Introduction to Human-Computer Interaction

This section will provide a (brief) introduction into designing software and technology in a way that makes it easier to use.

For more information:

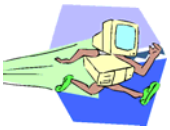
http://pages.cpsc.ucalgary.ca/~tamj/2008/481W/index.html

What Is Human-Computer Interaction?

- Basic definition: designing software and other technology to make it easier to use.
- Note: this doesn't mean that it will always be *easy* to use.
- Some applications involve extremely complex usage scenarios.
- In order for the technology to support the person using it some of the complexity has to be included in the technology.
  - –Examples: Scientific simulations, engineering applications, software for 3D modeling, financial software that must account for complex and detailed rules and regulations
- (Addendum to the definition: Don't make it any harder to use than it has to be).

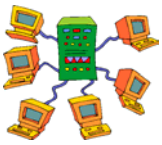
Human-Computer Interaction (HCI)

- Most of Computer Science deals with the 'technical' side of computers.



Run computers faster!

Make computers store more information!!



Increase the networking capabilities of computers!!!

- These technical issues (and others) are all very important but something is still missing...

Human-Computer Interaction

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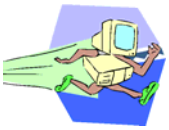

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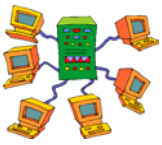


Increase the networking capabilities of computers!!!

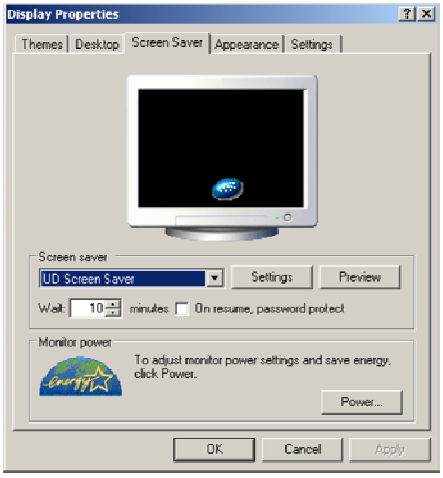
- These technical issues (and others) are all very important but something is still missing...

James Tam

Human-Computer Interaction

- ...but don't forget about the other side of the relationship.
- No matter how powerful the computer, and how well written is the software, if the user of the program can't figure out how it works then the system is useless.
- Software should be written to make it as easy as possible for the user to complete their task. (Don't make it any harder than it has to be).
- This is just common sense and should/is always taken into account when writing software?

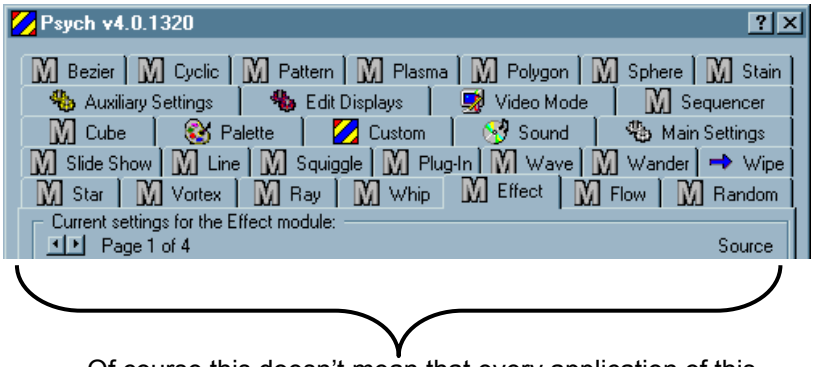
Human-Computer Interaction: Not Just Common Sense Information



Example:

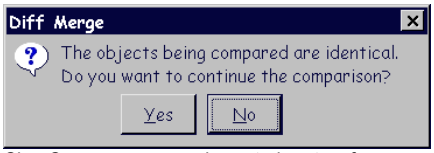
Grouping related functions (e.g., using tab folders) can be a good way of organizing the design and reducing the clutter.

Human-Computer Interaction: Not Just Common Sense Information (2)



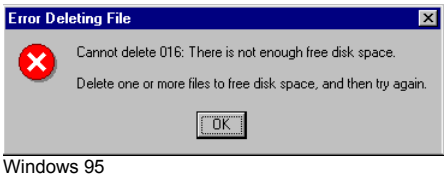
Of course this doesn't mean that every application of this approach is always a good one.

Human-Computer Interaction: Not Just Common Sense Information (3)



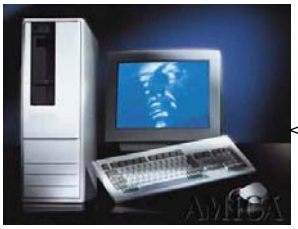
ClearCase, a source-code control system from Rational Software

Uhhh… I give up on this one [Mac shareware version of RISK]



Windows 95

Human-Computer Interaction (HCI) Deals With The Interaction Of A Person With A Computer



Technological perspective

Human perspective

Both components must be considered when designing and developing software

What Are Some Of The 'Human' Components Of HCI?

- There are far too many to develop a comprehensive list so just some of the important ones will be listed.
- Developing a clear and specific idea of who your user will be and what he/she wants to do with the technology (Task & User-centered design).
  - –Sounds common sense but surprisingly this component is ignored or minimized in actual practice to the detriment of the system being developed.
- Considering how people are physically 'wired' to perceive and process information and to represent information so that it can be noticed and interpreted more quickly (perception).

What Are Some Of The 'Human' Components For HCI? (2)

- Taking design principles from other areas and applying them, as appropriate in the design of software and technology.
  - –Graphic design: focuses on visual design and presentation.
    - Typical application: designing newsletters, magazines, product packaging, (book) publishing.
    - Techniques used include typography, page layout and the visual arts (ceramics, painting, sculpture, painting, photography, video and film making etc.)

What Are Some Of The 'Human' Components For HCI? (3)

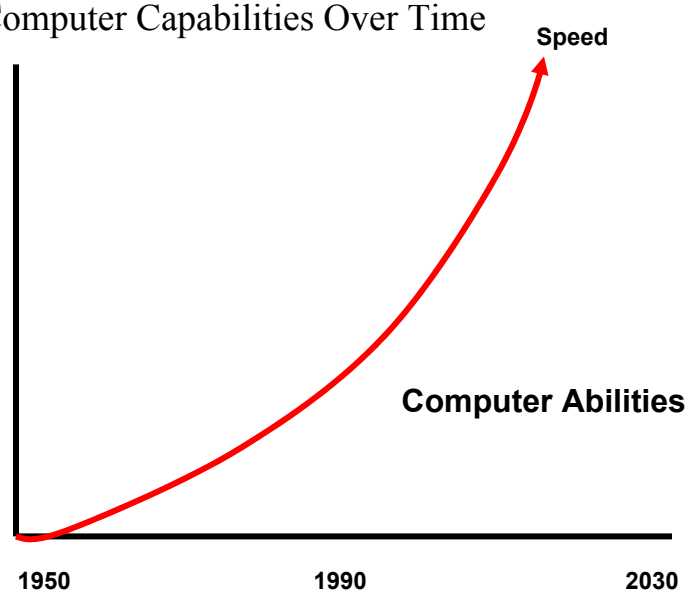
- –Industrial design: design of physical (real-world) objects
  - Typical application: anytime a physical object is built (car, lawnmower, cup, fan, remote control etc. etc.) – often work closely with people from the Engineering discipline.
  - Techniques and guiding principles: aesthetics ("looks good"), ergonomics (designing for safety and comfort), usability (the tool or object helps attain a particular goal).
- –Information visualization: encoding information in a way that:
  - makes it easier to find,
  - and once the information has been found the method of encoding makes it easier to interpret the information.
- –That is...really cool stuff!

Importance Of Human-Computer Interaction: Cost Of Using A Computer

- Costs from a technical perspective
  - –Hardware costs
  - –Software costs
- Costs from the user's perspective (personware)
  - –Training costs
  - –Daily usage

James Tam

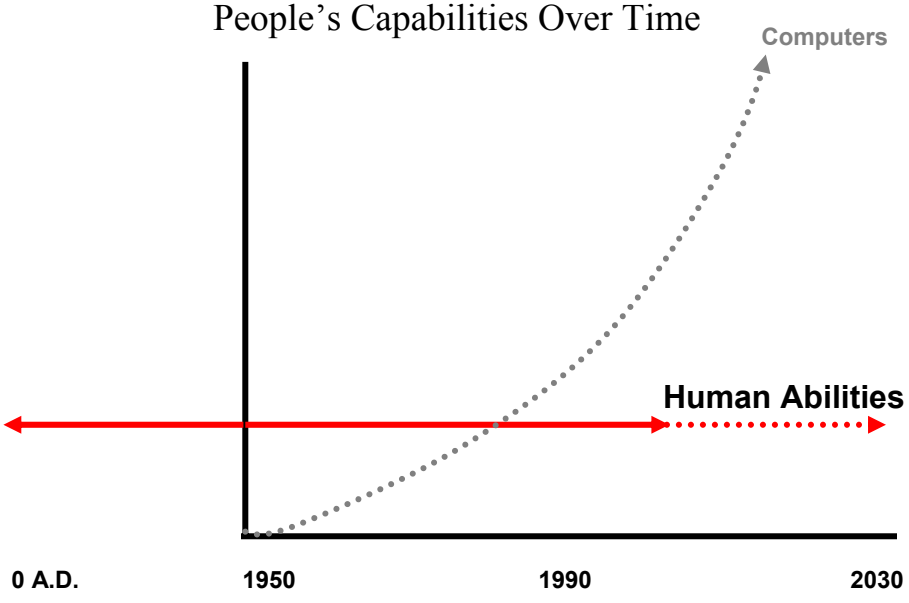
Computer Capabilities Over Time



These graphs are variations of those presented by Bill Buxton

James Tam

People's Capabilities Over Time



These graphs are variations of those presented by Bill Buxton

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Task-Centered Design

- Determining ***who*** will be doing exactly ***what*** with your system
- Traditional approach: focuses on the features of the software and the user is only considered peripherally.
  - –Designing for a faceless user: A pretend person that will magically change his or her abilities to adapt to your system (*elastic user*)

James Tam

Task-Centered Design (2)

- Task-centered approach: getting actual prototypical (good representative example) users and designing the system around their needs and capabilities:
  - –Designing for Mary Hart: A real person with real constraints that is trying to get her job done (*inelastic user*)

James Tam

Users "Who"

- Get in touch with real people who will be potential users of your system
  - –Identify an range of actual end users

Prototypical examples

Example users: Accountants

Extreme examples

James Tam

Tasks "What"

- Articulate concrete, detailed examples of activities they currently complete or those that they want to complete (ones that they want to do but can't do with the existing system)

Example task for in-store shopping
"Millie Varunda is price-comparing the costs of a child's bedroom set consisting of: a wooden desk, a chair, a single bed, a mattress, a bedspread, and a pillow all made by Furnons Inc. She takes the description and total cost away with her to check against other stores."

Approaches For Learning About Users

- Ways of getting information about users and their tasks
  - Direct contact (ideal)

  - Interview an intermediary (reasonable alternative)

OR

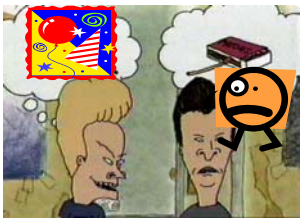
- If all else fails..
  - Describe your expected set of users and expected set of tasks
  - These will become your "assumed users and tasks"
  - Be sure that you verify this information and modify your assumptions accordingly

Methods For Involving The User

1. At the very least, talk to users
   - It's surprising how many designers don't!
2. Contextual Inquiries
   - Key characteristics:
     - **Interview** users **in their usage place** (e.g., office), **as they are going about their normal routine** (e.g., using your system while working)
   - Purpose:
     - Used to discover the user's culture, requirements, expectations, etc.

Methods For Involving The User (2)

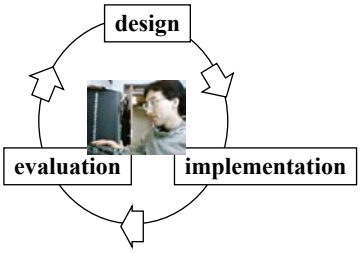
- 3) Create prototypes
  - It's hard to comment on something that doesn't yet exist



  - Users are good at giving feedback for something that is even partially built

Methods For Involving The User (3)

- 3) Create prototypes (continued)
  - –Get input at all design stages
    - All designs subject to revision



Early designs:

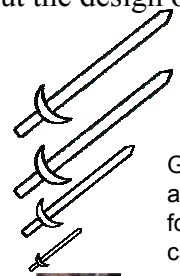
Techniques for developing prototypes early in the design process (before the first line of code is written)

Later designs:

The software development environment should make it easy to implement changes.

