

Greetings Anonymous Animals! Please feel free to contribute (we've got version history here, you can't break anything)!

This document is here to capture exercises that the members of #teaching-vis would like to share.

These are grouped by the area of dataviz that the exercise aims to help with.

To add an exercise try to stick to the following format:

Exercise Name

Contributor Name (or slack name)

Exercise description, detailing the following

- If this exercise hasn't been developed by you, who developed it
- What the students are asked to do
- Format: discussion, hands-on, coding, workshop, project, homework, play, other
- What materials/tools you might use for this
- The student profile (designers, researchers, analysts, general public, etc.)
- Amount of time it takes to do the exercise
- Indicators that the exercise has worked well (e.g. *Students are able to identify why scaling on a Fox News chart was misleading*)
- What works well
- What doesn't
- Links to further info (especially if you've seen this exercise somewhere else)
- Images, photos or other code that helps illustrate how the exercise works

Make sure you add the exercise to the appropriate section (below), and if the section doesn't exist, feel free to add it.

@Jovan for questions, ideas, suggestions, doubts :)

(Also, in the spirit of DVS, I'm intentionally leaving out tool-specific or code-specific exercises, with the aim to mainly share general dataviz teaching exercises)

(Also, apologies for picking on Fox News, easy target, I know)

Critique

Exercises that help your students think critically about a data visualisation, whether that's about tackling misleading visual representations or about being able to express a structured opinion about a visualisation piece.

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“Good/Bad Viz” (yes, it probably needs a new name!)

Contributor Name: Sheila B Robinson, University of Rochester, Warner School of Education
([@SheilaBRobinson](#))

- What the students are asked to do: As one of the course assignments, students are asked to find one high and one low-scoring visualization “in the wild” – on the Internet, in a print publication, etc.
 - Scoring is based on [Stephanie Evergreen and Ann Emery's Data Visualization Checklist](#).
 - Students upload the URLs or images to a discussion page on our online learning environment by the due date.
- Format: over the course of a few class sessions, I bring up each student's “good” and “bad” viz on the large screen (students can also bring them up on their own devices), and the student describes why the visualization scores high or low on the checklist.
 - Other students are then invited to contribute to the discussion (we take about 5 minutes per viz).
- Materials: Each student has [Stephanie Evergreen and Ann Emery's Data Visualization Checklist](#). I offered a list of online sources they can search for high scoring visualizations, and the website <http://viz.wtf/> to help them find low-scoring visualizations.
- The student profile: Students are K12 and higher education leaders, medical professionals (physicians, dentists, nurses), researchers, etc. all working or studying in a graduate school of education. They are beginners in data visualization.
- Amount of time it takes to do the exercise: About 8-10 minutes per student, but can depend on how long the instructor wants the discussion to go.
- Indicators that the exercise has worked well: Students became more and more familiar with the principles of good data visualization and were able to correctly identify where they existed and where they were lacking in the examples.
- What works well: All students were able to complete the activity and several mentioned it in feedback comments at the end of the course as something that contributed to their learning. What also worked is ensuring all students had access to each other's examples and could bring them up on their own screens during the class (as well as seeing the visualizations projected on the large screen). They could also go back and revisit examples if interested.
- What doesn't: This may not work well with a larger class due to time; it may need to be restructured if there can't be a whole class discussion of each student's examples. Students could be split into small groups (probably 3-4 students) and share their

visualization examples, then return to the large group format to debrief their findings and share highlights. Perhaps just a few visualizations could be selected for a large group discussion.

