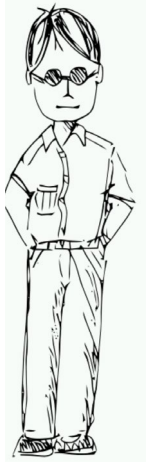
MONASH University

- *Discoverability* results from applying fundamental psychological concepts:
  - **Affordances**
  - **Signifiers**
  - **Feedback**
  - **Constraints**
  - **Mappings**
  - The conceptual model of the system:
    - It provides *understanding* about the meaning of the controls and settings and what all that means

Affordances

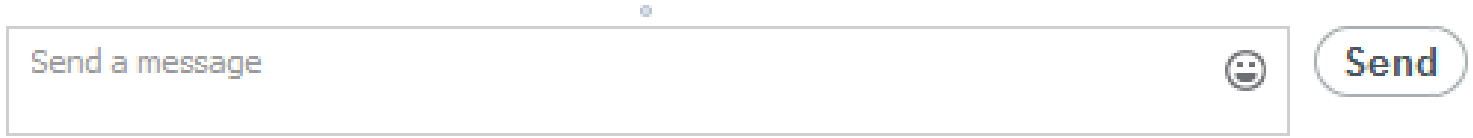
- Physical objects (and their physical appearance) communicate the **information about how we interact with them**
- Affordance is a relationship between the object and the user who discovers **how the object can be used**
- Affordance of an object defines **what actions we can perform on that object**

(Affordance was coined in 1977 by a psychologist, James Gibson)



Examples

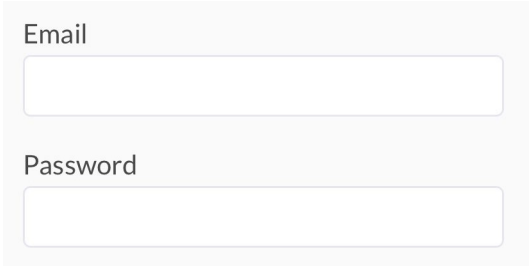
- What actions can be performed on each object? What is the affordance of each object?
- Does each object communicate the information about how we interact with them? How?



Perceived Affordances

- In effective design, affordances need to be discoverable and perceivable
- To design perceived affordances, **visible and strong visual clues** must be used so we can easily discover how to interact with it.

(Norman, 2013)



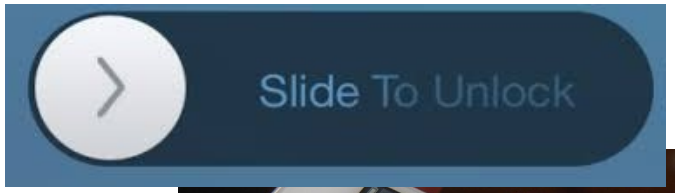
Signifiers

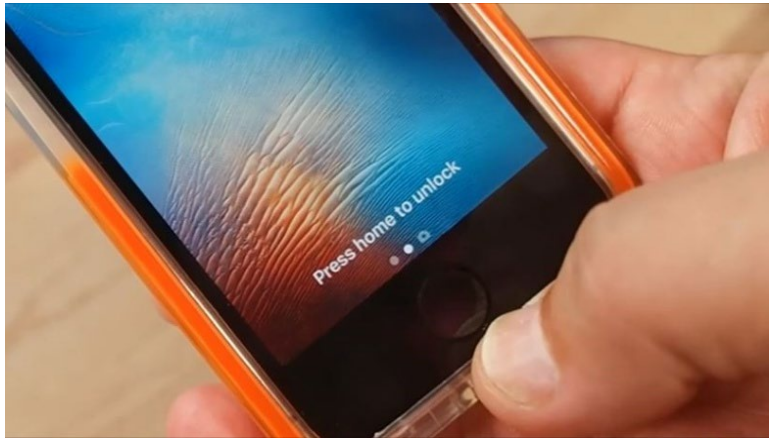
- When an affordance is not perceivable, signifiers need to be used
- Signifiers **communicate what actions we can do** and **where the action should take place**
- They signal the object's affordance
- Signifiers can be **signs, labels, arrows, icons or drawings** to indicate how to operate on an object

