Introduction to Business Analytics: Communicating with Data

Module 1

Professor Kevin Hartman

Welcome!

Syllabus Review

Topics and materials for Module 1

Module	Discussion Topics	References and Readings
1	**Pictures You See with Your Brain**—Frameworks and approaches behind data collection and analysis methods used by business professionals	Berinato: Introduction, Chapters 1, 2, and 9 A word from a founding father of web analytics: http://marketinggeek.blogspot.com/2006/02/geeks-in-marketing.html Comparing Data Visualization Software—Here Are the 7 Best Tools for 2018: https://www.forbes.com/sites/bernardmarr/2018/06/20/comparing-data-visualization-software-here-are-the-7-best-tools-for-2018/ A Curated Guide to the Best Tools, Resources and Technologies for Data Visualization: https://datavis.tools/ The "Door" Study—YouTube: https://www.youtube.com/watch?v=FWSxSQsspiQ What Make a Good Visualization? http://www.informationisbeautiful.net/visualizations/what-makes-a-good-data-visualization/

Syllabus Review

Topics and materials for Module 2

Module	Discussion Topics	References and Readings
2	**Working Fast and Thinking Slow** —Data collection, analysis methods, visualization techniques and tools used by business professionals based on data volume, velocity, and usability	Roles Required for Successful Web Analytics Endeavors: http://marketinggeek.blogspot.com/2006/11/data-visualization-practice.html Big Data, Big Deal: http://www.stephen-few.com/blog/2012/09/19/big-data-big-deal/ Big Data, Big Dupe—A Progress Report: http://www.stephen-few.com/blog/2018/02/23/big-data-big-dupe-a-progress-report/ Different Tools for Different Tasks: http://www.stephen-few.com/blog/2018/02/19/different-tools-for-different-tasks/

Syllabus Review

Topics and materials for Module 3

Module	Discussion Topics	References and Readings
3	**Finding Your Data Story**—Understanding visual form and how to begin the transition from work product to client-ready graphics	Berinato: Chapters 3 and 4 Wong: Introduction, Chapter 1 The World's Best Data Visualizations (2017): http://www.informationisbeautiful.net/2017/the-best-infographics-and-data-visualizations-2017/ FlowingData's R Visualization Tutorials: https://flowingdata.com/category/tutorials/

Syllabus Review

Topics and materials for Module 4

Module	Discussion Topics	References and Readings
4	**Getting Your Story Across**—Distinctions between effective and poor data presentation	Berinato: Chapters 5–8 Wong: Chapters 2–5 Know Your Audience—Good Luck with That: https://www.stephen-few.com/blog/2018/03/15/know-your-audience-good-luck-with-that/ Don't Refrain from Using Uncommon Visualizations—Explain Them: http://www.thefunctionalart.com/2017/12/dont-refrain-from-using-uncommon.html The "Action" Dashboard: http://www.kaushik.net/avinash/the-action-dashboard-an-alternative-to-crappy-dashboards/

Course Resources

Required reading: Berninato's *Good Charts*

(Berinato, 2016)

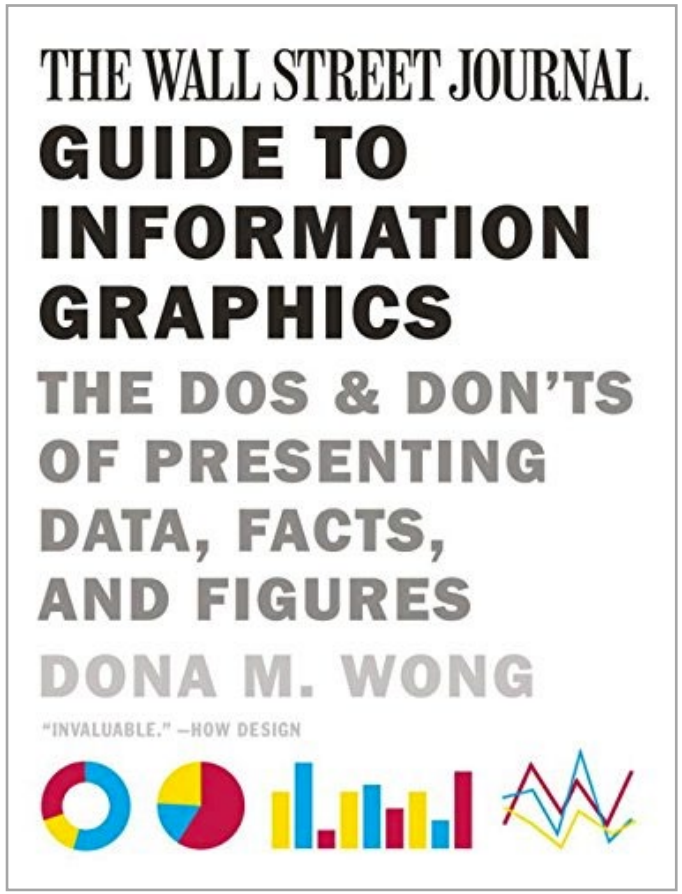
In *Good Charts,* Berinato provides an essential guide to how visualization works and how to use the new language of dataviz to impress and persuade. Dataviz today is where spreadsheets and word processors were in the early 1980s—on the cusp of changing how we work.

This book is much more than a set of static rules for making visualizations. It taps into both well-established and cutting-edge research in visual perception and neuroscience, as well as the emerging field of visualization science, to explore why good charts (and bad ones) create "feelings behind our eyes."

Good Charts will help you turn plain, uninspiring charts that merely present information into smart, effective visualizations that powerfully convey ideas.

Course Resources

Required reading: Wong's *The WSJ Guide*



(Wong, 2013)

The definitive guide to the graphic presentation of information.

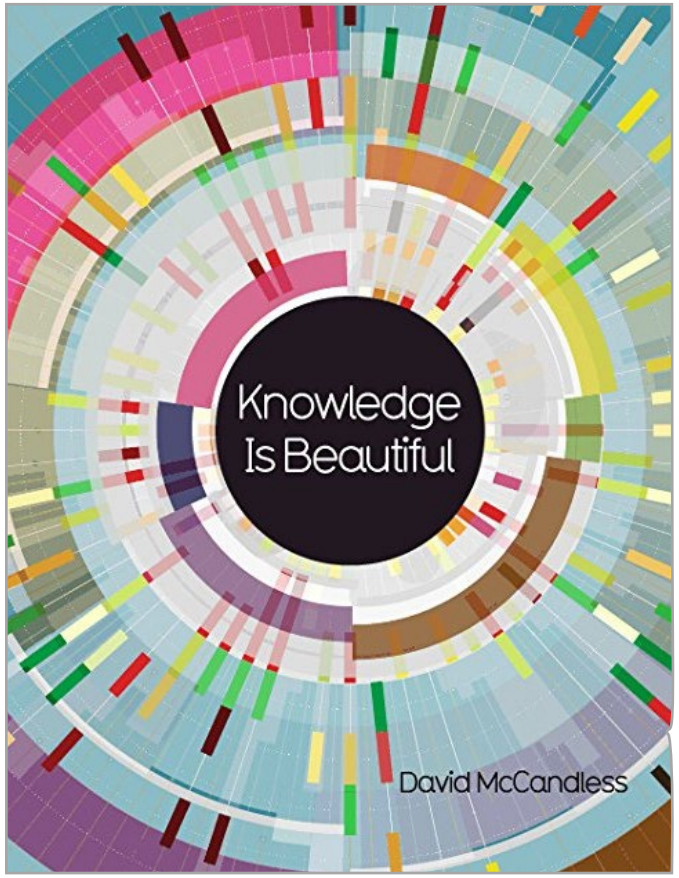
Information graphics is rarely taught in schools or is the focus of on-the-job training. Now, for the first time, Dona M. Wong, a student of the information graphics pioneer Edward Tufte, makes this material available to all of us. In this book, you will learn

- to choose the best chart that fits your data,
- the most effective way to communicate with decision makers when you have five minutes, and
- how to use color effectively.

Organized in a series of mini-workshops backed up with illustrated examples, this is an invaluable reference work for students and professional in all fields.

Course Resources

Recommended reading: McCandless's *Knowledge Is Beautiful*



(McCandless, 2014)

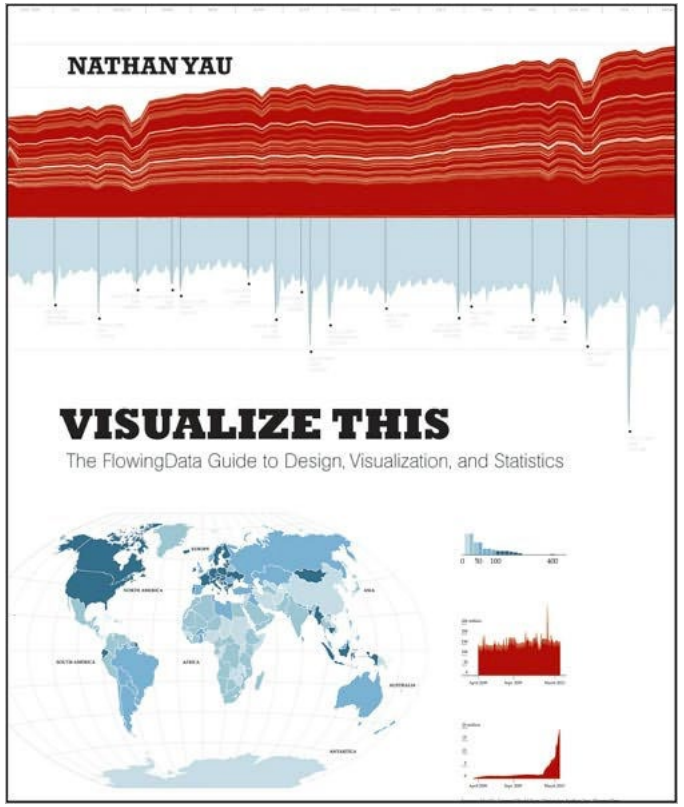
We are living in the Information Age, in which we are constantly bombarded with data on television, in print, and online. How can we relate to this mind-numbing overload?

Enter David McCandless and his amazing infographics: simple, elegant ways to understand information too complex or abstract to grasp in any way but visually. In his unique signature style, he creates dazzling displays that blend facts with their connections, contexts, and relationships, making information meaningful, entertaining, and beautiful.

Taking infographics to the next level, his book *Knowledge Is Beautiful* is an endlessly fascinating spin through the world of visualized data, which offers a deeper, more wide-ranging look at the world and its history. Covering everything from dog breeds and movie plots to the origins of life and a timeline of the far future, this stunning book is guaranteed to enrich your understanding of the world.

Course Resources

Recommended reading: Yau's *Visualize This*



(Yau, 2011)

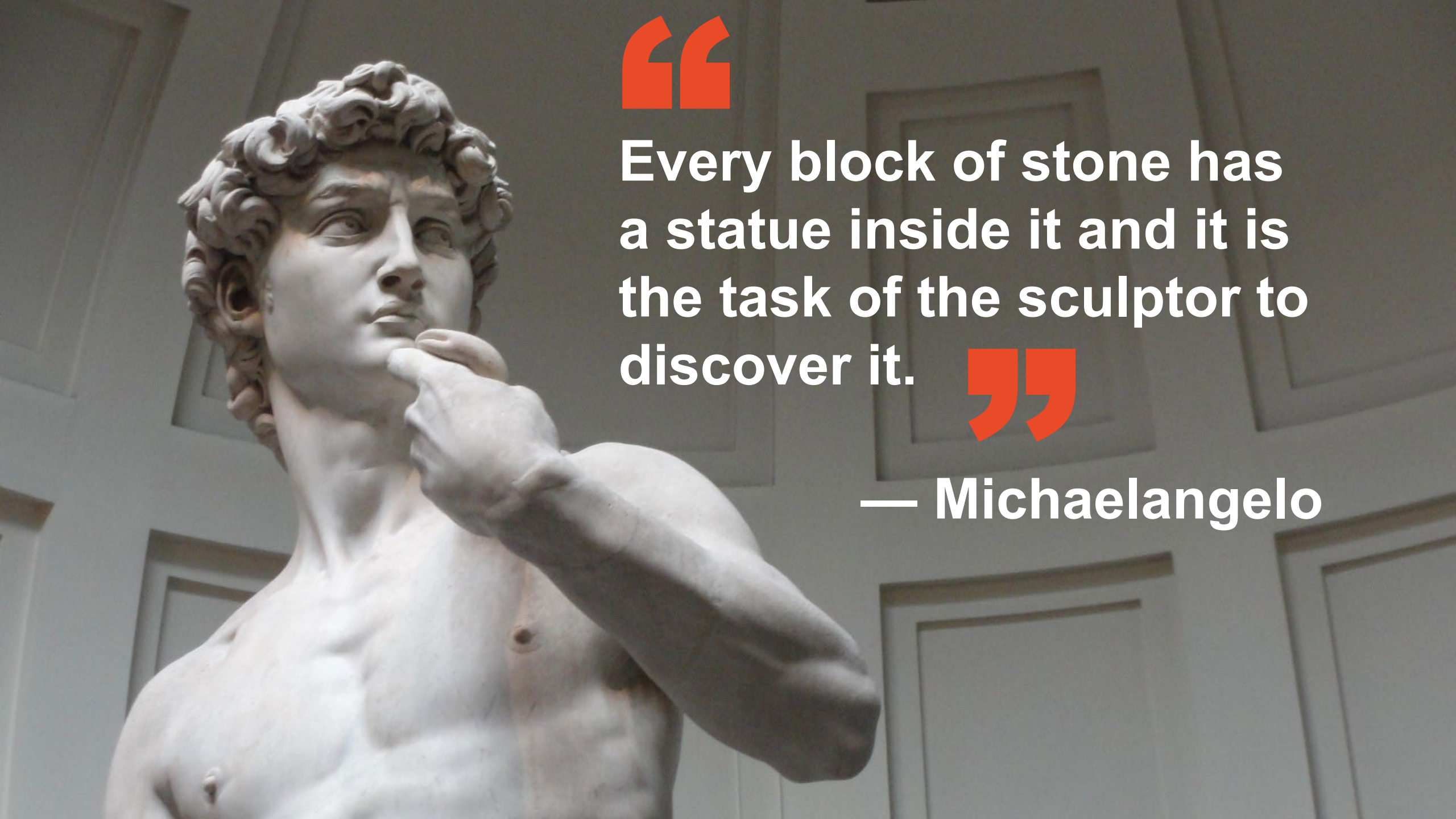
This book, by the data visualization expert and the creator of flowingdata.com Nathan Yau, presents a unique approach to visualizing and telling stories with data.

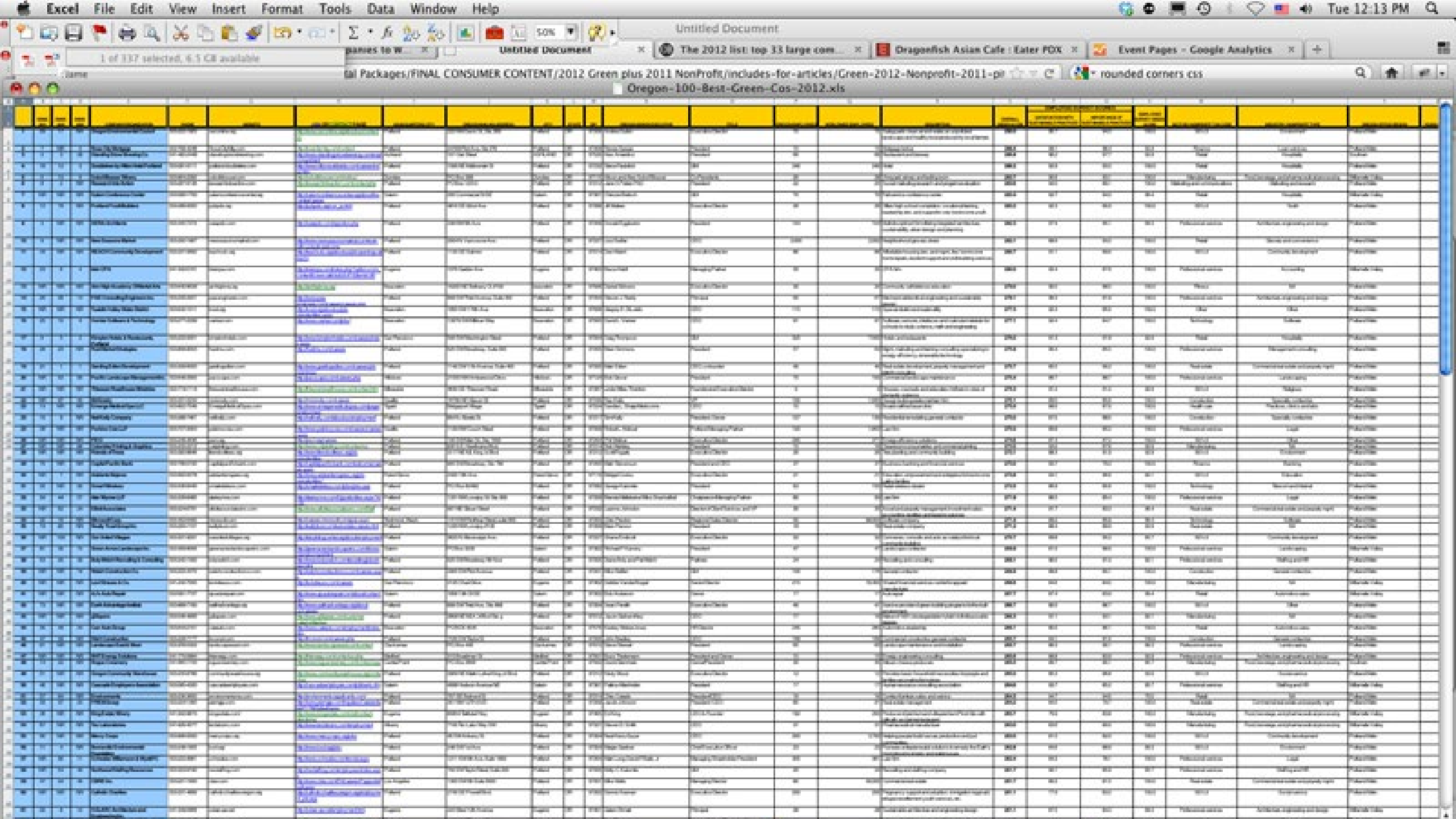
The book offers step-by-step tutorials and practical design tips for creating statistical graphics, geographical maps, and information design to find meaning in the numbers.

