



Navigation Design and Problem Representation

Human Computer Interaction
CSCI 4620U | SOFE 4850U | CSCI 5540G
Dr. Christopher Collins

Acknowledgement: Parts of these lectures are based on material prepared by Ron Baecker, Ravin Balakrishnan, John Chattoe, Ilona Posner, Scott Klemmer, and Jeremy Bradbury.

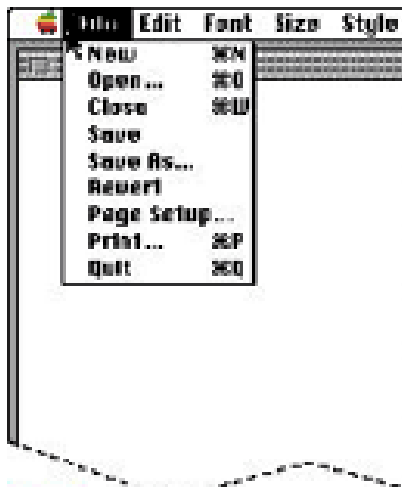
Last Time

- Principles of Interaction Design
- Screen Design Tips

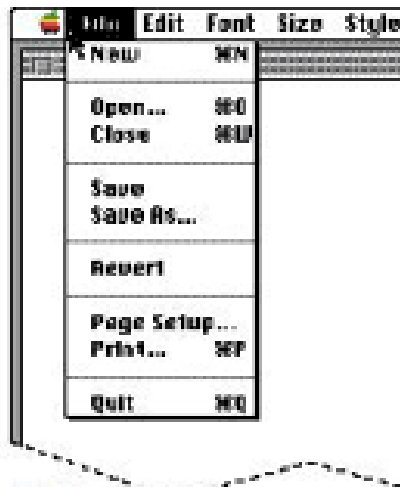
Principles of Interaction Design

- Identify the users' skill levels
- Identify the set of tasks
- Determine the appropriate interaction style
- Error prevention
- Balance automation with user control
- Be consistent
- Universal usability
- Provide feedback
- Design with closure in mind
- Make actions reversible
- Reduce the load on short-term memory
- Allow user to be in control

Grouping: Finding a Balance



Not enough groups



Too many groups



Just right?

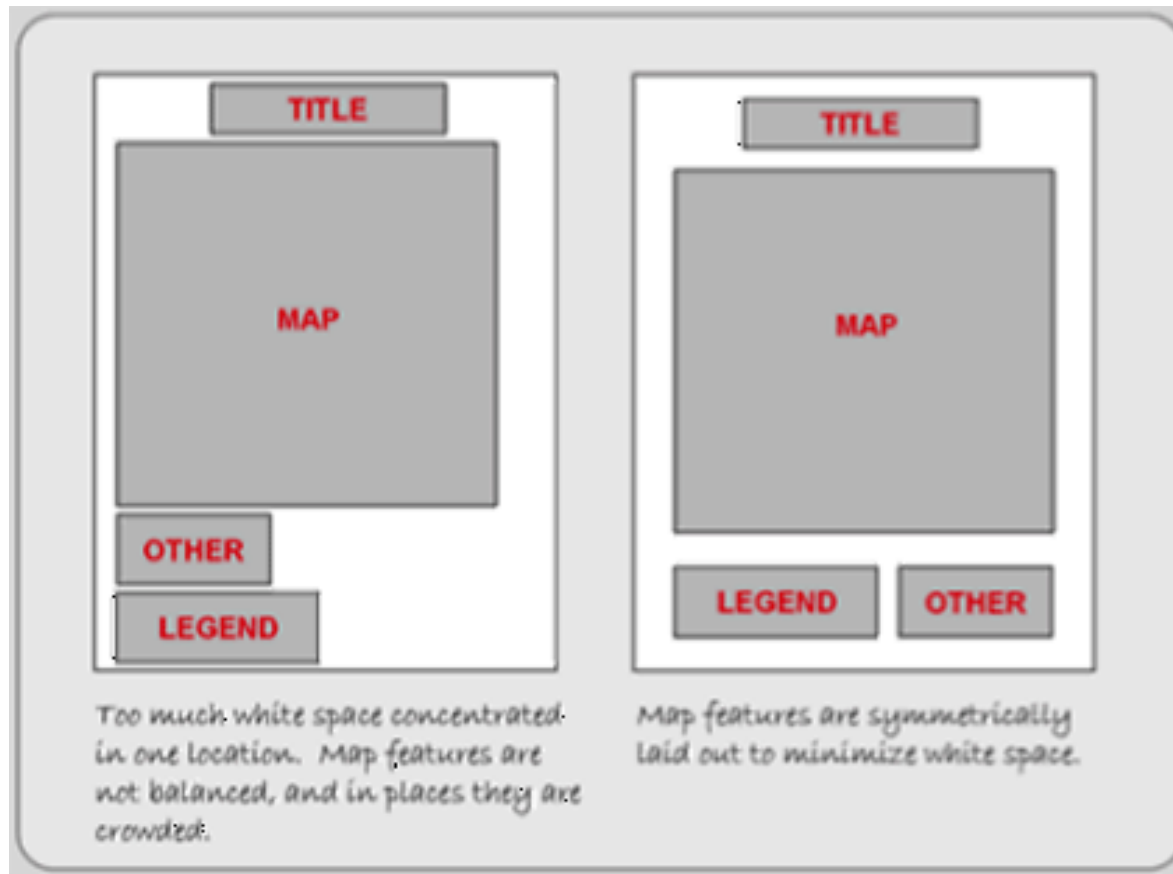
Menubar example from: <http://www.interfacemafia.org/articles/200109/200109-ar0002.shtml>

Screen Design: Alignment

- What can we do with multi-column lists of data?
- **Example: Look up Surname**

Alan	Dix	Yes
Janet	Finlay	
Gregory	Abowd	
Russell	Beale	

Balanced White Space



(http://giscommons.org/?page_id=18)

Screen Design: Internationalization

- Often software (e.g., Microsoft Office) is used in many countries or regions around the world with different languages and cultures
- In order to internationalize a screen design for another culture we need to:
 - Modify the language used in the design
 - Change icons, symbols, etc. to reflect local culture
 - Realign lists (if necessary)
 - ...

Screen Design: Action Affordances

- In addition to deciding how to display information, we have to also understand how people will interact with our screen design
 - People may need to enter data in forms, text areas, etc. which have to be grouped and aligned
 - Recall “Affordances” and use them where appropriate

