User Interface Design

Lecture 2: Cognitive Aspects

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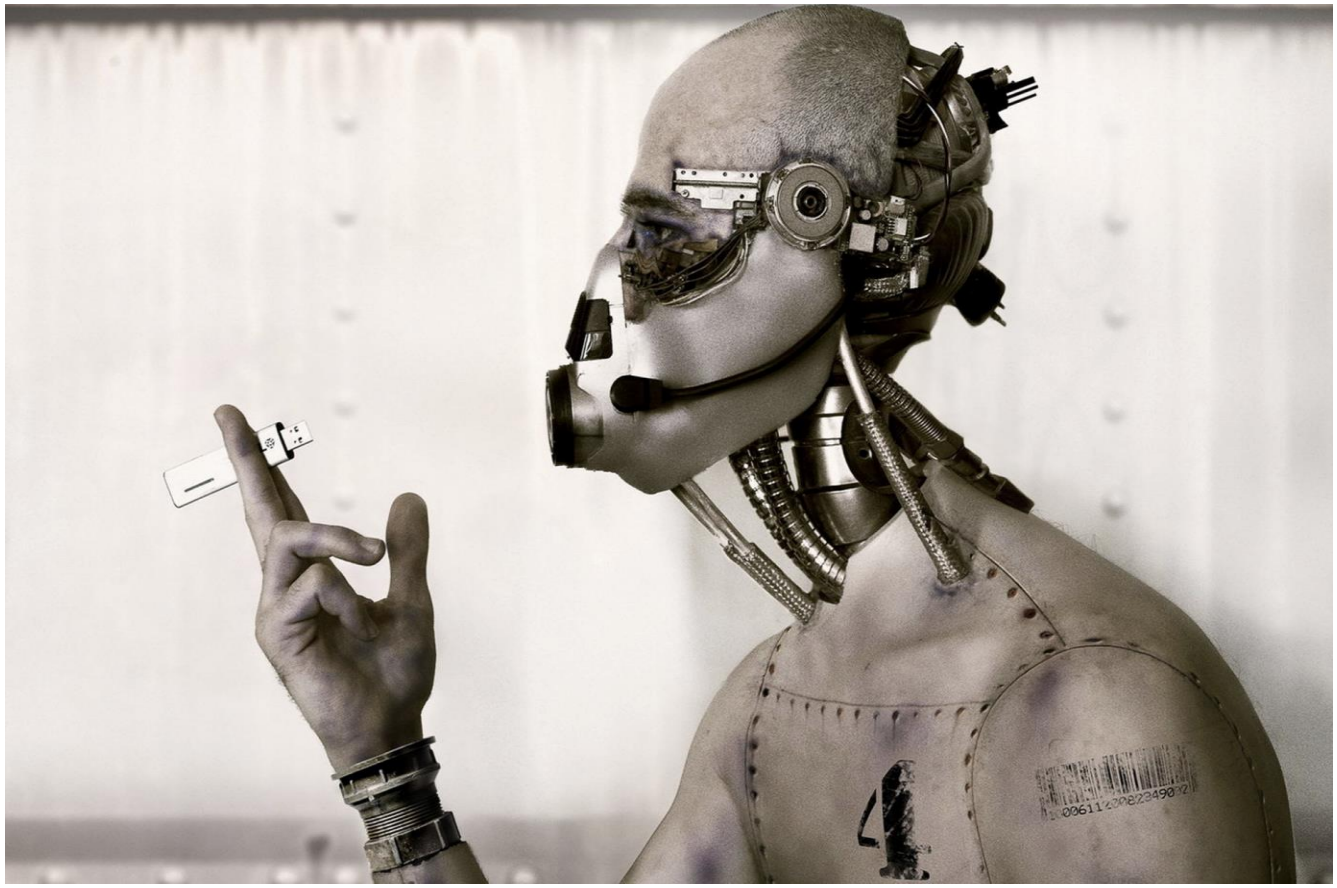
Learning Objectives

- Explain what cognition is and why it is important for interaction design.
- Discuss what attention is and its effects on our ability to multitask.
- Describe how memory can be enhanced through technology aids.

To understand human–computer interaction

… we need to understand humans first



Why do we need to understand users?

