

Avoid Chart Junk

Forgo moiré vibration, the grid, and the duck.

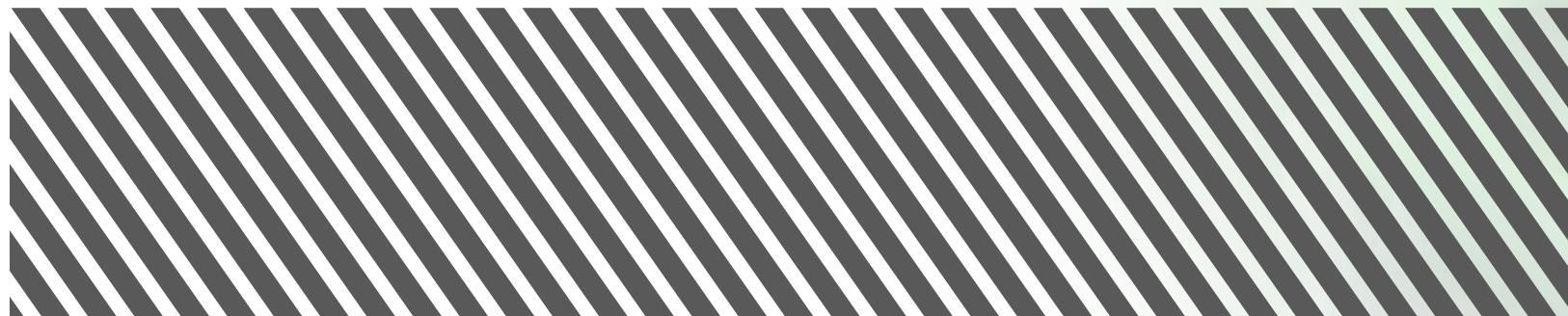
The Chart Junk

The *excessive* and *unnecessary* use of *graphical effects* in graphs used to demonstrate the *graphic ability of the designer* rather than *display the data*

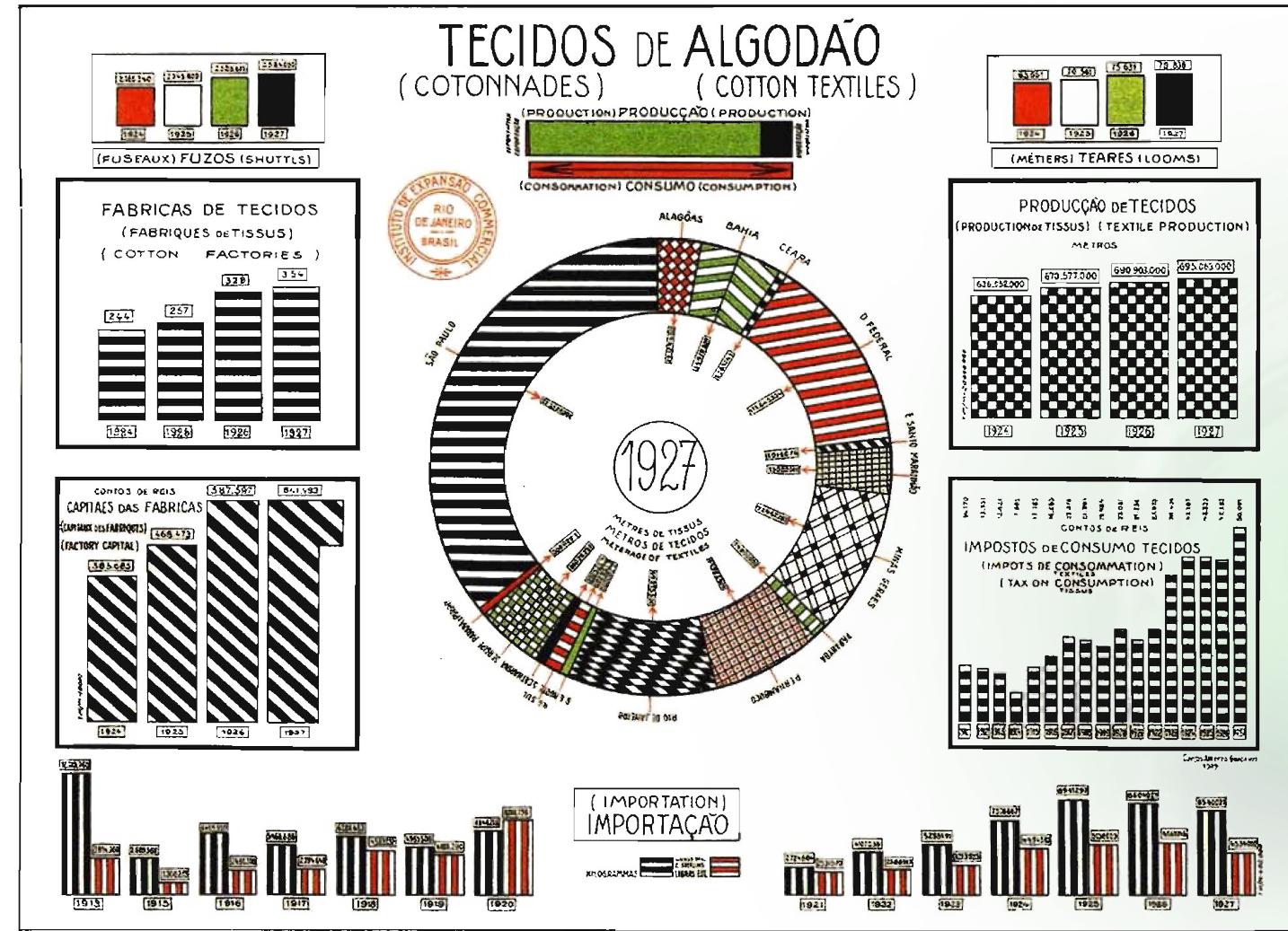
- *Non-data-ink* or redundant data-ink decoration
- Unintended *optical art* (Moiré vibration)
- The *grid*
- The *Duck: self-promoting graphics*

Unintended Optical Art

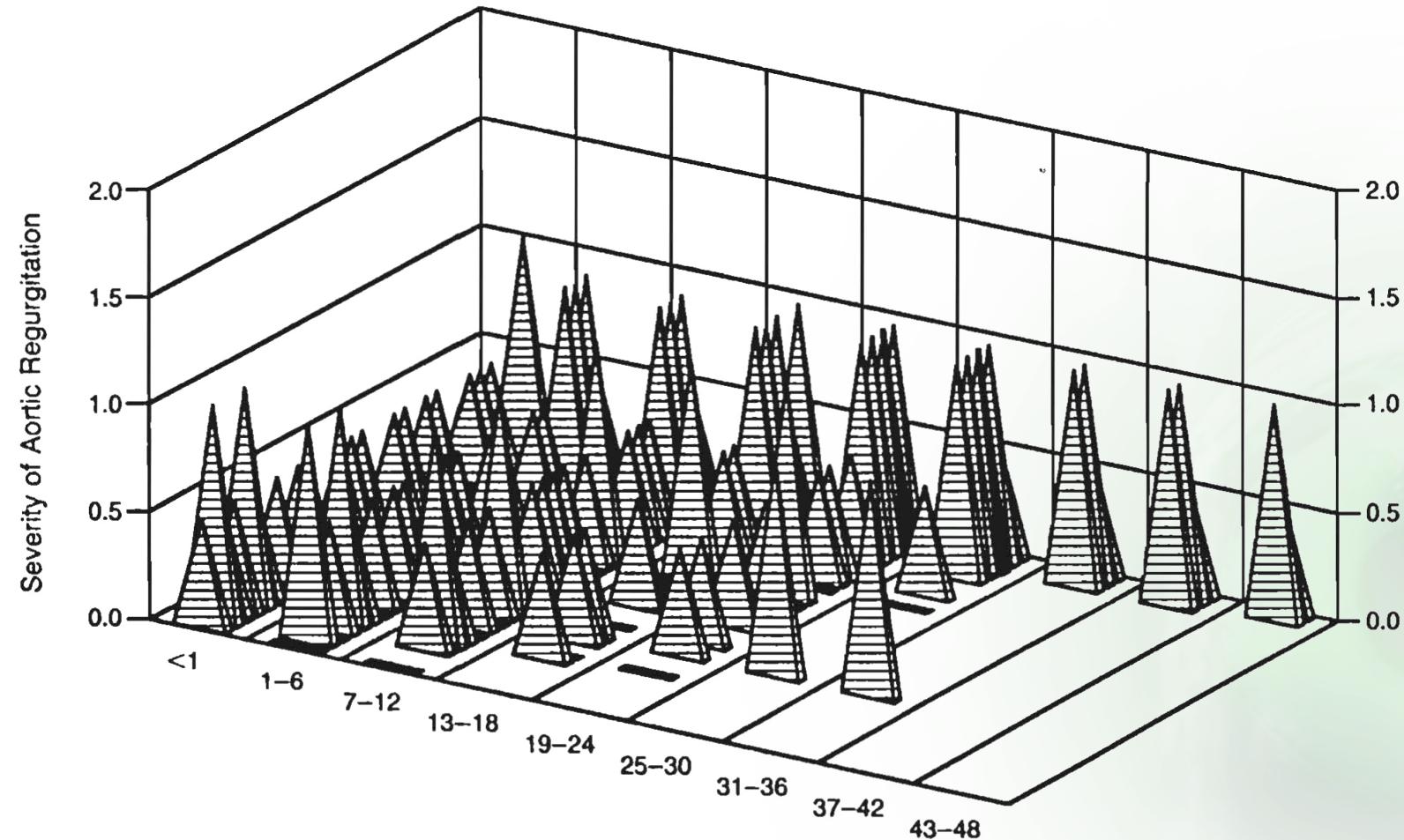
- Mainly rely on *moiré effects*
 - *Distracting appearance* of vibration and movement
 - The most common form of *graphical clutter*



Moiré Vibrations



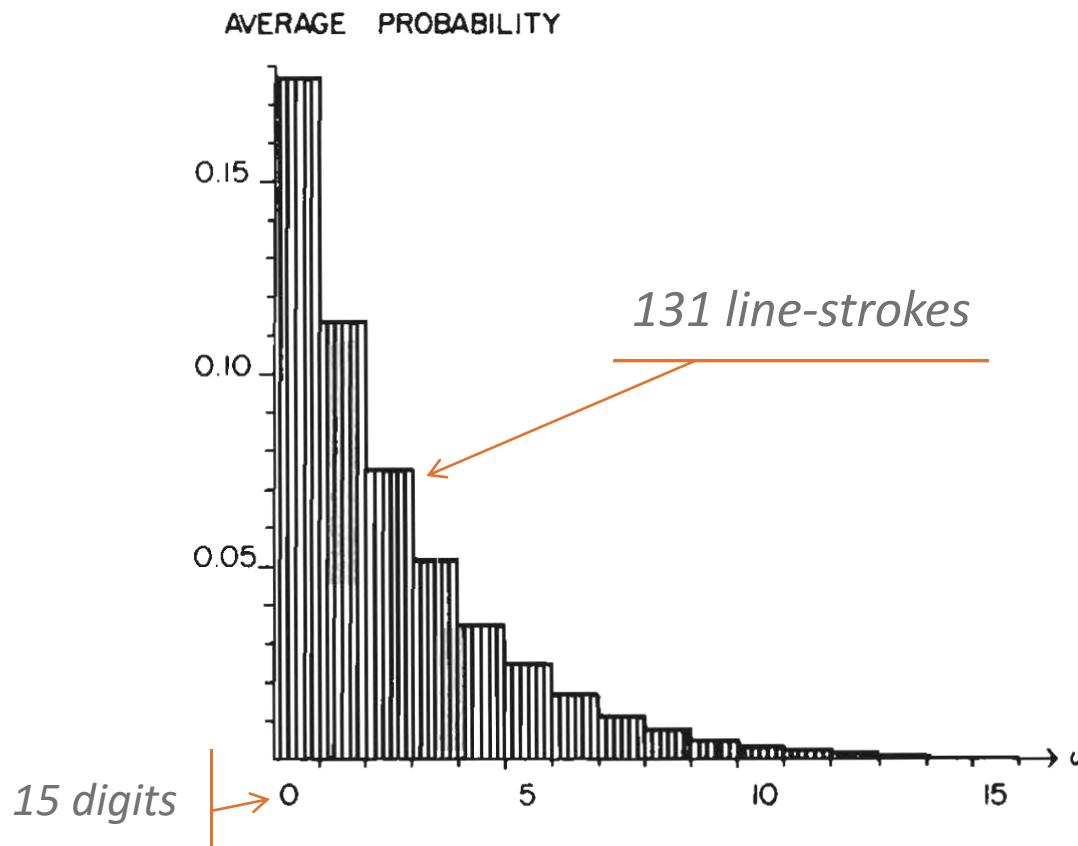
Moiré Vibrations



Simple tables are turned into bad graphics published in major scientific journals