Announcements

- Send thank you notes/emails to those who you interviewed

Project Updates

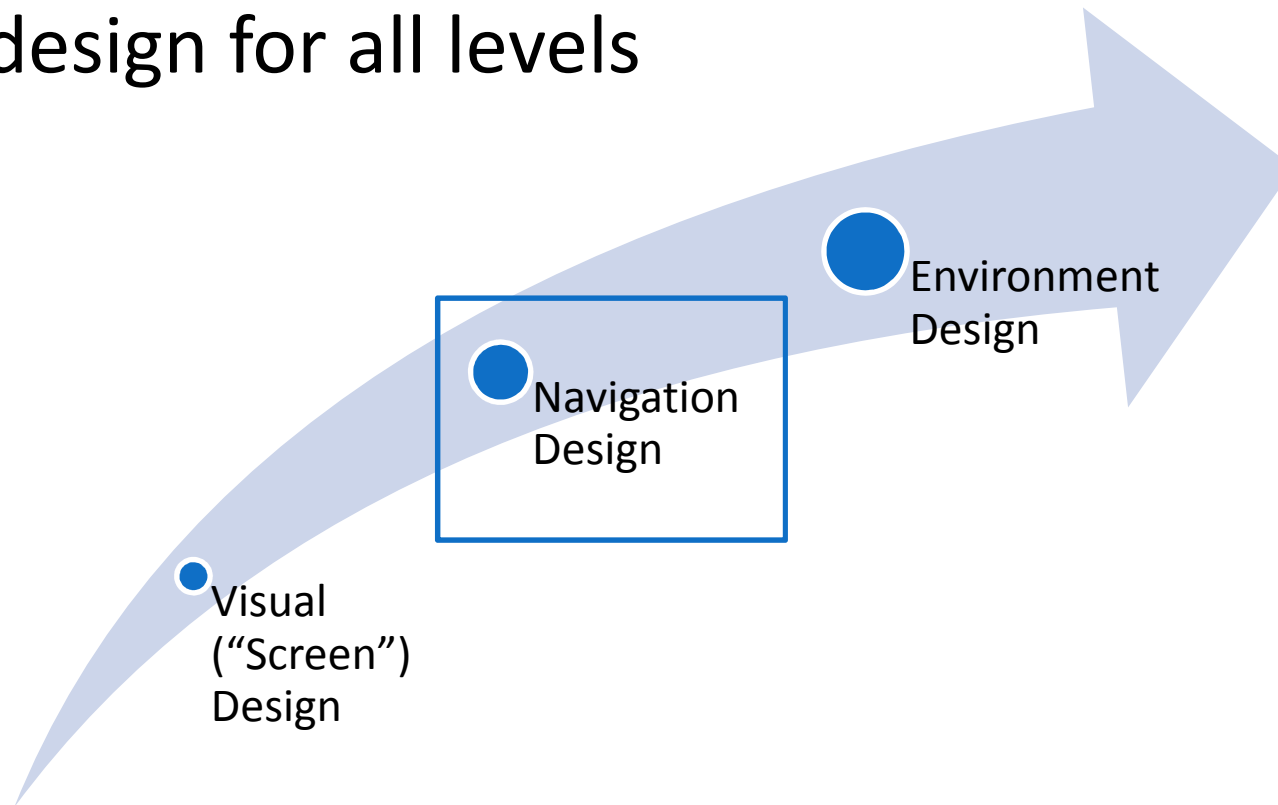
- For 1 minute, tell the class what you learned in part 2b

Today

- In today's lesson we will begin to explore techniques for creating designs:
 - Navigation Design
 - The Power of Representation

Design Stages

- There are different levels of interaction within any user interface – we have to ensure that we design for all levels





Benyon text
14.2-14.4

Principles of Design

NAVIGATION DESIGN

Navigation Design: Local Structure

- Local structure refers to navigating from the current screen
- Example: clicking a hyperlink to move from one webpage to another
- Our reference book provides 4 things to ensure regarding local structure:

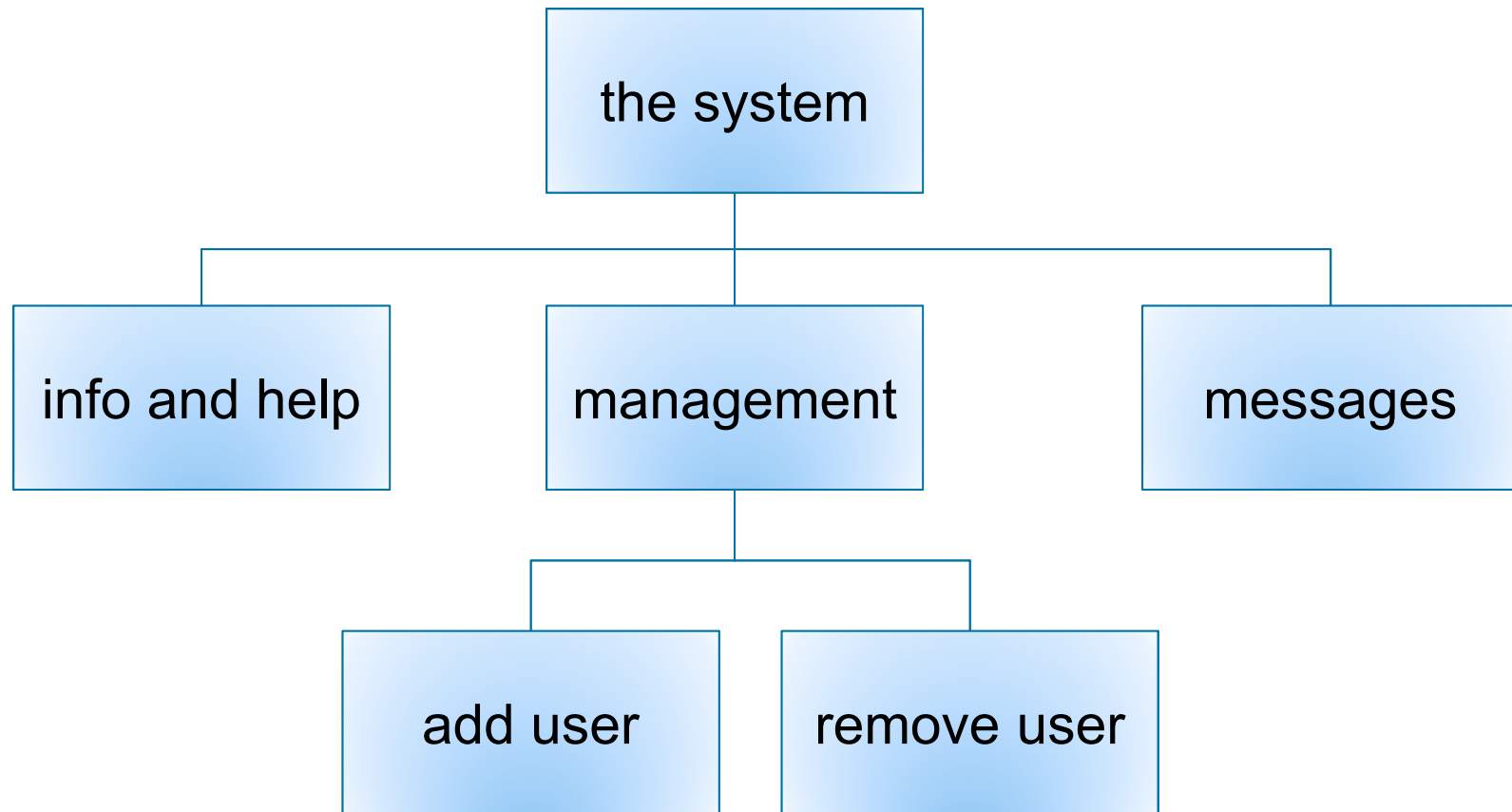
- “knowing where you are
- knowing what you can do
- knowing where you are going – or what will happen
- knowing where you’ve been – or what you have done”

- Dix et al.

Navigation Design: Global Structure

- The global structure is mainly concerned with navigating between screens and through the entire interface
- Example: navigation through the menu system in Microsoft Word
- We can view the entire interface/system structure using a hierarchical diagram

