

Understanding Users

Chapter 3

Overview

- Part 1: Cognitive view of behavior
- Part 2: Three conceptual frameworks
 - Mental models
 - Information processing
 - External Cognition
- FLOABN

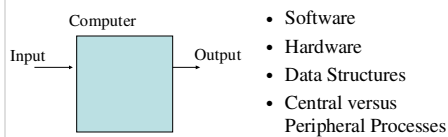
Part 1: Cognitive View of Behavior

- Representational Theory of Mind
- Behavior
- Perception
- Concept, Knowledge, and Representations
- Reasoning and Problem Solving
- Skill Acquisition

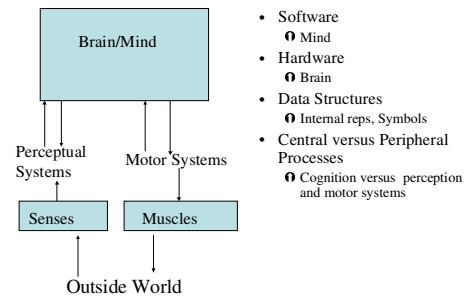
Representational Theory of Mind

- Internal representations are the data the mind reasons about
- Perceptual processes produce internal representations
 - Vision is a peripheral process that delivers internal representations that the central processes reason with
 - Vision system developed as result of evolutionary processes
- Cognitive Processes reason given an internal representation (for example, in a logical form) as produced by peripheral processes

Computer Architecture



Cognitive Architecture



Behavior

As mediated by an internal structure,
plans



Plan

- Control the order in which a sequence of operations is to be performed.
- Mediating organization of behavior
- Intended behavior is the unfinished parts of the plan
- Plan to go to the science library after class
 - Return book and notebooks to book bag
 - Put on coat
 - Walk down aisle
 - Walk to library
 - Open door

Issues

- What kinds of behaviors are mediated by plans?
 - Typing, walking, ...
- Where do plans come from?
 - Planners
- Plans versus execution
 - Uncertainty, Situated Activity, Improvisation
- Plan recognition
 - Speech Acts: Can you reach the salt?
What time does the train to Montreal leave?

Perception representation

Internal
representation ← produces



- Internal representation
 - A is a block
 - B is a block
 - C is a block
 - OnTable(B)
 - OnTable(A)
 - On(C,A)

Sense, Perception

Perception

Sense

External
Environment

- Perception versus raw sense input
- Perception produces representation
- Visual routines and attention
- Affordance
- Modularity (Fodor)

Sorting a string of letters.

Rules:

1. IF ba THEN ab
2. IF ca THEN ac
3. IF cb then bc

String of Letters

cbaca

Family Relationships

RULES:

1. IF X is a parent of Y AND Y is a parent of Z THEN X is a grandparent of Z.
2. IF X is a brother of Y AND Y is the parent of Z THEN X is the uncle of Z
3. IF X is a sister of Y AND Y is the parent of Z THEN X is the aunt of Z.

Facts

Shirley is a parent of Jesse.
Leslie is a parent of Jesse.
Tom is a parent of Mark.
Mark is a parent of Peter.
Tom is the brother of Shirley.
Shirley is the sister of Tom.

Skill Acquisition as Knowledge Compilation (ACT*)

- Speed-up in typing
- Analogous to interpreting versus compiling code
 - First you have to think about where each letter is (interpreting)
 - Then after a lot of practice you don't have to "mentally rehearse" where the letter T is (compiled)

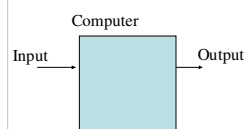
Part 2: Three conceptual frameworks

- Mental Models
- Information Processing (GOMS)
- External Cognition

Mental Models

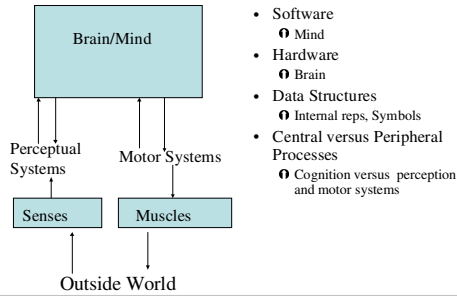
- Thermostat as a tap
Thermostat as a switch
- Intelligence (Robert Wood)
 - *Fluid* - inherent capacity to process, interpret, encode and manipulate
 - *Crystallized* - acquired knowledge, language, and culture and ability to recall info when needed
- Ability
 - *Entity theorists* believe that personal abilities are relatively fixed and difficult to change
 - *Incremental theorists* change and can be developed