Moiré Vibrations

A. Average Probabilities of W from $N(1,1)$
with $n = 10$

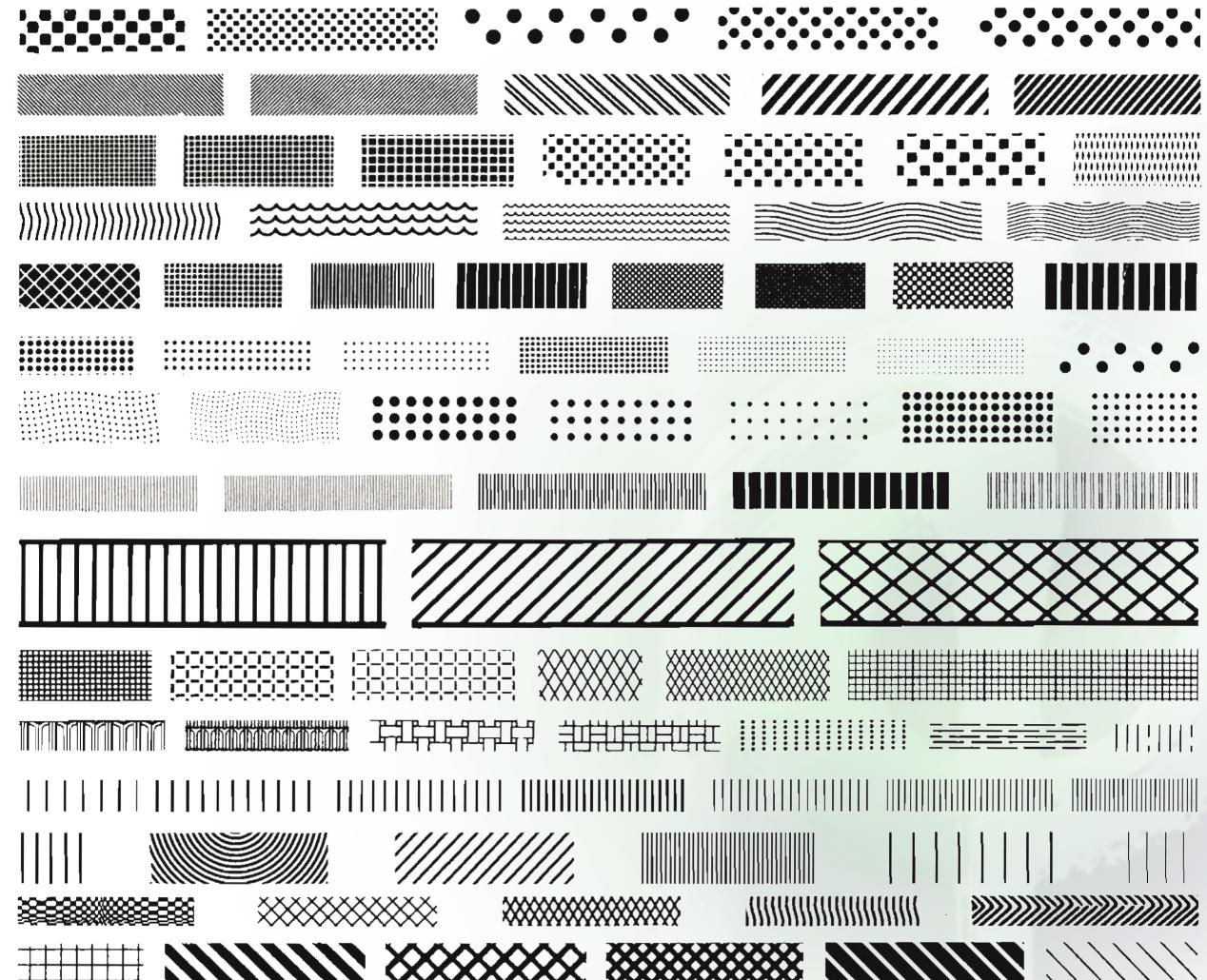


The ten most frequently cited
(footnoted) scientific journals: random
sample of issues published 1980–1982

	Percentage of graphics with moiré vibration	Number of graphics in sample
<i>Biochemistry</i>	2%	568
<i>Journal of Biological Chemistry</i>	2%	565
<i>Journal of the American Chemical Society</i>	3%	317
<i>Journal of Chemical Physics</i>	6%	327
<i>Biochimica et Biophysica Acta</i>	8%	432
<i>Nature</i>	11%	225
<i>Proceedings of the National Academy of Sciences, U.S.A.</i>	12%	438
<i>Lancet</i>	15%	364
<i>Science</i>	17%	311
<i>New England Journal of Medicine</i>	21%	338

Moiré Vibrations

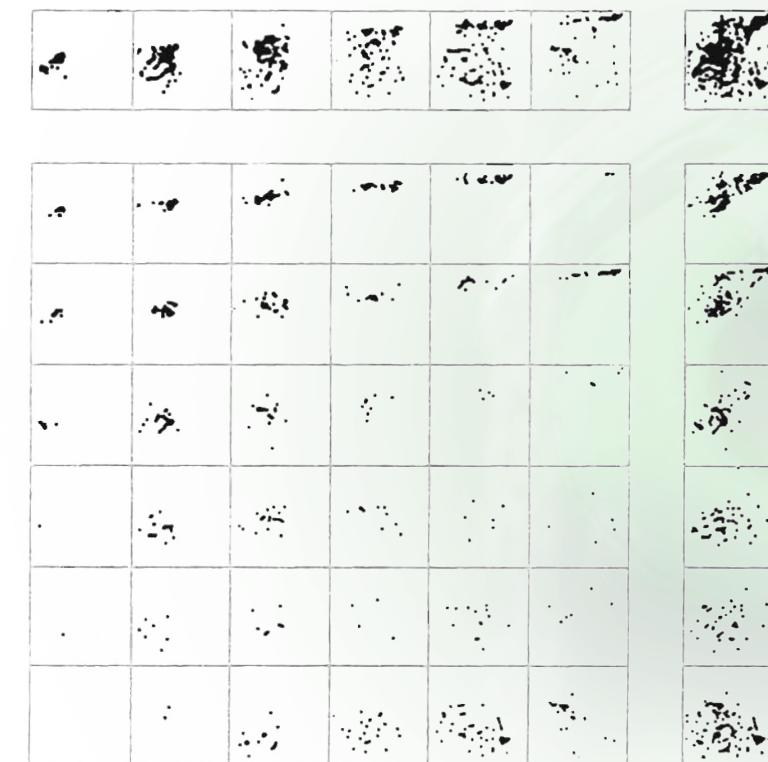
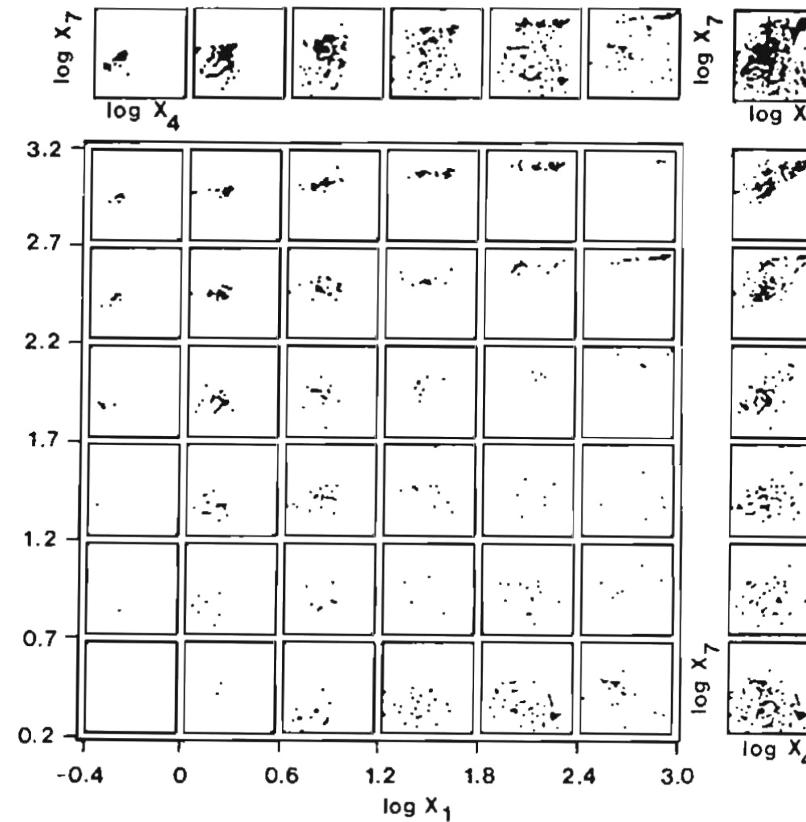
- Moiré effects have *proliferated* with *computer graphics*
- Instead of generated by *thin plastic transfer sheets*, now the computer *produces instant chartjunk*



The Grid

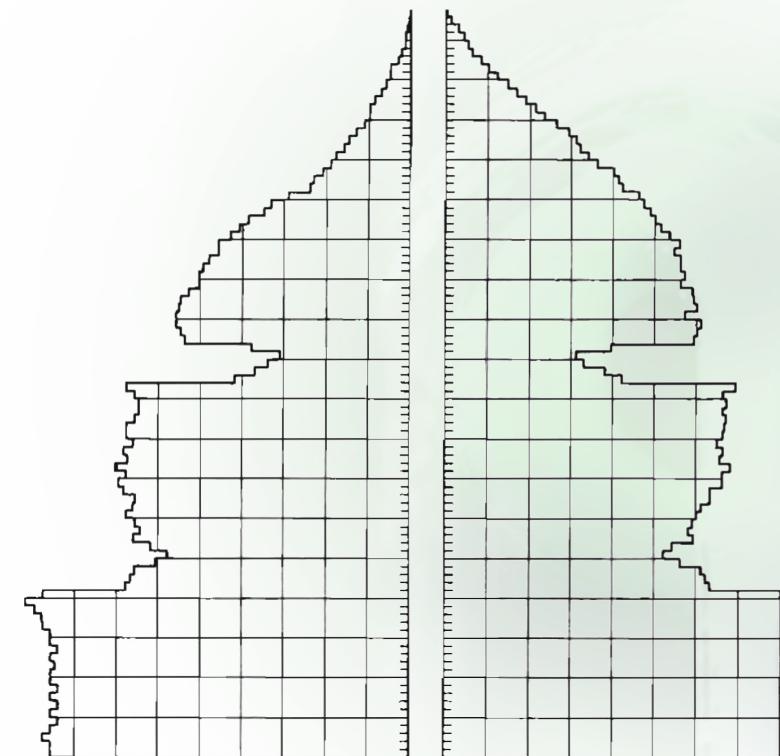
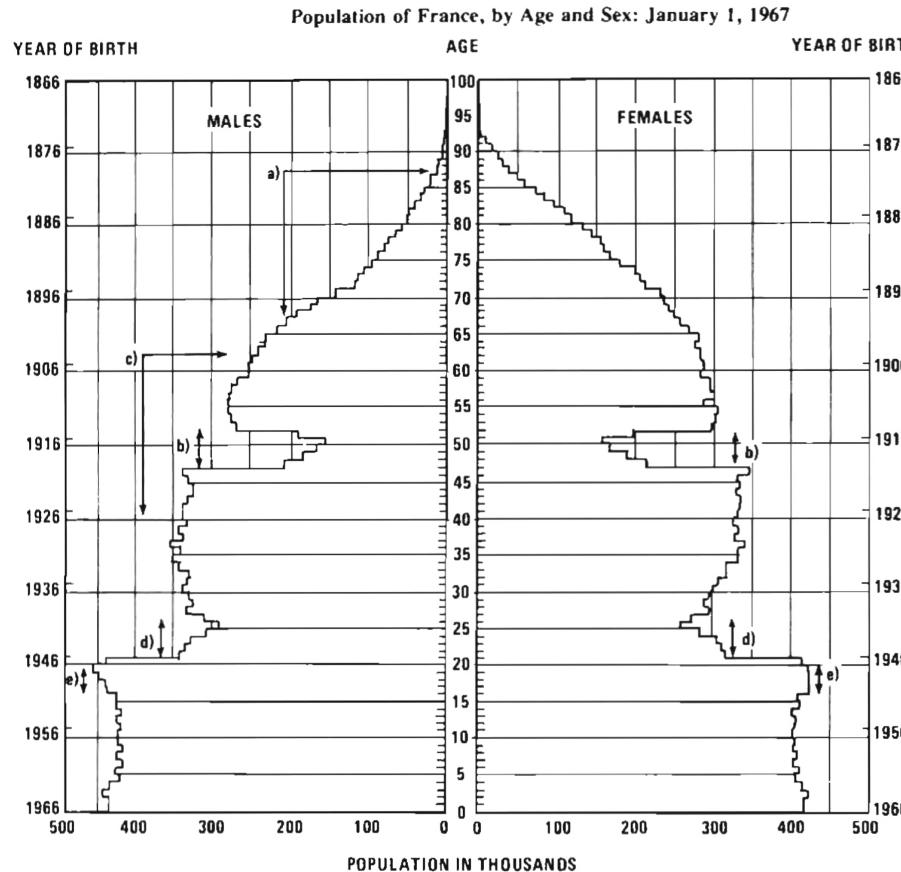
- *Dark grid lines* are chartjunk
- The grid should usually be *muted* or *completely suppressed*

