Topic 4: User Behaviour (Part 1)

SECV2113 Human-Computer Interaction

Faculty of Computing

Universiti Teknologi Malaysia

COGNITIVE ASPECT

01 WHAT IS COGNITION?

02 COGNITIVE PROCESSES & DESIGN IMPLICATIONS

Attention, Perception, Memory

Learning

Reading, speaking, listening

Problem-solving, planning, reasoning and decision-making

03 COGNITIVE FRAMEWORKS

WHAT IS COGNITION

What is Cognition?

- Thinking, remembering, learning, daydreaming, decision-making, seeing, reading, talking, writing…

- Ways of classifying cognition at a higher level:
  - Experiential vs. reflective cognition (Norman, 1993)
  - Fast vs slow thinking (Kahneman, 2011)

Which involves fast vs slow thinking?

- 2 + 2 =
- 21 × 29 =
- What colour eyes do you have?
- How many colours are there in the rainbow?
- How many months in the year have 31 days?
- What is the name of the first school you attended?

How can understanding cognition help?

- Provides knowledge about what people can and cannot be expected to do
- Identifies and explains the nature and causes of problems that people encounter when using technology
- Provides theories, modeling tools, guidance, and methods that can lead to the design of better interactive products

COGNITIVE PROCESSES & DESIGN IMPLICATIONS

....

Cognitive Processes

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

Note: The most relevant to ID are **Attention** and **Memory**

Cognitive Process: Attention

- Selecting things on which to concentrate 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
  - Focused 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
- Design recommendation
  - Information at the interface should be structured to capture peoples' attention, for example, use perceptual boundaries (windows), colour, reverse video, sound, and flashing lights

Activity

Two different ways of structuring the same information at the interface level. One makes
it much easier to find information than the other.

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

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

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Activity

Two different ways of structuring the same information at the interface level. One makes
it much easier to find information than the other.

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

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

Findings based on Activity

- 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 percent)?
- **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?
- Multitasking can cause people to lose their train of thought, make errors, and need to start over
- Ophir et al. (2009) compared heavy vs light multitaskers
  - **Heavy multitaskers** were more prone to being distracted than those who infrequently multitask
  - **Heavy multitaskers** are easily distracted and find it difficult to filter irrelevant information

Multitasking at Work

- It is increasingly common for workers to multitask
  - For example, hospital workers have to attend to multiple screens in an operating room that provide new kinds of real-time information
  - This requires clinician's constant attention to check if any data is unusual or anomalous
  - Need to develop new attention and scanning strategies

Apps to Help People Refocus

- Apps have been designed to help people get back on track or avoid being distracted
  - many are designed to block or limit the distracting sources, such as notifications, newsfeeds and social media

- An example is FocusMe that claims to ““wall off online temptation”
  - help people improve their willpower so they can develop better digital habits

Is it OK to use phone when driving?

No!

- Driving is very demanding and drivers are prone to being distracted and causing accidents
  - drivers' reaction times are longer to external events when talking on the phone in a car (Caird et al., 2018)
- Drivers often try to imagine what the other person's face is like − the person to whom they are speaking
  - Doing so competes with the processing resources needed to enable them to notice and react to what is in front of them
  - when using their phones they rely more on their expectations about what is likely to happen next
- But some drivers persist despite the dangers!

Are hands-free phones safer to use when driving?

- No, as same type of cognitive processing is happening when talking
- The same thing happens when talking with front seat passenger
  - But both can stop in mid-sentence if a hazard is spotted allowing the driver to switch immediately to the road
  - So, it's less dangerous talking to a front seat passenger than a remote person
  - A remote person on the end of a phone is not privy to what the driver is seeing and will carry on the conversation when there is a hazard
  - This makes it difficult for the driver to switch all their attention to the road

Design Implications for Attention

- Context: Make information salient when it needs to be attended to at a given stage of a task
- Use techniques to achieve this:
  - For example, colour, ordering, spacing, underlining, sequencing, and animation
- Avoid cluttering visual interfaces with too much information
- Consider designing different ways to support effective switching and returning to an interface

Cognitive Process: Perception

- How information is acquired from the world and transformed into experiences
- Obvious implication is to design representations that are readily perceivable, for instance:
  - Text should be legible
  - Icons should be easy to distinguish and read

Activity

Is colour 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

Activity

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

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Findings based on 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)
- Some argue that too much white space on web pages is detrimental to search process
  - Makes it hard to find information

- Do you agree?

