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 [Agarawala 06]

VIDEO

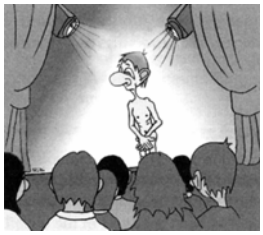
Upcoming Schedule

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

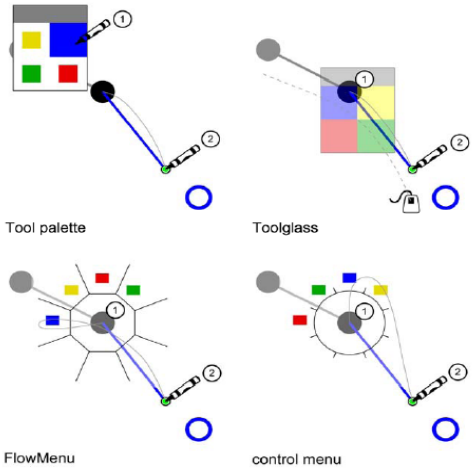
To control properly, usually limited to low-level issues
- Menu selection method A faster than method B

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

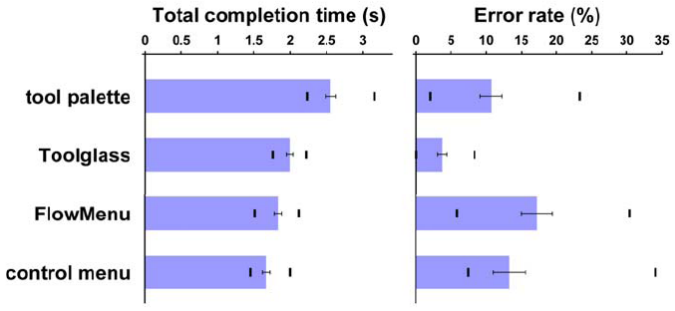


[Guimbretiere et al. 03]

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)

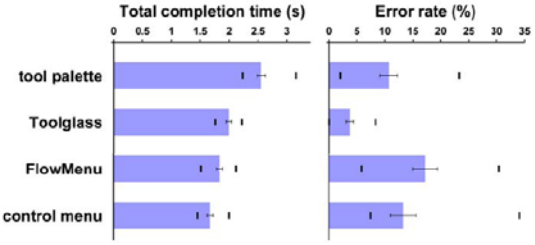
- Likelihood results due to chance variation (i.e. null hyp. is true)
- $p < 0.05$ usually considered significant (Sometimes $p < 0.01$)
  - Means that < 5% chance that null hypothesis is true

Statistical tests

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

Explaining Psychological Statistics
Barry H. Cohen

Review: Menu Selection Example



RM-ANOVA → 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?

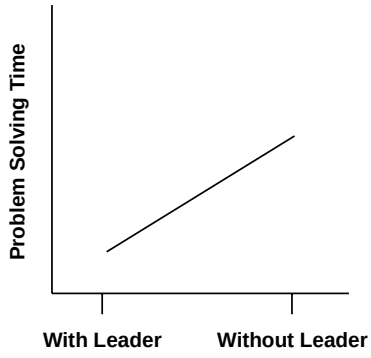
- Does the experiment reflect real use?
  - External validity
  - Ecological validity
- Are there other parameters at play?
  - Internal validity

Interactions

Multiple IVs effect DV non-additively

Example of Interactions

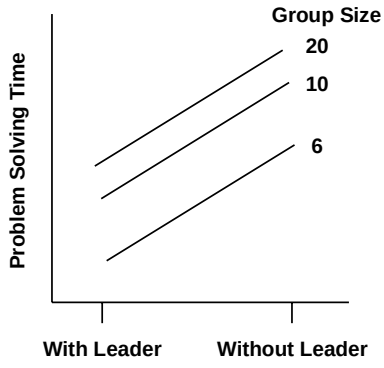
Group problem solving
- Independent variable: Leadership



[from Martin 04]