ULTIWINDOW PLOT OF PARTICLE PHYSICS MOMENTUM DATA



The Grid

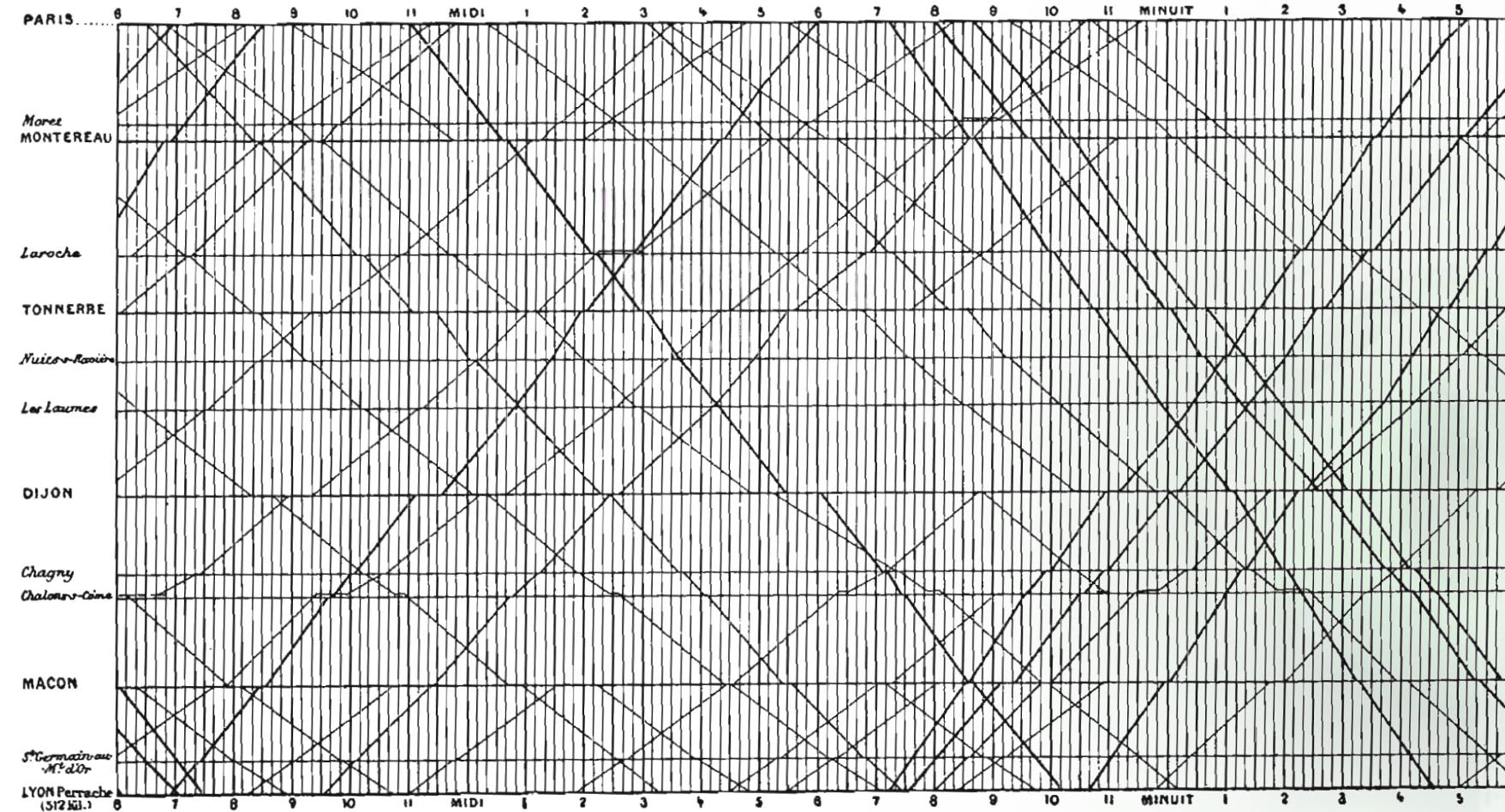
- The grids *carry no information*, *clutter up* the graphic, and generate graphic activity *unrelated to data information*



Redrawn by Henry S. Shryock and Jacob S. Siegel

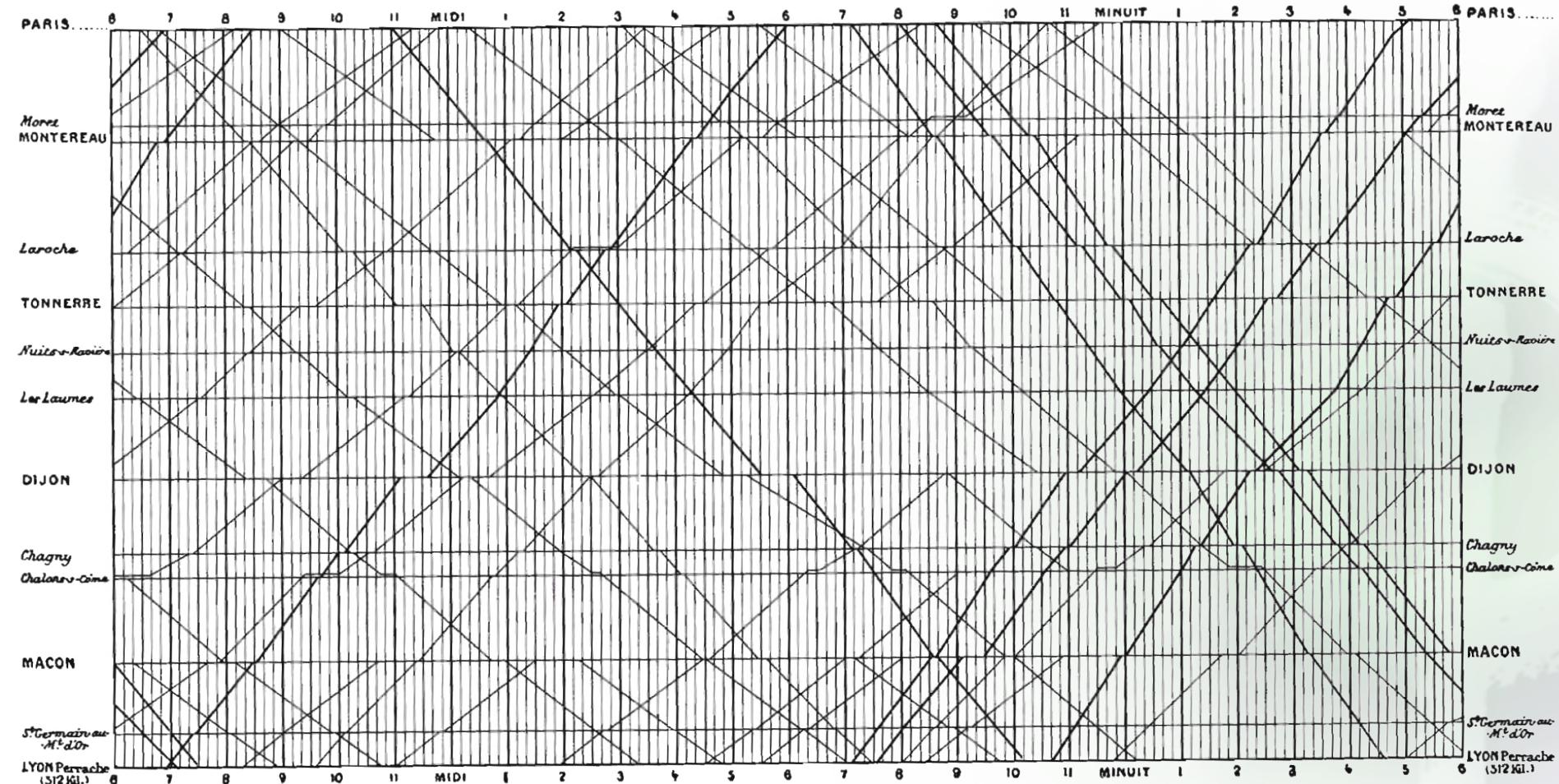
The Grid

Marey's train schedule



The Grid

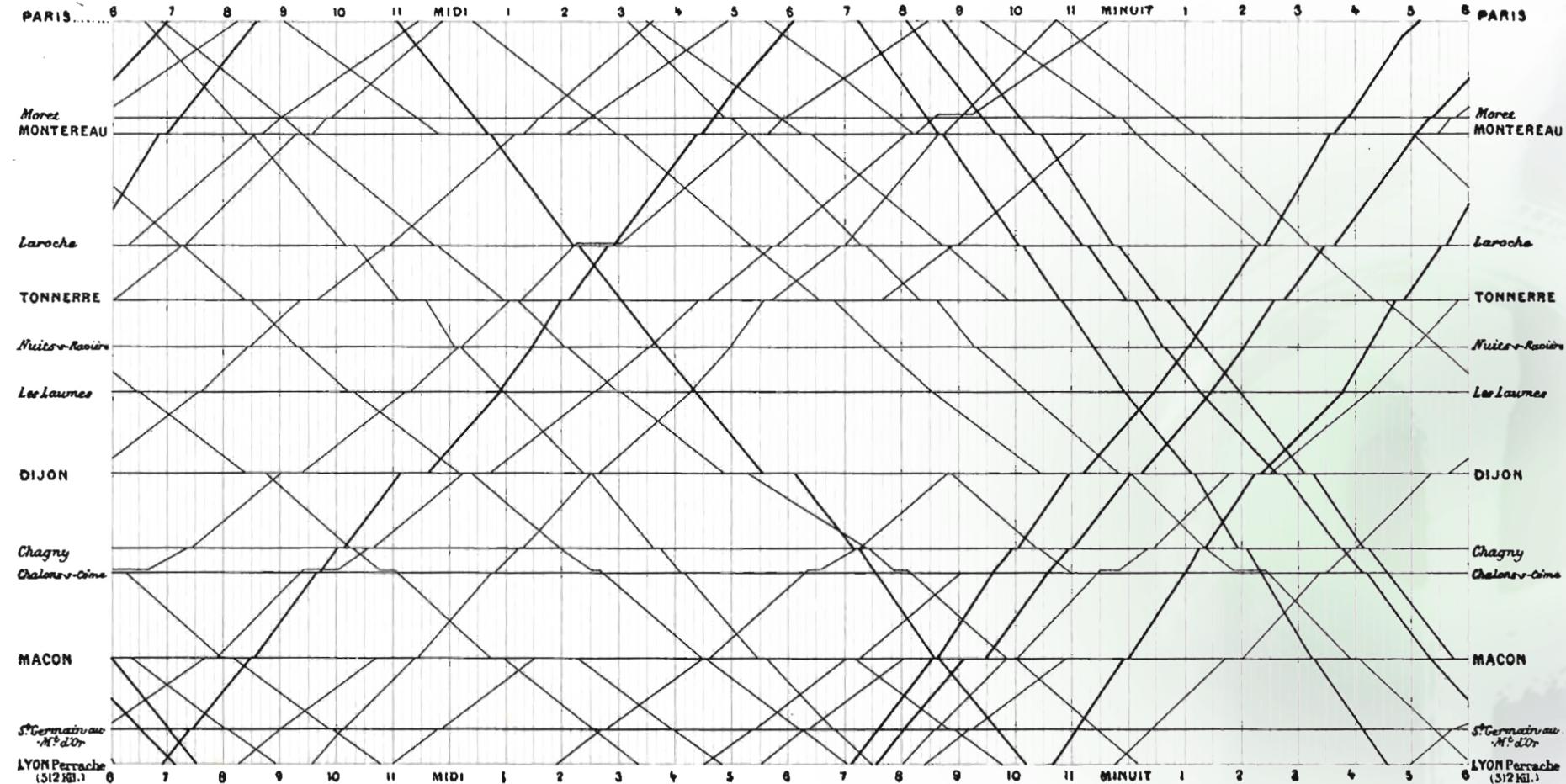
Marey's train schedule



Thinning the grid lines helps a little bit!

The Grid

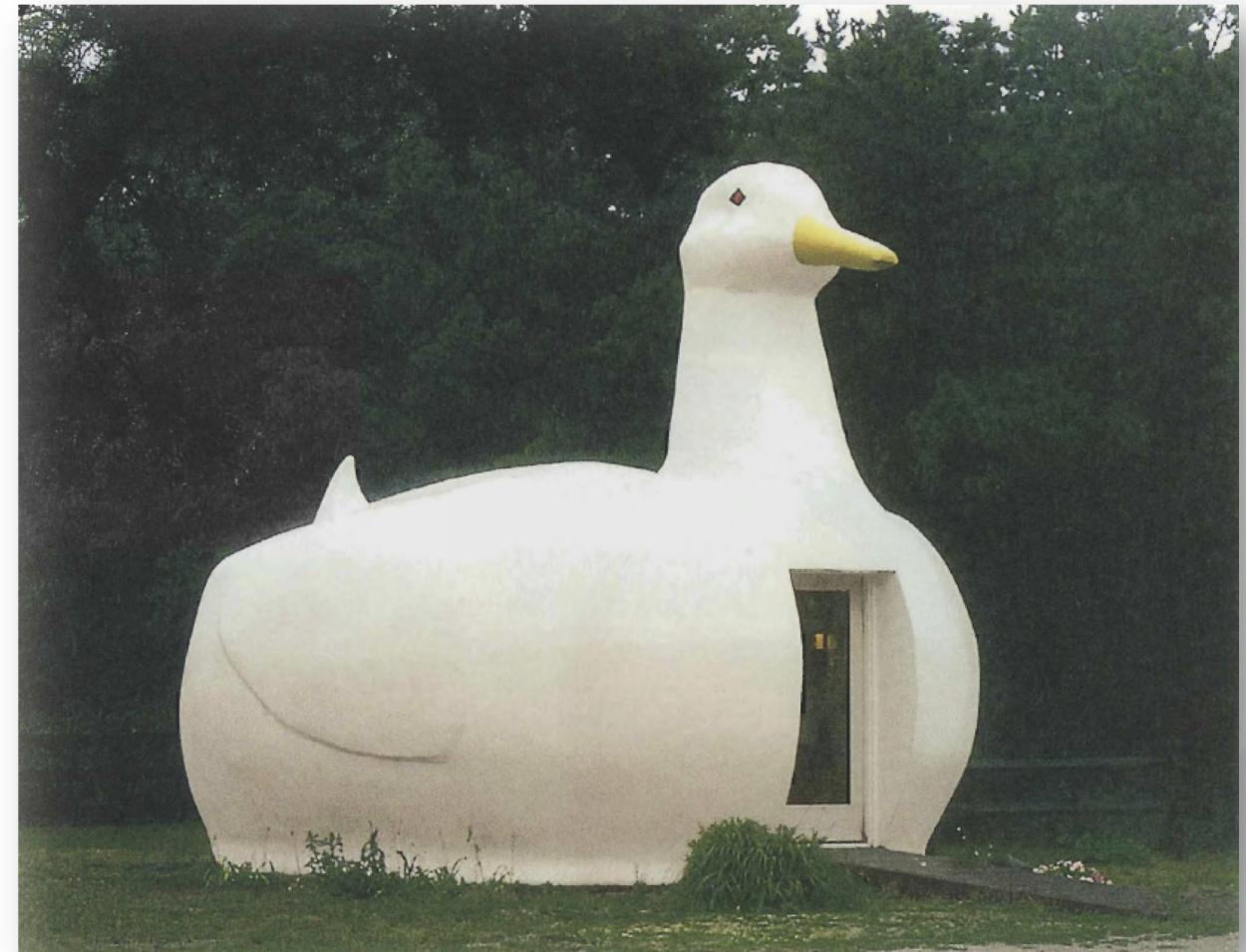
Marey's train schedule



A gray grid gives a better graphic!