Activity

Which is the easiest to read and why?

What is the time?

What is the time?

What is the time?

What is the time?

What is the time?

Design Implications for Perception

- Icons should enable users to distinguish their meaning readily
- Bordering and spacing are effective visual ways of grouping information
- Sounds should be audible and distinguishable
- Research proper color contrast techniques when designing an interface:
  - Yellow on black or blue is fine
  - Yellow on green or white is a no-no
- Haptic feedback should be used judiciously

Cognitive Process: Memory

- Involves recalling various kinds of knowledge that allow people to act appropriately
  - For example, recognising someone's face or remembering someone's name
- First encode and then retrieve knowledge
- We don't remember everything−it involves filtering and processing what is attended to
- Context is important as to how we remember (that is, where, when, how, and so on)
- We recognise things much better than being able to recall things
  - We remember less about objects that we have photographed than when we observe them with the naked eye (Henkel, 2014)

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…
- 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
  - For example, when learning about HCI, 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, listen to a lecture or watch a video about it

What is the difference between working & long-term memory?

- **Working memory** refers to our ability to recall a small amount of information from a recent time period
  - e.g. what someone said last during a conversation.

- **Long-term memory** is the capacity to recall memories from a longer time ago
  - e.g a tune someone heard from two decades ago

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:
  - “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 in the hallway of your apartment building, and seeing him out of context makes him difficult to recognise initially”

Activity

- Try to remember the dates of your grandparents' birthday
- Try to remember the cover of the last two books you read
- Which was easiest? Why?

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

Recognition vs. Recall

- **Command-based interfaces** require people to recall from memory a name from a possible set of 100s of names

- **Graphical interfaces** provide visually-based options (menus, icons) that people need only browse through until they recognize one

- **Web browsers** provide tabs and history lists of visited URLs that support recognition memory

The problem with the classic 7+or-2 memory phenomenon

- George Miller's (1956) theory of how much information people can remember
- People's immediate memory capacity is very limited to 7+or−2
- Has been applied in interaction design when considering how many options to display
- But is it a good use of a theory in HCI?
- Is it helpful?

When creating an interface, should the designer…

- 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?
- Not necessarily…

The reason is…

- People can scan lists of bullets, tabs, and menu items for the one they want
- They don’t have to recall them from memory, having only briefly heard or seen them
- So you can have more than nine at the interface
  - For instance, history lists of websites visited
- Sometimes a small number of items is good
  - For example, smart watch displays
- Depends on task and available screen estate

Saving and Searching Files

- The number of documents written, images created, music files recorded, videoclips downloaded, emails with attachments saved, etc. is huge
  - 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
- But can be difficult to remember, especially when you have 10,000s
- How might such a process be facilitated taking into account people's memory abilities?

Personal Information Management

- Bergman and Whittaker (2016) suggest helping people manage their “digital stuff” better
  - by deciding what personal information to keep
  - how to organise that information when storing it
  - which strategies to use to retrieve it later
- Provide richer metadata tools, such as time stamping, categorizing, tagging, and attribution (for example colour, text, icon, sound, or image)
- However, trying to remember which metadata was created some time back may also prove to be difficult!
- What strategy do you find works for you best?

Apple's Spotlight Search Tool

Memory Load

- Online/mobile and phone banking now require users to provide multiple pieces of information to access their account
  - For instance, ZIP code, birthplace, a memorable date, first school attended
  - Known as multifactor authentication (MFA)
- Why?
  - Increased security concerns
- Password managers, such as LastPass, have been developed that require only one master password
  - reduces stress and memory load on users
- Passwords could become extinct with the widespread use of biometrics and computer vision algorithms

Digital Forgetting

- When might you wish to forget something that is online?
  - When you break up with a partner
  - Emotionally painful to be reminded of them through shared photos, social media, and so on.

