CMPT 363: User Interface Design
Summer 2021

Week 8: Cognition & Graphical Screen Design

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Recap from Last Lecture

- Cognition – the process by which knowledge & understanding is developed in the mind
  - Allow us to understand how human minds work and thus design interfaces that facilitate those activities
  - Ways to describe them – by state of mind, by context, by kinds of process
  - Design implications for cognition processes – attention, perception, memory

Today

- Cognition – the process by which knowledge & understanding is developed in the mind
  - Design implications for cognition processes – learning, reading, speaking, & listening, problem-solving, planning, reasoning, & decision-making
- Cognitive frameworks
  - Distributed cognition
  - External cognition
  - Embodied interaction

Cognitive by Specific Kinds of Process

Cont'd from last lecture

Learning

- Refers to the process of acquiring skills & knowledge, in computer interfaces, it can refer to:
  - how to use the application/system (e.g., how to use Word to write a report)
  - the subject matter through the application/system (e.g., learn about spelling by using an educational app)
- Typically hard by just following a set of instructions
  - Most people prefer learning through doing
    - Scaffolded learning – start simple and build up
  - Other techniques like cultural conventions & observing others also help

Using Technologies to Aid Learning

- Enrich ways for using the interface
  - GUIs & direct manipulation promote discovering and understanding the interface
  - Design principles and heuristics help guiding users to use the interface properly
- Make use of interactivity to provide alternative ways to represent and interact with information
  - web-based learning that allows interaction with the content
  - multimedia like animations, videos, sound
  - simulation of abstract concepts (e.g., laws of physics)
  - combination of various representations for a concept

Design Implications for Learning

- Design interfaces that encourage exploration
- Design interfaces that constrain & guide users to select appropriate actions when initially learning
  - and provide alternatives/shortcuts when they become experts
- Dynamically link concrete representations and abstract concepts to facilitate learning of complex material

Reading, Speaking, and Listening

- Refers to the processing of language
  - similar in meaning
  - different in modes of delivery
    - written languages is permanent while spoken/listened languages are transient
    - written languages can be consumed quicker
    - listening requires less cognitive effort
    - written languages tend to be grammatical and often in complete format
    - impacted by different cognitive disorders (e.g., dyslexia) or disabilities (e.g., audio impairment)

Using Technologies to Aid Reading, Speaking, and Listening

- Combine different modes of delivery to suit different needs
- Support speech as a mode of interaction for transient, in-the-moment activities
- Provide cognitive aids for people who have difficulties with reading, writing, and/or speaking
- Provide ways for people with disabilities to interact with computers

Design Implications for Reading, Speaking, and Listening

- Keep length of speech-based menus & instructions to minimum (typically up to 3-4 options)
  - For example, in a phone-in interface break down options into menus & sub-menus
- Accentuate the intonation of computer-generated speech
- Provide ways to customize display of information
  - For example, allow users to change the text size, contrast, and view modes

Problem Solving, Planning, Reasoning, and Decision Making

- Refer to the processing of thought & reflection
  - depends on the person's level of experience with a domain, application, or skill
    - novices tend to be slower, error-prone, irrational
    - experts tend to be efficient, accurate, able to think ahead
  - affected by the amount of information presented, use different strategies
    - exhaustively process all information and make trade-offs between options
    - apply simple heuristics (make "good enough" decisions by gut feeling)

Design Implications for Problem Solving, Planning, Reasoning, and Decision Making

- Provide just enough information and in the right form to facilitate good decisions
  - E.g., step-by-step instructions, context-aware text/speech
- Hide additional information but provide easy access
  - E.g., tool-tips, collapsed text
- Provide defaults or frequently used functions for rapid decision making
  - E.g., pre-filled info boxes, related searches

Cognitive Frameworks

to explain and predict user behaviour

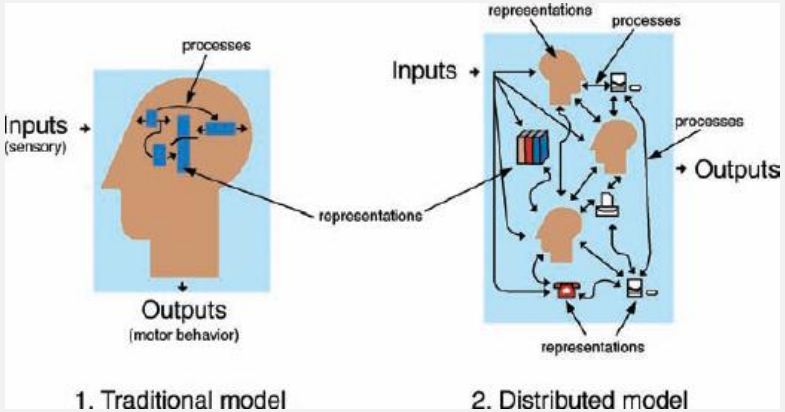
Distributed Cognition

- Knowledge and cognition is distributed across individuals, artifacts, and internal & external representations, connected through interactions amongst them and the environment they are in
  - Proposed by Edwin Hutchins at UCSD with his study in the work of a navigation team on a navy ship (Hutchins 1995)
    - The team used specialized tools and coordinated activity to accomplish more than could be done by anyone individually

Hutchins, E. (1995). Cognition in the wild / Edwin Hutchins. MIT Press.

