Colorful Graphics

How to use colors correctly and wisely

Cédric Scherer // rstudio::conf // July 2022

Channels to Encode Information

Use of Double Encoding

The RGB Color Space

Michael Horvath

The HCL Color Space

Michael Horvath & Christoph Lipka

Hue
color family

Chroma
colorfulness

Luminance
lightness / brightness

Modified from ***uxplanet.org***

RGB versus HCL

hclwizard.org

Color Palette Choice

Sequential

Palette

Desaturated

Use to encode
numerical information with order

use highest contrast for most important information

either single- or multi-hue

Modified from the {colorspace} R package vignette

Color Palette Choice

Sequential

Palette

Desaturated

Use to encode
numerical information with order

use highest contrast for most important information

either single- or multi-hue

Diverging

Palette

Desaturated

Use to encode
numerical information with critical midpoint

ensure a meaningful midpoint value and use balanced extremes

combination of two sequential palettes

Modified from the {colorspace} R package vignette

Sequential versus Diverging Palettes

"When to use sequential and when to use diverging color scales" by Lisa C. Muth / DataWrapper

Color Palette Choice

Sequential

Palette

Desaturated

Use to encode
numerical information with order

use highest contrast for most important information

either single- or multi-hue

Diverging

Palette

Desaturated

Use to encode
numerical information with critical midpoint

ensure a meaningful midpoint value and use balanced extremes

combination of two sequential palettes

Qualitative

Palette

Desaturated

Use to encode
categorical information

pick distinct colors with the same perceptual weight

limit categories to 6–8

Modified from the {colorspace} R package vignette

Sequential versus Qualitative Palettes

"What to consider when choosing colors for data visualization" by Lisa C. Muth / DataWrapper

Use color wisely (and correctly)

Original graphic with a random categorical palette

Use color wisely (and correctly)

Original graphic with a random categorical palette

Reworked graphic using a diverging palette

Use color wisely (and correctly)

Original graphic with a random categorical palette

Makeover using a continuous palette

Reduce your Carbon Footprint: *Take the Train*

It's too far to walk or go by bike? Trains are nearly always the winning option over other moderate-to-long distance transportation modes. Taking a train instead of a car for medium-length distances would cut your emissions by ~80% and by ~84% if the train ride replaces a domestic flight.

Graphic: Cédric Scherer | Source: UK Department for Business, Energy & Industrial Strategy via OurWorldInData
* Data is based on official conversion factors used in UK reporting, measured as GHG Emissions (GCO2E/KM) 2018

Reworked gaphic as contribution to the #30DayChartChallenge 2022

cedricscherer.com @CedScherer z3tt

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Don't trust color palettes **— test them!**

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ColourSimulations

SimDaltonims (Mac only)

ColorFilter (for URLs)

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Ensure Readibility for Color-Blind Persons

"Fundamentals of Data Visualization" by Claus O. Wilke

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Viz Palette displaying the "colors in action" without color deficiency

Viz Palette displaying the "colors in action" with deuteranopia

Viz Palette displaying the "colors in action" with a greyscale

Viz Palette displaying the same "colors in action" on a dark background

Viz Palette also checks if there is conflicts in colors and color names

The Myndex APCA Contrast Calculator displays modern contrast ratios for various combinations of text size and font weight

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The Myndex APCA Contrast Calculator displays modern contrast ratios for various combinations of text size and font weight

APCA allows for lighter grey on light backgrounds...

... but also requests lighter grey on dark backgrounds

"It's time for a more sophisticated color contrast check for data visualizations" by Lisa C. Muth / DataWrapper

Med Phys. 2015 Jun; 42(6): 2942–2954. Published online 2015 May 20. doi: 10.1118/1.4921125

PMCID: PMC5148121 | PMID: 26127048

Effect of color visualization and display hardware on the visual assessment of pseudocolor medical images

Silvina Zabala-Travers, Mina Choi, Wei-Chung Cheng, and Aldo Badano[a)]

10 March 2017

Interpretation of the rainbow color scale for quantitative medical imaging: perceptually linear color calibration (CSDF) versus DICOM GSDF

Frédérique Chesterman, Hannah Manssens, Céline Morel, Guillaume Serrell, Bastian Piepers, Tom Kimpe

Author Affiliations +

Proceedings Volume 10136, Medical Imaging 2017: Image Perception, Observer Performance, and Technology Assessment; 101360R (2017) https://doi.org/10.1117/12.2253885

Event: SPIE Medical Imaging, 2017, Orlando, Florida, United States

IEEE Computer Graphics and Applications

Rainbow Color Map (Still) Considered Harmful

March/April 2007, pp. 14-17, vol. 27

DOI Bookmark: 10.1109/MCG.2007.46

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Education and communication

Rainbow color map distorts and misleads research in hydrology – guidance for better visualizations and science communication

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[2]Department of Civil Engineering, University of Bristol, Bristol, UK

Med Phys. 2015 Jun; 42(6): 2942–2954. Published online 2015 May 20. doi: 10.1118/1.4921125

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"The ad hoc manner in which color is handled and the lack of standard approaches have been associated with suboptimal and **inconsistent diagnostic decisions with a negative impact on patient treatment and prognosis**."

Zabala-Travers, Choi, Cheng & Badano 2015 Med Phys.

Modified from Fabio Crameri

true-color Phil

rainbow Phil

batlow Phil

Modified from Fabio Crameri

Appendix

Bivariate Color Palettes

Strode et al. (2020) "Operationalizing Trumbo's Principles of Bivariate Choropleth Map Design"

Value-Suppressing Uncertainty Palettes

Correll, Moritz & Heer (2018) "Value-Suppressing Uncertainty Palettes"

Bivariate Color Palettes versus Value-Suppressing Uncertainty Palettes

Correll, Moritz & Heer (2018) "Value-Suppressing Uncertainty Palettes"

"CMYK Vice Map" by John Nelson & Craig Williams

"CMYK Vice Map" by John Nelson & Craig Williams