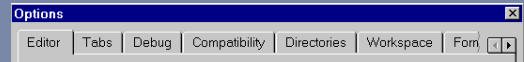


## Conceptual Models & Interface Metaphors

Prof. James A. Landay  
University of Washington  
Autumn 2008

October 23, 2008

## Interface Hall of Fame or Shame?



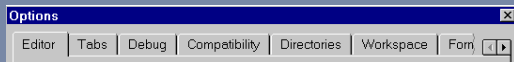
- Tabbed dialog for setting options in MS Web Studio
  - more tabs than space to display them
- Clicking on the right arrow once gives



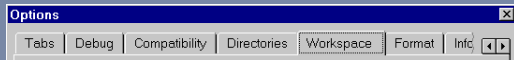
## Conceptual Models & Interface Metaphors

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## Outline

- Review
- Meetings
- *Design of Everyday Things*
- Conceptual models
- Interface metaphors
- Ubiquitous computing

## Human Abilities Review

- Color can be helpful, but pay attention to ?
  - how colors combine
  - limitations of human perception
  - people with color deficiency
- Model Human Processor ?
  - perceptual, motor, cognitive processors + memory
  - model allows us to make predictions
    - e.g., perceive distinct events in same cycle as one
- Memory ?
  - three types: sensor, WM, & LTM
  - interference can make hard to access LTM
  - cues in WM can make it easier to access LTM
- Key time to remember?
  - 100 ms (~processor cycle time & memory access)
- Fitts' Law ?
  - moving hand is a series of microcorrections predicted by D & S
    - $T_{pos} = a + b \log_2(D/S + 1)$
  - time to move hand depends only on *relative precision* required

## Design of Everyday Things

- By Don Norman (UCSD, Apple, HP, NN Group)
- Design of everyday objects illustrates problems faced by designers of systems
- Explains conceptual models
  - doors, washing machines, digital watches, telephones, ...
- Resulting design guides

→ Highly recommend this book



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## Conceptual Models

- Mental representation of how an artifact works & how interface controls affect it
- People may have preconceived models that are hard to change
  - (4 + 5) vs. (4 5 +)
  - dragging to trash?
    - deletes file but ejects disk
- Interface must communicate model
  - visually (& possibly physically or using sound)
  - online help and documentation can help, but shouldn't be necessary



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## Affordances as Perceptual Clues

- Well-designed objects have affordances
  - clues to their operation
  - often visual, but not always (e.g., speech)



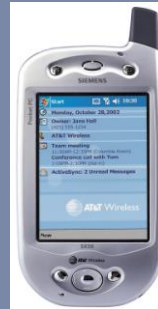
What affordances do you see here?

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## Affordances as Perceptual Clues



Siemens Pocket PC Phone  
 Pen input, no keypad



Handspring Treo  
 Pen input/keypad input

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## Affordances as Perceptual Clues

- Poorly-designed objects
  - no clues or misleading clues



French artist Jacques Carelman  
 Crazy design for a screw punch!

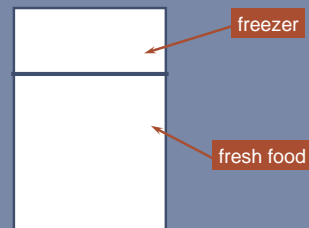


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## Refrigerator



Problem: freezer too cold, but fresh food just right

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## Refrigerator Controls

Normal Settings	C and 5
Colder Fresh Food	C and 6-7
Colest Fresh Food	B and 8-9
Colder Freezer	D and 7-8
Warmer Fresh Food	C and 4-1
OFF (both)	0

A B C D E

7 6 5 4 3

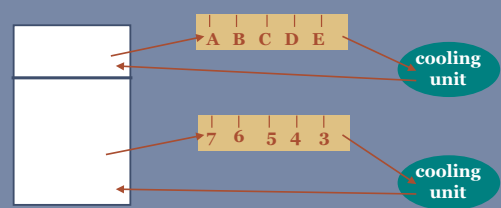
What is your conceptual model?

