Graphic Design and Gestalt Principles

CS160: User Interfaces
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Slides based on those of John Canny, Pat Hanrahan and James Landay

Keepin’ it Real: Pushing the Desktop Metaphor with Physics, Piles and the Pen [Agrawala 06]

VIDEO
Upcoming Schedule

Pilot User Study (due Monday before class)
- 3 users will test 3 tasks (one easy, one medium, one hard)
- Finish necessary implementation
  - WOZ is fine – you will probably need to build interface to each job of person acting as computer
  - Canned functionality is not ok
- Compute summary statistics (mean, stdev)
- Think about the variables you might have in a full expt.

Review: Managing Participants

- Testing is distressing
- Treat participants with respect
  - Follow human subjects protocol
  - Obtain informed consent
  - Make sure experiment is ethical
Review: Why Quantitative Studies

Repeatable, reliable evaluation of interface elements

To control properly, usually limited to low-level issues
  – Menu selection method A faster than method B

Pros/Cons
  – Objective measurements → scientific method
    • Good internal validity → repeatability
  – But, real-world implications may be difficult to foresee
    • External validity!
  – Significant results doesn’t imply real-world importance
    • 3.05s versus 3.00s for menu selection

Review: Designing an Experiment

1. State a lucid, testable hypothesis
2. Identify variables (independent, dependent control, random)
3. Design the experimental protocol
4. Choose user population
5. Apply for human subjects protocol review
6. Run pilot studies
7. Run the experiment
8. Perform statistical analysis
9. Draw conclusions
Review: Menu Selection

[Guimbretiere et al. 03]

Review: Statistical Analysis

Compute central tendencies (descriptive summary statistics) for each independent variable

- Mean
- Standard deviation
Review: Are the Results Meaningful?

Hypothesis testing
- **Hypothesis**: Manipulation of IV effects DV in some way
- **Null hypothesis**: Manipulation of IV has no effect on DV
- Null hypothesis assumed true unless statistics allow us to reject it

Statistical significance (p value)
- Likelihood results due to chance variation (i.e. null hyp. is true)
- $p < 0.05$ usually considered significant (Sometimes $p < 0.01$)
  - Means that < 5% chance that null hypothesis is true

Statistical tests
- **T-test** (1 factor, 2 levels)
- **Correlation**
- **ANOVA** (1 factor, > 2 levels, multiple factors)
- **MANOVA** ( > 1 dependent variable)

Review: Menu Selection Example

RM-ANOVA $\rightarrow$ means for completion times were significantly different ($F(3,33) = 73.4$, $p < .0005$)

Need to run pairwise T-tests to determine which means differ significantly
- Tool palette significantly slower than others ($p < .0001$ in all cases)
- Control menu faster than FlowMenu but not sig ($p = .2$)
- FlowMenu faster than Toolglass ($p < .01$)
- Control menu faster than Toolglass ($p < .0005$)

Separate analysis for error rates
Draw Conclusions

Why are the results the way they are?

What is the scope of the finding?
- Does the experiment reflect real use?
  - External validity
  - Ecological validity
- Are there other parameters at play?
  - Internal validity

Interactions

Multiple IVs effect DV non-additively
Example of Interactions

Group problem solving
- Independent variable: Leadership

[Graph showing problem solving time with and without leader]

Example of Interactions

Group problem solving
- Independent variable: Leadership
- Independent variable: Group size

[Graph showing problem solving time with and without leader for different group sizes]

[from Martin 04]
Example of Interactions

Group problem solving

- Change in time due to leadership is same regardless of group size
- Change in time due to group size is same regardless of leadership
- Independent variables do not interact

[Diagram showing problem solving time with and without leader for different group sizes, indicating that the change due to leadership is the same for every group size and the change due to group size is the same whether or not there is a leader.]

