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

- 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 usto focus on information that isrelevant to what we are

  doing ▪ involves auditory and/or visualsenses

  (Preece, Sharp and Rogers, 2015)

Attention

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

Which one is easier to find information?

(Preece, Sharp and Rogers, 2015)

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

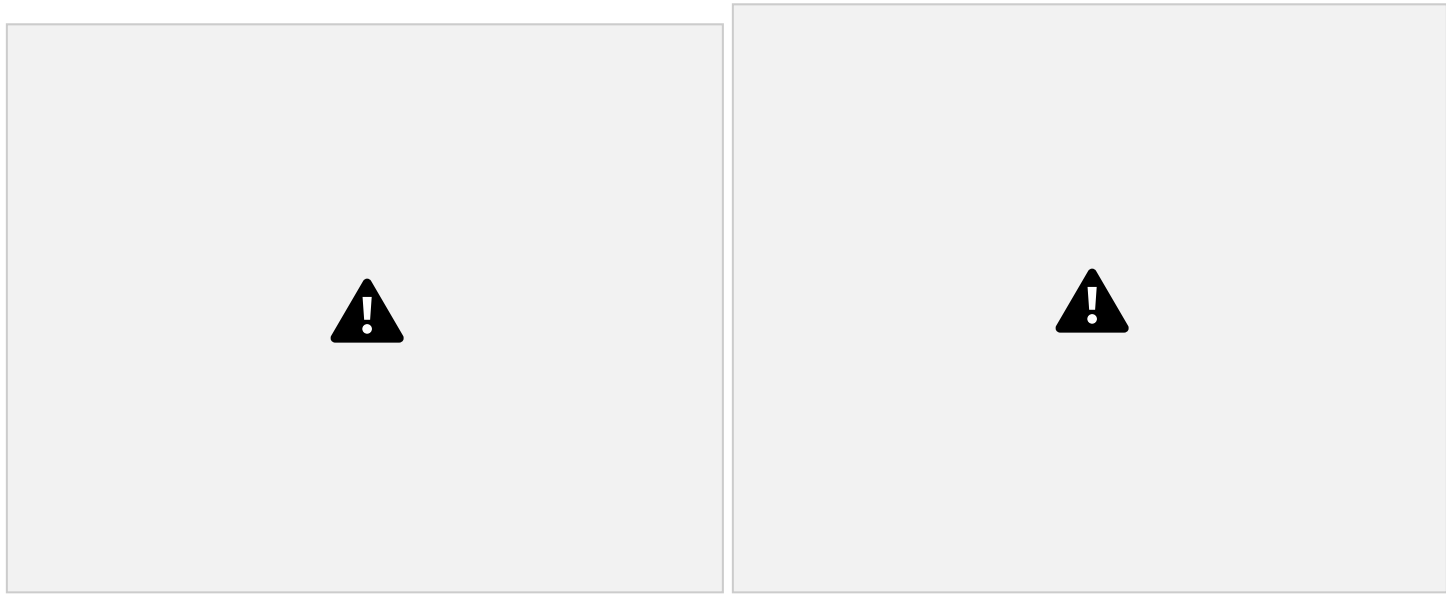 (Preece, Sharp and Rogers, 2015)

⚠ 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

Which one is easier to perceive and locate items when grouping 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 ▪ Soundsshould be audible and distinguishable

    - Textshould 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

⚠ 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

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 isstored 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 instructionsin a manual

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

  - supporting exploratory interaction

  - allowing usersto 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 orspeaking.

  - Written language tends to be grammatical while spoken language is often ungrammatical.

(Preece, Sharp and Rogers, 2015)

⚠️

Reading, Speaking

and Listening

- Design implicationsfor*reading*,*speaking* and *listening*:
  - Keep the length ofspeech-based menus and instructionsto 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 isthinking 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.

Additionalresources

- 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)