Hierarchical Diagrams

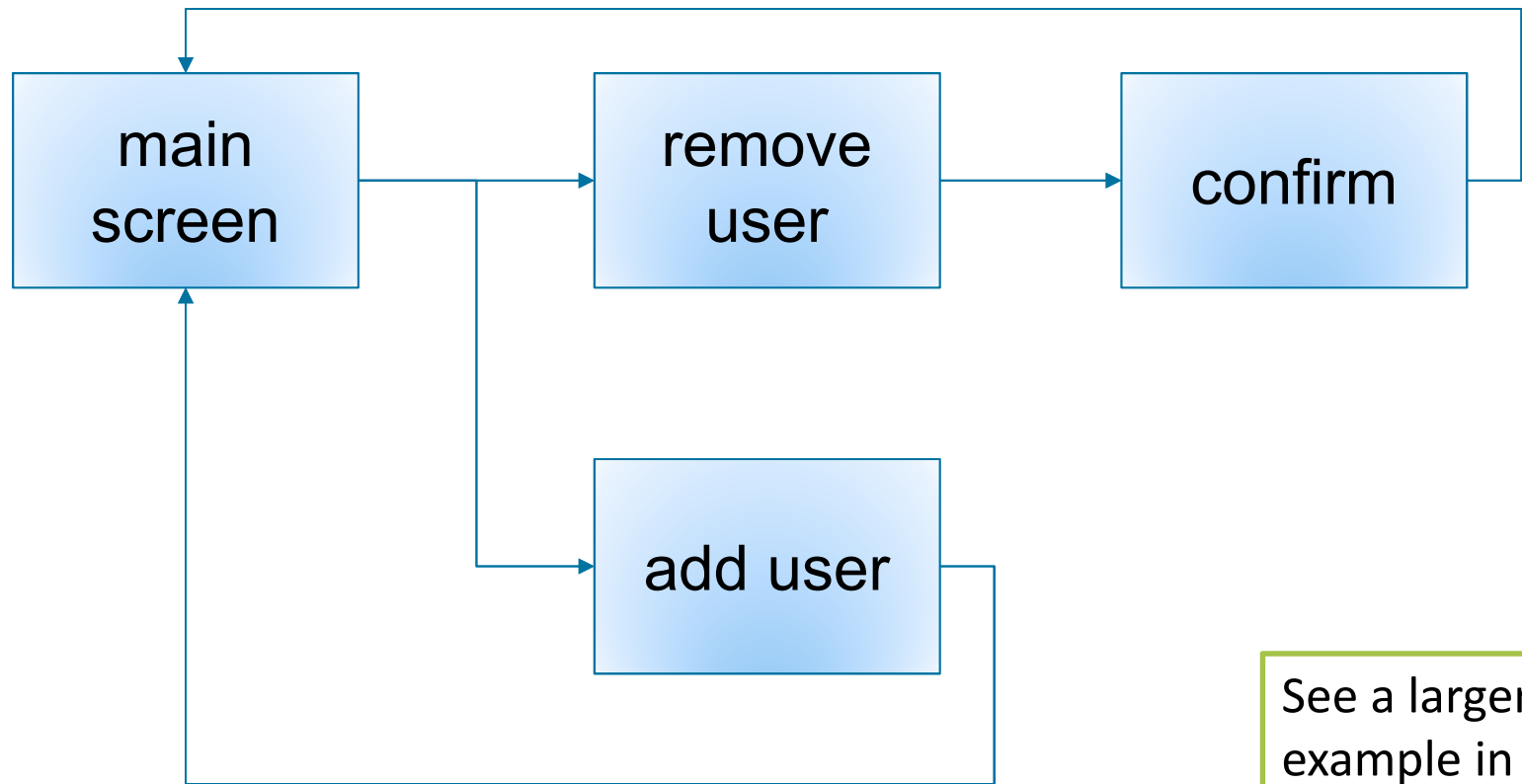


(Source: Dix, Finley, Abowd, Beale, *"Human-Computer Interaction"*)

Navigation Design: Global Structure

- In addition to hierarchical navigation there are also other ways to navigate through a system's interface.
- Example: [cross-links](#) between different sections of a website
- We can use network diagrams to show this kind of navigation

Network Diagrams



(Source: Dix, Finley, Abowd, Beale, *"Human-Computer Interaction"*)

See a larger
example in
Benyon, Fig
14.3!

Focus Traversal

- The order of 'Tab traversal' should follow user expectations to allow for minimal switching of input devices

The screenshot illustrates the focus traversal order for the 'Edit Project Information' form. The form is divided into two main sections: 'General Information' and 'People'. The 'General Information' section contains fields for Project Name, Start Date, Project Manager, Project Status, Project Long Name, and Project Description. The 'People' section contains a table with columns for Name, Role, Organization, Phone, and Email. The focus traversal order is indicated by numbered callouts (1-28) and an arrow labeled 'Returns to Stop 1' pointing from the bottom of the table back to the top of the form.

Oracle Product Name | 1 me | 2 nistration | 3 erences | 4 o | 5 n Out

6 Primary Tab 1 | 7 Primary Tab 2 | 8 Primary Tab 3 | 9 Search | 10

Edit Project Information | 11 Save | 12 Save and Close | 13 Cancel

General Information

14 Project Name: Senior Home Visits (15) | 16 Start Date: 1/3-2002 (17) | 18 Project Manager: Sherlock Holmes (19) | 20 Project Status: me (21) | 22 Project Type: Monthly Volunteer Event (23) | 24 End Date: 1/3-2002 (25) | 26 Organization: Vision Services (27)

People

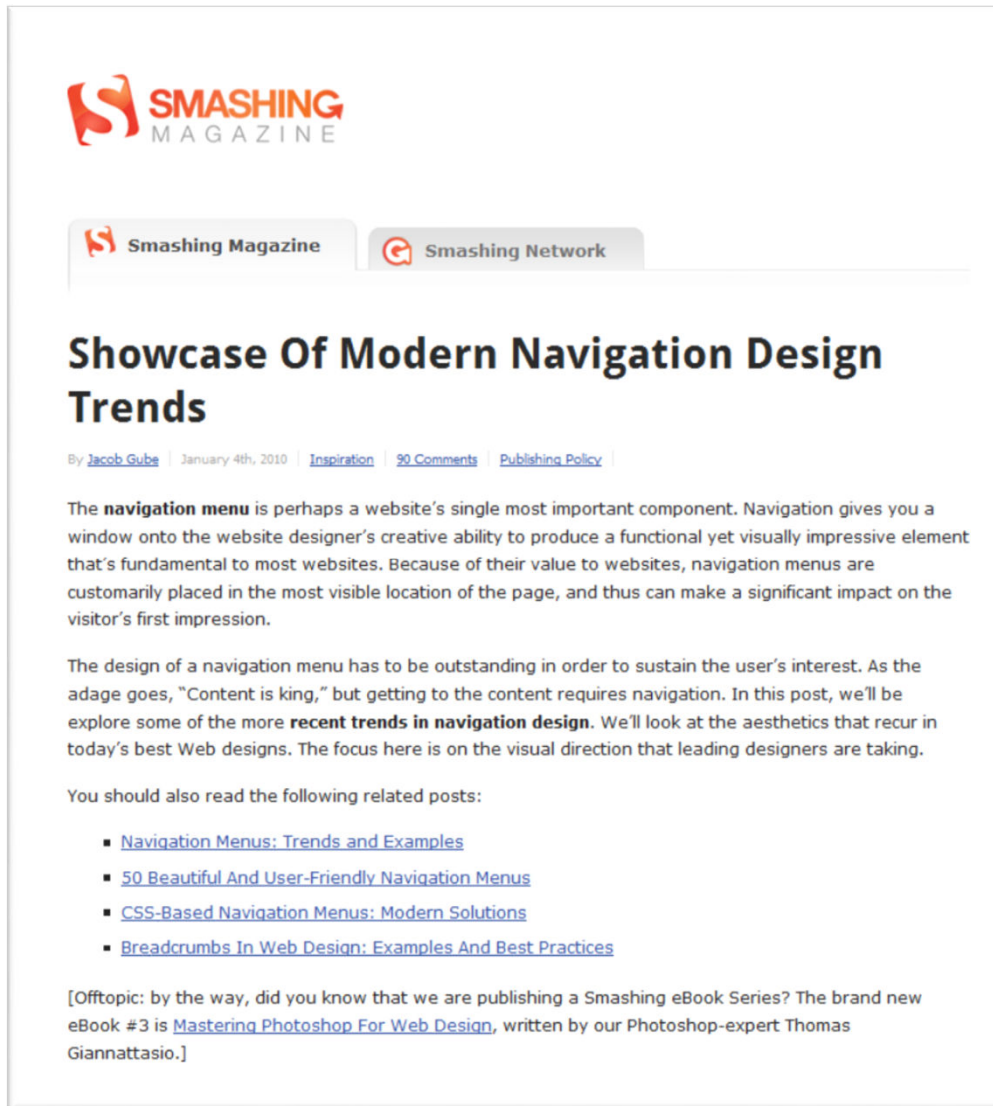
Name	Role	Organization	Phone	Email
Alisa Thompson	Developer	Applications	685/212-4170	athompson@aaa.bbb
Sherlock Holmes	Project Manager	Vision Services	929/244-3931	sholmes@ggg.bbb
Hillman Associates	Customer	Hillman Associates	784/301-9148	ha@hillman.com
Casa Del Milo	Customer Liason	Hillman Associates	738/917-4766	casa@hillman.com

28 Returns to Stop 1

Universal Design

- Focus traversal also affects screen reading interfaces – sensible flow is easier to follow through audio

Smashing Magazine Showcase



Note: These are more 'visual design for navigation menus', not 'navigation design' in the formal sense.

