How Does it Work?
How does air/fabric freshener work?
- “Captures” the stink molecules
- “Blocks” the stink
- “Freshens” your fabric

Actual: release a stronger, more pleasant odor

Consider: Why does the sun cross the sky?
- Wheels of a god’s chariot
- Ten “sun-bird” brothers, carried their mother
- It revolves around the earth
Computing Folk Theories & Superstitions

- Only connect to projector AFTER everything else is set up
- Reboot when computer “gets slow”
- Don’t be the first to upgrade (“Wait for Service Pack 2”)
From Learning to Mental Models

- Simple learning
  - Stimulus/Response: How do I get the response I want?
  - Memorization: What sequence of steps do I need to take?

- Model formulation
  - How is the system generating the response?
  - What other responses is the system capable of generating?
  - Why do I need to take those steps?
  - What other steps would lead to similar outcomes?
  - What steps would lead to other outcomes?
1.8 My Refrigerator. Two compartments—fresh food and freezer—and two controls (in the fresh food unit). The illustration shows the controls and instructions. Your task: Suppose the freezer is too cold, the fresh food section just right. How would you adjust the controls so as to make the freezer warmer and keep the fresh food the same? (From Norman, 1986.)

<table>
<thead>
<tr>
<th>NORMAL SETTINGS</th>
<th>C AND 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>COLDER FRESH FOOD</td>
<td>C AND 6-7</td>
</tr>
<tr>
<td>COLDEST FRESH FOOD</td>
<td>B AND 6-9</td>
</tr>
<tr>
<td>COLDER FREEZER</td>
<td>D AND 7-8</td>
</tr>
<tr>
<td>WARMER FRESH FOOD</td>
<td>C AND 4-1</td>
</tr>
<tr>
<td>OFF (FRESH FD &amp; FRZ)</td>
<td>0</td>
</tr>
</tbody>
</table>

1. SET BOTH CONTROLS
2. ALLOW 24 HOURS
3. TO STABILIZE
Don Norman’s Fridge

1.8 My Refrigerator. Two compartments—fresh food and freezer—and two controls (in the fresh food unit). The illustration shows the controls and instructions. Your task: Suppose the freezer is too cold, the fresh food section just right. How would you adjust the controls so as to make the freezer warmer and keep food the same? (From Norman, 1986.)

<table>
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<tr>
<th>Setting</th>
<th>Controls</th>
</tr>
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<tbody>
<tr>
<td>Normal Settings</td>
<td>C AND 5</td>
</tr>
<tr>
<td>Colder Fresh Food</td>
<td>C AND 6-7</td>
</tr>
<tr>
<td>Coldest Fresh Food</td>
<td>B AND 6-9</td>
</tr>
<tr>
<td>Colder Freezer</td>
<td>D AND 7-8</td>
</tr>
<tr>
<td>Warmer Fresh Food</td>
<td>C AND 4-1</td>
</tr>
<tr>
<td>Off (Fresh FD &amp; FRZ)</td>
<td>0</td>
</tr>
</tbody>
</table>

1. Set both controls
2. Allow 24 hours to stabilize

 Attempt to create stimulus-response pairs

 Attempt to create script
How Don’s Fridge Works

Presented Model

Actual Model
Design Model: What the designer has in mind

User’s Model: What the user believes

System Image: What the system actually embodies
Norman’s Models

**Design Model:**
What the designer has in mind

**User’s Model:**
What the user believes

**System Image:**
What the system actually embodies

**Implementation shortcomings**

**Misunderstandings**
The role of affordances

The actionable properties between the world and an actor.

--Norman paraphrasing Gibson (http://www.jnd.org/dn.mss/affordances_and.html)
Affordances?
Some Notes on Affordances

- A relationship between “the world and an actor”
- Don’t need to account for the *origin* of the affordance
  - Can be innate
  - Can be learned
  - Can vary from person to person
- Norman clarified his use of “affordance” later
The Role of Schemas

- Homer tries telecommuting
  - [Link](http://www.hulu.com/watch/19900/the-simpsons-any-key)
Metaphors Leverage Schema
XEROX
6085 Workstation

User-Interface Design
To make it easy to manage text and graphics, the Xerox 6085 Workstation uses a revolutionary user interface design.