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## A Common Conceptual Model



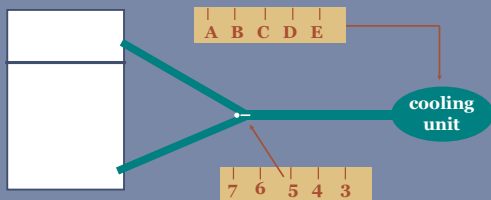
independent controls

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## Actual Conceptual Model



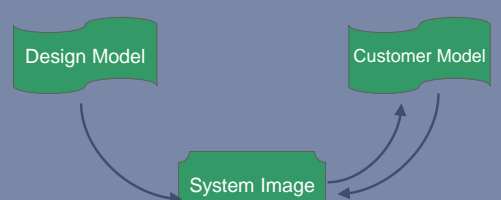
- Can you fix the problem?
- Possible solutions
  - make controls map to customer's model
  - make controls map to actual system

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## Design Model & Customer Model



- Customers get model from experience & usage
  - through system image
- What if the two models don't match?

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## Conceptual Model Mismatch

- Mismatch between designer's & customer's conceptual models leads to...
  - slow performance
  - errors
  - frustration
  - ...



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## Notorious Example

### Confusion over Palm Beach County ballot

Although the Democrats are listed second in the column on the left, they are the third hole on the ballot.

Punching the second hole casts a vote for the Reform Party.

(REPUBLICAN)	3	(REFORM)	4
GEORGE W. BUSH - PRESIDENT		PAT BUCHANAN - PRESIDENT	
DICK CHENEY - VICE PRESIDENT		EZOLA FOSTER - VICE PRESIDENT	
(DEMOCRATIC)	5	(SOCIALIST)	6
AL GORE - PRESIDENT		DAVID McREYNOLDS - PRESIDENT	
JOE LIEBERMAN - VICE PRESIDENT		MARY CAL HOLLIS - VICE PRESIDENT	
(LIBERTARIAN)	7	(CONSTITUTION)	8
HARRY BROWNE - PRESIDENT		HOWARD PHILLIPS - PRESIDENT	
ART OLIVER - VICE PRESIDENT		J. CURTIS FRAZIER - VICE PRESIDENT	
(GREEN)	9	(WORKERS WORLD)	10
RALPH NADEAU - PRESIDENT		MONICA MADOREHEAD - PRESIDENT	
WINDRA LaDUKE - VICE PRESIDENT		GLORIA La RIVA - VICE PRESIDENT	
(SOCIALIST WORKERS)	11		
JAMES HARRIS - PRESIDENT			
MARGARET TROVIE - VICE PRESIDENT			
(NATURAL LAW)	13		
JOHN HAGELIN - PRESIDENT			
NAT GOLDHABER - VICE PRESIDENT			

WRITE IN CANDIDATE  
 To vote for a write in candidate, follow the directions on the long stub of your ballot card.

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Ken-Geometric Interface (Charles Hollnagel)

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## Car Example



## Design Guides

- Provide good conceptual model
  - customer wants to understand how UI controls impact object
- Make things visible
  - if object has function, interface should show it
- Map interface controls to customer's model
  - infix vs. postfix calculator – whose model is that?
- Provide feedback
  - what you see is what you get! (WYSIWYG)

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## Make Things Visible

- Refrigerator (?)
  - make the A..E dial something about percentage of cooling between the two compartments?
- Controls available on watch w/ 3 buttons?
  - too many and they are not visible!
- Compare to controls on simple car radio
  - #controls = #functions
  - controls are labeled (?) and grouped together



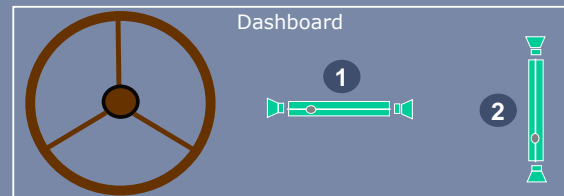
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## Map Interface Controls to Customer's Model

- Which is better for car dashboard speaker front / back control?
- Control should mirror *real-world*