Example of Interactions

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

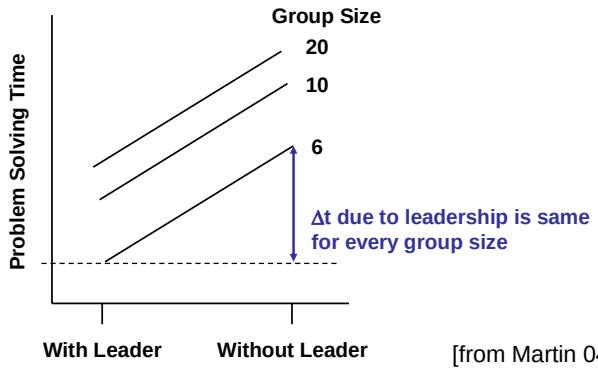


[from Martin 04]

Example of Interactions

Group problem solving

- Change in time due to leadership is same regardless of group size

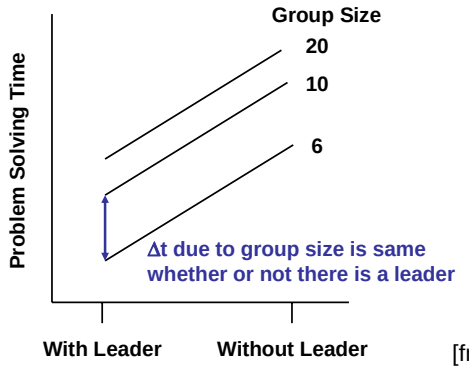


[from Martin 04]

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

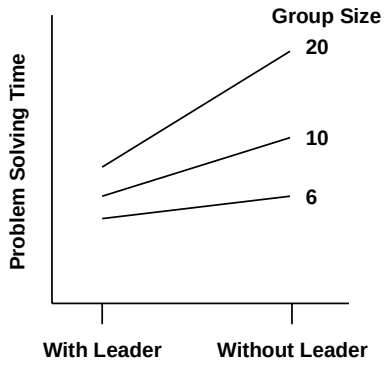


[from Martin 04]

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



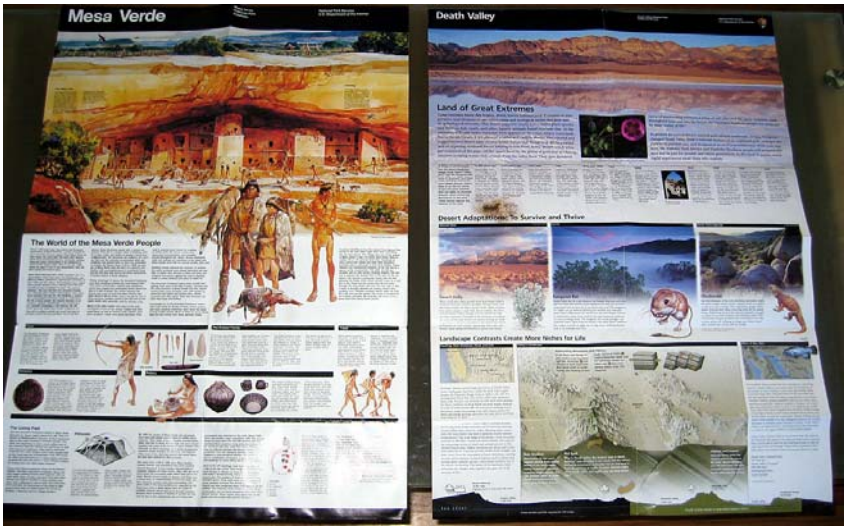
[from Martin 04]

Topics

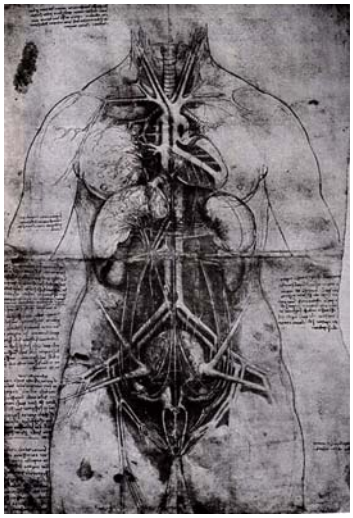
- Graphic design
- Simplicity and elegance
- Color
- Gestalt principles
- Grid-based design