Chart Types

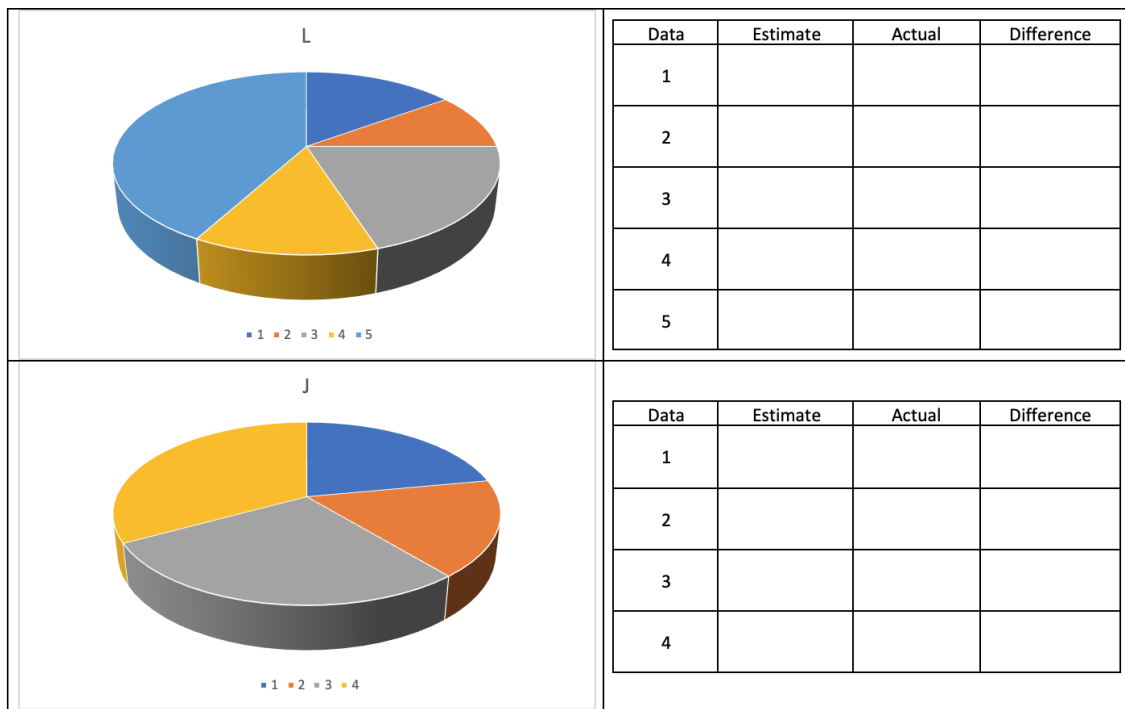
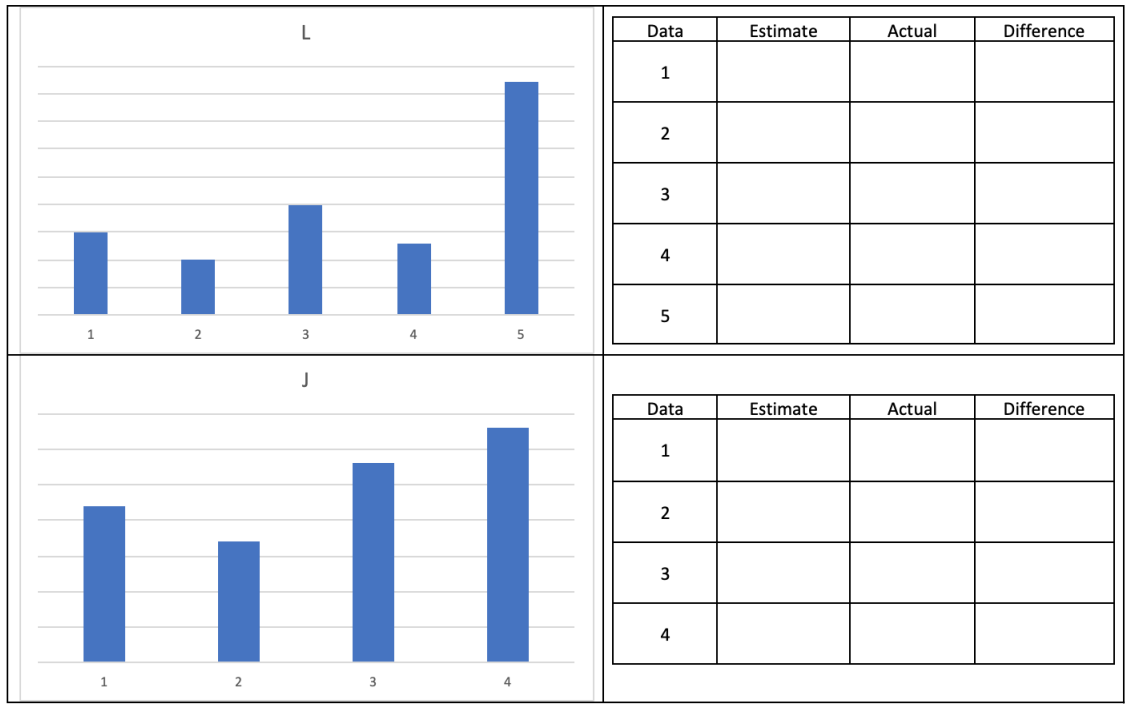
Exercises that help students understand different chart types, when to use them, how to apply effective practices. For example, activities that might be built around the [FT's Visual Vocabulary](#).

Value Estimation

Contributor Name: Martin Chorley

- What the students are asked to do:
 - Students are presented with a set of simple visualisations, (each one representing the same set of data). They are asked to estimate the data values presented in each chart.
 - Each student receives a different set of visualisations, one type at a time. So for instance, a student might first examine 3 or 4 bar charts, then 3 or 4 3D Pie charts and so on, until they get bored (or you have collected enough data)
 - Students then enter their estimates into a form (paper or online)
- Format: hands-on, discussion
- What materials/tools you might use for this:
 - Multiple handouts with different visualisation types (see end for examples). Each set should use the same data. Some visualisations can have axes/annotations/labels or not, depending on how hard/easy you want each set to be to estimate.
- The student profile (designers, researchers, analysts, general public, etc.)
 - This has worked well with graduate students
- Amount of time it takes to do the exercise
 - Each set of visualisations can be assessed in five-ten minutes, so allow that long for each type you want the students to see.
- Indicators that the exercise has worked well
 - Students develop an appreciation of the relative merits/disadvantages of each type of visualisation.
 - Students become more aware of how visualisations can be improved with scales/labelling/annotations.
- What works well
 - Students are surprised when they discover that the same data has been used to create all the visualisations.
 - Entering estimates into an online form allows a very quick analysis of the estimates, so you can reveal results to students in the same session. For instance you might quickly be able to show the error in estimates for 3D pie charts is much higher than that for bar charts
 - This can lead into discussions about errors, MAE and so on, and also experimental bias.
- What doesn't

- If you want to do data analysis in the same class, very clear and explicit instructions on how to enter the estimates are needed so the amount of data cleaning needed is minimal
- Links to further info
- Example handouts:



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Gestalt

Exercises that help students understand how gestalt principles can help design a visualisation. For example, an exercise that works around [the explainer](#) built by @Elijah Meeks.

