CSCI 4550/6550 Interactive Visualization

https://www.cs.rpi.edu/~cutler/classes/visualization/S24/

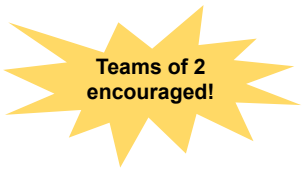
# Lecture 8: More Color & How to Read, Write, and Review a Paper

## Today

- Worksheet on Color and Homework 5: Experimenting with Color
- How to Read a Research Paper
- Components of a Well-written Research Paper
- How to Review a Research Paper
- 3 Readings for Today
  - “Modeling Color Difference for Visualization Design”
  - “Hue-Preserving Color Blending”
  - “A Linguistic Approach to Categorical Color Assignment for Data Visualization”
- Readings for Tuesday

## Homework Assignment 5: Experimenting with Color

- Revisit an earlier assignment/data/toolkit
  - Make a non-color-related improvement to this visualization
- Prepare many versions of the same visualization experimenting with different color palettes, e.g.:
  - Shades of grey
  - Black & white
  - Cool vs. warm tones
  - Bold/saturated vs. pastel
  - Colorblind aware
  - Light vs dark background and/or color negation
  - Etc.




- Analyze the effectiveness of the color scheme for each visualization.
- How well does it convey the message? Or mislead the viewer?
- Compare the visualizations to each other.

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# How to Read a Research Paper?

*especially an advanced paper in a new area…*

-

# How to Read a Research Paper?

- Abstract, conclusion, then the middle
- Read it more than once
- Skim the procedure section (only necessary if you're trying to reproduce)
- Identify the problem, what's a good solution, what is their solution, results
- Look at the figures/tables
- Skim the whole thing, make note of what to come back to
- Read first sentence of every paragraph
- Skip the math, go back to it later
- Print the paper, highlight where the identify the problem,
  search for where they solve it, search for discussion/future work
- Make notes on acronyms/procedures that are unfamiliar, to minimize scrolling
- Google the topic, if background is unfamiliar
  (technical jargon can break up your efficiency in reading)
- When you have lots of jargon, slow down, decode what they are trying to say
- Skip the related work if you don't know the area (don't know the authors and papers already)
- Be well rested & awake

# 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

# Suggested Reading (only 2 pages!)

**How to Read a Paper**

S. Keshav
David R. Cheriton School of Computer Science, University of Waterloo
Waterloo, ON, Canada
keshav@uwaterloo.ca

http://ccr.sigcomm.org/online/files/p83-keshavA.pdf

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## Components of a Well-Written Research Paper?

-

# Components of a Well-Written Research Paper?

- Define all your acronyms – the first time you use it in the paper!
- Clearly state how you used prior work to build your new technique
- Clearly state what problem you are trying to address
- Relevant and supporting images & figures, with good captions!
- It's not a mystery novel, no suspense, tell me the answer in the abstract
- Use standard section titles (organized into logical sections & labeled subsections)
- Good balance of figures and math algorithms and explanation
- Varied examples and tests in the experimental portion (not all the same, test the boundaries/extremes)
- Give justification for your choices (no arbitrary constants)
- Define what makes a good/ideal solution and why your result/solution is good
  - Evaluate prior work on the same criteria, explain what needs improvement
- Explain design decisions and constraints on the problem/application
- External/internal validities: Is the experiment consistent? Will it be valid in the future?
- Accessibility & audience: don't target too narrowly, not just specialists in your area, people who will actually use it

# 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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## How to Review a Paper?

constructive feedback to classmates/research peers, or serving on committee to decide paper acceptances

-

## How to Review a Paper?

constructive feedback to classmates/research peers, or serving on committee to decide paper acceptances

- Point out things you like & don't like
- Provide suggestion or reasons, why was it confusing
- Read a paper critically, but also generously/charitably, don't be a "paper killer"
- Get high level understanding, critique their explanation (constructive feedback)
- Figure out author's intention. Did they execute that?
- Learned from Art Critiques: Don't say "boring, interesting, good", dig deep, look at specific details, question/admire, be more descriptive
- Restate the problem. Then ask the author if you got it right.
- It's better almost if you don't already know the work, external perspective
- Make sure your feedback is not based on opinion
- Make sure you are sufficiently up-to-date on this topic
- Critique the flow of the paper, is it easy to read
- Make overall note of spelling & grammar (but this is not your primary "job")

