Overview of Human Cognition and its Impact on User Interface Design (Part 2)
Brief Recap

- Gulf of Evaluation
  - What is the state of the system?
- Gulf of Execution
  - What specific inputs needed to achieve goals?
Brief Recap

- Mental Models
Brief Recap

- Affordances

- Feedback times
  - 100 msec, 1 sec, 10 sec

- Mappings
Metaphors Aren’t Always Effective

- Magic Cap
  - Somewhat unwieldy, not good use of screen real estate
Outline

• Color
• Grouping
• Layout
Why Study Color?

1) Color can be a powerful tool to *improve* user interfaces by communicating key information.

2) Inappropriate use of color can severely *reduce* the *performance* of systems we build.
Visible Spectrum
Human Visual System

- Light passes through lens
- Focused on retina
Retina

- Retina covered with light-sensitive receptors
- **Rods**
  - primarily for night vision & perceiving movement
  - sense intensity or shades of gray
  - can’t discriminate between colors
  - ~75,000,000 – 150,000,000 rods
- **Cones**
  - used to sense color
  - ~7,000,000 cones
Distribution of Cones and Rods

• Center of retina has most of the cones
  – allows for high acuity of objects focused at center
  – Ex. if looking here, can’t read text on bottom easily

• Edge of retina is dominated by rods
  – allows detecting motion of threats in periphery

Some text used as an example
Design Implications

• Design implication #1
  – LOTS more rods than cones
  – Humans roughly 10x more sensitive to intensity than hue
    • Hue is roughly color
    • Saturation is purity of color (grey)
    • Value is intensity (roughly)
  – Easier for people to see fine differences based on intensity differences than hue
Maps Discussion

• Example of intensity being more useful than hue for fine differences
  – If you want to vary color, vary the intensity
  – Ways of measuring intensity include luminance (HSL), value (HSV), brightness (HSB) (though not equivalent)

• Example of mapping (good and bad)
  – 1\textsuperscript{st} map – ordered by hue (bad)
  – 2\textsuperscript{nd} map – ordered by intensity (good)

• Example of minimalist aesthetics
  – 1\textsuperscript{st} map is just plain ugly 😊
How to Get Color Right

- Design Tip #1
  - Design in grayscale first
    - Forces you to focus on intensity
    - Can use a photocopier to help here
    - Keep luminance (intensity) values from grayscale when moving to color
    - Helps ensure everything remains clear
Color Perception via Cones

- “Photopigments” used to sense color
- 3 types: blue, green, “red” (really yellow)
  - each sensitive to different band of spectrum
  - ratio of neural activity of the 3 \(\rightarrow\) color
    - other colors are perceived by combining stimulation
Color Sensitivity

from [http://insight.med.utah.edu/Webvision/index.html](http://insight.med.utah.edu/Webvision/index.html)
Distribution of Photopigments

- Photopigments not distributed evenly
  - Mainly reds (64%) & few blues (4%)
  - Less sensitive to short wavelengths (blue)
- Few blue cones in retina center (high acuity)

- As we age our lens yellows & absorbs shorter wavelengths
Focus

- Different wavelengths of light focused at different distances behind eye’s lens
  - If your UI has lots of colors (?)
  - Need for constant refocusing (?)

- Design Implication #4
  - Pure (saturated) colors require more focusing than less pure (desaturated, pastels)
  - Don’t use saturated colors in UIs unless you really need something to stand out (stop sign)
Color Guidelines

- Avoid simultaneous display of highly saturated, spectrally extreme colors
  - e.g., minimize cyans/blues at the same time as reds, why?
    - refocusing!
  - desaturated combinations are better → pastels
Color Deficiency
(AKA “color blindness”)

• Trouble discriminating colors
  – besets about 9% of males, 0.5% of females

• Two main types
  – different photopigment response most common
    • reduces capability to discern small color diffs
  – red-green deficiency is best known
    • lack of either green or red photopigment →
      can’t discriminate colors dependent on R & G
Color Deficiency Example

Add/Update Shipping Information

We found an error while verifying your shipping address.
We've marked the problem in red for you.

Update the address book of

Required information is marked in GREEN CAPS.
HELP for questions about shipping.

NICKNAME: MYSELF

Please assign a "nickname" for the person you're shipping to. You may change or delete this information at any time.