(Norman 2013)

Affordances and Signifiers

MONASH University





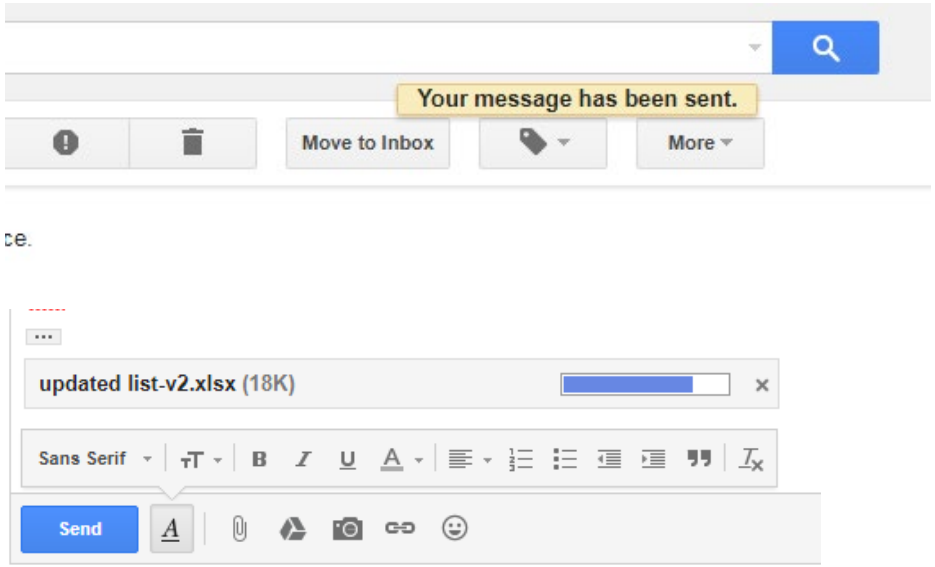
Feedback

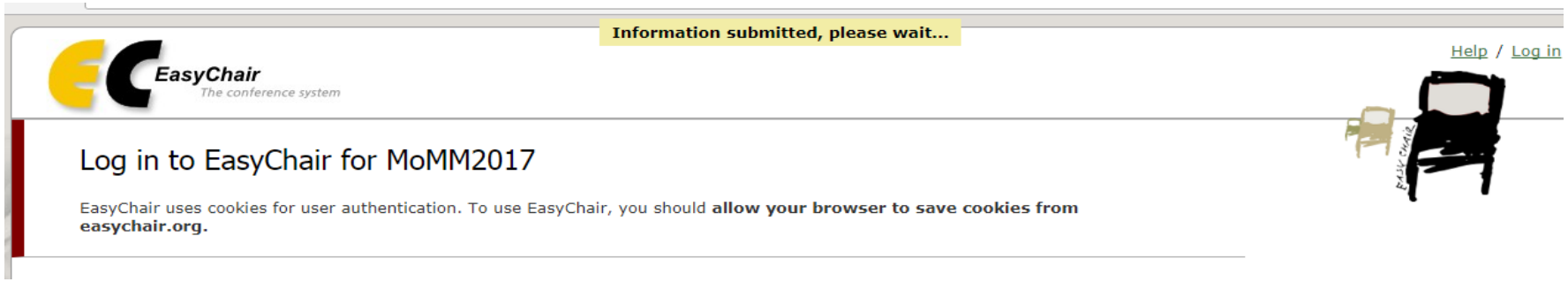
MONASH University

- Feedback communicates the results of an action
- Feedback tells us what is happening or/and what happened
- It can be textual, visual, auditory, or as vibration (mobile)
- Feedback must be informative
- Poor feedback can be worse than no feedback
- Immediate feedback (for inline validation)
- Feedback is very important to evaluate the results of an action
  - whether a specific goal was achieved or something went wrong

(Norman 2013)

Feedback Examples





Constraints

MONASH University

What is a constraint?