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Perception

Perception is complicated to understand and complicated to explain. So teaching it can be an interesting challenge. Exercises that help understand how this works (possibly involving optical illusions).

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Design

Helping students understand how to use design principles, from type to layout and everything in between.

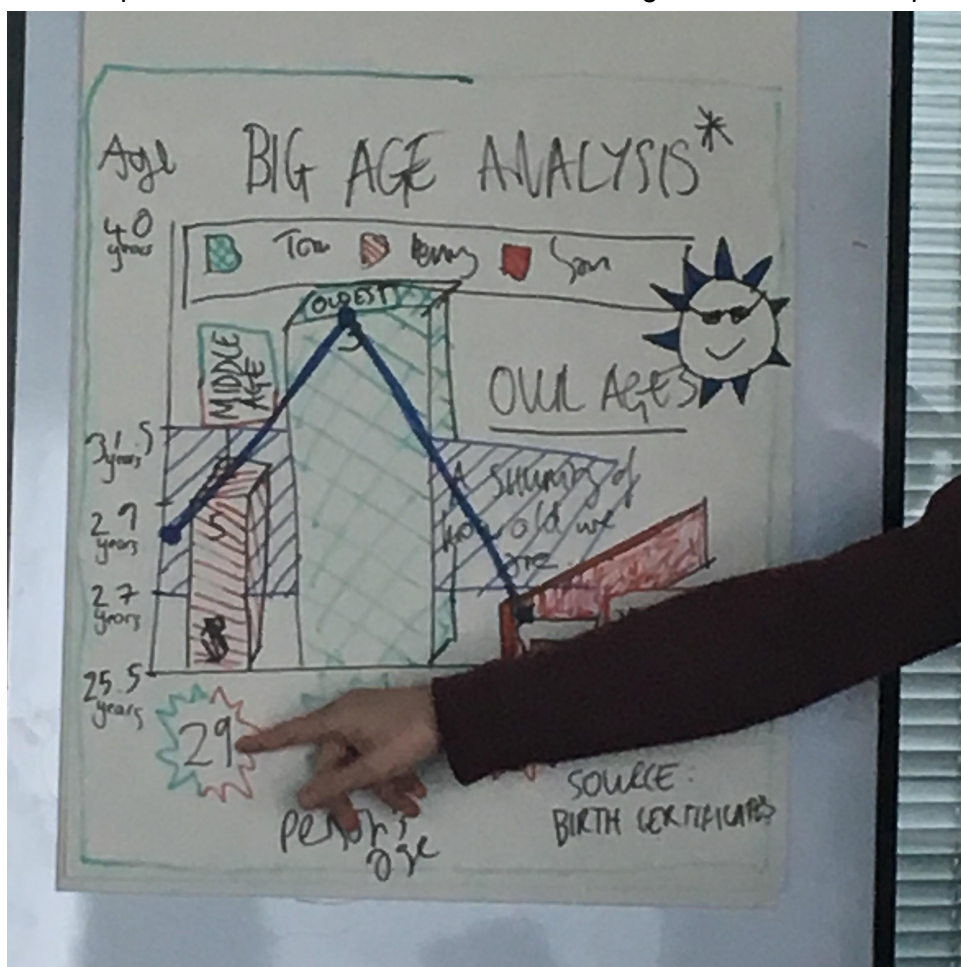
Make a Horrible Graph

Contributor: @Jovan

- **What the students are asked to do:** After covering gestalt principles, accessibility, colour basics and data-ink I ask the students to design a disgusting, horrible, appalling, terrible graph. The catch is, they have to provide a rationale for every design decision based on the preceding sections that explains why it's a horrible graph. Normally done in small groups (around 5 people)
- **Format:** hands-on, followed by discussion
- **What materials/tools you might use for this:** Different group get different tools, crucially I like to have one group using pen & paper, as it's also a great way of demonstrating how the tools they use influence their design decisions.
- **The student profile:** dataviz beginners
- **Amount of time it takes to do the exercise:** a good 10 minutes to create horrible graphs (the more time the team has the more creative they get) and another 10 minutes to explain their decisions
- **Indicators that the exercise has worked well:** students are able to explain why their graphs are horrible, they've covered each of the previously taught sections in their graph design

(so, low data/ink, low-accessibility, gestalt principles used in an inappropriate way, and colour used in a way that confuses the user).

