Color… part 2

Today

- How to Read a Research Paper
- Components of a Well-written Research Paper
- 3 Readings for Today
  - "Modeling Color Difference for Visualization Design" Szafir, IEEE TVCG / IEEE VIS 2017
  - "Hue-Preserving Color Blending" Chuang, Weiskopf, and Möller, TVCG 2009
  - "A Linguistic Approach to Categorical Color Assignment for Data Visualization", Setlur and Stone, IEEE InfoVis 2015
- Reading for Tuesday
- Pop Worksheet on Color!

How to read a research paper?

(especially an advanced paper in a new area)

- Read abstract & conclusion first, then the stuff in the middle (maybe)
- Read the section headers, read the sections that you're interested in/have background to understand, skim the not relevant sections
- Skip the related work section (until you need it, on 2nd or 3rd pass)
- Don't wait until the last minute… Multiple readings might be necessary, pausing in the middle can be good. Take stretch breaks, refocus, think.
- Take notes as you go, & new definitions/terms that will be used
- Look at the pictures! Read relevant sections for more info as you look at the picture
- Look at the video, helps understand complicated algorithms or try to use the tool (helps with motivation),
- Google things, background reading, look for simpler explanations
- For in depth reading, print & take notes by hand
- Try to code it, try a small example by hand

How to read a research paper?

(especially an advanced paper in a new area)

- Multiple readings are often necessary
- Don't necessarily read from front to back
- Lookup important terms
- Target application & claimed contributions
- Experimental procedure
- How well results & examples support the claims
- Scalability of the technique (order notation)
- Limitations of technique, places for future research
- Possibilities for hybrid systems with other work

Components of a well-written research paper?

- Language is of complexity appropriate for intended audience, include more intuitive descriptions (big picture motivation)
  - Explain terms that audience may not know. Decode your acronyms
- Well labeled sections & subsections (mostly standard sections)
- Not completely terrible writing, not too dense, not poorly written, minimize non-native english difficulties, avoid unusual vocabulary/slang,
- Helpful images & figures, embedded in text
- Proper citation, reliable sources
- List of rules/acronyms/terms/hypotheses up front in table
- Clear objectives, criteria
- Appropriate examples & use cases
- Acknowledge limitations, how to mitigate these edge cases/exceptions
- Make explicit how sections fit together… "transitions" between sections/chapters!
- Sections should stand on their own, be able to read just one
- Summarize previous stuff as needed, so reader can understand what you're doing as an extension
- Prepare supplemental material

Components of a well-written research paper?

- Motivation/context/related work
- Contributions of this work
- Clear description of algorithm
  - Sufficiently-detailed to allow work to be reproduced
  - Work is theoretically sound (hacks/arbitrary constants discouraged)
- Results
  - well chosen examples
  - clear tables/illustrations/visualizations
- Conclusions
  - limitations of the method are clearly stated

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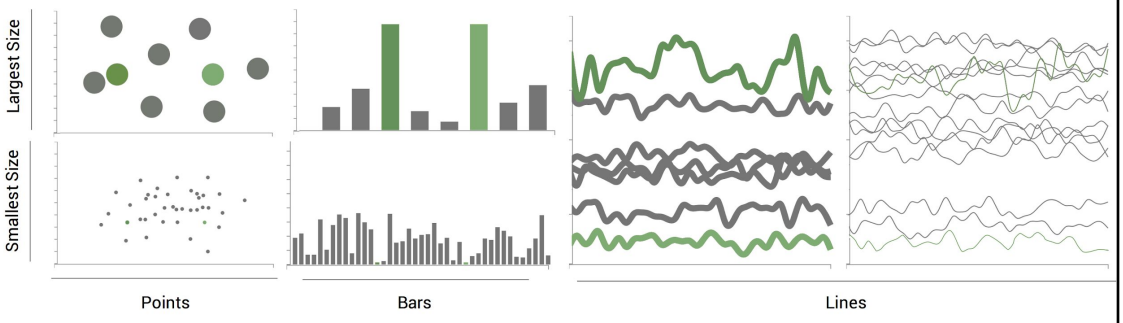
Reading for Today:

"Modeling Color Difference for Visualization Design"
Szafir, IEEE TVCG / IEEE VIS 2017



- JND: just noticeable difference, discriminability
- Perceived color difference varies inversely with size
  - Due to our visual system, elongated marks easier to distinguish
  - If noticable difference is not adjusted, will be more conservative than necessary when choosing colors
  - Visual field degree / pixels
- Assumptions: Simple world vs. uncalibrated display, isolation vs. complex visualization, size/shape geometry
- Experiments
  - Use Mechanical Turk
  - Are these 2 colors different?
    (plotted as data surrounded by other dots/bars/lines of grey)
  - Mixed factors, mixed participants,
  - Fatigue effect
  - Significance of results, ANCOVA
- Colors for visualization "where data is known at design time"
  - e.g., "data journalism" uses fixed datasets

"Modeling Color Difference for Visualization Design"
Szafir, IEEE TVCG / IEEE VIS 2017

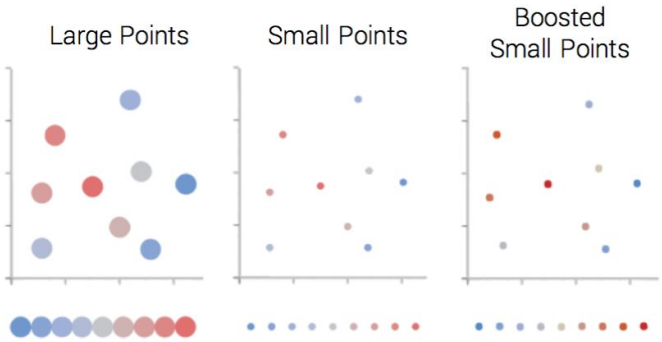


Table 1. Regression results for points, where $p = m_x * \Delta X$.

Axis	Size (s)	Size in Px	Slope	R^2	$ND(50\%)$ in ΔE
L	0.25°	6 px	0.059	0.948	8.37
L	0.5°	12 px	0.074	0.97	6.74
L	0.75°	18px	0.087	0.981	5.75
L	1°	25px	0.087	0.965	5.75
L	1.5°	37 px	0.082	0.996	6.08
L	2°	50 px	0.091	0.974	5.47
a	0.25°	6 px	0.031	0.984	16.11
a	0.5°	12 px	0.05	0.988	9.98
a	0.75°	18px	0.059	0.987	8.52
a	1°	25px	0.064	0.992	7.81
a	1.5°	37 px	0.073	0.985	6.87
a	2°	50 px	0.073	0.994	6.84
b	0.25°	6 px	0.026	0.978	19.46
b	0.5°	12 px	0.037	0.988	13.34
b	0.75°	18px	0.044	0.994	11.35
b	1°	25px	0.05	0.979	10.03
b	1.5°	37 px	0.056	0.979	8.97
b	2°	50 px	0.063	0.99	7.99

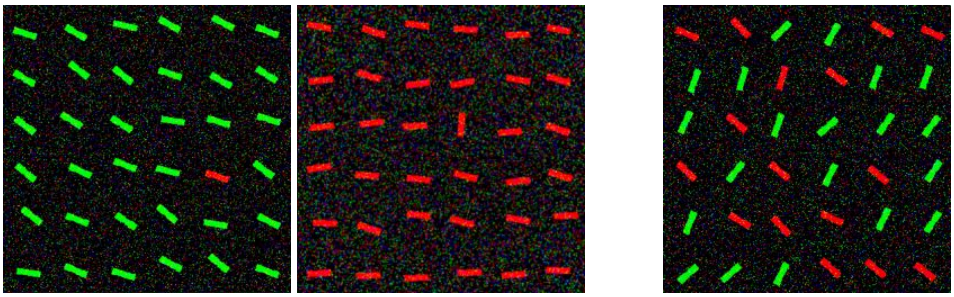
Table 2. Regression results for lines, where $p = m_x * \Delta X$.

