Interaction Design

DECO1200

Outline

Introduction to Cognitive Models

What are cognitive models? Why do they matter?

Cognitive Processes

What are the different types of cognition?

Conceptual Models for Cognition

What are the different types of cognitive models?

Information Design

How do cognitive models affect design?

What is Cognition?

Cognition is what goes on in our heads.

Thinking, sensing, understanding, learning, reasoning, planning, imagining, decision making, problem solving, using language, etc.

Experiential vs Reflective Cognition

Experiential: perceiving, acting and reacting to events
Reflective: thinking, planning and decision-making

Cognitive Models

What are cognitive models?

Cognitive models are models of human cognition

How are cognitive models developed?

Psychologists and cognitive scientists study how humans perceive, think, act in laboratory tests

What do cognitive models tell us?

Cognitive models tell us about human cognitive strengths and weaknesses, i.e. what humans are good and bad at.

Benefits of Cognitive Modelling

Cognitive models can help interaction designers in a number of ways:

Inform design decisions

Help designers produce better designs

Extend human capabilities

Help designers produce systems that build on what humans are already good at

Compensate for human weaknesses

Help designers produce systems that can help people do things that that find difficult

Cognitive Processes

Cognitive is often described as processes

- Attention
  - Paying attention to what's important in the world
- Perception
  - Perceiving and recognising things in the world
- Memory
  - Remembering useful things about the world
- Learning
  - Learning new things about the world
- Using Language
  - Listening, speaking, reading and writing
- Problem-Solving
  - Planning, reasoning and decision-making

Attention

Selecting things to concentrate on

Depends upon a person's goals and the information available in the person's situation

Goals

The goals that a person is trying to achieve can greatly affect what people will consider important.

Information

How information is presented can greatly effect what people attend to in an interface.

Inattentional Blindness

What is inattentional blindness?

In a famous psychology experiment subjects were asked to monitor the passing of a basketball between two teams. During the video a woman wearing a gorilla suit or carrying an umbrella walks across the scene. After watching the video subjects were asked if they noticed anything out of the ordinary. Typically, 50% of the subjects did not report seeing the gorilla.

UOS	SID	Family Name	Given Name	Email
DECO1200	306133962	ARBIB	ADAM	aarb8905@mail.usyd.edu.au
DECO1200	307140059	CHEE	EMMA	eche5110@mail.usyd.edu.au
DECO1200	307195392	CHEN	KUAN-YU KEVIN	kche7341@mail.usyd.edu.au
DECO1200	307185478	CHENG	YU-HSUAN EILEEN	yche3715@mail.usyd.edu.au
DECO1200	306151405	COLBORNE	SARAH ANNE	scol6803@mail.usyd.edu.au
DECO1200	307189317	COSGROVE	DREW	dcos5821@mail.usyd.edu.au
DECO1200	307197263	DENNIS	MICHAEL JAMES	mden3855@mail.usyd.edu.au
DECO1200	307220575	DU	QUOC HOA	qudu6448@mail.usyd.edu.au
DECO1200	307187004	FAY	NATHANIEL ERIN	nfay4384@mail.usyd.edu.au
DECO1200	307199258	FRANCIS	ALEXANDER JOHN	afra3632@mail.usyd.edu.au
DECO1200	307141594	GINIS	HARRISON	hgin2007@mail.usyd.edu.au
DECO1200	307165760	GOUNIAI	MARTHA	mgou6318@mail.usyd.edu.au
DECO1200	306210649	GREEN	BETHANY CLAIRE	bgre2665@mail.usyd.edu.au
DECO1200	307202267	JIANG	MICHAEL YI XIAO	mjia8924@mail.usyd.edu.au

