CSC 484 Lecture Notes Week 4, Part 2
Understanding Users, Cognitively

I. **Relevant Reading** -- chapter 3 of the book.

II. **Applying cognitive understanding to interaction design.**

    A. *Cognition* is how people think.

    B. Understanding cognition can provide some useful guidelines for interaction design, e.g.,

        1. how to lay out an interface,

        2. how much to put in an interface,

        3. how to keep a user's attention while interacting.

    C. "Useful guideline" is an important characterization.

        1. There are very few "laws" of design that can be determined from understanding cognition.

        2. Cognition itself is an immensely complicated process, that we are only just beginning to understand.

    D. Designers must be aware that

        1. different types of people think in different ways;

        2. the same people think in different ways depending on the tasks they're performing;

        3. there are many aspects of cognition that are only weakly understood, and some aspects are not understood at all;

        4. cognitive theories are subject to change, as new experimental results are obtained.

    E. Hence, designers must always remember the golden rule -- *know thy users*.

        1. Cognitive theories can be quite helpful in many cases.

        2. However, particular users in particular domains may think quite differently than general cognitive theory suggests.

    F. What you should take away from this chapter.

        1. There is a lot of research available on many aspects of human cognition.

        2. If you are designing an interactive product where one or more cognitive aspects comes to the fore, look at what the literature says about that aspect.

        3. E.g., if your product requires that a user remember certain things in order to use the product effectively, then look to the research for guidance on how to design an interface that takes best advantage of what and how people remember.

III. **Introduction to Chapter 3 (Section 3.1).**

    A. This section outlines the aspects of cognition that are useful for interaction design.

    B. Understanding what people are good at and bad at can be particularly helpful.

        1. Technologies can be designed to *extend* capabilities for tasks people can do well.

        2. Complementarily, good designs can *compensate* for human weaknesses.

    C. The specific topics covered in the chapter are:

        1. an explanation of what cognition is;

        2. descriptions of the ways cognition can be applied to interaction design;

        3. examples of such application;

        4. explanation of *mental models*.

IV. **What is cognition? (Section 3.2)**

    A. It's what goes on in the "wetware".

    B. Donald Norman has identified two general modes:
        1. *experiential* -- doing things
        2. *reflective* -- thinking about things

    C. A more specific categorization of cognitive processes includes the following:
        1. ***attention*** -- selecting things to concentrate on
        2. ***perception and recognition*** -- acquiring information from the environment
        3. ***memory*** -- recalling knowledge to support action
        4. ***learning*** -- learning to use something, or using a tool to learn about something
        5. ***reading, speaking, listening*** -- using and processing language
        6. ***problem solving*** -- planning, reasoning, and deciding how to act

V. **Design implications related to attention (Page 98).**

    A. Organize information into categories, and provide distinguishable separation between the categories.

    B. Make information that requires attention prominent and noticeable.

    C. Avoid clutter.

    D. Use color and other forms of decoration to help focus attention, not just for eye candy.

    E. As always, keep it simple.

VI. **Design implications related to perception and recognition (Page 99).**

    A. Make display elements meaningful, and readily distinguishable from one another.

    B. As for attention, structure information into related categories, with recognizable separation.

    C. These guidelines apply to all forms of presentation, including graphical, textual, audio, and tactile.

VII. **Design implications related to memory (Page 110).**

    A. Keep it simple, i.e., do not overload users' memory with overly complicated procedures.

    B. Provide interfaces that promote *recognition* rather than *recall*.

    C. Use visual cues to index information.

    D. Provide a *variety of ways* to save and retrieve information, so that users can choose the ways that suit their styles of remembering, including
        1. mnemonic naming
        2. keyword tagging
        3. hierarchical organization
        4. prioritized ordering
        5. temporal ordering

VIII. **Design implications related to learning (Page 113).**

    A. Promote exploration, through various forms of information linkage.

    B. Guide and constrain learning users, but allow expert users to disable constraints and assistive guidance.

    C. Allow users to undo mistakes easily.

D. Allow learning users to zoom in on details, from higher-level abstractions.

IX. **Design implications related to reading, speaking, listening (Page 114).**

A. Keep speech-based instructions of minimum length.

B. Allow text size to be varied.

C. Designers should be hypesensitive to particular users' abilities for reading, speaking, and listening.

X. **Design implications related to problem solving (Page 116).**

A. Provide selectively accessible detailed information, that explains more complex tasks of problem solving, planning, reasoning, and decision making.

B. Keep it simple, in particular for problem domains that require rapid problem-solving action.

XI. **Cognitive Frameworks (Section 3.3)**

A. Such frameworks have been developed to explain and predict human behavior.

B. The following are applicable to interaction design, to varying degrees:
1. *mental models* -- models users have in their heads about how things work
2. *theory of action* -- models that explain or predict how users act
3. *information processing* -- models that treat humans as information processing agents
4. *external cognition* -- models of humans combined with external cognitive supports
5. *distributed cognition* -- models of multi-human, multi-machine cognitive systems

XII. **Mental models (Section 3.3.1)**

A. Regarding the mental models maintained by users themselves, about an interactive system:
1. Some users have (and want to keep) shallow mental models of how an interactive system works.
2. Others want or need deep mental models, i.e., understand in detail how a system works.
3. To accommodate both, interface designers can provide a simple initial interface, plus user-selectable ways to access more detailed information.

B. Regarding engineered representations of users' mental models:
1. There has been a variety of research, particularly in artificial intelligence, to develop computer-based models of how users understand things, in particular how they understand computer-based systems.
2. Not much of this research has as yet been applied to interaction design.
3. An interesting formal approach to mental modeling is the subject of next week's research reading.

XIII. **Theory of action (Section 3.3.2).**

A. Detailed theories of action, such as Norman's outlined in the book, do not provide particularly concrete guidance for interaction designers.

B. In general, the theories suggest the importance of providing feedback to users, about the state of actions being carried out. (Recall the first of Nielson's ten usability heuristics.)

C. Another of Norman's theories focuses on the *gulfs* between users' goals and the physical system used to enact the goals.

D. This theory has helped spark some interesting developments in HCI, with interfaces that reveal to end users how the system-level model of execution works.

E. Next week's research reading also addresses the gulf between system and user, by trying to identify mismatches between system behavior and a user's mental model of that behavior.

XIV. **Information processing (Section 3.3.3).**

A. This approach to cognitive frameworks tries to model cognition based on a psychological model of humans as information processing agents.

B. Norman and others have dismissed this approach as overly simplistic, due to its exclusion of external contexts that influence cognition.

XV. **External cognition (Section 3.3.4).**

A. This "framework" is simply the recognition that people use external media to help them remember things, and to perform cognitive tasks.
   1. E.g., using a tool or devise to carry out a computation.
   2. Using external media to record tasks, and trace task progress.
   3. Visualizing complicated data in alternative representations, to help better understand it.

B. The design of interactive systems should consider all of these forms of external cognitive support, as appropriate to users' abilities and application domain.

XVI. **Distributed cognition (Section 3.3.5).**

A. This framework extends the model of cognition to include multiple human actors, multiple machine-based systems, plus the distributed environment in which they operate.

B. Next week's research reading focuses on the airline cockpit, sited in this section of the book as a good example of distributed cognition.

XVII. **Epilogue -- Google versus Yahoo.**

A. What does Google know about human cognition that Yahoo doesn't?

B. Consider

    weblogs.media.mit.edu/SIMPLICITY/nonflickr/05_yahoogle.html

C. Will Yahoo ever learn?

   - http://www.yahoo.com
   - http://www.google.com