Two Theoretical Principles in Distributed Cognition

- The boundary of cognition is not limited to the brain alone
  - Distributed Cognition looks for cognitive processes, wherever they may occur, on the basis of the functional relationships of elements that participate together in the process
- Cognitive events are not limited to memory processes
  - Distribution Cognition includes artifacts from the material world that helps memory and reorganizing the whole cognitive system



From ID-Book (3rd edition) Figure 3.11 Comparison of traditional and distributed cognition approaches

Three Kinds of Distribution

- Across individual and aspects of the material environment (material distribution)
  - E.g., doing multiplication on paper instead of just in the head
- Across multiple individuals interacting & communicated in an organized way (social distribution)
  - E.g., complex tasks distributed amongst individuals
- Across time, in that products of earlier cognitive processes change the nature of later cognitive tasks (temporal distribution)
  - E.g., writing things down in the past as records provides a basis for future decisions

Source: http://faculty.lawrence.edu/wp-content/uploads/sites/18/2015/11/DCog.pdf

Distributed Cognition – Example

- A distributed cognitive system as an airline cockpit (From ID-Book p128)
- Information of the activity is transformed through different media (over the radio, through the pilot, and via a change in the position of an instrument)

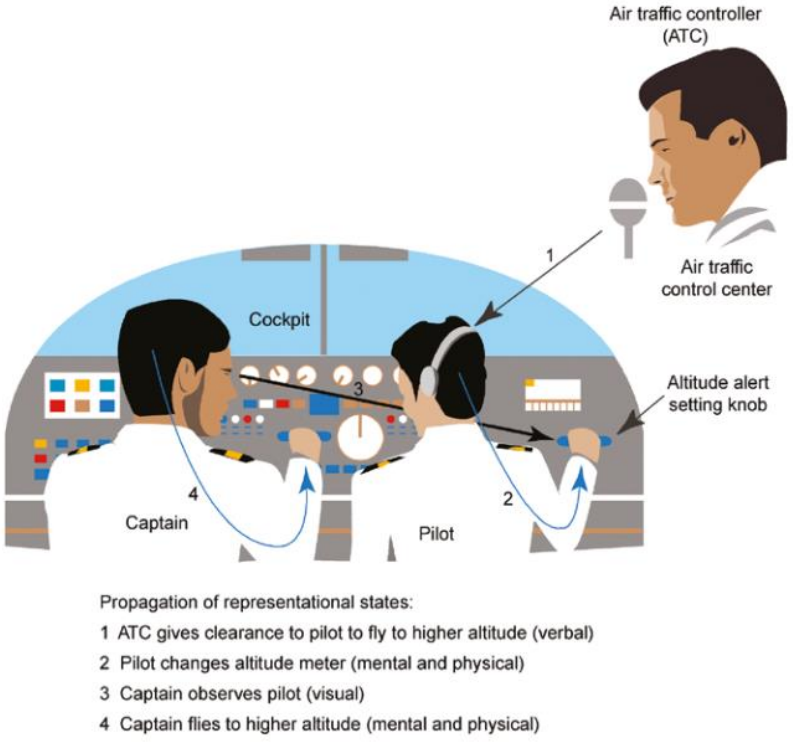
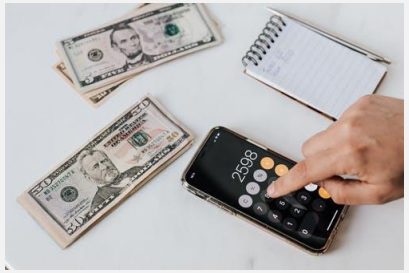


Figure 4.9 A cognitive system in which information is propagated through different media

External Cognition

- The use of external representations (e.g., diagrams, reminders) to help (or even enhance) cognition
  - Reduce memory load (use tools to remember things)
    - E.g., mark important dates on calendars, write down procedures/to-dos
  - Computational offloading (use tools to carry out mental activities)
    - E.g., use pen & paper to do math, write marks to count things
  - Annotating and Cognitive Tracing (modify representations to reflect changes or give structures)
    - E.g., cross things off a to-do list, organize cards to ease understanding



Embodied Interaction

- The interaction itself carries meaning
  - How content is created, manipulated, and shared affects the information it carries (i.e., embedded)
- Our bodies and active experiences shape how we perceive, feel, or think
  - Different people sense things different with different emotions attached, thus process things differently
  - The way we use our body to interact with the system affects how we perceive the system

Implications of Other Cognitive Frameworks

- Understand how users perform mental activities with others and the environment allows better design of technologies and interfaces
  - Not just an individual
  - How interaction affect cognitive process
  - How artifacts change over time
- Can help to explain phenomenon where something "doesn't feel right"

Summary

- Cognition
  - Design implications for cognitive process
    - attention, perception, memory, learning, reading, speaking, & listening, problem-solving, planning, reasoning, & decision-making
- Cognitive frameworks
  - Distributed cognition, external cognition, embodied interaction

Post-Lecture Activity

- Read/watch these (and those in the slides)
  - ID-Book Ch. 4
  - Shestopalov, S. Optical Effects in User Interfaces: An Illustrated Guide https://medium.muz.li/optical-effects-9fca82b4cd9a
  - Henry, D. UI Sound Design https://www.asoundeffect.com/ui-sound-design-henry-daw-small-sounds-make-big-difference/

- Exercise
  - There is a well-known phenomenon in cognitive science called "change blindness". Investigate what it is and explain how is it related to the topics we discuss in this week. How does it impact interface design?