The Duck

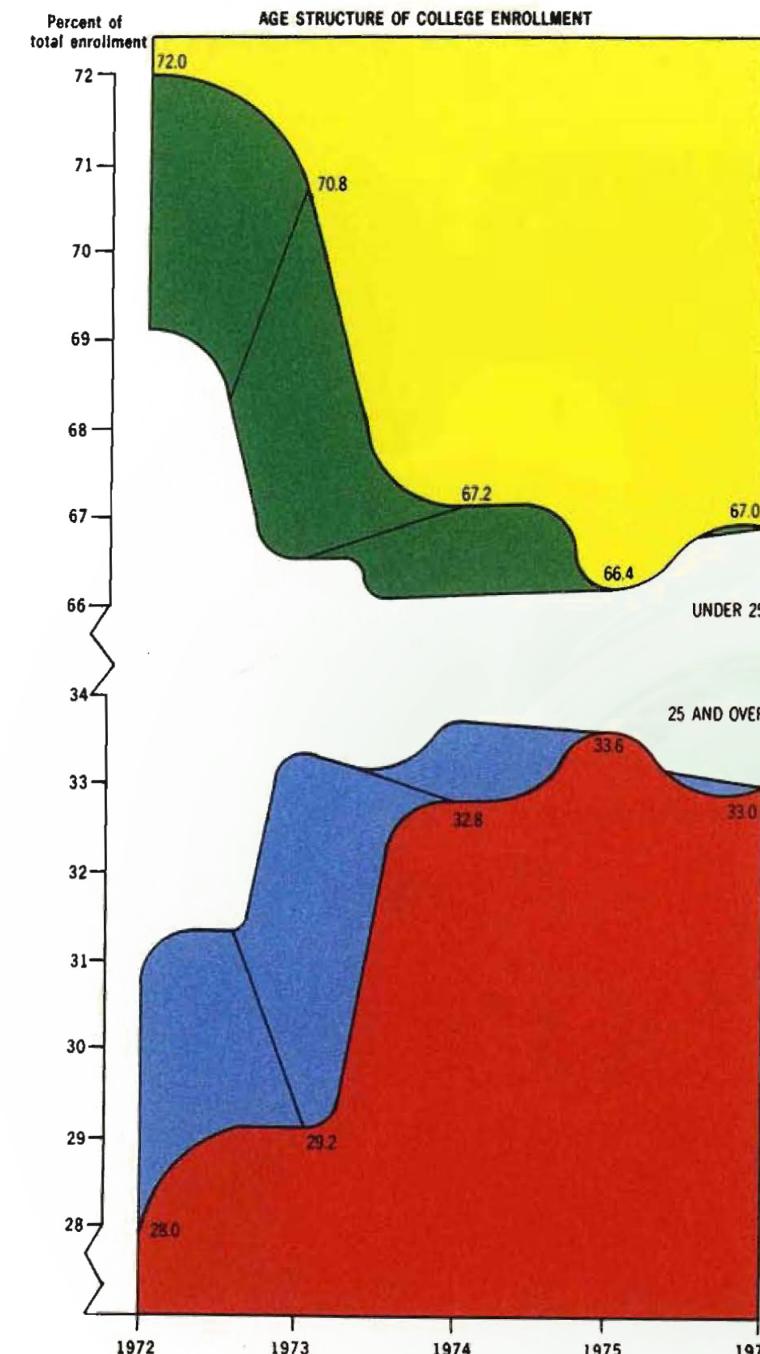
- Self-promoting Graphics:
when the *data measures*
become *design elements*



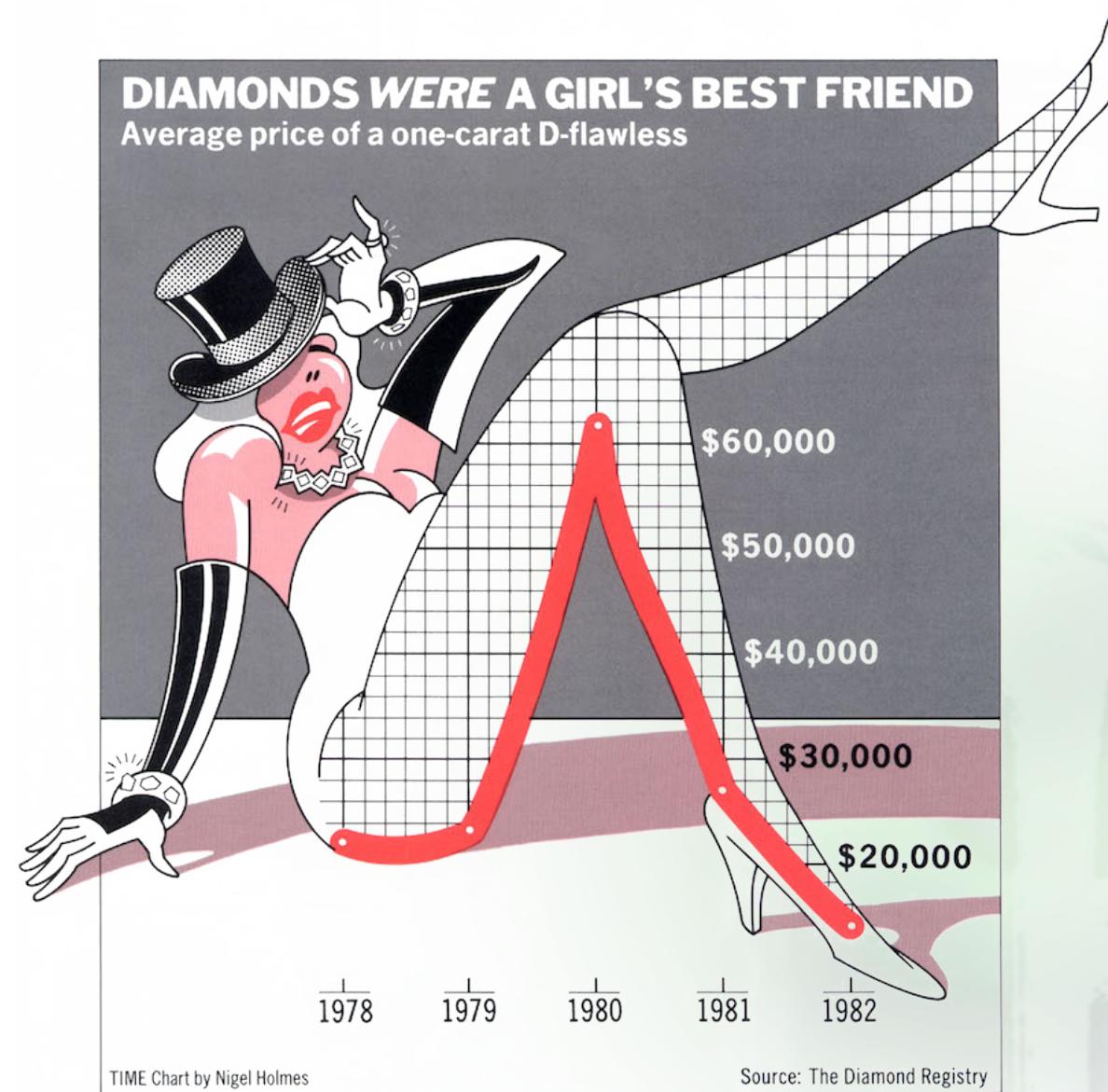
The Duck Example

This is according to Tufte possibly the *worst graph ever*:

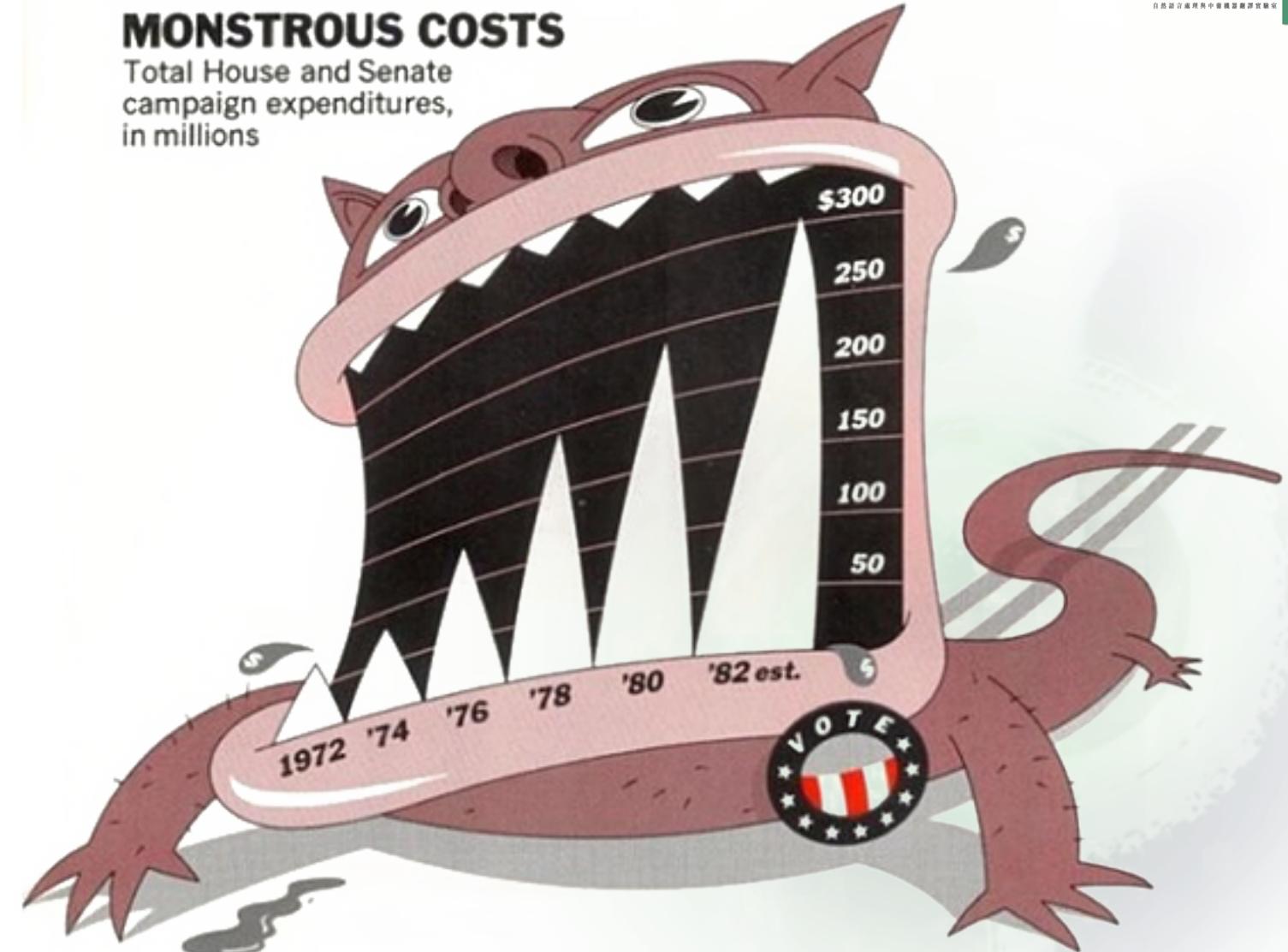
"A series of weird three-dimensional displays appearing in the magazine of American Education in the 1970's delighted the connoisseurs of the graphically preposterous. Here five colors report, almost by happenstance, only 5 pieces of data (since the division within each adds to 100%). This may well be the worst graphic ever to find its way into print."