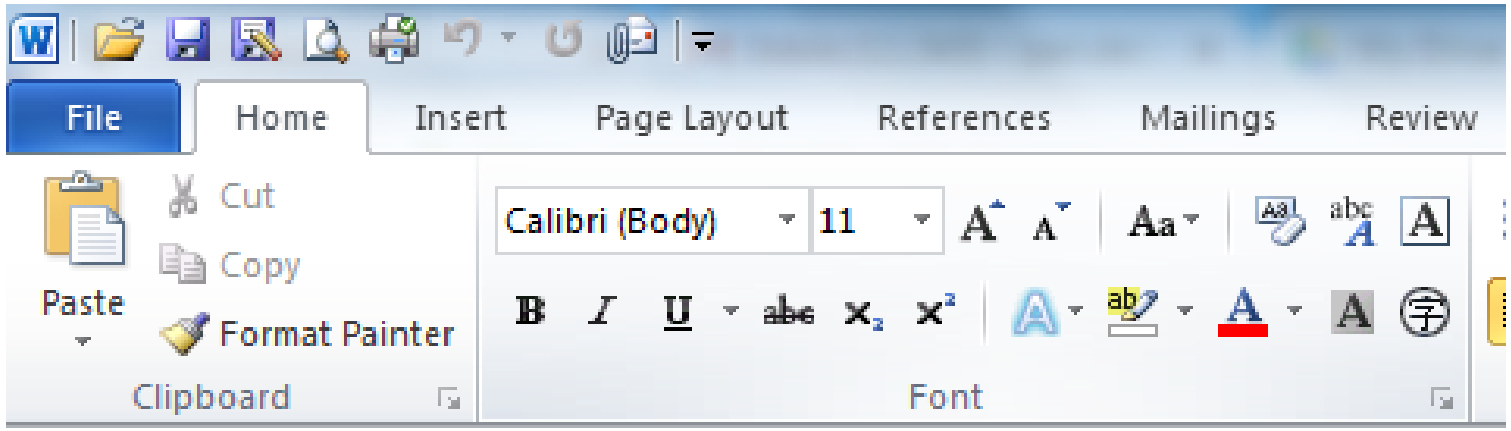
- Constraints provide different ways of restricting the kind of interaction that the user can have
- They can limit the set of possible actions

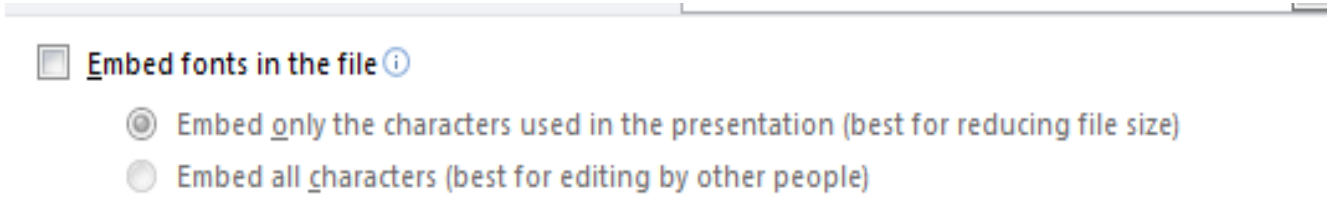
Why important for good design?

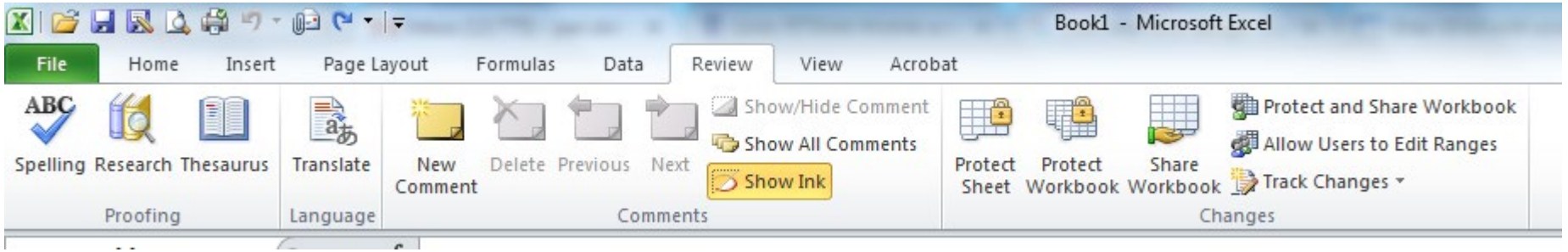
- They prevent user errors, and reduce memory load by minimising the information to be remembered
- Examples:
  - using a list of options to select from
  - disabling a button or menu options
  - limiting the number of digits or letters in form fields
  - controlling the order of steps to complete a task