Industrial Design

- (Recall)Techniques and guiding principles: aesthetics ("looks good"), ergonomics (designing for safety and comfort), usability (the tool or object helps attain a particular goal).
- Industrial design isn't just about the design of a better 'tool'.

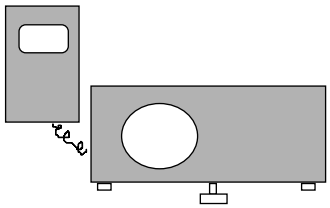


Good design always accounts for human capabilities

Images from "The Lord of the Rings (1978)" © Warner Home Video

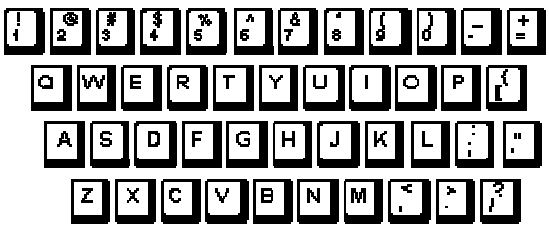
Simple Doesn't Always Mean Easy To Use

- Remote control from Leitz slide projector
  - How do you forward/reverse the slideshow?

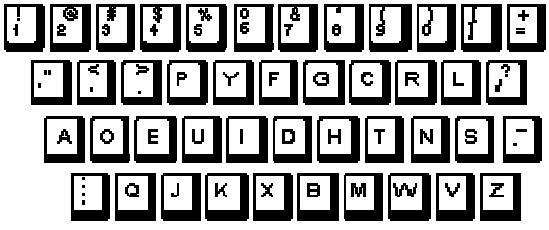


Challenge: Some Designs Are Resistant To Change, Computer Keyboards

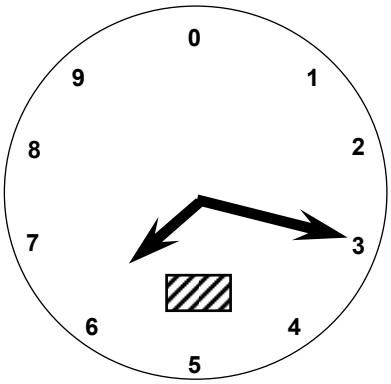
Qwerty



Dvorak



Challenge: The Interface Keeping Up With Technological Advances



- Early days (< 1000'):
  - Only one needle needed
- As ceilings increased over 1000'
  - Small needle added
- As they increased beyond 10,000'
  - Box indicated 10,000' increment through color change

< 10,000'

> 10,000'

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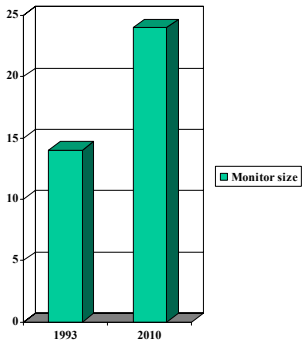
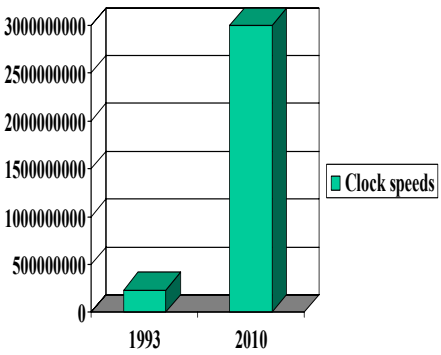
Challenge: The Interface Keeping Up With Technological Advances (2)





Note: This doesn't even take into consideration the challenge of small screen (mobile) displays.

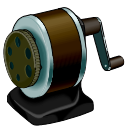
James Tam

Some Useful Principles From Industrial Design

- Visual affordances
- Visual constraints
- Mappings

Visual Affordances

- How something looks indicates *how it's can be used*
  - Chair for sitting
  - Table for placing things on
  - Knobs for turning
  - Slots for inserting things into
  - Buttons for pushing



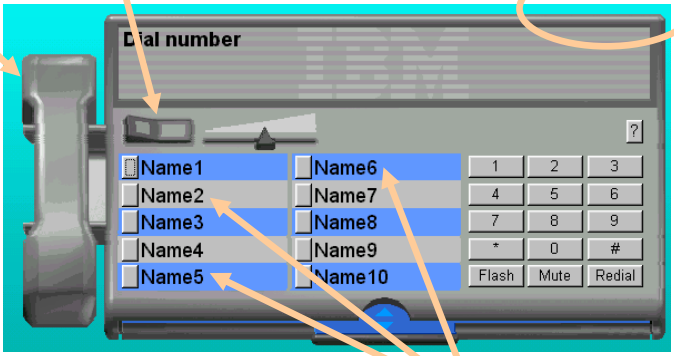
- Complex things may need explaining, but simple things should not
  - When simple things need pictures, labels, instructions, then design has failed
  - Their usage should be obvious based upon their appearance

Visual Affordances: Telephony

Is this a graphic or a control?

A button is for pressing, but what does this one do?

Visual affordances for window controls are missing!



Text is for editing, but you can't do that here

James Tam

Perceived Vs. Actual Affordances

- Perceived affordance: clues about how to use an object based on it's visual appearance.
- Actual affordance: the actual way in which an object actually should be used.
- If the perceived affordances aren't the same as the actual affordances then there's a problem!

James Tam

Perceived Vs. Actual Affordances (2)

• Perceived affordance of handles...lifting!

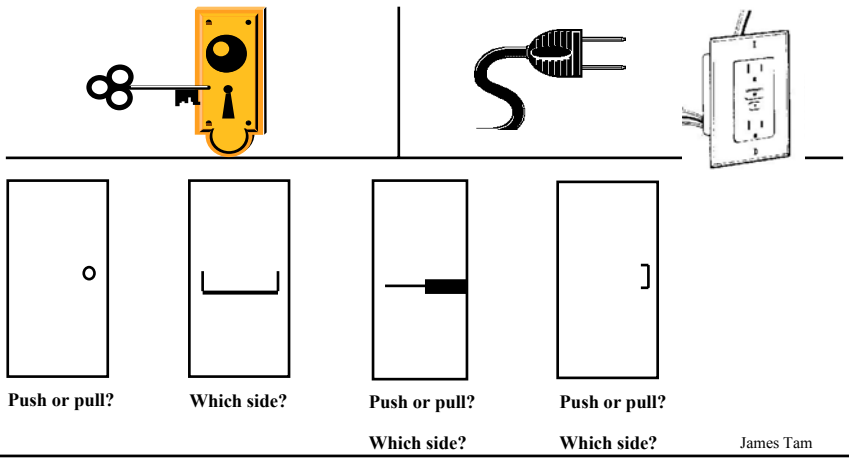
• Actual affordance of these handles...scrolling!

From *AudioRack 32*, a multimedia application

James Tam

Visual Constraints

• *Limitations* on the actions possible which are perceived from an object's appearance.



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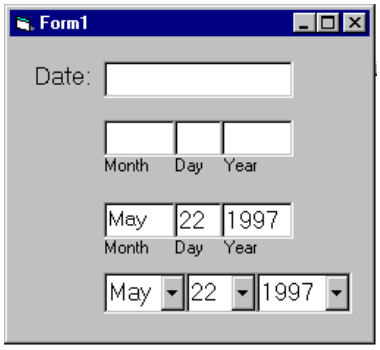
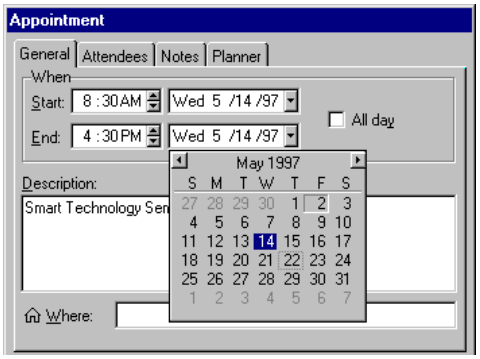
Visual Constraints: Calendar Controls

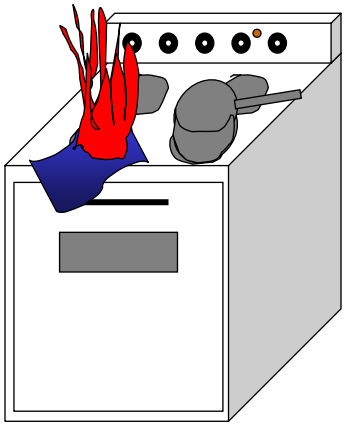




Visual Affordances And Visual Constraints In Computer Interaction

- These design principles (and the ones that follow) should guide the designer's choices in the method of interaction.
  - –e.g., Determining the minimum and maximum prices for buying a house
  - –What if you used text input?
  - –What if you used combo boxes?
  - –What if you tried a different control?

Mappings



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Mappings

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Mappings

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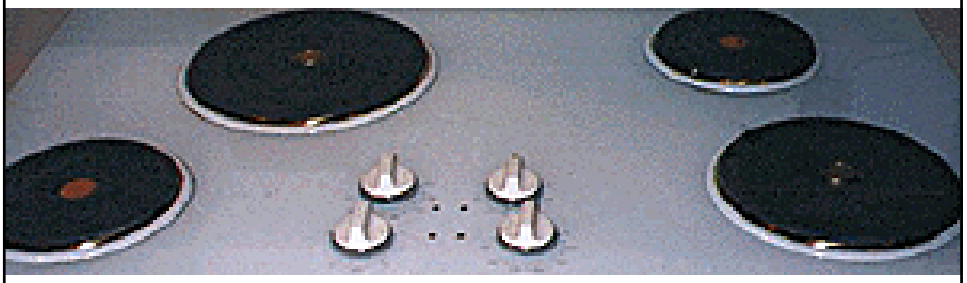
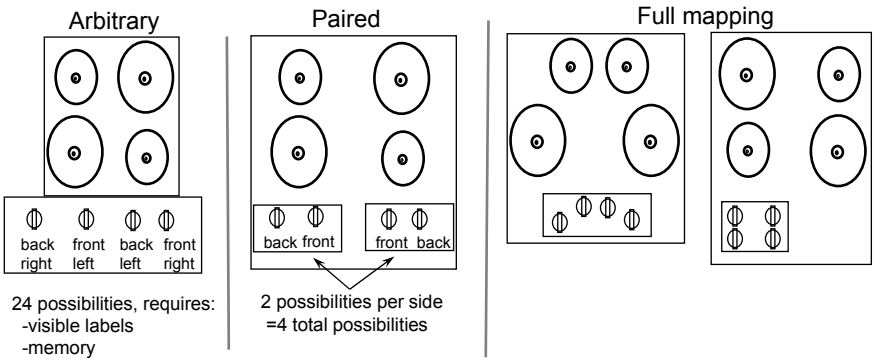


From www.baddesigns.com

James Tam

Mappings

- The set of possible relations between objects:
  - The relation between the control and what is being controlled
    - e.g., relationship between the burners and the mimic diagrams on a stove
  - Cause and effect relationships
    - e.g., turn the car's steering wheel right and the car goes right.



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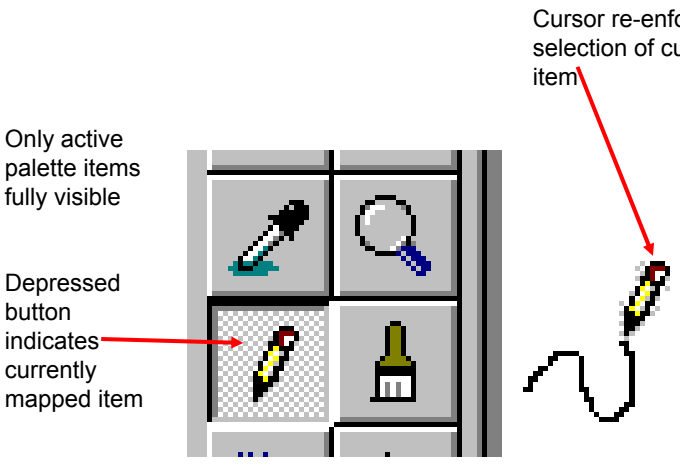
Mappings: Drawing Tools



MS-Paint

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Mappings: Input Devices

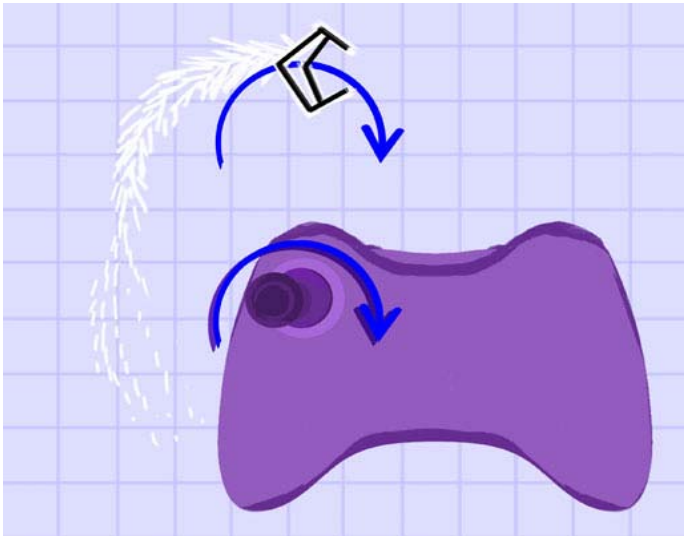


Image from: www.steveswink.com

Mappings

- "*If a design depends upon labels, it may be faulty. Labels are important and often necessary, but the appropriate use of natural mappings can minimize the need for them. Wherever labels seem necessary, consider another design*." – Don Norman

Why Design Is Hard

1) The number of things to control has increased dramatically

– E.g., Car radios:

1950's – 1970's

1990's – 2000's

Why Design Is Hard (2)

2) Displays are sometimes overly abstract

- Red lights in car indicate problems vs. flames for fire
- Is your digital watch alarm on and set correctly?