<http://www.smashingmagazine.com/2010/01/04/showcase-of-modern-navigation-design-trends/>

DESIGN FOR THE ENVIRONMENT

Designing for the Software Environment

- A system *rarely* works in isolation
- **Example:** most software on our laptops work with other software with an OS
- We need to ensure that our application conforms to the standard look-and-feel established by the platform
- We need to ensure that our application handles standard features and meets i/o standards
- We need to ensure that our application works with other applications when needed

Designing for the Physical Environment

- Consider the context of use: lighting, sound, temperature
- **Examples:**
 - Cannot use iPhone in Canadian winters without frostbite (or special gloves!)
 - Cannot use voice commands in a shopping mall
 - Cannot read yellow on white in sunlight

How does Environment Affect Your Project?



Benyon text
Chapters 23.3-

Representation

DISTRIBUTED COGNITION



The Oranges Puzzle

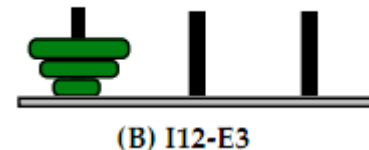
- Goal** Order the oranges by size: largest-to-smallest, left-to-right
- Rule 1** Only one orange can be transferred at a time
- Rule 2** An orange can only be transferred to a plate on which it will be the largest
- Rule 3** Only the largest orange on a plate can be transferred to another plate



(A) I123

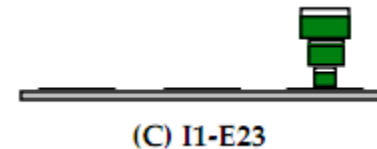
The Doughnuts Puzzle

- Goal** Order the doughnuts by size: largest-to-smallest, left-to-right
- Rule 1** Only one doughnut can be transferred at a time
- Rule 2** A doughnut can only be transferred to a peg on which it will be the largest
- Rule 3** Only the largest doughnut on a peg can be transferred to another peg



The Coffee Cups Puzzle




- Goal** Order the coffee cups by size: largest-to-smallest, left-to-right
- Rule 1** Only one cup can be transferred at a time
- Rule 2** A cup can only be transferred to a plate on which it will be the largest
- Rule 3** Only the largest cup on a plate can be transferred to another plate



What did we learn?

The Coffee Cups Puzzle

- Goal** Order the coffee cups by size: largest-to-smallest, left-to-right
- Rule 1** Only one cup can be transferred at a time
- Rule 2** A cup can only be transferred to a plate on which it will be the largest
- Rule 3** Only the largest cup on a plate can be transferred to another plate

		Rule1	Rule2	Rule3
<i>Orange</i>		Int	Int	Int
<i>Donut</i>		Int	Int	<u>Ext</u>
<i>Coffee</i>		Int	<u>Ext</u>	<u>Ext</u>

Jiajie Zhang and Donald A. Norman, Representations in Distributed Cognitive Tasks, *Cognitive Science*, 18, pp 87-122, 1994. doi=10.1.1.73.7799

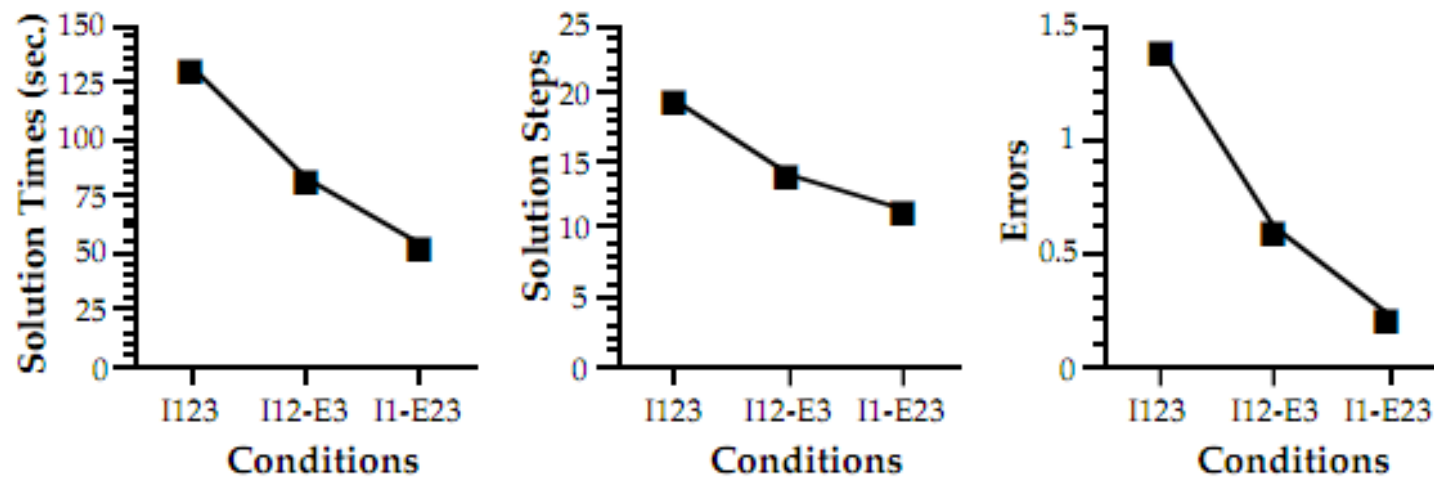
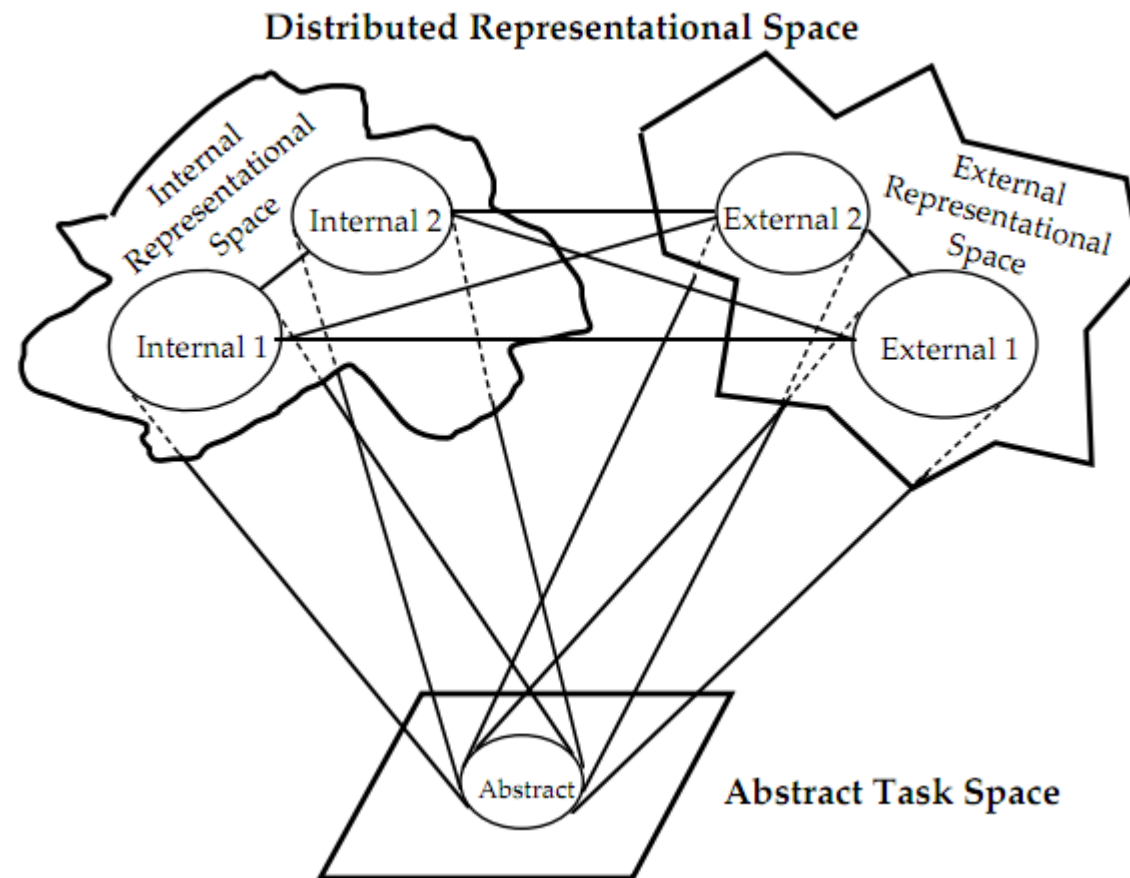


