CS4051 –User capabilities

Human Factors

"*The presence of a small clock symbol in the upper left corner of the LCD indicates the alarm is armed, but in a dimly lit bedroom, the clock symbol cannot be seen. The LCD has a built-in backlight that makes the clock symbol visible, but the backlight only comes on when the CD or radio is explicitly turned on….The alarm simply won't ever sound while the CD is on, regardless of the setting of the alarm*".

"*It is simple to disarm the alarm: Simply press the "Alarm" button once, and the clock symbol disappears from the display. However to arm it, I must press the alarm button exactly five times.*"

(From Alan Cooper, "*The inmates are running the asylum*").

Why do we need to understand users?

- Interacting with technology is cognitive
- We need to take into account cognitive processes involved and cognitive limitations of users
- We can provide knowledge about what users can and cannot be expected to do
- Identify and explain the nature and causes of problems users encounter
- Supply theories, modelling tools, guidance and methods that can lead to the design of better interactive products

Cognition

- Attention
- Perception and recognition
- Memory
- Learning
- Reading, speaking and listening.
- Problem-solving, planning, reasoning, decision making.

Attention

- Selecting things to concentrate on at a point in time from the mass of stimuli around us
- Allows us to focus on information that is relevant to what we are doing
- Involves audio and/or visual senses
- Focussed and divided attention enables us to be selective in terms of the mass of competing stimuli but limits our ability to keep track of all events
- Information at the interface should be structured to capture users' attention, e.g. use perceptual boundaries (windows), colour, reverse video, sound and flashing lights

Activity: Find the price of a double room at the Holiday Inn in Bradley

Pennsylvania
Bedford Motel/Hotel: Crinaline Courts
(814) 623-9511 S: $18 D: $20
Bedford Motel/Hotel: Holiday Inn
(814) 623-9006 S: $29 D: $36
Bedford Motel/Hotel: Midway
(814) 623-8107 S: $21 D: $26
Bedford Motel/Hotel: Penn Manor
(814) 623-8177 S: $19 D: $25
Bedford Motel/Hotel: Quality Inn
(814) 623-5189 S: $23 D: $28
Bedford Motel/Hotel: Terrace
(814) 623-5111 S: $22 D: $24
Bradley Motel/Hotel: De Soto
(814) 362-3567 S: $20 D: $24
Bradley Motel/Hotel: Holiday House
(814) 362-4511 S: $22 D: $25
Bradley Motel/Hotel: Holiday Inn
(814) 362-4501 S: $32 D: $40
Breezewood Motel/Hotel: Best Western Plaza
(814) 735-4352 S: $20 D: $27
Breezewood Motel/Hotel: Motel 70
(814) 735-4385 S: $16 D: $18

Activity: Find the price for a double room at the Quality Inn in Columbia

South Carolina

City	Motel/Hotel	Area code	Phone	Rates Single	Rates Double
Charleston	Best Western	803	747-0961	$26	$30
Charleston	Days Inn	803	881-1000	$18	$24
Charleston	Holiday Inn N	803	744-1621	$36	$46
Charleston	Holiday Inn SW	803	556-7100	$33	$47
Charleston	Howard Johnsons	803	524-4148	$31	$36
Charleston	Ramada Inn	803	774-8281	$33	$40
Charleston	Sheraton Inn	803	744-2401	$34	$42
Columbia	Best Western	803	796-9400	$29	$34
Columbia	Carolina Inn	803	799-8200	$42	$48
Columbia	Days Inn	803	736-0000	$23	$27
Columbia	Holiday Inn NW	803	794-9440	$32	$39
Columbia	Howard Johnsons	803	772-7200	$25	$27
Columbia	Quality Inn	803	772-0270	$34	$41
Columbia	Ramada Inn	803	796-2700	$36	$44
Columbia	Vagabond Inn	803	796-6240	$27	$30

Activity

- Tullis 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
  - In the 1st screen the information is bunched up together, making it hard to search
  - In the 2nd screen the characters are grouped into vertical categories of information making it easier

Multitasking and attention

- Is it possible to perform multiple tasks without one or more of them being detrimentally affected?

- Ophir et al (2009) compared heavy vs light multi-taskers
  - heavy 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

Distraction and interruption

- Users should know where they are in the system and what information is being displayed.
- This is particularly important in interfaces based around forms.
- Users should be able to pick up where they left off easily. Security mechanisms like auto-logoff can often disrupt this.
- They may be distracted or interrupted - “Cup of tea” problem.

Design implications for attention

- Make information salient when it needs attending to
- Use techniques that make things stand out like colour, ordering, spacing, underlining, sequencing and animation
- Avoid cluttering the interface - follow the google example of crisp, simple design
- Avoid using too much because the software allows it

Perception and 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
  - Speech output should enable users to distinguish between the set of spoken words
  - Tactile feedback should allow users to recognize and distinguish different meanings

Is color contrast good? Find italian

Black Hills Forest	Peters Landing	Jefferson Farms	Devlin Hall
Cheyenne River	Public Health	Psychophysics	Positions
Social Science	San Bernardino	Political Science	Hubard Hall
South San Jose	Moreno Valley	Game Schedule	Fernadino Beach
Badlands Park	Altamonte Springs	South Addision	Council Bluffs
Juvenile Justice	Peach Tree City	Cherry Hills Village	Classical Lit
Results and Stats	Highland Park	Creative Writing	Sociology
Thousand Oaks	Manchesney Park	Lake Havasu City	Greek
Promotions	Vallecito Mts.	Engineering Bldg	Wallace Hall
North Palermo	Rock Falls	Sports Studies	Concert Tickets
Credit Union	Freeport	Lakewood Village	Public Radio FM
Wilner Hall	Slaughter Beach	Rock Island	Children's Museum
Performing Arts	Rocky Mountains	Deerfield Beach	Writing Center
Italian	Latin	Arlington Hill	Theater Auditions
Coaches	Pleasant Hills	Preview Game	Delaware City
McKees Rocks	Observatory	Richland Hills	Scholarships
Glenwood Springs	Public Affairs	Experts Guide	Hendricksville
Urban Affairs	Heskett Center	Neff Hall	Knights Landing
McLeansboro	Brunswick	Grand Wash Cliffs	Modern Literature
Experimental Links	East Millinocket	Indian Well Valley	Studio Arts
Graduation	Women's Studies	Online Courses	Hughes Complex
Emory Lindquist	Vacant	Lindquist Hall	Cumberland Flats
Clinton Hall	News Theatre	Fisk Hall	Central Village
San Luis Obispo	Candlewood Isle	Los Padres Forest	Hoffman Estates

Are borders and white space better? Find french

Webmaster	Curriculum	Student Life	Dance
Russian	Emergency (EMS)	Accountancy	Gerontology
Athletics	Statistics	McKnight Center	Marketing
Go Shockers	Award Documents	Council of Women	College Bylaws
Degree Options	Language Center	Commute	Why Wichita?
Newsletter	Future Shockers	Small Business	Tickets
Geology	Intercollegiate	Thinker & Movers	Career Services
Manufacturing	Bowling	Alumni	Doers & Shockers
Management	Wichita Gateway	Foundations	Core Values
UCATS	Transfer Day	Corbin Center	Grace Wilkie Hall
Alumni News	Job Openings	Jardine Hall	Strategic Plan
Saso	Live Radio	Hugo Wall School	Medical Tech
Educational Map	Beta Alpha Psi	Staff	Softball, Men's
Physical Plant	Liberal Arts	Aerospace	McKinley Hall
Graphic Design	Counseling	Choral Dept.	Email
Non Credit Class	Biological Science	Alberg Hall	Dental Hygiene
Media Relations	Duerksen Fine Art	French	Tenure
Advertising	EMT Program	Spanish	Personnel Policies
English	Religion	Parents	Instrumental
Graduate Complex	Art Composition	Wrestling	Nursing
Music Education	Physics	Philosophy	Opera
Advising Center	Entrepreneurship	Wichita Lyceum	Sports History
Medical School	Koch Arena	Fairmount Center	Athletic Dept.
Levitt Arena	Roster	Women's Museum	Health Plan

Activity

- Weller (2004) found people took less time to locate items for information that was grouped using a border (2nd screen) compared with using color contrast (1st screen)

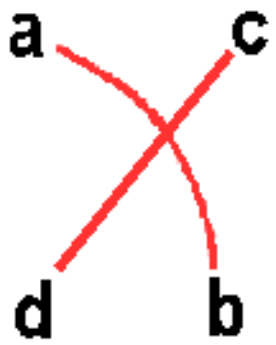
Layout

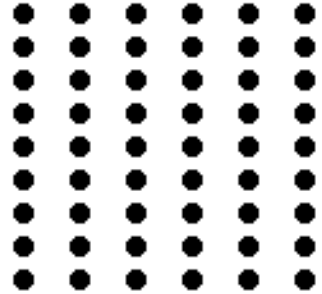
- Layout is an important aspect of the design.
- Consistent layout - such as using different areas of the screen for different purposes can be helpful to the user.
- Grouping items together can also be helpful to indicate that they are related in some fashion.
- Lack of whitespace is not just aesthetically unpleasing – it makes it difficult for the user to perceive structure in the interface and hence makes it more difficult to find information.