Why Design Is Hard (3)

3. Feedback can be more complex, subtle, and less natural
   - What is wrong with my printer?

Why Design Is Hard (4)

What Do The Buttons/Lights Do/Mean?

Why Design Is Hard (5)

4) Errors increasingly serious and/or costly
   - Airplane crashes, losing days of work...
   - From InfoWorld, Dec '86
     - "London:
     - An inexperienced computer operator pressed the wrong key on a terminal in early December, causing chaos at the London Stock Exchange. The error at [the stockbrokers office] led to systems staff working through the night in an attempt to cure the problem."

Image from the Washington Times January 9 2004

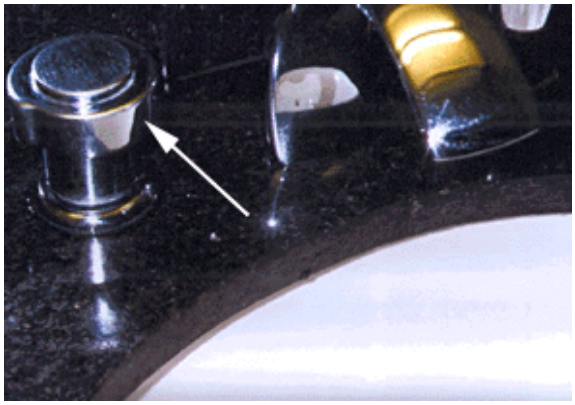
Why Design Is Hard (6)

5) Marketplace pressures

- Adding functionality (complexity) now easy and cheap
  - Computers & other electronics
- Adding controls/feedback expensive
  - Physical buttons on calculators, microwave ovens
  - Widgets consume screen real estate
- Design usually requires several iterations before success
  - Product pulled if not immediately successful

Why Design Is Hard (7)

6) People often consider cost and appearance over designing with Human Factors in mind
   –Bad design not always visible or obvious or it is not given priority



www.baddesigns.com

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Why Design Is Hard (8)

...Cost and appearance over Human Factors design

e.g., the wave of cheap telephones:

- Accidentally hangs up when button hit with chin
- Bad audio feedback
- Cheap pushbuttons—mis-dials common
- Trendy designs that are uncomfortable to hold
- Hangs up when dropped
- Functionality that can't be easily accessed (redial, mute, hold)

7) People tend to blame themselves when error

- "I was never very good with machines"
- "I knew I should have read the manual!"
- "Look at what I did! Do I feel stupid!"

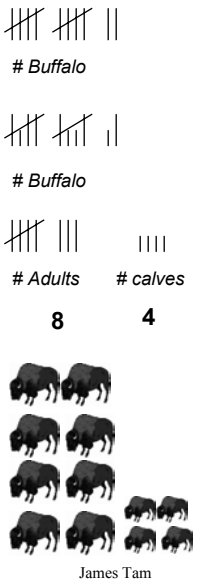
From "The Simspons"

James Tam

Information Visualization

- Another important component of Human-Computer Interaction.
- Good visualizations
  - Captures essential elements of the event / world
  - Deliberately leaves out / mutes the irrelevant
  - Appropriate for the person and their interpretation
  - Appropriate for the task, enhancing judgment ability

Example: How Many Buffalo?



Good Representations

- Information visualization is about using effective representations.
- There's two important guiding principles:
  1. Encoding information to make it easier to find the relevant information.
     - Solving a problem simply means representing it so as to make the solution transparent … ***(Simon, 1981)***
  2. (Once the information has been found) good representations makes it easier to make use of the information.
     - Allow people to *compute* desired conclusions
     - Trying to make use of the information may be: (i) a difficult process or (ii) "for free" depending on the representation chosen

Representations: The Information Is Present But Hard To Find

Representations: The Information Is Present But Making Sense Of It Requires Much Effort

Quarterly Income Statements
in millions, except earnings per share

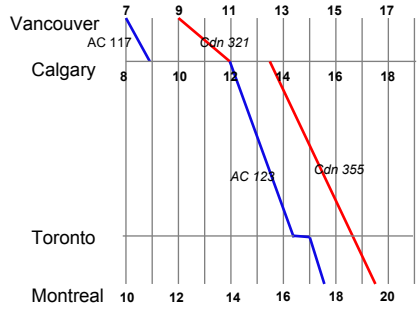
	Q2-01*	Q3-01*	Q4-01*	Q1-02	Q2-02	Q3-02	Q4-02	Q1-03	
Revenue	$ 6,550	$ 6,403	$ 6,577	$ 6,126	$ 7,741	$ 7,245	$ 7,253	$ 7,746	$
Operating expenses:									
Cost of revenue	864	899	867	978	1,691	1,567	1,463	1,344	
Research and development	990	1,069	1,364	1,398	1,595	1,474	1,832	1,707	
Acquired in-process technology									
Sales and marketing	1,290	1,198	1,359	1,457	1,676	1,449	1,670	1,415	
General and administrative	212	239	236	286	885	343	329	252	
Other expenses									
Total operating expenses	3,356	3,405	3,826	4,119	5,847	4,833	5,294	4,718	
Operating income	3,194	2,998	2,751	2,007	1,894	2,412	1,959	3,028	
Losses on equity investees and other	(28)	(46)	(33)	(30)	(37)	(11)	(14)	(22)	
Investment Income	751	706	(2,620)	(980)	553	739	(617)	41	
Noncontinuing items									
Income before income taxes	3,917	3,658	98	997	2,410	3,140	1,328	3,047	
Provision for income taxes	1,293	1,207	33	319	771	1,005	425	1,006	
Income before accounting change	2,624	2,451	65	678	1,639	2,135	903	2,041	
Cumulative effect of accounting change	-	-	-	-	-	-	-	-	
Net income	$ 2,624	$ 2,451	$ 65	$ 678	$ 1,639	$ 2,135	$ 903	$ 2,041	$
Preferred stock dividends									
Net income available for common shareholders	$ 2,624	$ 2,451	$ 65	$ 678	$ 1,639	$ 2,135	$ 903	$ 2,041	$
Basic EPS before accounting change	$0.25	$0.23	$0.01	$0.06	$0.15	$0.20	$0.08	$0.19	
Diluted EPS before accounting change	$0.24	$0.22	$0.01	$0.06	$0.15	$0.19	$0.08	$0.19	

James Tam

Example One: Which Is The Best Flight?

		Depart	*Arrive*
AC 117	Vancouver - Calgary	7:00	9:00
Cdn 321	Vancouver - Calgary	9:00	12:00
Cdn 355	Calgary - Montreal	13:30	19:30
AC 123	Calgary - Toronto	12:30	16:30
AC 123	Toronto - Montreal	16:45	17:30

*time zone: +1 van-cal, +2 cal-tor, mtl



James Tam

Example Two: When Do I Take My Drugs? (From "*Things That Make Us Smart*" By Don Norman

- *Note: 10 - 30% error rate in taking pills, same for pillbox organizers*
  - Inderal - 1 tablet 3 times a day
    Lanoxin -1 tablet every a.m.
    Carafate - 1 tablet before meals and at bedtime
    Zantac - 1 tablet every 12 hours (twice a day)
    Quinag - 1 tablet 4 times a day
    Couma - 1 tablet a day

	Breakfast	Lunch	Dinner	Bedtime
Lanoxin	O			
Inderal	O	O	O	
Quinag	O	O	O	O
Carafate	O	O	O	O
Zantac		O		O
Couma				O

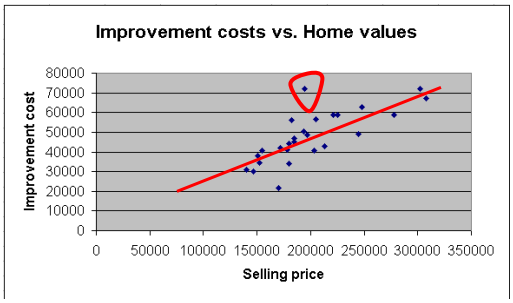
Breakfast	Lunch	Dinner	Bedtime
Lanoxin			
Inderal	Inderal	Inderal	
Quinag	Quinag	Quinag	Quinag
Carafate	Carafate	Carafate	Carafate
	Zantac		Zantac
			Couma

Organized by both time of day and by drug

James Tam

Example Three: Do I Deserve A Tax Break

	A	B
1	Market value ($)	Improvement cost ($)
2	140000	31120
3	147000	29980
4	151000	38120
5	152000	34360
6	155000	40710
7	170000	21620
8	172000	42100
9	178000	41070
10	180000	34210
11	180000	44090
12	182000	55960
13	185000	45170
14	185000	46820
15	193400	50200
16	**194500**	**71860**
17	197000	48460
18	203000	40720
19	205000	56600
20	213000	42780
21	221000	58770
22	225000	58960
23	245000	48910
24	248000	62620
25	278000	58580
26	302500	72200
27	308000	67320



James Tam

Pictures Vs. Words: When To Use Pictures

- People have a powerful ability to recognize images that they have previously seen.
  - e.g., Standing et. al. (1970)[1] had over a 90% accuracy rate with test subjects recognizing whether or not they had previously seen an image (out of 2560 viewed over several days)

1 Standing, L., Auto Numbering, I., and Haber, R.N. (1970) Perception and memory for pictures: single trial learning of 2560 visual stimuli. Psychonomic Science 19: 73 – 74).

James Tam

Pictures Vs. Words: When To Use Pictures

- Pictures are better than text for showing structural relations.

Text

Jane is Jim's boss.

Jim is Joe's boss.

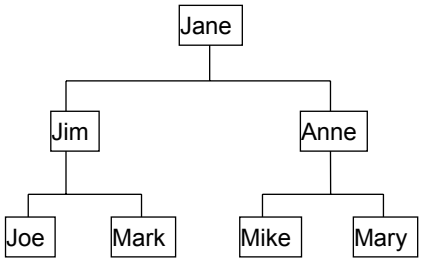
Anne works for Jane.

Mark works for Jim

Anne is Mary's boss.

Anne is Mike's boss.

Structure diagram



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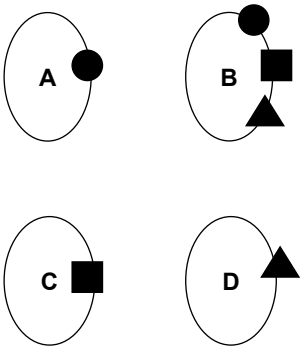
Pictures Vs. Words (2)

- Generally images should when:
  - –Structural information must be shown (links between entities or groups of entities).
  - –A great deal of information needs to be remembered (images are more easily recalled than text except for abstract images e.g., when the concept being represented is new and must be represented abstractly by an image and out of context).

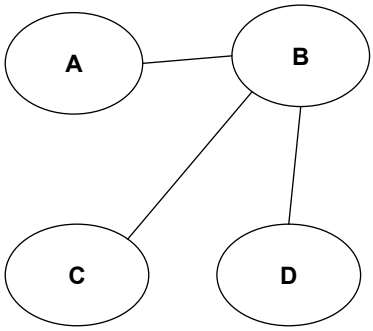
- Generally text or the spoken language should be used when:
  - –Abstract concepts must be portrayed e.g., freedom, efficiency.
  - –The information is complex, procedural or non-spatial (it isn't related to something in the physical world).

Not All Diagrammatic Representations Are Equally Effective

First representation



Second representation



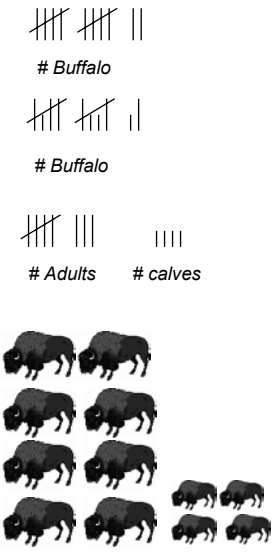
From Information Visualization: Perception for Design by Colin Ware.