Figure 13. The results of Experiment 2. Problem difficulty decreased with the increase of the number of external rules.

Jiajie Zhang and Donald A. Norman, Representations in Distributed Cognitive Tasks, *Cognitive Science*, 18, pp 87-122, 1994. doi=10.1.1.73.7799

Learning Through Doing



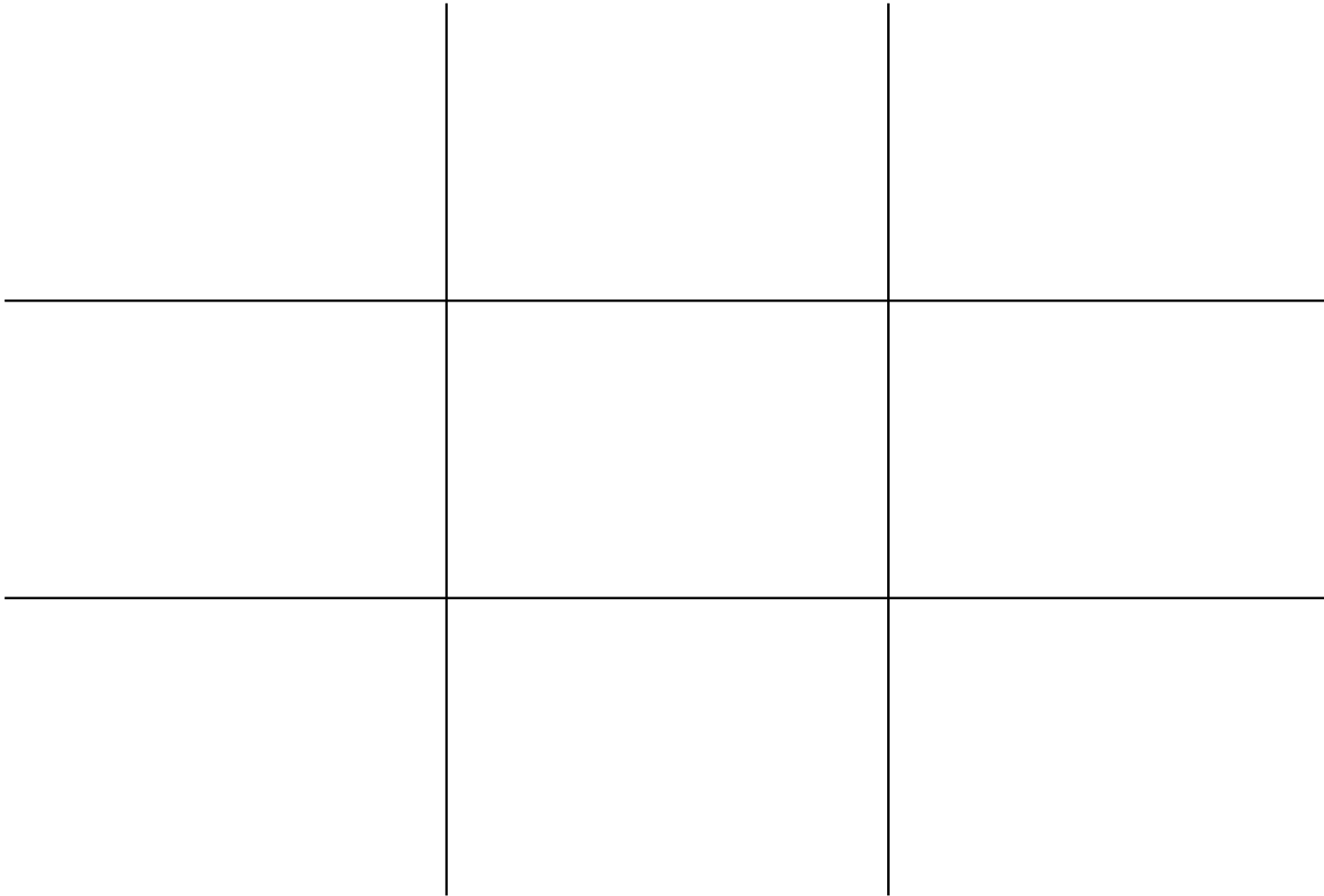


Jiajie Zhang and Donald A. Norman, Representations in Distributed Cognitive Tasks, *Cognitive Science*, 18, pp 87-122, 1994. doi=10.1.1.73.7799