Graphic Design

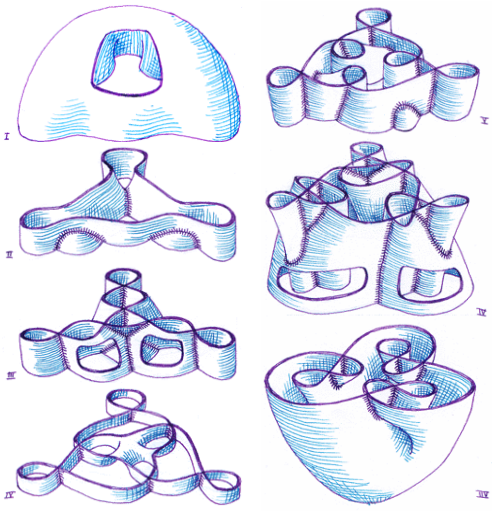
Design is about Communication



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

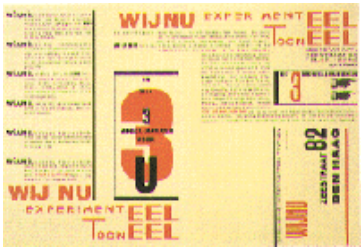
- Form – good designs should be a pleasure to use
- Function – good design supports users' tasks

3 Principles of Modern Design

Form follows function

3 Principles of Modern Design

Economy of form - limited vocabulary - minimalism



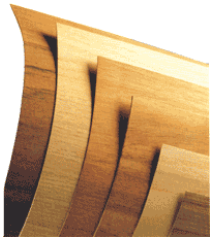
3 Principles of Modern Design

Integrity of materials

3 Principles of Modern Design

Integrity of materials – not just a modern principle

Shaker Furniture

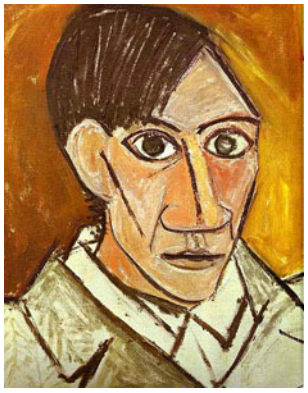


Wood Veneer

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)

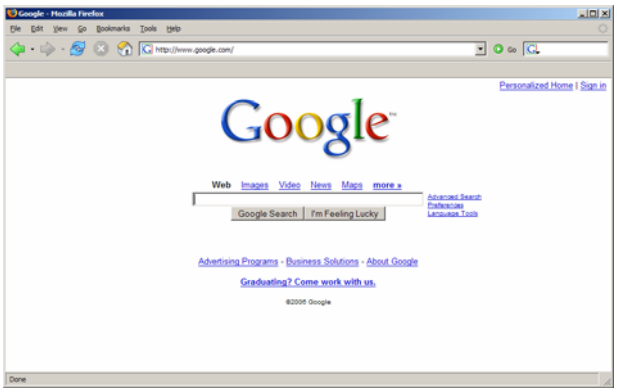
Benefit: Approachability

Visual elements rapidly understood - invite further exploration

Benefit: Recognizability

Less visual clutter makes it easier to recognize what is there

Benefit: Immediacy



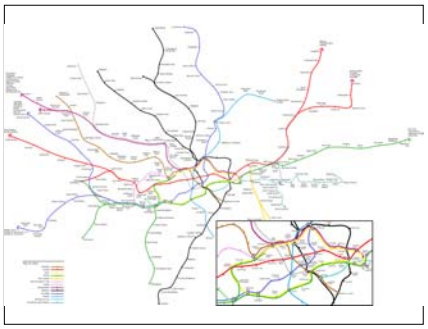
Eye is immediately drawn to important visual elements
- Details that remain are more prominent

Unity

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

Refinement

London Underground [Beck 33]



Geographic version of map

Draw viewers' attention to essential information

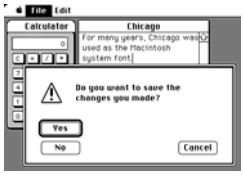
- Straighten subway lines to emphasize sequence of stops

Fitness

Match design to capabilities of technology and user

The Quick Brown Fox Jumps Over The Lazy Dog.