- Sas and Whittaker (2013) suggest ways of harvesting and deleting digital content
  - For example, making photos of ex into an abstract collage
  - Helps with closure

Memory Aids

- **SenseCam**, developed by Microsoft Research Labs (now Autographer)
  - A wearable device that intermittently takes photos without any user intervention while worn
  - Digital images taken are stored and revisited using special software
  - Has been found to improve people's memory, especially those suffering from dementia

- Other aids include **RemArc**, which triggers long-term memory using old BBC materials

SenseCam

Figure 3.5 The SenseCam device and a digital image taken with it

Source: ©Microsoft Research Cambridge.

Design Implications for Memory

- Reduce cognitive load by avoiding long and complicated procedures for carrying out tasks

- Design interfaces that promote recognition rather than recall

- Provide users with various ways of labelling digital information to help them easily identify it again
  - For example, folders, categories, colour, flagging, and time stamping

Cognitive Process: Learning

- Involves the accumulation of skills and knowledge involving memory
- Two main types:
  - Incidental learning (for example, recognizing people's faces, what you did today)
  - Intentional learning (for instance, studying for an exam, learning to cook)
  - Intentional learning is much harder!
  - Many technologies have been developed to help (for example, multimedia, animations, VR)
- People find it hard to learn by following instructions in a manual
- People prefer to learn by doing

Design Implications for Learning

- Design interfaces that encourage exploration
- Design interfaces that constrain and guide learners
- Dynamically linking concepts and representations can facilitate the learning of complex material

Cognitive Process: Reading, Speaking and Learning

- The ease with which people can read, listen, or speak differs:
  - Many prefer listening to reading
  - Reading can be quicker than speaking or listening
  - Listening requires less cognitive effort than reading or speaking
  - Dyslexics have difficulties understanding and recognizing written words

Reading, Speaking and Learning Applications

- Voice user interfaces allow users to interact with them by asking questions
  - e.g. Google Voice, Siri, Alexa
- Speech-output systems use artificially-generated speech
  - e.g. written text-to-speech systems for the visually impaired
- Natural-language systems enable users to type in questions and give text-based responses
  - e.g. chatbots

Design Implications for Reading, Speaking and Learning

- Speech-based menus and instructions should be short
- Accentuate the intonation of artificially generated speech voices
  - They are harder to understand than human voices
- Provide opportunities for making text large on a screen

Cognitive Process: Problem-solving, Planning, Reasoning and Decision-making

- All these processes involve *reflective* cognition
  - For example, thinking about what to do, what the options are, and the consequences
- Often involves conscious processes, discussion with others (or oneself), and the use of artifacts
  - Such as maps, books, pen and paper
- May involve working through different scenarios and deciding which is best option
- Weighing up alternatives

Design Implications for Problem-solving, Planning, Reasoning and Decision-making

- Provide information and help pages that are easy to access for people who wish to understand more about how to carry out an activity more effectively (for example, web searching)

- Use simple and memorable functions to support rapid decision-making and planning

Dilemma

- The app mentality is making it worse for people to make their own decisions because they are becoming risk averse (Gardner and Davis, 2013)
  - Instead, they now rely on a multitude of apps
  - This makes them increasingly anxious
  - They are unable to make decisions by themselves
  - They need to resort to looking up info, getting other's opinions on social media, and comparing notes
- Do you agree?
- Did it happen to you when deciding which university/school to attend?