(Norman 2013)

Constraints Examples







Mapping

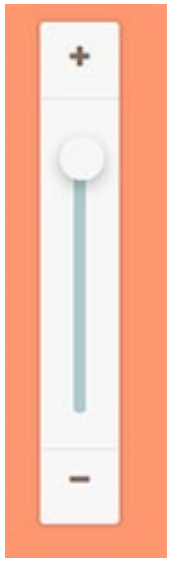
- Mappings are the **relationships between the elements of two sets of things**
  - two sets include controls and what is being controlled
- Mapping is important in the design and layout of controls and displays
- Identifying mappings between the elements **should be clear and easy**

(Norman 2013)

Natural Mapping

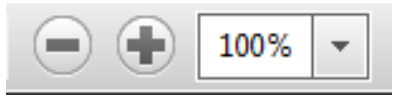
- When **the relationship** between controls and objects we want to control are **obvious**
- Good natural mapping does not require labels and instructions
  - Easy to understand and learn, and reduces memory load

(Norman 2013)



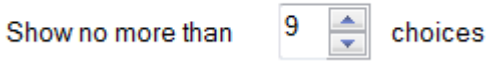
Mapping Examples

Plus and minus symbols which one on the left?

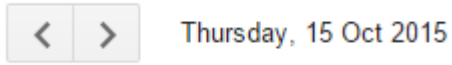


which one on the right?

Increase number size, up or down?



Select dates on a calendar - left or right?