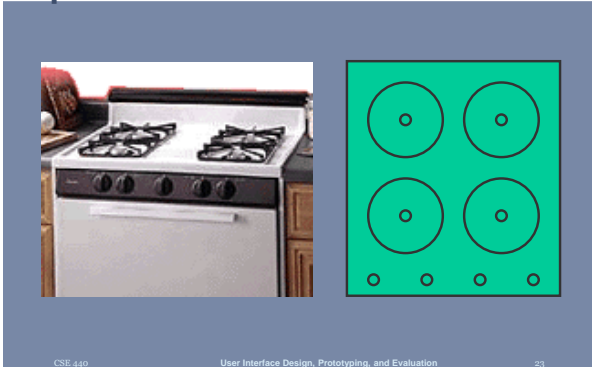


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## Map Interface Controls to Customer's Model

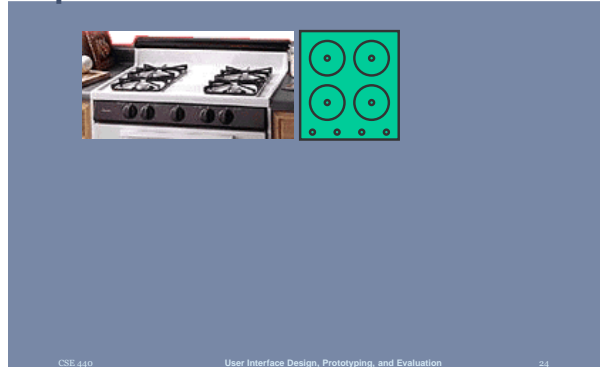


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## Map Interface Controls to Customer's Model



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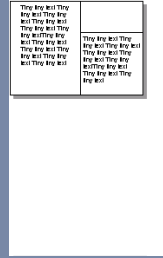
## Metaphor

- Definition ?
  - “The transference of the relation between one set of objects to another set for the purpose of brief explanation.”
- Lakoff & Johnson, *Metaphors We Live By*
  - “...the way we think, what we experience, and what we do every day is very much a matter of metaphor.”
  - in our language & thinking – “argument is war”
    - ... he attacked every weak point
    - ... criticisms right on target
    - ... if you use that strategy
- We can use metaphor in interface design to leverage existing conceptual models



## Desktop Metaphor

- Suggests a conceptual model
  - not really an attempt to simulate a real desktop
  - a way to explain why some windows seemed blocked
  - leverages existing knowledge about files, folders, & trash



## Example Metaphors

- Global metaphors
  - personal assistant, wallet, clothing, pens, cards, telephone, eyeglasses
- Data & function
  - rolodex, to-do list, calendar, applications documents, find, assist
- Collections
  - drawers, files, books, newspapers, photo albums

## How to Use Metaphor

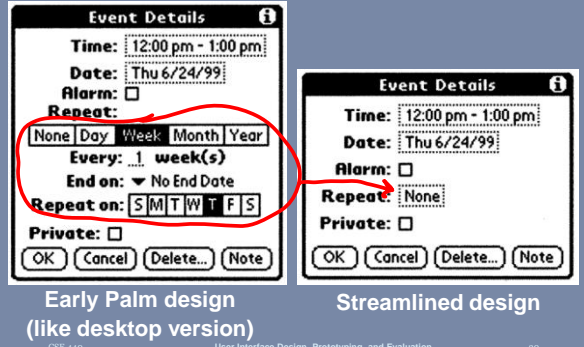
- Develop interface metaphor tied to conceptual model
- Communicate that metaphor to the user
- Provide high-level task-oriented operations, not low-level implementation commands

## Is Consistent Always Better? NO

- PDA example: should “new appointment” & “delete appointment” be in the same place?
- New (add) is common, but delete is not



## Is Consistent Always Better? NO



## Is Consistent Always Better? NO

### Firefox 3 Back/Forward Buttons

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## Ways of Being Consistent

- Interfaces should be consistent in a *meaningful way*
  - E.g., ubiquitous use of same keys for cut/copy/ paste
- Types of consistency
  - consistent internally
    - e.g., same terminology and layout throughout
  - consistent with other apps
    - ex. works like MS Word, uses keyboard conventions
    - design patterns (across many apps)
  - consistent with physical world