Computer Architecture



- Software
- Hardware
- Data Structures
- Central versus Peripheral Processes

Cognitive Architecture



Information Processing (GOMS as an example)

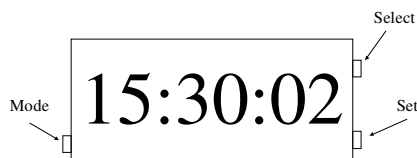
GOALS - Typical goals for user of a device

Operators - Provided by interface to the device.

Methods - A series of steps consisting of operators that the user performs

Selection Rule - If there is more than one method to accomplish a Goal, a selection rule chooses the appropriate method depending on the context.

The Watch



- *Mode* goes from Time to Alarm to Alarm Set to Time Set
- *Set* advances the current selection in a Set mode
- *Select* changes the current selection in a Set mode
- Buttons are stiff and give little feedback

GOMS ANALYSIS

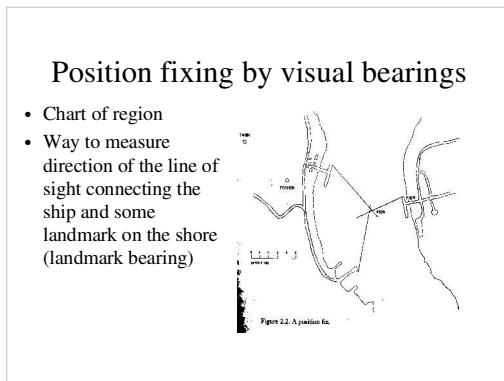
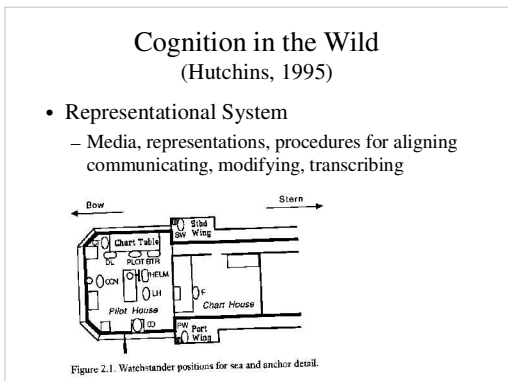
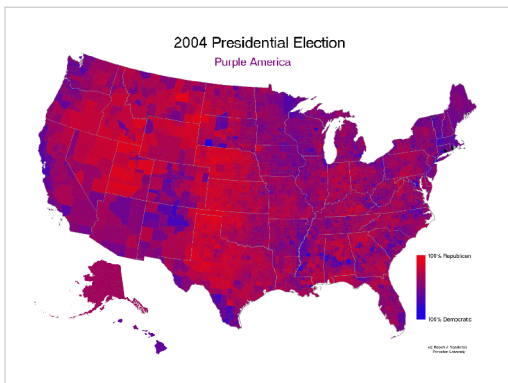
- Top level goal : Set time
- Operators
 - Press button
 - Release button
 - Check digits flashing
- Selection rule: If not in proper mode change modes
- Method: Advance the minute of the watch
 - Press and release mode button
 - Check digits are flashing
 - Press and release select button
 - Press and release set buttons
 - Press and release mode button
 - Check digits no longer flashing

GOMS ANALYSIS

- Timings
 - M - time it takes to mentally prepare
 - K - time it takes to push a button
 - H - time it takes to move finger from one control to another
 - R - time waiting for a response
 - E - time it takes to evaluate response
- Method: Advance the minute of the watch
 - Press and release mode button
 - Check digits are flashing
 - Press and release select button
 - Press and release set buttons
 - Press and release mode button
 - Check digits no longer flashing
- Calculation
 - (MHK)(RE)(MHK) ...