UOS,SID,Family Name,Given Name,Email,Degree Type,Degree Code,Gender
DECO1200,306133962,ARBIB,ADAM,aarb8905@mail.usyd.edu.au,B.Des.Comp.,CH009,M
DECO1200,307140059,CHEE,EMMA,eche5110@mail.usyd.edu.au,B.S.T.,LH035,F
DECO1200,307195392,CHEN,KUAN-YU KEVIN,kche7341@mail.usyd.edu.au,B.Des.Comp.,CH009,M
DECO1200,307185478,CHENG,YU-HSUAN
EILEEN,yche3715@mail.usyd.edu.au,B.Des.Comp.,CH009,F
DECO1200,306151405,COLBORNE,SARAH ANNE,scol6803@mail.usyd.edu.au,B.Des.Comp.,CH009,F
DECO1200,307189317,COSGROVE,DREW,dcos5821@mail.usyd.edu.au,B.Des.Comp.,CH009,M
DECO1200,307197263,DENNIS,MICHAEL
JAMES,mden3855@mail.usyd.edu.au,B.Des.Comp.,CH009,M
DECO1200,307220575,DU,QUOC HOA,qudu6448@mail.usyd.edu.au,B.S.T.,LH035,M
DECO1200,307187004,FAY,NATHANIEL ERIN,nfay4384@mail.usyd.edu.au,B.Des.Comp.,CH009,M
DECO1200,307199258,FRANCIS,ALEXANDER JOHN,afra3632@mail.usyd.edu.au,B.S.T.,LH035,M
DECO1200,307141594,GINIS,HARRISON,hgin2007@mail.usyd.edu.au,B.Des.Comp.,CH009,M
DECO1200,307165760,GOUNIAI,MARTHA,mgou6318@mail.usyd.edu.au,B.Des.Comp.,CH009,F
DECO1200,306210649,GREEN,BETHANY CLAIRE,bgre2665@mail.usyd.edu.au,B.Des.Comp.,CH009,F
DECO1200,307202267,JIANG,MICHAEL YI XIAO,mjia8924@mail.usyd.edu.au,B.Des.Comp.,CH009,M

Design Implications of Attention

Make information salient when it's needed

Use techniques like animation, color, decoration, ordering, sequencing and layout to draw attention.

Avoid cluttering up an interface

Interfaces that are plain are much easier to use because it is easier for users to find important information.

Personalized Home | Sign in

Web Images Groups News **more »**

Advanced Search
Preferences
Language Tools

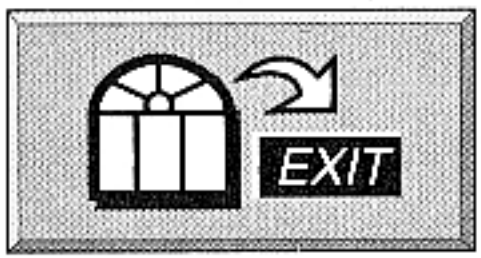
Google Search I'm Feeling Lucky

Search: the web pages from Australia

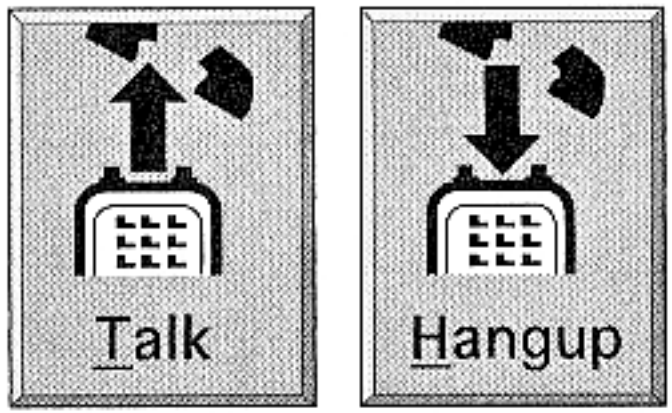
Advertising Programmes - Business Solutions - About Google - Go to Google.com

Perception

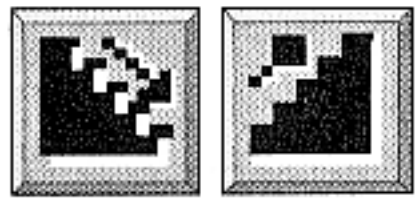
- Getting information from the environment
  - Information is sensed and transformed into experiences through pattern recognition
- Vision is the dominant sense for humans
  - Interestingly, when trying to remember things, recalling the smell can often be the most powerful perception to unlocking a difficult memory
- During perception sense data is combined
  - Perceptions often involve multiple senses making multimedia a powerful interaction design tool
    - Care must be taken to ensure perception is successful e.g. a slight mismatch is lip-sync is unnerving