It details tools that can be used to visualize data-native graphics for the web—such as ActionScript, Flash libraries, PHP, and JavaScript—and tools to design graphics for print, such as R and Illustrator.

It contains numerous examples and descriptions of patterns and outliers and explains how to show them.

A Centering Thought …


“Every block of stone has a statue inside it and it is the task of the sculptor to discover it.”
— Michaelangelo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Visualization is hard. I've written books, created software, directed films in my career, but visualization is by far the most challenging discipline I've ever engaged with. It's something about the precision needed at every level, I think. Concept, data, story, design, style—all are precision arts. In visualization, they're stacked one on top of the other. If one sags or slips, the entire edifice can collapse.

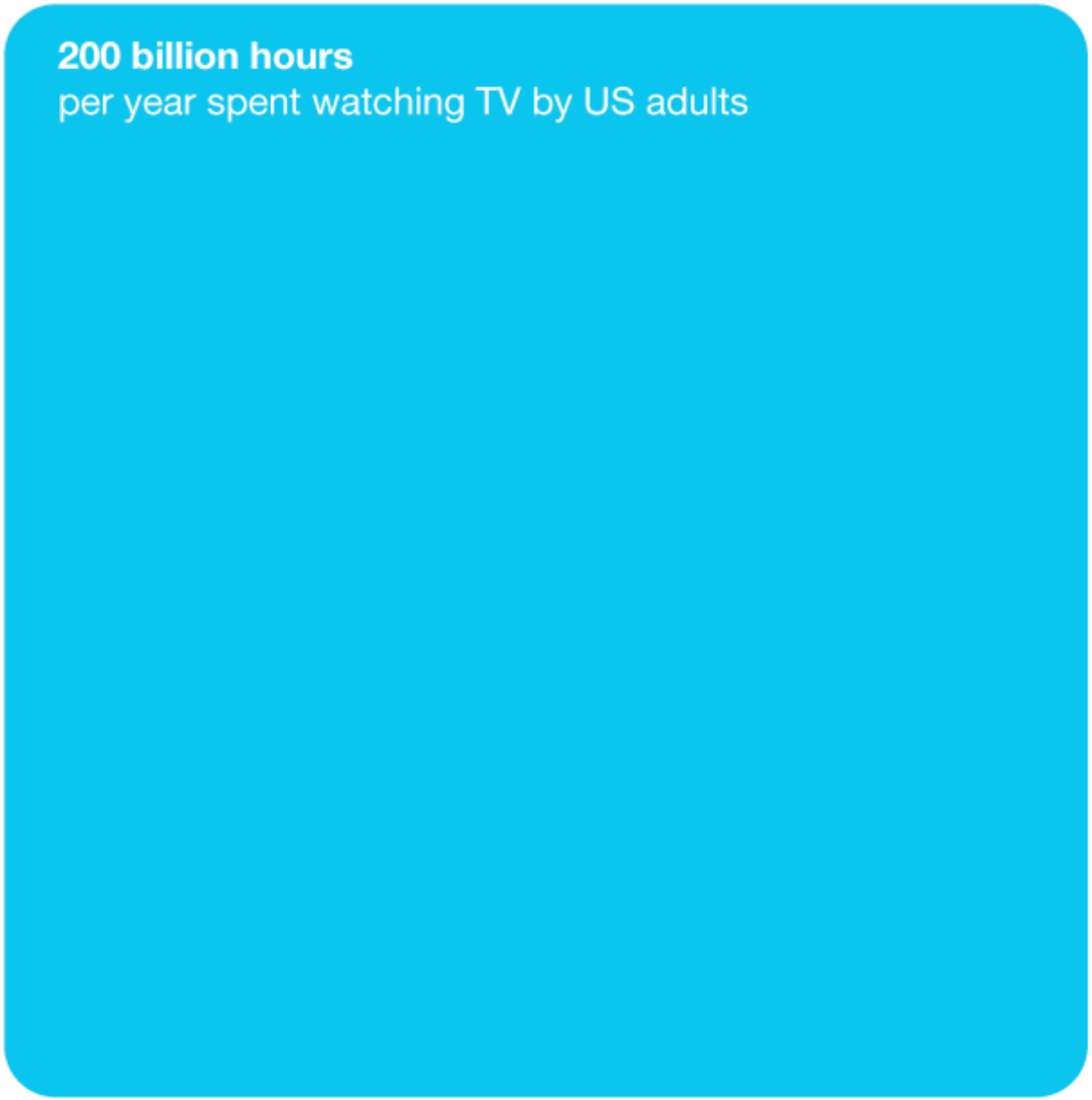
— David McCandless

200 billion hours
per year spent watching TV by US adults

Source: David McCandless

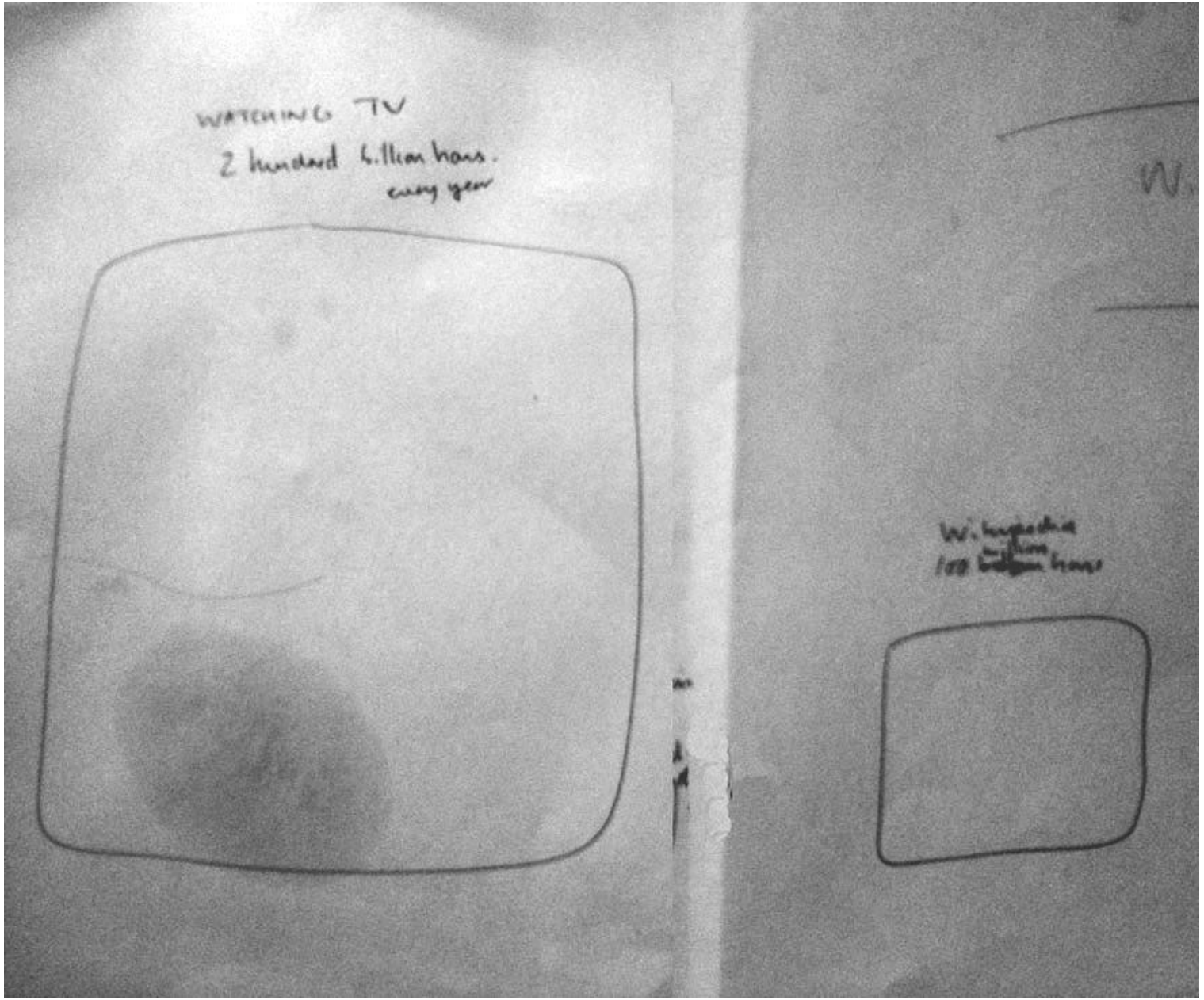
200 billion hours
per year spent watching TV by US adults

Source: David McCandless



100 million hours
to create Wikipedia

Source: David McCandless



Source: David McCandless

In This Module

Module 1: Pictures You See with Your Brain

Key Concepts

Studying the history of dataviz

Understanding today's dataviz tools

Making connections with visuals

Evaluating the effectiveness of dataviz

References

Berinato, S. (2016). *Good Charts: The HBR Guide to Making Smarter, More Persuasive Data Visualizations*. Brighton, MA: Harvard Business Review Press

McCandless, D. (2010). *Cognitive Surplus Vsualized* [Online image]

McCandless, D. (2014). *Knowledge Is Beautiful: Impossible Ideas, Invisible Patterns, Hidden Connections—Visualized*. New York, NY: Harper Design

Wong, D. M. (2013). *The Wall Street Journal Guide to Information Graphics: The Dos and Don'ts of Presenting Data, Facts, and Figures*. New York, NY: W. W. Norton & Company

Yau, N. (2011). *Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics*. Hoboken, NJ: Wiley

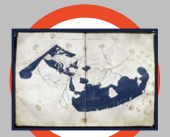
Module 1 Lesson 1

Studying the History of Dataviz

Studying the History of Dataviz

Dataviz has a long history, starting with mapmaking and fanning into statistics, politics, medicine, and other fields

1



Pre-1600

The earliest seeds of visualization arose in geometric diagrams, in tables of the positions of stars and other celestial bodies, and in the making of maps to aid in navigation and exploration

3

1700s

The 18th century witnessed the germination of the seeds of visualization as mapmakers began to show more than just geographical position and, as a result, many new graphic forms were introduced

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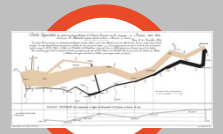


1850–1899

The late 1800s, which started as the "age of enthusiasm" in graphics, may be called the golden age of data visualization with pieces of unparalleled beauty and many graphical innovations

7

1950–1974

Still under the influence of the formal and numerical zeitgeist from the mid-1930s on, data visualization began to rise from dormancy in the mid-1960s, spurred largely by technology and data democratization

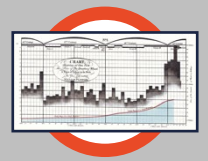
6200 BC | 1600 | 1700 | 1800 | 1900 | Today

2

1600s

This century saw great growth in theory and the rise of analytic geometry, theories of measurement and estimation, probability, and the beginnings of demographic statistics and "political arithmetic"

4



1800–1849

With the fertilization of design and technique innovations, the first half of the 19th century witnessed growth in statistical graphics and thematic mapping at a rate not equaled until modern times

6

1900–1949

If the late 1800s were the golden age of visualization, the early 1900s were the "modern Dark Ages," as the pervious period's enthusiasm was supplanted by the rise of quantification and formality

8

1975–today

The development of highly interactive computer systems and new methods for visualizing high-dimensional data has ushered in a dataviz renaissance period limited only by human imagination

Source: Adapted from Friendly and Denis, http://datavis.ca/milestones/

A **6200 BC:** Town map, with an erupting volcano (Hasan Daö?) and the Konya Plain, possibly the first map created

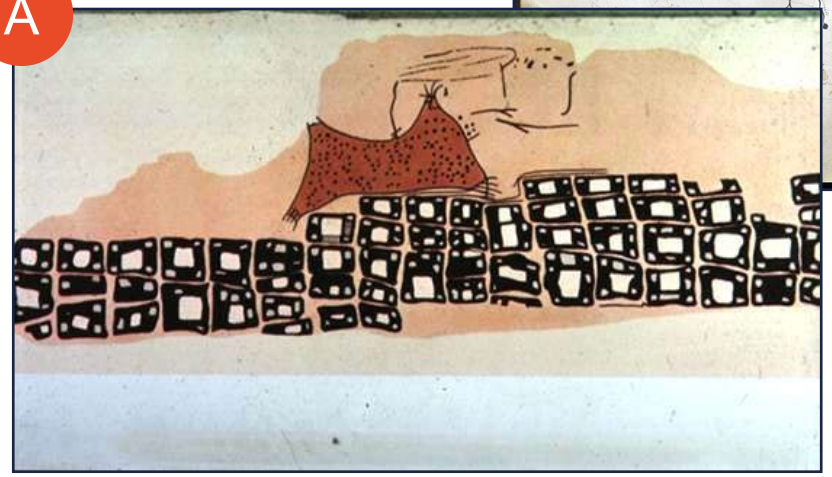
B **150:** Ptolemy's world map

C **1375:** Catalan Atlas

Epoch I: Early Maps And Diagrams (Pre-1600)

B

A



C

Source: Adapted from Friendly and Denis, http://datavis.ca/milestones/

A **1626:** Christopher Schooner's visual representations used to chart the changes in sunspots over time

B **1644:** Michael F. van Langren; variations in determination of longitude between Toledo and Rome

C **1669:** Christiaan Huygens; first graph of a continuous distribution function, a graph of Gaunt's life table

Epoch II: Measurement and Theory (1600s)

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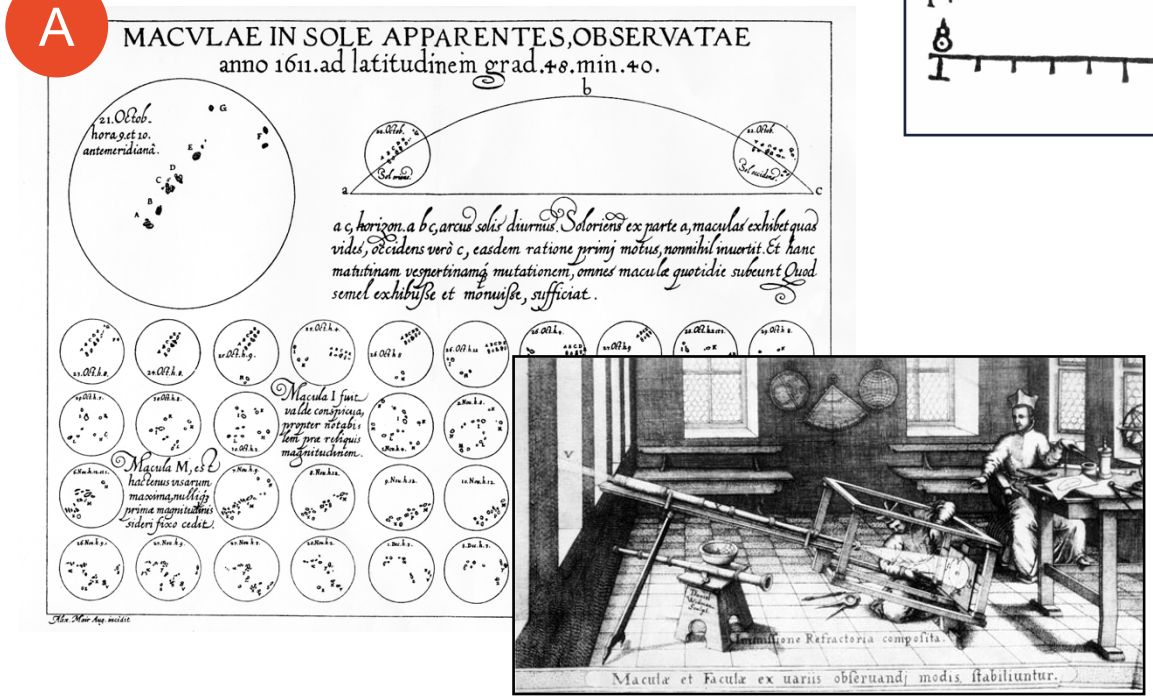