Axis	Size (s)	Size in Pixels	Slope (m)	R^2	$ND(50\%)$ in ΔE
L	0.05°	2px	0.033	0.876	15.35
L	0.1°	3px	0.042	0.92	11.98
L	0.15°	4px	0.058	0.921	8.69
L	0.25°	6px	0.065	0.955	7.74
L	0.3°	7px	0.069	0.947	7.23
L	0.35°	9px	0.072	0.96	6.92
a	0.05°	2px	0.036	0.978	13.92
a	0.1°	3px	0.043	0.956	11.57
a	0.15°	4px	0.049	0.959	10.28
a	0.25°	6px	0.053	0.94	9.39
a	0.3°	7px	0.061	0.933	8.15
a	0.35°	9px	0.064	0.919	7.79
b	0.05°	2px	0.026	0.981	19.47
b	0.1°	3px	0.031	0.967	16.15
b	0.15°	4px	0.033	0.934	15.17
b	0.25°	6px	0.036	0.918	13.75
b	0.3°	7px	0.04	0.927	12.43
b	0.35°	9px	0.045	0.945	11.05

Visual Salience

Laurent Itti (2007), Scholarpedia, 2(9):3327.
http://www.scholarpedia.org/article/Visual_salience

- … is the perceptual quality that makes some items in the world stand out from their neighbors and grab our attention



- Designers use saliency to create objects (such as this emergency triangle) that appear highly salient in a wide range of viewing conditions

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"Hue-Preserving Color Blending"
Chuang, Weiskopf, and Möller, TVCG 2009

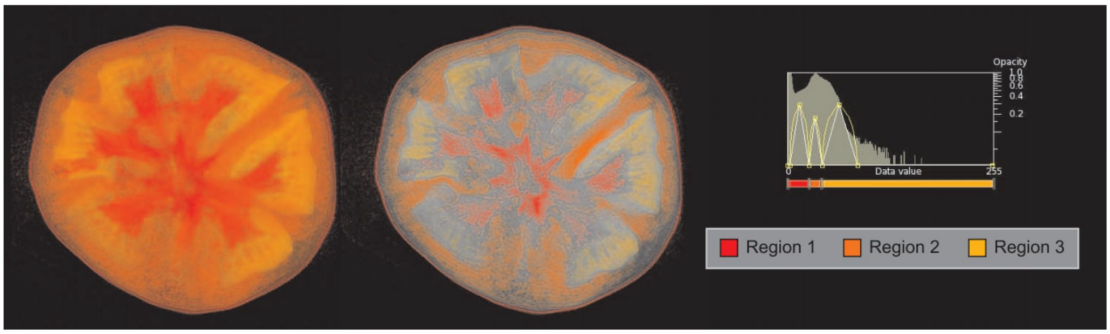
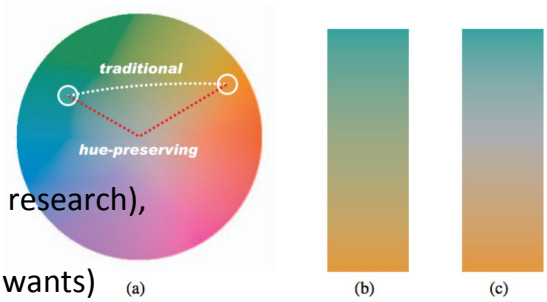
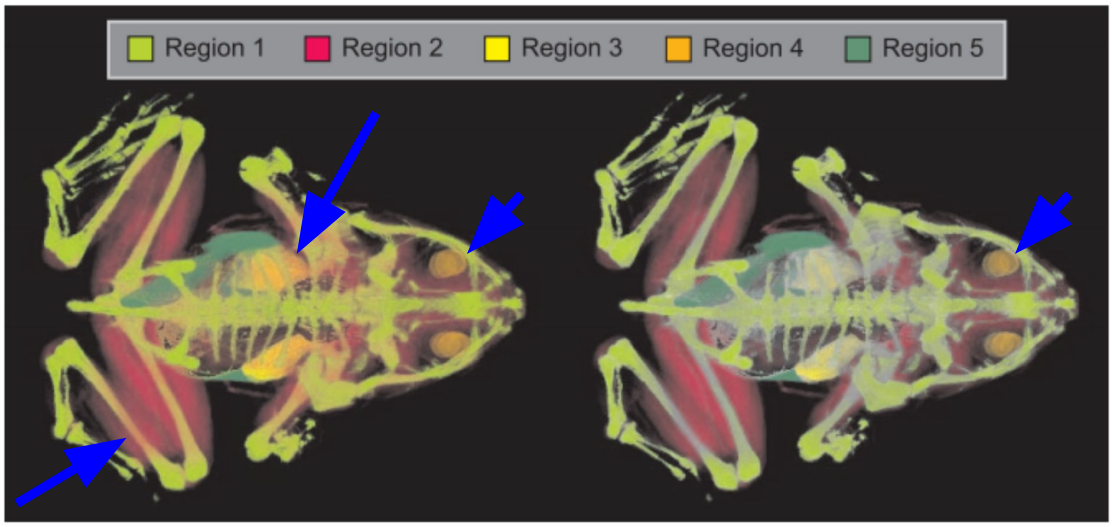