Bit-map display - Each bit on the 19" screen is a bit in memory, thus an arbitrarily complex image can be displayed. The 6085 displays all text and graphics so they will be printed. In addition, familiar office objects such as documents, folders, file drawers and in-boxes are portrayed as recognizable images.

The mouse - A unique pointing device that allows the user to quickly select any text, graphic or office object on the display.

See and Point
All functions are visible to the user on the keyboard or on the screen. The user selects and retrieves by selecting them with the mouse and touching the word, COPY, DELETE OR PROPERTIES command keys. Text and graphics are edited with the same keys.

Shorter Production Times
Experience at Xerox with prototype workstations has shown shorter production times and lower costs, as a function of the percentage of use of the workstations. The following equation can be used to express this:

18-point text.
24-point text.
36-point text.
XEROX
6095 Workstation

User-Interface Design

To make it easy to compose text and graphics, the Xerox 6095 Workstation utilizes a desktop metaphor. The user can quickly select any text, graphic, or object on the display.

See and Point

All functions are visible to the user on the keyboard or on the screen. The user doesn't need to work by selecting with the mouse or touching the keyboard; the user can point and click to select new on-screen objects and interact with them.

Shorter Production Times

Experience at Xerox with prototype workstations has shown shorter production times and lower costs, as a function of the percentage of use of the workstations. The following equation can be used to express this:

18-point text
24-point text
36-point text.
The Desktop Metaphor

You have documents (represented by icons) arranged on your desk however you like.
The Desktop Metaphor

Just “open” a document, system will worry about providing the right tool.
The Desktop Metaphor

Open documents are “windows” on top of the desktop. They can be stacked and rearranged, like paper.
Multiple files can be collected into folders
Simple, useful tools can be arranged on the desktop, too.
Metaphors at work?
Pushing the Desktop Metaphor

- Bumtop
  - http://www.ted.com/talks/anand_agarawala_demos_his_bumtop_desktop.html
Alternatives to the Desktop

Freeman and Gelertner. Lifestreams. 1996
Microsoft Bob (1994)

http://www.youtube.com/watch?v=ZegWedG-jk4
Alternatives to the Desktop

- Apple’s Knowledge Navigator
  - [http://www.youtube.com/watch?v=kl3CVaWtF-o&feature=related](http://www.youtube.com/watch?v=kl3CVaWtF-o&feature=related)
Mental Models and Action

- “7 stages of action”
- Describes how we interact
  - With the world (in general)
  - With designed systems (in particular)
Mental Models and Action

- Users evaluate progress towards goal to select next action
- Users formulate/re-formulate goals as they go
- Users also update their models of how the system works
The Gulfs (Execution and Evaluation)

Gulf of Execution?

(connect to Internet) (make a phone call)
More Gulfs

- http://www.havenworks.com/
- http://si.umich.edu/index.htm
Gulf of Evaluation?
Gulf of Evaluation?

Outlook Express
There was an error opening this message.
An error has occurred.

OK

Microsoft Outlook
The operation failed. An object could not be found.

OK

Dialog Name
Question or information that needs the user's immediate attention

Yes  No  Cancel

DEX

Basic Search
1. Enter the person's last name or last name & first name:
   Last: Smith
   First: Christian
   Check this box to find similar names (Example: Bob & Robert)

2. Select a Location:
   City: Provo
   State: Select State
   Check this box to include surrounding areas

SEARCH THE LISTINGS
The Applicant Tracking System seems to have lost communication with the printer.

To solve this problem, make sure that the printer is switched on, and try to print again.

If printing still fails, try wiggling the cable that runs between the computer and the printer. Make sure the cable is connected securely at both ends, and try to print again.

If the program still fails to print properly, please call Joe Grant at (212) 555-1212, and tell him that the program is reporting Error ATSPR35 at line 31 in module PRNFNC.