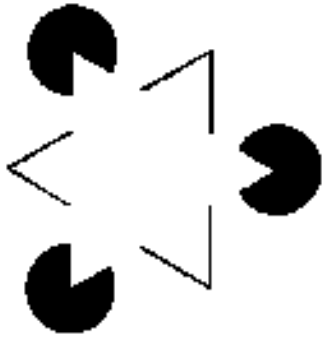
Laws of Gestalt

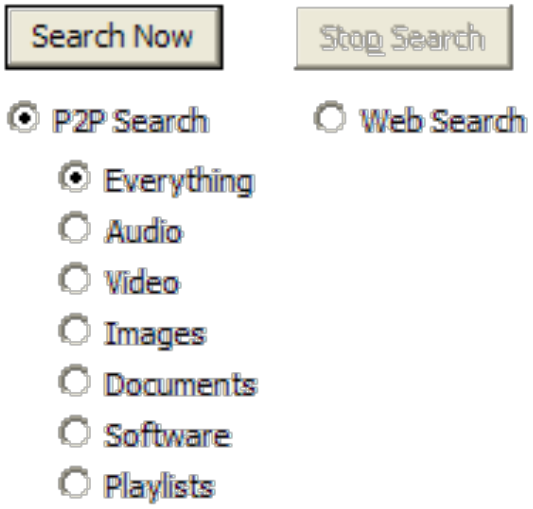
- Proximity – items are grouped according to the nearness of their respective parts
- Similarity – similar items tend to be grouped
- Good continuation – e.g. straight lines appear to continue as straight lines, curves as curves.
- Closure/Good form – completed items are grouped together
- Membership character – a single part of the whole is defined by the context in which it appears.

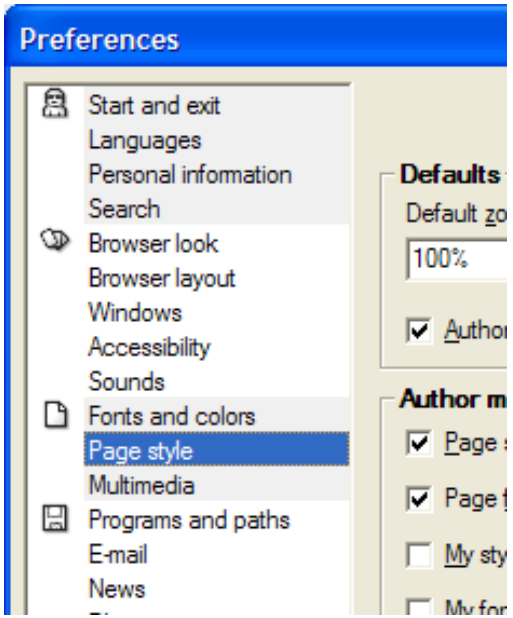
Gestalt illustrations

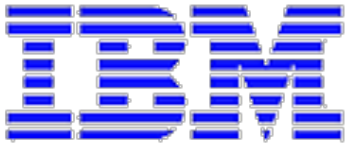












Examples from interaction-design.org

Graphic design example

- In 1966, engineers and designers at Dow Chemical working for the National Cancer Institute set out to create an icon for biohazardous materials.
- They laid out six design criteria. The solution had to be:
- **Striking in form in order to draw immediate attention**
- **Unique and unambiguous to avoid confusion with other symbols**
- **Quickly recognizable and easily recalled**
- **Easily stencilled**
- **Symmetrical, in order to appear identical from all angles**
- **Acceptable to groups of varying ethnic backgrounds**

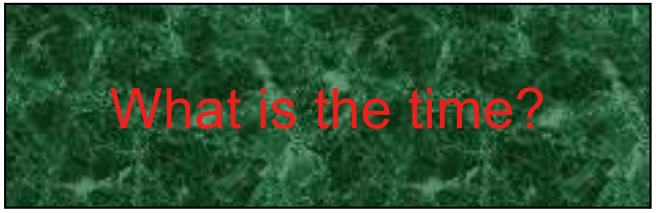
Graphic design example

- Showed a set of 24 symbols to 300 people with various amounts of income and formal education from 25 American cities.
- Asked to guess the meaning of each, giving a "meaningfulness score." A week later, the same participants were shown the original 24 symbols with 36 more and asked to identify which symbols they remembered seeing before.

One scored joint highest in memorability, but the lowest in meaningfulness. So it was unforgettable, but also a had no conflicting interpretation.

Baldwin, C.L. and Runkle, R.S. *Science* 158: 264-265, 1967

Which is easiest to read and why?



What is the time?

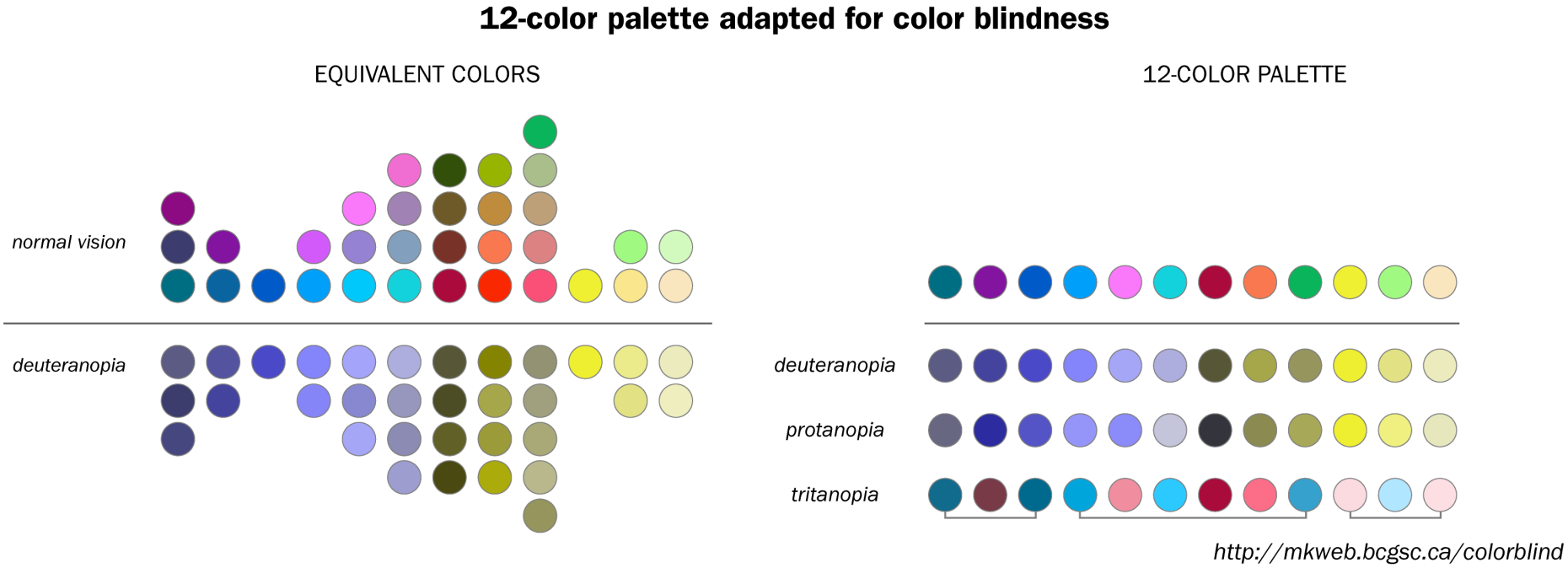
What is the time?

What is the time?

What is the time?