Fig. 1. Volume rendering of a tomato data set using traditional (left) and hue-preserving (middle) color blending. The data histogram, transfer function, and color legend are shown on the right.

- Color is particularly effective for visual grouping
- Volume visualization classifies data into material components -> want to visualize these regions
  - Great potential for application to medical data
- Opposite colors should be used for semi-transparent layers to avoid hue shift after alpha blending
  - Just a small change in the traditional method
  - No change (if colors are already opposite), or
  - More significant change (forcing blend through gray)
- Clearly states:
  - Observations (from perception research),
  - Design criteria (wants), and
  - Requirements (compromise of wants)



Region 4 = eyes
(only the eyes
should be orange)



original

hue preserving

- Example images were very well chosen
- "when using many colors of different hues, I get a blended hot mess of color that completely washes out and detail of the underlying 3D rendered model"
- Long sections could be broken up with subsection titles
  - limitations/drawbacks is buried in the middle of "results" (not enough attention paid to negatives?)
- The Matlab "jet" color scheme is the default (and it looks so pretty!), but it is misleading!

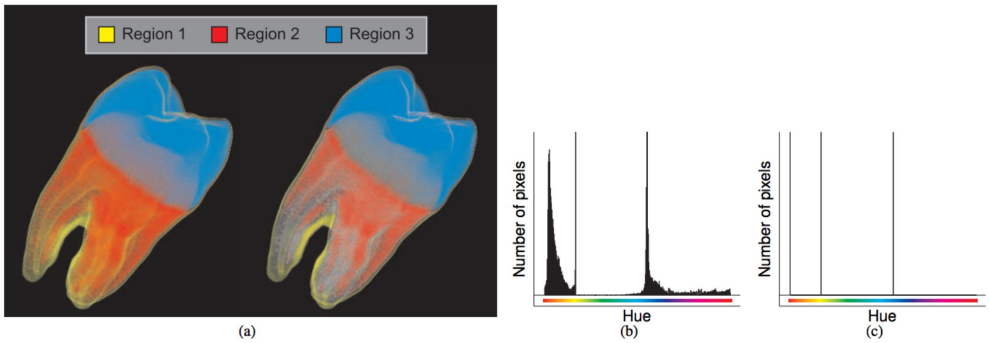


Fig. 7. (a) Traditional (left) and hue-preserving (right) rendering of a tooth data set. In the traditional rendering, orange colors can be seen where red and yellow mix. There are also purple hues where red and blue mix. These extraneous hues completely disappear in the hue-preserving rendering. The color hue histograms for both renderings are shown in (b) and (c). Note the three vertical lines in the hue-preserving histogram, representing the original color hues.