- **What works well:** this is a lot of fun - students have described it as “chart-therapy”, I think it works great as a way to recap some diverse concepts they’ve been taught, the big concepts really bed in
- **What doesn’t:** just very important to ask them to remember this how they **shouldn’t** do things in the future
- Here’s a personal favourite where students managed to add a double-perspective 3D chart



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Visual Encoding

How to get students to understand visual encoding, possibly tackling some of Bertin's thinking, but could see Santiago Ortiz's 45 [Ways to Communicate Two Quantities](#) as great example of this.

Cutting up the Visual Vocabulary

Contributor Name: Henry Lau

Exercise description, detailing the following

- Who developed it: I stole the idea from Martin Chorley
- What materials/tools you might use for this
 - The individual charts from the visual vocabulary cut up on paper, and the headings also cut up. (print them in black and white so it's not too easy!)
- What the students are asked to do
 - Think about what data relationship is encoded in a chart, then place each chart from the visual vocabulary under the heading they think best represents the relationship.
- The student profile (designers, researchers, analysts, general public, etc.)
 - Has worked well with researchers, designers.
 - Has worked well with graduate students
- Amount of time it takes to do the exercise
 - About 15 minutes
- Indicators that the exercise has worked well (e.g. *Students are able to identify why scaling on a Fox News chart was misleading*)
 - Student can discuss what relationships each chart shows and which relationship is prioritised in that chart
- What works well
 - Getting people to discuss in small groups where they think each chart should go. As charts often display multiple relationships there is discussion about which one is the most important or visible.
- What doesn't
 - People are unfamiliar with the more uncommon chart types
- Links to further info (especially if you've seen this exercise somewhere else)
- Images, photos or other code that helps illustrate how the exercise works
 - <https://twitter.com/martinjc/status/962987107433308161>

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- Amount of time it takes to do the exercise
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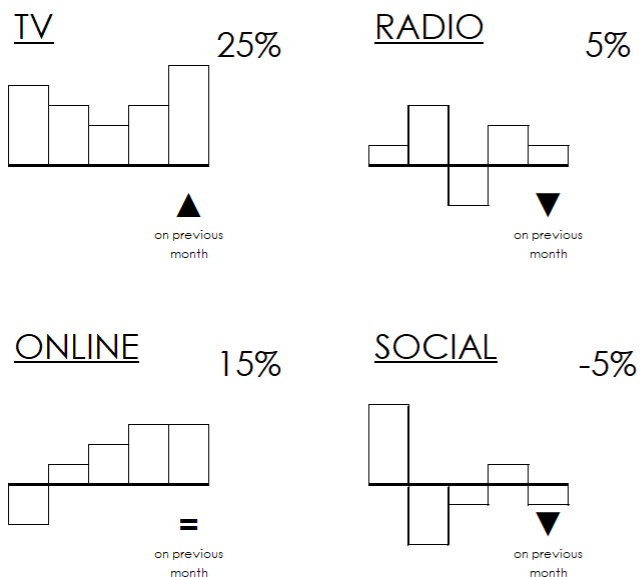
Colour

Oh colour. Colour's not easy and this might need some subsections, but which exercises help your students really **get** colour?

Excel Colouring Book

Contributor Name (or slack name): @Jovan

- **What the students are asked to do:** Students are given a black & white set of charts that could represent a view in a dashboard or a slide in a presentation. They're asked to use colour to show meaningful relationships in the data.
- **Format:** hands-on and discussion
- **What materials/tools you might use for this:** Excel, though can be coloured pens & paper
- **The student profile:** beginner data viz makers (make graphs frequently but are untrained)
- **Amount of time it takes to do the exercise:** around 5 minutes (giving students more time often leads to overcomplicated results).
- **Indicators that the exercise has worked well:** students have used one or two colours, either emphasising similarity or difference in the data display
- **What works well:** easy to do, quick exercise, easy for students to "get it right"
- **What doesn't:** the exercise emphasises simplifying approaches to colour, so this won't help students with colour choices or how palettes (though it does follow a section on palettes)
- Screenshot of the exercise below:



So here's your next exercise...

Welcome to the Excel Colouring Book!

(I'm totally making this a thing now...)

Use the excel fill tool and font colour tool to create relationships between the four graphs.

You might want to zoom out to 70% at this point.

How does your use of colour influence the perception of relationships?