Colour

- Made up of hue, intensity, saturation
  - blue acuity is lowest
- About 8% of men have some form of colour vision deficiency, about 0.5% of women



Stroop Experiment

- Need a volunteer
- Start saying **colors** you see in list of words, as fast as you can.
- Say “done” when finished
- Everyone else time it…

Green

White

Yellow

Red

Black

Blue

Experiment

- And again…

Paper

Back

Home

Schedule

Change

Page

Experiment

- And again…

Blue

Red

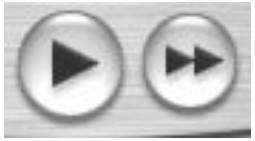
Black

White

Green

Yellow

Readability

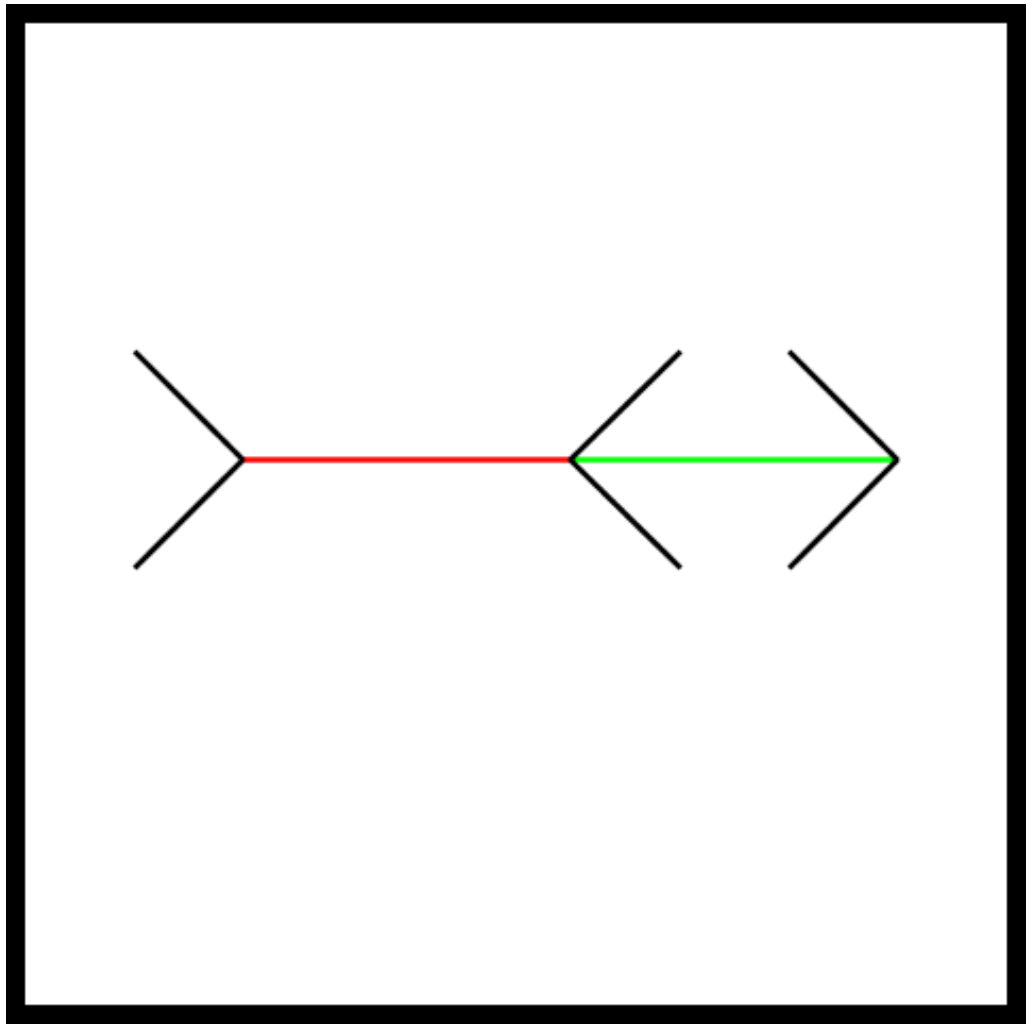


- Which is better?
- W3C recommends brightness difference and minimum colour difference

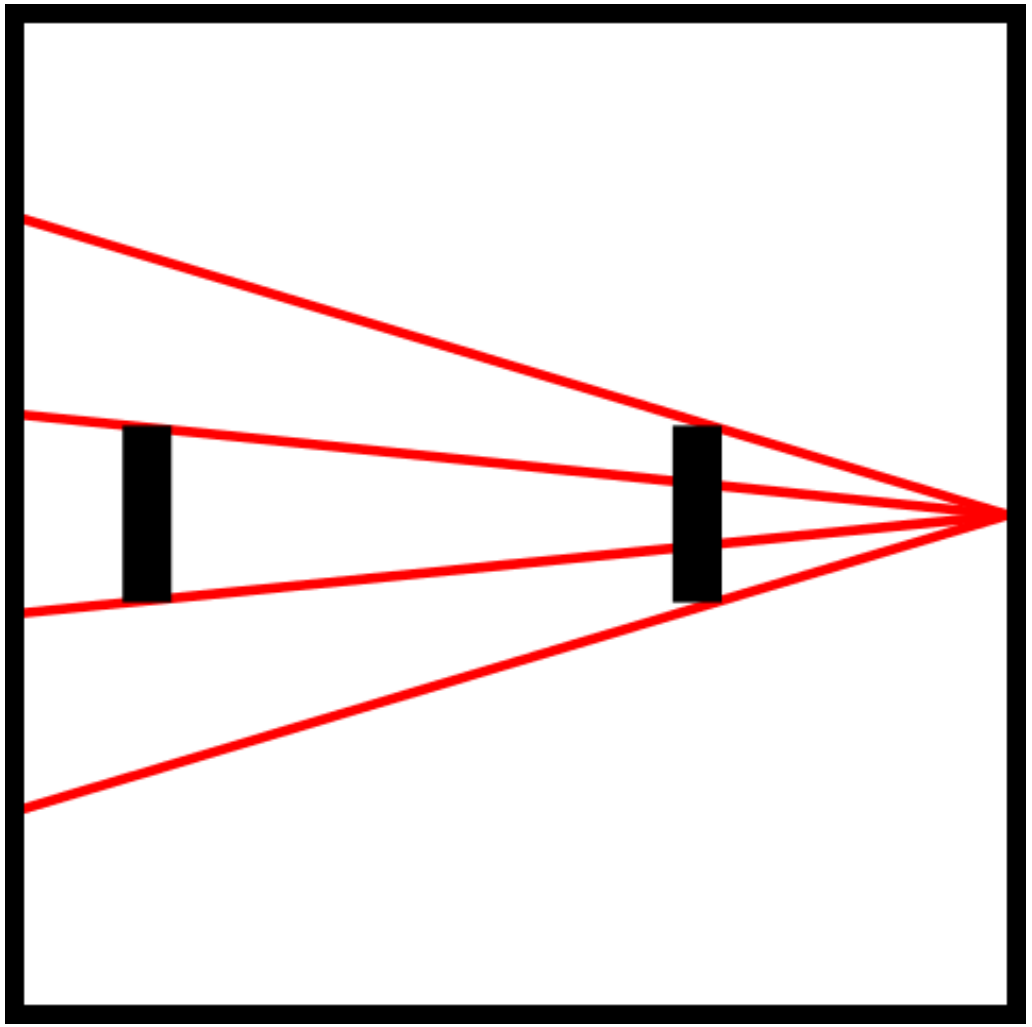
Vision

- The visual system compensates for:
  - movement
  - changes in luminance.
- Context is used to resolve ambiguity
- Optical illusions sometimes occur due to over compensation

Optical Illusions

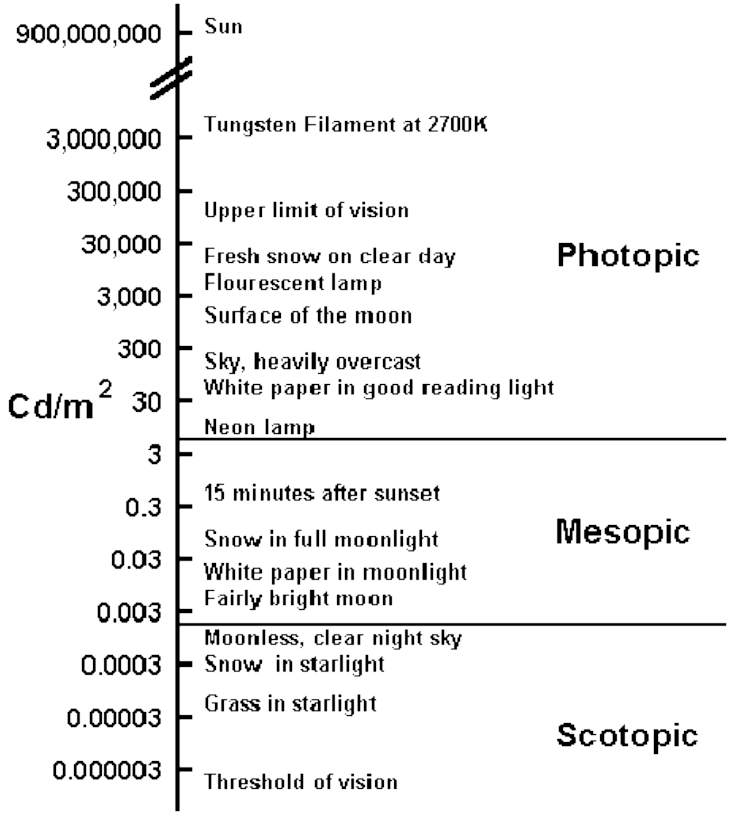


Optical Illusions



Lighting

- 300-500 Lux – office lighting
- 10,000–20,000 Lux - full sunlight, looking towards horizon.