COGNITIVE FRAMEWORKS

Cognitive Frameworks

- These are used to explain and predict user behaviour at the interface
  - Based on theories of behaviour
  - Focus is on mental processes that take place
  - Also use of artifacts and representations

- Most well known are:
  - Mental models
  - Gulfs of execution and evaluation
  - Distributed cognition
  - External and embodied cognition

Mental Models

- People develop an understanding of a system through learning about and using it
- This knowledge is sometimes 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

More on 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
  - Imagery and analogies are activated

- Deep versus shallow models
  - For example, how to drive a car and how it works

Everyday Reasoning and Mental Models

- You arrive home on a hot afternoon, and your house feels like an oven. Do you set the air conditioner to the lowest temperature (e.g., 16°C) thinking it will cool the room faster, or do you set it to a comfortable temperature (e.g., 24°C)?

- You want to iron your clothes quickly before going out. The iron's instructions suggest setting it to medium heat for your fabric type, but you turn it to the highest heat instead, thinking it will remove wrinkles faster.

Reasoning

- Many people when asked (a) choose the first option
- Why?
  - They think it will cool the room up quicker
  - General valve theory, where ‘more is more’ principle is generalised to different settings (for instance, gas pedal, gas cooker, tap, radio volume)
  - But it is a wrong mental model for thermostats based on on-off switch model
- Many people when asked (b) choose the first option
  - Iron work on the same principle as thermostats
- Most of us have erroneous mental models (Kempton, 1996)

Erroneous Mental Models

- Lots of people hit the button for elevators and pedestrian crossings at least twice
  - Why? Think it will make the lights change faster or ensure that the elevator arrives!

- What kinds of mental models do users have for understanding how interactive devices work?
  - Poor, often incomplete, easily confusable, based on inappropriate analogies and superstition (Norman, 1983)

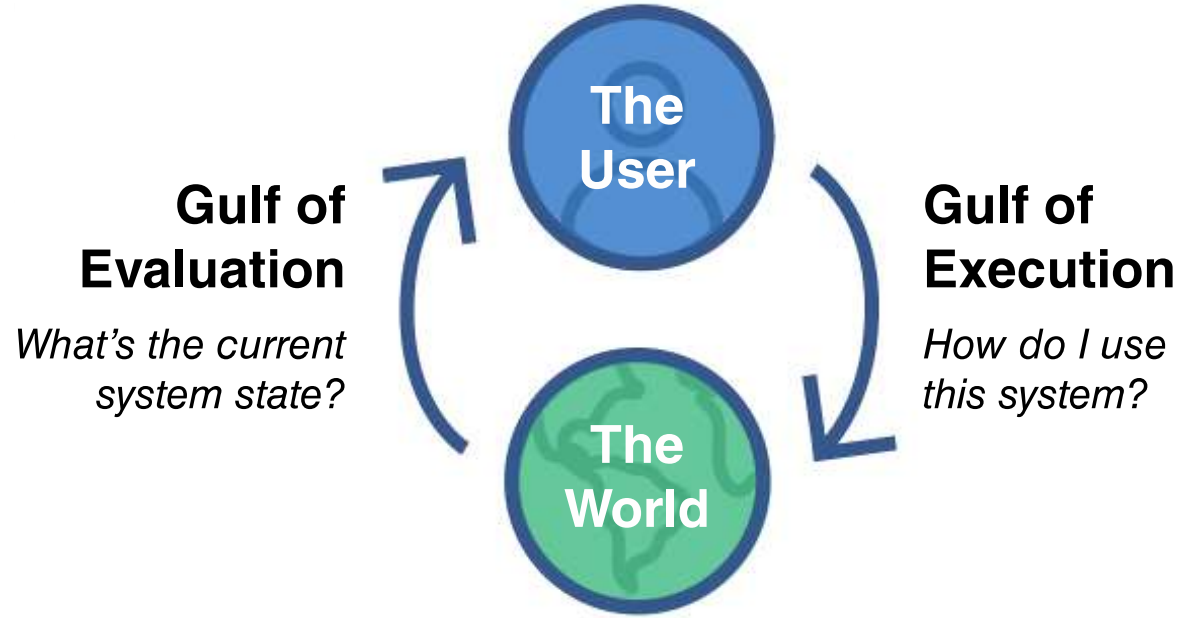
How can UX be designed to help people build better mental models?