FIRST NAME: DOUGLAS

LAST NAME: 

ADDRESS: 245 SAN JOSE RD
Design Implications

- Design Implication #5
  - Don’t rely solely on hue b/c of potential color deficiencies
  - Use mixtures of colors (red / green issues)
  - Also good to have contrast in intensity (+ redundant cues)
Color Summary

• Design implication #1
  – Humans more sensitive to intensity than hue

• Design Implication #2
  – Don’t rely on blue for text or small objects

• Design Implication #3
  – As we age our lens yellows, sensitivity to blue reduced
  – Need more intensity for older users

• Design Implication #4
  – Minimize use of saturated colors, causes refocusing

• Design Implication #5
  – Use mix of colors, contrast in intensity, & redundant cues
1 minute break
Outline

• Color
• Grouping
• Layout
Visual Grouping
Visual Grouping
Visual Grouping

1  2
3  4
5  6
Visual Grouping
Visual Grouping
Visual Grouping
Amazon Has Grouping Problems

1 of 3 people found the following review helpful:

⭐⭐⭐⭐⭐ = Durability ⭐⭐⭐⭐⭐ = Fun ⭐⭐⭐⭐⭐ = Educational ⭐⭐⭐⭐⭐ = Overall
Has a place in my collection, April 29, 2002
Reviewer: Andrew Graves (Lafayette LA) - See all my reviews
Tigris and Euphrates is a keeper in my game collection. It is easy for new players to get the deviousness of the game. The game is difficult to describe, however the maneuverability of the game, will turn a seeming early win to a defeat. After you learn the ropes, it's months or so.
Visual Grouping

Proximity

Similarity

Connected
Visual Grouping

Continued

Symmetric
Visual Grouping
Making Things Distinct

- Grouping looks at how to make things look related
- Now, how to make things look different?
Making Things Distinct

<table>
<thead>
<tr>
<th>Size</th>
<th>Value</th>
<th>Orientation</th>
<th>Texture</th>
<th>Shape</th>
<th>Position (2D / 3D)</th>
</tr>
</thead>
</table>

![Diagram of visual elements](image)

52: Bertin’s “retinal variables” form the basis for all forms of visual coding. A visual code can be based on (from left to right) contrasts in size, value, orientation, texture, shape, or position in 2D or 3D space. Hue (chromatic color) provides an additional dimension not pictured here.

Kevin Mullet and Darrell Sano, *Designing Visual Interfaces*
Let’s Play a Game

- I’ll show you a series of pictures
- Say out loud:
  - **Same** if every object is the same
  - **Different** if at least one object is different
Making Things Distinct

Shape

Color

Size
Preattentive Processing

• Some things easy for low-level visual processing to automatically handle
  – It just pops out at you
• Preattentive processing
  – ~200 msec to see differences
  – Based on simple diffs
    • Is there a red circle? →
Animation Useful for Making Things Distinct

- Remember, rods sensitive to motion in periphery
- Can be very useful, but easy to overdo it
  - Motion distracting if in peripheral vision, hard to read
  - Simple is better here
Small Multiples for Making Things Distinct

• “Information consists of differences that make a difference.”
  – Edward Tufte, *Envisioning Information*
International Women’s Day

Echeverria, Heriberto  1971
March 8 - International Women’s Day

Diaz, Estela  1974
March 8 - International Women’s Day

Cuban Poster Art Gallery, http://www.sims.berkeley.edu/~lcush/GenCat.html/
SMALL MULTIPLES

Reid Miles, Blue Note Cover

Freddie Hubbard, Duke Jordan, Sam Jones, Art Taylor

Blue Note 84041

TRUE BLUE TINA BROOKS

Blue In and Out

Gibralt Blue

Alice Blue

Blue-Hoo

Sticks like Blue

Blue Away

True Blue

Too Blue
Small Multiples

**Film Clips**
Also opening today

Mick LaSalle, Edward Guthmann, C.W. Nevius

- [Printer-friendly version](#)
- [Email this article to a friend](#)

**New Flicks Roundup**

How about a New Flicks newsletter? [Sign up here.](#)

- "Capturing the Friedmans"  
  *Superb.*

- "Dumb and Dumberer: When Harry Met Lloyd"  
  *Yep, dumb.*

- "The Eye"  
  *Plodding.*

- "Hollywood Homicide"  
  *Appealing.*

- "Marito"  
  *Low-budget wonder.*

- "Respriro"  
  *Haunting.*

"Respriro" is partly of interest for what it doesn't do. It's set on an Italian island south of Sicily, but it doesn't try to imbue the setting with romance. It's about a sexy young wife and mother who doesn't fit in with her neighbors, but the movie is not an indictment of village provinciality. She may be the prettiest and liveliest person on her island, but she is also a bit crazy.
Small Multiples