Tufte's Principles Of Information Visualization[1]

- Graphics should reveal the data
  - Show the data
  - Not get in the way of the message
  - Avoid distortion
  - Present many numbers in a small space
  - Make large data sets coherent
  - Encourage comparison between data
  - Supply both a broad overview and fine detail
  - Serve a clear purpose

1 "Visual Display of Quantitative Information" by E. Tufte
Note: Some of the visual examples on the following slides are taken from Tufte's books

Show The Data



Not Get In The Way Of The Message

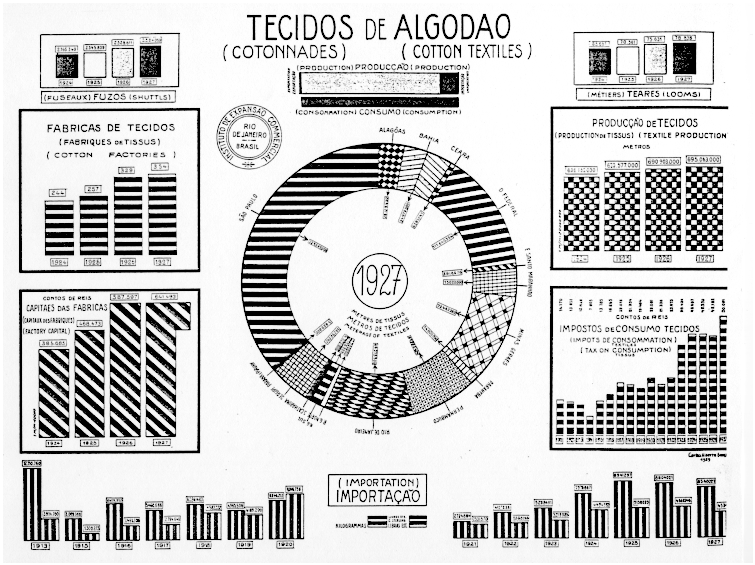


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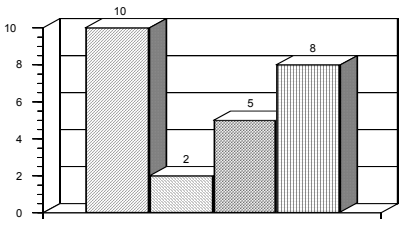
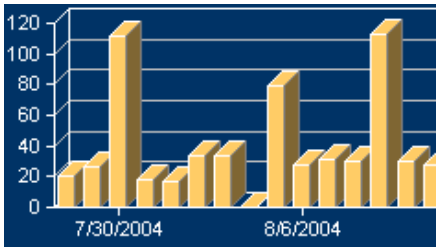
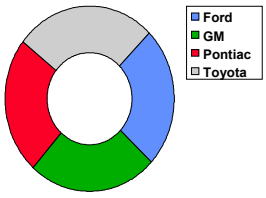
Chart Junk: A Common Error (The Representation Getting In The Way Of The Message)

- Information display is not just pretty graphics
  - Graphical re-design by amateurs on computers gives us
    - Overly complicated or even deceptive representations







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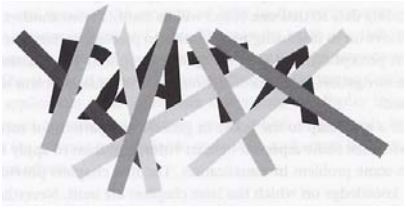
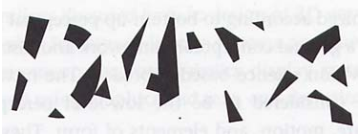
The Representation Should Not Get In The Way Of The Message

- But it's not just as simple as removing "irrelevant" information.

Extra clutter?

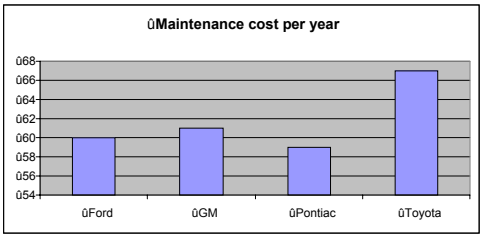


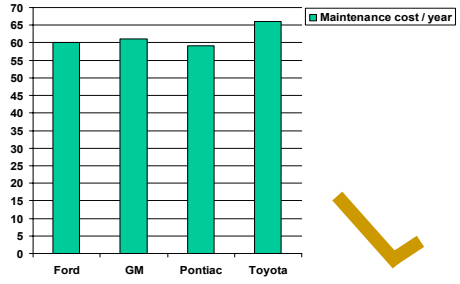
Is the message clearer?



From "Information Visualization: Perception for Design" by Colin Ware

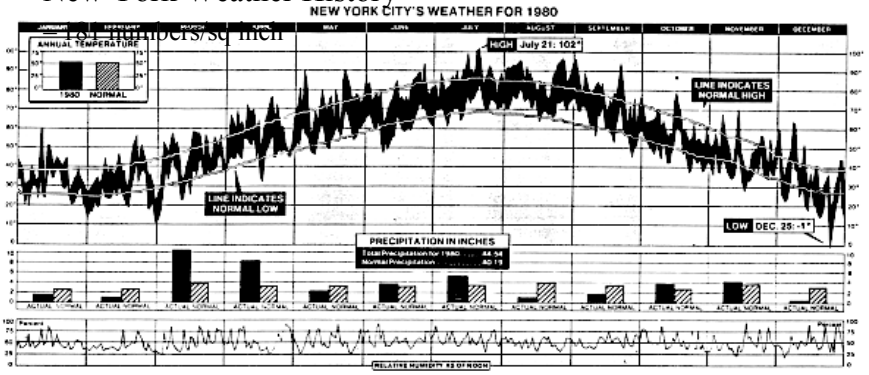
Avoid Distortion: The Representation Alters The Message





Present Many Numbers In A Small Space, Make Large Data Sets Coherent

- New York Weather History
  - 181 numbers/sq inch



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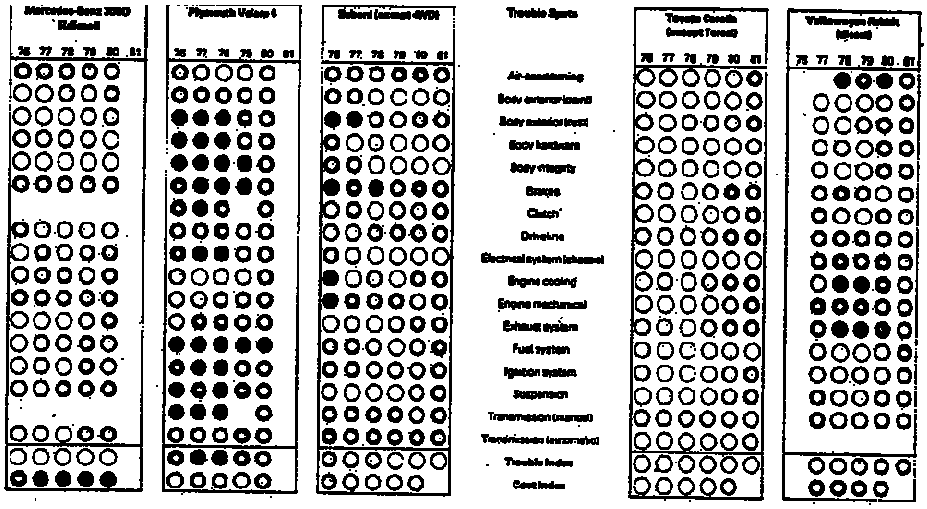
Encourage Comparisons Between The Data, Broad Overview And Fine Detail



James Tam

Representing Information And Perception

- Information visualization: deals with the problem of representing abstract information (often when there is too much information to show at once e.g., stock information, geological data, astronomical information etc.)
- Leveraging knowledge about human perception can produce a more effective representation.
- Making sense of a large data set is a two stage process[1]:
  1. Extracting low level properties of the visual scene (narrowing down the focus)
  2. Sequential goal-directed processing (once the focus has been narrowed to a part of data set, the goal is to extract details) e.g., using representations like text.

1 From "Information Visualization: Perception for Design" by Colin Ware

Extracting Low Level Properties Of The Visual Scene

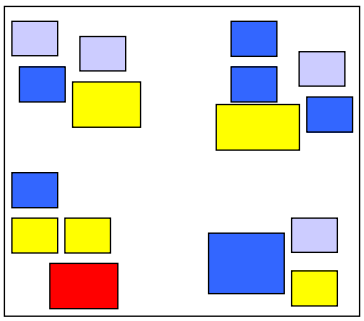
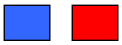
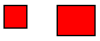


Diagram being viewed

- Different properties of diagram are processed by the neurons in the retina.
- This processing automatically occurs.
- The processing is done in parallel

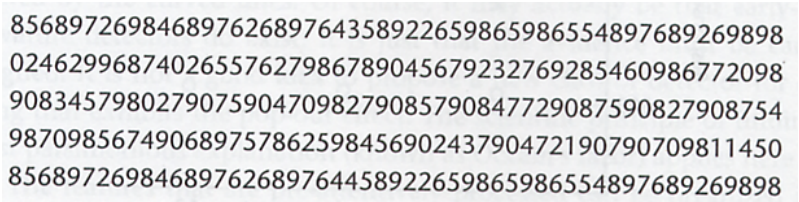
Extracting Low Level Properties Of The Visual Scene (2)

- Characteristics of visual information that can be automatically processed:
  1. Processing cannot be inhibited
  2. Information is rapidly processed
  3. Information can be processed in parallel
  4. Can be understood without training
- Communicate information by relying on perceptual powers of the brain without learning.

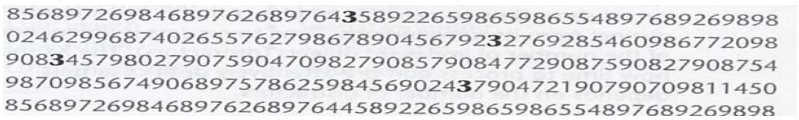
  Examples:
  - Color 
  - Size 
  - Position, shape, value (brightness, orientation, texture, movement)

Extracting Low Level Properties Of The Visual Scene (3)

- Representing information in a manner that can be automatically processed can help the person browse a large data set.

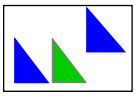


Vs.



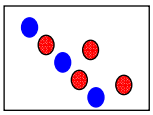
Color: The Most Used (And Misused) Representation

- Color works well for:
  - –Making things stand out



This is **important** stuff!

  - –Grouping related items



Heading 1
- Subheading
- Subheading

Heading 2
- Subheading
- Subheading

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Using Color (2)

- Color should not be used for:
  - –Communicating numerical information

  - –Example: An inappropriate use of color

Demographics of medical study participants

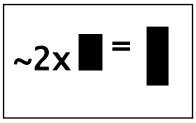
LEGEND

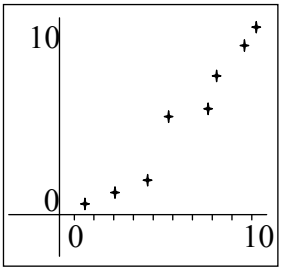
Icon	Age of participant
	14
	15
	16
	17
	18

James Tam

Using Color (3)

•In cases where exact numerical information must be shown consider using alternative representations such as a graph (size in a bar graph or position in a scatter graph).

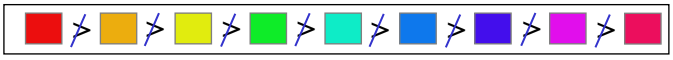




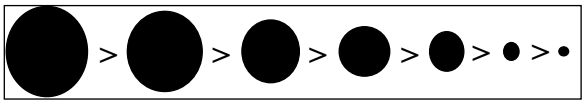
Using Color (4)

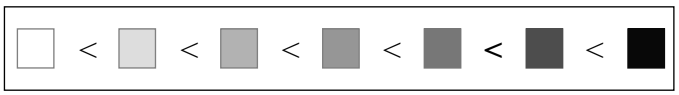
•Color should not be used for:

–Showing a ranking between items



–(In these cases): Consider using something else like size, position or brightness/value.

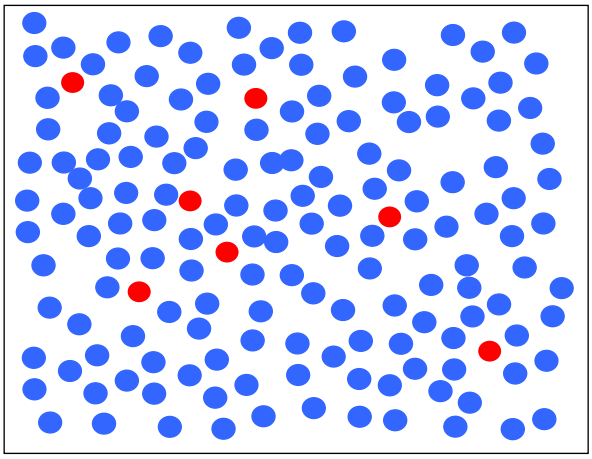




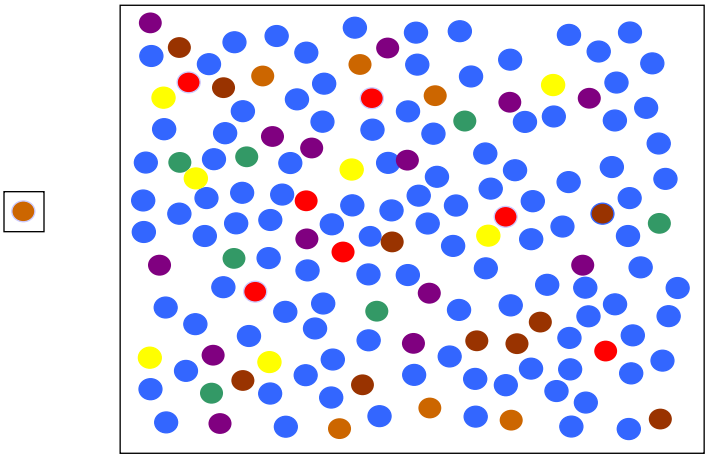
Use Color Sparingly

•Don’t use color like did when you were a child.