Reading

- Several stages:
  - visual pattern perceived
  - decoded using internal representation of language
  - interpreted using knowledge of syntax, semantics, pragmatics
- Reading involves saccades and fixations
- Perception occurs during fixations
- Word shape is important to recognition
- Negative contrast (dark on light) improves reading from computer screen

Audio in Interfaces

- How might we make use of sound in an interface?
  - Getting the user's attention
  - Continuous status information
  - Confirmation
  - Navigation?

Touch

- Provides important feedback about environment.
- May be key sense for someone who is visually impaired.
- Stimulus received via receptors in the skin:
  - thermoreceptors: heat and cold
  - nociceptors: pain
  - mechanoreceptors: pressure (some instant, some continuous)
- Some areas more sensitive than others e.g. fingers.
- Kinesthesis and proprioception - awareness of body position and movement, affects comfort and performance.

Haptic feedback

- Simple haptic feedback may be on/off.
- Responses to keypresses.
- Continuous cycling.
- Pulses.

Haptic device

Haptics - surgical simulators

Haptic screens

Tangible interfaces

Figure 4 mediaBlocks and media sequencer (Copyright 1998 ACM; reprinted with permission from *Computer Graphics Proceedings (SIGGRAPH 98)*[13])

Movement

- Time taken to respond to stimulus: reaction time + movement time
- Movement time - dependent on age, fitness etc.
- Reaction time - dependent on stimulus type:
  - visual ~ 200ms
  - auditory ~ 150 ms
  - pain ~ 700ms
- Decreasing reaction time decreases accuracy in the unskilled operator but not in the skilled operator.

Movement (cont)

- Fitts' Law (1954) describes the time taken to hit a screen target:

  $$Mt = a + b \log2(D/S + 1)$$

- Where ***a*** and ***b*** are empirically determined constants
  - Mt is movement time
  - D is Distance
  - S is Size of target

$\Rightarrow$ targets as large as possible, distances as small as possible

Design implications for representation

- Representations of information need to be designed to be perceptible and recognisable
- Icons and other graphical representations should enable users to readily *distinguish* their meaning
- Bordering and spacing are effective visual ways of grouping information
- Sounds should be audible and distinguishable
- Speech output should enable users to distinguish between the set of spoken words
- Text should be legible and distinguishable from the background

Memory

- Involves first encoding and then retrieving knowledge
- We don’t remember everything - involves filtering and processing what is attended to
- Context is important in affecting our memory (i.e., where, when)
- Well known fact that we recognise things much better than being able to recall things
  - Better at remembering images than words
  - Why interfaces are largely visual

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 a topic, it is much better to reflect upon it, carry out exercises, have discussions with others about it, and write notes than just passively read a book or listen to a lecture.

Memory

There are three types of memory function:

Sensory memories (buffers for stimuli: visual → iconic, auditory → echoic, touch → haptic)

Short-term memory or working memory

Long-term memory

Short-term memory (STM)

- Scratch-pad for temporary recall
  - rapid access ~ 70ms
  - rapid decay ~ 200ms
  - limited capacity - 7± 2 chunks

Examples

212348278493202

00353 1 2626262

HEC ATR ANU PTH ETR EET

Long-term memory (LTM)

- Repository for all our knowledge
  - slow access ~ 1/10 second
  - slow decay, if any
  - huge or unlimited capacity

- Two types
  - episodic - serial memory of events
  - semantic - structured memory of facts,concepts, skills
  - information in semantic LTM derived from episodic LTM.

LTM - Storage of information

- Rehearsal
  - information moves from STM to LTM
- Total time hypothesis
  - amount retained proportional to rehearsal time
- Distribution of practice effect
  - optimised by spreading learning over time
- Structure, meaning and familiarity
  - information easier to remember

LTM - Forgetting

- Decay
  - information is lost gradually but very slowly
- Interference
  - new information replaces old: retroactive interference (eg. phone number)
  - old may interfere with new: proactive inhibition
- May not forget at all: memory is selective…
- Affected by emotion - can subconsciously "choose" to forget

LTM - retrieval

- Recall
  - information reproduced from memory
  - can be assisted by cues, e.g. categories, imagery
- Recognition
  - information gives knowledge that it has been seen before
  - less complex than recall - information is cue

Context is important

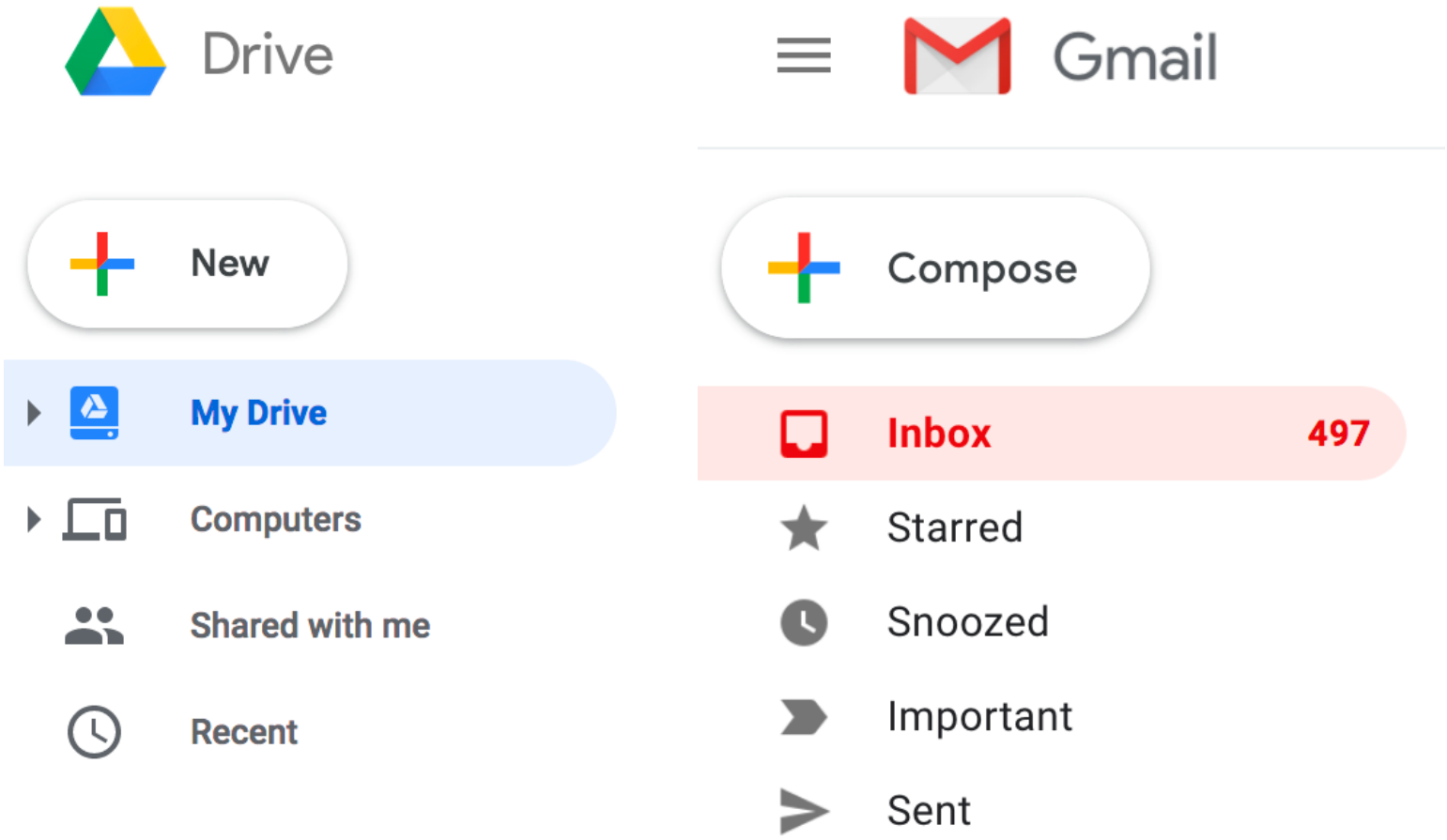
- Context affects the extent to which information can be subsequently retrieved
- Sometimes it can be difficult for people to recall information that was encoded in a different context
  - e.g., You are on a train and someone comes up to you and says hello. You don't recognise him for a few moments but then realise it is one of your neighbours. You are only used to seeing your neighbour near where you live and seeing him out of context makes him difficult to recognise initially

Recognition versus recall

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

Reducing memory load - consistency

- Consistency is useful as it can allow the user to predict what will happen when they carry out a certain action.
- Likewise they can have expectations on where certain information can be found.
- This can work across a given application, suite of applications, or an entire technology platform.