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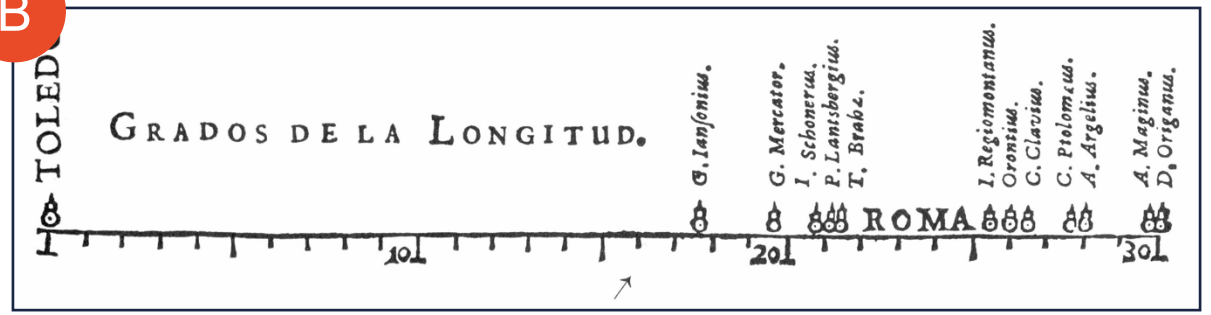

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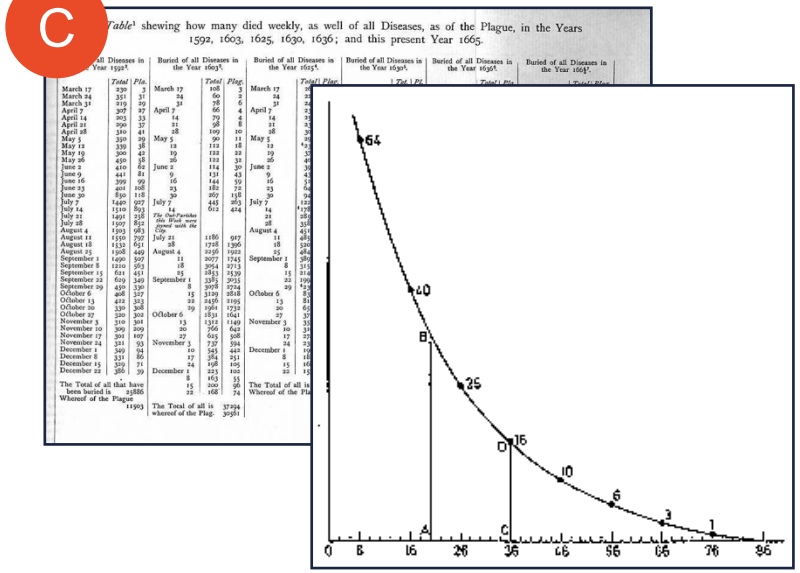


Source: Adapted from Friendly and Denis, http://datavis.ca/milestones/

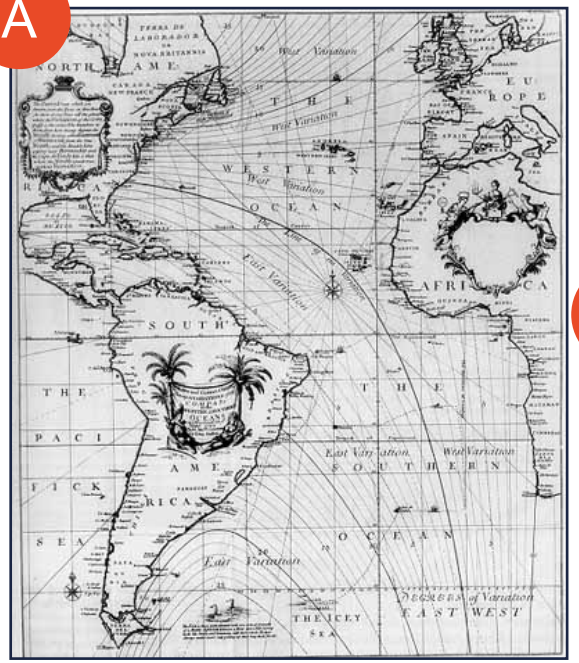
A **1701:** Edmond Halley; contour maps showing curves of equal value (an isogonic map, lines of equal magnetic declination for the world, possibly the first contour map of a data-based variable)

B **1765:** Joseph Priestley; life spans of 2,000 famous people, 1200 B.C. to 1750 A.D., quantitative comparison by means of bars

C **1782:** Charles de Fourcroyde; use of geometric, proportional figures (squares) to compare demographic quantities by superposition, an early "tableau graphique"

Epoch III: New Graphic Forms (1700s)

A



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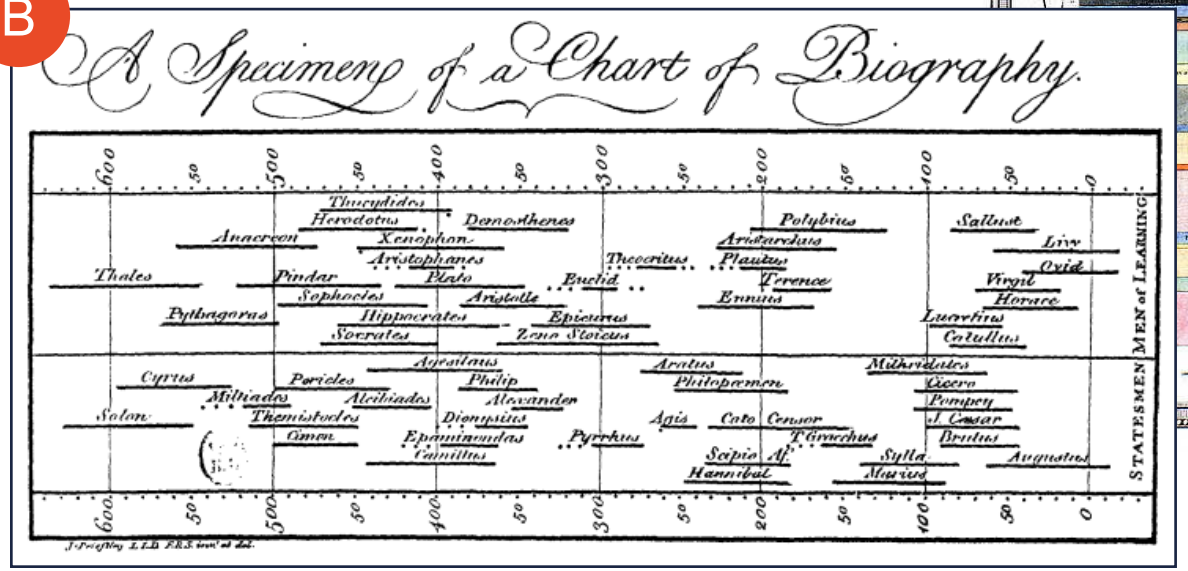

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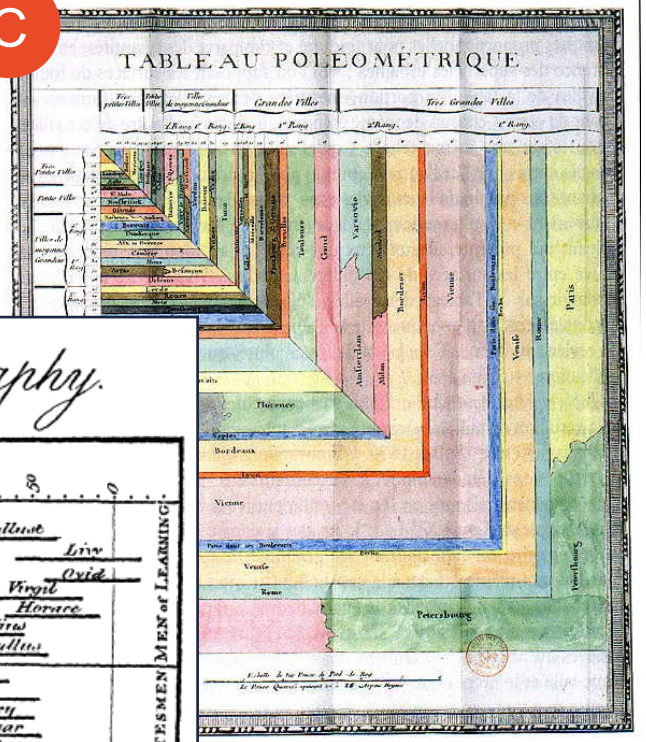


Source: Adapted from Friendly and Denis, http://datavis.ca/milestones/

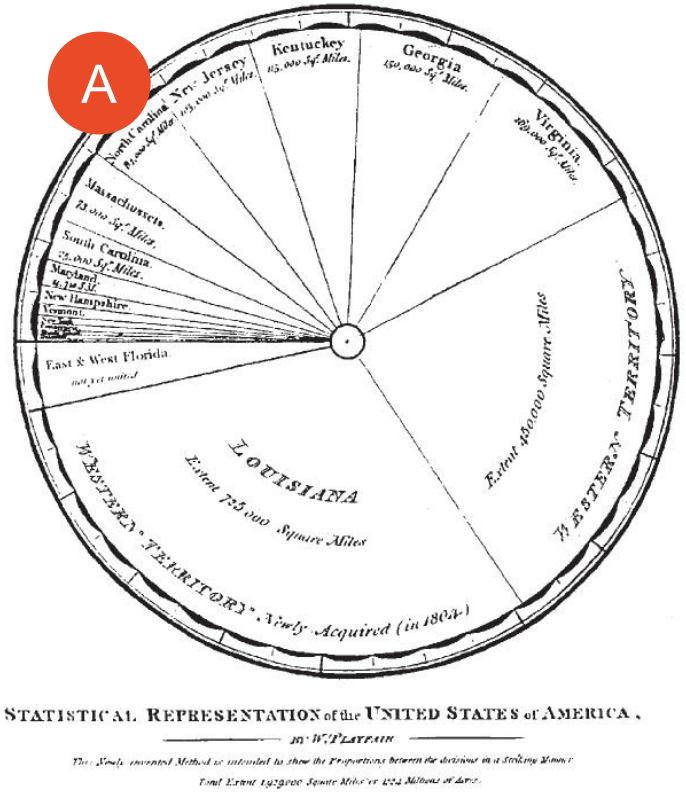
A **1801:** William Playfair; invention of the pie chart and circle graph, used to show part-whole relations

B **1821:** Playfair; time series graph of prices, wages, and ruling monarch

C **1830:** Armand Joseph Frere de Montizon; first simple dot map of population, 1 dot = 10,000 people

Epoch IV: Beginnings of Modern Graphics (1800–1849)

A



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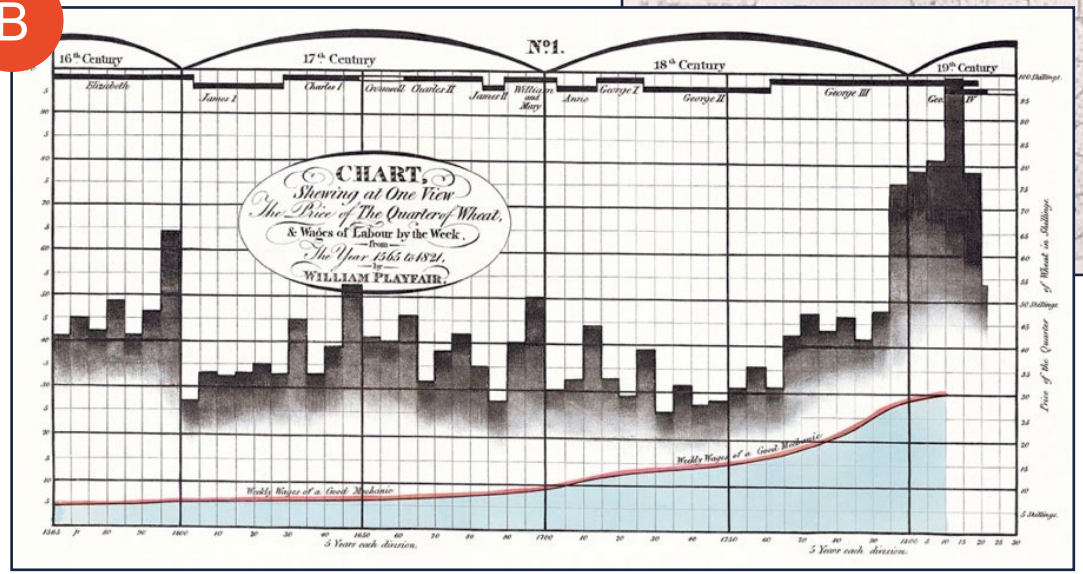

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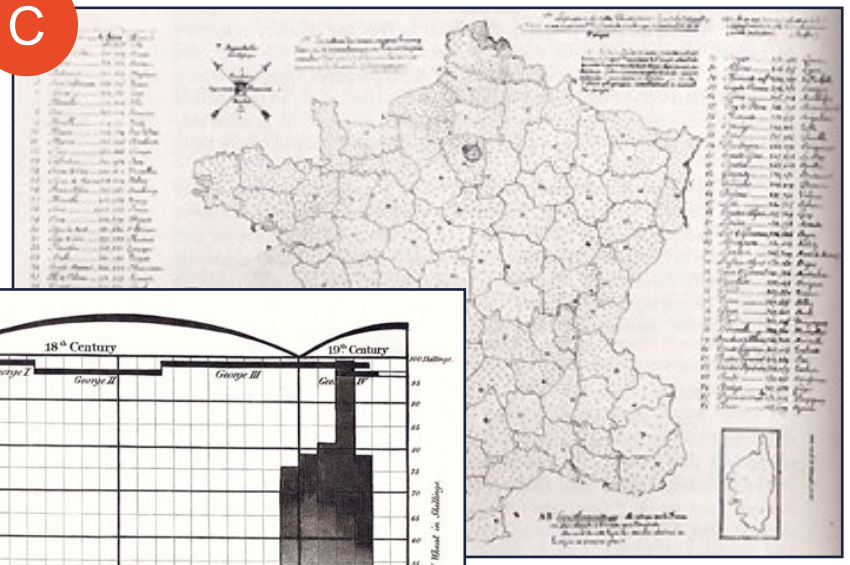


Source: Adapted from Friendly and Denis, http://datavis.ca/milestones/

A **1855:** John Snow; use of a dot map to display epidemiological data leads to discovery of the source of a cholera epidemic

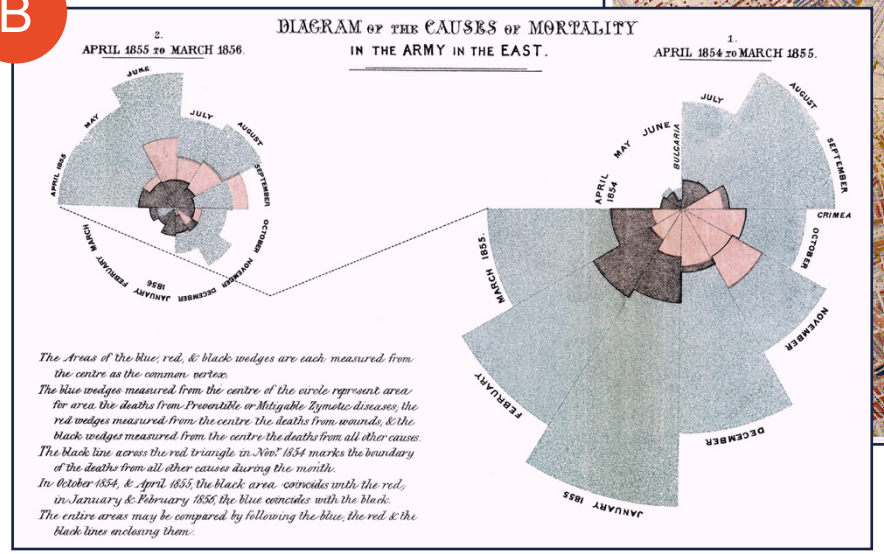
B **1857:** Florence Nightengale; polar area charts, known as "coxcombs," used in a campaign to improve sanitary conditions in the army

