HUMAN - COMPUTER INTERACTION

CT273

Chapter 3: Cognitive Psychology in HCI

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Content

- What is Cognition

- The Core Cognitive Processes

What is Cognition

- There are many different kinds of cognition, such as *thinking*, *remembering*, *learning*, *daydreaming*, *decision making*, *seeing*, *reading*, *writing*, and *talking*.

- Norman (1993) distinguishes between two general modes: *experiential cognition* and *reflective cognition*.

- **Experiential cognition** is a state of mind in which we perceive, act, and react to events around us intuitively and effortlessly.

- **Reflective cognition** involves mental effort, attention, judgment and decision making.

(Preece, Sharp and Rogers, 2015)

The Core Cognitive Processes

- The core cognitive processes include:
  - Attention
  - Perception
  - Memory
  - Learning
  - Reading, Speaking and Listening
  - Problem Solving, Planning, Reasoning and Decision Making

Attention

- *Attention*

  - is the process of selecting things to concentrate on, at a point in time, from the range of possibilities available

  - allows us to focus on information that is relevant to what we are doing

  - involves auditory and/or visual senses

  (Preece, Sharp and Rogers, 2015)

Attention

South Carolina

City	Motel/Hotel	Area code	Phone	Rates Single	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

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

Which one is easier to find information?

(Preece, Sharp and Rogers, 2015)

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Attention

- Design implications for *attention*:

  - Make information salient when it needs attending to

  - Use techniques like animated graphics, color, underlining, ordering, sequencing and spacing

  - Avoid cluttering the interface with too much information

  - Search engines and form fill-ins that have simple and clean interfaces are easier to use

    (Preece, Sharp and Rogers, 2015)

Perception

- *Perception* refers to how information is acquired from the environment via the different sense organs – eyes, ears, fingers – and transformed into experiences of objects, events, sounds, and tastes.

  (Roth, 1986)

- **Human senses**: sight, hearing, touch, taste and smell

Perception

Black Hills Forest Cheyenne River Social Science South San Jose Badlands Park Juvenile Justice	Peters Landing Public Health San Bernardino Moreno Valley Altamonte Springs Peach Tree City	Jefferson Farms Psychophysics Political Science Game Schedule South Addision Cherry Hills Village	Devlin Hall Positions Hubard Hall Fernadino Beach Council Bluffs Classical Lit		Webmaster Russian Athletics Go Shockers Degree Options Newsletter	Curriculum Emergency (EMS) Statistics Award Documents Language Center Future Shockers	Student Life Accountancy Mc Knight Center Council of Women Commute Small Business	Dance Gerontloge Marketing College Bylaws Why Wichita? Tickets
Results and Stats Thousand Oaks Promotions North Palermo Credit Union Wilner Hall	Highland Park Machesney Park Vallecito Mts. Rock Falls Freeport Slaughter Beach	Creative Writing Lake Havasu City Engineering Bldg Sports Studies Lakewood Village Rock Island	Sociology Greek Wallace Hall Concert Tickets Public Radio FM Children's Museum		Gelogy Manufacturing Management UCATS Alumni News Saso	Intercollegiate Bowling Wichita Gateway Transfer Day Job Openings Live Radio	Thinker & Movers Alumni Foundations Corbin Center Jardine Hall Hugo Wall School	Career Services Doers & Shockers Core Values Grace Wilkie Hall Strategic Plan Medical Tech
Performing Arts Italian Coaches Mckees Rocks Glenwood Springs Urban Affairs	Rocky Mountains Latin Pleasant Hills Observatory Public Affairs Heskett Center	Deerfield Beach Arlington Hill Preview Game Richland Hills Experts Guids Neff Hall	Writing Center Theater Auditions Delaware City Scholarships Hendricksville Knights Landing		Educational Map Physical Plant Graphic Design Non Credit Class Media Relations Advertising	Beta Alpha Psi Liberal Arts Counseling Biological Science Duerksen Fine Art EMT Program	Staff Aerospace Choral Dept. Alberg Hall French Spanish	Softball, Men's McKinley Hall Email Dental Hygiene Tenure Personnel Policies
McLeansboro Experimental Links Graduation Emory Lindquist Clinton Hall San Luis Obispo	Brunswick East Millinocket Women's Studies Vacant News Theatre Candlewood Isle	Grand Wash Cliffs Indian Well Valley Online Courses Lindquist Hall Fisk Hall Los Padres Forest	Modern Literature Studio Arts Hugher Complex Cumberland Flats Central Village Hoffman Estates		English Graduate Complex Music Education Advising Center Medical School Levitt Arena	Religion Art Composition Physics Entrepreneurship Koch Arena Roster	Parents Wrestling Philosopy Wichita Lyceum Fairmount Center Women's Museum	Instrmental Nrsing Opera Sports History Athletic Dept. Health Plan

Which one is easier to find information?

(Preece, Sharp and Rogers, 2015)

Perception

- Design implications for *perception*:

  - Representations of information need to be designed to be perceptible and recognizable

  - 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

  - Text should be legible and distinguishable from the background

(Preece, Sharp and Rogers, 2015)

Memory

- *Memory* involves recalling various kinds of knowledge that allow us to act appropriately.