Color Is Used Sparingly: Effective



The Increased Use Of Color: Mutes The Message



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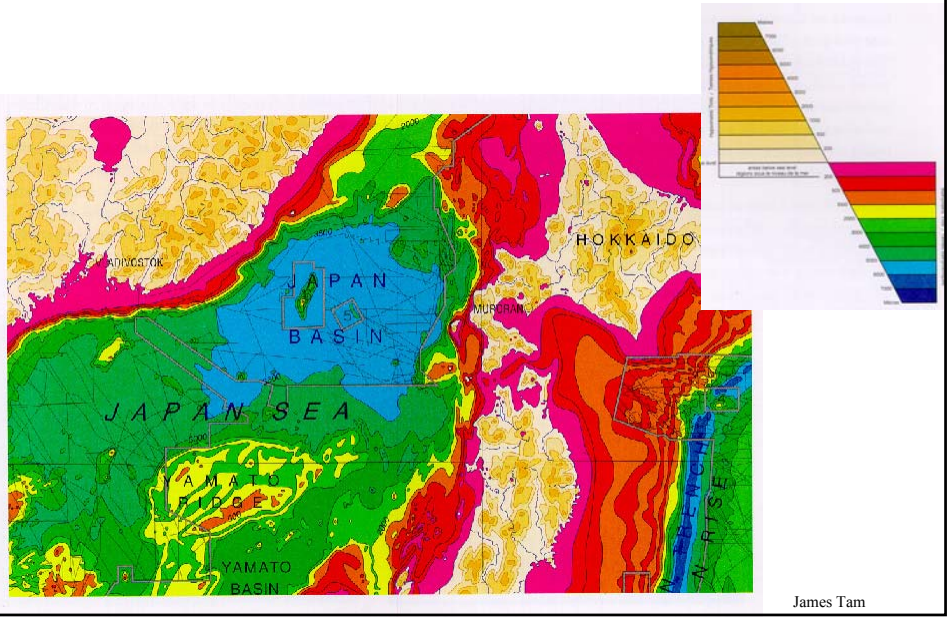
Over Use Of Color: Mutes The Message



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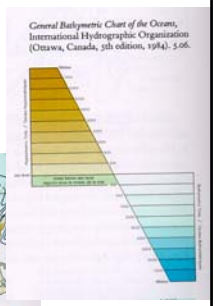
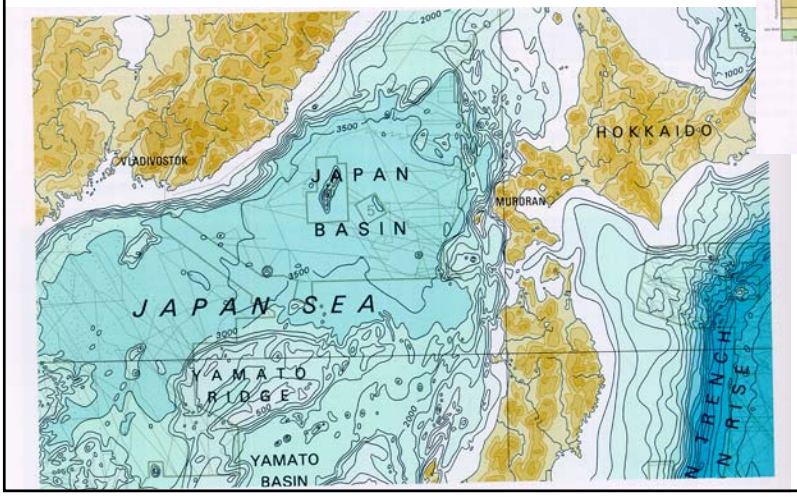
Color Is Used Sparingly: Effective





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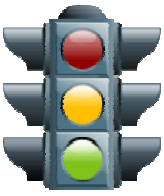
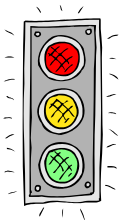
Additional Issues Associated With Color

- Color blindness:
  - The majority of people who are color blind are red-green color blind so these colors should be avoided when communicating information.
  - Or represent the information with these colors and also represent it using another mechanism e.g., traffic lights.





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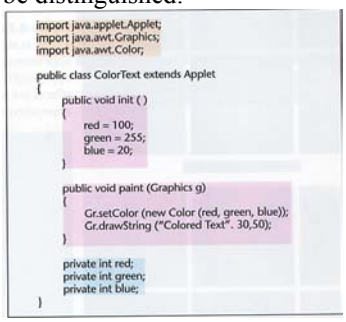
Additional Issues Associated With Color (2)

- Field size
  - –The larger the area to be color coded, the more easily that colors can be distinguished.



```
import java.applet.Applet;
import java.awt.Graphics;
import java.awt.Color;

public class ColorText extends Applet
{
    public void init ( )
    {
        red = 100;
        green = 255;
        blue = 20;
    }

    public void paint (Graphics g)
    {
        Gr.setColor (new Color (red, green, blue));
        Gr.drawString ("Colored Text", 30,50);
    }

    private int red;
    private int green;
    private int blue;
}
```

  - –This means that if you use color for a large surface area you can use more muted/subtle colors. If you are using color for a small surface area then you need richer colors in order to make them stand out more.

Additional Issues Associated With Color (3)

–When objects are small (text or small images) and color is used to distinguish information use stronger (more noticeable) colors.

This is **important** information!

This is **important** information!

–Generally though muted colors are preferable to ones that are overly bold.

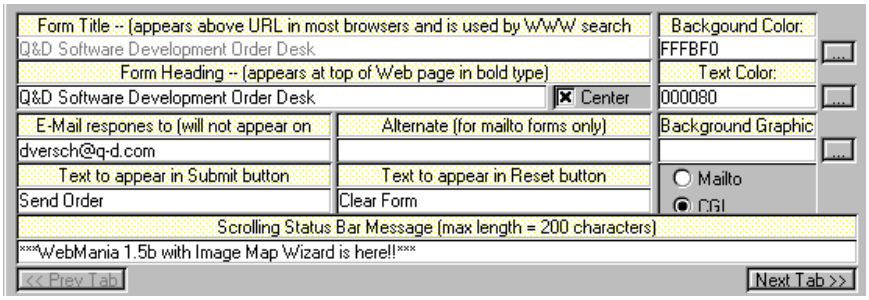
Absorb what is useful

Absorb what is useful

Graphic Design

- (Recall): It focuses on visual design and presentation.
  - –Typical application: designing newsletters, magazines, product packaging, (book) publishing.
  - –Techniques used include: typography, page layout and the visual arts (ceramics, painting, sculpture, painting, photography, video and film making etc.)

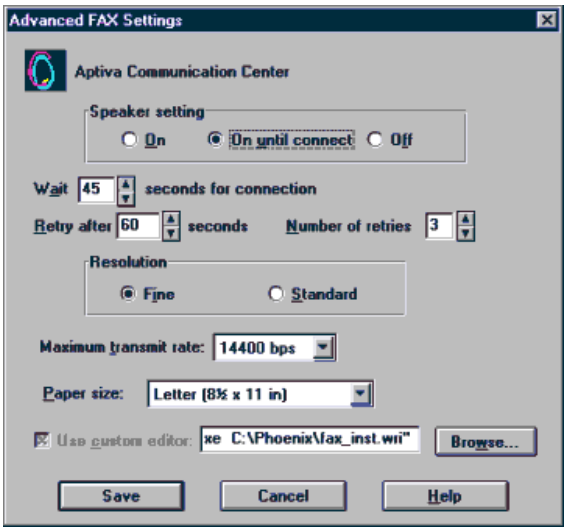
Example Of A Poor Presentation: Input Vs. Output?



Webforms

- **Problems:**
  - –What Are The Input Fields?
  - –What Is Output Only?
- **Causes:**
  - –Bad alignment
  - –Poor choice of colors to distinguish labels from editable fields

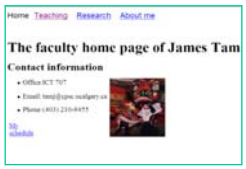
Example Of A Poor Presentation: No Regard For Order and Organization



IBM's *Aptiva Communication Center*

The Squint Test: A Tool For Evaluating Layout

- Squint at the document or screen so that details (such as text) appear blurred.



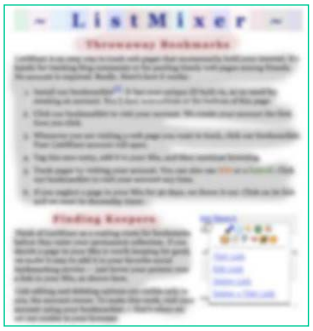
Original webpage

Blurred version

- It's used to determine what stands out or what elements appear to belong together
  - The goal is to determine the overall structure by hiding details

A Webpage That Fails The Squint Test

Original webpage



Blurred version

Images from: http://www.usabilitypost.com/

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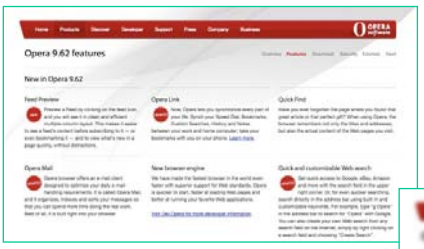
A Webpage With Better Squint Test Results



Original webpage

Blurred version

Images from: http://www.usabilitypost.com/

James Tam

An Important Tool For Graphical Screen Design & Evaluation[1]

- Contrast
- Repetition
- Alignment
- Proximity

1 From "The Non-designers Design Book" by Robin Williams

Contrast

- Make different things look very different
- Make important things stand out, less important things are made more subtle

Poor contrast ✗

Heading
Subheading
Heading
Subheading
Heading

Stronger contrast √

Heading
Subheading
Heading
Subheading
Heading

Example: Insufficient Contrast

http://www.webdesignfromscratch.com

- Grey is overused: makes it harder to read.
- Problems compounded by small text and logo size.
- (The Firefox logo is the most prominent part yet it's not a key part of the page).

Example: Revised Webpage, Better Contrast

http://www.webdesignfromscratch.com

- The main logo stands out more
- The background is changed to make the text easier to read
- Also the change in background color makes the headings stand out more.

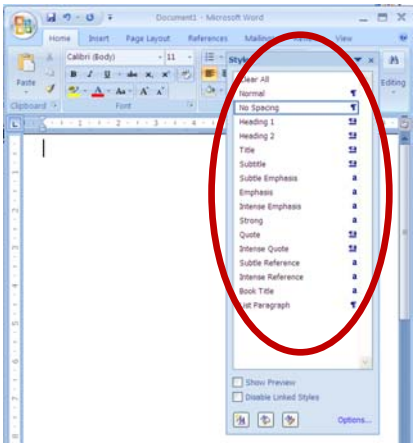
Repetition

- Consistency
- Repeat conventions in order to demonstrate structure and relationships

From "The Non-Designers Design book by Robin Williams

Repetition When Using MS-Word

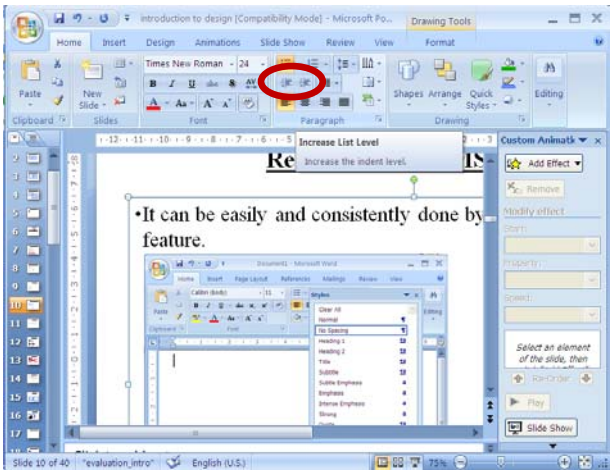
- It can be easily and consistently done by using the 'styles' feature.



MS-Word © Microsoft

Repetition When Using MS-PowerPoint

•It can be enforced by using the 'levels' (level of bulleting) feature.