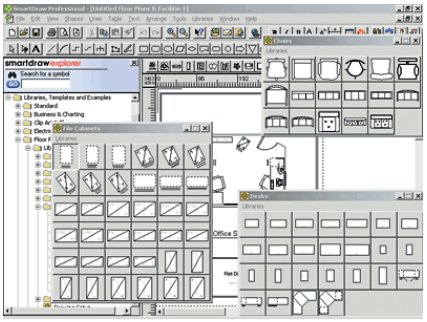
abcdefghijklmnopqrstuvwxyz0123456789 [ ] ( ) { } / \ < > ?

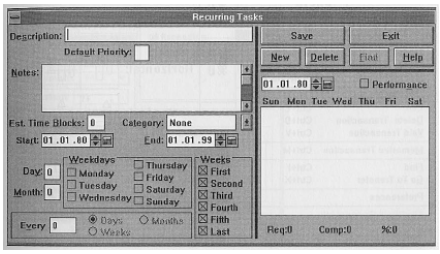


Chicago screen font designed for early low-res Macintosh display

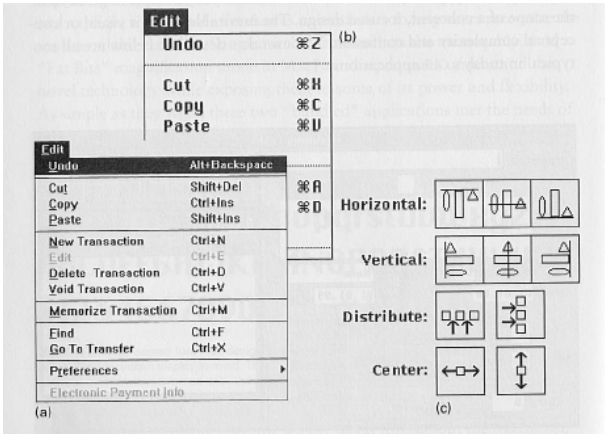
- Thick verticals ensure visibility after applying 50% gray pattern
- Used as default font 1984-1997