  (Preece, Sharp and Rogers, 2015)

- *Memory* is usually divided into a set of memory processes and a number of different types of memory store.

- The three main memory stores:

  - Sensory stores

  - Working memory

  - Long-term memory

  (Benyon, 2014)

Sensory Stores

- Main components
  - **The iconic store** (visual)
  - **The echoic store** (auditory)

  They are temporary stores where information is held before it enters working memory

- Key associated processes
  - The contents of these stores are transferred to working memory within a fraction of a second

(Benyon, 2014)

Working Memory

- Main components
  - **The central executive**: involving in decision making
  - **The articulatory loop**: holding auditory information
  - **The visuo-spatial sketchpad**: holding visual information

- Key associated processes
  - **Rehearsal**: the process of refreshing the contents of working memory (e.g. repeating aloud a phone number)
  - **Displacement**: the process by which the current contents of working memory are pushed out by new material

(Benyon, 2014)

- The capacity of working memory itself is approximately three or four items where an item may be a word or a phrase or an image.

(MacGregor, 1987; LeCompte, 1999)

Long-term Memory

- Main components

  - **Semantic memory**: holding information related to meaning

  - **Procedural memory**: storing our knowledge of how to do things like typing or driving

  - **Episodic** and/or **autobiographical memory**: relating to memories personal to an individual like memories of birthdays

  - **Permastore** (Bahrick, 1984): storing the things you never forget.

  (Benyon, 2014)

Long-term Memory

- Key associated processes
  - **Encoding**: the process by which information is stored in memory.
  - **Retrieval**: the process by which memories are recovered from long-term storage.
  - **Forgetting**: the name of a number of different possible processes by which we fail to recover information.

  (Benyon, 2014)

Recall and Recognition

- Being able to retrieve stored information by way of *recall* and/or *recognition*.

  - **Recall** is the process whereby individuals actively search their memories to retrieve a particular piece of information.

  - **Recognition** involves searching our memory and then deciding whether the piece of information matches what we have in our memory stores.

- *Recognition* is generally easier and quicker than *recall*.

(Benyon, 2014)

Design Implications for Memory

- Do not overload users' memories with complicated procedures for carrying out tasks.
- Design interfaces that promote recognition rather than recall by using menus, icons, and consistently placed objects.
- Provide users with a variety of ways of encoding digital information to help them access them again easily, through the use of categories, color, tagging, time stamping, icons...

(Preece, Sharp and Rogers, 2015)

Learning

- People much prefer *learning through doing* instead of learning by following a set of instructions in a manual

- GUIs and direct manipulation interfaces are good environments to support *learning through doing* by

  - supporting exploratory interaction

  - allowing users to undo their actions

(Preece, Sharp and Rogers, 2015)

Learning

- Design implications for *learning*:

  - Design interfaces that encourage exploration.

  - Design interfaces that constrain and guide users to select appropriate actions when initially learning.

    (Preece, Sharp and Rogers, 2015)

Reading, Speaking and Listening

- *Reading*, *speaking* and *listening* are three forms of language processing that have similar and different properties.

- **Similarity**: The meaning of sentences or phrases is the same regardless of the mode in which it is conveyed

- **Differences**:
    - Written language is permanent while listening is transient.
    - Reading can be quicker than speaking or listening.
    - Listening requires less cognitive effort than reading or speaking.
    - Written language tends to be grammatical while spoken language is often ungrammatical.

(Preece, Sharp and Rogers, 2015)

Reading, Speaking and Listening

- Design implications for *reading*, *speaking* and *listening*:
    - Keep the length of speech-based menus and instructions to a minimum
    - Accentuate the intonation of artificially generated speech voices
    - Provide opportunities for making text large on a screen without affecting the formatting

    (Preece, Sharp and Rogers, 2015)

Problem Solving, Planning, Reasoning and Decision Making

- *Problem solving*, *planning*, *reasoning* and *decision making* include

  - thinking about what to do

  - what the options are

  - what the consequences might be of carrying out a given action

- They often involve

  - conscious processes (being aware of what one is thinking about)

  - discussion with others or oneself

  - the use of various kinds of artifacts (e.g. maps, books, pen and paper)

(Preece, Sharp and Rogers, 2015)

Problem Solving, Planning, Reasoning and Decision Making

- Design implications for *problem solving*, *planning*, *reasoning* and *decision making*

  - Provide additional hidden information that is easy to access for users who wish to understand more about how to carry out an activity more effectively (e.g. web searching).

  - Use simple and memorable functions at the interface for computational aids intended to support rapid decision making and planning that takes place while on the move.

(Preece, Sharp and Rogers, 2015)

Summary

- Cognition comprises many processes, including attention, perception, memory, learning, reading, speaking and listening, problem solving, planning, reasoning and decision making.

- The way an interface is designed can greatly affect how well people can perceive, attend, learn, and remember how to carry out their tasks.

Additional resources

- Designing Interactive Systems: A comprehensive guide to HCI, UX and interaction design, 3rd Edition (David Benyon, 2014)

- Interaction Design: Beyond Human-Computer Interaction, 4th Edition (Jennifer Preece, Helen Sharp, Yvonne Rogers, 2015)