EXIT

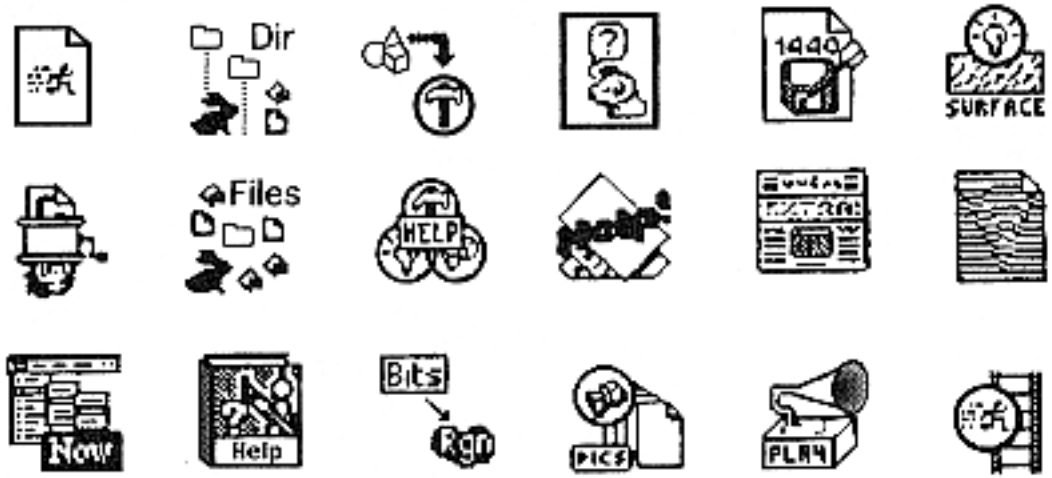
(a)


Talk
Hangup

(b)



(c)


Dir
SURFACE
Files
HELP
Now
Help
Bits
Rgn
PICS
PLAY

(d)

Design Implications of Perception

Information needs to be represented in ways that are easily recognised

- The meaning of icons and symbols should be obvious
- Sounds should be easily distinguished from each other
- Text should be easily distinguished from its background
- Speech should be easily distinguished and understood
- Tactile feedback should be distinct and appropriate

Memory

Recalling knowledge and experiences

Memories are recalled to support cognition and take appropriate actions

Memories do not store every detail

Typically, memories of experiences do not contain every sight, smell, sound etc.

Memories aren't perfect

We forget things we'd like to remember and we remember things we'd like to forget

Context is important

Context can greatly affect what we remember and can lead to the construction of false memories

Strategies for Remembering

Mnemonics

Mnemonics turn unmemorable sequences into easily remembered phrases

e.g. Many people find it difficult to remember the order of the compass directions in a clockwise order is NESW, especially the positions of east and west, a mnemonic is "Never Eat Shredded Wheat"

Sequencing

Memory experts have developed strategies to remember long sequences of things, e.g. sequences of playing cards

One of the most common is to construct stories to remember sequences, the more bizarre the stories the more memorable they become

The Magic Number 7 ± 2

One of the most famous psychological theories is that short-term memory can contain 7 ± 2 chunks of information

- A chunk is a piece of easily remembered information like a number, a word or a phrase
- Some strategies for remembering work by building larger chunks using more memorable elements

Design rules based on 7 ± 2 are only useful when they relate to short-term memory

- Typically, user interface design issues are not problems with memory but are problems with recognition

Design Implications of Memory

Do not overload the user's memory with complicated procedures

- Keep procedures short and make them consistent

Design interfaces that promote recognition rather than recall

- Menus, icons, organisation, feedback, etc.

Provide users with useful ways to help them support their memory

- Folders, labels, colors, flags, tags, timestamps, icons, etc.

Memory and Security

Many people have to remember passwords and other security information

- Security systems are often based around a number of bits of information that the user must remember

Unique IDs

- Short sequences that can be memorised, possibly using mnemonics, e.g. Personal Identification Number (PIN)

Security Questions

- Questions about unique information that can be recalled when required, e.g. mother's maiden name, birthplace, names of pets, etc.