- Clear and easy to use instructions
- Appropriate tutorials and contextual sensitive guidance
- Provide online videos and chatbot windows when needing help
- Transparency: to make interfaces intuitive to use
- Affordances of what actions an interface allows
  - For example, swiping, clicking, or selecting

Gulfs of Execution and Evaluation

- The ‘gulfs’ explicate the gaps that exist between the user and the interface
- The gulf of execution
  - The distance from the user to the physical system
- The gulf of evaluation
  - The distance from the physical system to the user
- Bridging the gulfs can reduce cognitive effort required to perform tasks
- Can reveal whether interface increases or decreases cognitive load and whether it is obvious what to do next (Norman, 1986; Hutchins et al, 1986)

Bridging the Gulfs

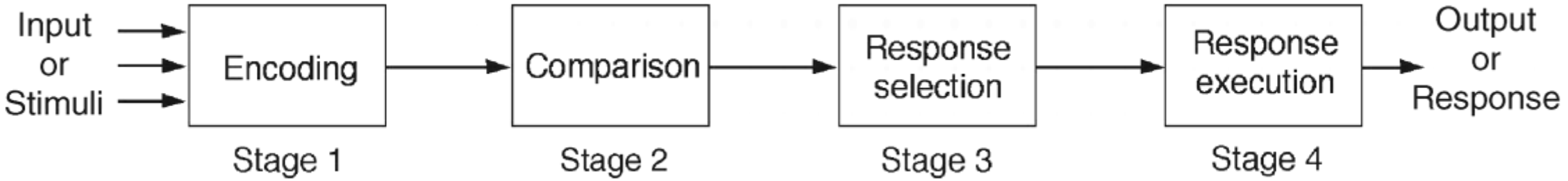


The notions of gulfs provided a discourse to explore potential mappings and mismatches between how a system was designed to work and how a person understands how to do a task using it

Source: www.nngroup.com/articles/two-ux-gulfs-evaluation-execution.
Used courtesy of the Nielsen Norman Group

Information Processing

- Conceptualises human performance in metaphorical terms of information processing stages



Source: P. Barber (1998). Applied Cognitive Psychology. London: Methuen. Used courtesy of Taylor & Francis

