Color and Icons

SE 444
Color Topics

- Color perception
- Using color in interaction design
- Color concerns for interaction design

Color Reference
Color Perception - A Physics Review

• A light source emits light waves at visible frequencies that strike an object
  – The object absorbs and or reflects different frequencies
    ▪ The object may be opaque, transparent, or translucent

• The reflected frequencies determine the object’s color
  – Black if all frequencies absorbed
  – White if all frequencies reflected
  – Other combinations produce the color spectrum

• The perceived color varies based on light source properties and viewing conditions
Color Perception

- The human visual system (rods and cones)
  - The cones prevalent in the central retina are sensitive to color
    - Sensitive to red, green, and blue
  - The rods prevalent on the retina periphery are sensitive to motion and low-light environments

- Visual limitations
  - Color perception is weak in our peripheral vision
  - Eyes are most sensitive to the middle frequencies, green and yellow
Color Deficiencies

- Photoreceptors vary greatly from person to person
- People with photoreceptors that do not respond to certain frequencies do not perceive those colors in the same way that other people do; “color blindness”
  - 8% of male individuals
  - 0.4% of female individuals
- The most common form is a reduced sensitivity to green, known as deuteranomaly
  - 5% of male individuals
  - 95% of color deficiencies in female individuals
Types of Color Blindness

Protanopic color vision, no ability to perceive red

Normal trichromatic color vision

Deuteranopic color vision, no ability to perceive green

Color Blindness Simulator
Color Perception

- Factors affecting color perception:
  - Culture
  - Age
  - Fatigue
  - Emotions
  - Ambient light
  - Light sources
  - Blood oxygen levels

- Color can evoke:
  - An **expectation**, **preferences**
  - **Emotion** – aesthetic appeal – “**warm**” versus “**cold**” colors
  - **Localization** – differences by culture or commercial context (logo color) in the meaning and emotion of color
Using Color in Interaction Design

- Clarification, Relation, and Differentiation
- Searching
- Comprehension, Retention, and Recall
- Task Performance
- Redundant Coding
- Color Concerns for Interaction Design
Clarification, Relation, and Differentiation

- Color can be used to **clarify differences** and **similarities** and **communicate relationships**
- Color codes can be used to support a logical information structure; e.g., multi-variable graph
Searching

- Color can be used to **catch the attention** of the user
  - Keywords, string types

```html
<!-- This is the content area of the page -->
<table cellspacing="2" cellpadding="2" border="1"
style="text-align: left; width: 100%;">
<tbody>
<tr>
<td style="vertical-align: top; text-align: center;">
  &nbsp;&nbsp;When Netscape Navigator 7.1 displays the source code of a web page, it colors the element names purple, the attribute names black, the attribute values blue, the comments green and character entities orange.
</td>
</tr>
</tbody>
</table>
```
Comprehension, Retention, and Recall

- Color can enable us to **comprehend patterns** in complex data structures

- Color can aid in **remembering and recalling** information
Task Performance and Redundancy

- Studies show **color** improves task **performance** for:
  - Recall
  - Search-and-locate
  - Retention
  - Decision judgment

- Redundancy – **color alone is not enough**
  - A clear **HCI structure and presentation** must **already be present** before color is introduced
  - Use **multiple sensory cues** (e.g. color and shape)
  - Don’t use color to delineate shapes – contrast issues
Color Concerns for Interaction Design

- **Limitations** in the perception of subtle color differences
- Number and choice of colors
  - To aid in color recognition and recall, **use only a few distinct colors**
    - Red, green, blue, and yellow are best
    - Five to nine colors for coding information
  - Don’t **distract** the user or **compete** with content
  - Keep color **perception limitations** in mind
    - E.g., we see green and yellow best, so avoid small blue objects
  - **Avoid saturated colors** – can cause visual fatigue
Color Concerns - Contrast

- **Incompatible differences** - some specific color combinations cause unique problems:
  - Colors at opposing ends of the spectrum such as red and blue
  - **Positive contrast** makes characters appear to glow (Halation)
Foreground-Background Color Contrast

- **Color Backgrounds**
  - An object’s *perceived color* is affected by the *background color*
Introduction to Icons

- Human issues concerning icons
- Using icons in interaction design
- Technical issues concerning icons

What is an icon?