The Duck Example



The Duck Example



Avoid Chart Junk

Extraneous visual elements that distract from the message



Avoid Chart Junk

Remove the *Vertical Gridlines*



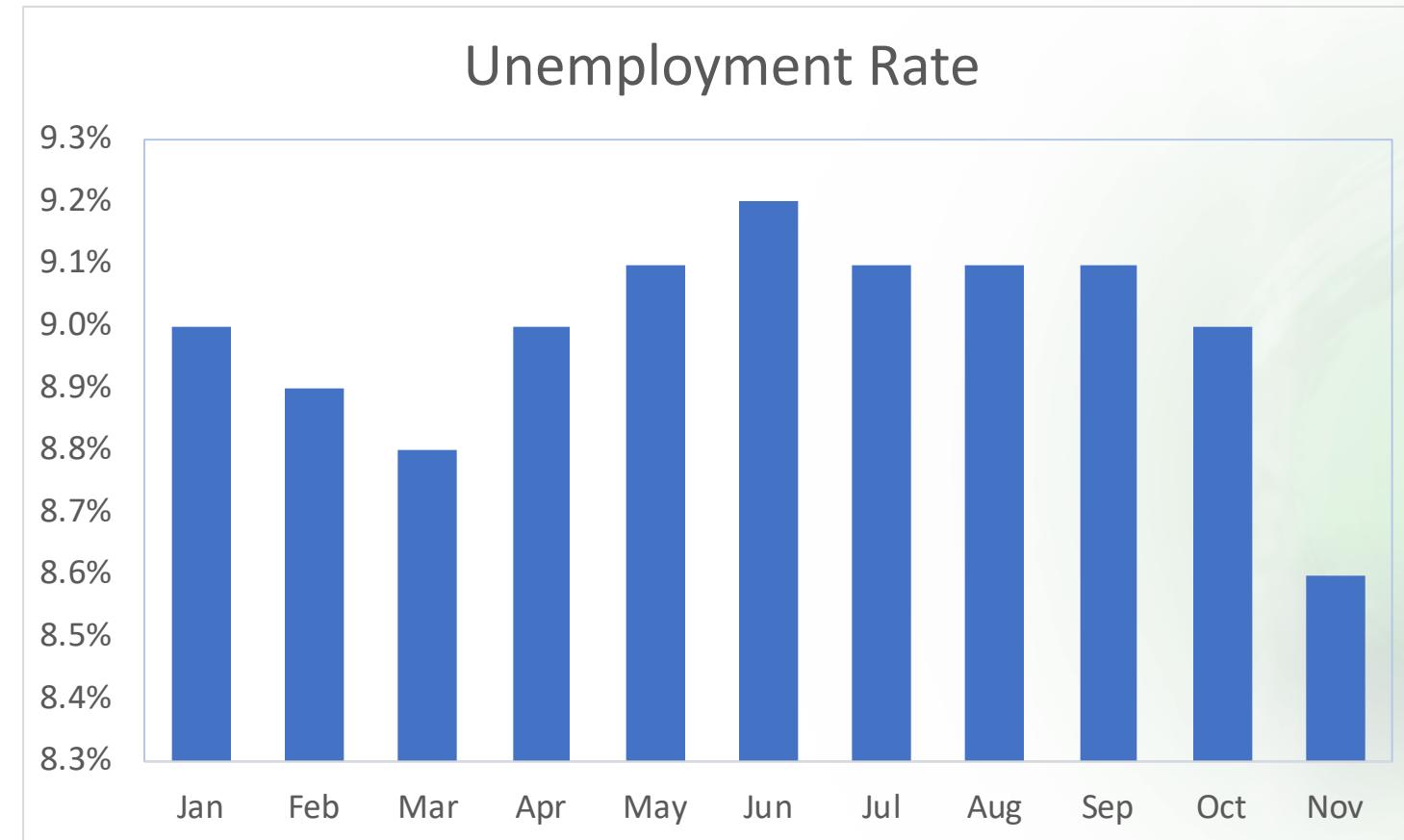
Avoid Chart Junk

Remove the *Horizontal Gridlines*



Avoid Chart Junk

Remove the *Background Color*



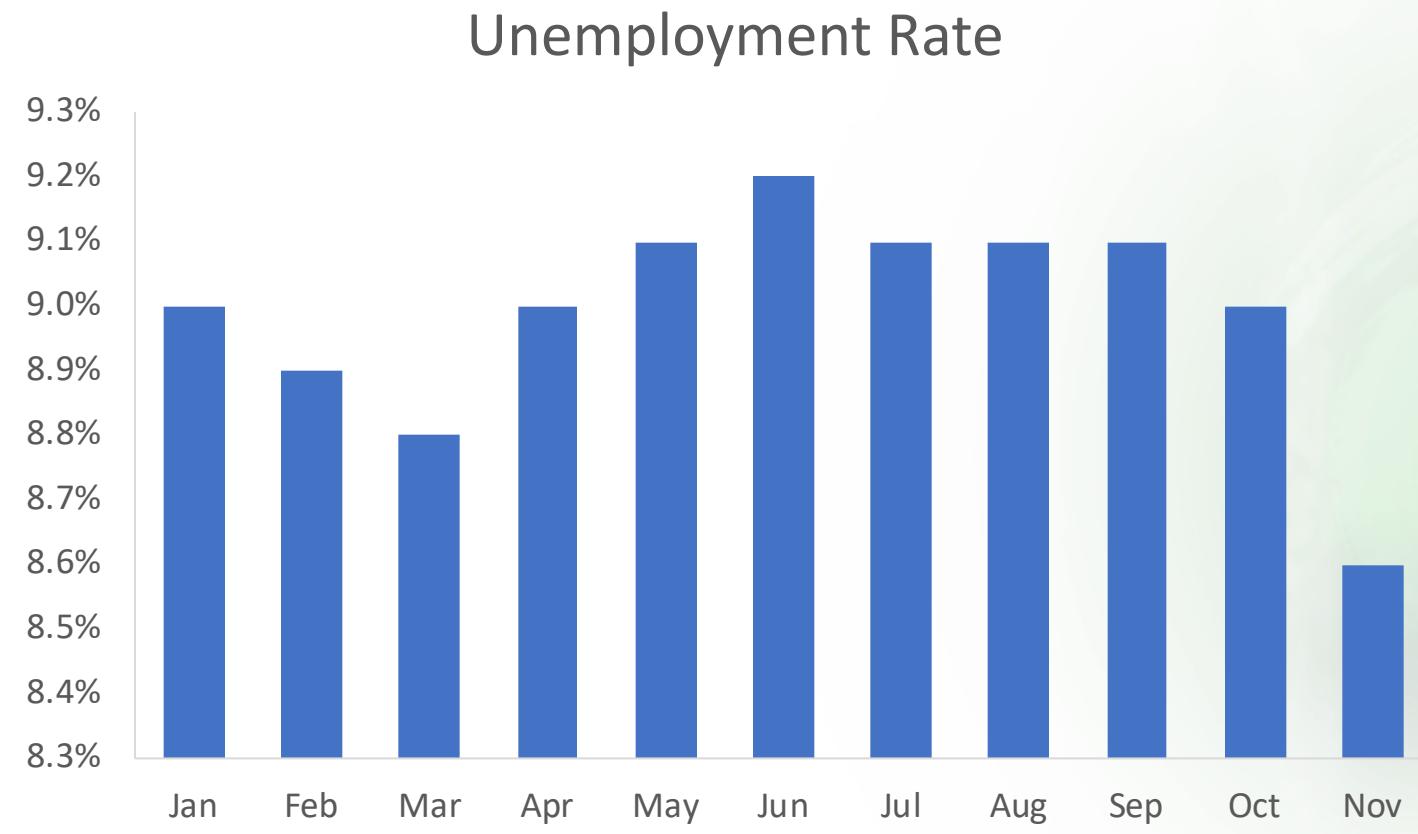
Avoid Chart Junk

Remove the *Outer Border*



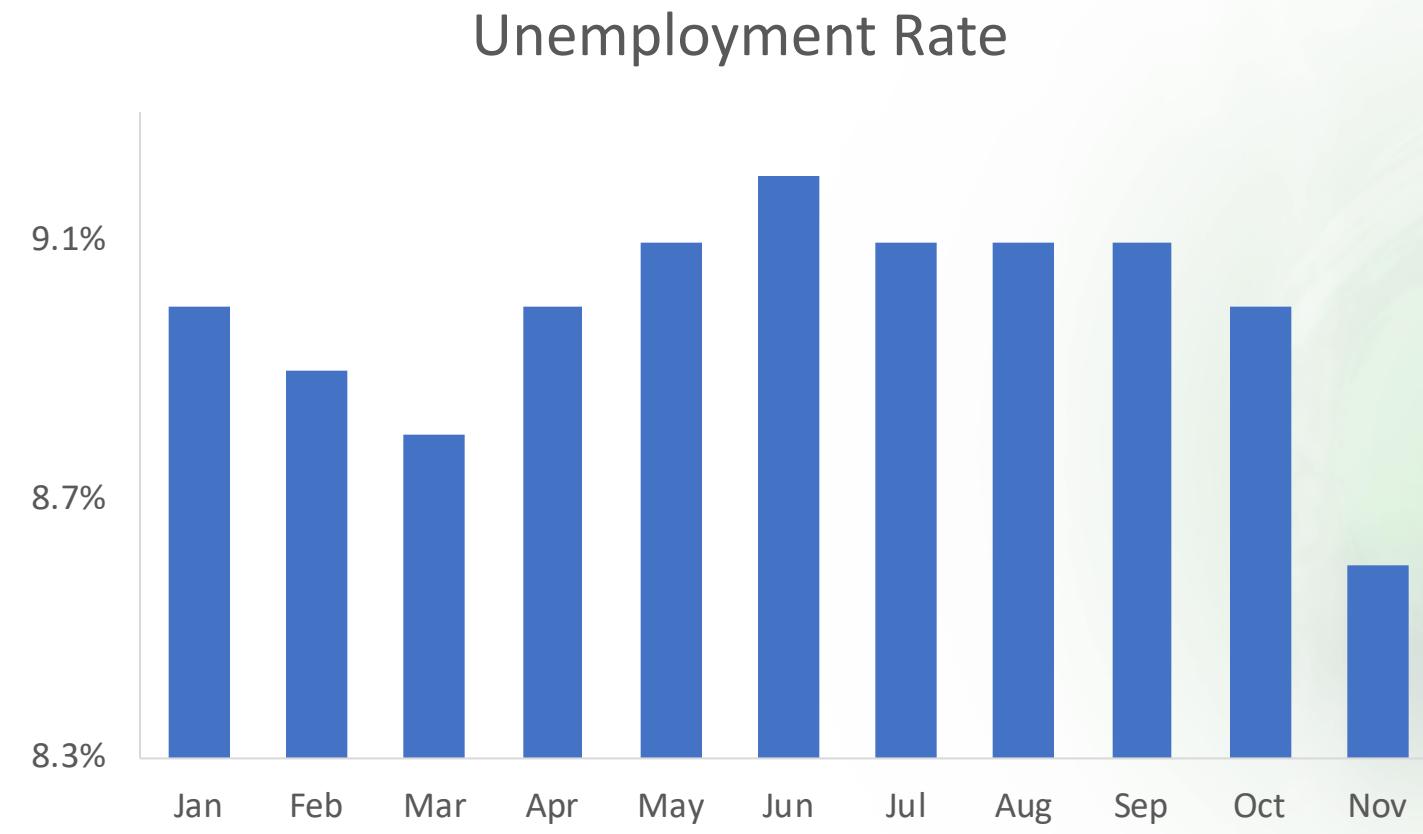
Avoid Chart Junk

Remove the *Inter Border*



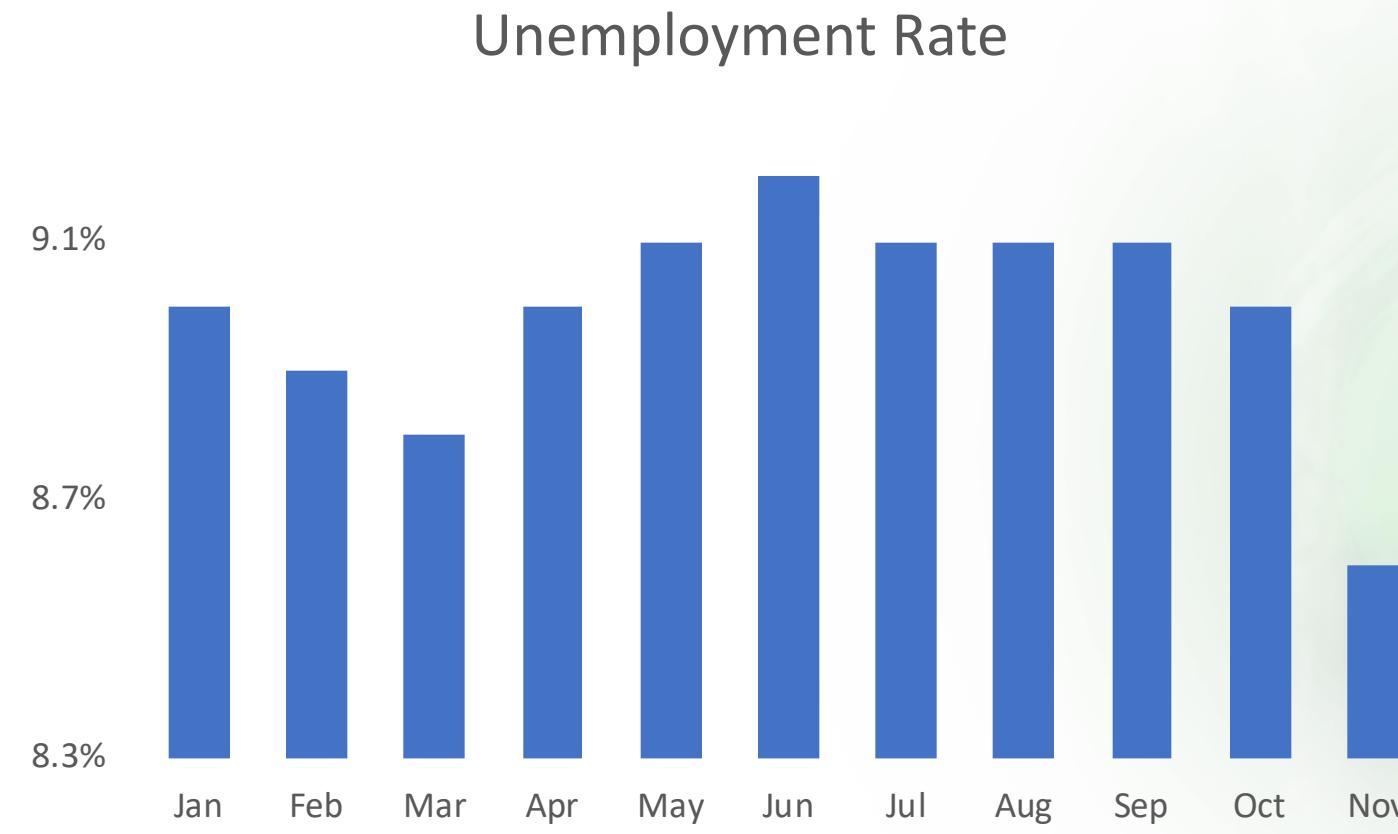
Avoid Chart Junk

Format the *values of vertical axis*



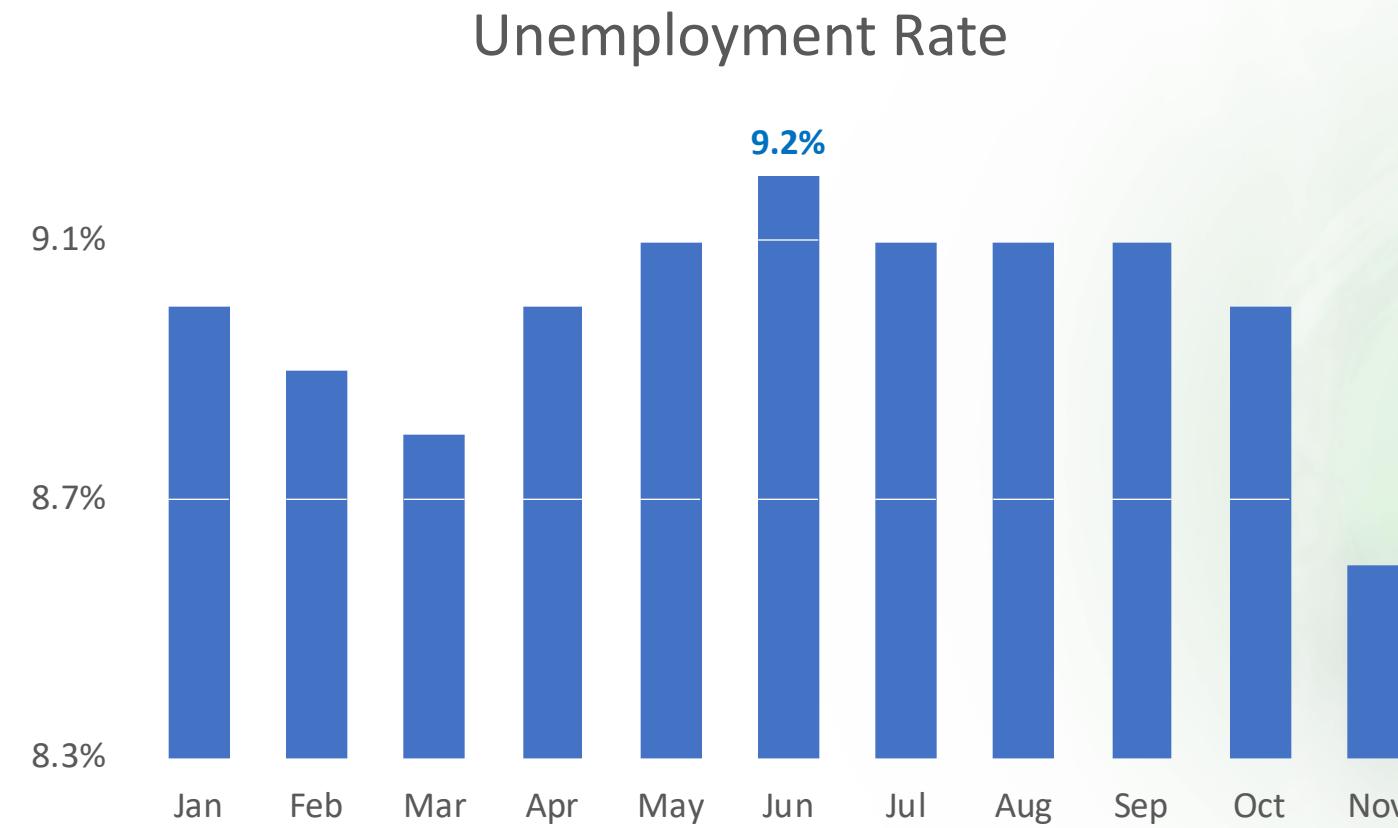
Avoid Chart Junk

Remove the *vertical* and *horizontal axis' line*

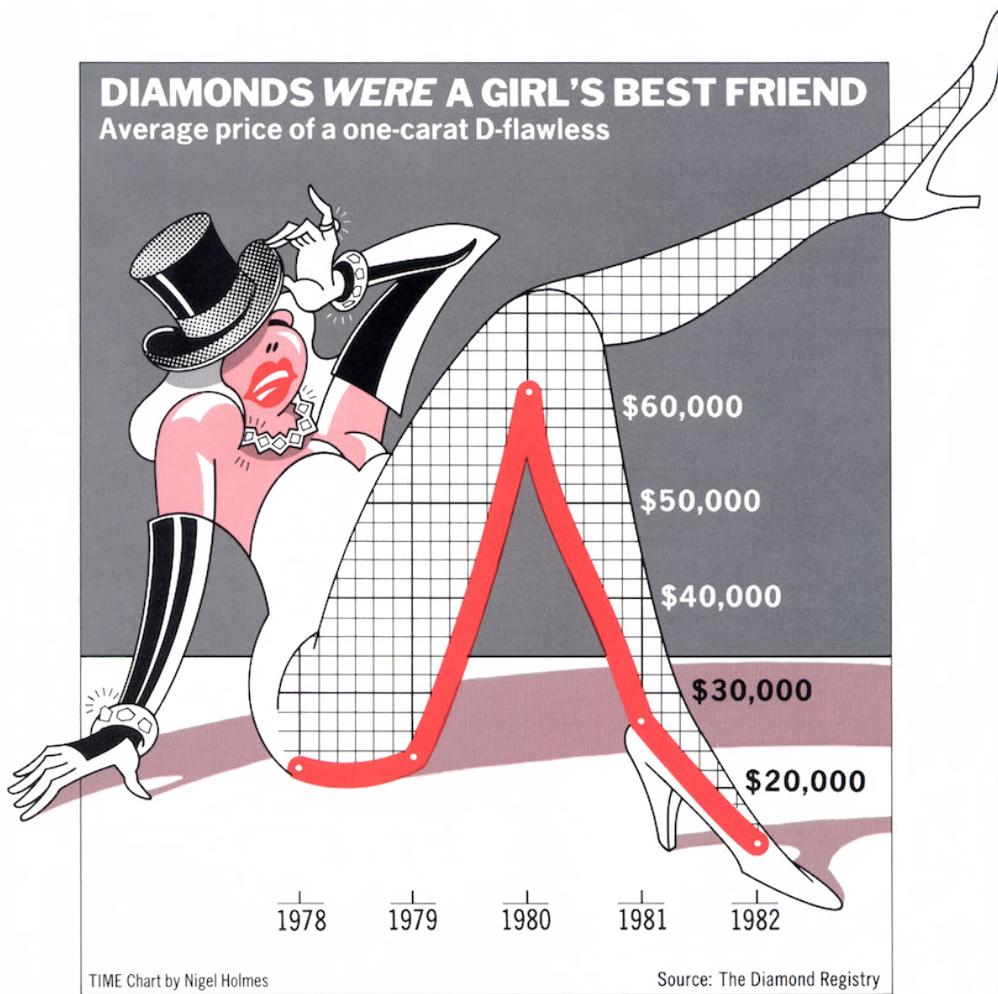


Avoid Chart Junk

Add the transparent *gridlines* and necessary *annotation*



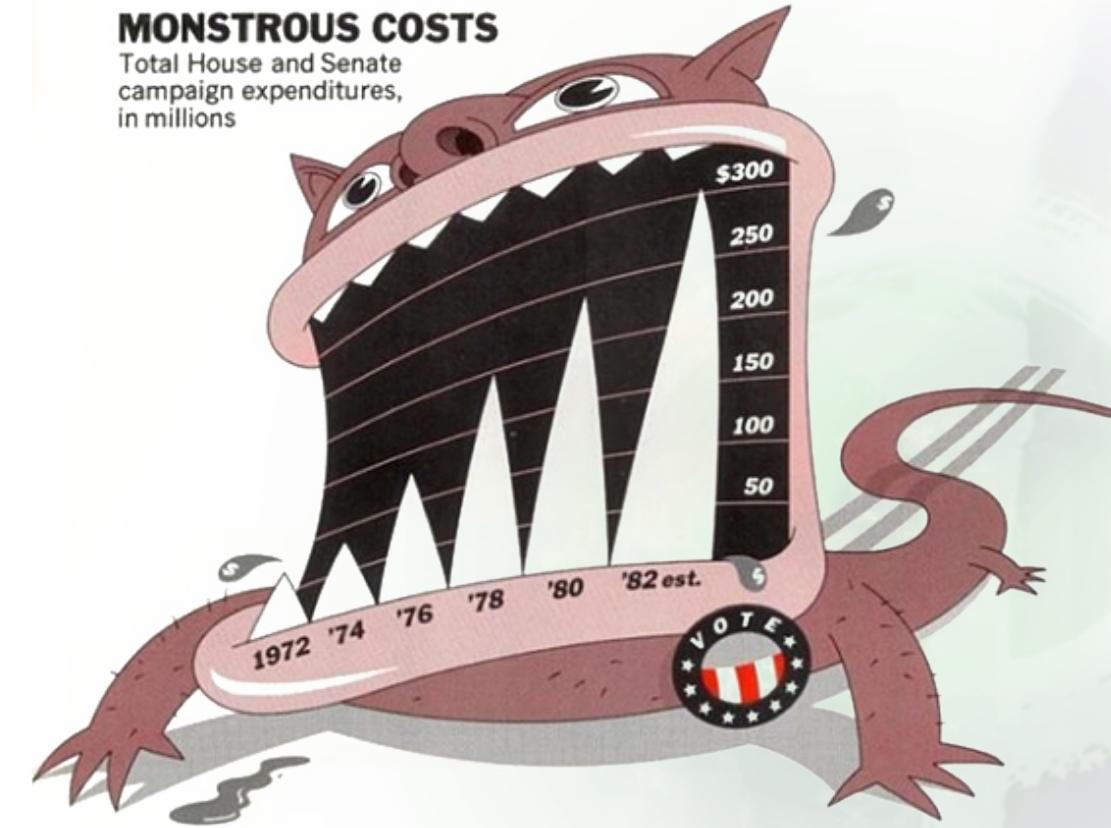
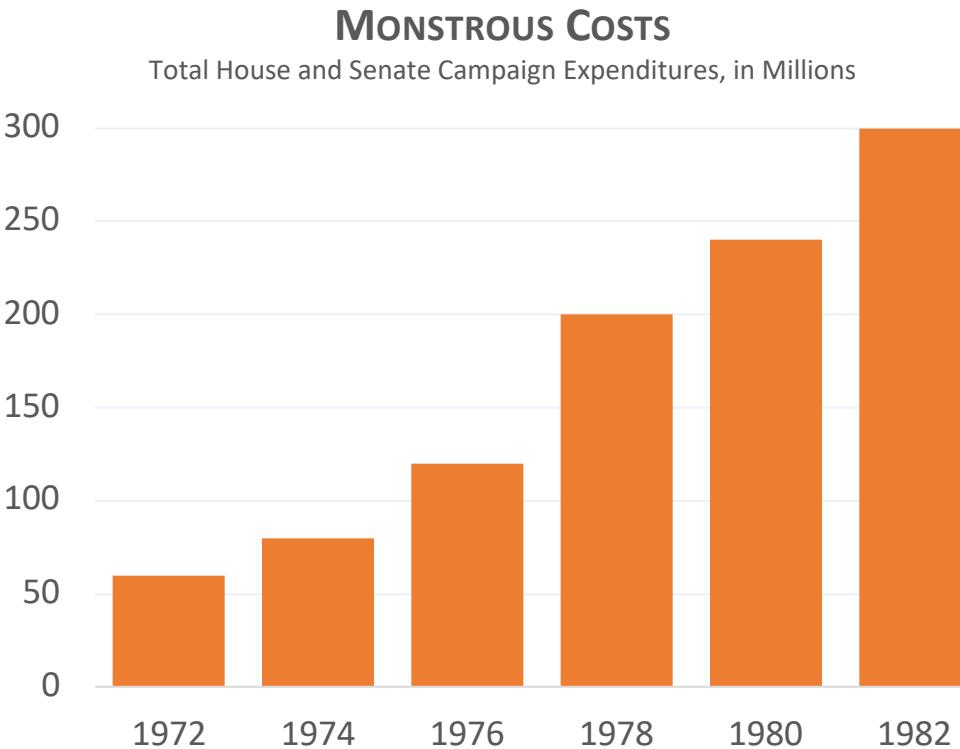
Which One is Better?



Diamonds Were A Girl's Best Friend
Average price of a one-carat D-flawless



Which One is Better?



Useful Junk? The Effects of Visual Embellishment on Comprehension and Memorability of Charts

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ABSTRACT

Guidelines for designing information charts often state that the presentation should reduce ‘chart junk’ – visual embellishments that are not essential to understanding the data. In contrast, some popular chart designers wrap the presented data in detailed and elaborate imagery, raising the questions of whether this imagery is really as detrimental to understanding as has been proposed, and whether the visual embellishment may have other benefits. To investigate these issues, we conducted an experiment that compared embellished charts with plain ones, and measured both interpretation accuracy and long-term recall. We found that people’s accuracy in describing the embellished charts was no worse than for plain charts, and that their recall after a two-to-three-week gap was significantly better. Although we are cautious about recommending that all charts be produced in this style, our results question some of the premises of the minimalist approach to chart design.