C **1889:** Charles Booth; street maps of London showing poverty and wealth by color, transforming existing methods of social survey toward the end of the 19th century

Epoch V: The Golden Age of Data Analytics (1850–1899)

A

B



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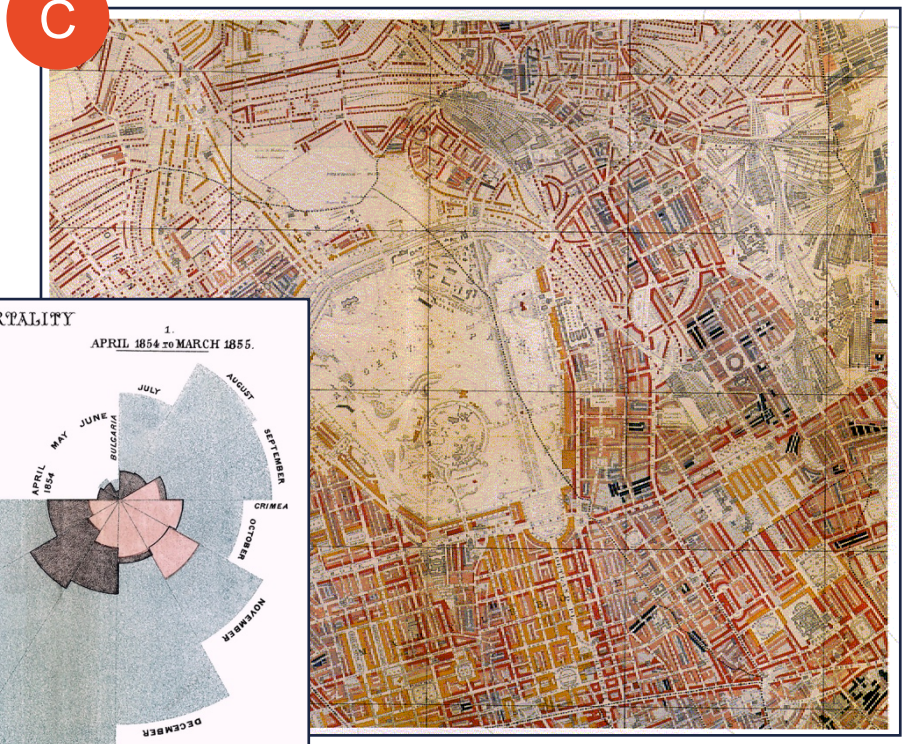
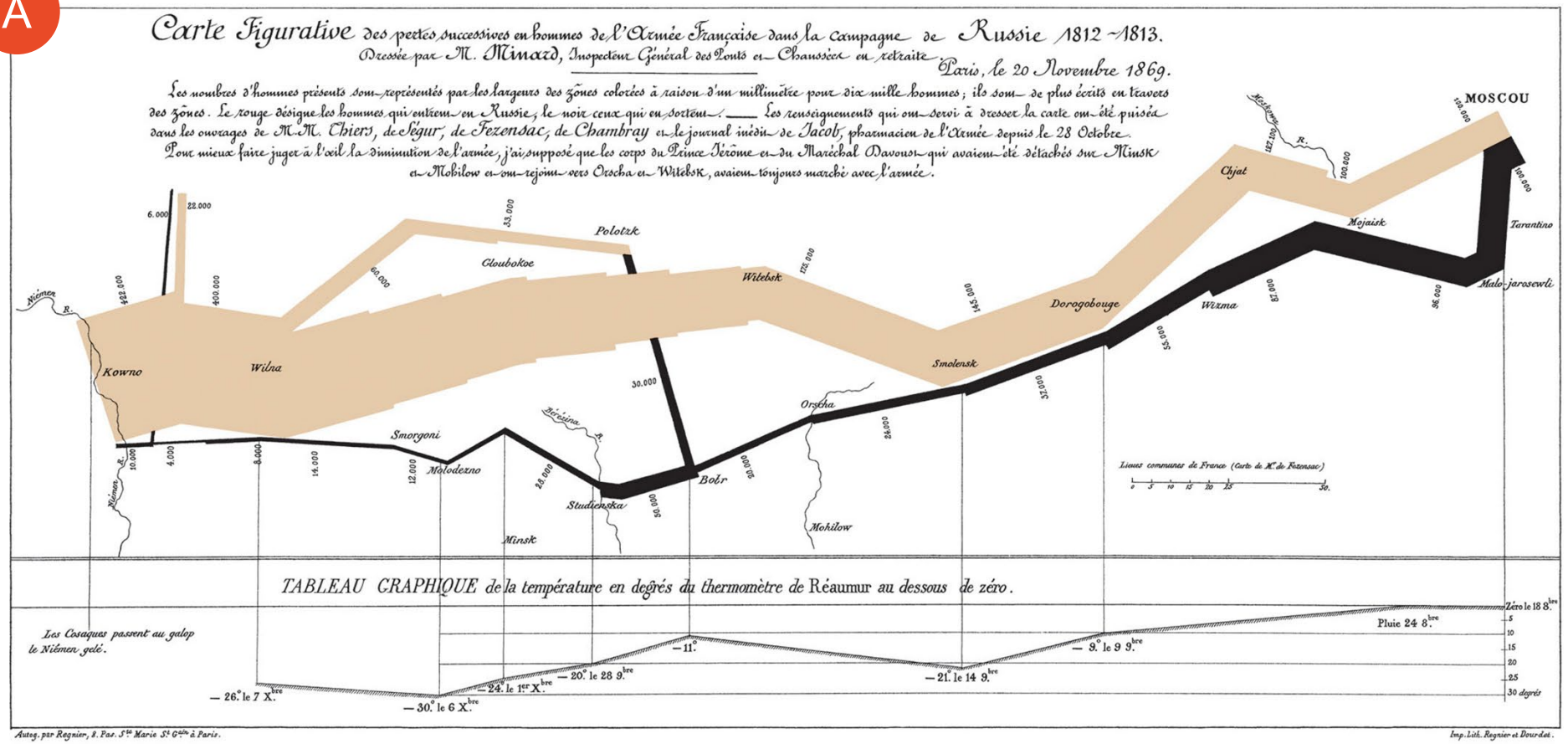


Source: Adapted from Friendly and Denis, http://datavis.ca/milestones/

A **1869:** Charles Joseph Minard; flow map of Napoleon's March on Moscow frequently called the best graphic ever produced. The illustration depicts Napoleon's army departing the Polish-Russian border bound for Moscow. A thick band illustrates the size of his army at specific geographic points during its advance and retreat. It displays six types of data in two dimensions: the number of Napoleon's troops, the distance traveled, temperature, latitude and longitude, direction of travel, and location relative to specific dates.

Epoch V: The Golden Age of Data Analytics (1850–1899)

A



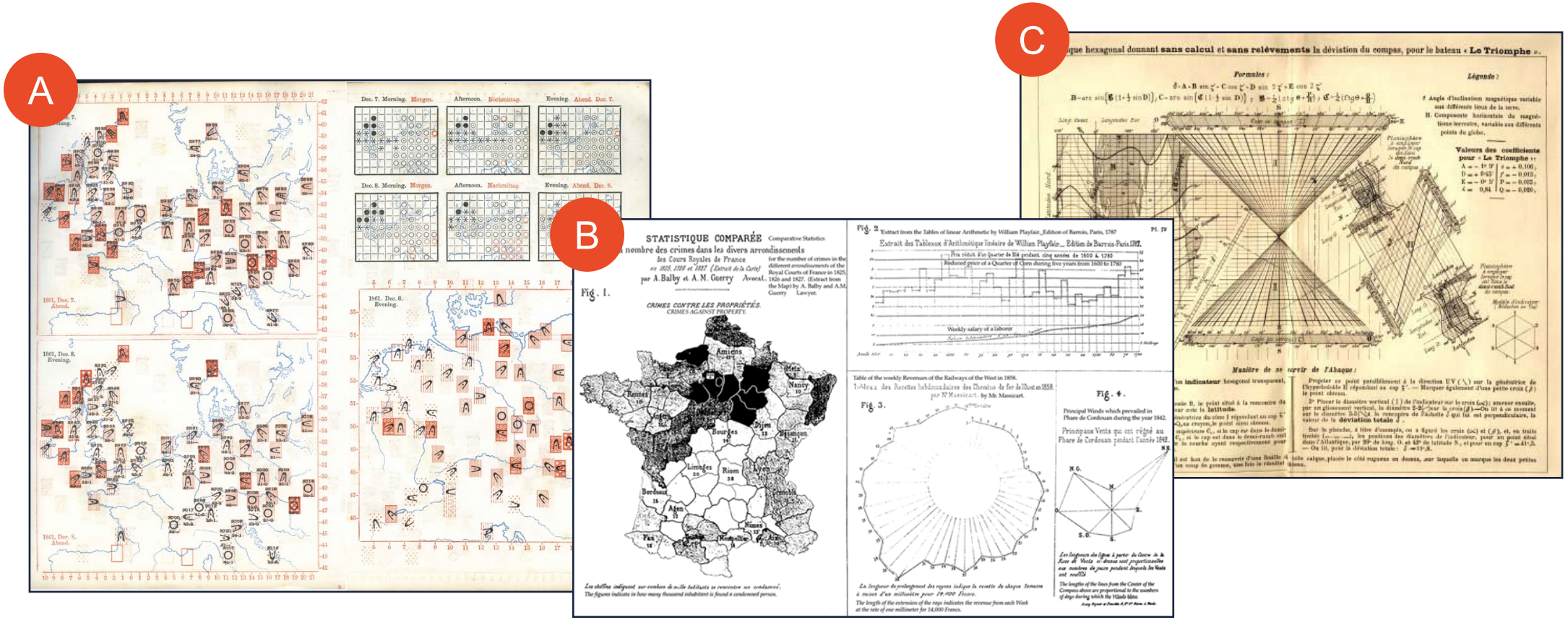
Source: Adapted from Friendly and Denis, http://datavis.ca/milestones/

A **1861:** Francis Galton; the modern weather map, a chart showing area of similar air pressure and barometric changes by means of glyphs displayed on a map

B **1885:** Émile Levasseur; review of all available statistical graphics presented to the Statistical Society of London, classified as figures, maps, and solids

C **1885:** Charles Lallemand; combination of many variables into multifunction nomograms using 3D, juxtaposition of maps, parallel coordinate and grids

Epoch V: The Golden Age of Data Analytics (1850–1899)



Source: Adapted from Friendly and Denis, http://datavis.ca/milestones/

A **1914:** Willard Cope Brinton; pictograms representing a series of numbers by icons (combining concepts of the bar graph and pictogram of varying sizes)

B **1924:** Otto Neurath; introduction of the ISOTYPE standard (International System of Typographic Picture Education)

C **1932:** N.J. Washburn; spate of articles on experimental tests of statistical graphical forms

Epoch VI: The Modern Dark Age of Data Analytics (1900–1949)

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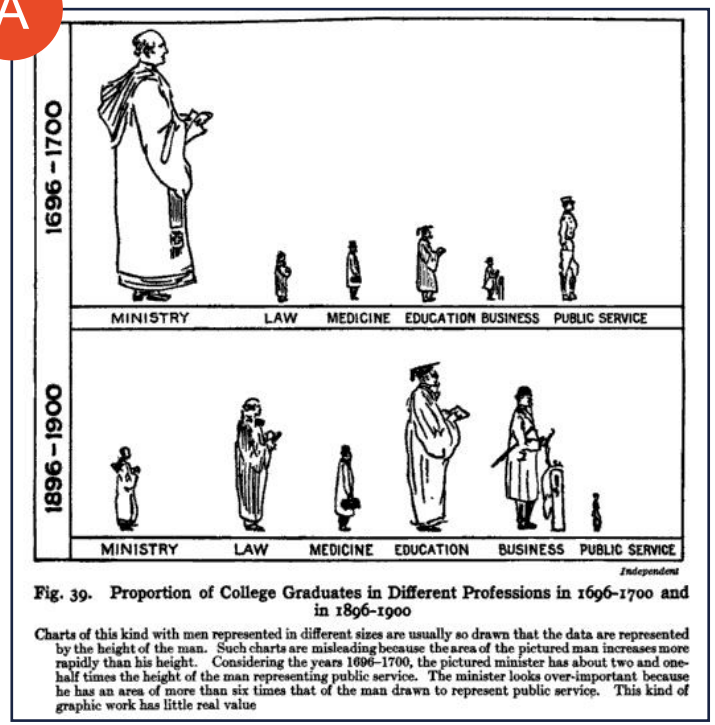
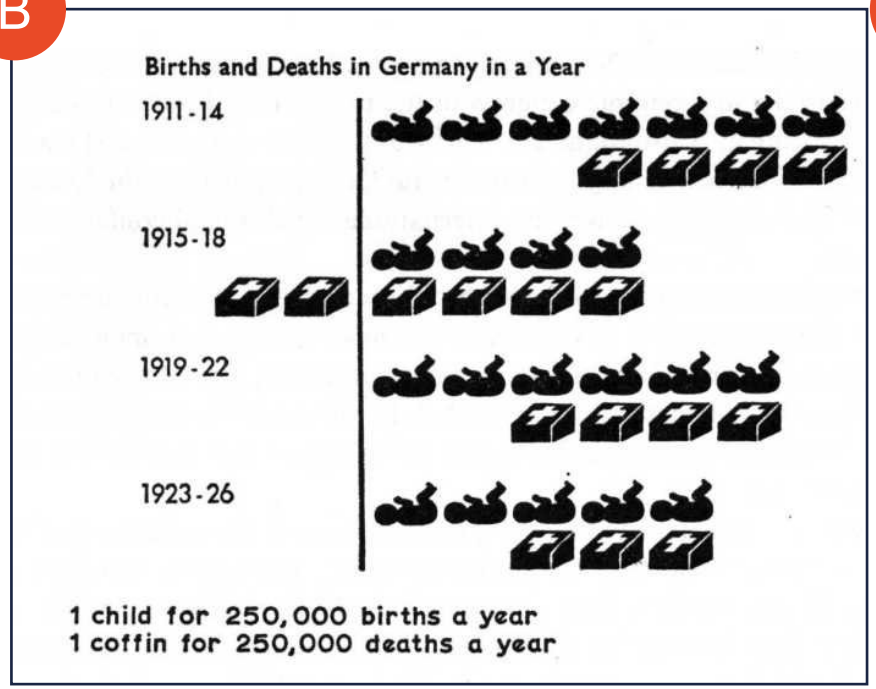


Fig. 39. Proportion of College Graduates in Different Professions in 1696-1700 and in 1896-1900

Charts of this kind with men represented in different sizes are usually so drawn that the data are represented by the height of the man. Such charts are misleading because the area of the pictured man increases more rapidly than his height. Considering the years 1696–1700, the pictured minister has about two and one-half times the height of the man representing public service. The minister looks over-important because he has an area of more than six times that of the man drawn to represent public service. This kind of graphic work has little real value