Drive
New
My Drive
Computers
Shared with me
Recent
Gmail
Compose
Inbox 497
Starred
Snoozed
Important
Sent

The problem with the classic ‘7±2’

- George Miller’s theory of how much information people can remember
- People’s immediate memory capacity is very limited
- Many designers have been led to believe that this is useful finding for interaction design

What some designers get up to…

- Present only 7 options on a menu
- Display only 7 icons on a tool bar
- Have no more than 7 bullets in a list
- Place only 7 items on a pull down menu
- Place only 7 tabs on the top of a website page
  - But this is wrong? Why?

Why?

- Inappropriate application of the theory
- People can scan lists of bullets, tabs, menu items till they see the one they want
- They don’t have to recall them from memory having only briefly heard or seen them
- Sometimes a small number of items is good design
- But it depends on task and available screen estate

Personal information management

- Personal information management (PIM) is a growing problem for most users
  - Who have vast numbers of documents, images, music files, video clips, emails, attachments, bookmarks, etc.,
  - Major problem is deciding 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 many thousands.
  - 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

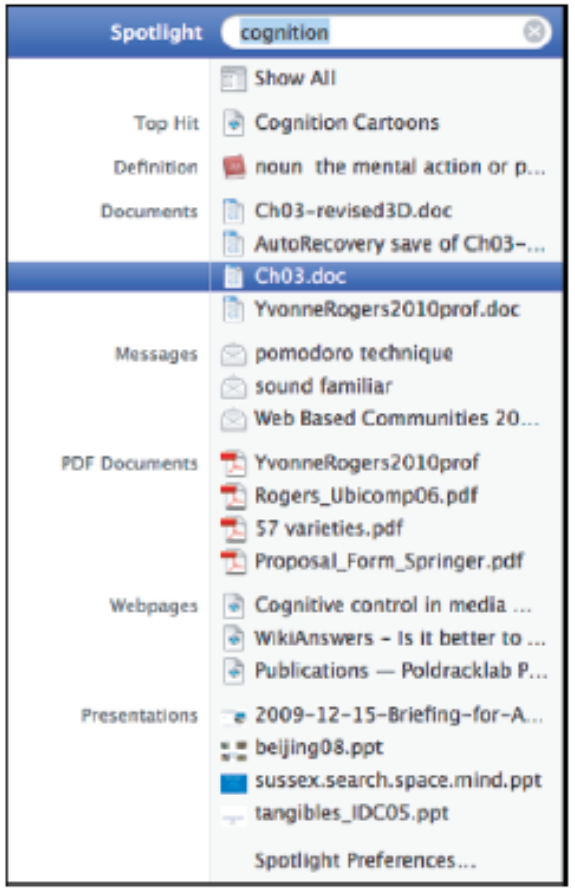


Figure 3.3 Apple's Spotlight search

Design implications

- 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, color, flagging, time stamping

Mental models

- Users develop an understanding of a system through learning and using it
- Knowledge is often described as a mental model
  - How to use the system (what to do next)
  - What to do with unfamiliar systems or unexpected situations (how the system works)
- People make inferences using mental models of how to carry out tasks

Mental models

- Craik (1943) described mental models as internal constructions of some aspect of the external world enabling predictions to be made
- Involves unconscious and conscious processes, where images and analogies are activated
- Deep versus shallow models (e.g. how to drive a car and how it works)

Everyday reasoning and mental models

(a) You arrive home on a cold winter's night to a cold house. How do you get the house to warm up as quickly as possible? Set the thermostat to be at its highest or to the desired temperature?

(b) You arrive home very hungry. You look in the fridge and find all that is left is an uncooked pizza. You have an electric oven. Do you warm it up to 175 degrees first and then put it in (as specified by the instructions) or turn the oven up higher to try to warm it up quicker?

Heating up a room or oven that is thermostat-controlled

- Many people have erroneous mental models (Kempton, 1996)
- Why?
  - General valve theory, where ‘more is more’ principle is generalised to different settings (e.g. car accelerator, gas cooker, tap, radio volume)
  - Thermostats based on model of on-off switch

Heating up a room or oven that is thermostat-controlled

- Same is often true for understanding how interactive devices and computers work:
  - Poor, often incomplete, easily confusable, based on inappropriate analogies and superstition (Norman, 1983)
  - e.g. elevators and pedestrian crossings - lot of people hit the button at least twice
  - Why? Think it will make the lights change faster or ensure the elevator arrives!

Exercise: ATMs

- Write down how an ATM works
  - How much money are you allowed to take out?
  - What denominations?
  - If you went to another machine and tried the same what would happen?
  - What information is on the strip on your card? How is this used?
  - What happens if you enter the wrong number?
  - Why are there pauses between the steps of a transaction? What happens if you try to type during them?
  - Why does the card stay inside the machine?
  - Do you count the money? Why?

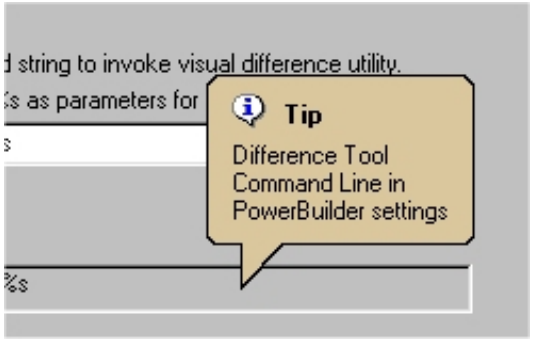
How good is your model?

- Your mental model
  - How accurate?
  - How similar?
  - How shallow?
- Payne (1991) did a similar study and found that people frequently resort to analogies to explain how they work
- People's accounts greatly varied and were often ad hoc

Levels of experience

- As users gain experience with a system their style of use will change, from novice to expert.
- For novices, the main concern is ease of learning.
- For experts the main concern is ease of use.
- Systems used on a daily basis by many people are more likely to have a majority of expert users. Thus ease of use must be the main concern, allowing expert users to perform their tasks quickly.

Novice and expert users



- Other systems, such as decision support systems are likely to have only occasional users, thus greater emphasis must be placed on ease of learning.
- Some features for novices may distract or inconvenience expert users.

Externalising to reduce memory load

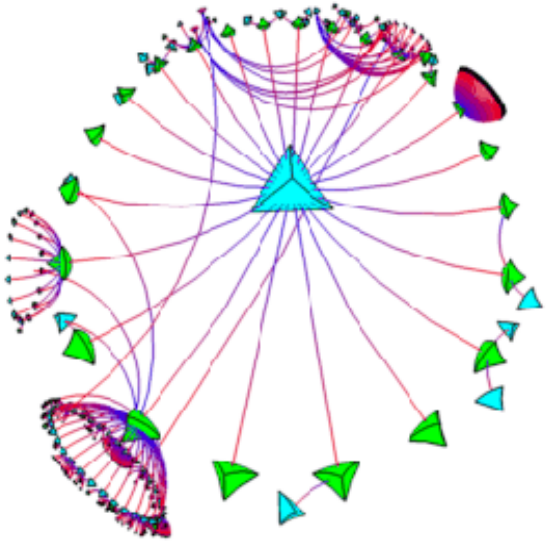
- Diaries, reminders, calendars, notes, shopping lists, to-do lists - written to remind us of what to do
- Post-its, piles, marked emails - where placed indicates priority of what to do
- External representations:
  - Remind us that we need to do something (e.g. to buy something for mother's day)
  - Remind us of what to do (e.g. buy a card)
  - Remind us when to do something (e.g. send a card by a certain date)

Annotation and cognitive tracing

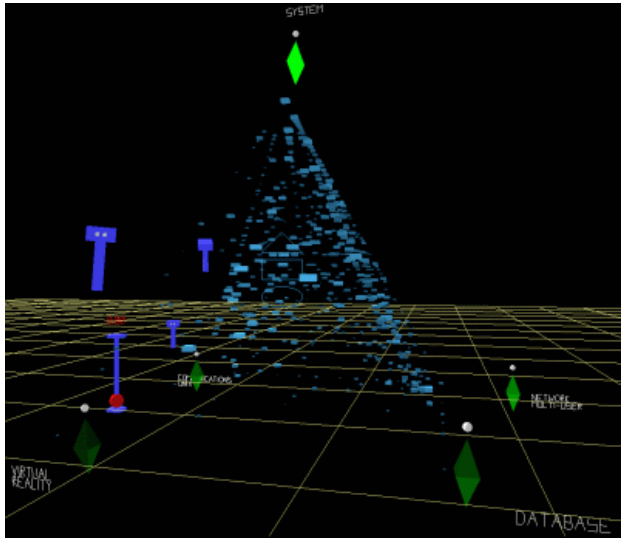
- Annotation involves modifying existing representations through making marks
  - e.g. crossing off, ticking, underlining
- Cognitive tracing involves externally manipulating items into different orders or structures
  - e.g. playing scrabble, playing cards
- Computational offloading: where we use a tool or device in conjunction with an external representation to help us carry out a computation – eg. using a pen and paper to do a mathematical problem.