Learning

Learning can be through first-person “doing” or third-person “reading”

- People find learning through doing to be much easier than learning through reading

Design Implications of Learning

Design interfaces to encourage exploration

Allow users to explore possibilities and undo mistakes

Design interfaces that constrain and guide

Guide users to help them select appropriate actions

Design interfaces to encourage learning

Provide users with helpful context-sensitive information

Using Language

Language can be used to convey meaning in different ways that have different qualities

- Writing is permanent, listening is transient
- Reading is quicker, listening is easier
- Written is grammatical, listening is ungrammatical

People differ in their preference and ability to use language

- Some prefer listening to reading and speaking to writing
- Some have difficulty recognising written language
- Some have difficulty hearing spoken language

Design Implications of Using Language

Keep spoken menus to a minimum

It's hard to remember more than a few spoken options

Use accentuation and intonation

Intonation and accentuation makes natural and artificial speech easier to understand

Allow text to be resized

Users should be able to resize text to make it easier for them to read

Problem-Solving, Planning, Reasoning

The degree of reflective cognition depends on a person's experience and skill

- Novices tend to act through trial-and-error, exploring and experimenting with ways of doing things
  - They are likely to be slow, make mistakes and generally be inefficient
- Experts tend to reflect more upon what they want to achieve and then select optimal strategies
  - They are likely to be able to think ahead and consider the consequences of actions

Design Implications of Reasoning

Provide additional information to users who wish to better understand more about the activities their are engaged in

- As users gain experience with a product they may want more information about their activities to support more reflective cognition

Conceptual Frameworks

Conceptual frameworks for cognition can be used to guide interaction design

- Mental Models
  - Considers the models constructed by users through interaction with a product
- Information Processing
  - Compares the mind to an information processing system, e.g. a computer
- External Cognition
  - Considers the external representations used by people to support decision making

Mental Models

Mental models are constructed by users to understand how things work

- Mental models differ depending on the interactions that a person has with a product, e.g. a TV engineer will have a different mental to a TV watcher

Mental models are used to determine what to do to achieve an effect

- Sometimes people's mental models don't match how the thing they are interacting with works, e.g. thermostats are often misunderstood