[from Martin 04]
Example of Interactions

Multiple IVs effect DV non-additively
- Change in time due to leadership differs with changes in group size
- Independent variables do interact

Topics

- Graphic design
- Simplicity and elegance
- Color
- Gestalt principles
- Grid-based design
Graphic Design

Design is about Communication
Design is about Communication

- Principal organs & vasculature (Leonardo da Vinci ca. 1490)
- Strange immersion of torus in 3-space (Curtis 92)

Design is about Form and Function

- Form – good designs should be a pleasure to use
- Function – good design supports users’ tasks

- MP3 player
- Chair
- Suitcase
3 Principles of Modern Design

Form follows function

3 Principles of Modern Design

Economy of form - limited vocabulary - minimalism
3 Principles of Modern Design

Integrity of materials – not just a modern principle

Shaker Furniture

Wood Veneer
Steal Good Design Ideas

“Good artists borrow (from other artists), but great artists steal!” - Pablo Picasso

Compelling visual design takes practice and experience — a natural part of which is study and critique of other’s work

Simplicity and Elegance
Simplicity

Simple, minimalist, designs are usually the most effective

Elegance

Reduction: Only include essential elements
Regularization: Use one set of shapes, colors, forms etc.
Leverage: Use elements in multiple roles (i.e. scrollbar)
**Benefit: Approachability**

Visual elements rapidly understood - invite further exploration

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**Benefit: Recognizability**

Less visual clutter makes it easier to recognize what is there
Benefit: Immediacy

Eye is immediately drawn to important visual elements
- Details that remain are more prominent

Unity

One path to simplicity & elegance is through unifying themes:
- Forms, colors, components with like qualities
**Refinement**

Draw viewers’ attention to essential information
- Straighten subway lines to emphasize sequence of stops

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**Fitness**

Match design to capabilities of technology and user

The Quick Brown Fox Jumps Over The Lazy Dog.

Chicago screen font designed for early low-res Macintosh display
- Thick verticals ensure visibility after applying 50% gray pattern
- Used as default font 1984-1997
Mistakes: Clutter & Noise

Mistakes: Interference
Mistakes: Too Much Explicit Structure

Mistakes: Belaboring the Obvious
Mistakes: Gratuitous use of 3D

Mistakes: Excessive Embellishment

Minimalists hate it, but sometimes users like embellishments (i.e. Apple’s designs)
Color

Color Spaces

RGB
Additive
Electronic Media

CMY
Subtractive
Printed Media

Parameters of color space driven by technology
Technology-Centered Colors

- Nice RGB Hex codes, “evenly” distributed
- But, lime green and hot pink?

Perceptual Organization

Parameters of color space driven by perception
Munsell Color Space
Perceptually uniform book of painted chips

Chroma vs. Value

Tips for Picking Colors

• Use a small palette (6 color Java look and feel)

• Don’t use all fully saturated colors

• Ensure good color contrast for text
Let Someone Else Pick For You

![ColorBrewer.org](https://colorbrewer.org)

Imhof, Cartographic Relief Projection

Let Someone Else Pick For You

![ColorBrewer.org](https://colorbrewer.org)

Imhof, Cartographic Relief Projection
Gestalt Principles

Principles

- figure/ground
- proximity
- similarity
- symmetry
- connectedness
- continuity
- closure
- common fate
- transparency
Figure/Ground

Principle of surroundedness

Principle of relative size

http://www.aber.ac.uk/media/Modules/MC10220/visper06.html

Figure/Ground

Ambiguous

Unambiguous

http://www.aber.ac.uk/media/Modules/MC10220/visper06.html
Proximity

Dots that are near one another are grouped
Dots that are concentrated are grouped

[from Ware 00]

Similarity

Rows dominate due to similarity [from Ware 04]
Symmetry

Bilateral symmetry gives strong sense of figure [from Ware 04]

Connectedness

Connectedness overrules proximity, size, color shape [from Ware 04]
Continuity

We prefer smooth not abrupt changes [from Ware 04]

Connections are clearer with smooth contours [from Ware 04]

Continuity: Vector Fields

Prefer field that shows smooth continuous contours [from Ware 04]
Closure

We see a circle behind a rectangle, not a broken circle [from Ware 04]

Illusory contours [from Durand 02]

Common Fate

Dots moving together are grouped

http://coe.sdsu.edu/eet/articles/visualpercl/start.htm
Transparency

Requires continuity and proper color correspondence [from Ware 04]