B



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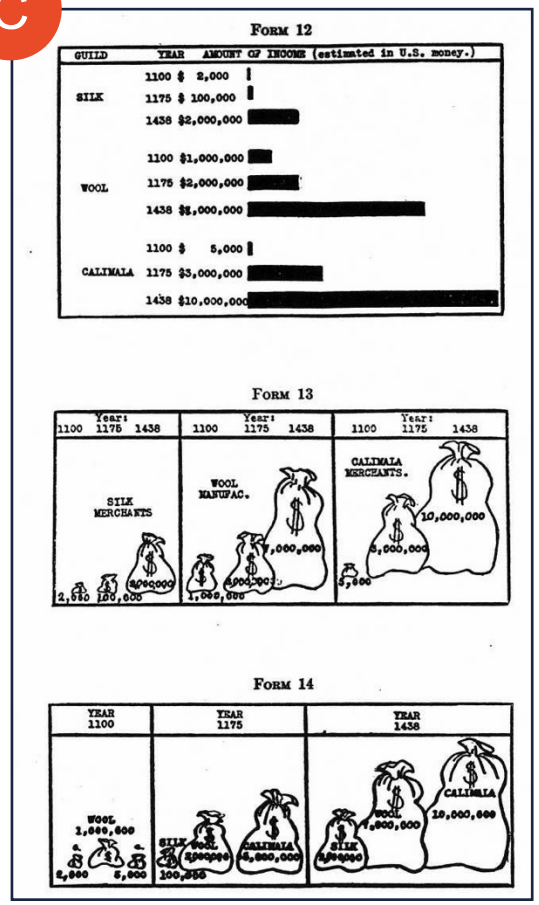
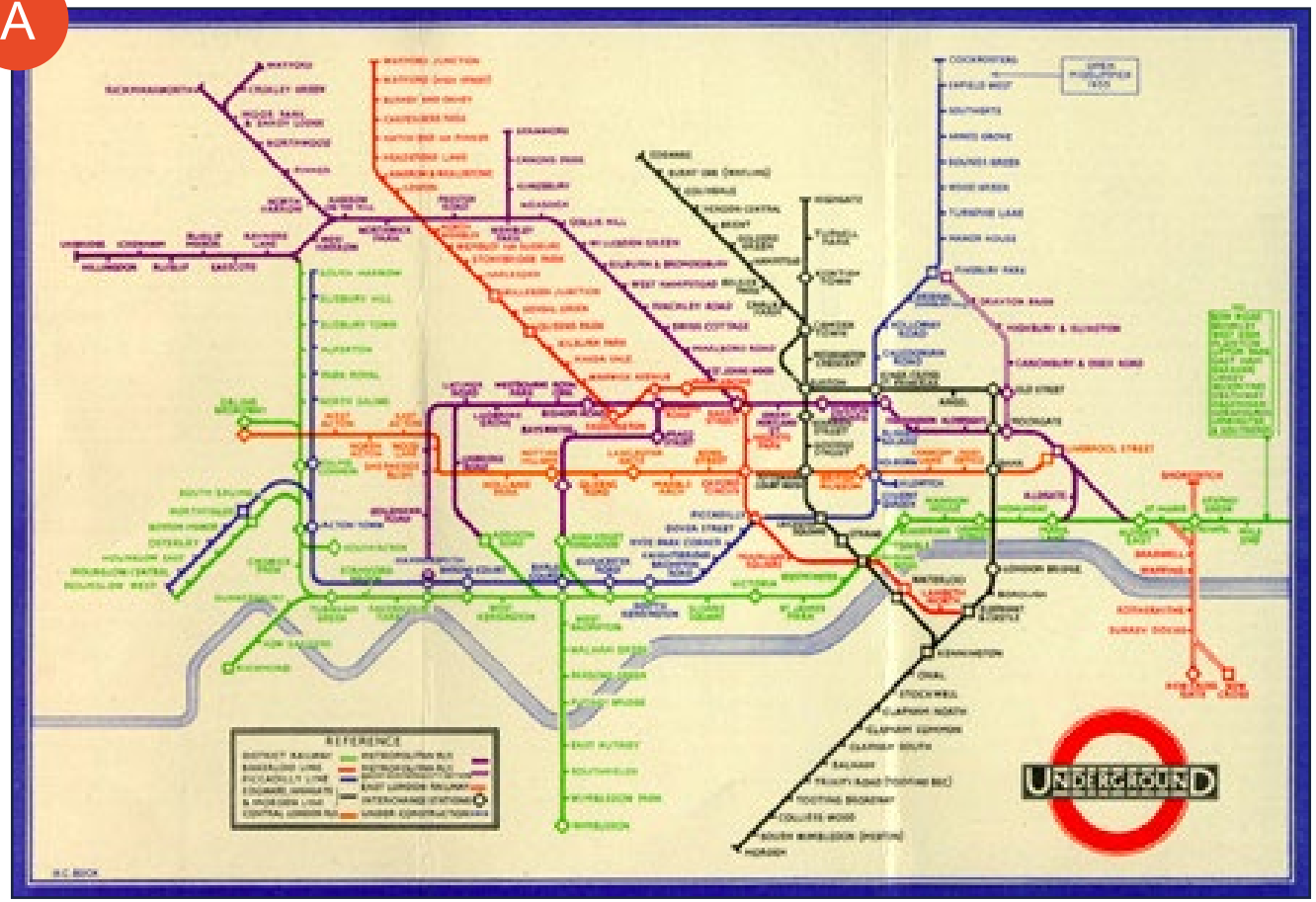


Source: Adapted from Friendly and Denis, http://datavis.ca/milestones/

A **1933:** Henry Beck, an engineering draughtsman, designed a map like an electrical circuit board, using only vertical, horizontal and 45-degree angled lines. He located stations according to available space. The resulting map was geographically inaccurate but easier to use to determine how to get from point A to point B. Beck's idea was soon copied by most subway (and bus) companies around the world.

Epoch VI: The Modern Dark Age of Data Analytics (1900–1949)

A

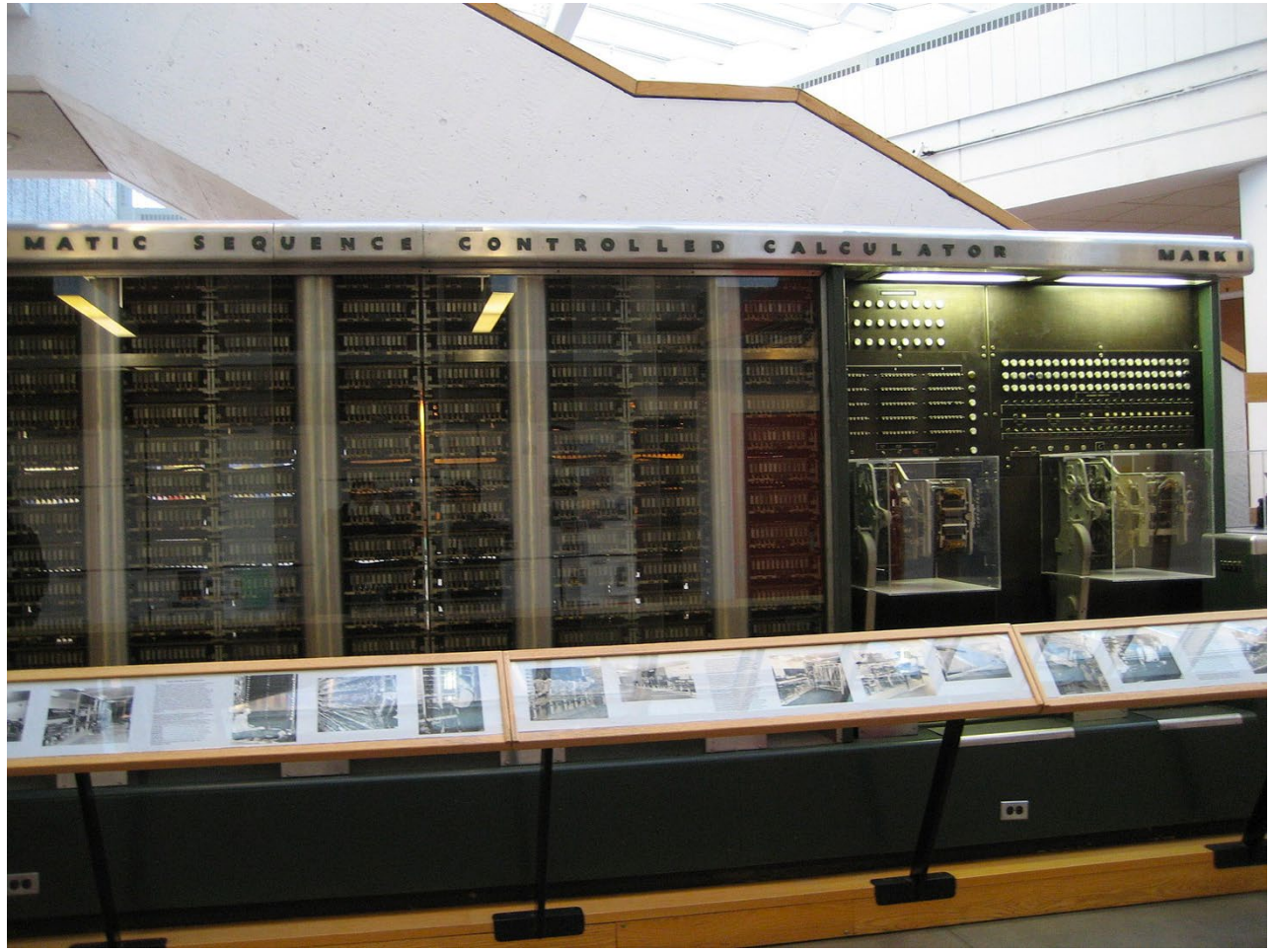


Source: Adapted from Friendly and Denis, http://datavis.ca/milestones/

A **1944:** Harvard's Mark I, the first digital computer put in service. Known as the IBM Automatic Sequence Controlled Calculator' (ASCC), it was 50 feet long and weighed about 5 tons. The machine could perform all four arithmetic operations; moreover, it had special built-in programs to handle logarithms and trigonometric functions. It was slow, requiring 3 to 5 seconds for a multiplication, but it was fully automatic and could complete long computations without human intervention.

Epoch VI: The Modern Dark Age of Data Analytics (1900–1949)

A



Source: Adapted from Friendly and Denis, http://datavis.ca/milestones/

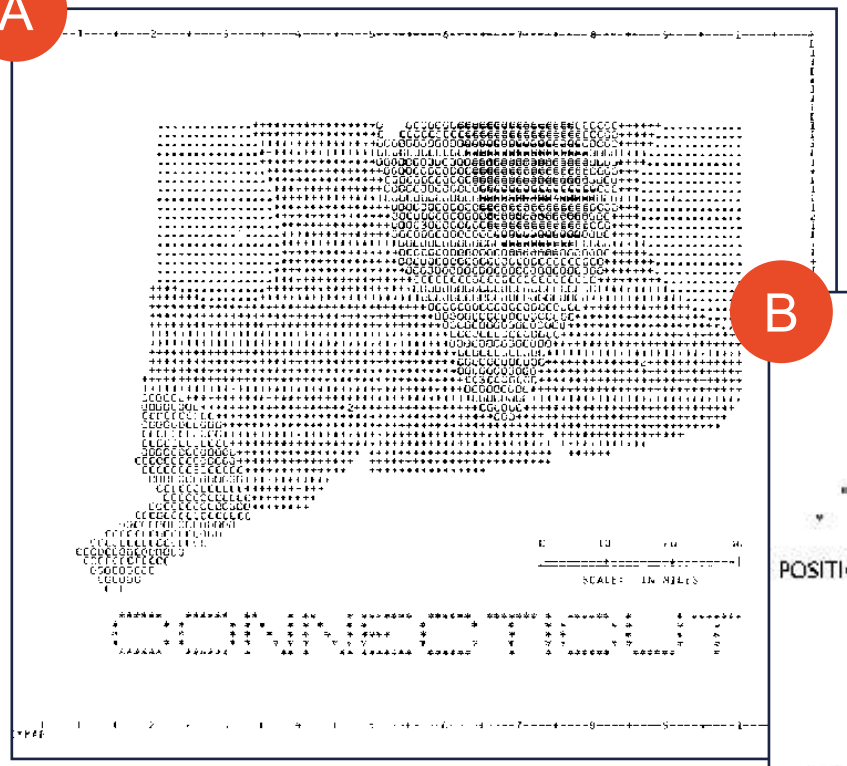
A **1960:** Howard Taylor Fisher; initial development of geographic information systems, combining spatially-referenced data, spatial models, and map-based visualization

B **1967:** Jacques Bertin; comprehensive theory of graphical symbols and modes of graphics representation

C **1974:** US Census Bureau; color-coded bivariate matrix to represent two variables in a single map

Epoch VII: The Rebirth of Data Analytics (1950–1974)

A



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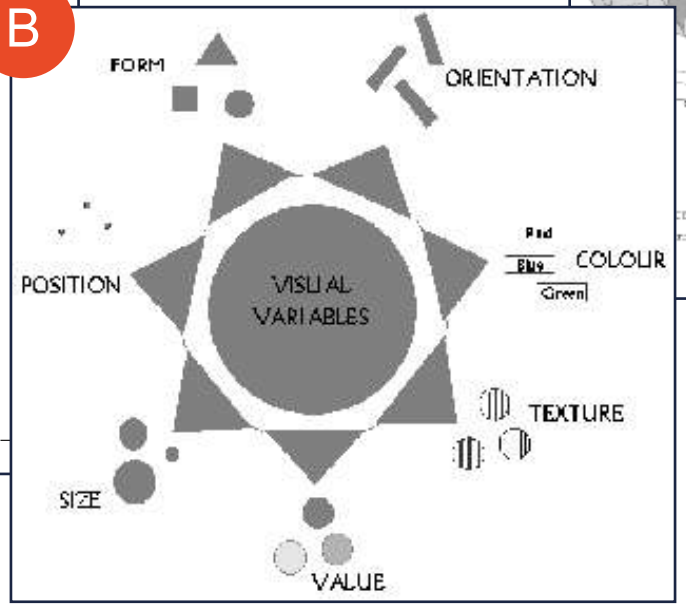
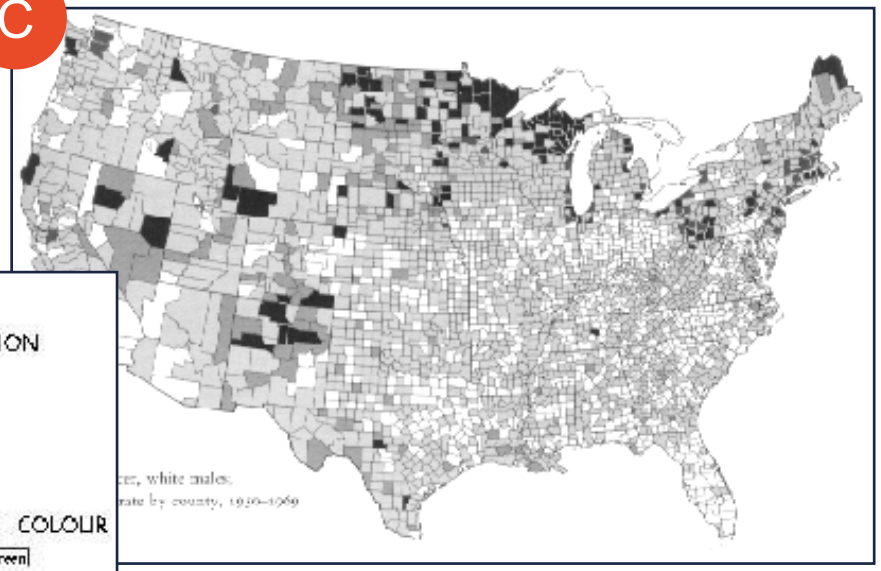


C



Source: Adapted from Friendly and Denis, http://datavis.ca/milestones/

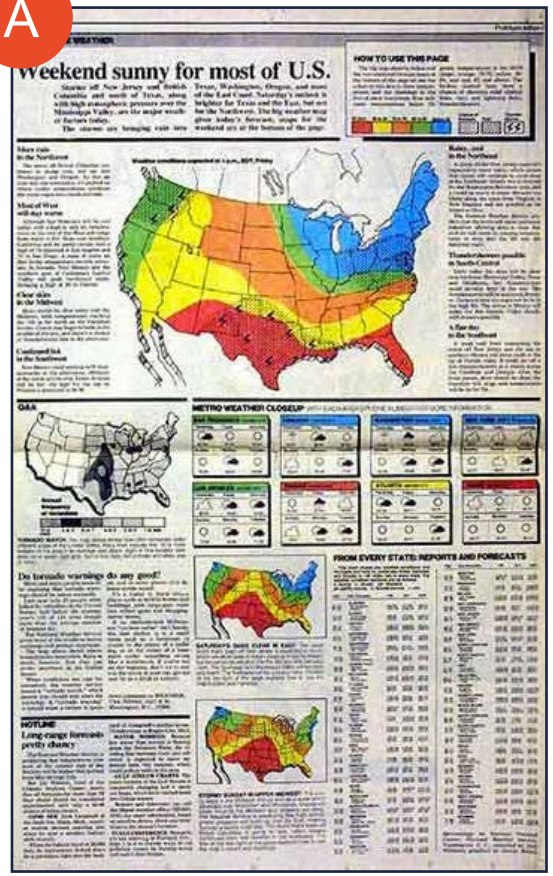
A **1982:** The *USA Today* color weather map begins an era of color information graphics in newspapers

B **2006:** Hans Rosling; 'the moving bubble chart' in the form of Trendalyzer software

C **2006:** Hadley Wickham; an influential, open-source implementation of the Grammar of Graphics from Wilkinson in R (ggplot2)

Epoch VIII: High-Definition Data Analytics (1975–today)