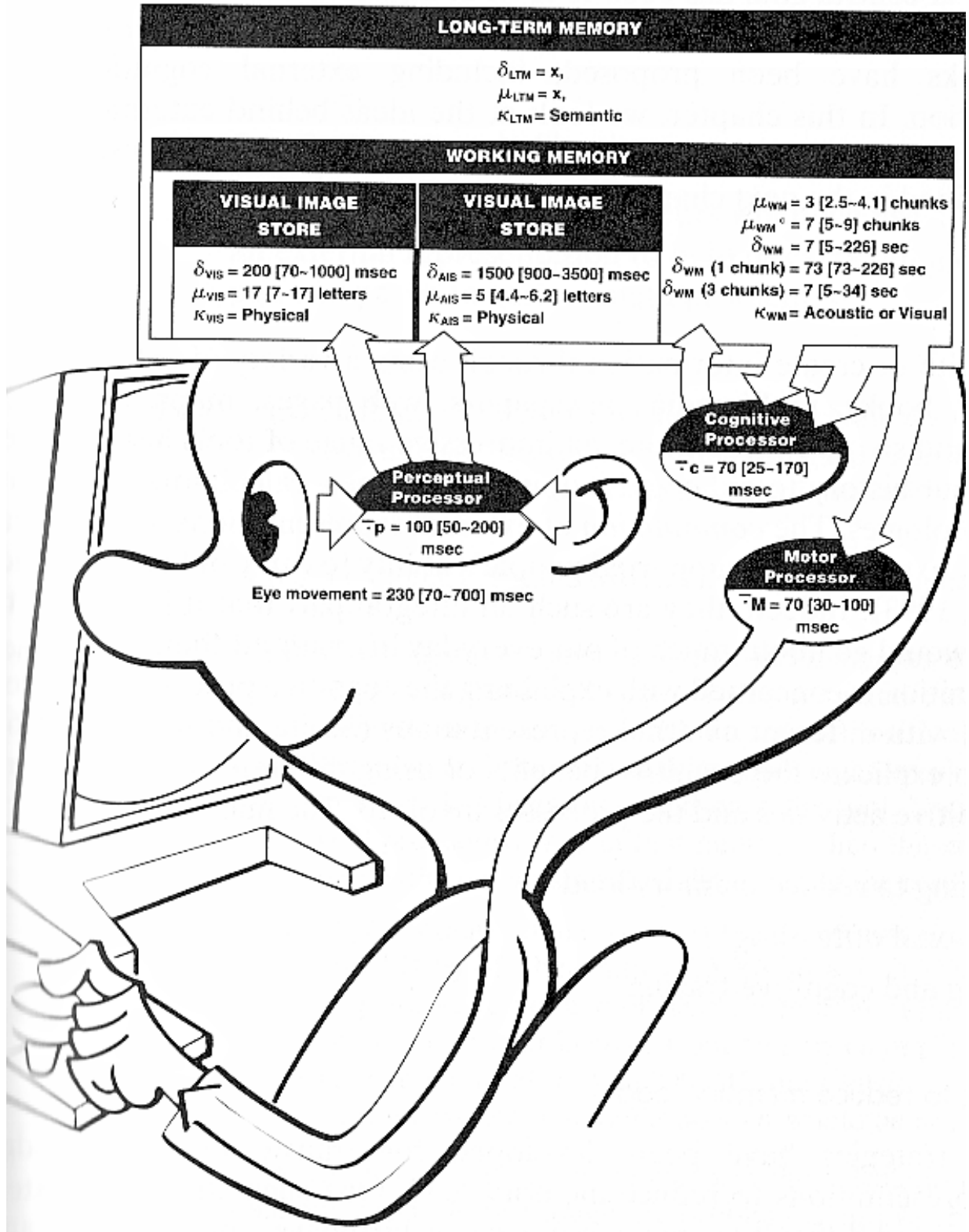
Information Processing

Information processing assumes that the mind consists of a number of processes that manipulate representations

- Processes include pattern matching, comparing, scanning, selecting, transforming, etc.
- Representations include images, symbols, rules, mental models and other forms of knowledge

Information processing provides a model for making predictions about cognition

- Cognitive science has provided data about how long processes take and the limits of representations


LONG-TERM MEMORY
δ_{LTM} = x,
μ_{LTM} = x,
κ_{LTM} = Semantic
WORKING MEMORY
VISUAL IMAGE STORE
δ_{VIS} = 200 [70~1000] msec
μ_{VIS} = 17 [7~17] letters
κ_{VIS} = Physical
VISUAL IMAGE STORE
δ_{AIS} = 1500 [900~3500] msec
μ_{AIS} = 5 [4.4~6.2] letters
κ_{AIS} = Physical
μ_{WM} = 3 [2.5~4.1] chunks
μ_{WM} ' = 7 [5~9] chunks
δ_{WM} = 7 [5~226] sec
δ_{WM} (1 chunk) = 73 [73~226] sec
δ_{WM} (3 chunks) = 7 [5~34] sec
κ_{WM} = Acoustic or Visual
Cognitive Processor
$\bar{}$c = 70 [25~170] msec
Perceptual Processor
$\bar{}$p = 100 [50~200] msec
Motor Processor
$\bar{}$M = 70 [30~100] msec
Eye movement = 230 [70~700] msec

External Cognition

Externalising information

Reducing information overload

e.g. setting reminders to perform actions

Computational offloading

Using tools to carry out computation

e.g. using a calculator to compute a sum

Annotating and cognitive tracing

Marking and modifying representations to track progress

e.g. crossing things off a to-do list

Information Design

- Information design principles use theories and frameworks to produce design rules
  - Information design principles often simplify the theories and frameworks to provide specific advice
- GOMS (Goals Operators Methods Selection)
  - GOMS can be used to describe how a user performs an task in terms of goals (e.g. save a file) and the selection of methods and operators to achieve the goals
    - GOMS can be used to produce predictions of the time to complete tasks based on data gathered about cognitive processes

Summary

Cognitive Models

Understanding cognition to inform design decisions

Cognitive Processes

Cognitive processes include attention, perception, memory, learning, using language, reasoning

Conceptual Frameworks

Conceptual models include mental models, information processing, external cognition

Information Design

Applying theories, models and framework to produce design principles, concepts, rules, analysis and evaluation