## Formal Task of Paper Reviewer (1 of 2)

- Description: Briefly describe the paper and its contribution to computer graphics and interactive techniques. Please give your assessment of the scope and magnitude of the paper's contribution.
- Clarity of Exposition: Is the exposition clear? How could it be improved?
- Quality of References: Are the references adequate? List any additional references that are needed.
- Reproducibility: Could the work be reproduced from the information in the paper? Was any code or data submitted with the supplemental materials? If so, does it support the claims in the paper? Are all important algorithmic or system details discussed adequately in the paper?

Review form for SIGGRAPH

# Formal Task of Paper Reviewer (2 of 2)

- Please rate this paper on a continuous scale from 1 to 5, where:
  - 1 = Definitely reject. I would protest strongly if it's accepted.
  - 2 = Probably reject. I would argue against this paper.
  - 3 = Possibly accept, but only if others champion it.
  - 4 = Probably accept. I would argue for this paper.
  - 5 = Definitely accept. I would protest strongly if it's not accepted.
- Please rate your expertise in the subject area of the paper on a continuous scale from 1 to 3, where:
  - 1=Beginner
  - 2=Knowledgeable
  - 3=Expert
- Explanation of Rating: Explain your rating by discussing the strengths and weaknesses of the submission, contributions, and the potential impact of the paper. Include suggestions for improvement and publication alternatives, if appropriate. Be thorough. Be fair. Be courteous. Your evaluation will be forwarded to the authors during the rebuttal period.
- Private Comments: You may enter private comments for the papers committee here. These comments will not be sent to the paper author(s). Please do not mention any other papers that are currently in review, or the names of people associated with these papers.

Review form for SIGGRAPH

# Another Suggested Reading

**How NOT to review a paper**
**The tools and techniques of the adversarial reviewer**

Graham Cormode
AT&T Labs–Research
Florham Park NJ, USA
graham@research.att.com*

https://sigmodrecord.org/publications/sigmodRecord/0812/p100.open.cormode.pdf

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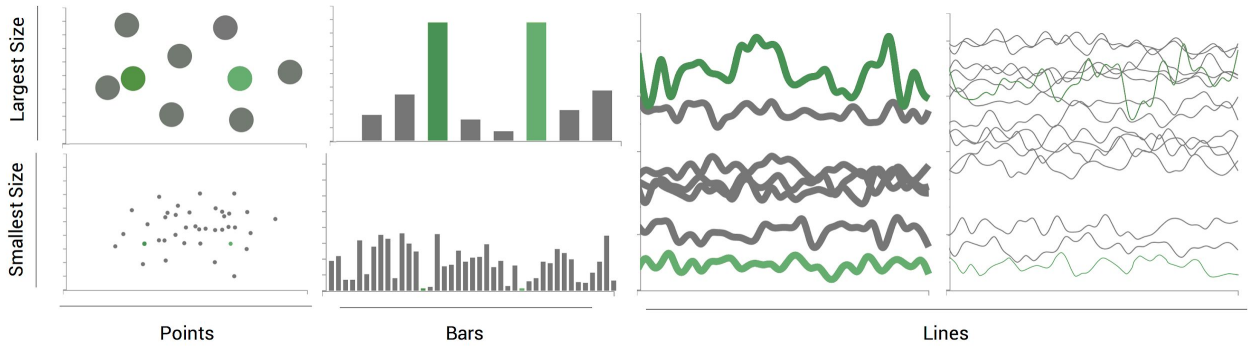
# Reading for Today

“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 noticeable 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