Author Keywords

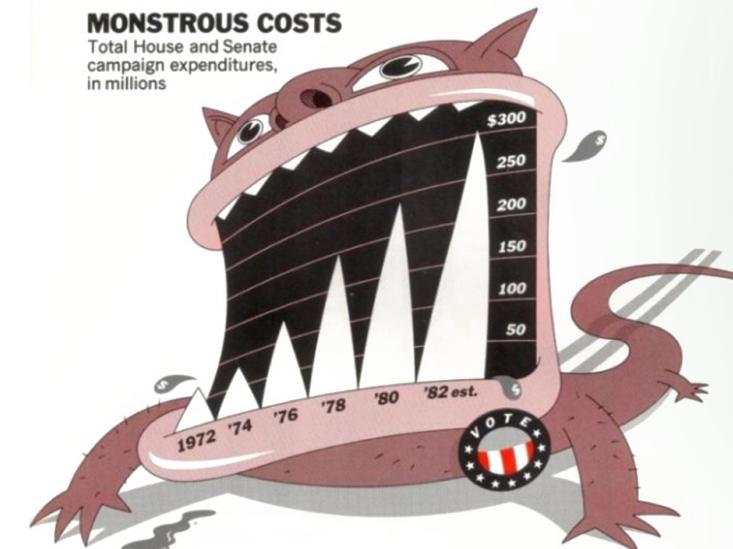
Charts, information visualization, imagery, memorability.

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI):
Miscellaneous.

data-ink – or the ink in the chart used to represent data.

Despite these minimalist guidelines, many designers include a wide variety of visual embellishments in their charts, from small decorations to large images and visual backgrounds. One well-known proponent of visual embellishment in charts is the graphic artist Nigel Holmes, whose work regularly incorporates strong visual imagery into the fabric of the chart [7] (e.g., Figure 1).



Research Questions

- Does *chart junk* impact *comprehension*?
- Does chart junk provide *additional information* to the reader than may *enhance comprehension*?

Note: The Chartjunks were designed by [Nigel Holmes](#) to debate with [Edward Tufte](#)

Experimental Questions

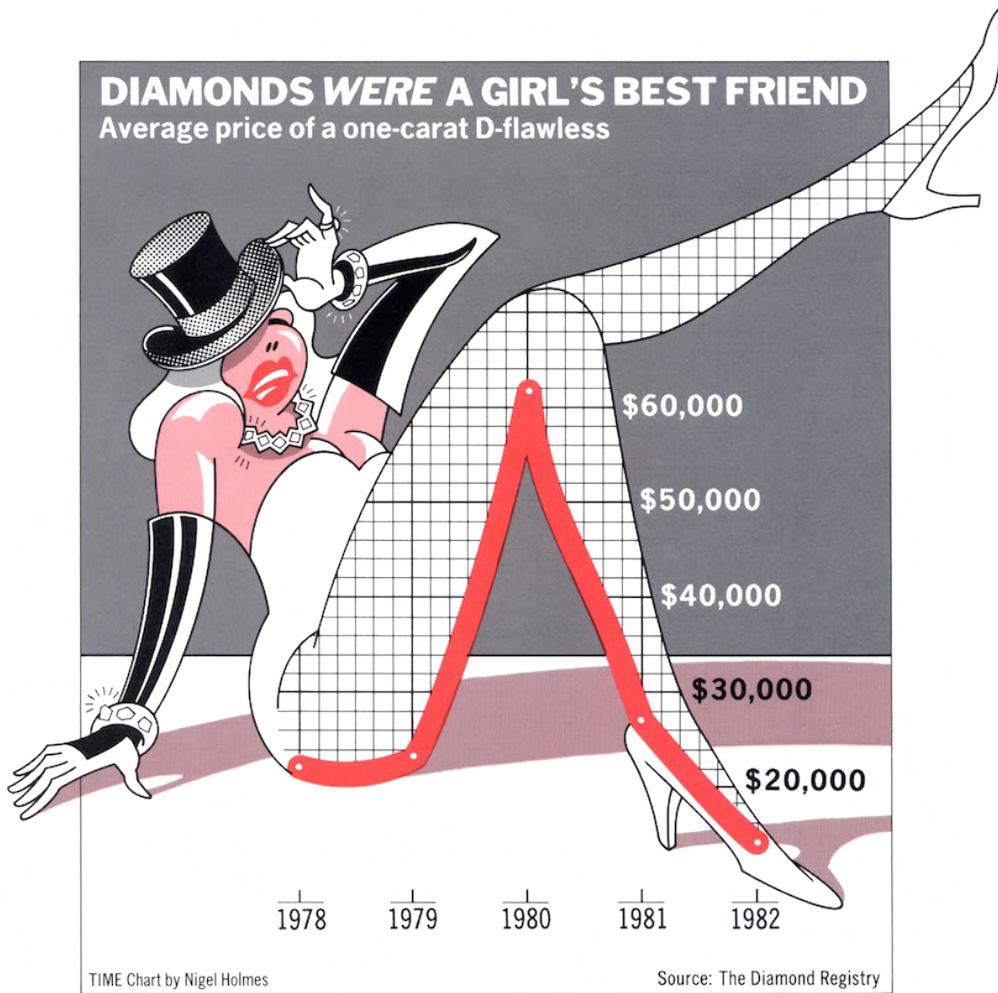
Q1 – Subject: “*What is the chart is about?*” (Tell me about the basic subject of the chart)

Q2 – Values: “*What are the displayed categories and values?*” (Tell me how the chart is organized and any relevant values)

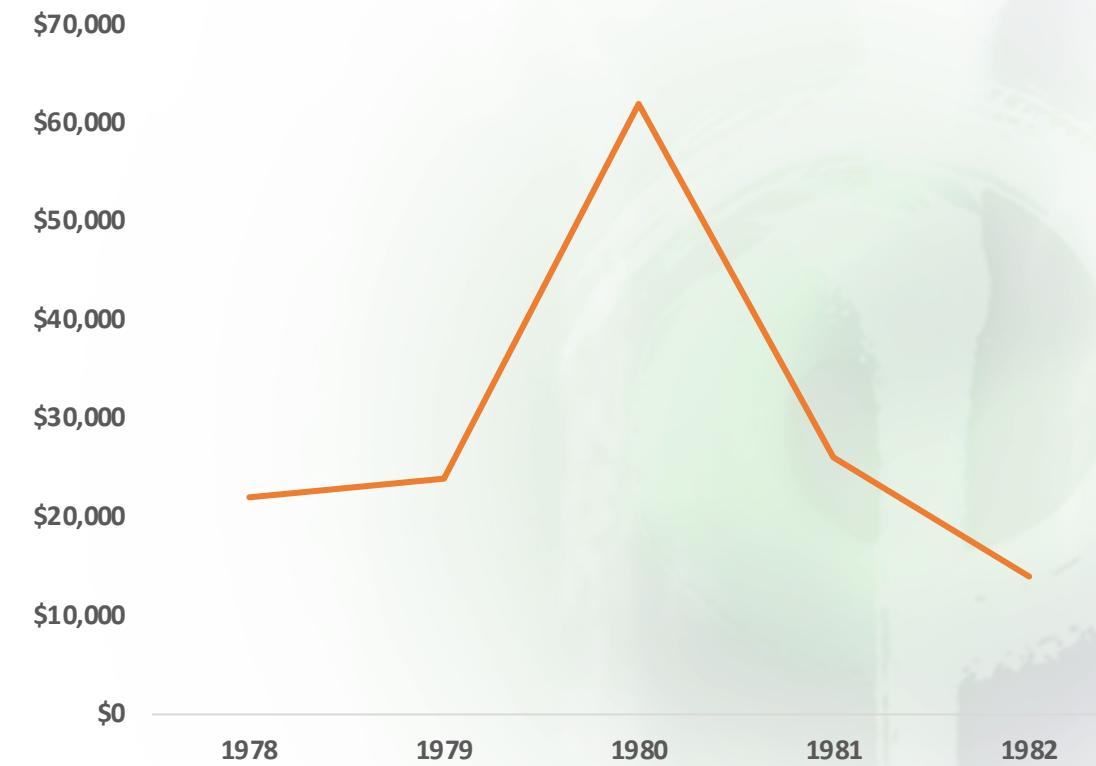
Q3–Trend: “*What is the basic trend of the graph?*” (Tell me whether the chart shows any changes and describe these changes)

Q4–Value Message: “*Is the author trying to communicate some message through the chart?*” (Is the author trying to get across a specific point or is he or she merely presenting objective information?)

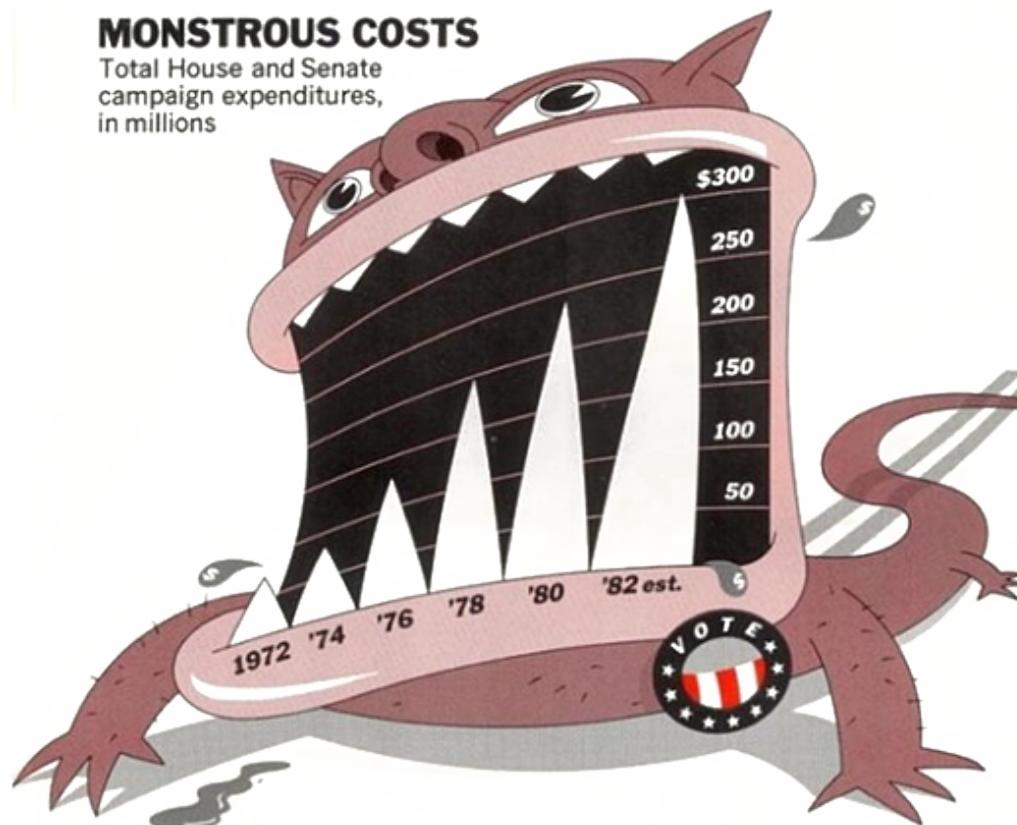
Redesigned Chart



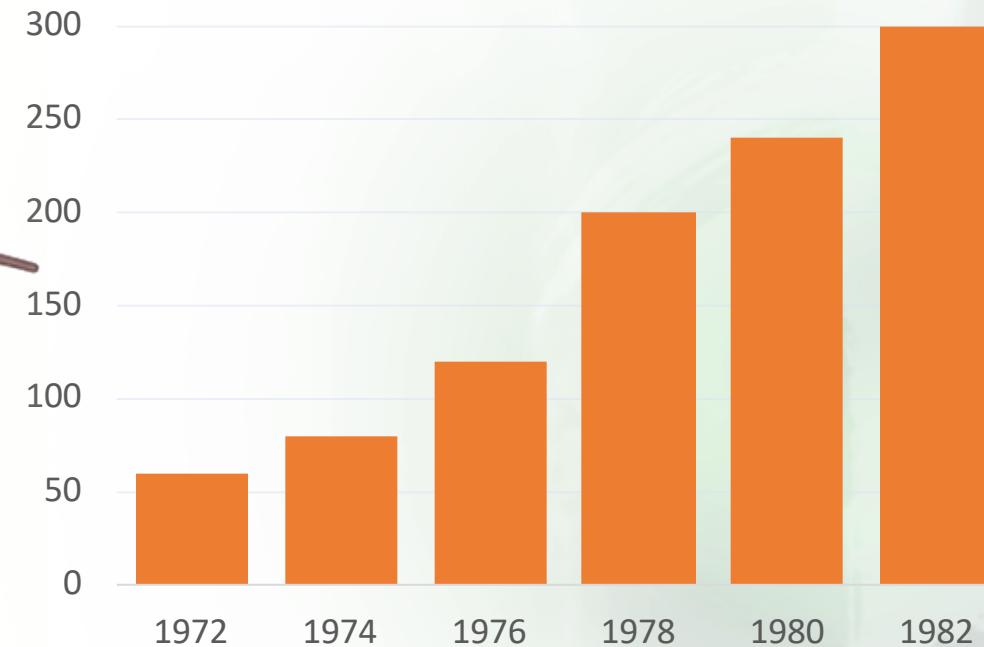
Diamonds Were A Girl's Best Friend
Average price of a one-carat D-flawless