A



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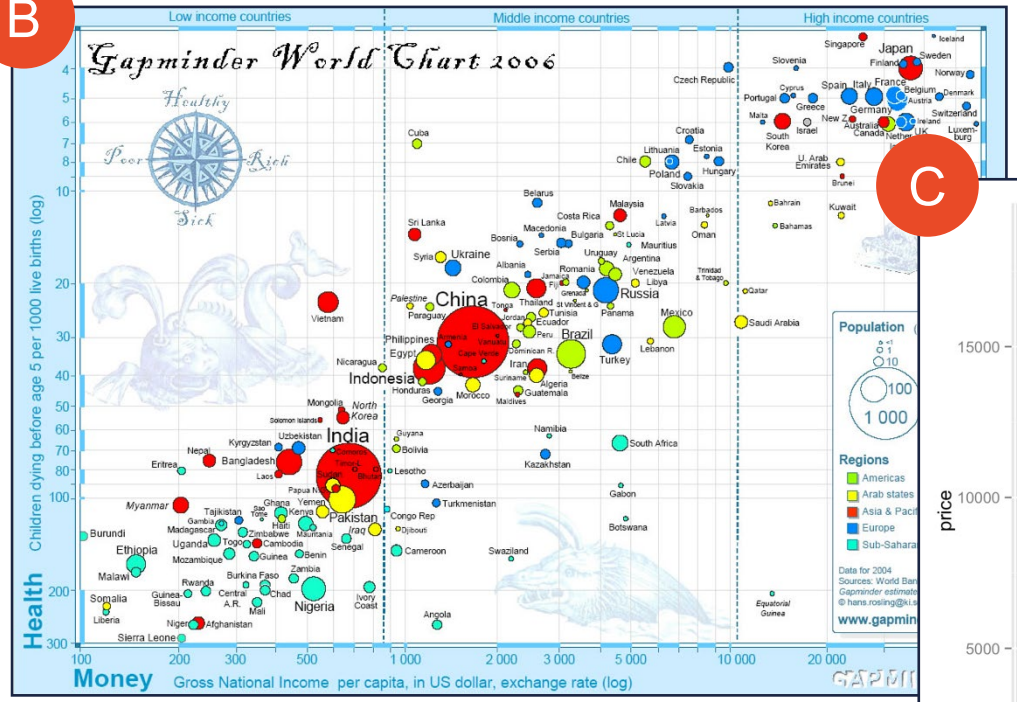

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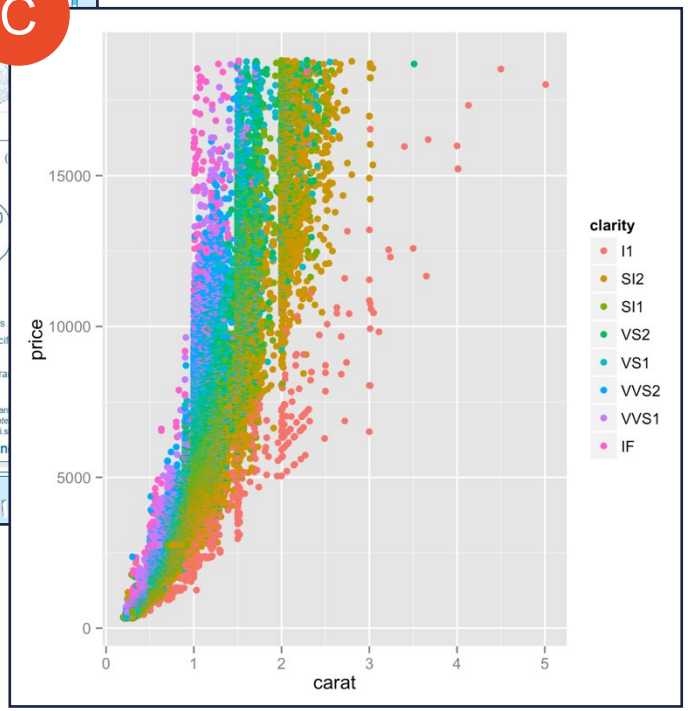

Source: Adapted from Friendly and Denis, http://datavis.ca/milestones/

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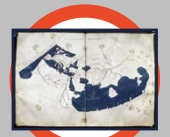


Pre-1600

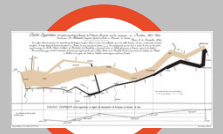
The earliest seeds of visualization arose in geometric diagrams, in tables of the positions of stars and other celestial bodies, and in the making of maps to aid in navigation and exploration

3

1700s

The 18th century witnessed the germination of the seeds of visualization as mapmakers began to show more than just geographical position and, as a result, many new graphic forms were introduced

5



1850–1899

The late 1800s, which started as the "age of enthusiasm" in graphics, may be called the golden age of data visualization with pieces of unparalleled beauty and many graphical innovations

7

1950–1974

Still under the influence of the formal and numerical zeitgeist from the mid-1930s on, data visualization began to rise from dormancy in the mid-1960s, spurred largely by technology and data democratization

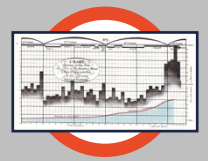
6200 BC | 1600 | 1700 | 1800 | 1900 | Today

2

1600s

This century saw great growth in theory and the rise of analytic geometry, theories of measurement and estimation, probability, and the beginnings of demographic statistics and "political arithmetic"

4



1800–1849

With the fertilization of design and technique innovations, the first half of the 19th century witnessed growth in statistical graphics and thematic mapping at a rate not equaled until modern times

6

1900–1949

If the late 1800s were the golden age of visualization, the early 1900s were the "modern Dark Ages," as the pervious period's enthusiasm was supplanted by the rise of quantification and formality

8

1975–today

The development of highly interactive computer systems and new methods for visualizing high-dimensional data has ushered in a dataviz renaissance period limited only by human imagination

Source: Adapted from Friendly and Denis, http://datavis.ca/milestones/

Studying the History of Dataviz Can Inspire and Inform

Eight distinct epochs trace the long, rich history of data visualization

Dataviz has evolved from hand-painted maps into sophisticated computer-generated visuals

Over time, the practice of data visualization has confronted issues of data scarcity, human politics, data misuse, and the scourge of clip art

Dataviz has emerged as a discipline that offers the ultimate blend of art and science

References

Friendly, M., & Denis, D. J. (2001). *Milestones in the history of thematic cartography, statistical graphics, and data visualization* [Web document].

Module 1 Lesson 2

Understanding Today's Dataviz Tools

Understanding Today's Dataviz Tools

Dataviz tools represent an evolution in analytics that can best be described along two important dimensions

Dataviz Tools Can Be Defined by Two Dimensions

Ease of use

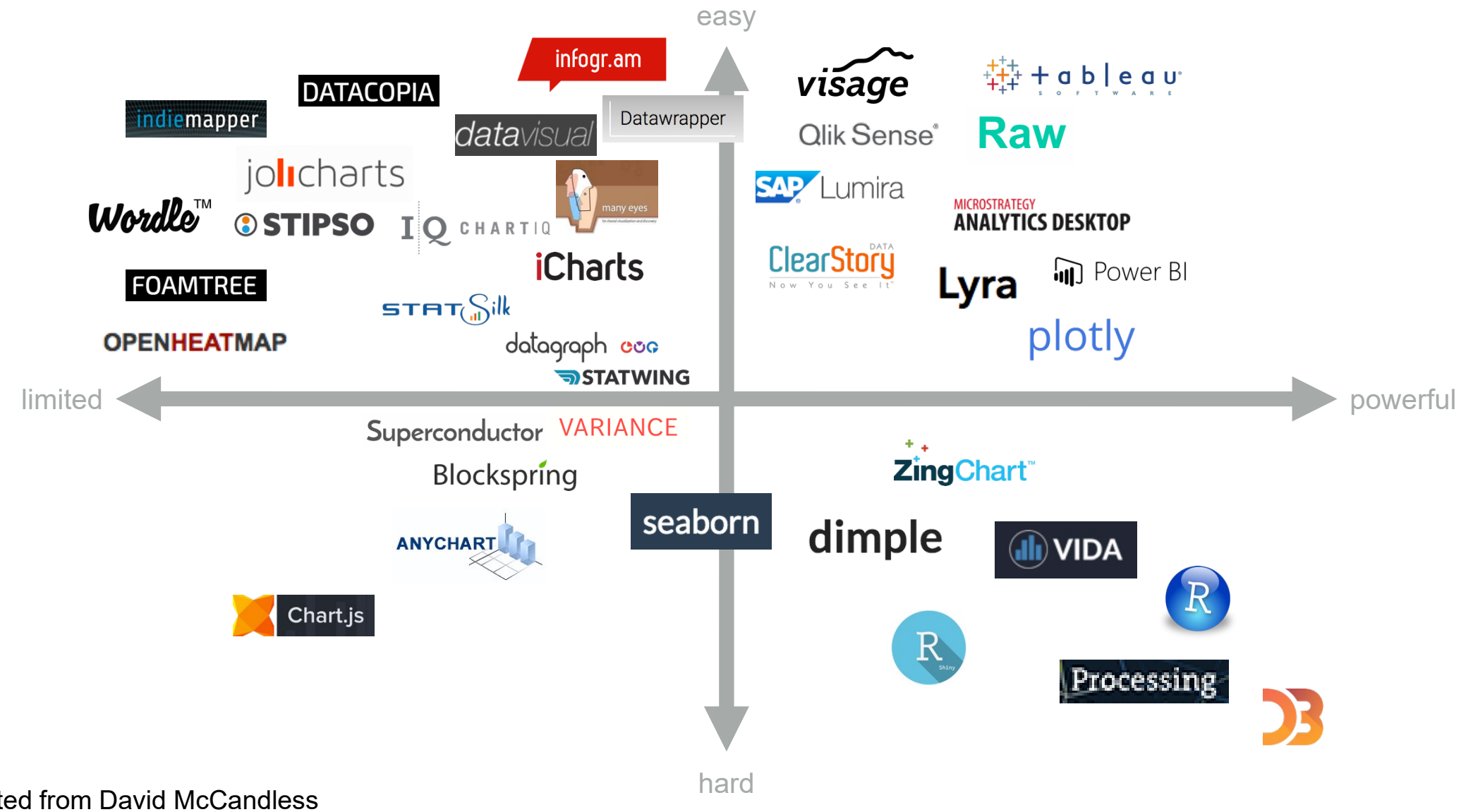
How quickly can one reasonably expect to learn the tool? How intuitive is it? What special skills does it require?

Capability

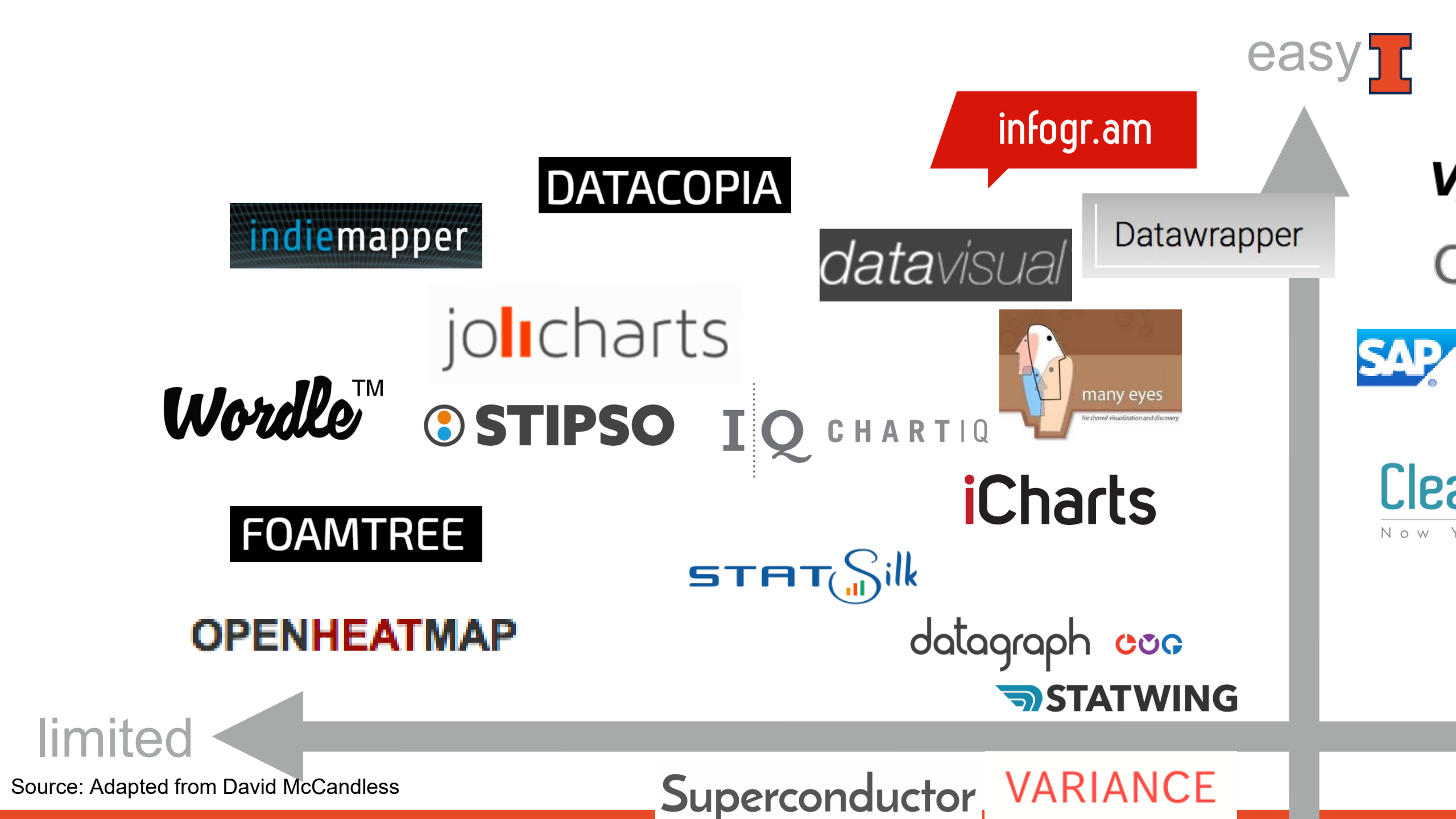
What is the breadth of the tool's functionality? How flexible is it? How much data can the tool effectively manage?

THE DATA VISUALIZATION TOOL MARKET

An analysis of ease of use and capability



Source: Adapted from David McCandless



Source: Adapted from David McCandless

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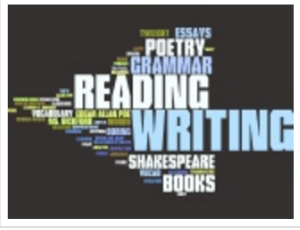
Wordle is a toy for generating "word clouds" from text that you provide. The clouds give greater prominence to words that appear more frequently in the source text. You can tweak your clouds with different fonts, layouts, and color schemes. The images you create with Wordle are yours to use however you like. You can print them out, or save them to your own desktop to use as you wish.

Create your own.

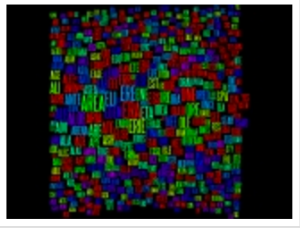
View some examples created by others...