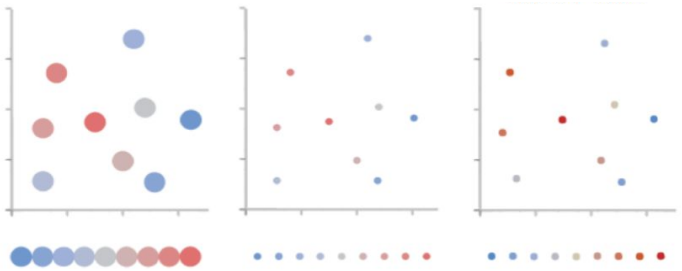


Table 1. Regression results for points, where $p = m_x * \Delta X$.

| Axis | Size ($s$) | Size in Px | Slope | $R^2$ | $ND(50\%)$ in $\Delta E$ |
|---|---|---|---|---|---|
| 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 |

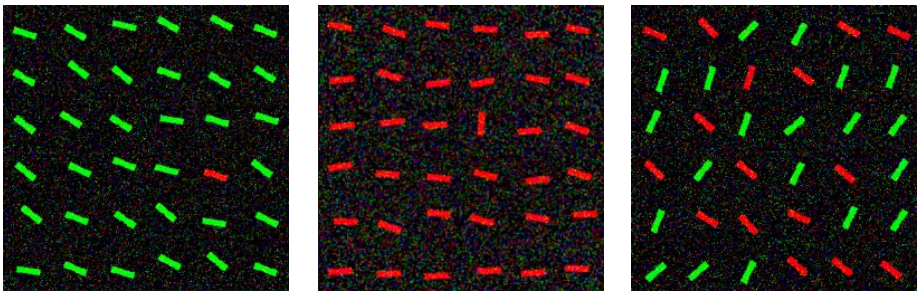
Table 2. Regression results for lines, where $p = m_x * \Delta X$.

| Axis | Size ($s$) | Size in Pixels | Slope ($m$) | $R^2$ | $ND(50\%)$ in $\Delta E$ |
|---|---|---|---|---|---|
| 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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# Reading for Today

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

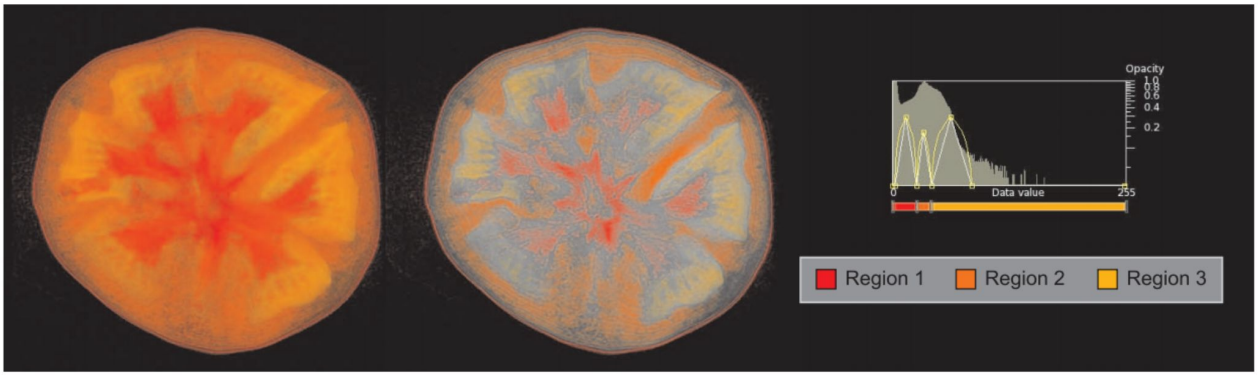
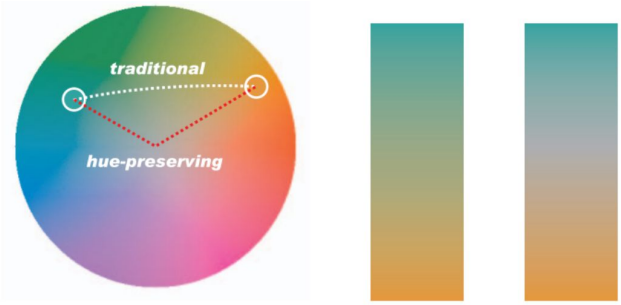
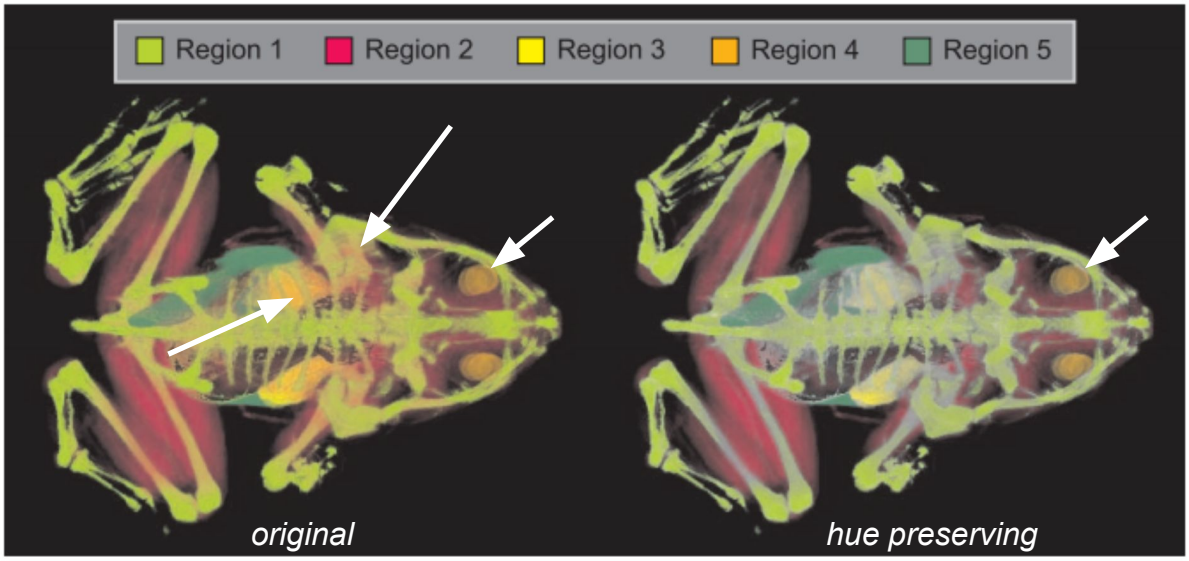