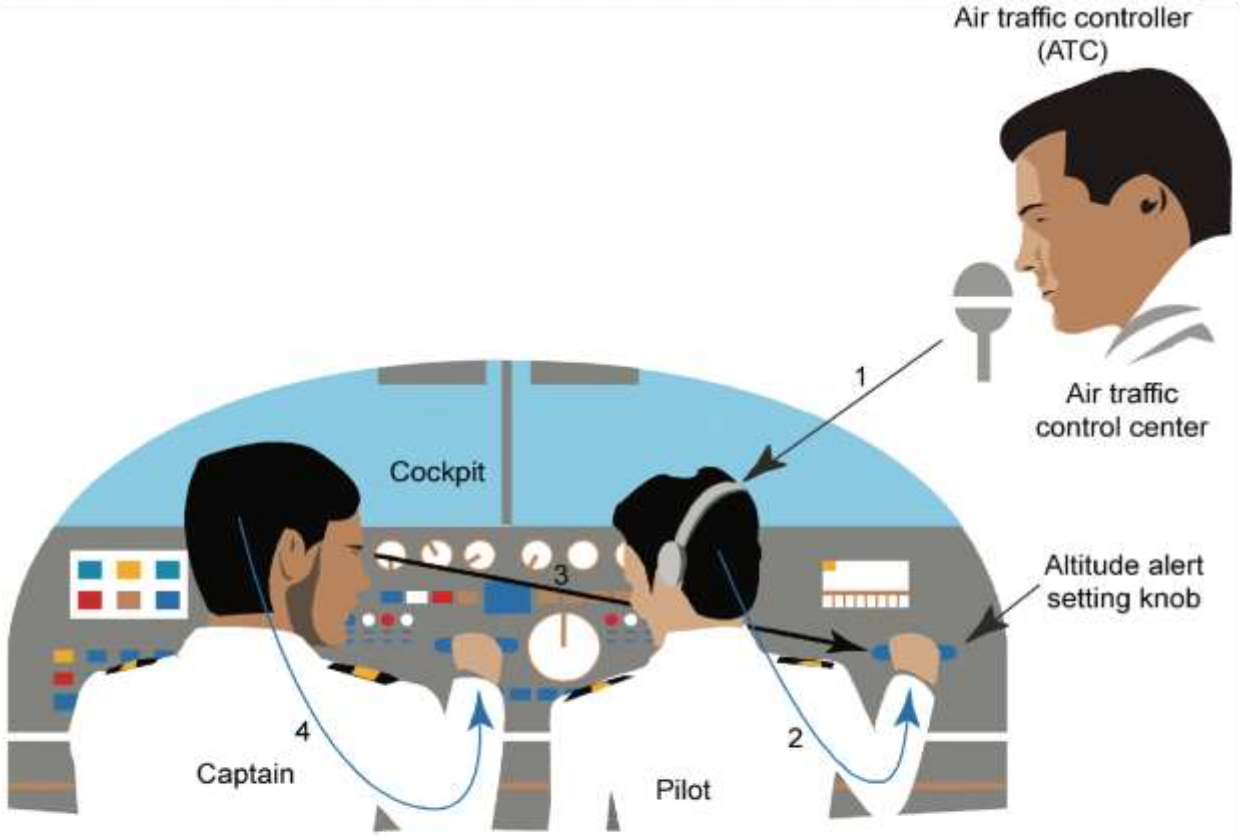
Limitations

- Based on modelling mental activities that happen exclusively inside the head
- Do not adequately account for how people interact with computers and other devices in real world
- Nowadays the model is rarely used as other models have superseded it
- Instead, a move towards understanding cognitive activities in the context in which they occur and analysing how we interact with technologies in the wild

Distributed Cognition

- 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)

A Cognitive System for ATC



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)

A cognitive system in which information is propagated through different media

What's Involved during ATC

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

External Cognition

- Concerned with explaining how we interact with external representations (such as maps, notes, and diagrams)
- What are the cognitive benefits and what processes involved
- How they extend cognition
- What technologies can we develop to help people carry out complex tasks (for example, learning, problem solving, and decision-making)?

Cognitive Offloading

- Common strategy to prevent forgetting and to avoid the effort of remembering
  - Examples include the use of diaries, reminders, calendars, notes, shopping lists, to-do lists, post-its, piles, marked emails
- External representations:
  - Remind us that we need to do something (for example, to buy something for mother's day)
  - Remind us of what to do (for instance, buy a card)
  - Remind us when to do something (for example, send a card by a certain date)
- An obvious area where technology can be designed to help remind us

Computational Offloading

- When a tool is used in conjunction with an external representation to carry out a computation (for instance, pen and paper)
- Try doing the two sums below (a) in your head, (b) on a piece of paper, and (c) with a calculator.

234 ×456 = ??

CCXXXIIII×CCCCXXXXXVI = ???

- Which is easiest and why? Both are identical sums

Annotation and Cognitive Tracing

- Annotation involves modifying existing representations through making marks
  - For example, crossing off, ticking, and underlining

- Cognitive tracing involves externally manipulating items into different orders or structures
  - For instance, playing Scrabble or cards

Design Implication

- Provide external representations at the interface that can reduce memory load and facilitate computational offloading
  - For example, information visualizations have been designed to allow people to make sense and rapid decisions about masses of data

Embodied Interaction

- The practical engagement with the social and physical environment (Dourish, 2001)
- Creating, manipulating and making meaning through our interaction with things
- How our bodies and active experiences shape how we perceive, feel, and think (Hornecker et al., 2017)
- They enable us to develop a sense of the world at both a concrete and abstract level
- Can provide new ideas about interaction and better design principles
    - For example, we think with our bodies not through them (Kirsh, 2013)

Summary

- Cognition involves many processes including attention, memory, perception, and learning
- The way an interface is designed can greatly affect how well people 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
- This can lead to thinking about how to design better products