Design implications

- Provide external representations at the interface that reduce memory load and facilitate computational offloading

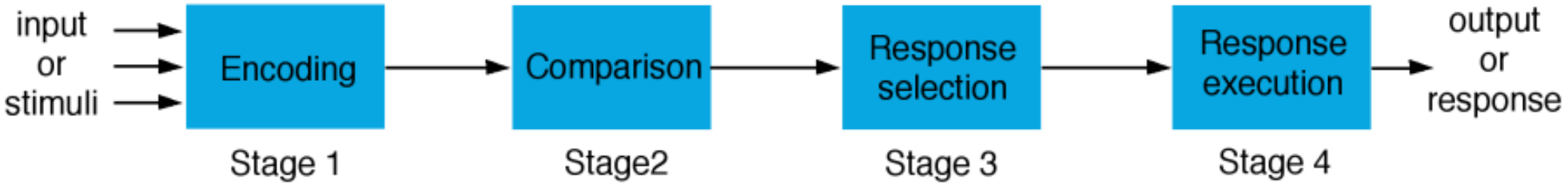


e.g. Information visualizations have been designed to allow people to make sense and rapid decisions about masses of data



Information processing

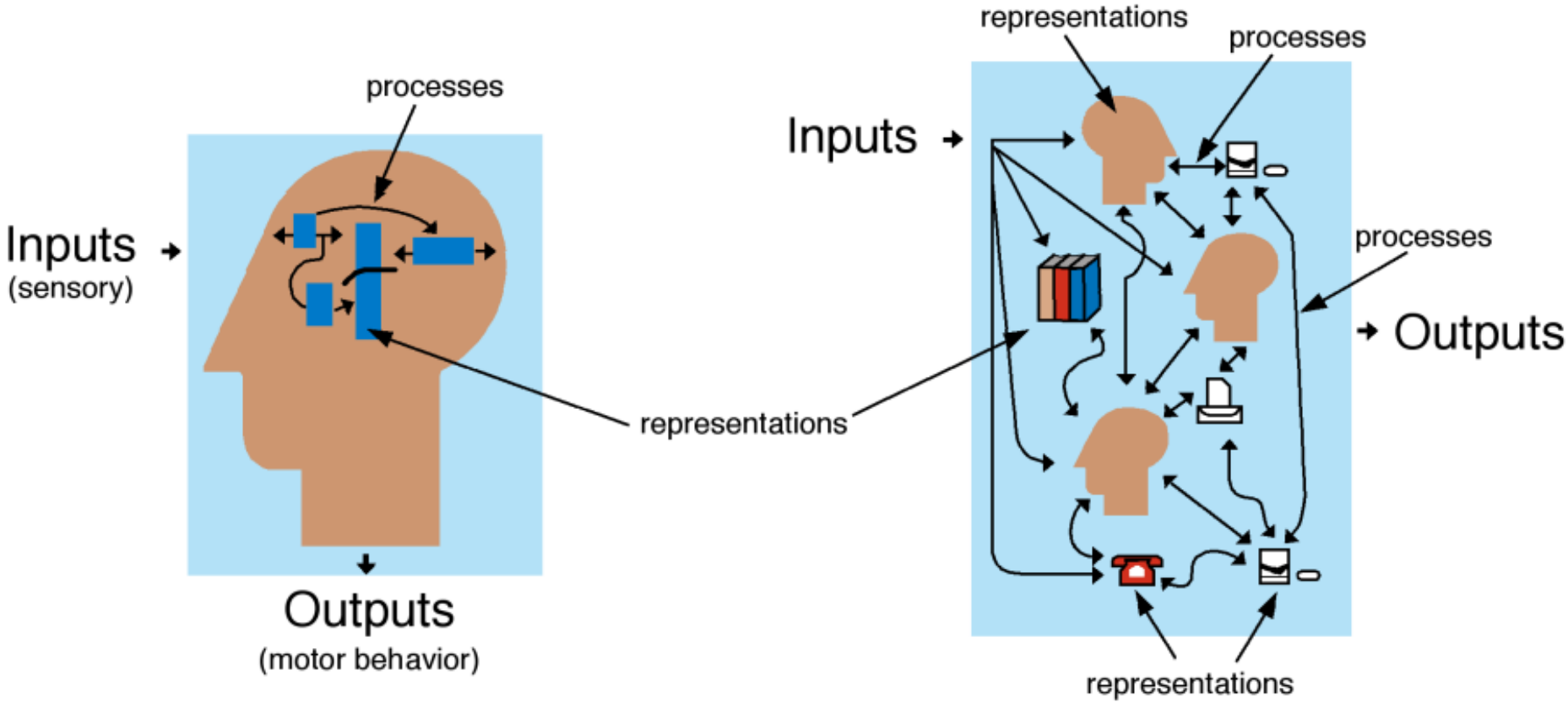
- Conceptualises human performance in metaphorical terms of information processing stages



Distributed cognition

- Many complex systems rely on interactions with external representations (e.g. maps, notes, diagrams)
- Distributed cognition is concerned with the nature of cognitive phenomena across individuals, artifacts, and internal and external representations (Hutchins, 1995)
- Describes these in terms of propagation across representational state
- Information is transformed through different media (computers, displays, paper, heads)

How it differs from information processing



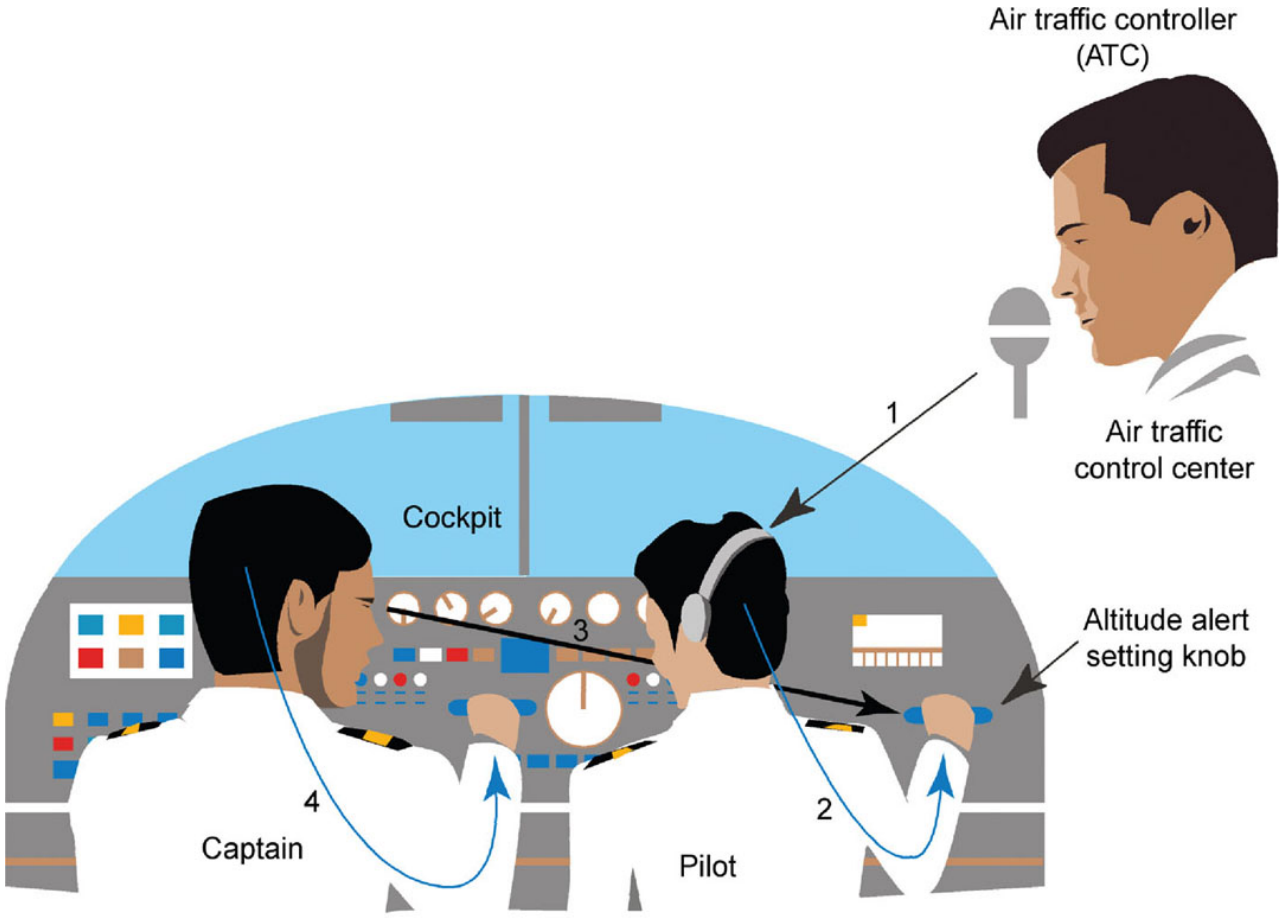
1. Traditional model

2. Distributed model

What's involved

- The distributed problem-solving that takes place
- The role of verbal and non-verbal behaviour
- The various coordinating mechanisms that are used (e.g., rules, procedures)
- The communication that takes place as the collaborative activity progresses
- How knowledge is shared and accessed