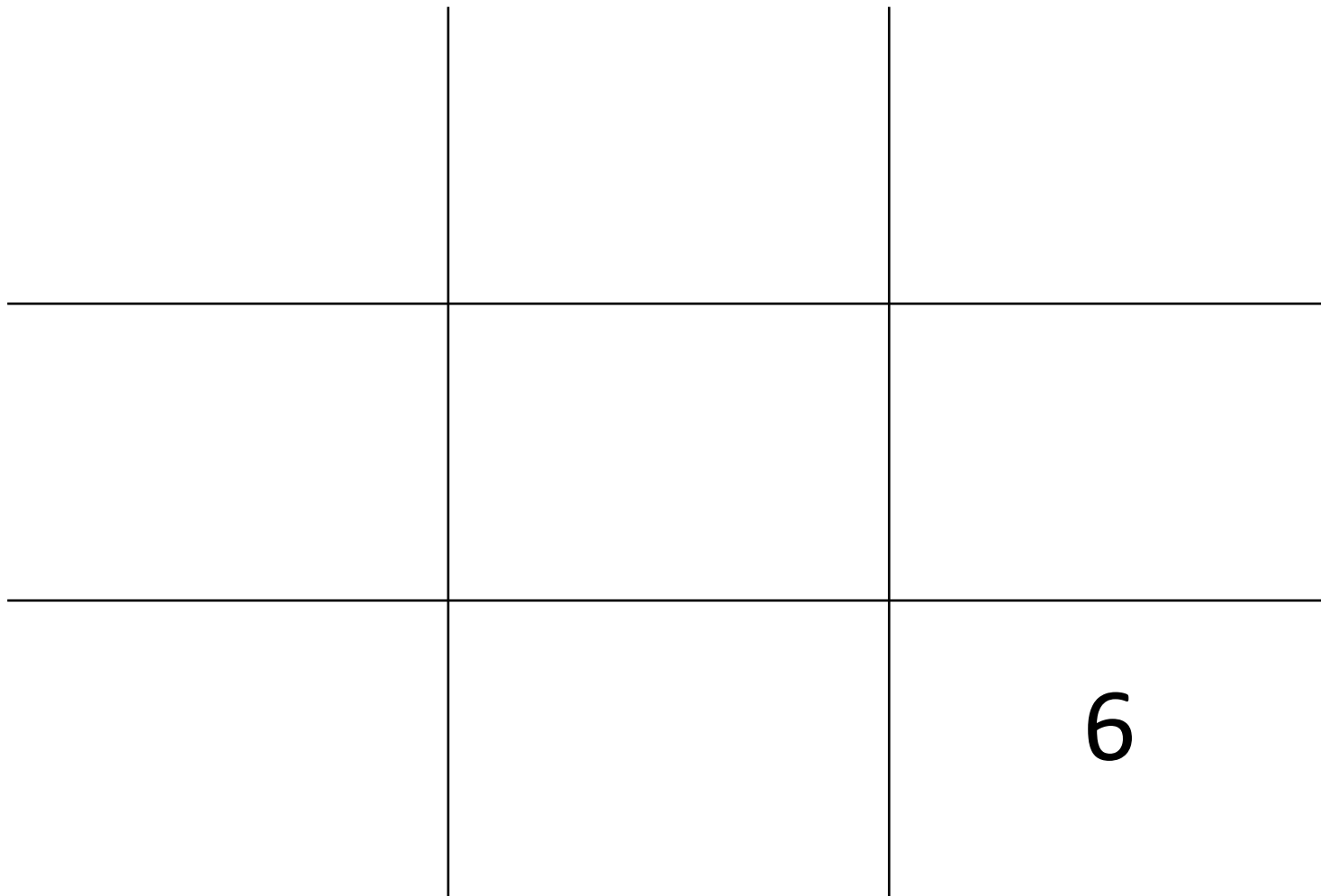
Let's Play

- Two players
- On the table, there are nine cards, numbered 1 to 9
- Players draw alternately
- The objective is to make a “book” – a set of 3 that adds to 15

Tic Tac Toe



Isomorphic Games



		6

Isomorphic Games

4	9	2
3	5	7
8	1	6

Solving a problem simply
means representing it so as to
make the solution transparent
(Simon, 1981)

External Cognition

- Also called “distributed cognition”

Source: Interaction Design:
Beyond Human-Computer
Interaction by Preece, Rogers,
and Sharpe

External Cognitive Activities



1. Externalizing memory load

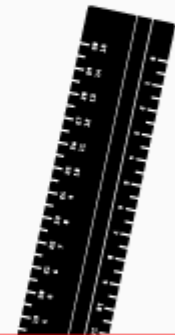
The practice of transferring knowledge to external representations to minimize memory load.

Examples include use of diaries, calendars, reminders, this blog and music annotations.

2. Computational offloading

The use of a tool or equipment together with external representations to perform computational tasks.

Examples include use of a calculator or pen and paper to divide up a bill, use of ruler to calculate length or distance.



3. Annotating, cognitive tracing

The modification of external representations including manipulation of order or structure.

Examples include drawing on a black board, checking off items on a list, and re-arranging cards.



Other Examples

Three Types of Distribution

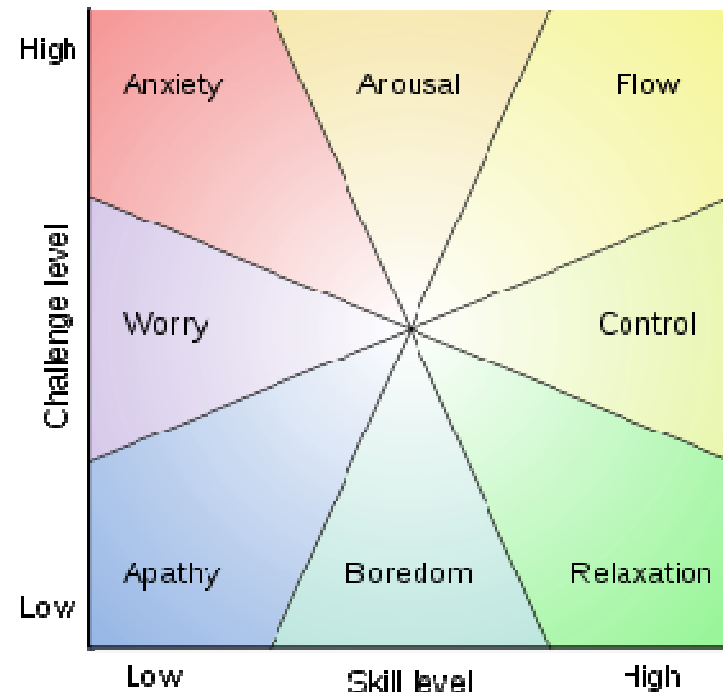
- Cognitive processes may be distributed across a social group
- Cognitive processes may involve coordination between internal and external structures
- Processes may be distributed through time
 - the products of earlier events can transform the nature of later events

Affordances

- Affordances “are what the environment offers animals, what it provides or furnishes, for good or ill.”
- For HCI, Norman focused on ‘perceived affordances’:
 - Perceived affordances tell the user what actions can be performed on an object and, to some extent, how to do them. They are more about conventions than about reality.