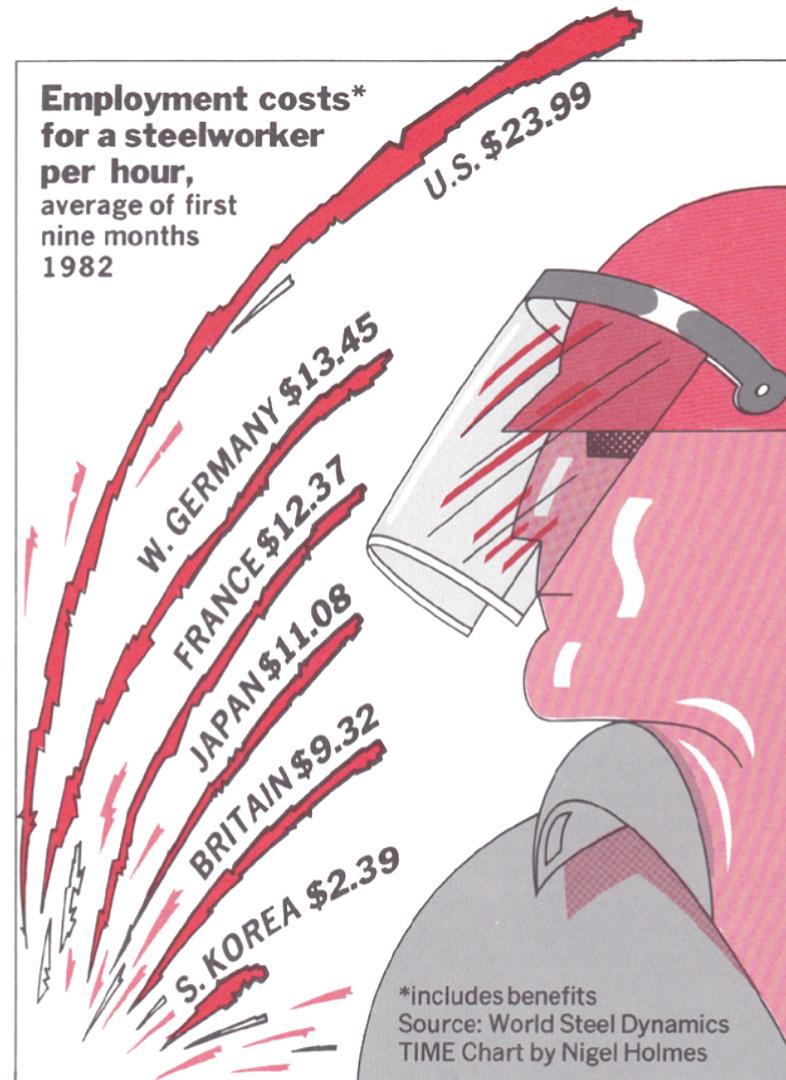
Redesigned Chart



MONSTROUS COSTS
Total House and Senate Campaign Expenditures, in Millions



Redesigned Chart



Experimental Results

- *No significant difference* between *plain* and *image charts* for interactive *interpretation accuracy*
- *No significant difference* in *recall accuracy* after a *five minute gap*
- *Significantly better recall* for *Holmes charts* of both the *chart topic* and the *details* (categories and trend) after long-term gap (2-3 weeks)
- Participants saw *value messages* in *Holmes charts* significantly more often than in the *plain charts*
- Participants found the *Holmes charts* *more attractive, most enjoyed them*, and found that they *were easiest and fastest to remember*

What Makes a Visualization Memorable?

Michelle A. Borkin, *Student Member, IEEE*, Azalea A. Vo, Zoya Bylinskii, Phillip Isola, *Student Member, IEEE*, Shashank Sunkavalli, Aude Oliva, and Hanspeter Pfister, *Senior Member, IEEE*

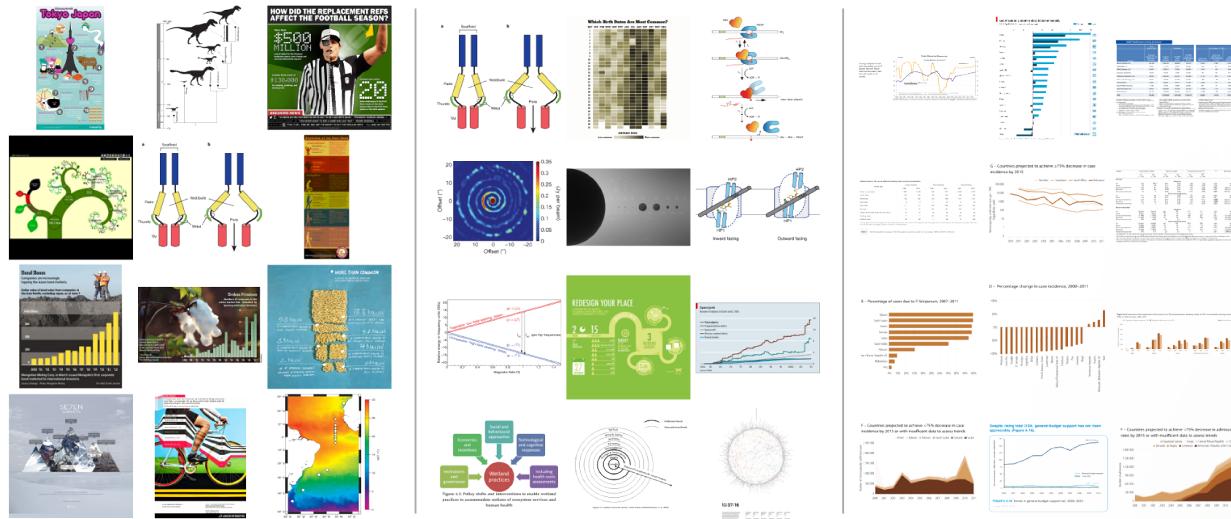


Fig. 1. **Left:** The top twelve overall most memorable visualizations from our experiment (most to least memorable from top left to bottom right). **Middle:** The top twelve most memorable visualizations from our experiment when visualizations containing human recognizable cartoons or images are removed (most to least memorable from top left to bottom right). **Right:** The twelve least memorable visualizations from our experiment (most to least memorable from top left to bottom right).

Abstract—An ongoing debate in the Visualization community concerns the role that visualization types play in data understanding. In human cognition, understanding and memorability are intertwined. As a first step towards being able to ask questions about impact and effectiveness, here we ask: “What makes a visualization memorable?” We ran the largest scale visualization study to date using 2,070 single-panel visualizations, categorized with visualization type (e.g., bar chart, line graph, etc.), collected from news media sites, government reports, scientific journals, and infographic sources. Each visualization was annotated with additional attributes, including ratings for data-ink ratios and visual densities. Using Amazon’s Mechanical Turk, we collected memorability scores for hundreds of these visualizations, and discovered that observers are consistent in which visualizations they find memorable and forgettable. We find intuitive results (e.g., attributes like color and the inclusion of a human recognizable object enhance memorability) and less intuitive results (e.g., common graphs are less memorable than unique visualization types). Altogether our findings suggest that quantifying memorability is a general metric of the utility of information, an essential step towards determining how to design effective visualizations.

Hypotheses

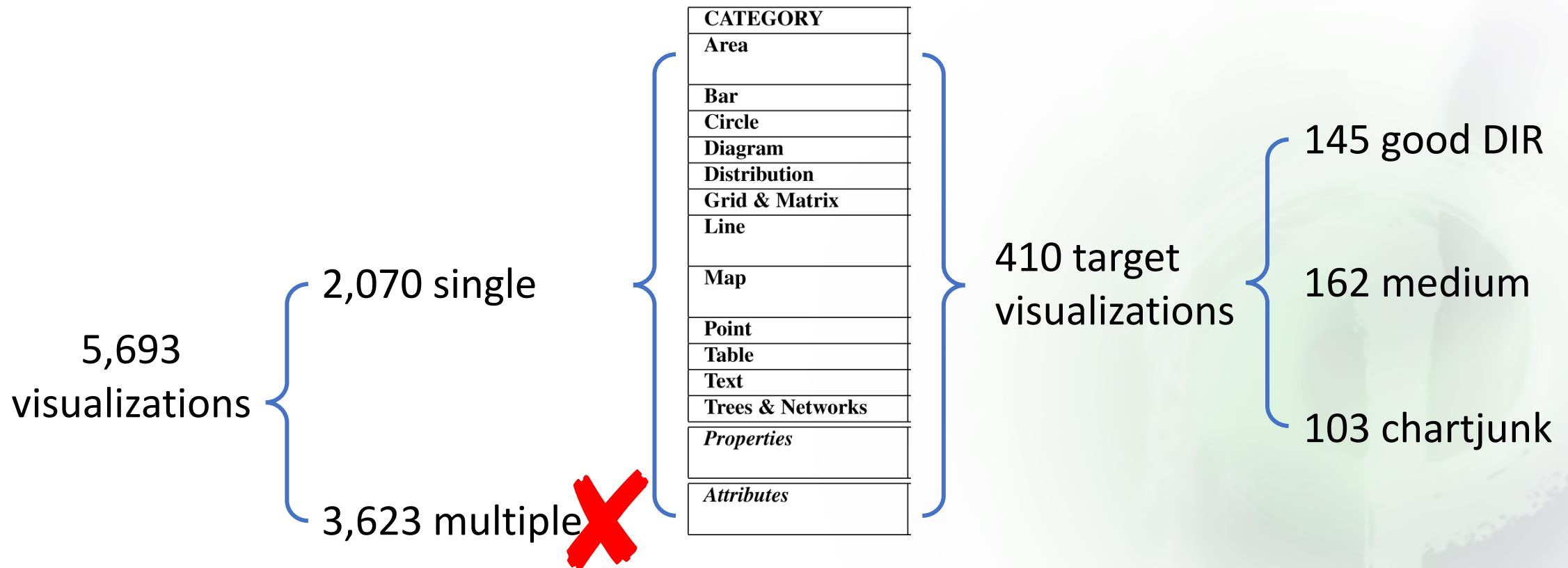
- H.1 Participants will *perform worse* (i.e., overall have a *harder time remembering visualizations*) as compared to natural images/photos
- H.2 A visualization is *more memorable* if it includes a *pictogram* or *cartoon* of a *recognizable* image
- H.3 A visualization is *more memorable* if there is *more color*
- H.4 A visualization is *more memorable* if it has *low visual density*
- H.5 A visualization is *more memorable* if it is “*good*” *data-ink ratio*
- H.6 A visualization is *more memorable* if it includes a “*familiar*” *visualization type* (i.e., basic graph type taught in school)
- H.7 A visualization is *less memorable* if it comes from a *scientific publication venue*

Investigated Visualization Elements

CATEGORY	SUBTYPES
Area	Area Chart (Area Chart, Overlapped Area Chart, Stacked Area Chart); Proportional Area Chart (Aligned Area Chart, Centered Area Chart, Overlapped Area Chart, Stacked and Linked Area Chart)
Bar	Bar Chart (Bar Chart, Grouped Bar Chart, Stacked Bar Chart, Circular Bar Chart, Waterfall Chart, Bullet Graph)
Circle	Belt Chart; Donut Chart; Pie Chart; Sector Graph
Diagram	Flow Chart; Illustration or Rendering; Sankey Diagram; Timeline; Venn Diagram
Distribution	Box-and-Whisker Plot; Distribution Curve; Dot Array; Histogram; Point Graph; Stem-and-Leaf Plot; Stripe Graph; Tally Graph
Grid & Matrix	Heatmap
Line	Contour Graph; Density Graph; Line Graph (Line Graph, Circular Line Graph, Trend Line (and Residual Graph)); Slopegraph; Star Plot; Surface Graph; Vector Graph
Map	Flow Map; Geographic Map (Geographic Map, Street Map); Statistical Map (Choropleth Map, Contour Map, Distorted Map, Plotted Map)
Point	Dot Plot; Scatter Plot (Bubble Graph, Scatter Plot, (Trend Line and) Residual Graph, Trilinear Scatter Plot)
Table	Table; Text Chart
Text	Phrase Net; Word Cloud; Word Tree
Trees & Networks	Trees and Networks (Graph, Matrix Representation, Tree, Treemap); Hive Graph; Hierarchical Edge Bundling
Properties	<i>Dimension (2D; 3D), Multiplicity (Single; Multiple; Grouped; Multi-panel; Small Multiples; Combination), Pictorial (Pictorial; Pictorial Unit), Time (Time Series)</i>
Attributes	<i>Black & White [yes, no], Number of Distinct Colors [1, 2-6, ≥ 7], Data-Ink Ratio [good, medium, bad], Visual Density [low, medium, high], Human Recognizable Objects [yes, no], Human Depiction [yes, no]</i>

Table 1. Visualization Taxonomy

Collected Visualized Data



Experiment Setup

- Set up as a *game* on *Amazon Mechanical Turk*
- Workers were presented with a *sequence of images*, and asked to *press a key* if they *saw an image for the second time* in the sequence
- Images were selected from the *2,070 candidates*
- The *repeated images* were from the *410 target visualizations*

Experimental Results

- *Color* and *human recognizable objects* *enhance memorability*
- More *chart junk* and *clutter* are *more memorable* than *clean visualizations*
- *Common graphs* are *less memorable* than *unique visualization types*

References

- Edward Tufte (1983), *The Visual Display of Quantitative Information*, Graphics Press, Cheshire CT.
- Erik W. Anderson, Kristin C. Potter, Laura E. Matzen, Jason F. Shepherd, Gilbert Preston, Cláudio T. Silva (2011). [A User Study of Visualization Effectiveness Using EEG and Cognitive Load](#). Comput. Graph. Forum 30(3): 791-800.
- Scott Bateman, Regan L. Mandryk, Carl Gutwin, Aaron Genest, David McDine, Christopher A. Brooks (2010). [Useful junk?: the effects of visual embellishment on comprehension and memorability of charts](#). CHI 2010: 2573-2582.
- Michelle Borkin, Azalea A. Vo, Zoya Bylinskii, Phillip Isola, Shashank Sunkavalli, Aude Oliva, Hanspeter Pfister (2013). [What Makes a Visualization Memorable?](#) IEEE Trans. Vis. Comput. Graph. 19(12): 2306-2315.

Acknowledgements

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- Alvitta Ottley, Doug Smith