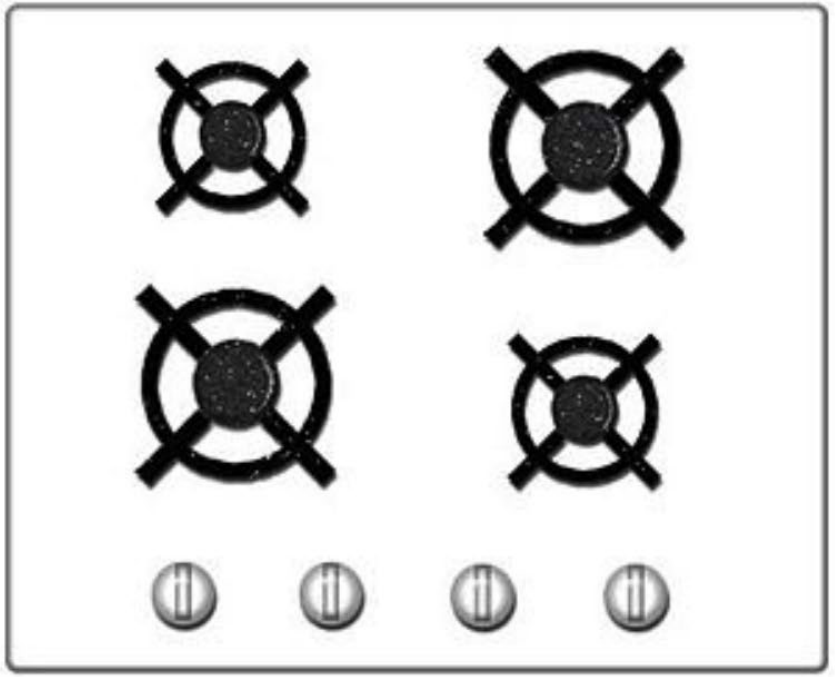


Some are not easy if we have no knowledge in our head

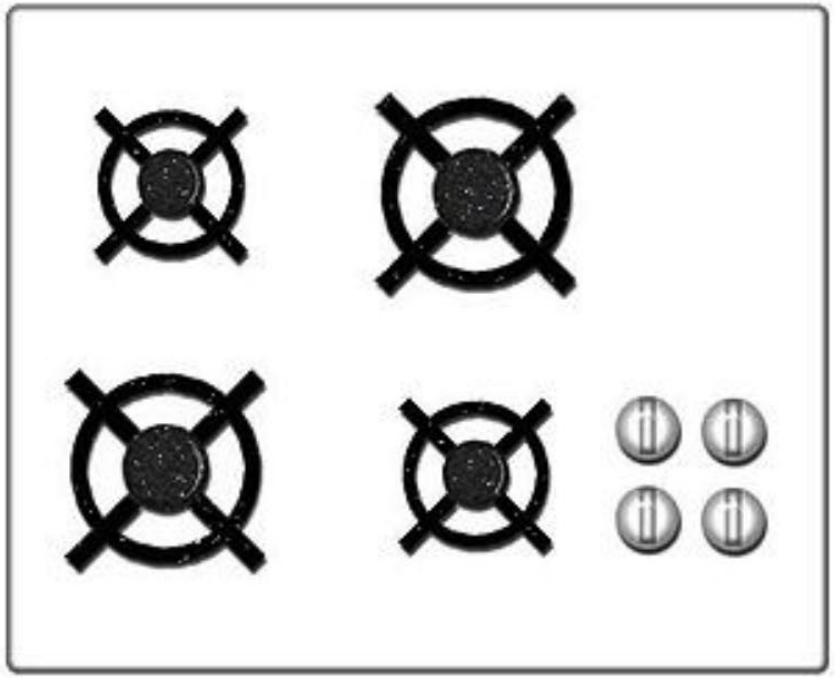
When Natural Mapping Goes Wrong

MONASH University

Poor mapping



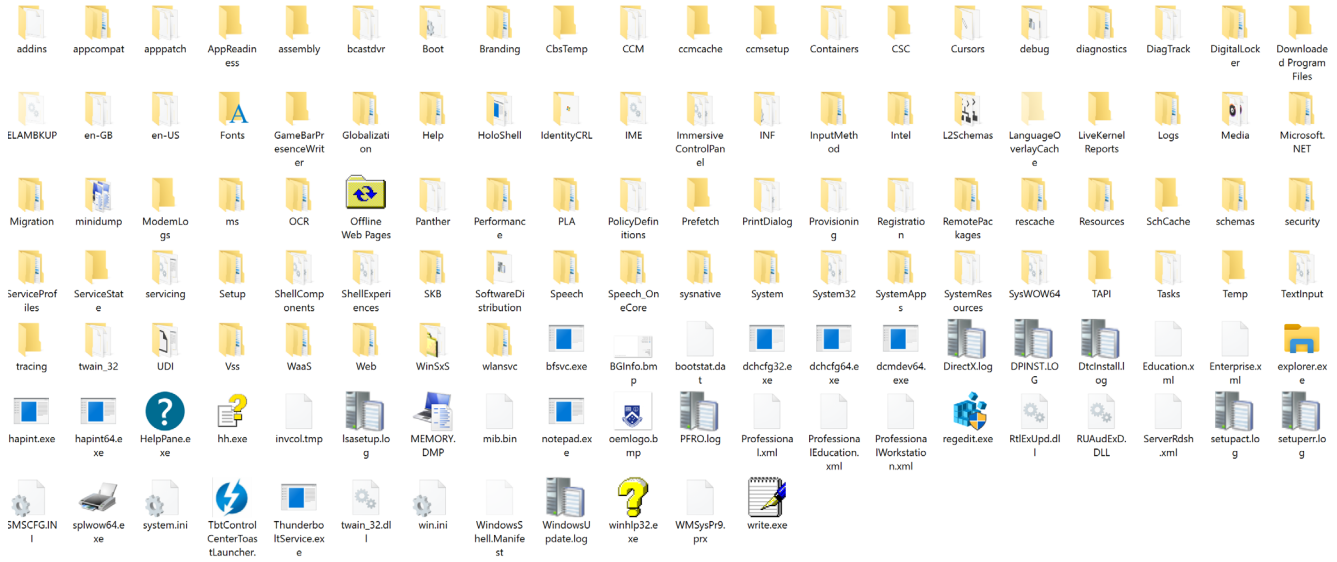
Good mapping



Conceptual Models - Users

- A conceptual model is our ‘true understanding’ of a product
- A conceptual model tries **to explain how a product works**
- Conceptual models in the user’s mind are known as **‘mental models’**
- Mental models are created by **experience, training or interaction with the product**

(Norman, 2013)



Conceptual Models - Designers

- The designer's conceptual model can be different from the user's conceptual model (mental model)

- The designer's communication with users is limited to **the system image:**
  1. the physical structure of the product, and the discoverability through using affordances, signifiers, constraints and mappings
  2. technical manuals and documentations

(Norman, 2013)

Designer's Conceptual Model and User's Mental Model

(Source Norman, 2013, pg 32)

Knowledge in the Head

- **Knowledge in the head** is the knowledge in the human memory system
- It requires learning
- We can get the knowledge of the world and transfer it into our head

*(*Norman 2013*)*

Knowledge in the World

- Knowledge in the world is external knowledge
- "**Knowledge in the world** is always there, waiting to be seen, waiting to be used" *(*Norman 2013*, pg 110)*
- Much of the knowledge we need to perform tasks can come from the information in the world (using affordances, signifiers, feedback and mappings)
- "…the designer can put sufficient cues into the design—knowledge in the world - that good performance results even in the absence of previous knowledge"

(Norman, 2013, *pg 77)*

Cognitive Process

- Cognition occurs through cognitive processes
- Cognitive processes include:
  - attention (the first step) can be visual or auditory,