A small image representing an object
Android Material Design
Android Material Design
Human Issues Concerning Icons

- **Recall** of images is **superior** to that of text
- **Images** are **more easily distinguished** than text
- People **perform better** with **icon** targets than with text targets
- However, icons are **not automatically self-explanatory**
- The dual nature of icons
  - Perceived as **representations of objects** in the interface
  - Also perceived as the **objects themselves**
  - E.g., MS Office save icon
- Icon design should reflect **metaphors of real world objects**
Using Icons in Interaction Design: Distinguish Icons

- The **intensity** of an icon’s physical characteristics is important to find and comprehend icons
  - Humans **respond first** to the icon’s physical properties and **then semantic associations**

- **Physical attributes** that can affect the way we **perceive icons**
  - Detail
  - Color
  - Size
  - Shape
  - Location
- (Research results – it depends on context)
Using Icons in Interaction Design: Follow Conventions

Amazon.com shopping cart

Audio icon—notes

Home icon

Secure Connection icon

Secure Login

Firebox browser

http://glyphicons.com/

Android Material Design Icons
Using Icons in Interaction Design: Context

- **Context supplies a frame of reference**
  - B I U vs B I U in Office applications

- **Icons can be seen in many different contexts:**
  - **Physical**
    - Screen location, contrast, juxtaposition to each other, screen density
  - **Cognitive** – user knowledge and experience, culture
  - **Metaphorical** – real world meaning
  - **Temporal** – viewing context changes via screen navigation; e.g., icons may be grayed out or disappear
Using Icons in Interaction Design: 
Context

Global meaning

European Road Signs

Local Conditions

Cow warning sign
Deer warning sign
People warning

Italian street signs
Technical Issues Concerning Icons - Terminology

- **Pictogram**: a picture that resembles what it signifies
  - Email envelope

- **Abstract Shapes**
  - Arithmetic symbols, question mark

- **Ideogram**: a symbol that stands for an idea or concept
  - Floppy disk to save a file to a folder

- **Logogram** (Logograph): a symbol that represents a word
  - Letter “U” to represent “you” or heart graphic for “love”
Principles for Icon Creation

- **Simplicity/complexity** – research is inconclusive on what is best; want high information **signal to noise ratio**

- **Cohesiveness** – families of related icons
  - **Conceptual** – perform related functions
  - **Visual** – share visual characteristics

- **Distinctiveness** of individual icons (within a group / family)

- **Familiarity** to user
  - Real world metaphors; e.g., mailbox
  - Abstract symbol based on universally understood conventions
  - In domain context – system and locale
Technical Issues Concerning Icons – Icon Grammar

- **Principles** that govern the **internal structure and meaning** of icon families
- This “grammar" is constructed on rules and procedures

![Zoom icons.](image1)

![Pen icons.](image2)

![Lasso selection icons.](image3)

- The grammatical rules must be **observable, logical, predictable, and consistent**; i.e., the user gets it
Technical Issues: Deconstructing Icons

- Basic shapes
- Indicators
- Styles
- Canonical view
- Aggregate symbols
Technical Issues: Deconstructing Icons

- Basic shapes
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Technical Issues: Deconstructing Icons

- Basic shapes
- **Indicators** show action, state, direction
- Styles
- Canonical view
- Aggregate symbols
Technical Issues: Deconstructing Icons

- Basic shapes
- Indicators
- **Styles**
  - Photo, drawing, caricature, outline, silhouette
- Canonical view
- Aggregate symbols
Technical Issues: Deconstructing Icons

- Basic shapes
- Indicators
- Styles
- **Canonical view** is most common, easily recognized, typifies the object

Box is 3D

- Aggregate symbols
Technical Issues: Deconstructing Icons

- Basic shapes
- Indicators
- Styles
- Canonical view
- **Aggregate symbols**: symbol combos for complexity
Technical Issues: Deconstructing Icons

- **Icon size and shape**
  - Typically **square**
  - **Size standards** exist for the different **platforms**
    - Application icons should be in 16-color and 256-color versions and in three sizes: 16x16 pixels, 32x32 pixels, and 48x48 pixels (*Microsoft Co.*, 2006)
    - Finder icons are a 128 x 128 image. App icons should be 32 x 32, and 16 x 16 (*Apple*, 2007)

- **Transparency and background**
  - **Icon on application background** (icon background is transparent)
    - May need dark **borders** to contrast **application backgrounds**
  - **Icon with background mask** to contrast **application background**
Icon Analysis