Lecture 2

Psychological and Sociological
Foundations

Main Ideas

- We blame ourselves for problems in using everyday objects
- We have problems because of the nature of human *memory* and *action*
- Good design takes the nature of human memory and action (including social) into account

Why is it getting worse?

- As objects develop complex, hidden internal states, we find it harder and harder to relate past experience to explain their behavior and relate it to our actions
  – Buffer in a word processor

Why use psychology & sociology in user interface design?

- If human behavior be predicted, we can use those predictions to improve our designs
- Even if it can't be predicted, we might be able to use these foundations to explain where our designs go wrong and improve them

Can human behavior be predicted?

- Almost impossible to predict a single individual's behavior
- Possible to predict the probable behavior of collections of people using "averaging" statistics

Goal of the Lecture

- Describe basic psychological behavior of individuals
  - Perception
  - Movement
  - Cognition
- Describe basic sociological behavior of individuals
  - Human groups and social interaction
  - Organizations
  - Culture
  - Communication
- Link to design issues for usability

Psychology: Perception

- Vision ---> Graphics
  - Color perception, Size of characters, discrimination
- Hearing -----> Audible interaction
  - Sound perception, loudness, discrimination
- Touch ------> Haptic interaction
  - Touch & kinaesthetic perception, discrimination

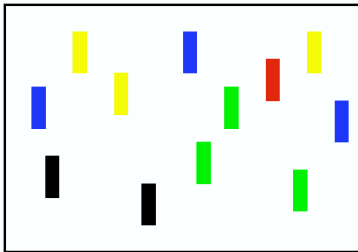## Find the red target

Find the horizontal red target
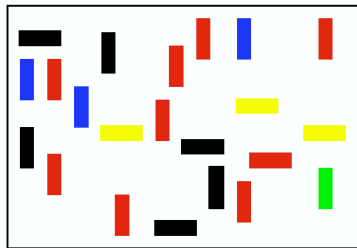
Psychology: Movement

- Fitts Law

  Pointing time = a + b log2 (D/W + .5)

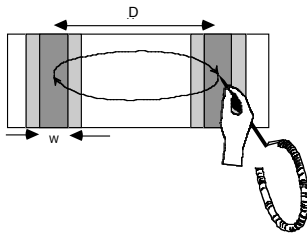 where D = distance; W=width of target

- Applies to all limbs

Fitts Task

Human Pointing Movement

- Fitts Law applies to computer pointing devices and prediction!

  Pointing time = a + b log2 (D/W + .5)

  - Mouse
    - a= 1.03; b=.096
    - Average pointing time approximately 1.1 sec (NOTE: This is about 5 times slower than keying.)
    - Fastest and most accurate pointing device
  - Trackball
    - About 30% slower than mouse
  - Joystick
    - About twice as slow as the mouse

Psychology: Cognition

- Memory
- Action (Planning & Decision Making)
- Practiced skill
- Learning

Memory

- Approximate, abstraction of previous events & objects
- Prototypes, stereotypes and theories
  - Birds
- Explanation: Theories relate cause and effect (action and results)
  - Thermostat
- Misconception: Mismatch between expectation and reality

A Test of your Memory!
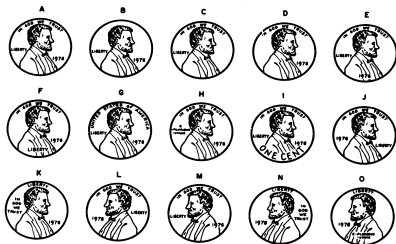
Norman's Model of Human Action

```
                          Goals
              Intention to Act        Evaluation
              Sequence of Actions     Interpretation
              Physical Execution      Perception
                          The WORLD
```
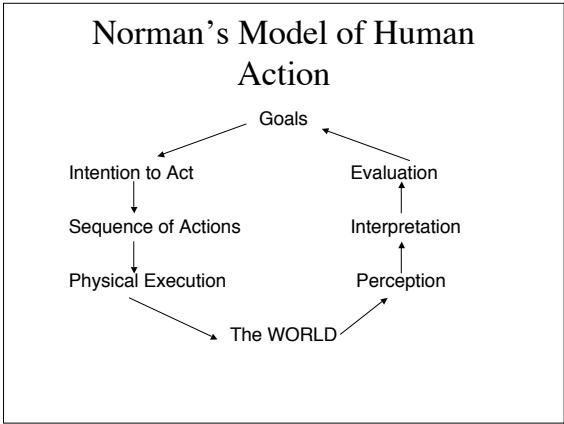
Breakdown in Action