English notebook cover
by Ace Acedemic!
6 years, 5 months ago



Period G
by Meredith
6 years, 4 months ago

US Constitution
by Jonathan
6 years, 2 months ago



Most Common Crossword Answers
by Jonathan
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Terms of Use

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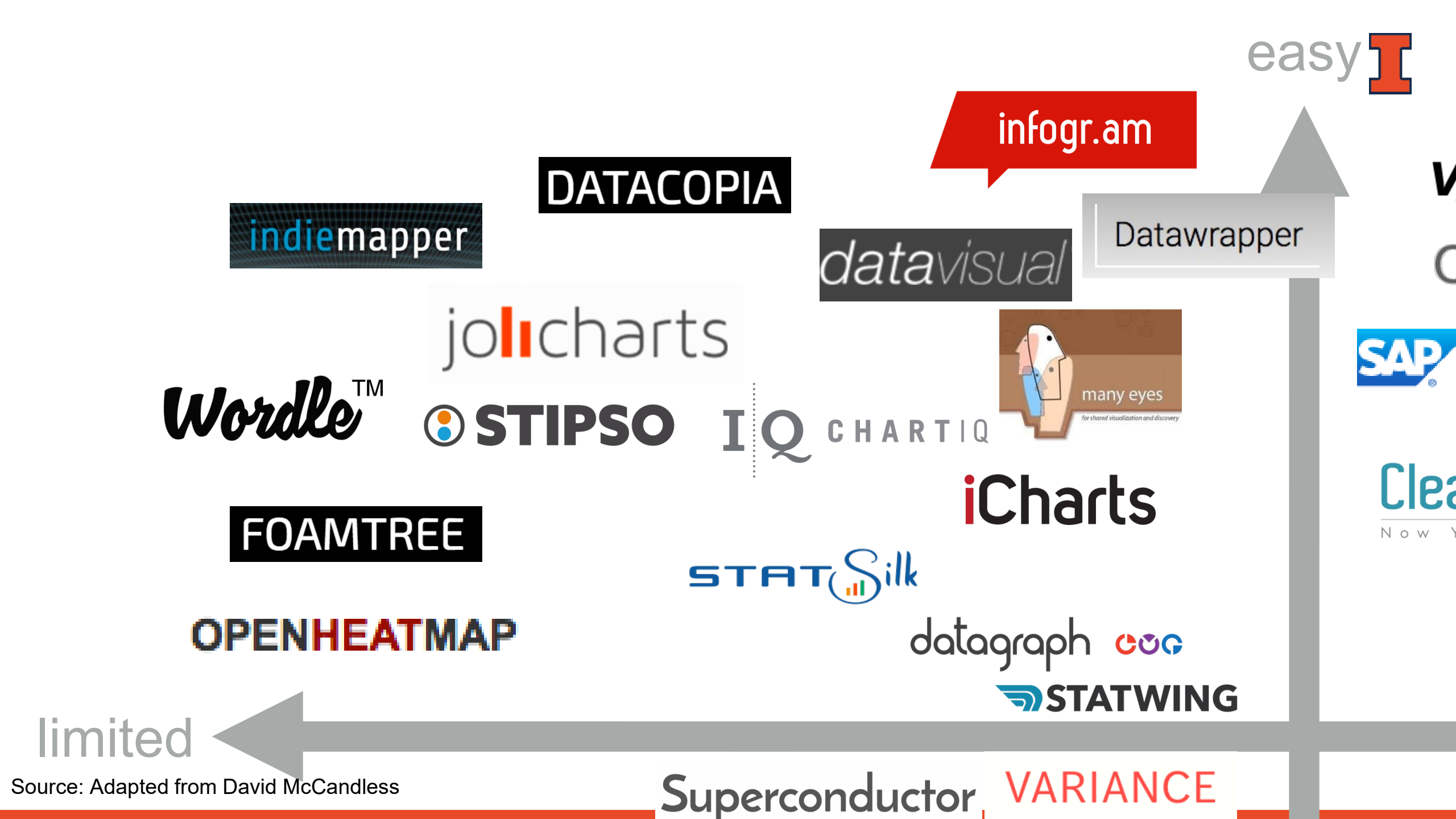

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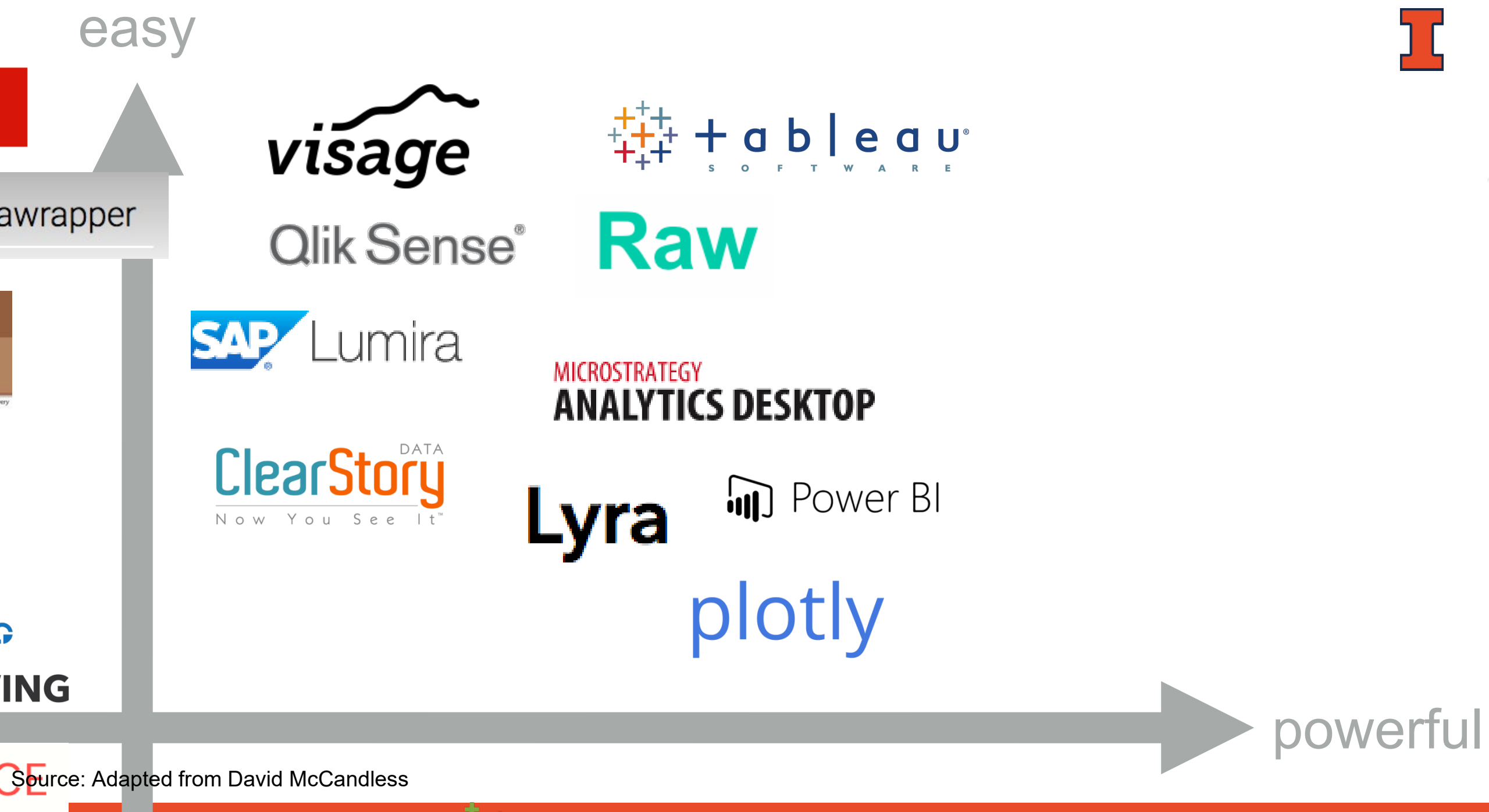
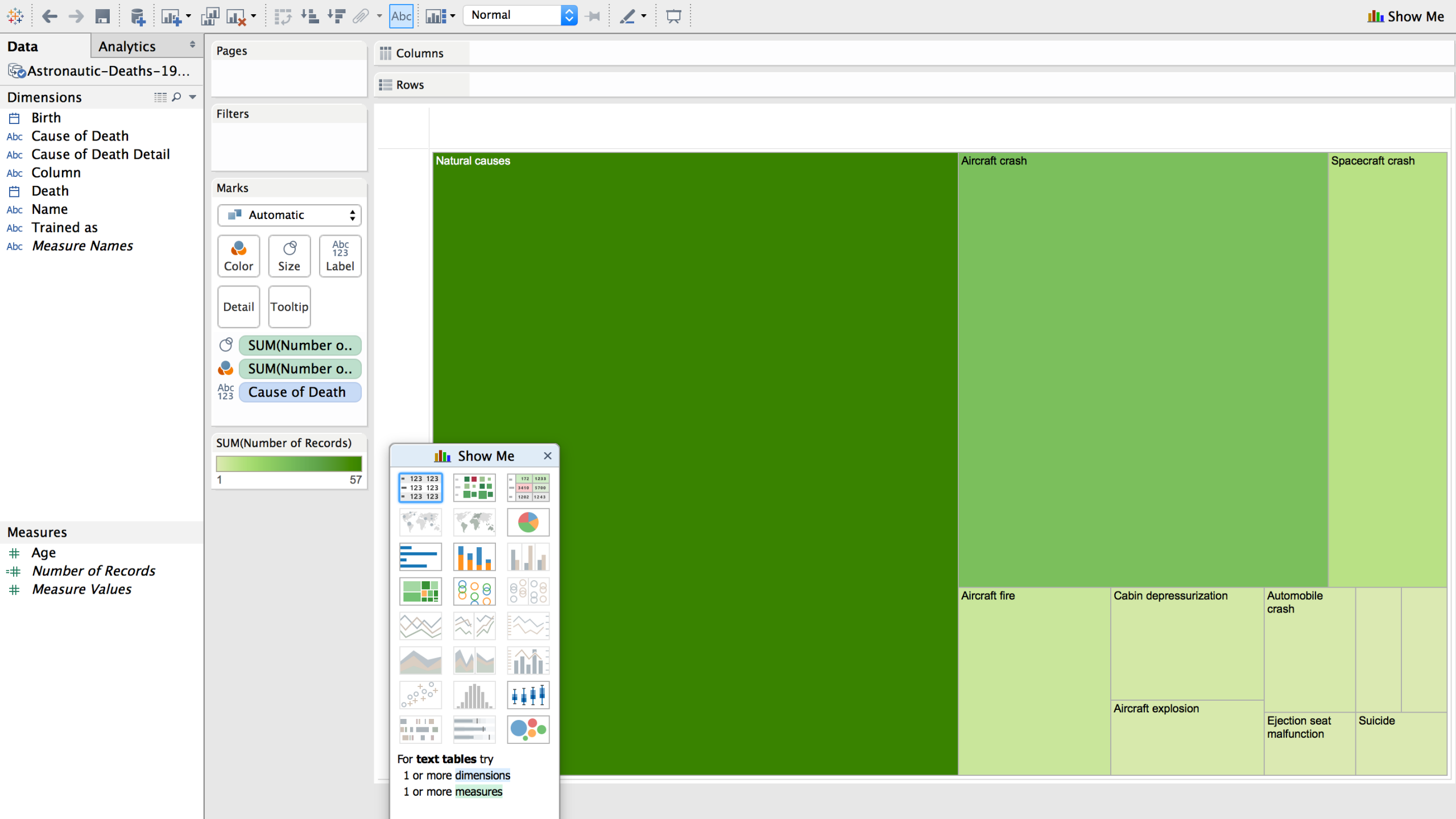


Source: Adapted from David McCandless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Spacecraft crash
Aircraft fire
Cabin depressurization
Automobile crash
Aircraft explosion
Ejection seat malfunction
Suicide
Show Me
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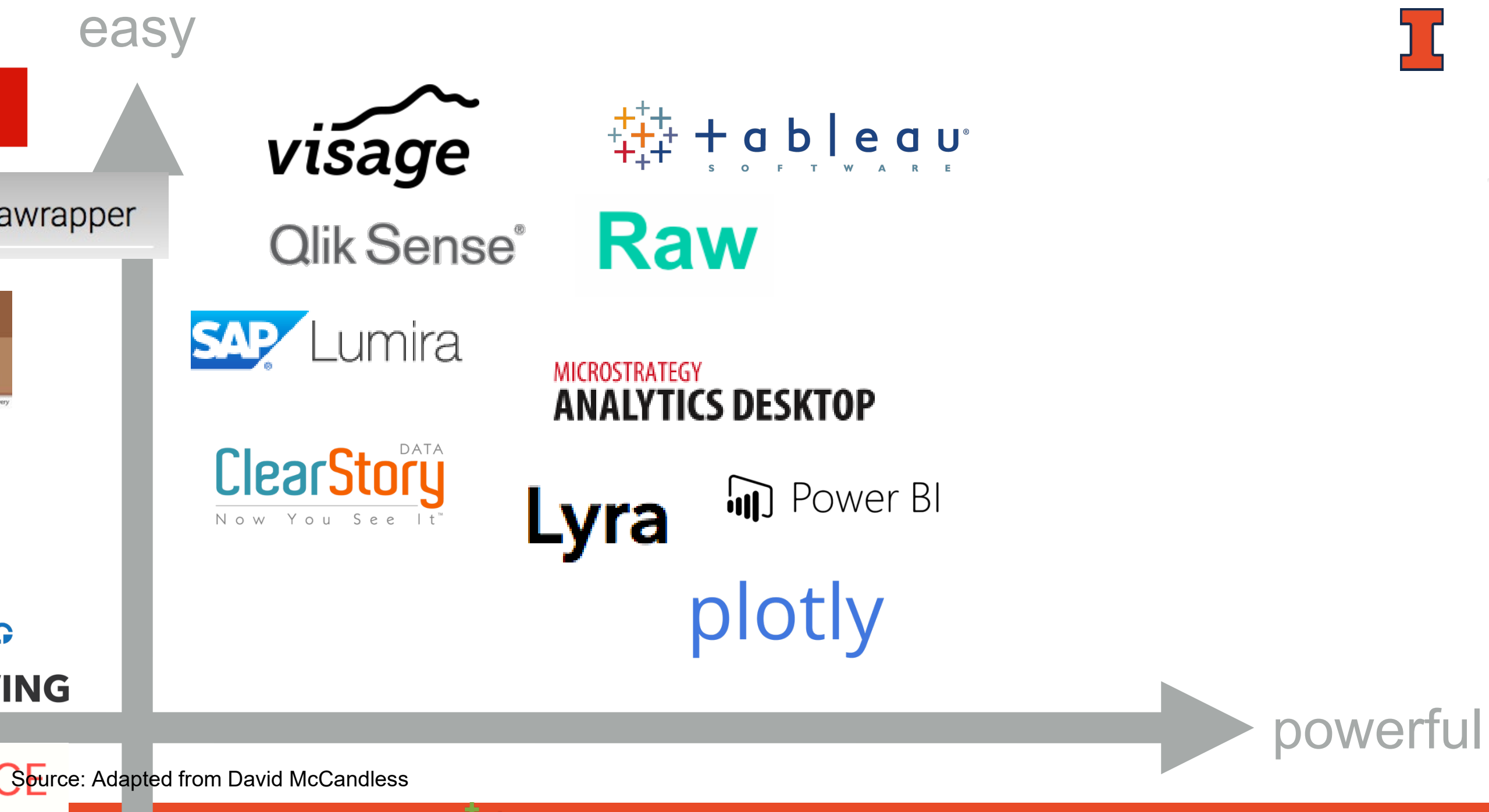
1 or more dimensions
1 or more measures



Source: Adapted from David McCandless

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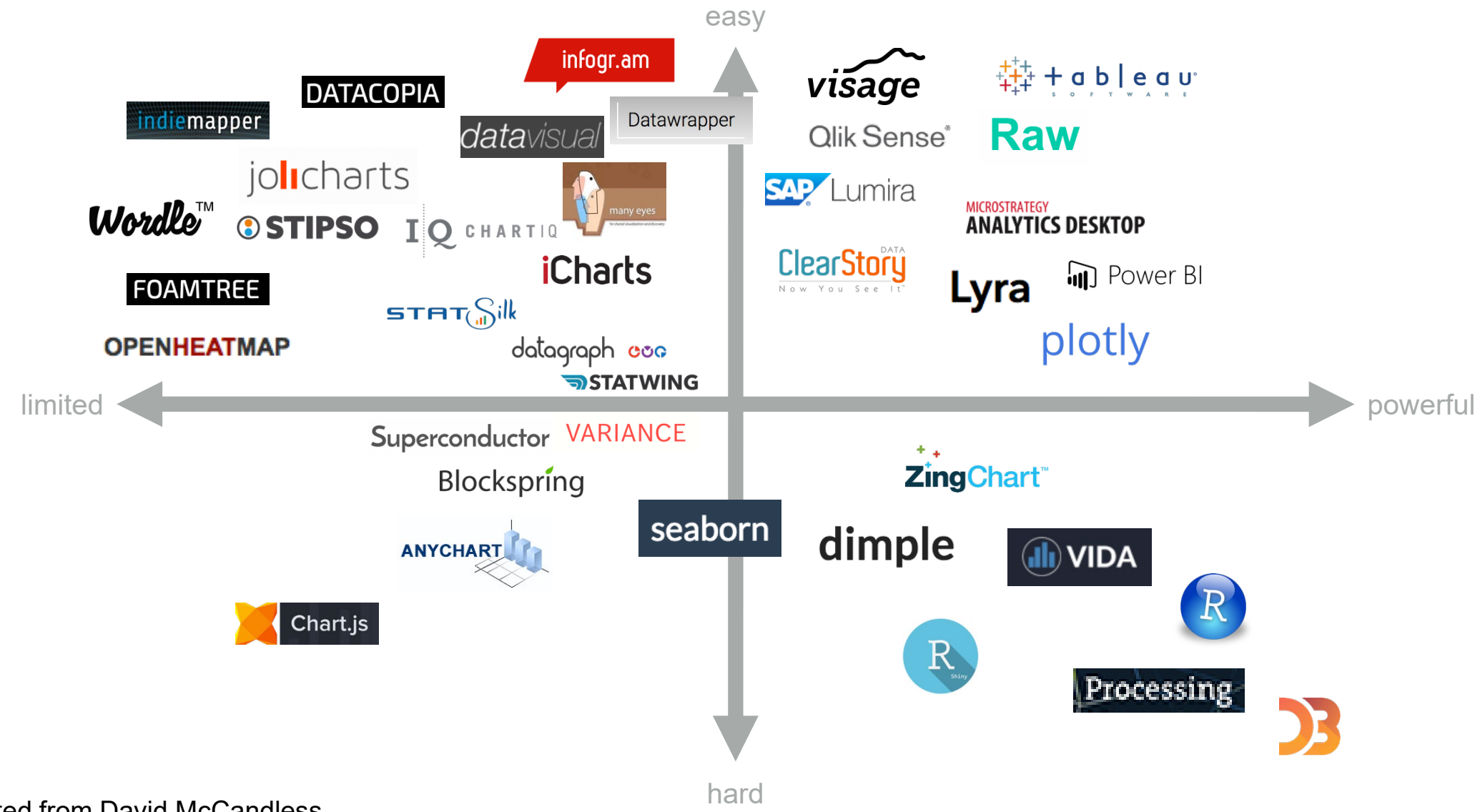
THE DATA VISUALIZATION TOOL MARKET

An analysis of ease of use and capability



Source: Adapted from David McCandless.

