Smart Color for Powerful Visual Communication in Your Applications

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Abstract and Introduction

Design applications using color to communicate, not to decorate.

This paper reports proven benefits of communicating with color, and emphasizes software-independent color design principles. It covers key technical aspects of color communication, some unique to SAS/GRAPH*.

The poster illustrates effective color communication with examples. *Because the paper cannot be published in color, no illustrations are included.* But, upon request, the author may be able to provide some.

Web publishing has caused an explosion of color communication. An intranet exhibits your color use enterprise-wide. The Internet exhibits your color use worldwide. Color printing has been available over fifteen years for computer graphic applications. In recent years manufacturers have been producing moderately priced full-color laser printers that use toner (not wax or wax transfer) and plain paper. Also now available are comparatively cheap ink jet printers that provide very good quality output, but require special paper for best results. Advances in technology will increase quality, speed, and functionality while decreasing price.

Industry analysts say untrained color users are unlikely to gain productivity or competitive advantage. To do so requires good design.

(For non-color aspects of design, see my paper "Chart Smart: Design Graphs to Inform and Influence", elsewhere in *Proceedings*.)

Always Remember These Facts about Color

Prof. Jay Neitz of the Eye Institute of the Medical College of Wisconsin: 8 out of 10 males have some form of color blindness, but, due to genetic differences, women rarely have any.

The commonest form of color blindness cannot distinguish red from green.

Reported Benefits of Color

- increased readership
- increased reading speed & comprehension
- faster learning
- reduced error rates
- improved recognition
- improved recall
- people prompted to act

Jan White on Color Communication

- If everybody screams, all you get is noise.
- The less color used, the more effective it is.
- Color consistency provides recognition.
- Use color to sort and/or link information.
- Make large areas pale, small areas bright.
- Colored text or lines must be thicker than black.
- Don't waste color on titles—for emphasis, use large or bold print instead.
- On a graph, use color to emphasize an important **visual** message.

Michael Turton on Color Communication

- Color works better with space around it.
- Color is more effective in bigger masses, since it is less dense than black.
- Color prioritizes information, whether meant to or not.
- Color is more effective if it has some function; it confuses if used arbitrarily.
- Color can guide the viewer.

Aaron Marcus on Color Communication

Use blue for large areas, not text or lines. Blue-sensitive color receptors are the least numerous in the retina's central focusing area.

Use red or green in the center of the visual field. The edges of the retina are not very sensitive to these colors.

Use thin, light text or lines on dark backgrounds for viewing in low light situations; use dark text or lines on light backgrounds for viewing in high light situations.

In an image, use the highest contrast for text. For the best contrast, use black and white.

LeRB on Color Communication

- Color does not improve bad design.
- Design color applications to communicate, not to decorate.

When to Use Color on a Graph

- No response levels/categories: black & white
- Few levels or categories: gray shades maybe
- Many levels or categories: color necessary

Benefits of Boring Black-and-White

- Faster, cheaper, more reliable
- Easier to use (simpler equipment, no agonizing over color strategy)
- More copyable (more, cheaper, and faster copiers available): **Good Graphs Get Copied**

Color Differs on Different Media

With hardcopy vs. transparency or slide, the same color looks different due to the difference between reflected and transmitted color.

With monitor vs. hardcopy or transparency, the same color may look different because a monitor uses Red, Green, and Blue (RGB) additive primaries to mix colors, whereas printing uses Cyan, Magenta, Yellow, and Black (CMYK) subtractive primaries.

Furthermore, with different technology from different vendors, even for devices in the same class the same color may look different.

Given such confusion, it's no surprise that many vendors of software and hardware for color have begun to adopt standard ways and tools to specify and calibrate colors across all the facilities one might use, so that a color will (should) look the same wherever you display it.

Use Reliable SAS/GRAPH Color Names

For good control of color design, use H*hhhllss* color names, if available for your device.

- *hhh* = Hue
- *ll* = Lightness
- *ss* = Saturation
- *hhh*, *ll*, *ss* are hexadecimal values
- *hhh*, *ll*, *ss* ranges are 000-168, 00-FF, 00-FF
- *hhh* = 000 - 168 defines a "wheel of hues", 0 - 360 degrees (this makes sense when you see the illustration)
- ll = 00 (0%) is always black
- ll = FF (100%) is always white
- ss = FF (100%) is full saturation
- ss = 00 (0%) is always gray
- llss = 80FF is what I call the "true "color"

Confusing SAS/GRAPH Color Names

Consider the pair

C = VIOLET (violet)
C = LIV (light violet)

"Under the covers", the HLS colors assigned are (spaces inserted in color name for clarity):

C = H 01E B0 67 for VIOLET
C = H 022 75 4E for LIV

Since 75 < B0, it's no surprise that "LIGHT" VIOLET is darker than VIOLET. And why does the hue vary?

Use HLS color names: they are reliable.

SAS/GRAPH Names for Grays

For GRAY, "light", "medium", and "dark" do work as expected, but, even with WHITE and BLACK, may not provide enough colors. If so, use color names of the form GRAY*ll*, where *ll* is hexadecimal with range 00-FF. FF (hex for decimal 255) is 0% gray, i.e., WHITE. 00 (hex for decimal 0) is 100% gray, i.e., BLACK. 80 (hex for decimal 128) is 50% gray. Here are other correspondences for your convenience: D5 = 17%, CC = 20%, C0 = 25%, AA = 33%, 99 = 40%, 66 = 60%, 55 = 67%, 40 = 75%, 33 = 80%, 2B = 83%.

How to Choose/Use SAS/GRAPH Grays

Gray shades too close together are difficult or impossible to distinguish. Decide how many (N) grays are needed for the chart, divide 256 by N - 1, and use the quotient (in hexadecimal) as increment from 00 to FF for *ll* in GRAY*ll* assignments. Subsets of the values provided in the section above can produce equally spaced grays for sets of 3, 4, 5, 6, or 7 PATTERN statements. But it should be noted that a photographer told the author that the human eye cannot reliably distinguish more than five shades of gray (or of any other color).

Black area-fill on a map will hide shared boundaries. Sometimes gray shades do not photocopy well.

How to Choose Colors

This deserves a treatise in itself. If you care about color significance across national boundaries, it's a quagmire. If you don't trust your intuition, ask the author for references.

Notices

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