- Interacting with technology is cognitive
- Need to take into account cognitive processes involved and cognitive limitations of users
- Provides knowledge about what users can and cannot be expected to do
- Identifies and explains the nature and causes of problems users encounter

Cognitive processes

- Attention
- Perception
- Memory
- Learning
- Reading, speaking and listening

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 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

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

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

Activity

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

Design implications for attention

- Make information salient when it needs attending to
- Use techniques that make things stand out like color, ordering, spacing, underlining, sequencing and animation
- Avoid cluttering the interface with too much information
- Search engines and form fill-ins that have simple and clean interfaces are easier to use

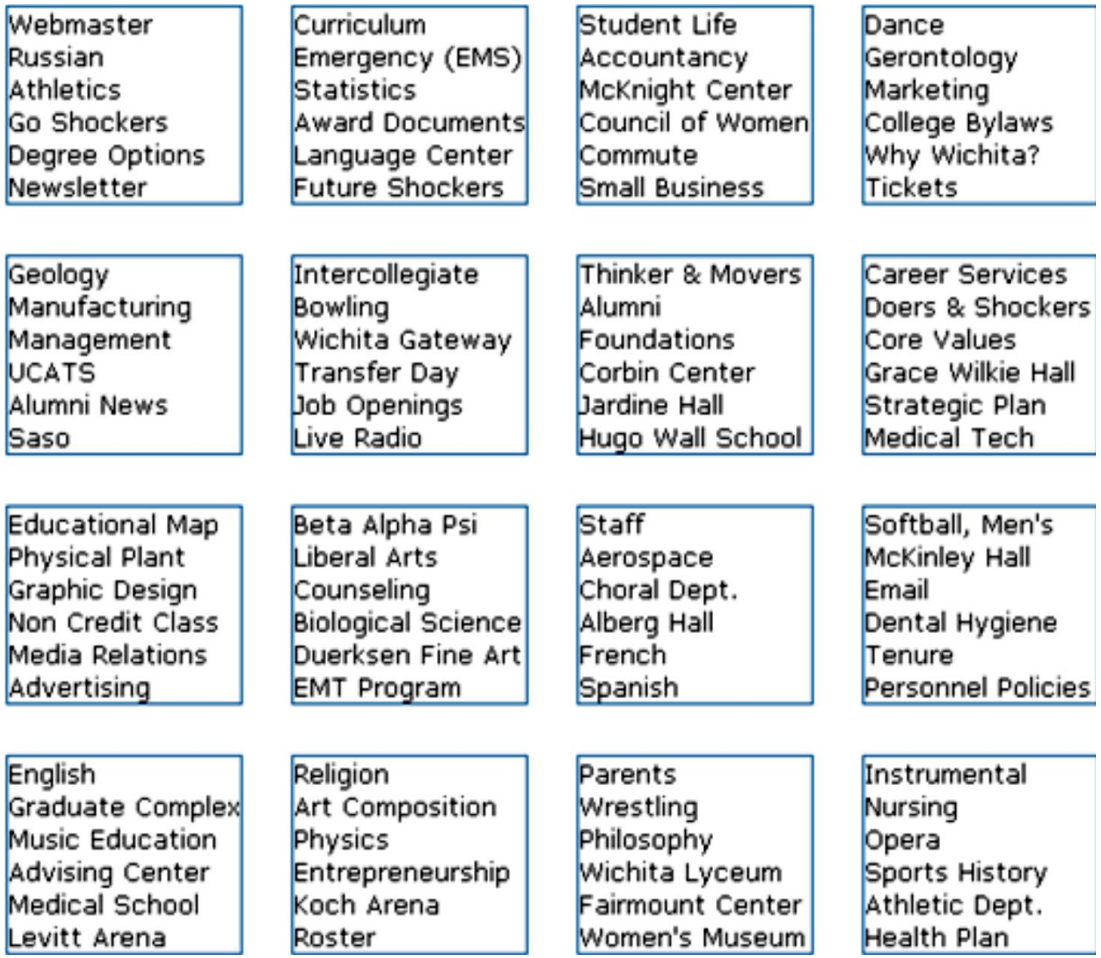
Perception

- 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

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



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
  - Makes it hard to find information
- Do you agree?

Design implications

- Icons 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
- Tactile feedback should allow users to recognize and distinguish different meanings

Human Memory

"Memory refers to the processes that are used to acquire, store, retain and later retrieve information."

- There are three major processes involved in memory: encoding, storage, and retrieval.

- In order to form new memories, information must be changed into a usable form, which occurs through the process known as encoding.