MS-PowerPoint © Microsoft

James Tam

Alignment

•Visually associate related elements by lining them up

•Alignment can structure a document or screen by suggesting structure.

Poor alignment (center alignment)

Heading	Heading	Heading	Heading
xxxxxxxx	xxxxxxxxxxxx	xxxxxx	xxxxxxxxxx
xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx		xxx	xxxxxxxxxxxxxx
xxxxxxx	xxxxxxxxxxxx	xxxxxxx	xxxxxxxxxxxxxx

James Tam

Alignment (2)

- Overuse of centering can make it harder to determine the structure of onscreen elements.

```
while ((reRun == 'y') || (reRun == 'e'))
                {
            if (reRun != 'e')
                b.scan();
              b.display();
            generation += 1;
System.out.println("\t\tGeneration: " + generation);
System.out.print("Do you wish to play another generation (y/n): ");
reRun = (char) Console.in.readChar();
          Console.in.readLine();
            if (reRun == 'e')
                b.edit();
                }
```


Alignment (3)

- Details are important!

Figure 1: Nurse

Figure 2: Doctor

Image and caption are aligned on the same axis.

Image and caption are aligned on the same axis.

Alignment (4)

Figure 1: Nurse

Figure 2: Doctor

Proximity

- Group related elements
- Separate unrelated elements

Even proximity: hard to distinguish headings and text

Who are you?
James Tam
How did you end up at your position?
Far too long a story to tell here. *lol*
Where do you work/live?
Normally Calgary Alberta, currently Doha Qatar.

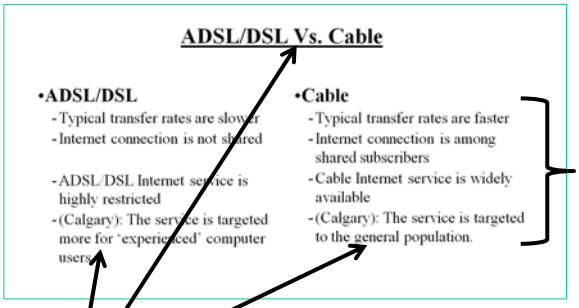
Proximity used to group related headings and text, separates different points

Who are you?
James Tam

How did you end up at your position?
Far too long a story to tell here. *lol*

Where do you work/live?
Normally Calgary Alberta, currently Doha Qatar.

Proximity (2)



Proximity is used to group these related items

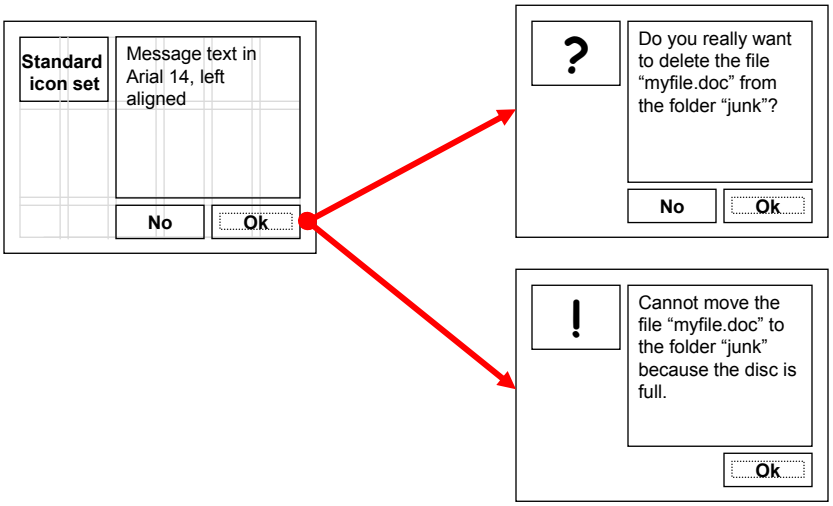
Proximity is used to separate these three groups

How Do These Principles (Contrast, Repetition, Alignment, Proximity) Apply

- As a design tool
  - As you create a graphic representation: software, webpage, report, spreadsheet, PowerPoint presentation etc. make sure that it conforms to these principles.

- As an evaluation tool
  - After the document or graphical design has been created these four principles can be used to determine how well it has been designed (how easy or hard it is to view and make sense of the design).

Using A Grid: Consistent



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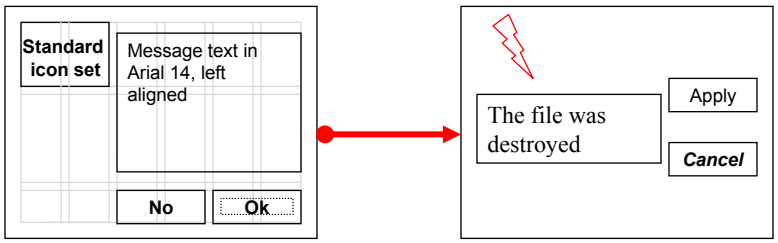
No Grid: Inconsistent



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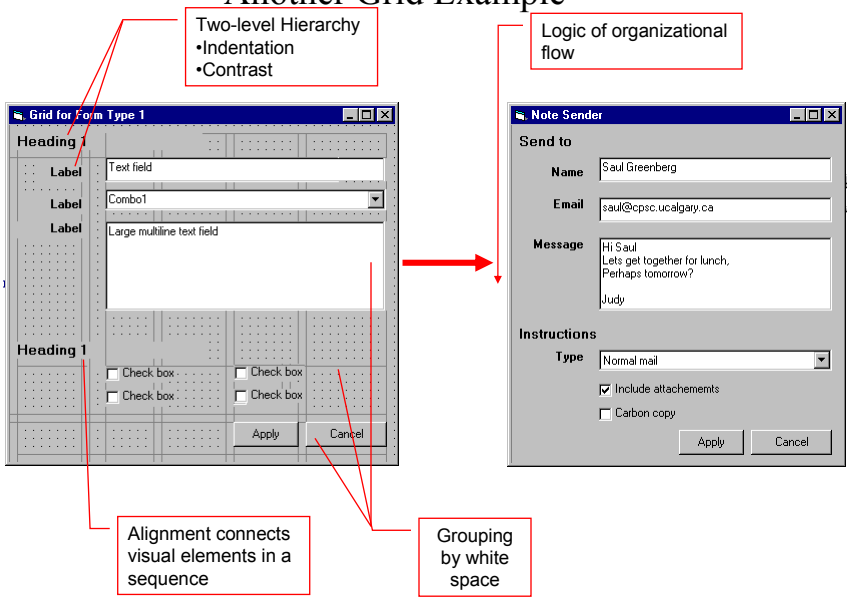
Another Grid Example



James Tam

Structure Is Difficult To Ascertain

With permanent persistence, the effort needed to find changes i.e., the acquisition cost is low because the information is always there. Ideally, a person merely has to shift their gaze over to see the information. Because people can become accustomed to the occurrence of workspace events, they can also ignore things that do not interest them and pay closer attention to things that are of interest (Gutwin 1997).

With passing persistence, information about changes is presented only for a limited duration. This is useful when the information applies only to a specific portion of the project (artifact or group of artifacts) being viewed, or when the change information otherwise becomes irrelevant. This is quite an important point for us. The matrix in Figure 4.1 suggests that these dimensions can be combined, giving eight possibilities. For example, a literal, situated and passing display of changes is depicted in Figure 4.2a. The figure shows an animation of a changed circle (by using a 'replay' technique) where the circle literally retraces the path that it took as it was moved. It is situated because the animation occurs in the same place that the change actually happened. The persistence is 'passing' because once an animation has replayed a change, the information is gone. Figure 4.2b shows two other examples within a concept map editor. The first illustrates the symbolic, situated and permanent octant, where color value (shades of gray) is used to indicate changed 'Jim' and 'Jack' nodes. Thus, it is symbolic because changes are mapped to a gray scale value, situated because the shading is applied directly to the node that was changed, and permanent because the color values are always on. Figure 4.2b also portrays an example of the symbolic, separate, and passing octant, where a person can raise a node's change details in a pop-up as a text description by mousing-over the node. Thus it is somewhat separate as the information appears outside the changed node, it is symbolic as it uses the text to describe the changes, and passing because the pop-up disappears when the person moves the mouse off the node (not quite on the node). In summary, these three dimensions provide the designer with a means of classifying change information. I now turn to other display issues, where we need to represent the change information in an easily understood and readily accessible fashion.

James Tam

Structure Is Difficult To Ascertain: Structure Is Don't Impose An Explicit Structure

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In summary, these three dimensions provide the designer with a means of classifying change information. I now turn to other display issues, where we need to represent the change information in an easily understood and readily accessible fashion.

James Tam

Structure Is Implied With White Space

With permanent persistence, the effort needed to find changes i.e., the acquisition cost is low because the information is always there. Ideally, a person merely has to shift their gaze over to see the information. Because people can become accustomed to the occurrence of workspace events, they can also ignore things that do not interest them and pay closer attention to things that are of interest (Gutwin 1997).

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James Tam

Structure Helps Determine Relationships Between Screen Elements

– Using white space (negative proximity) vs. forcing an explicit onscreen structure (e.g., the use of bounding boxes)

No structure

Mmmm:
Mmmm:
Mmmm:
Mmmm:
Mmmm:

✘

Explicit structure

Mmmm:
Mmmm:

Mmmm:
Mmmm:
Mmmm:

✘

Implicit structure

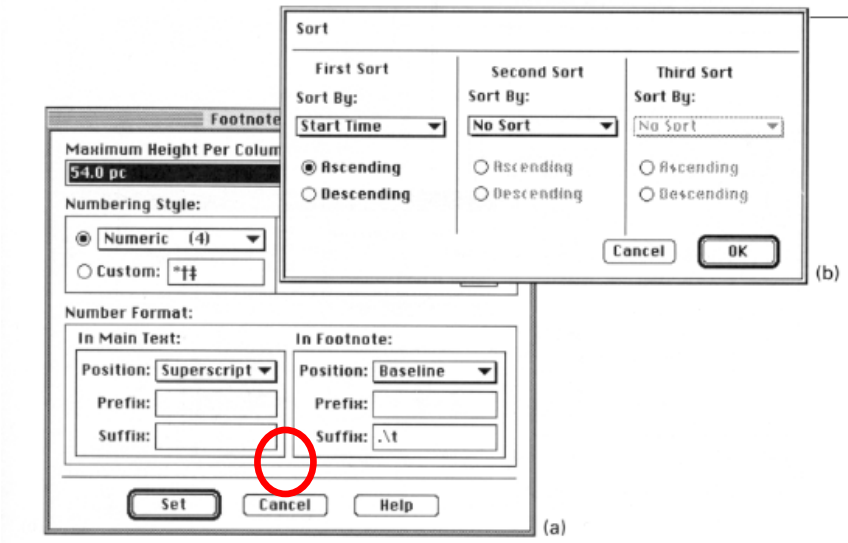
Mmmm:
Mmmm:

Mmmm:
Mmmm:
Mmmm:

✓

James Tam

Examples Of Explicit Structure



Using explicit structure as a crutch from Mullet & Sano page 31

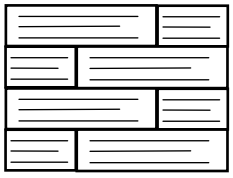
James Tam

Navigational Cues Are Important In The Real World

James Tam

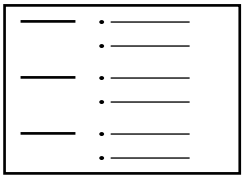
Navigational Cues

- Provide initial focus
- Direct attention to important, secondary, or peripheral items as appropriate
- Assist in navigation through material



✗

✓



✓

James Tam

Legibility And Readability: Fonts And Font Effects (2)

- Proper use of typography
  - 1-2 typographical effects (typeface or typography) - 3 max
    - Font types, normal, italics, bold, underline
  - 1-3 fonts sizes max

Large
Medium
Small

Readable

Design components to be inviting and attractive

Design components to be inviting and attractive

✓

Large
Medium
Small

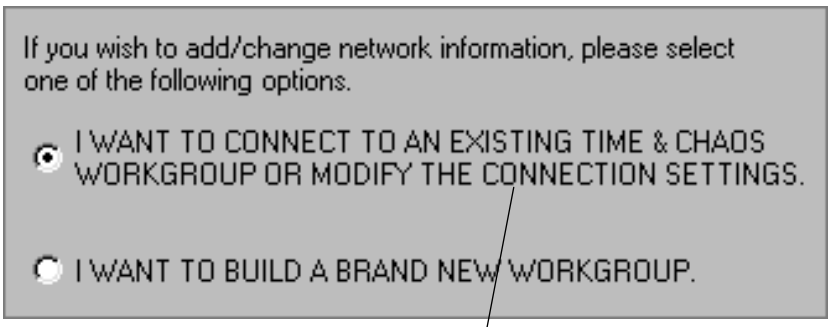
Unreadable

Design components to be *inviting* and attractive

Design components to be **inviting** and ***attractive***

✗

Legibility And Readability: The Effect Of Capitalization



These choices must be really important, or are they?