  - perception and recognition,
  - **memory**,
  - Learning (and then reading, speaking and listening)
  - reasoning and problem solving (reflective cognition)

- When users interact with a system/product it involves a number of cognitive processes

Memory

MONASH University

- Memory is the ability to store and remember information
- Different types of memory:
  - Sensory memory
    - very short (about milliseconds)
    - most sensory memory will be forgotten soon unless you get it into short-term memory by paying attention to it consciously
  - Short-term (or working) memory (STM)
    - holds a small amount of information for a short period of time
    - limited in terms of time and the number of the items it can retain
  - Long-term memory (LTM)
    - It can retain the information for hours, months or years
    - It has unlimited capacity

Memory and User Interface Design

MONASH University

Long Term Memory

- Long term memory is the storage of our past experiences and knowledge
- These memories can form our mental model of a product
  - This explains the difference between beginners and experts

Short Term Memory

- When interacting with a new interface, the user needs to learn about new elements and how things work, and store them in their short-term memory (with limited capacity)
- Good design aims to reduce the short term memory load
  - E.g. using ‘recognition rather than recall’

Cognitive Load

MONASH University

- Cognitive load is the amount of effort being used to perform a task
- Reducing memory load reduces cognitive load and is very important for good interface design

External Cognition

MONASH University

- We should minimise the need for users to remember things when they are interacting with a new product
- External cognition can reduce the cognitive load
- External cognition includes the ways that **external representations and aids** are used to augment the human's normal cognitive processes