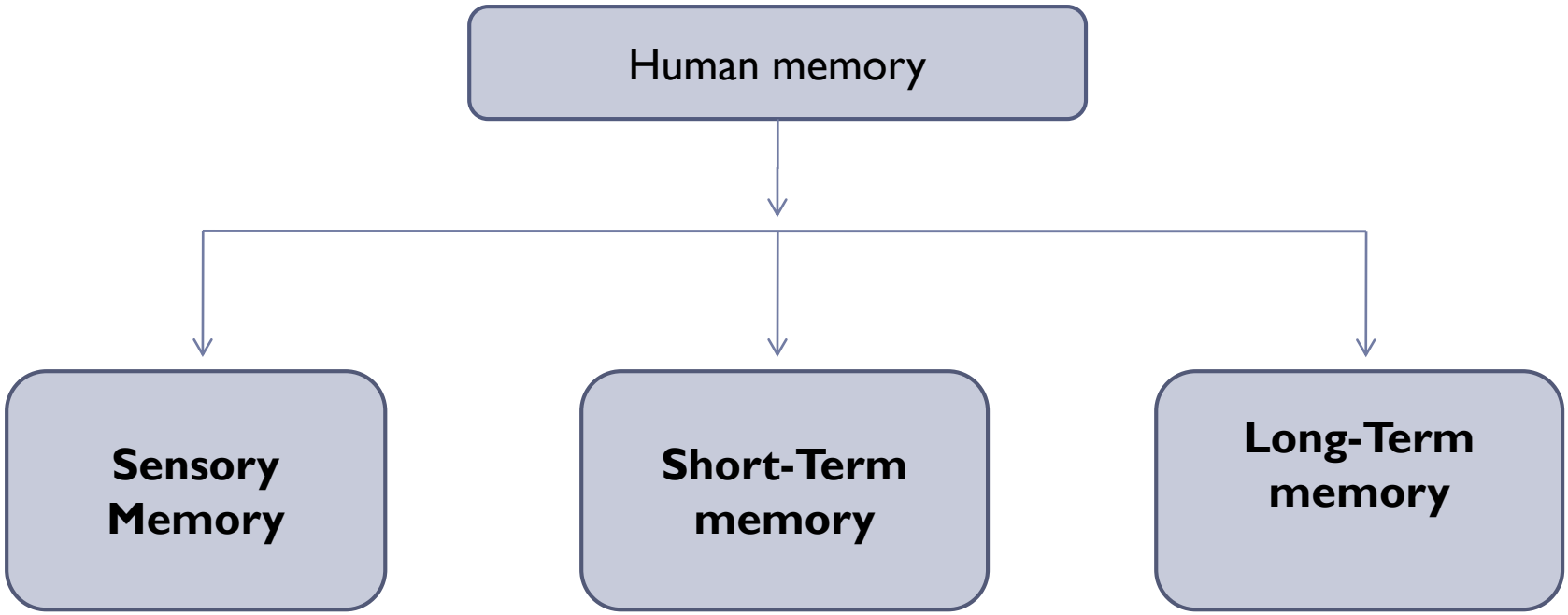
Human Memory

- Once information has been successfully encoded, it must be stored in memory for later use.

- The retrieval process allows us to bring stored memories into conscious awareness.

Human Memory

- There are three types of memory or memory function:



Human Memory

1. **Sensory Memory :**

Sensory memory is the earliest stage of memory. During this stage, sensory information from the environment is stored for a very brief period of time, generally for no longer than a half-second for visual information and 3 or 4 seconds for auditory information.