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## Summary

- Conceptual models ?
  - mental representation of how the object works & how interface controls effect it
- Design model should equal customer's model ?
  - mismatches lead to errors
  - use customer's likely conceptual model to design
- Design guides ?
  - make things visible
  - map interface controls to customer's model
  - provide feedback



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## Further Reading

- *Design of Everyday Things*, Donald Norman
- *Design as Practiced*, Donald Norman
  - Talks about failure to make changes to Macintosh
  - [http://www.jnd.org/dn.mss/Design\\_as\\_Practiced.html](http://www.jnd.org/dn.mss/Design_as_Practiced.html)
- *Computing the Case Against User Interface Consistency*, Jonathan Grudin
  - Talks about why interfaces should not always be consistent
  - <http://www1.ics.uci.edu/~grudin/Papers/CACM89/CACM89.html>

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## Ubiquitous Computing?



## Context-Awareness

- Modern computers divorced from our reality
  - unaware of who, where, and what around them
  - mismatch between expectations and functionality
  - also limits what we can do with computers
- Context-Aware Computing
  - one line of ubiquitous computing research
  - making computers more aware of the physical and social situations they are embedded in

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## Why Context-Aware Computing?

Existing Examples	Context Types	Human Concern
Auto Lights On / Off	Room Activity	Convenience
File Systems	Personal Identity & Time	Finding Info
Calendar Reminders	Time	Memory
Potential Examples	Context Types	Human Concern
Tag Photos	Time History	Finding Info
Health Alert	Location Identity	Safety
Service Fleet Dispatching	Activity Proximity	Efficiency

## Technology Trends

- **Location, Location, Location**
  - FCC's E911, location for cell phones
- **Lots of potential apps here**
  - electronic tour guides
  - locating restaurants / gas stations / etc
  - keeping track of a group of friends
  - location-based games
- **But many technological barriers as well**
  - reliability
  - indoor location

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## Sample Context-Aware Apps

### ParcTabs



#### ParcTabs

Xerox PARC  
 Want, Schilit, et al

- **Proximate selection**
  - display nearby objects
- **Auto-diaries**
  - people, places, and time
- **Triggers**
  - remind me to talk to John next time I see him
  - turn off oven when I leave
  - notify me on new coffee

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## Sample Context-Aware Apps

### ParcTabs

Name	Room	Distance
caps	35-2-2-00	200ft
<b>claudia</b>	<b>35-2-1-08</b>	<b>30ft</b>
<b>perfector</b>	<b>35-2-3-01</b>	<b>20ft</b>
snoball	35-2-1-03	100ft

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## Sample Context-Aware Apps

### ParcTabs



#### ParcTabs

Xerox PARC  
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### Subject Field

### Filter Field

— Title Line

— Biography

### Mike's Biography

## Sample Context-Aware Apps

### ParcTabs



**ParcTabs**  
Xerox PARC  
Want, Schilit, et al

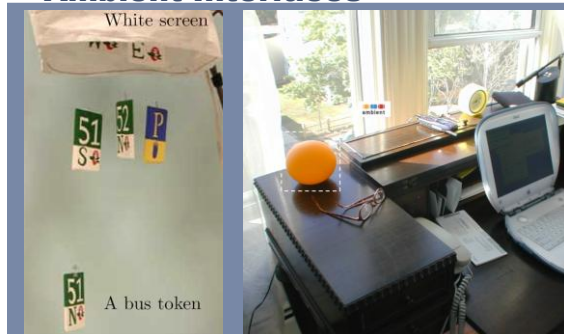
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## Ambient Interfaces



ambient bus display (Mankoff)

Ambient Devices stock orb

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## Next Time

- Heuristic Evaluation
- Read
  - [Lewis & Rieman 4.3-4.4](#)
  - [Nielsen HE chapter](#) (read 5 links under "Jakob Nielsen's Online Writings on Heuristic Evaluation")

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