Fig. 1. Volume rendering of a tomato data set using traditional (left) and hue-preserving (middle) color blending. The data histogram, transfer function, and color legend are shown on the right.

- Color is particularly effective for visual grouping
- Volume visualization classifies data into material components
  *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)




- 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!

- 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

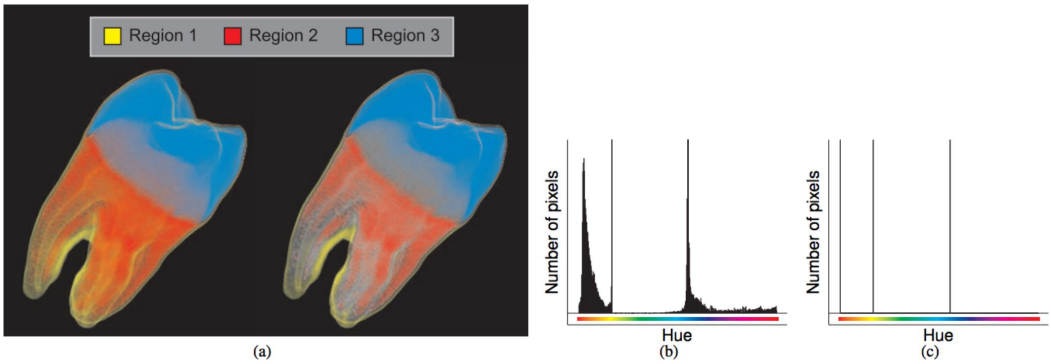



Fig. 7. (a) Traditional (left) and hue-preserving (right) rendering of a tooth data set. In the traditional rendering, orange colors can be seen where red and yellow mix. There are also purple hues where red and blue mix. These extraneous hues completely disappear in the hue-preserving rendering. The 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.