Transformation of representations



Propagation of representational states:

1 ATC gives clearance to pilot to fly to higher altitude (verbal)

2 Pilot changes altitude meter (mental and physical)

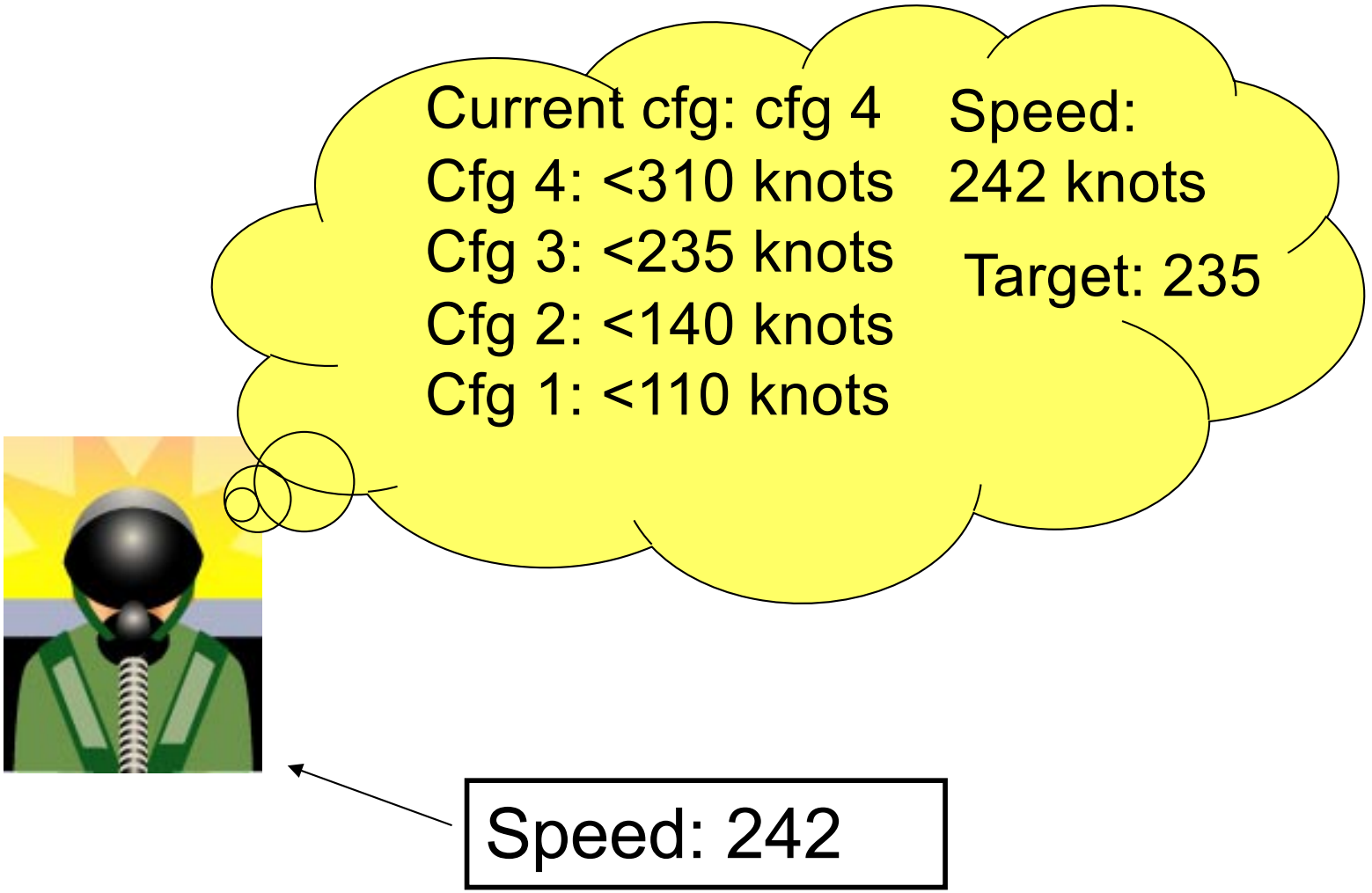
3 Captain observes pilot (visual)

4 Captain flies to higher altitude (mental and physical)

Cockpit example (Hutchins)

- Pilot Flying has to slide out slats and flaps at certain air speeds. If it were an internal task he would have to compute the air speed at which the different operations must be performed for a particular aircraft weight and keep that number in Short Term Memory as the plane slows down.
- Even reading the numbers of the ASI while flying and remembering the target numbers would most likely overtax the internal cognitive system
- Displaying the appropriate card for flap-slat speeds and putting speed bugs on the ASI converts the landing task from one in which STM triggers the operations into a task in which perceptual cues trigger those operations.

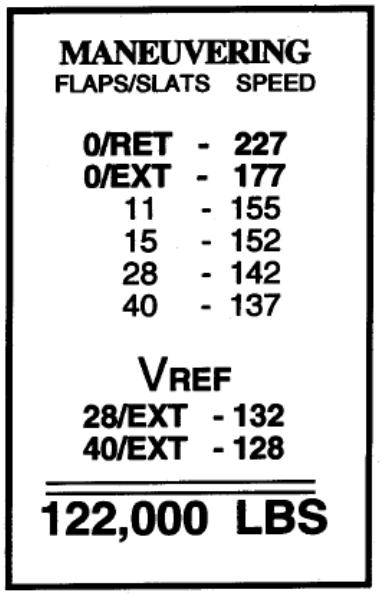
Traditional view

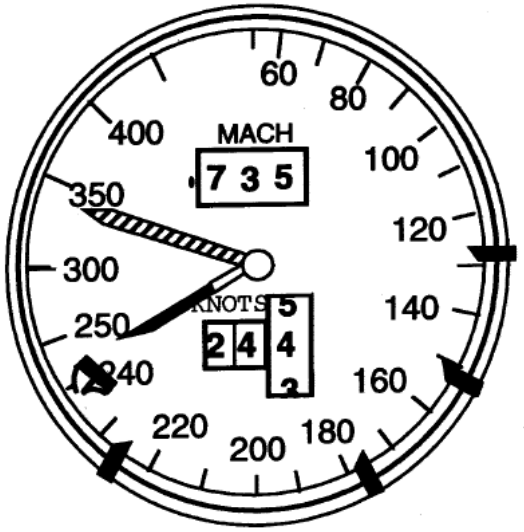



60
80
100
120
140
160
180
200
220
240
250
300
400
MACH
5 5 6
2 4 0

- Task: Extend the landing slats/flaps at specific points during landing.
- Cognitive tasks:
  - Know current speed
  - Know speed at which flaps should be lowered
  - Know upper and lower limits of this speed

- Converts cognitive activity of number matching to perceptual activity of region/angle matching.