- Where can failure occur in this cycle?
  - At any step
  - Gulf of Execution
    - Difference between intentions and allowable actions
    - Can be caused by short-term memory limitations & attention
  - Gulf of Evaluation
    - Amount of effort needed to interpret how well intentions and expectations have been met
- How is failure detected and repaired?
- How common is breakdown in tasks?
  - Example: Text Editing
    - 36% failure rate for experts
    - 26% of total time spent correcting failures

Applying the Action Model to Design

How easily can one:

```
                    Guess function
                      of device?
   Tell what actions          Know system in
    are possible?              desired state?
   Map intention to actions?  Interpret system
                                  state?
   Perform the action?        Guess system state?
                    The WORLD
                (Interactive Computer)
```
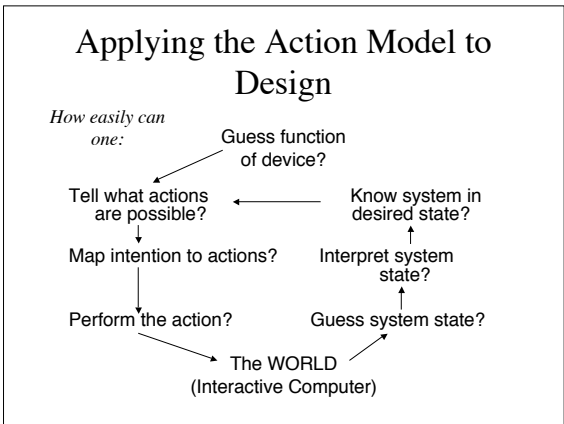
Design, memory and action

- Good design takes the limitations and strengths of human action and memory into account
  - Strengths: ties action to meaning (goals), able to problem solve, vast long-term memory
  - Limitations: approximate & partial, associations, often fails in performance
- Human knowledge is based on past experience both conceptual and procedural.

From Learning to Skill

- Categories of Behavior
  - Learning
  - Skill

- Levels of Knowledge
  - Novice
  - Casual
  - Expert

What is learning?

- Performance Improvement
  - Power Law of Practice: Performance of task improves with time
  - Affects perception, motor behavior, cognition
- Knowledge Acquisition
  - What is learned interacts with what is already known
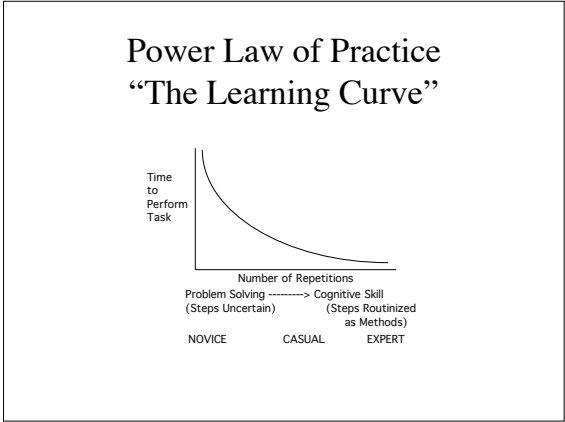   » Transfer of Training
    » Metaphor
    » Misconceptions

Power Law of Practice
"The Learning Curve"

Time
to
Perform
Task

Number of Repetitions

Problem Solving ---------> Cognitive Skill
(Steps Uncertain)   (Steps Routinized
                              as Methods)

NOVICE   CASUAL   EXPERT

Power Law of Practice

$$T_n = T_1 \, n^{-a}$$

where T_1 is time on first trial and a is in range [.2 to .6]

Plots as a hyperbolic curve

Alternate version:

$$\log T_n = \log T_1 - a \log n$$

Plots as a straight line

Design, learning and skill

- Good design takes learning and skill into account
  - Learning evolves into skill as a power function with the number of repetitions of a task
  - Learning and Skill may require different types of interactions and interfaces
- Learning builds on prior knowledge and often uses reasoning to form expectations
  - Affordance comes from this basis