Mistakes: Clutter & Noise

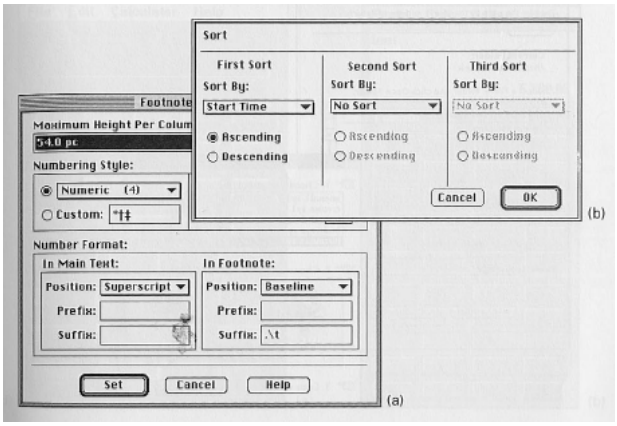




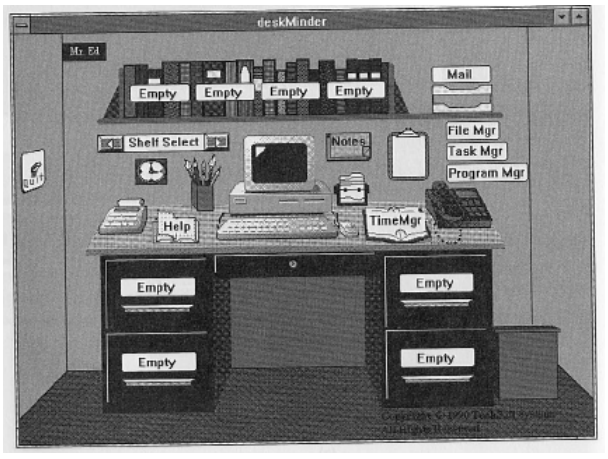
Mistakes: Interference



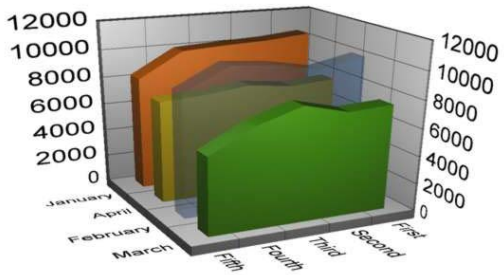
Mistakes: Too Much Explicit Structure

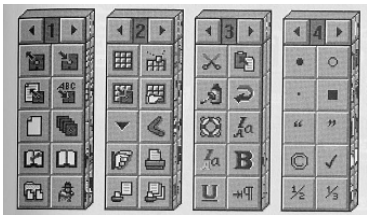


Mistakes: Belaboring the Obvious

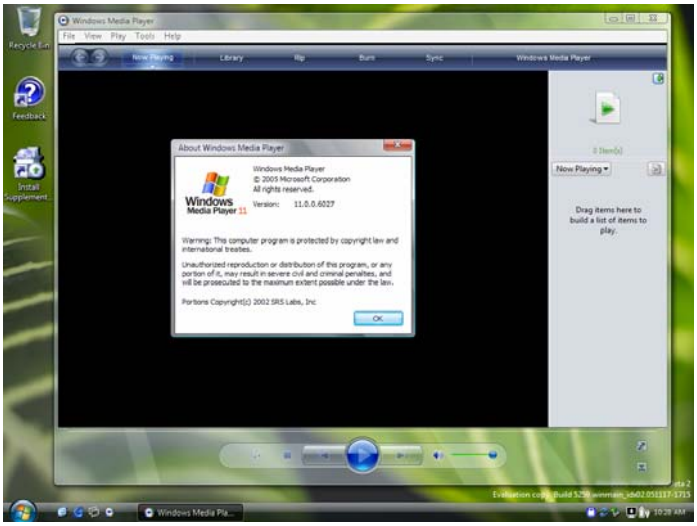


Mistakes: Gratuitous use of 3D





Mistakes: Excessive Embellishment



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

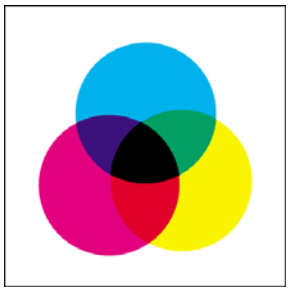
Color

Color Spaces

RGB

Additive

Electronic Media



CMY

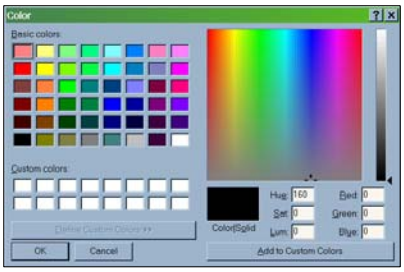
Subtractive

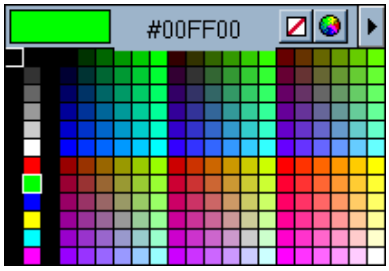
Printed Media

Parameters of color space driven by technology

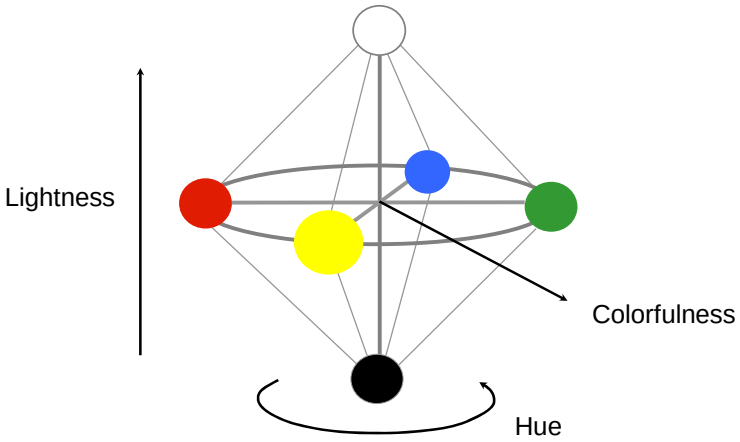
Technology-Centered Colors

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





Perceptual Organization