Cockpit example

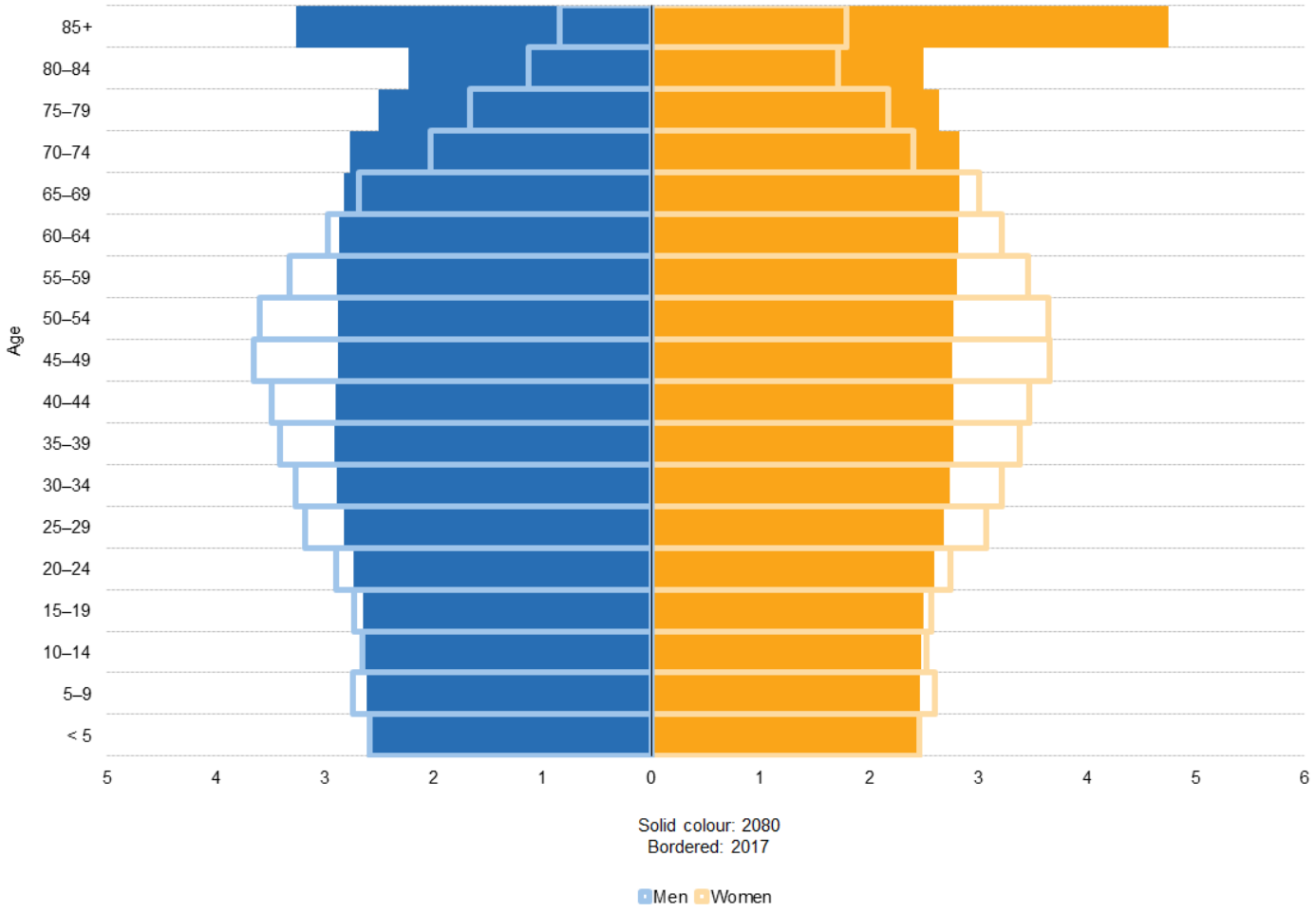
- The layout of the bugs on an analogue Air Speed Indicator substitutes a simple aiming of an arrow at a mark instead of a readout and temporary symbolic memory representation which has to be coordinated with a dial pointing at symbols.
- In order to minimise error in performing a task, simplify the tasks and have checks on accuracy of information needed to solve the problem. Externalising components of the system helps us do this.
- “The cockpit system remembers its speed, and the memory process emerges from the activity of pilots. The memory of the cockpit, however, is not made primarily of pilot memory.”

Individual differences

- Long term - gender, physical and intellectual abilities
- Short term - effect of stress or fatigue
- Changing - age
- Ask: will design decision exclude section of user population?

Aging

Population pyramids, EU-28, 2017 and 2080
(% of the total population)



Note: 2017: estimate, provisional. 2080: projections (EUROPOP2015).
Source: Eurostat (online data codes: demo_pjangroup and proj_15npms)

eurostat

Disability

People with visual impairments - blind
partially sighted

People with hearing impairments - deaf
deafened
hard of hearing

People with physical impairments - dexterity problems

People with cognitive impairments and specific learning difficulties (dyslexia)

Older people – often have a range of disabilities, more varied than younger people

Visual Impairment

- about 2 million people with severe sight problems in the UK (source: Royal National Institute for the Blind) in a population of 60 million (i.e. 1 in every 30 people). About 100000 in Ireland (NDA).
- 82% over the age of 65, but 166,000 people of working age and 24,000 children
- only 10% see “nothing”
- all want to use any vision they have
- Only 5% of totally blind people read Braille

Myths about blind people

- They do not have super acute hearing or sense of smell (but they do make much better uses of these senses than sighted people typically do)
- They are not inherently musical
- They “watch” television as much as sighted people of similar characteristics (source: RNIB)
- Very few have guide dogs (4,700 in the UK)

Deaf, deafened & hard of hearing people

- There are about 9 million deaf and hard of hearing people in the UK (source: Royal National Institute of Deaf People)
- 8.8 million have an acquired hearing loss - they have become hard of hearing usually through aging
- 120,000 people in the UK are prelingually deaf - born deaf or became deaf early in life; may have difficulty with written English
- 50,000 people use a sign language as their preferred language; see themselves as a linguistic and cultural minority, rather than a disability group; English is a second language for them

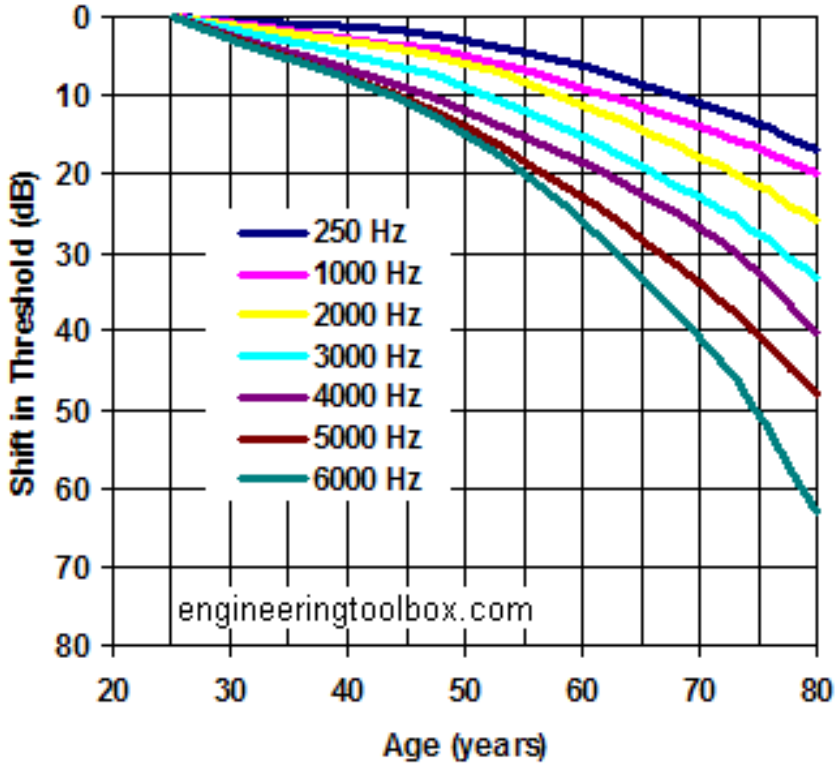
Older people

What do we mean by “older people”?

What’s old to you?

Our perceptual abilities start decreasing from about 20 years of age

In some contexts over 50 years of age



What changes with age

Kinesthetic sensitivity – awareness and confidence in our body position in the world

-older people fall much more than younger people, injure themselves, become less confident about getting about (about 250k people with locomotion problems in Ireland - NDA).

- huge problem, needs more technology to help in this area

Hearing

10% of middle aged adults have hearing losses that hinder social interaction

by age 65 – 50% of men and 30% of women

This will probably get a lot worse with the coming cohorts of older people – too much loud music in their youth in 1960s+

Vision

- 70% of people over the age of 45 wear corrective glasses
- By 65, 20% have vision that even with correction is functionally problematic
- Remember that correction isn't a perfect solution – distance, near vision and computers require potentially different corrections
- Aging affects our colour perception – the average 80 year old has only 40% of the colour vision of a 20 year old

Cognition

Working memory (7 +/- 2 things that we can remember) – decreases with age

Long term memory

semantic memory (remembering facts, conventions) - does not appear to change (but violating conventions may affect older users more)

prospective memory – event-based and time-based (remembering to take medication after 4 hours/after dinner) – time-based memory seems to decline more than event-based

Cognition

Visual attention – monitoring/noticing warnings, performance is less good as we age

Spatial cognition – following a map, a layout diagram etc (these skills build on working memory), declines with age

Comprehension of written and spoken language – making inferences less easy

Procedural knowledge – learning how to do things (ride a bike, operate a new technology) and do them automatically, less easy

Aging

People may notice some of these problems

People accept them as part of the aging process

Skills and knowledge (= wisdom) often make up for these problems

The more complex the task, the less you find age differences in performance

But older people may well need longer, better input to achieve the same end as younger people

Uninvited guests

- Commissioned from Superflux Lab by ThingTank project.
- As physical objects in the home become embedded with increasing smartness and autonomy, what relationships do we form with them?
- What role does human agency play in a world where mundane objects and environments begin to gain a level of agency and autonomy?
- How will smart objects and devices influence the rhythms and routines of our lives, and ours to theirs, and how will this in turn change our cultures, beliefs and preferences?

Key points

- Cognition involves several processes including attention, memory, perception and learning
- The way an interface is designed can greatly affect how well users can perceive, attend, learn and remember how to do their tasks
- Theoretical frameworks such as mental models and external cognition provide ways of understanding how and why people interact with products, which can lead to thinking about how to design better products
- Sensory impairments affect an increasingly large segment of the population, and this should be considered in design.