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# Reading for Today

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

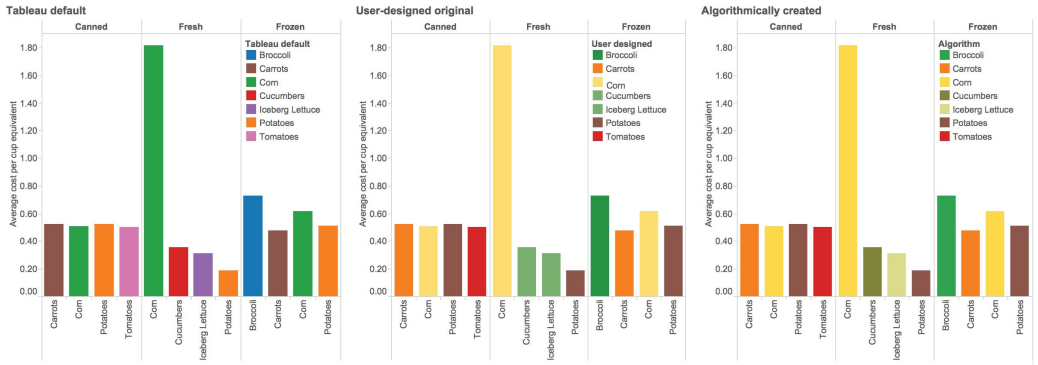
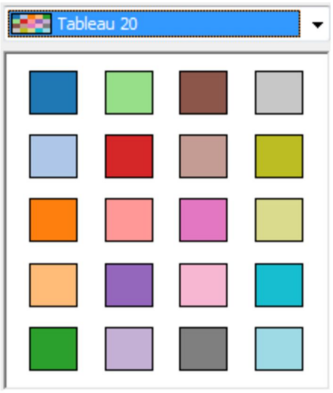



Fig. 1. This visualization was taken from a Tableau Public workbook [11] to illustrate the value of semantic color encoding. Left: The Tableau default colors are perceptually legible, but conflict with the data semantics ('Tomatoes' are pink, 'Corn' is green). Center: The Tableau author matched the colors 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.

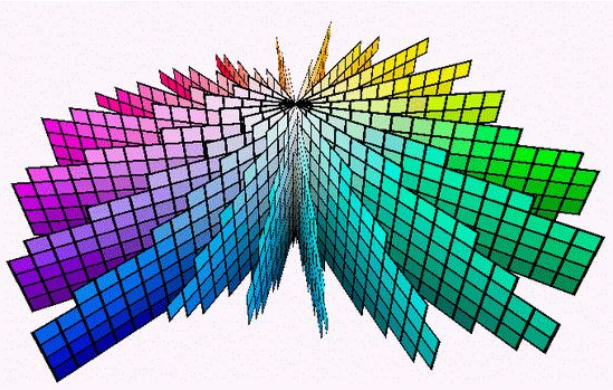
- Is a word colorable?
  - Use Google n-grams to find # of times it is associated with color (books only? Would this be even better if they had a general human speech corpus?)
  - Are there strong color associations for a word?
- What is the best color value?
  - Google Images (clipart or natural images?)
- 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."*

| | | | | |
|---|---|---|---|---|
| RED | GREEN | BLUE | YELLOW | PINK |
| ORANGE | BLUE | GREEN | BLUE | WHITE |
| GREEN | YELLOW | ORANGE | BLUE | WHITE |
| BROWN | RED | BLUE | YELLOW | GREEN |
| PINK | YELLOW | GREEN | BLUE | RED |