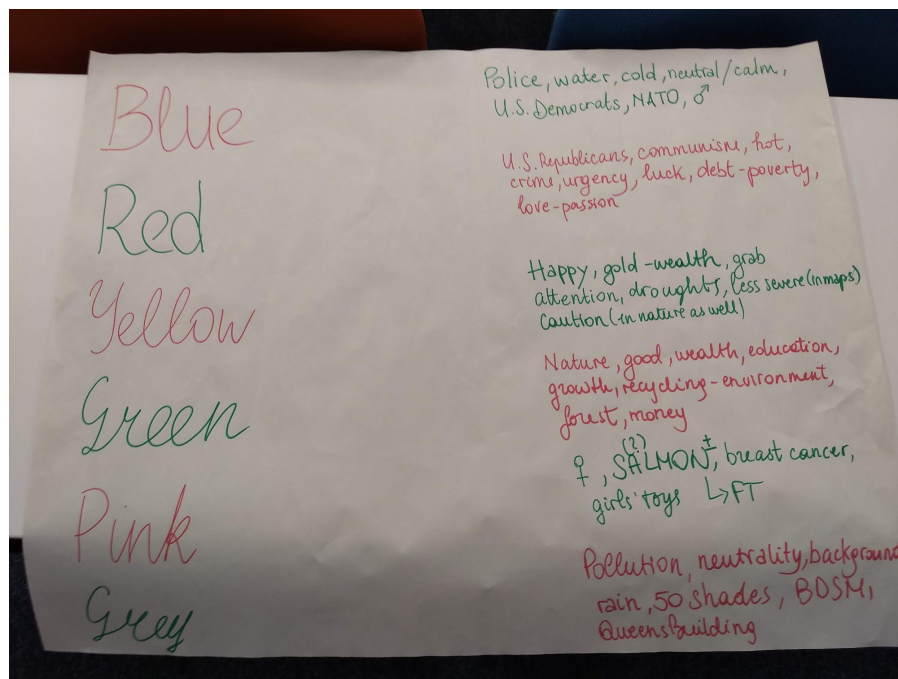
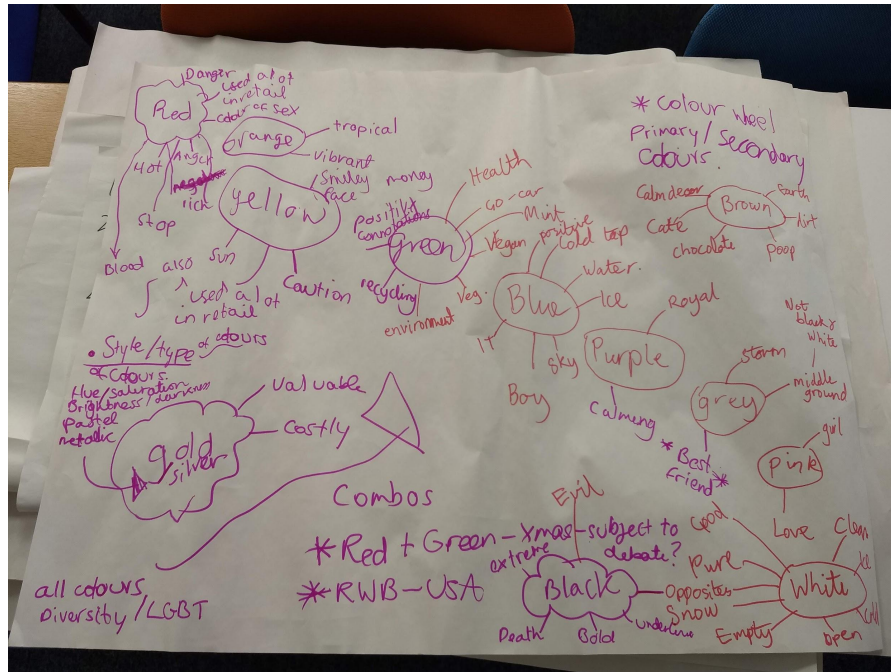
What visual cues are you giving the reader of this graph?