• Not having clear differences makes it hard to understand

• Versus…
Repetition

• Reinforcing structure through repetition
  – Repeat design elements across the program
  – Helps people understand what is basic, what is unique
Example Repetition – Amazon (2/3)
Example Repetition – Amazon (3/3)
Aside: Change Blindness

- People are bad at noticing some kinds of changes
  - Subtle changes over time
  - Distractors
  - Discontinuities (ex, in movies)
    - [http://viscog.beckman.uiuc.edu/djs_lab/demos.html](http://viscog.beckman.uiuc.edu/djs_lab/demos.html)

- On web site, errors displayed on same page, but new page looks too similar
  - Can’t easily tell that a new page loaded

- Unfortunately, design implications currently unclear
Create an account today! Receive the latest Dell product information, price drops, and checkout with pre-populated forms. Already have an account?

**Sign Up**

Note: Dell supports privacy protection for children online. You must be at least 14 or services.

- • Indicates required fields

- **First Name**
- **Mi**
- **Last Name**

- **Email Address**

- Yes, send me exclusive offers and specials by e-mail.

- **Address (Dell cannot ship to a P.O. Box)**

- **City**
- **State**

- Choose a state/province
Change Blindness

Create an account today! Receive the latest Dell product information, price drops, at checkout with pre-populated forms. Already have an account?

Sign Up

Note: Dell supports privacy protection for children online. You must be at least 14 or services.

* Indicates required fields

Please address the 8 item(s) indicated on this page.

First Name  
Barney

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Last Name  
File

Email Address

Yes, send me exclusive offers and specials by e-mail.

Please enter your street address:

Address (Dell cannot ship to a P.O. Box)
Outline

- Metaphor
- Color
- Grouping
- Layout
Grid Systems

143: Each of the grids in Figure 142 leaves a distinct imprint on the resulting layout. When the same grid is used throughout a book—or any application—this imprint becomes a unifying element for the entire work. From Basic Typography: Design with Letters, by Ruedi Rüegg, ABC-Verlag, Zürich, 1987.
142: These typographic grids for book design subdivide the page uniformly into one to six columns. Grids for UI design have important differences, but the goal of providing systematic structure is the same. From Basic Typography: Design with Letters by Ruedi Rüegg, ABC-Verlag, Zurich, 1987.
Example Grid – Amazon (1/3)
Example Grid – Amazon (2/3)
Example Grid – Amazon (3/3)
Grid Systems

Align related options along column guide

Place most important option near the top

Java Look and Feel Design Guidelines
Canonical Grid (2 Columns)

This two-column layout is based on the canonical grid (in our first three examples, the grid is not used for the labels in the left-hand column). To visualize this grid, ignore all but the middle three lines of Figure 176. The Name, Type, Vendor, and Note fields span both of the columns that remain, while the items in the Mode setting, Progress indicator, and Scope options span one column each.
Canonical Grid (6 Columns)

**Image:**

- Mode: Normal, Select, Hl Lite, Dim, Busy
- Image: Various grid and control icons
- Regions: Foregr, Code 1, Code 2, Code 3, Backgr
- Border: Optionally Transparent, Shadow

**Colors:**
- Red: 32765
- Green: 10024566
- Blue: 2345108

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180: In this example, the full six-column grid is used to lay out the left-most label column as well as five columns of controls. Note the presence of controls spanning one, two, three, and five columns. Note too that elements of different widths can be placed in the same row without problems.
No Grid (ie, Don’t Do This!)

![Datascan Clarity ERP for Tata Yazaki Autocomp Limited - User: VSK]

**Item Master**

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1. **Numberwise Items**
Summary

- Metaphors
  - Appropriate ones can make UI easier
- Color
  - Rods, cones, distribution
  - Design guidelines
- Grouping
  - How to make things look related
  - How to make things distinct
  - Repetition useful
- Layout
  - Grids useful
Administrativia

- Reading assignment due next time
  - In current syllabus
  - What is the Document Object Model?
    [http://www.w3.org/TR/WD-DOM/introduction.html](http://www.w3.org/TR/WD-DOM/introduction.html)
  - Wikipedia entry on Cascading Style Sheets
  - ~4 sentence summaries (x2)
  - 1 highlight (point of discussion, noteworthy, they did it wrong, etc)
P3

• Progress?