Human Memory

2. **Short-Time Memory :**

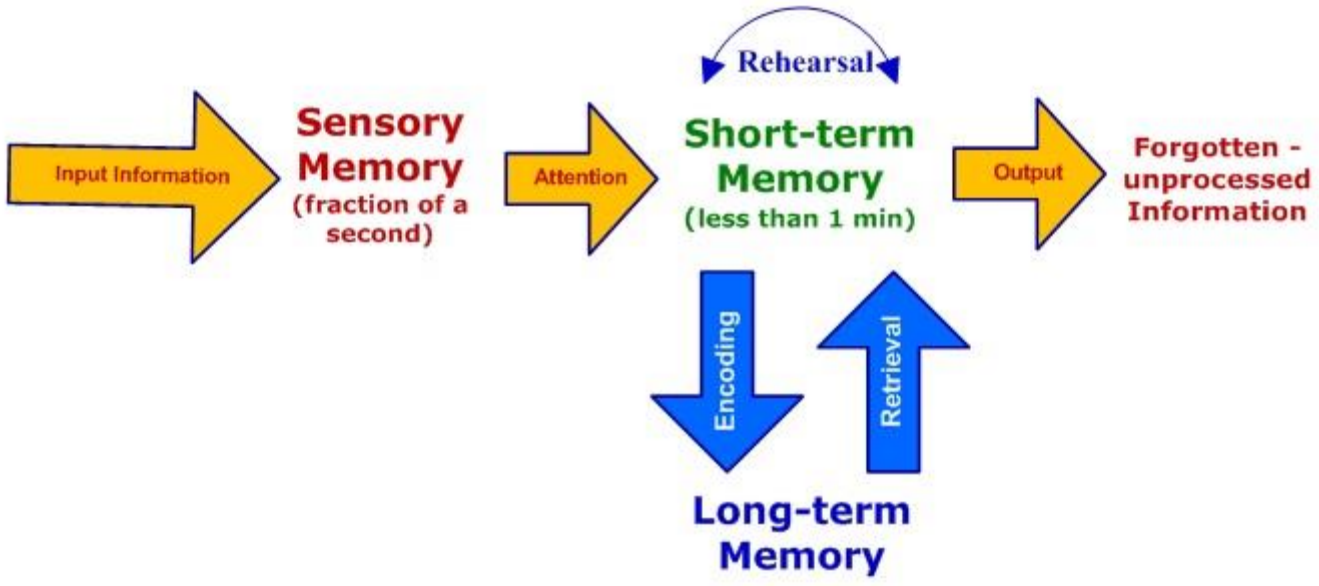
- Short-time memory, also known as active memory, is the information we are currently aware of or thinking about.
- Most of the information stored in active memory will be kept for approximately 20 to 30 seconds.
- Distraction erases short-term memory.
- Short-term memory capacity reduced 4% to 28% as people age. Especially for visually acquired information

Human Memory

3. **Long-Time Memory :**

- Long-time memory is intended for the long-term storage of information.
- Here we store factual information, experiential knowledge, procedural rules of behavior….
- Seemingly permanent and unlimited
- Access is harder and slower

Human Memory



Why we forgot?

- lack of use
- Interference.. similar things get in the way

Human Memory

- 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
- **Memory load**
  - Users perform tasks best when all required information fits in STM
  - accessing is fast
  - requires little work

Activity

- Try to remember the dates of your grandparents’ birthday
- Try to remember the cover of the last two DVDs you bought or rented
- Which was easiest? Why?
- People are very good at remembering visual cues about things
  - e.g. the color of items, the location of objects and marks on an object
- They find it more difficult to learn and remember arbitrary material
  - e.g. birthdays and phone numbers

Recognition versus recall

- **Recognition** is a response to a sensory cue. When you see something, you compare it to information stored in your memory, and if you find a match, you "recognize" it.

- **Recall** is the retrieval of information from memory without a cue. There is a question, and you must search your memory for the answer.

- We recognize things much better than being able to recall things

Recognition versus recall

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

The problem with the classic ‘7±2’

- George Miller’s (1956) theory of how much information people can remember
- People’s immediate memory capacity is very limited
- Many designers think this is useful finding for interaction design
- But…

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 for 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
- But depends on task and available screen estate

Design implications

- **How can we help users?**

1. Don't overload users memories with complicated procedures for carrying out tasks.

- 2. Help users stay concentrated by reducing distractors.

Design implications

3. Good interfaces promote recognition rather than recall by using menus, icons and consistently placed objects

4. Provide users with various ways of encoding information to help them remember

- e.g. categories, color, flagging, time stamping

Learning

- How to learn to use a computer-based application
- Using a computer-based application or YouTube video to understand a given topic
- People find it hard to learn by following instructions in a manual
  - prefer to learn by doing

Cognitive prosthetic devices

- We rely more and more on the internet and smartphones to look things up
- Cognitive resource cf. extended mind
- Expecting to have internet access reduces the need and extent to which we remember
- Also enhances our memory for knowing where to find it online (Sparrow et al,2011)
- What are implications for designing technologies to support *how* people will learn, and *what* they learn?

Design implications

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

Reading, speaking, and listening

- 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
  - Humans can read 200 words per minute on paper, and 180 words per minute on the screen. Reading is slower on the screen.
  - We frequently misremember visual information

https://www.youtube.com/watch?v=FWSxSQsspiQ&feature=player_embedded

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Design implications

- 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
- Avoid cluttering interface with too much information

Individual Differences

- All the points that we discussed apply to the majority of people.
- We should be aware of individual differences so that we can account for them as far as possible within our designs.
- These differences may be long term, such as sex, physical capabilities and intellectual capabilities. Others are shorter term and include the effect of stress or fatigue on the user.