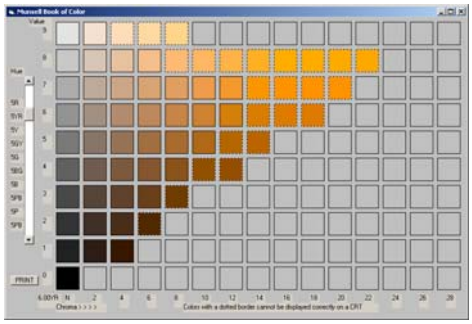


Parameters of color space driven by perception

Munsell Color Space

Perceptually uniform book of painted chips

Hue

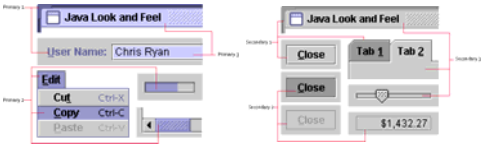


Chroma vs. Value

Munsell Color Utility: www.wallkillcolor.com

Tips for Picking Colors

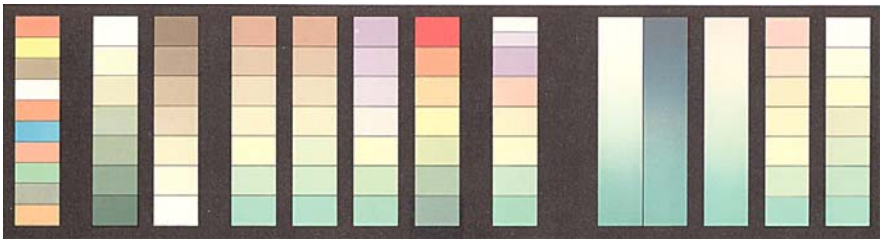
- Use a small palette (6 color Java look and feel)



- Don't use all fully saturated colors

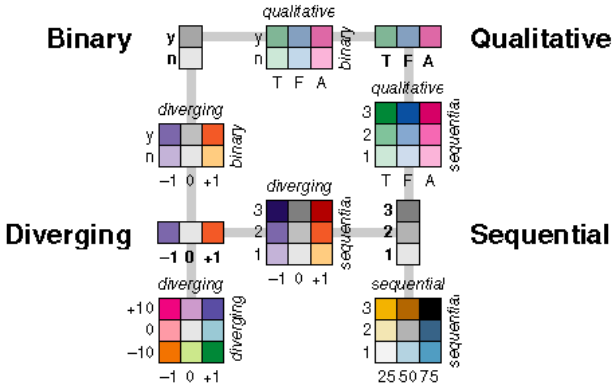
- Ensure good color contrast for text

Let Someone Else Pick For You



Imhof, Cartographic Relief Projection

Let Someone Else Pick For You



ColorBrewer.org

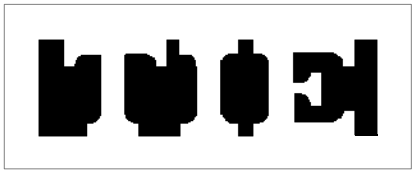
Gestalt Principles

Principles

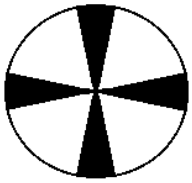
- figure/ground
- proximity
- similarity
- symmetry
- connectedness
- continuity
- closure
- common fate
- transparency