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

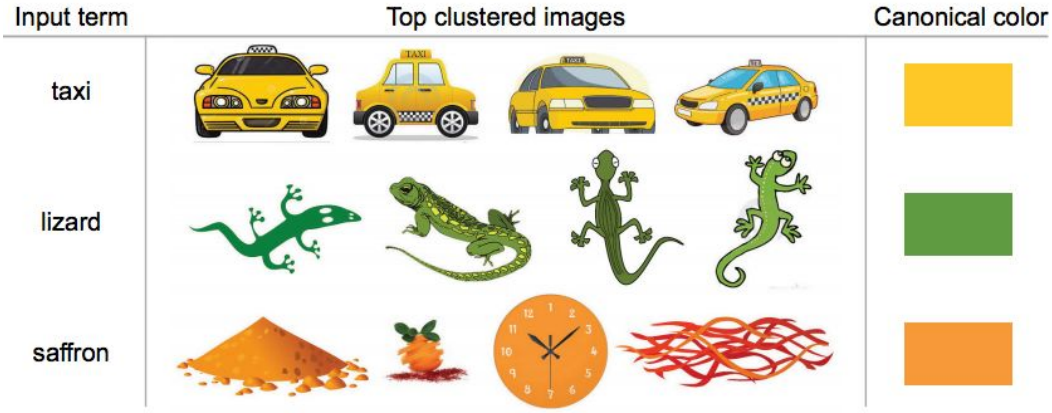



https://www.tableau.com/



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

- Query expansion, Ontology, Concept tree
- Why clipart?



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

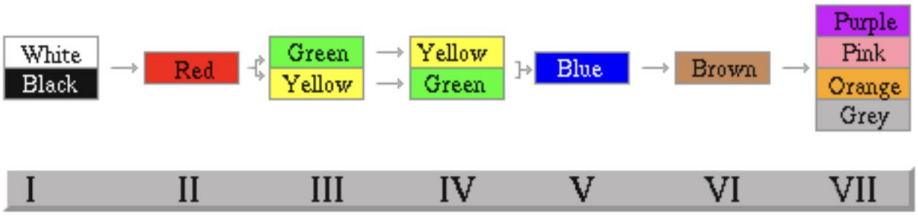



**Figure 3.** Berlin and Kay's hypothesis about seven evolutionary stages of colour terms (1969:4).

"The Colour and The Word", Virve Sarapik, Folklore, 1997.

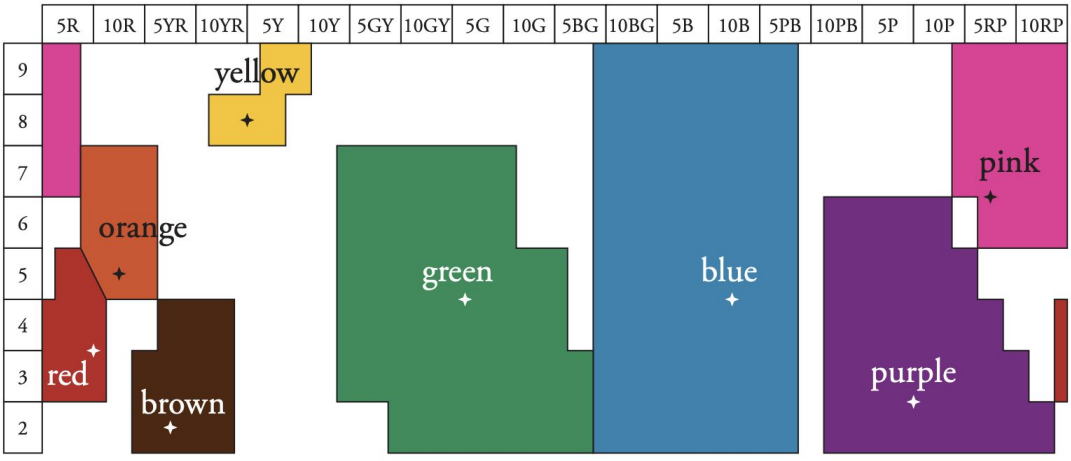



Fig. 6. Berlin and Kay's diagram of the eight basic colours in English (redrawn from [BK69, Appendix I, p.119]). As in Figure 5, the colour space is that of the Munsell colour system. See Figure 4 for an explanation of the notation. Berlin and Kay used a 320 chip Munsell array. They asked participants to determine, for each basic colour term, ***x***, (1) all those colour chips which they would, under any conditions, call ***x***, and (2) the best, most-typical examples of ***x***. The small crosses mark the locations of the "best, most-typical example" for each colour. The colour of each area matches that best most-typical example, within the limits of the available gamut. The white areas represent colour chips that were not given an unequivocal colour name.

"What is the "opposite" of "blue"? The language of colour wheels."
Dodgeson, Perceptual Imaging 2019.