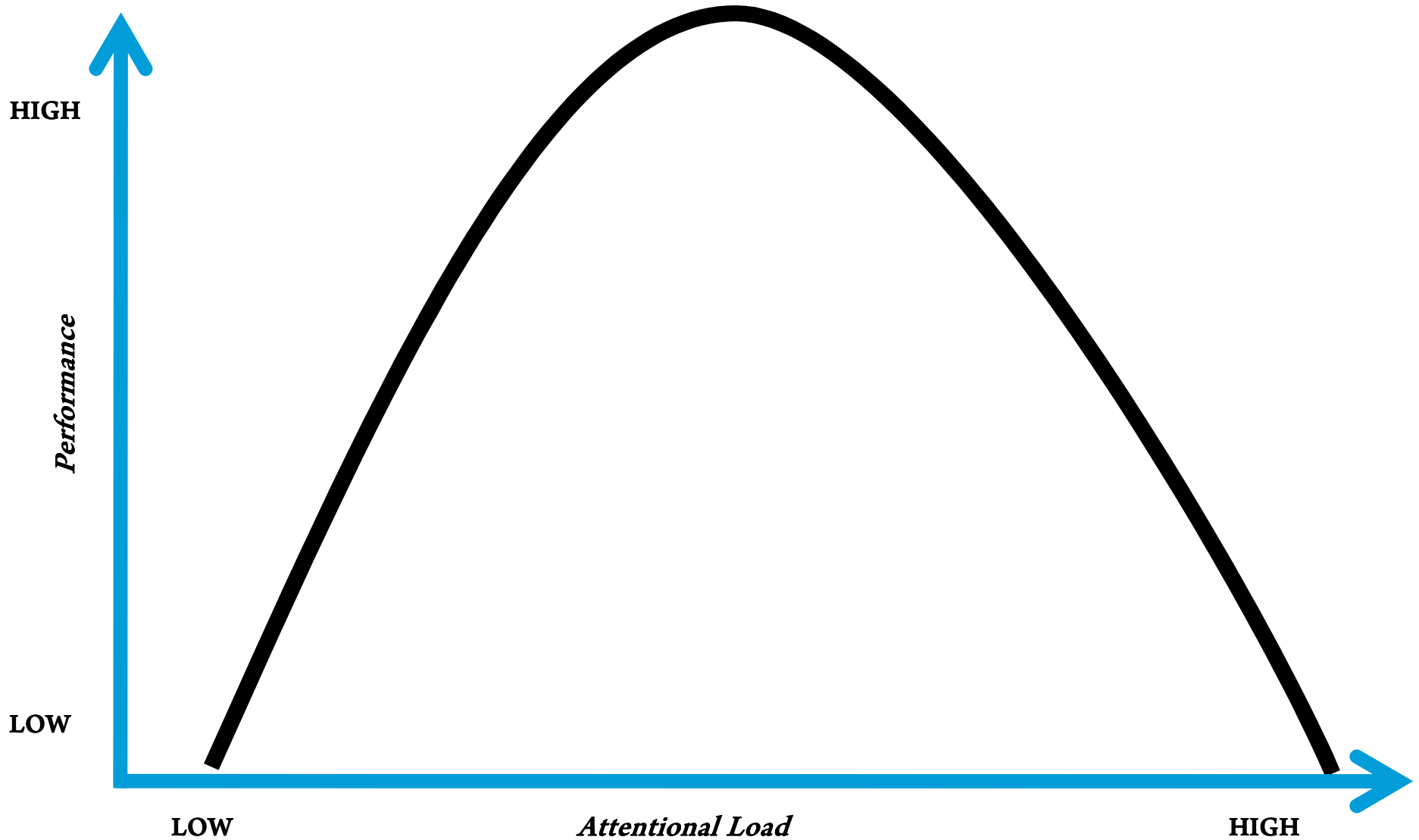
Csikszentmihalyi: Flow

- people are most happy when they are in a state of *flow*— a state of concentration or complete absorption with the activity at hand and the situation




http://en.wikipedia.org/wiki/Mihaly_Csikszentmihalyi

Attention, Stress, and Risk



example

Smart Cars



Anti-lock Brakes
Traction & Stability Control
Automatic Cruise Control
Lane-keeping systems