Figure/Ground

Ambiguous



Principle of surroundedness

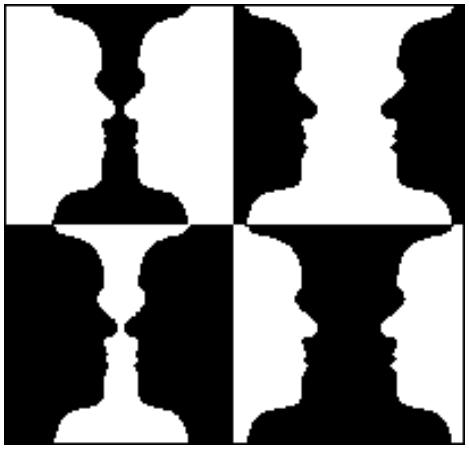


Principle of relative size

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

Figure/Ground

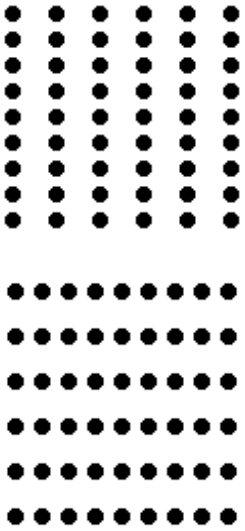
Ambiguous

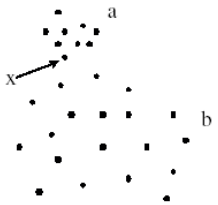


Unambiguous

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

Proximity

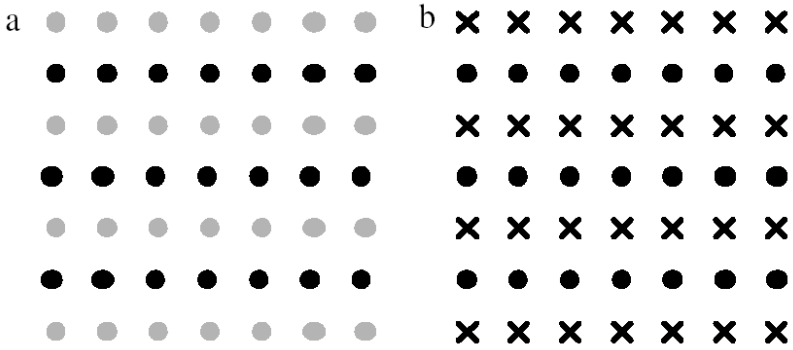




Dots that are near one another are grouped
Dots that are concentrated are grouped

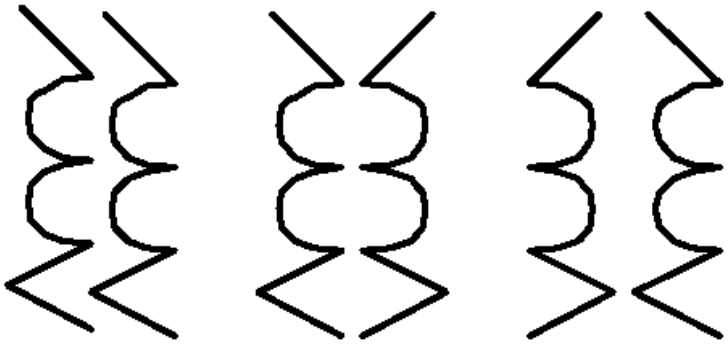
[from Ware 00]