OK
What about this?
Navigating the Gulfs as Problem Solving

- Based on mental models
- Avoids backtracking
- Suffers from
  - Functional Fixedness
  - Einstellung (strategic fixedness)
  - Insight requirements
  - Post-completion errors
- Especially challenging with *ill structured problems*
### Challenges to Problem Solving (Ritter)

**Table 8-1. Problem solving requirements and several potential difficulties.**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Difficulties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting goal state</td>
<td>Can’t tell if the system is at the starting state</td>
</tr>
<tr>
<td>Goal state</td>
<td>Can’t tell what is the goal state</td>
</tr>
<tr>
<td>Intermediate states</td>
<td>Can’t tell what state the system is in</td>
</tr>
<tr>
<td></td>
<td>Can’t tell distance to goal state</td>
</tr>
<tr>
<td></td>
<td>Can’t tell direction to goal state</td>
</tr>
<tr>
<td>Operators</td>
<td>Can’t tell what are the operators</td>
</tr>
<tr>
<td></td>
<td>Can’t tell is operator had an effect</td>
</tr>
<tr>
<td></td>
<td>Operators are difficult to perform (physically or mentally)</td>
</tr>
<tr>
<td></td>
<td>Have to apply a lot of operators</td>
</tr>
<tr>
<td></td>
<td>Can’t tell which operators are safe/appropriate to use</td>
</tr>
</tbody>
</table>
Suggestions for Design (Norman)

- Visibility
  - System state
  - Possible actions

- A good conceptual model
  - Consistent system image

- Good mappings
  - Actions -> results
  - Controls -> effects
  - State -> visible indications

- Feedback
  - Full, immediate, continuous information about results of actions
Decision Making: Hick-Hyman Law
Decision Making: Hick-Hyman Law
Decision Making: Hick-Hyman Law

- $T = a + b \log(n + 1)$
  - (other formulations exist)

- Constraints
  - Choices are all equally likely
  - Choices are arranged logically
Decision Making: Other issues

- Speed-accuracy tradeoff
  - Satisficing

- Stimulus-Response compatibility
Decision Making: Menus

Services

Following is a list of services offered by the University of Michigan Library. You may also contact one of our subject specialists directly.

- 7FASST
- Academic Integrity
- Ask a Librarian
- Audubon Room
- Borrowing and Circulation
- Café Shapiro
- CARMA
- Compact for Open-Access Publishing Equity
- Computer & Video Game Archive
- Computing at the Library
- Copy Services
- Copyright
- Course Reserves
- Deep Blue
- Delivery Services
- Digital Library Production Service (DLPS)
- Espresso Book Machine
- Faculty Exploratory
- For the Media
- Gallery in Room 100
- Instruction and Workshops
- Interlibrary Loan for Other Libraries
- Interlibrary Loan for UMI Community
- Knowledge Navigation Center
- Library Floor Plans
- Library Forms
- Michigan Digitization Project
- Michigan Information Transfer Service
- MLibrary Labs
- Mobile Technology
- MPublishing
- Online Video Gallery
- Preservation and Conservation
- Research Data Management and Publishing
- Support
- SAND (Spatial and Numeric Data Services)
- Scholarly Publishing Office (SPO)
- Serials and Microforms Services
- Services for Alumni
- Services for Faculty & Staff
- Services for Library Colleagues
- Services for Patrons with Disabilities
- Services for Retired Faculty and Staff
- Services for Undergraduate Students
- Services for Visitors
- Study Spaces
- TechDeck
- Text Creation Partnership (TCP)
- Usability in the Library
- Visual Resources Center
Decision Making: Biases

- **Mental models**
  - Should I go to the second page of results?
  - Should I try to draw this image in Word?

- **Confirmation bias**
  - Did I complete the task? Nothing said I didn’t.

- **Over-generalization** (regression to the mean)
  - I tried Windows once and it didn’t work
  - I found what I was looking for on Amazon right away. I’ll always go there

- **Availability bias** (rely on easy to recall memories)
  - List recall, recency effects, priming
  - This looks like a dialog I usually say OK to, so I’ll say OK

- **Framing**
  - Rating this movie will increase the likelihood you’ll get better recommendations
  - Not rating this movie might mean you’ll miss out on movies you want to see

- **Feedback**
  - Not getting feedback means people keep making bad decisions
Exercise: Supporting Problem Solving and Decision Making

- How do you convey a conceptual model of a complex system?
  - Does it need to be accurate?
  - ... or just useful?
- Design to support decision making
- Design to support problem solving

Windows Vista File Copy Dialog

Dourish’s “Accounts” for Reflective Computing

FIGURE 3: A structural model of the file copying example in terms of data buckets and the connections between them. Connections between elements of this model are the points at which strategies and policies can be identified.