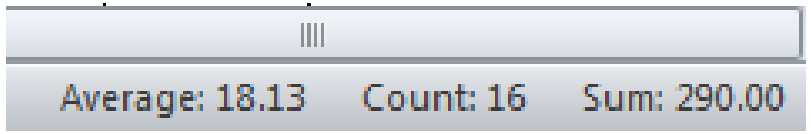
External Cognition Categories

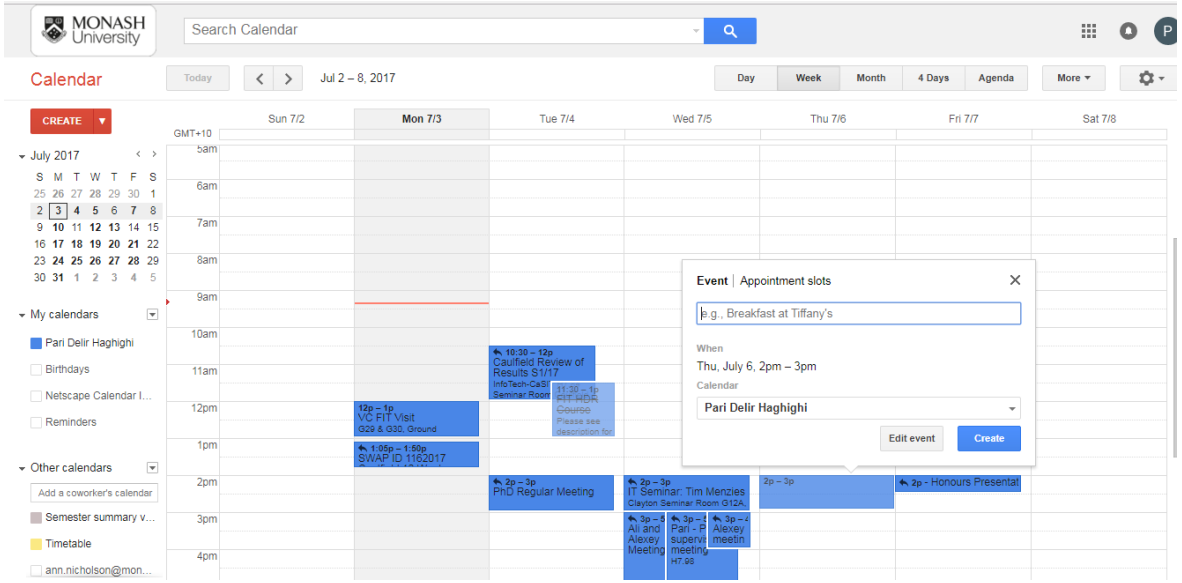
MONASH University

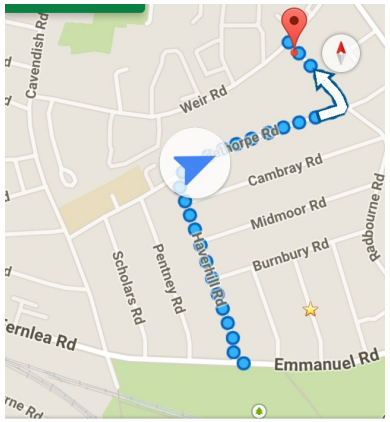
- Three main categories of external cognition:
  - **Externalising**
    - Transforming knowledge into external representations, e.g. using a calendar or diary (birthdays, appointments)
  - **Computational offloading**
    - e.g. a calculator
  - **Annotating** and **cognitive tracing**
    - such as Word Track Changes

(Rogers, Sharp, Preece, Tepper 2007)

Examples: External Cognitive Aids







What does all this mean for design?

MONASH University

We apply these theories and principles to our design to enhance people's understanding of what can be done, what is happening, and what has just occurred, and reduce short memory load:

- by minimising controls and including only those that are necessary we reduce short memory load
- by minimising clutter and avoid including too much information
- by making affordances visible, discoverable and perceivable
- by providing feedback
- by using natural mapping
- by using constraints
- by using consistency and redundancy
- by considering users' mental models and knowledge in the head (designing based on what users know, and their previous knowledge)

“Whenever you see hand-lettered signs pasted on doors, switches, or products, trying to explain how to work them, what to do and what not to do, you are also looking at poor design.”

(Norman 2013, *pg 19)*

References

- Don Norman, 2013, The Design of Everyday Things
- Jennifer Preece, Yvonne Rogers, Helen Sharp (2002). Interaction design: beyond human-computer interaction, John Wiley & Sons (Chapter 3)