- Is this too lossy? Are we highlighting the important data or just showing the easy to present data?
- Needs a user study, with real case studies, and domain experts, measuring accuracy in domain-specific analysis

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"A Linguistic Approach to Categorical Color Assignment for Data Visualization", Setlur and Stone, IEEE InfoVis 2015

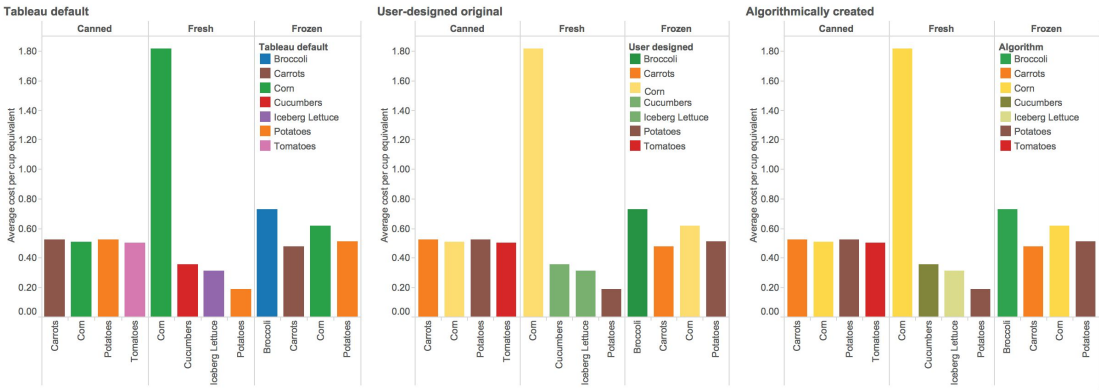
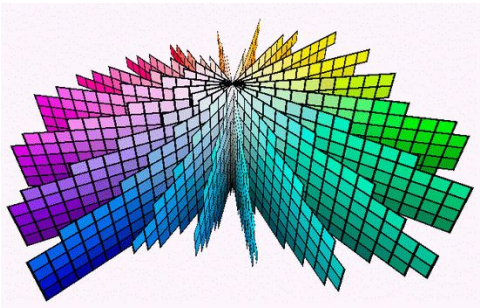


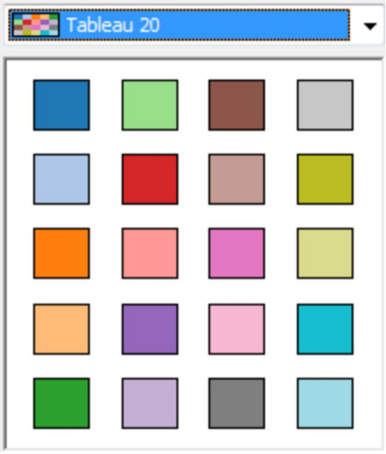
Fig. 1. This visualization was taken from a Tableau Public workbook [11] to illustrate the value of semantic color encoding. Left: The Tableau default colors are perceptually legible, but conflict with the data semantics ('Tomatoes' are pink, 'Corn' is green). Center: The Tableau author matched the colors to the data semantics (red for 'Tomatoes', yellow for 'Corn'), which makes it easier to identify the different types of vegetables in the graph. Right: Our algorithm automatically created a similarly effective result.

Stroop Effect
http://faculty.washington.edu/chudler/words.html



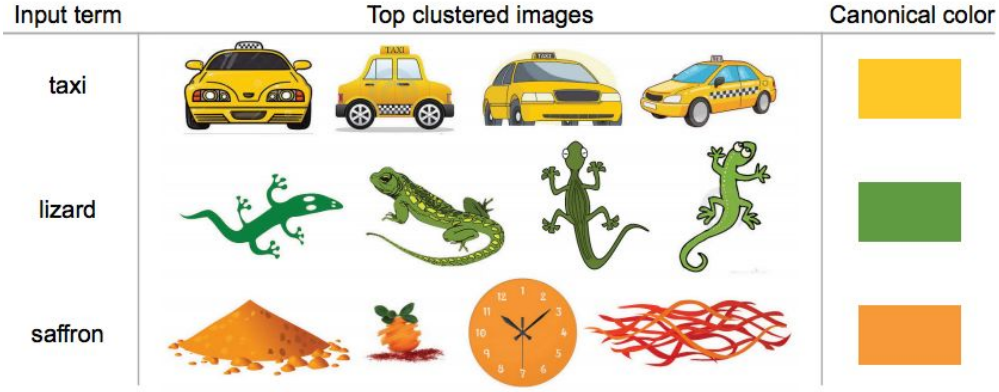
Musell Color System
http://www.codeproject.com/Articles/7751/
Use-Direct-D-To-Fly-Through-the-Munsell-Color-So