Similarity



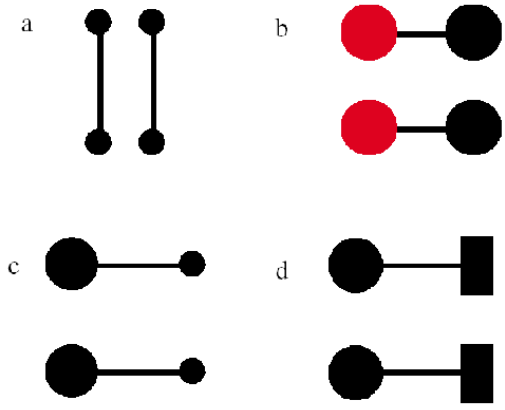
Rows dominate due to similarity [from Ware 04]

Symmetry



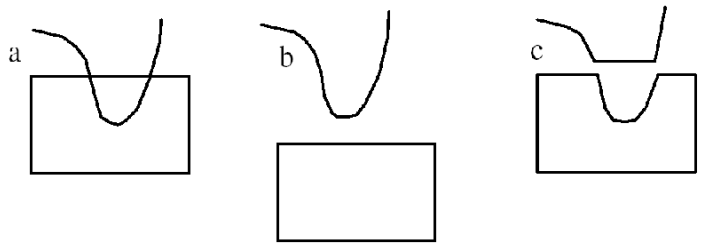
Bilateral symmetry gives strong sense of figure [from Ware 04]

Connectedness

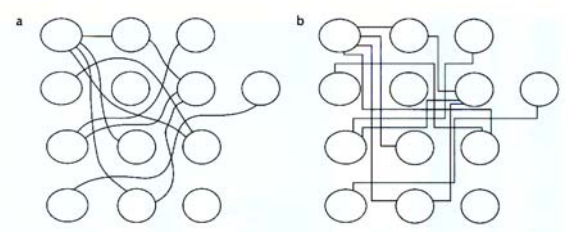


Connectedness overrules proximity, size, color shape [from Ware 04]

Continuity

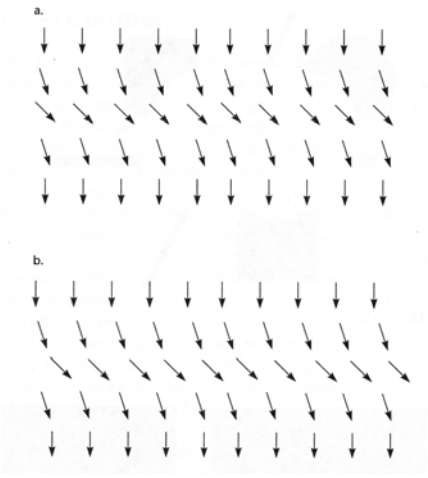


We prefer smooth not abrupt changes [from Ware 04]



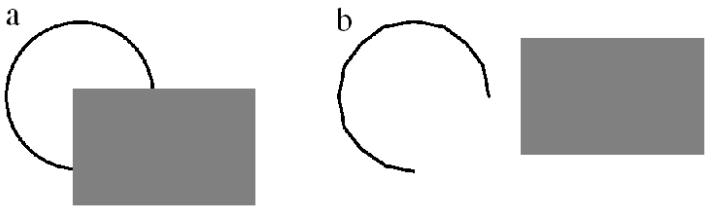
Connections are clearer with smooth contours [from Ware 04]

Continuity: Vector Fields

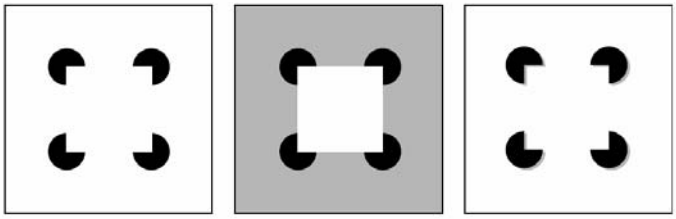


Prefer field that shows smooth continuous contours [from Ware 04]

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/visualperc1/start.htm

Transparency

Requires continuity and proper color correspondence [from Ware 04]