- Not surprised that it performs poorly for logos
- Even if the results are always perfect, this can be a huge timesaver!
  - 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 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?

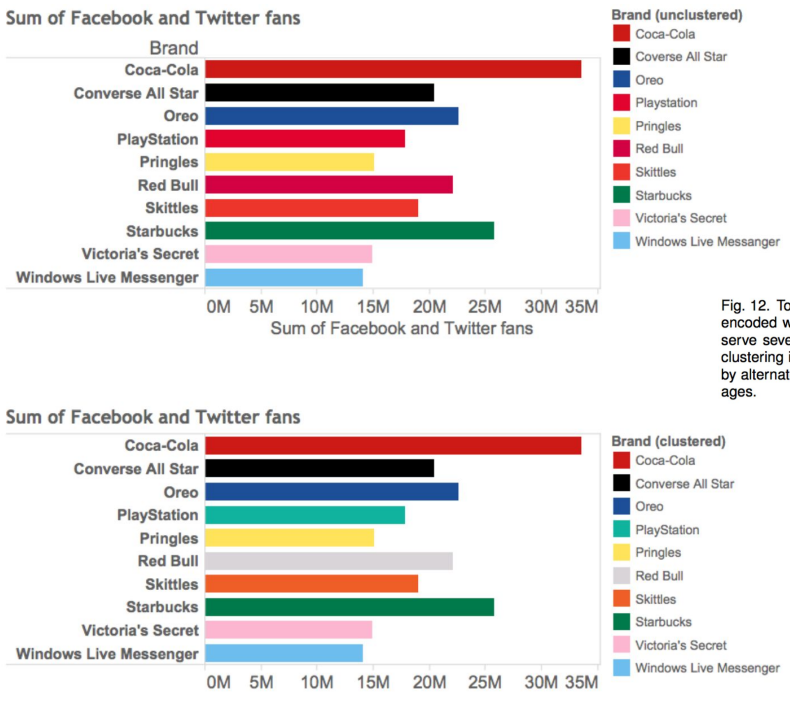



Fig. 12. Top row: A Tableau Public visualization [11] semantically color encoded with our algorithm before clustering is applied. One can observe several brands colored with shades of red. Bottom row: Once clustering is applied to the set of colors, some of the reds are replaced by alternate canonical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

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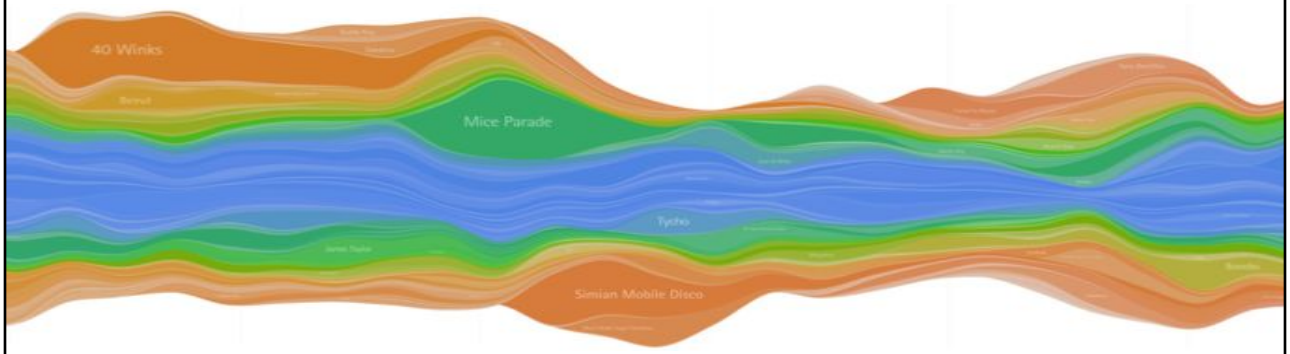
# Reading for Tuesday *pick one*

“Stacked Graphs – Geometry & Aesthetics”
Lee Byron & Martin Wattenberg, IEEE TVCG 2008



# Reading for Tuesday *pick one*

"Baby Names, Visualization, and Social Data Analysis"
Martin Wattenberg, IEEE InfoVis 2005