Norman's 7 Principles of Good Design

1. Put knowledge in the world and exploit knowledge in the head
2. Simplify the structure of tasks
3. Make things visible
4. Get the mappings right
5. Exploit the power of constraints, both natural and artificial
6. Design for error
7. When all else fails, standardize

1. Put knowledge in the world and exploit knowledge in the head

- Put knowledge in the world
  - recognition
  - details
- and exploit knowledge in the head
  - affordance
  - conceptual models
  - metaphors
  - transfer of training
  - transition from recognition to recall if frequently used

2. Simplify the structure of tasks

- Focus on the most useful functions
- Minimize steps for tasks, especially frequent (core) ones
- Organize functionally
- Modularize
- Consistency
  - Use identical actions for identical goals
  - Use identical feedback for identical state changes
- Give user the control

3. Make things visible

- Affordance: cues of how to use
- Controls not visible
- Too much "visibility": Which controls do what?
- Conceptual model: Glass box versus Black box
- Bridge the Gulf of Execution
  - options readily available
  - show mode changes
- Bridge the Gulf of Evaluation
  - always give understandable feedback for actions

4. Get the mappings right

- Physical
  - Spatial positioning and movement of controls related to result
- Psychological
  - Flashing draws attention to most important item
- Logical
  - Light switch has only two states
- Cultural
  - Searching follows scanning of reading (left to right, top to bottom for English)
  - Common icons (trashcan, mailbox) have cultural meanings

5. Exploit the power of constraints

- Constraints limit possible actions or interpretations
- Physical
  - Example: Diskette insertion
  - Example: Button has only two states
- Cultural
  - Example: Hot water is on the left
  - Example: Logging on requires a name and password

6. Design for Error

- Understand the causes of error and design to minimize
- Make it easy to discover errors
  - understandable feedback
  - good messages
  - mapping of conceptual model to system image
- Make it possible to correct errors
- Make it possible to reverse actions
  - undo
- Make it hard to do what can't be reversed
- Test designs with users!

7. When all else fails, standardize

- Standardization is creating cultural constraints!
- Standardization promotes consistency and thus transfer of training
- Pitfalls
  - Lowest common denominator
  - May not be the best
  - May have to violate standard for better design

The Paradox of Good Design

If it is a good design, we frequently will not know it!

Resources

- Don Norman, *The Psychology of Everyday Things*

Sociology

- Human groups and social interaction
  - Human species is a *social*, not solitary, species
  - Social psychology outlines social attributes
    - Issues of social control
      - Power relations and trust
      - Rules of social behavior
    - Emotional responses to other humans
    - Aspects of social dysfunction
      - Psychological depression
      - Criminal and other anti-social behavior
  - Computer mediated social interaction such as a chat room will have all the manifestations of social groups
    - Example: Email flaming, spamming, pornographic websites

Organizations and groups

- Formal or informal
- Life-cycle
- Structure

Culture

- According to Samovar and Porter (1994), culture refers to the cumulative deposit of knowledge, experience, beliefs, values, attitudes, meanings, hierarchies, religion, notions of time, roles, spatial relations, concepts of the universe, and material objects and possessions acquired by a group of people in the course of generations through individual and group striving.

Communication

- Inherent part of sociability of human species
- 5000 natural (human) languages
  - Lexical, syntactic, semantic, pragmatic aspects
  - Written vs. spoken
  - Non-verbal gestures and emotion
  - Extremely subtle and complex
  - Culture is communication, communication is culture. (Edward T. Hall)

How social issues affect user interface design

- Social context must be taken into account
  - Development, tech support, documentation
  - Attitudes, expectations, evaluation are part of a culture of any social group
- Many innovations in computing integrate communication with computing
  - Social interaction must be understood and designed
  - Example: turn-taking in virtual conferencing

How social issues affect user interface design

- Different interpretations for different cultures
  - icons, symbols, words or color
    - two different human cultures
    - in a culture and one of its subcultures
  - Designing for an international community
    - universal usability

Exercises

- Find examples of social interaction with a news group, email, or a chat room.
- Find examples of issues of trust in groupware.
- Find examples of bad design with a news group, email, or a chat room, describe how it fails, and how to fix it.

Resources

- J. Preece, "Online communities: Designing usability, supporting sociability"