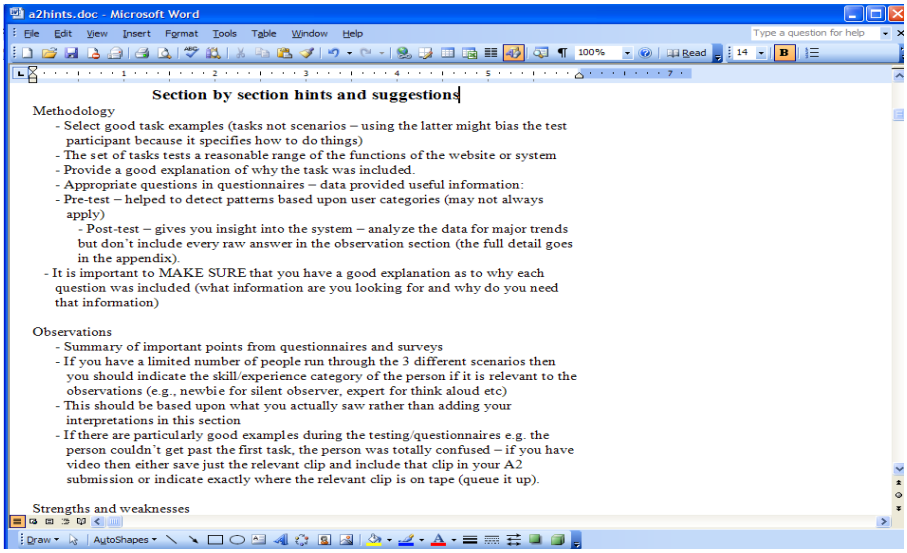
Legibility And Readability: The Effect Of Capitalization (2)

DO NOT OVERUSE CAPITALIZED TEXT BECAUSE CAPITAL LETTERS ARE HARD TO READ. ALTHOUGH SOME PEOPLE BELIEVE THAT USING CAPITAL LETTERS WILL DRAW ATTENTION TO THEIR MESSAGE AND MAKE THEM STAND OUT MANY PEOPLE TEND TO SKIP READING OVER CAPITALIZED TEXT.

Do not overuse capitalized text because capital letters are hard to read. Although some people believe that using capital letters will draw attention to their message and make them stand out many people tend to skip reading over capitalized text.

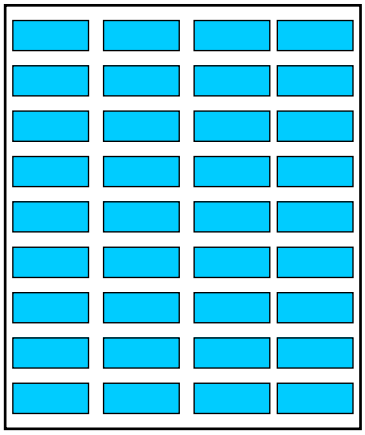
James Tam

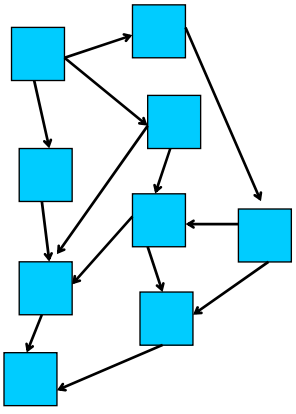
Use Capitalization Sparingly



James Tam

Balance Between Too Many Controls On A Single Screen Vs. Too Many Screens

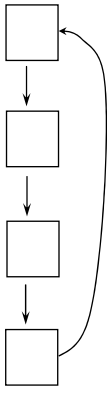


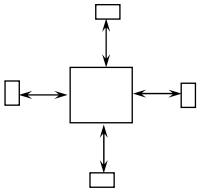


Screen Design And Complexity

– How can window navigation and clutter be reduced?

- Avoid long paths
- Avoid deep hierarchies
- Re-factor/combine functions





The Gestalt School Of Psychology

- Founded in 1912 to investigate the way that people perceive form:
  - –How do people organize the world into meaningful units and patterns.




What Is A Gestalt?

- Gestalt: is German for ‘pattern’ or ‘configuration’.
- Motto of the Gestalt psychologists:
  - –“The whole is more than the sum of it’s parts’.
  - –What you perceive is greater than what you see.
  - –Example one: Motion is perceived from a series of still images


What Is A Gestalt? (2)

–Example two: the following is more than just a series of splotches of light and dark (a pattern can be perceived).

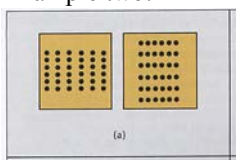
The Gestalt Laws

- They are rules that describe the way that people see patterns in visual displays:
  1. Proximity
  2. Similarity
  3. Continuity
  4. Symmetry
  5. Closure
  6. Relative size
  7. Figure and ground

1. Proximity

- Things that are near to each other tend to be grouped together.
  - –Example one:

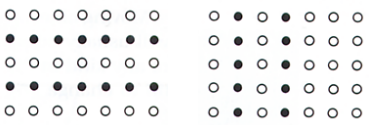
  - –Example two:



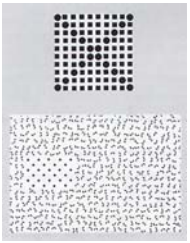
2. Similarity

- Things that are alike tend to perceived as belonging together.
- Similarity can be perceived in many ways:
  - –Color
  - –Shape
  - –Size
  - –Etc.

Example one:



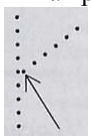
Example two:



3. Continuity

•Lines and patterns tend to be perceived as continuing in time and space.

–Example one:

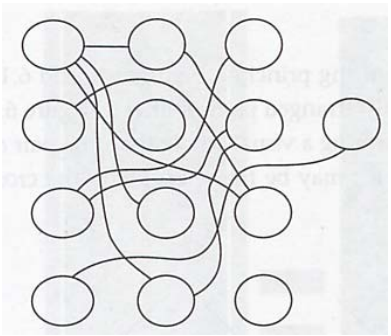


–Example two:

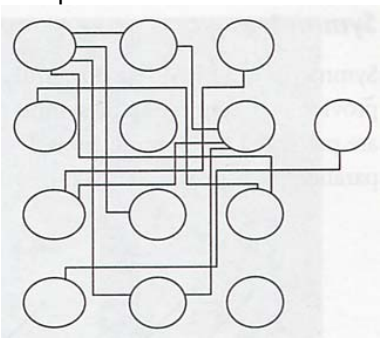
3. Continuity (2)

•Visual entities (groupings) are more likely to be perceived out of visual elements that are smooth rather than elements with abrupt changes in direction.

Smooth connections



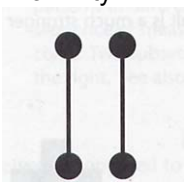
Abrupt connections



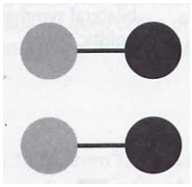
3. Continuity (3)

- Connectedness is a stronger grouping principle than:

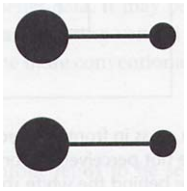
Proximity



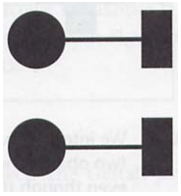
Value



Size



Shape

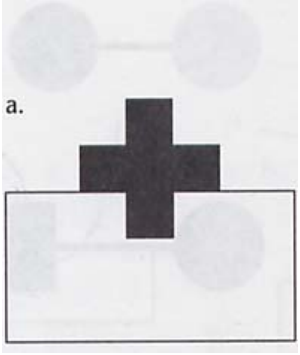


James Tam

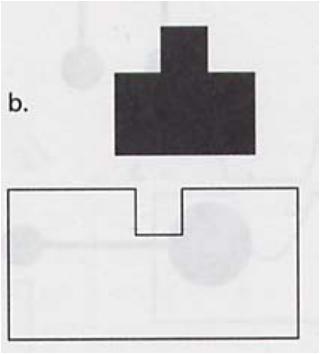
4. Symmetry

- People are more likely to perceive a grouping from something that's symmetrical than something that is not.

Image: perceived as a cross in front of a rectangle (more symmetric)



Rather than perceiving it as a less symmetrical image.

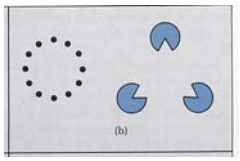


James Tam

5. Closure

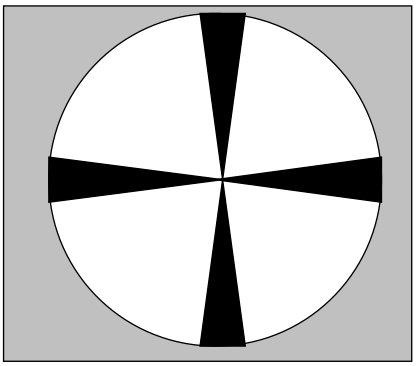
- The human brain tends to fill in gaps in order to perceive complete forms.
  - –Example one:

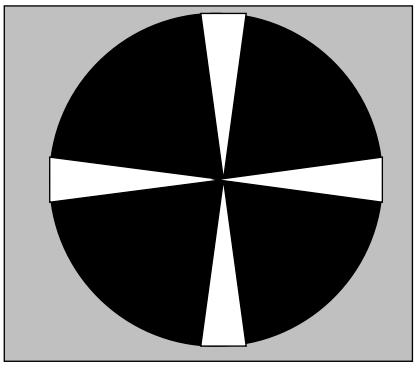
  - –Example two:



6. Relative Size

- Smaller components are more likely to be perceived as objects than larger ones.
  - –Example:

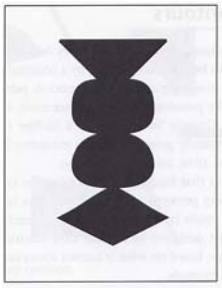




7. Figure And Ground

- A figure: something that is perceived to be in the foreground.
- Ground: what lies behind the figure.

Example one: figure-ground is clear



Example two: cues for figure vs. ground are balanced

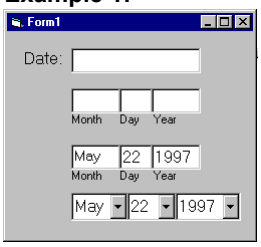
Rules Of Thumb For Interaction Design

- (The following list comes from Jakob Nielsen's 10 usability heuristics from the book "*Usability Engineering*"
  1. Minimize the user's memory load
  2. Be consistent
  3. Provide feedback
  4. Provide clearly marked exits
  5. Deal with errors in a helpful and positive manner

1. Minimize The User's Memory Load

- Describe required the input format, use examples, provide default inputs
- Examples:

Example 1:



Example 2:

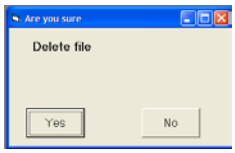
```
[csc loops 25 ]> python hci.py
Enter your birthday <month> <day> <year> e.g., 11 17 1977
Birthday:
```

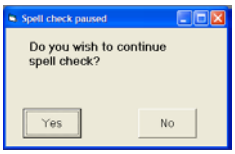

2. Be Consistent

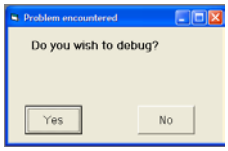
- Consistency of effects
  - –Same words, commands, actions will always have the same effect in equivalent situations.
  - –Makes the system more predictable.
  - –Reduces memory load.

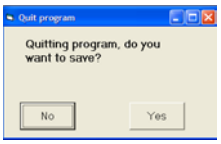
2. Be Consistent

- Consistency of language and graphics
  - –Same information/controls in same location on all screens / dialog boxes (forms follow boiler plate).
  - –Same visual appearance across the system (e.g. widgets).