TableauColors



- Is a word colorable?
  - Use Google n-grams to find # of times it is associated with color (books only? Would this be even better if they had a general human speech corpus?)
  - Are there strong color associations for a word?
- What is the best color value?
  - google images (clipart or natural images?)
- Semantic context
  - apple the fruit or apple the company?
  - NLP (Natural Language Processing)
- K-means clustering to create set of distinct colors (flexibility of different colors for some items)
- *"The power of these names is not their accuracy, but their memorability and ease of use."*

- Berlin & Kay's 11 basic color terms:
  - black, white, red, green, yellow, blue, brown, purple, pink, orange, gray
- Why clipart?



- Query expansion, Ontology, Concept tree

- Not surprised that it performs poorly for logos
- Even if the results are always perfect, this can be a huge timesaver! And expand what colors we should consider.
  - Why limit choices to Tableau 20? Why not pantone? Or Munsell?
- Good scientific organization to paper
- Larger datasets & statistics always(?) better than surveys
  - Presented algorithms are entirely dependent on these datasets
- Impressive result for 2 different fields
  (could alternatively be a paper in an NLP conference)
- Lots of detail in the paper (good for reproducibility)…
  but also feels like lots of padding/redundancy in the paper?
  (same example used multiple times)
- Discussion could be stronger/more complete
  - Competitor's results often (always?) seemed better…
- Xkcd is awesome
- Sentiment analysis (sorta creepy)
- Why include poem?

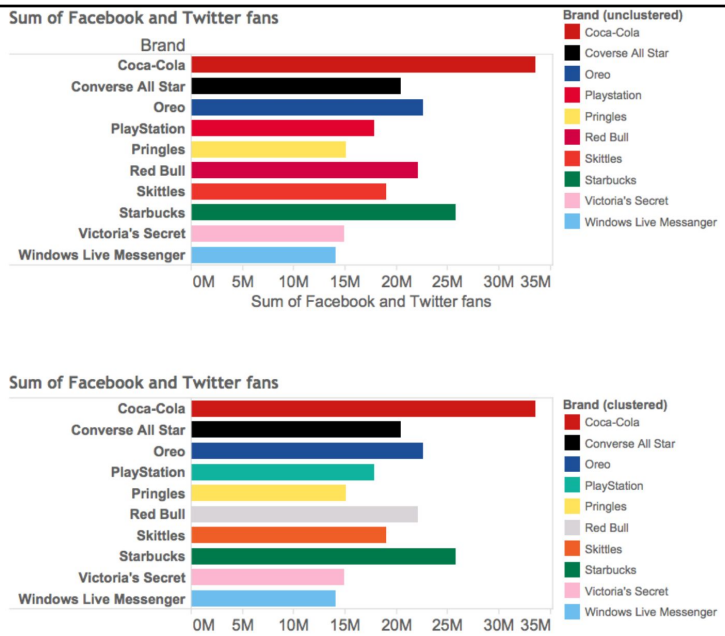


Fig. 12. Top row: A Tableau Public visualization [11] semantically color encoded with our algorithm before clustering is applied. One can observe several brands colored with shades of red. Bottom row: Once clustering is applied to the set of colors, some of the reds are replaced by alternate canonical colors obtained from the corresponding logo images.

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Reading for Tuesday:

- "Stacked Graphs – Geometry & Aesthetics" Lee Byron & Martin Wattenberg, IEEE TVCG 2008