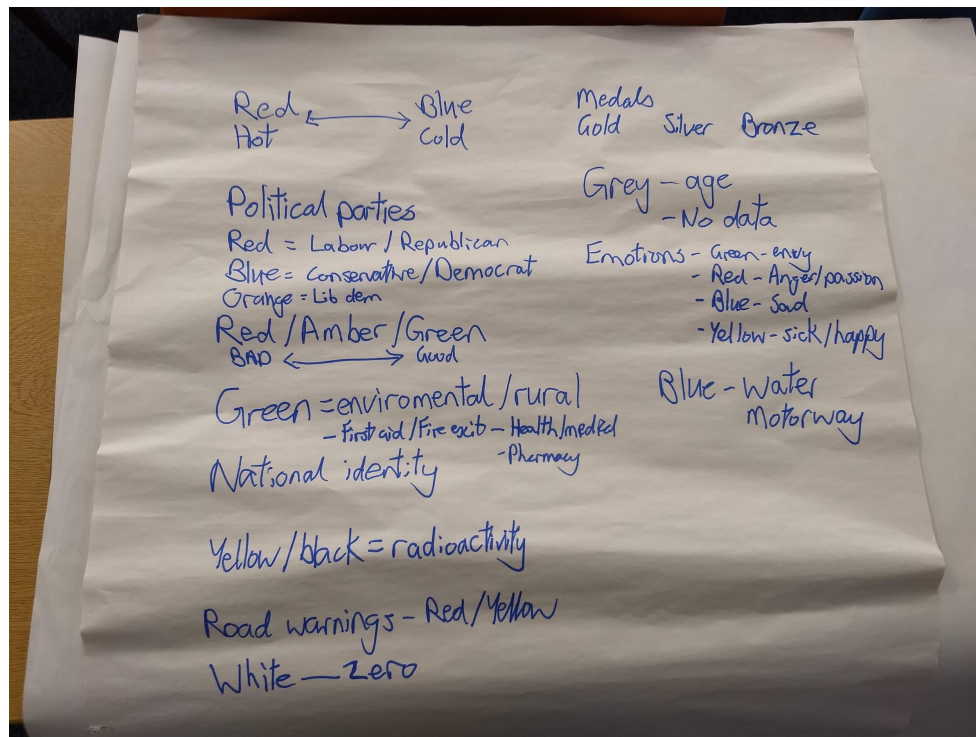
Colour Semantics

Contributor Name: Martin Chorley

- Format:
 - discussion, play,
- What the students are asked to do:
 - Students are asked to think of as many *meanings* that can be applied to colours (or sets of colours) as possible, and to discuss within their groups any benefits or disadvantages from using those colours/palettes.
 - Once small groups have come up with their lists they can be combined in a large group discussion.
 - A motivating example can be provided to kick things off - for example: "when representing data about males and females, the colours pink and blue are sometimes used to differentiate between the genders. However, this is potentially an outdated and cliched view of gender and can even be offensive to some."
- What materials/tools you might use for this
 - A large piece of paper/flipchart and some pens for each group to write down ideas is a good idea
- The student profile (designers, researchers, analysts, general public, etc.)
 - This has worked successfully with graduate students (MSc)
- Amount of time it takes to do the exercise
 - Fifteen minutes for small group discussions, fifteen to twenty minutes for large group wrap-up
- Indicators that the exercise has worked well
 - Students are aware of the implicit/explicit semantics linked to colour choices
- What works well

- This can be used to link into discussions about usability and accessibility (colour blindness etc) and cultural differences (lucky colours change between countries, political colours change meaning between USA and UK, etc)
- What doesn't
 -
- Images, photos or other code that helps illustrate how the exercise works
 - Examples of the kinds of output produced by groups:





Colour Terminology

Contributor Name (or slack name): Christine P'ng

- What the students are asked to do: Students are paired up, one is given a colour swatch (ex. Paint colour samples from any hardware store), the other has a PPT slide open on their laptop with a single rectangle and the colour picker open. Without showing each other their colour/screen, the student with the colour swatch tries to describe their colour for the other to recreate. The aim is to practice describing colours by hue/value/saturation. Once the pair feels semi-confident, they share their colours and see how they did.
- Format: Hands-on, discussion afterwards
- What materials/tools you might use for this: Colour swatches and laptops with any colour picker software open
- The student profile: beginner data viz makers (unfamiliar with picking colours)
- Amount of time it takes to do the exercise: 5-10 min (can switch partners so both get a chance to try describing the colour)
- Indicators that the exercise has worked well: Students are able to describe colours
- What works well: easy to do, quick exercise, easy for students to "get it right", introduces the colour picker and how to talk about colours beyond just hue, students start recognizing complexities with describing colour - can also mention differences between CMYK and RGB colour spaces with trying to replicate a print colour swatch on a screen. Helps solidify terminology for later parts of colour lecture, when hue/value/saturation is used to describe different colour palettes
- Notes: I handed out colours that tended to be more desaturated, since that was the aspect of colour terminology students were least familiar with
- Images, photos or other code that helps illustrate how the exercise works:



Colour Scales

Contributor Name: Martin Chorley

- What the students are asked to do:
 - This is a fairly simple introduction to different types of colour scale (sequential, diverging, categorical, ...)
 - Students are given a sheet with samples of each type of colour scale, and a sheet listing different examples of data, and are asked to select which type of colour scale they would use for each dataset
- Format: discussion
- What materials/tools you might use for this
 - Hand-out with samples of colour scales, listing of different datasets
- The student profile (designers, researchers, analysts, general public, etc.)
 - Worked well with graduate students
- Amount of time it takes to do the exercise
 - Depends on how many datasets - probably no more than a couple of minutes for each dataset, and ten-fifteen minutes to wrap up at the end
- Indicators that the exercise has worked well
 - Students choose the correct colour scales for their data
- What works well
 - Can lead into a good discussion around rainbow colour scales and when/if they're appropriate, and the reasons for using a diverging rather than a sequential scale
- What doesn't
 -
- Images, photos or other code that helps illustrate how the exercise works:

Data Descriptions

Look at the sheet of colour schemes you have been given. For each of the data examples below, decide in your group which type of colour scheme you would use and why. If you feel that none of them match the situation, propose a new colour scheme.

1. The change in the percentage of students working full-time jobs during their degrees (ranges from -15.6% to 25%)

Colour Schemes

Categorical:



Diverging:



Sequential:



Rainbow:



Color Relativity

Annette Greiner, adapted from Josef Albers's [*Interaction of Color*](#) for an online live classroom

Students are given a selection of files (.ppt, .pdf, or .doc) that contain vector-based images showing two pairs of nested rectangles. The students are asked to open one of the files on their local machine and begin adjusting the colors of the rectangles to discover whether they can make one color look like two different colors by changing the colors surrounding them. As they work, the instructor asks them to call out if they succeed. If the students don't seem to be having success, the instructor gives hints (e.g., "try playing with colors of different lightness", "try playing with different hues".) If a student offers a solution, the instructor asks them to share their screen, and the class verifies that they were successful. There are infinite solutions to this problem, and the

group can discuss the different ways in which students have succeeded. This exercise can also be done asynchronously, where students work offline and then post their thoughts and solutions to a shared space.