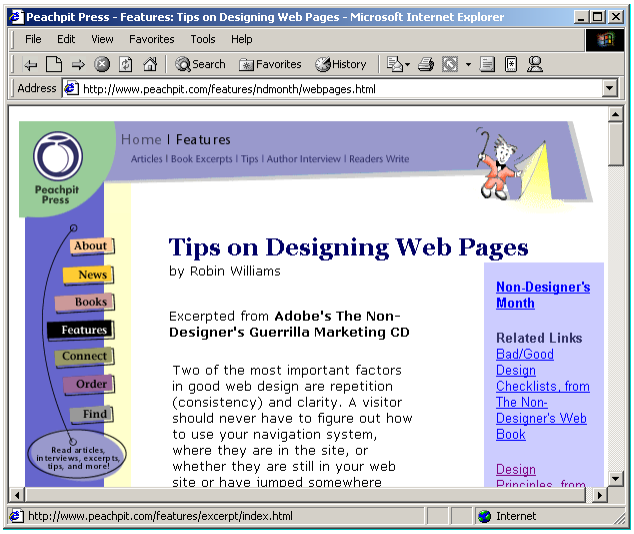






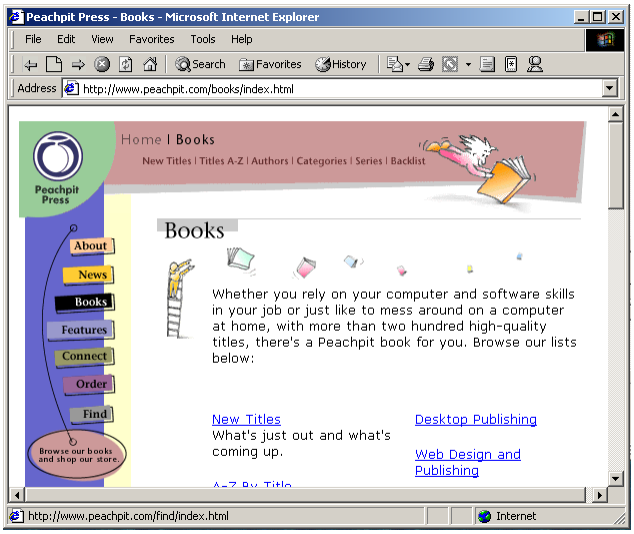
James Tam

2. Be Consistent



James Tam

2. Be Consistent



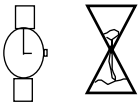
2. Be Consistent

This last option allows the user to proceed to the next question.

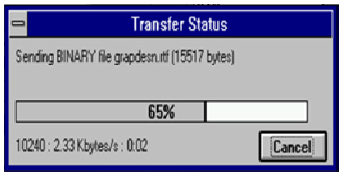
```
FIRST CATEGORY: ELECTRICITY
---------------------------
You can either enter your monthly kilowatt hours or have an estimate
based on the size of the accomodation that you live in.

(e)stimate
(k)ilowatt hours used
(q)uit this question and proceed to the next question
Enter selection: q

Tons of carbon generated from powering accomodation: 0
Current tons of carbon currently generated: 0


SECOND CATEGORY: HEATING
------------------------

What size of place do you live:
(s)mall house or a flat
(m)edium house
(l)arge house
(q)uit this question and proceed to the next question
Enter selection:
```

3. Provide Feedback

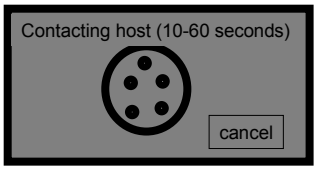
- What is the program doing?



Cursor



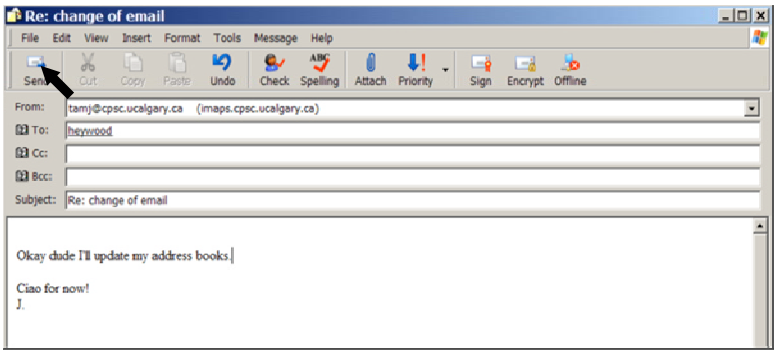
Progress bar



Random graphic James Tam

3. Provide Feedback

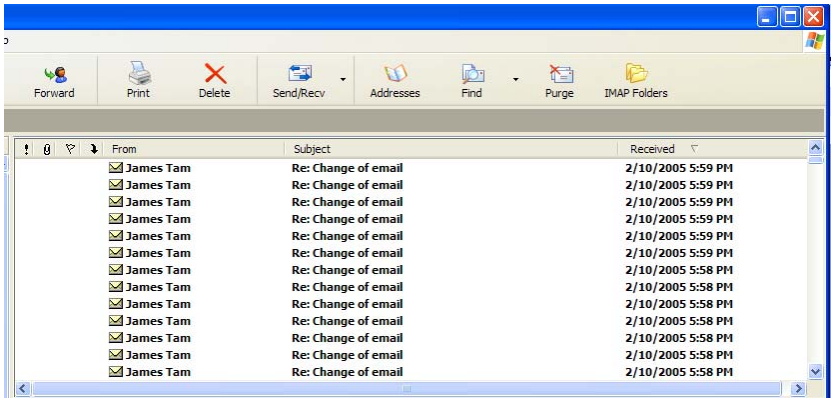
- What is the program doing?



James Tam

3. Provide Feedback

- The rather unfortunate effect on the (poor) recipient.



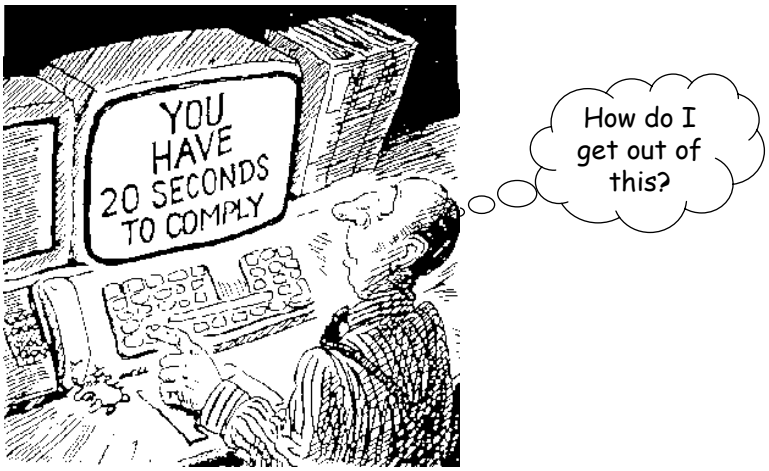
3. Provide Feedback

- In terms of text-based systems in this course letting the user know:
  - what the program is doing (e.g., opening a file),
  - what errors may have occurred (e.g., could not open file),
  - and why (e.g., file "input.txt" could not be found)

...it is not hard to do and not only provides useful updates with the state of the program ("Is the program almost finished yet?") but also some clues as to how to avoid the error (e.g., make sure that the input file is in the specified directory).

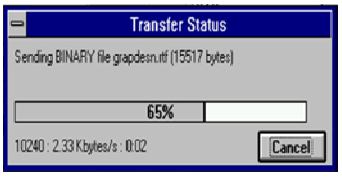
4. Provide Clearly Marked Exits

- User's should never feel 'trapped' by a program.



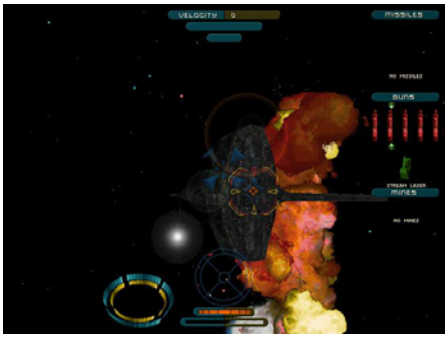
4. Provide Clearly Marked Exits

- This doesn't just mean providing an exit from the program but the ability to 'exit' (take back) the current action.
  - –Universal Undo/Redo
    - ▪e.g., <Ctrl>-<Z> and <Ctrl>-<Y>
  - –Progress indicator & Interrupt
  - –Length operations



4. Provide Clearly Marked Exits

•Restoring defaults



Wing Commander: Privateer 2 © Origin-EA

James Tam

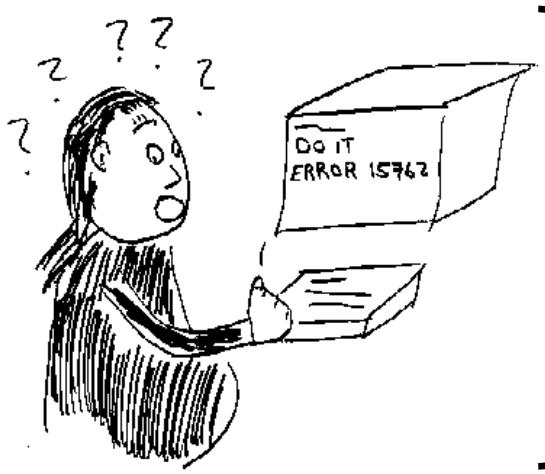
4. Provide Clearly Marked Exits

The user can skip any question

```
FIRST CATEGORY: ELECTRICITY
---------------------------
You can either enter your monthly kilowatt hours or have an estimate
based on the size of the accomodation that you live in.

(e)stimate
(k)ilowatt hours used
(q)uit this question and proceed to the next question
Enter selection: q

Tons of carbon generated from powering accomodation: 0
Current tons of carbon currently generated: 0


SECOND CATEGORY: HEATING
------------------------

What size of place do you live:
(s)mall house or a flat
(m)edium house
(l)arge house
(q)uit this question and proceed to the next question
Enter selection:
```

James Tam

5. Deal With Errors In A Helpful And Positive Manner



Error handling in "The good 'ole days"

What is "error 15762"?

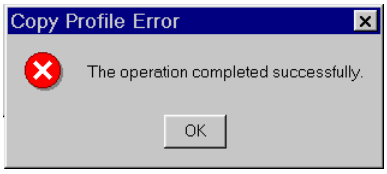
James Tam

Rules Of Thumb For Error Messages

1. Polite and non-intimidating
   - Don't make people feel stupid
     - Try again, bonehead!
2. Understandable
   - Error 25
3. Specific
   - Cannot open this document
   - Cannot open "Chapter 5" because the application "Microsoft Word" is not on your system
4. Helpful
   - Cannot open "Chapter 5" because the application "Microsoft Word" is not on your system. Open it with "WordPad" instead?

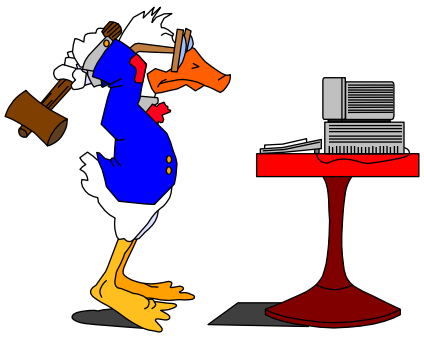
James Tam

Examples Of Bad Error Messages



Microsoft's NT Operating System

James Tam

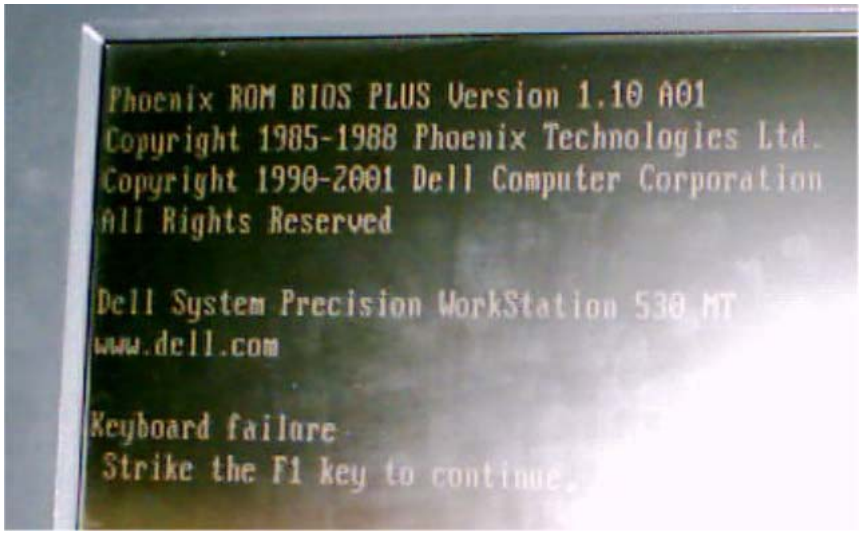


“HIT ANY KEY TO CONTINUE”

James Tam

James Tam

I Think I'd Rather Deal With The Any Key!!!



Picture courtesy of James Tam: An error message from a Dell desktop computer

James Tam

You Should Now Know (2)

- What is the focus of Human-Computer Interaction (HCI)
- Why is HCI an important part of computer science
- How to employ the Task-Centered approach in the design and development of software
- Methods for getting user involvement in the software development process
- Some principles from industrial design: affordances, constraints and mappings
- The two guiding principles of developing effective representations
- When to use pictures vs. words
- Tufte's principles of information visualization

You Should Now Know (2)

- When should color be used (and not used) to represent information
- How the squint test can be used to evaluate layout
- How to use the principles of C.R.A.P. in the design and evaluation of a layout
- What is implicit structure and how it can be used to determine the relationship between graphical elements
- What are navigational cues and how they can be used to help structure a design
- Guidelines in the use of fonts and font effects
- What are the Gestalt laws
- Five of Nielsen's usability heuristics