External Cognition

- External representations
- Cognitive Behavior is embedded in rich representational system
 - Model work as effort required to reason about external representations and transform, align and map between representational forms
- Re-designing the representational system changes the complexity of the task
 - Re-distribute memory/computational load



The Fix Cycle

- Continuously plot the ship's position, project the track, and prepare to plot the next position
2. New info from bearing takers (find landmarks)
 - a. Report over telephone circuit to bearing timer-recorder

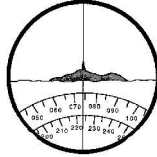


Figure 2.1. View through an alidade.

Fix Cycle (continued)

1. Bearing timer recorder records reported bearing in bearing log
2. Plotter plots the bearings reported by the bearing taker
 - a. Either told bearing by recorder or reads them out of the log
 - b. Projects where the ship will be at time of the next few fix observations
 - c. Needs to know heading and speed of the ship; reads this info from deck log

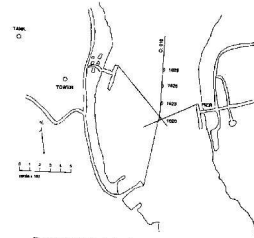


Figure 2.3. The projected track.

Fix Cycle (continued)

1. When project position of the ship has been plotted, bearing timer-recorder consults with plotter to decide which landmarks will be in appropriate position for the next fix
 - a. assigns landmarks to bearing takers

FLOABN

Cognitive model of skill acquisition
for devices

FLOABN

(with Roland Zito-Wolf and Tamitha Carpenter)



FLOABN



Run of System

1. DIAL PHONE call from home.
2. TOUCHTONE PHONE call from Rick's office;
phone numbers on wall.
3. SODA MACHINE downstairs at Ford Hall.
4. COIN OPERATED PHONE/LOCAL CALL
5. COIN OPERATED PHONE/NON-LOCAL CALL
6. COIN OPERATED PHONE/LONG-DISTANCE CALL
7. Computer SCIENCE DEPT. COPIER (base case)
8. LIBRARY COPIER (different positioning requirements, payments)
9. ADMINISTRATION BUILDING COPIER (different controls and payment)
10. FAX Machine

FLOABN's assumes average everyday task environment

- Task environment:
 - It is the task that defines a point of view about an environment, and that, in fact, allows an environment to be delimited. (Newell & Simon, 1972)
 - Blocks world
- Everyday Task Environment
 - At Home
 - Designed to support task

Adaptive Planning (Basic Cycle)

1. The actor is engaged in activity within a home task environment as a function of memory of prior experiences at doing this task in the home task environment.
2. A breakdown occurs.
3. Adaptation is mediated by the design of the task environment and instruction information available at the scene of the activity.
4. Action continues.

Riding the NYC Subway for the first time

Principles Underlying FLOABN's Model of Memory

- The immediate context is part of the individual's memory for the activity
 - *Principle: Memory is distributed into the home task environment.*
- Memory of relevant procedural facts is organized in terms of activity within the task environment.
 - *Principle: Activity organizes memory.*
- Reminding of relevant facts occurs as action unfolds (not in advance of action).
 - *Principle: Retrieval is piecemeal and interactive.*
- There is a tight integration of activity and task environment
 - *Principle: Memory function integrates particulars of regularly co-occurring pairs of tasks and task environments.*

Cultural History

1. The development of a working device and the design of its interface are in some ways independent.
2. At any given point in time, usually exists several different interface designs
3. Building the interface is a problem of communication. (Designer)
4. A resource available to a designer is that a new interface can be a composite of pieces of existing interfaces for related kinds of devices.
5. Over extended periods of time, as technology develops, interfaces change, and designers continue to borrow from previous designs, interfaces accrue a 'cultural history'.
6. Individuals immersed in the culture are much more likely to readily avail themselves of the usage of some device than an 'outsider.'
7. The processes by which an individual adapts to both the evolution and variance in interface design is guided by the indirect communication between designer and end users which has its basis in culture.
8. The achievement of using a device for the first time simultaneously extends the lifetime of that design within the culture, and the range of the individual's behavior.