Risk



Tradeoffs

LOW RISK

HIGH RISK



Divergent Thought

Convergent Thought

Exploration/Simulation

Concentration/ Commitment

Safety/Playfulness

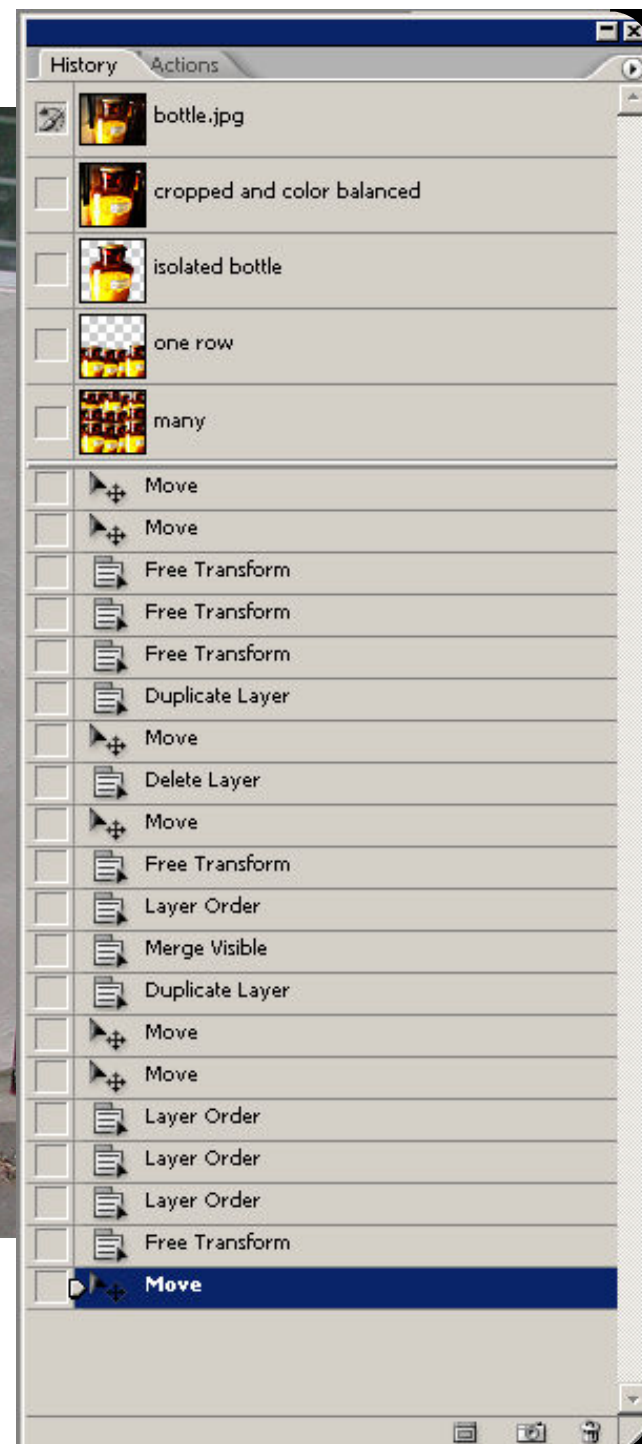
Exhilaration

Freedom to Act

Forced to Act

risk

Commitment



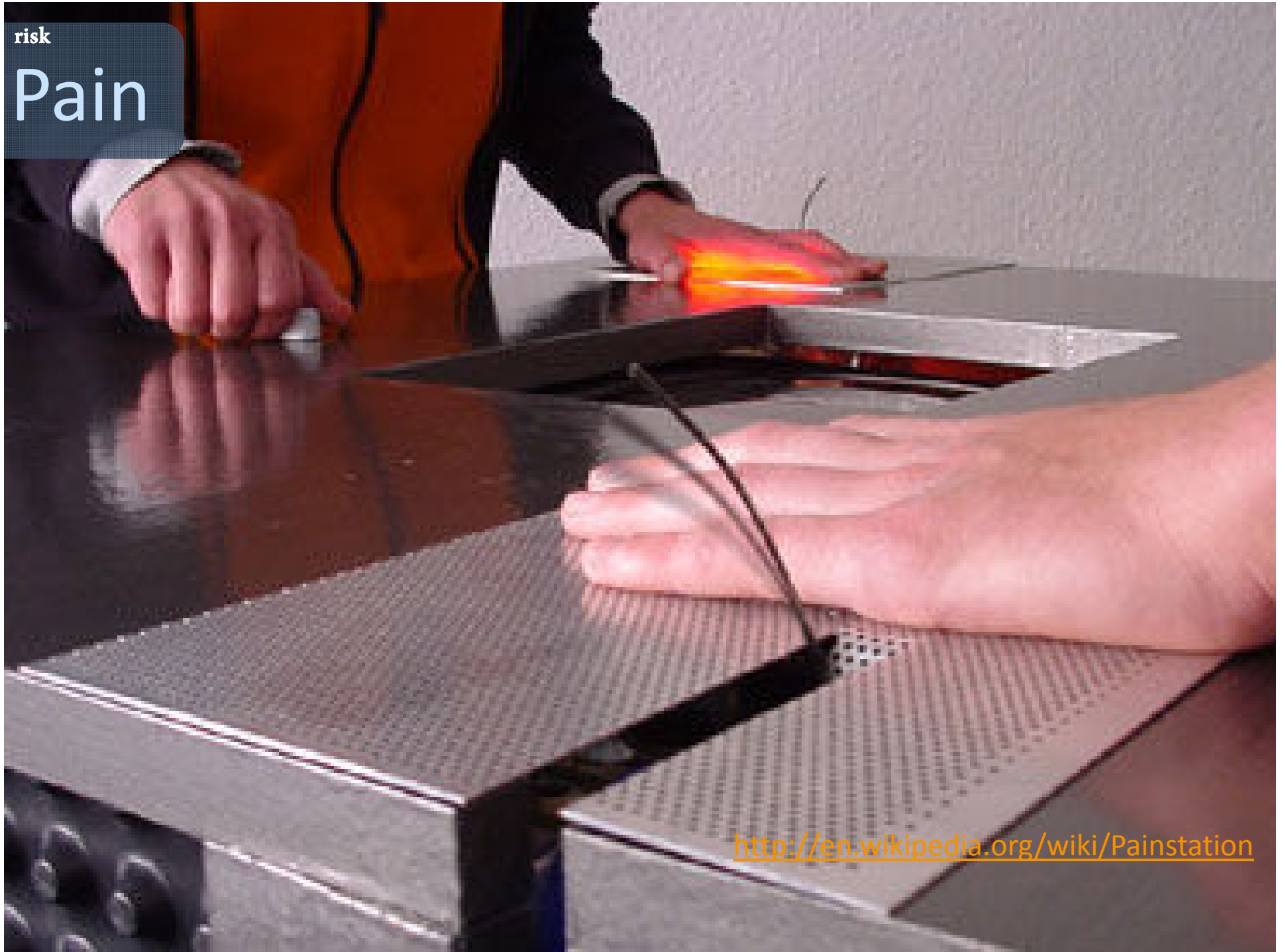
risk

Social Cost



risk

Pain



<http://en.wikipedia.org/wiki/Painstation>

HCI Theory

DESIGN REVIEWS AND CRITIQUES

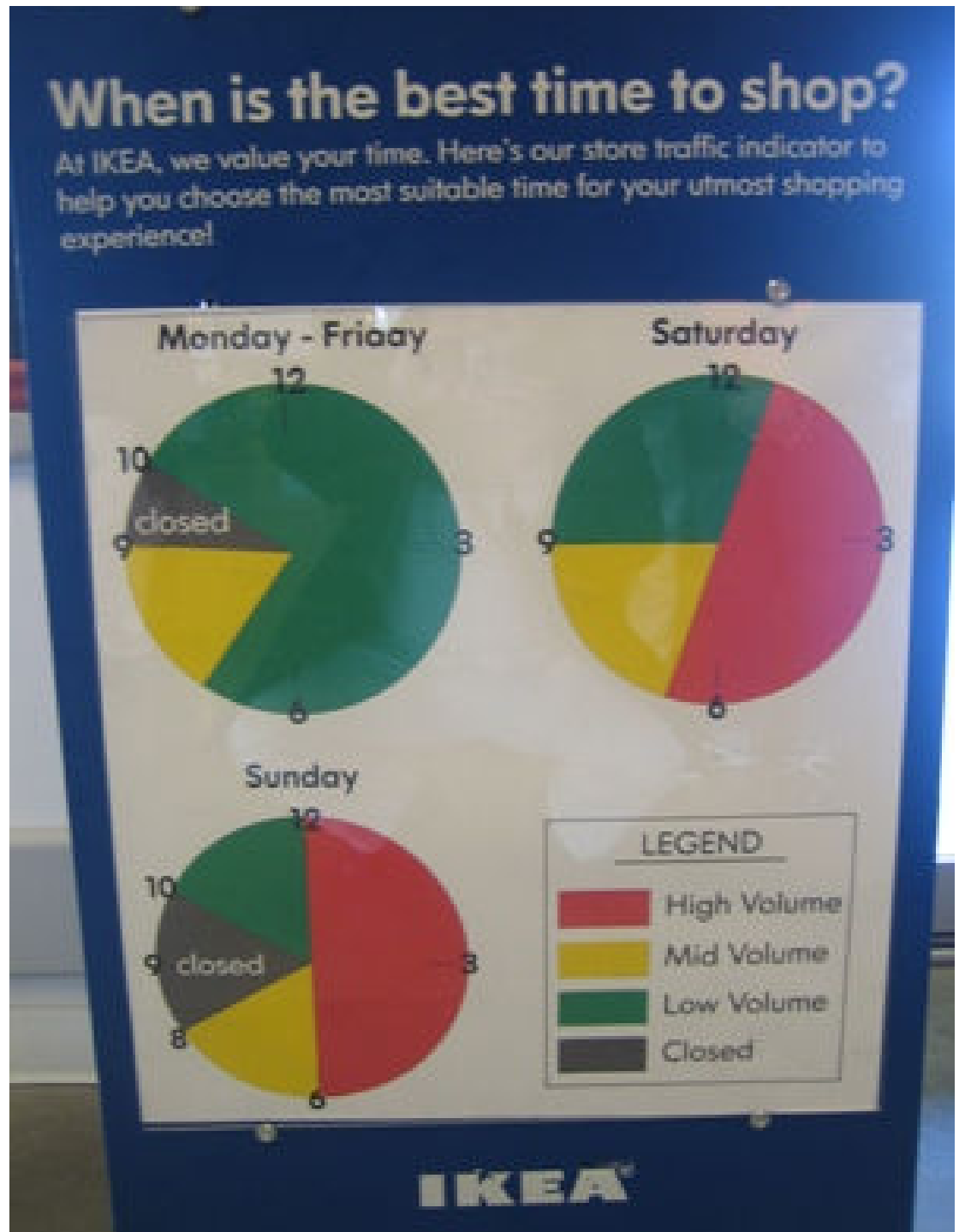
Neilson's Usability Heuristics

- Visibility of system status
- Match between system and the real world
- User control and freedom
- Consistency and Standards
- Help users recognize, diagnose, and recover from errors
- Error prevention
- Recognition rather than recall
- Flexibility and efficiency of use
- Aesthetic and minimalist design
- Help and documentation

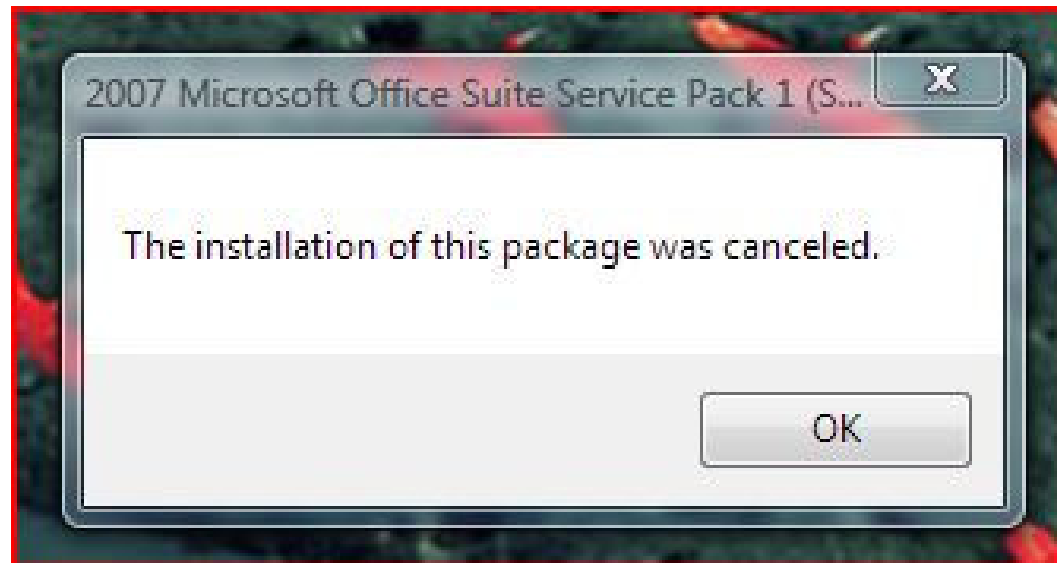
Norman's Model of Interaction

1. Goal is established
2. Intention is formed
3. The action sequence is specified
4. The action is executed
5. The system state after the action is perceived
6. The perceived system state is interpreted
7. The system state is evaluated based on the original goals and intentions (see stages 1 & 2)

Swedish Pie Charts



Cancelled.



Summary

- Today we introduced:
 - Two types of Navigation Design
 - The Cognitive Effects of Representation
- Next time
 - Implementing HCI software

Your Action Items

- Keep up with readings: textbook chapter 12, 14.2-14.4, 23.3
- Finish part 3a!

Ongoing Course Evaluation

- Please complete the Lecture 13 feedback form if you have comments!