Format: hands-on

Materials: vector graphics files with black and white rectangles

Student profile: graduate students in a semester course on data visualization

Time to complete: 20 mins

Indicators that the exercise has worked well: students find multiple solutions

What works well: allowing students to use whatever application they are most comfortable with, explaining the connection between the exercise and use of color in a visualization, where adjacent colors influence our perception.

What doesn't: requiring the use of software the students are not familiar with (they spend the time learning how to use it).



Arts and Crafts

Contributor: Iris Morgenstern, Westfälische Wilhelms-Universität Münster

Idea

The exercise is based on the article of Huron, Jansen and Carpendale (2014) who had lay people create tangible visualizations with Froebel squares. Friedrich Froebel was a German educator who invented the Kindergarden in the early 20th century. Froebel developed standardized material for young children to explore the world of geometry.

Format

Hands on, discussion

Students profile

The course is part of the Master of Education program. Students aim to become teachers for all kinds of subjects and at all educational levels – from primary school teacher to math high school instructor.

Amount of time it takes to do the exercise

The exercise takes up one entire session (1.5 h). It takes place after I introduced the concept of using visual variables to represent numeric variables (theory) but before we talk about chart types (practice).

Goals

- kick off the process of thinking about data visualization
- introduce the visualization process according to Jansen and Dragicevic (2013)
- introduce the concept of numerical data being represented by visual variables according to Jaques Bertin
- make them understand that every data visualization needs a question, a goal and a story

What the students are asked to do:

I ask students to visualize the bank statement of a friend and advise him how to save money.

What material/ tools you might use for this?

- a printout of a fake bank statement
- a set of squares in red, blue, green, purple and orange
- flip chart paper and Edding

Indicators that the exercise has worked well

(1) Students recognized that there are different ways to visualize a data set. (2) They acknowledge that doing DataViz is more complex than choosing Excel templates. (3) They understand the coding process in which a numeric variable is paired with a visual representation. (4) They have fun and take pictures of their work.

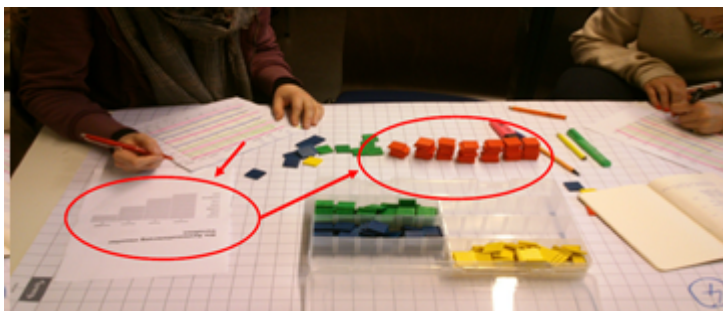
What works well

Students form groups and create visualizations with the Froebel squares. Preferred group size is three people. With three participants, students have to interact and discuss the process rather than solving the problem in their heads or non-verbal with their best friend. I found the need to verbalize a very valuable part of the exercise.

What doesn't

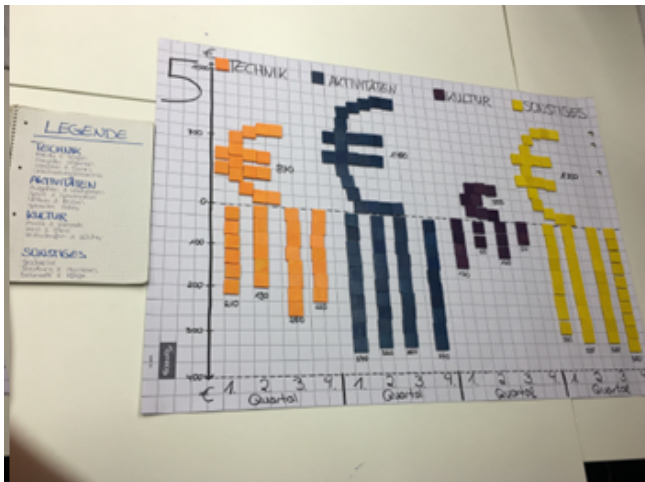
Sometimes student's approaches differ very much in complexity and time need. So some of them are done early and have to wait for the rest of the group.

Pictures of the Process:

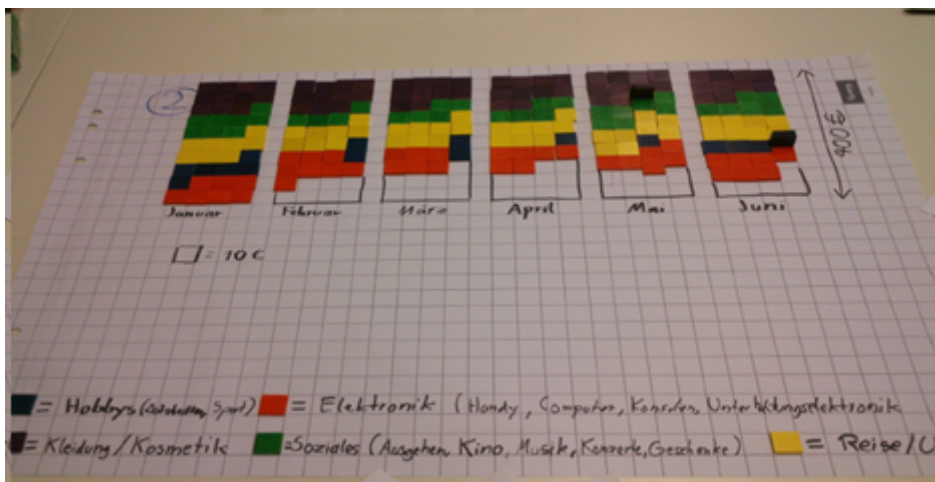


The arrows and circles indicate the mapping process. The student (1) reads / highlights data in the data sheet, (2) checks with an overview of Bertins visual variables in front of her (red circle at the left hand side) while organizing the orange squares.

Pictures of Results:



The size of the € signs is proportional to the amount of spending in the respective category.



Further links and references

You can find information on Friedrich Froebel here, although it is only in German:

<https://www.friedrich-froebel-online.de/s-p-i-e-l-g-a-b-e-n/>

Huron, S., Jansen, Y., & Carpendale, S. (2014). Constructing visual representations: Investigating the use of tangible tokens. *IEEE transactions on visualization and computer graphics*, 20(12), 2102-2111.

Data-ink

And other general Tufte principles.

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Aesthetics

Exercises that help students understand the role aesthetics play in presenting data.

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Animation

Helping students understand how to apply animation for data visualisation.

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Medium / Format

Exercises that tackle the question of how you adapt to the medium you're using, whether that be developing for the web, for print, sonified or editorial graph, dashboard, data art, infographic, etc.

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Reading visualisation

Any exercises that focus on helping students get a more structured, critical approach to reading viz.

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Contributor Name (or slack name)

Exercise description, detailing the following

- If this exercise hasn't been developed by you, who developed it
- What the students are asked to do
- Format: discussion, hands-on, coding, workshop, project, homework, play, other
- What materials/tools you might use for this
- The student profile (designers, researchers, analysts, general public, etc.)
- Amount of time it takes to do the exercise
- Indicators that the exercise has worked well (e.g. *Students are able to identify why scaling on a Fox News chart was misleading*)
- What works well
- What doesn't
- Links to further info (especially if you've seen this exercise somewhere else)
- Images, photos or other code that helps illustrate how the exercise works

Storytelling

Exercises that help students understand the role of storytelling in visualisation. Personally, I always thought [Kurt Vonnegut's Shapes of Stories](#) would make for a great exercise, but haven't figured out the mechanics yet...

Same data different target audience

Contributor Name: Hilje

Exercise description:

What the students are asked to do:

I ask student to visualise a simple dataset on sales of certain items sold in a flowershop (flowers, plants, vases, etc.). In the first part they have to visualise the data for a flowershop owner who wants insight in his/her sales. In the second part they have to visualise the same dataset but now the client is a magazine that has an item on flowershops.

Format & materials: They can use pen, paper, crayons, etc. Afterwards we discuss each others work, if the group is large I ask a couple of students to explain their visualisations.

The student profile (designers, researchers, analysts, general public, etc.): Graduate students

Amount of time it takes to do the exercise: 20 minutes for designing the 2 visualisations and 10-20 minutes for discussion.

Indicators that the exercise has worked well: it is a good way to experience the importance of the target audience for the story you are telling with your data.

Data Art

Exercises that get your students thinking creatively about expressive visualisations.

Interaction

Details

Data Abstraction

Details

Data Transformation

Details

Producing Data Questions

E.g. proxy values and proxy tasks concept from [Making Data Visual](#), as suggested by Enrico.

User Experience

Details

GIS / Maps

Details

Geographic vs ...

Contributor Name: Martin Chorley

- What the students are asked to do:
 - The students are given maps showing the same set of data, but represented as a geographic map, a fixed area cartogram, a population distorted cartogram, etc...

and are asked to discuss them in groups and decide which one is best. A simple show of hands for each type can then lead into discussion about the reasoning for different preferences.

- Format: discussion
- What materials/tools you might use for this:
 - I like to use the graphic below as a good example of different types of geographic map all showing the same data in different ways:
http://geographical.co.uk/media/k2/items/cache/97b69b9f7e1a5c5d4d0fd3d24f506fa4_XL.jpg
- The student profile:
 - This has worked well with graduate students
- Amount of time it takes to do the exercise
 - Depends on the complexity, but probably five/ten minutes for discussion in groups and then ten/fifteen to bring it together
- Indicators that the exercise has worked well:
 - Students are able to recognise the tradeoffs with different forms of mapping
- What works well
 - There's a lot to unpack around maps, and this can be a good entry point. You can discuss size of representation vs. perceived importance, geographic distortion and reader understanding, technical challenges of creating fixed area forms. The example above also has some issues with colour that are interesting to mention.
- What doesn't
 -

General

Any exercises that don't fit into the other categories or exercises that are aimed at helping students have an introduction to dataviz.

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