Keep a Number of Data Visualization Tools in Your "Toolbox"

Evaluate dataviz tools in their ability to offer efficiency: the ease with which you can access its capabilities

Immediately discard hard-to-learn tools that do not offer exceptional capabilities

Anchor on an easy-to-use tool with broad capabilities

Utilize other tools when they are the most efficient tools for the job

Constantly search for new dataviz tools in this dynamic, ever-changing market

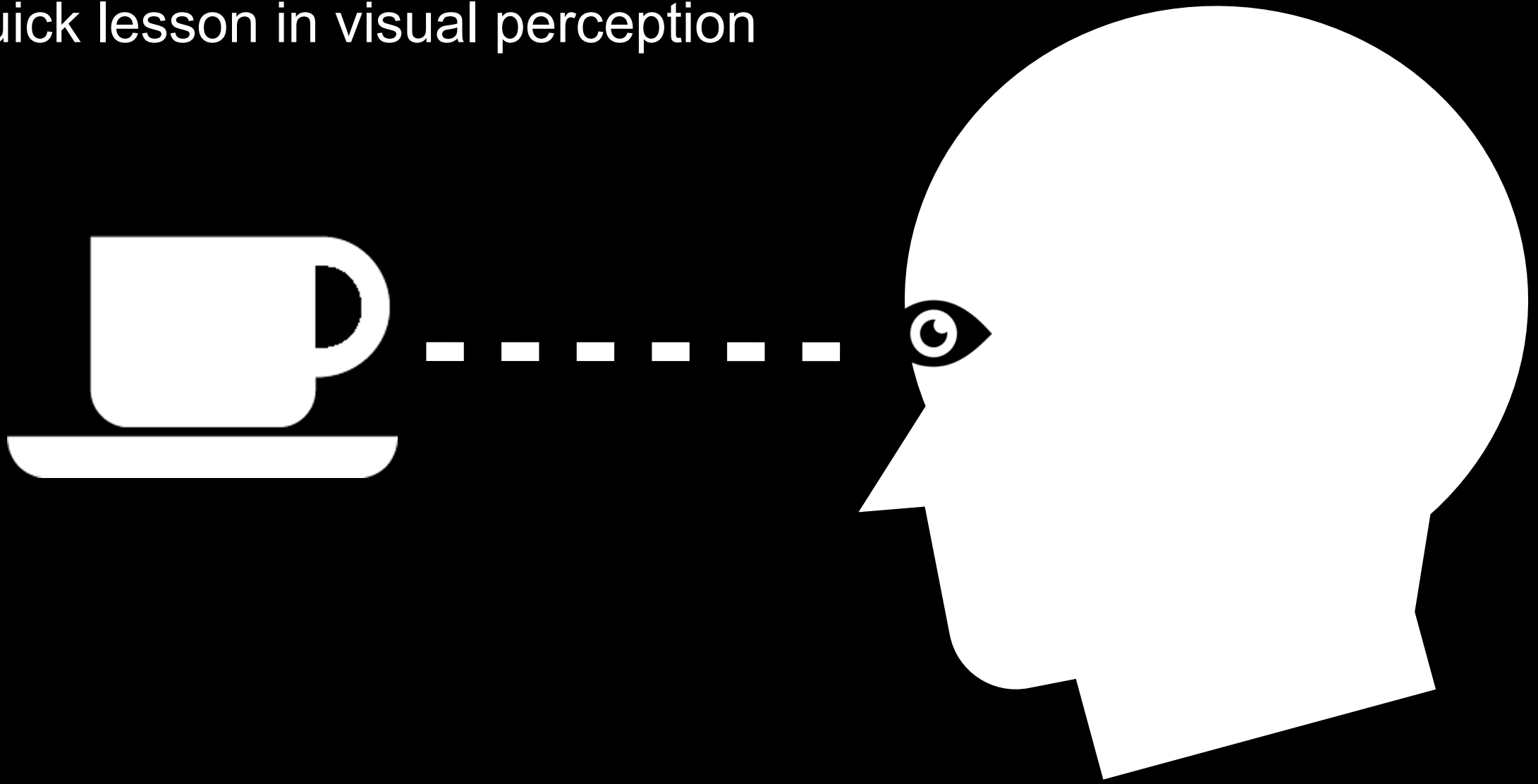
Module 1 Lesson 3

Making Connections with Visuals

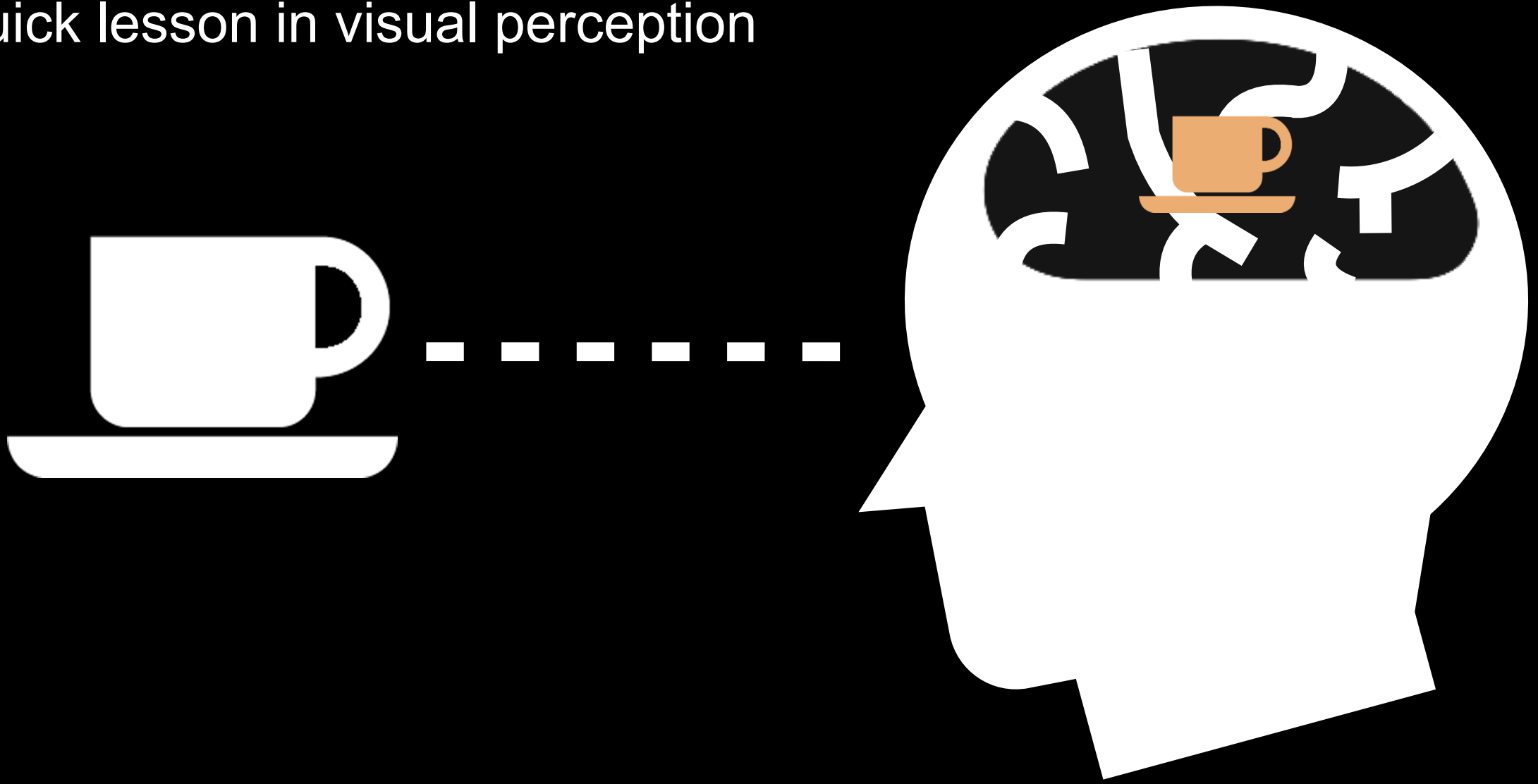
Making Connections with Visuals

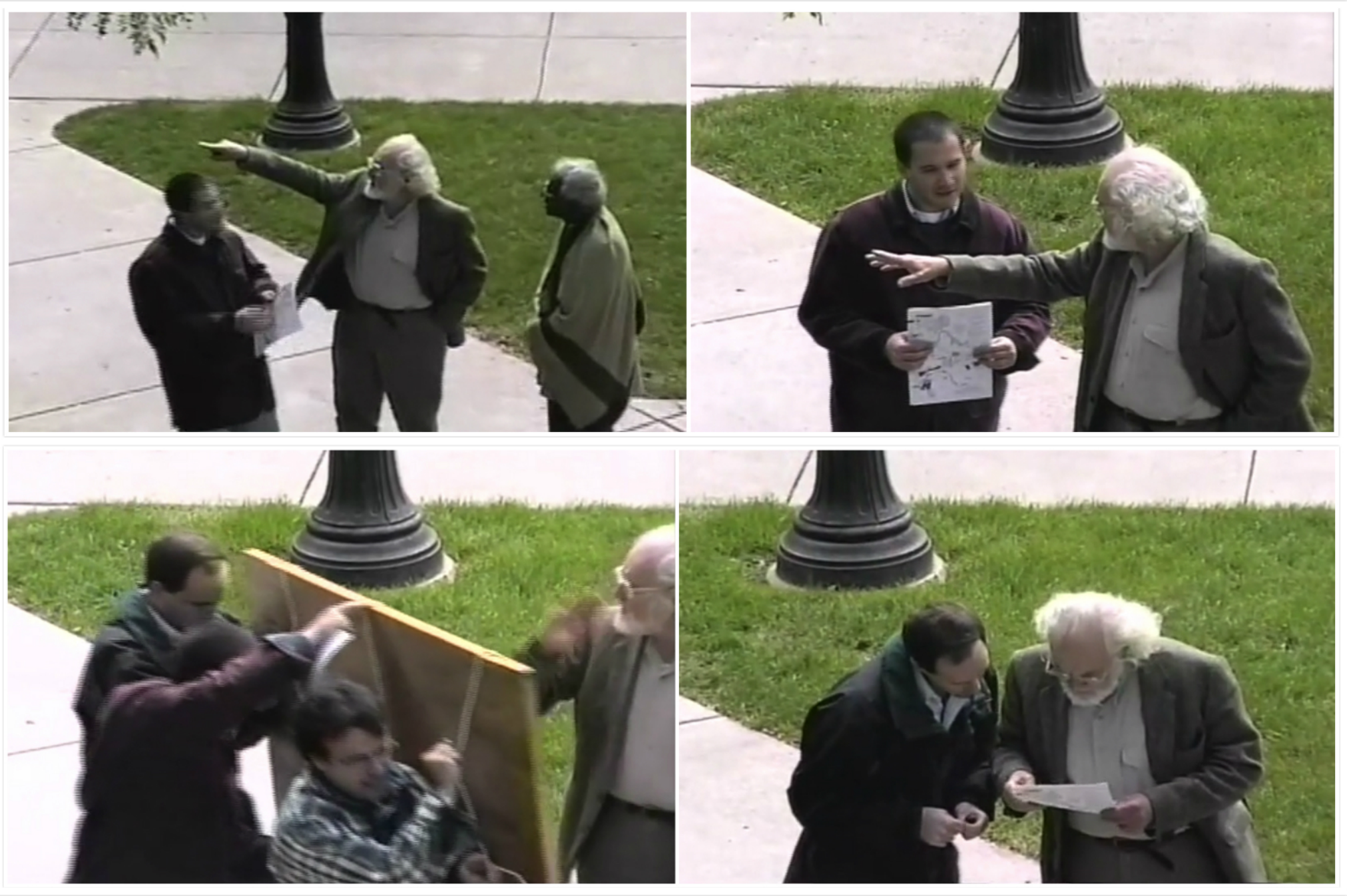
Visualization is rooted in brain science and is one of the most efficient ways to communicate ideas, insights, and concepts

A quick lesson in visual perception



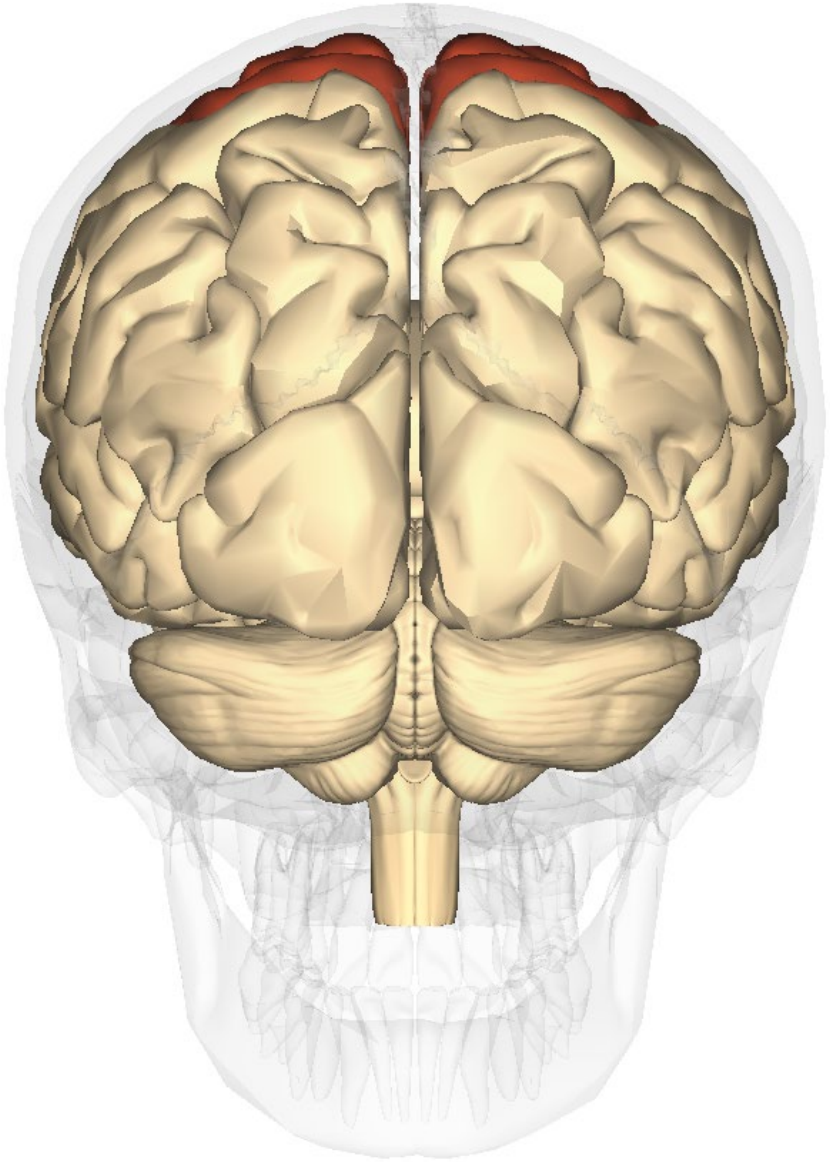
A quick lesson in visual perception



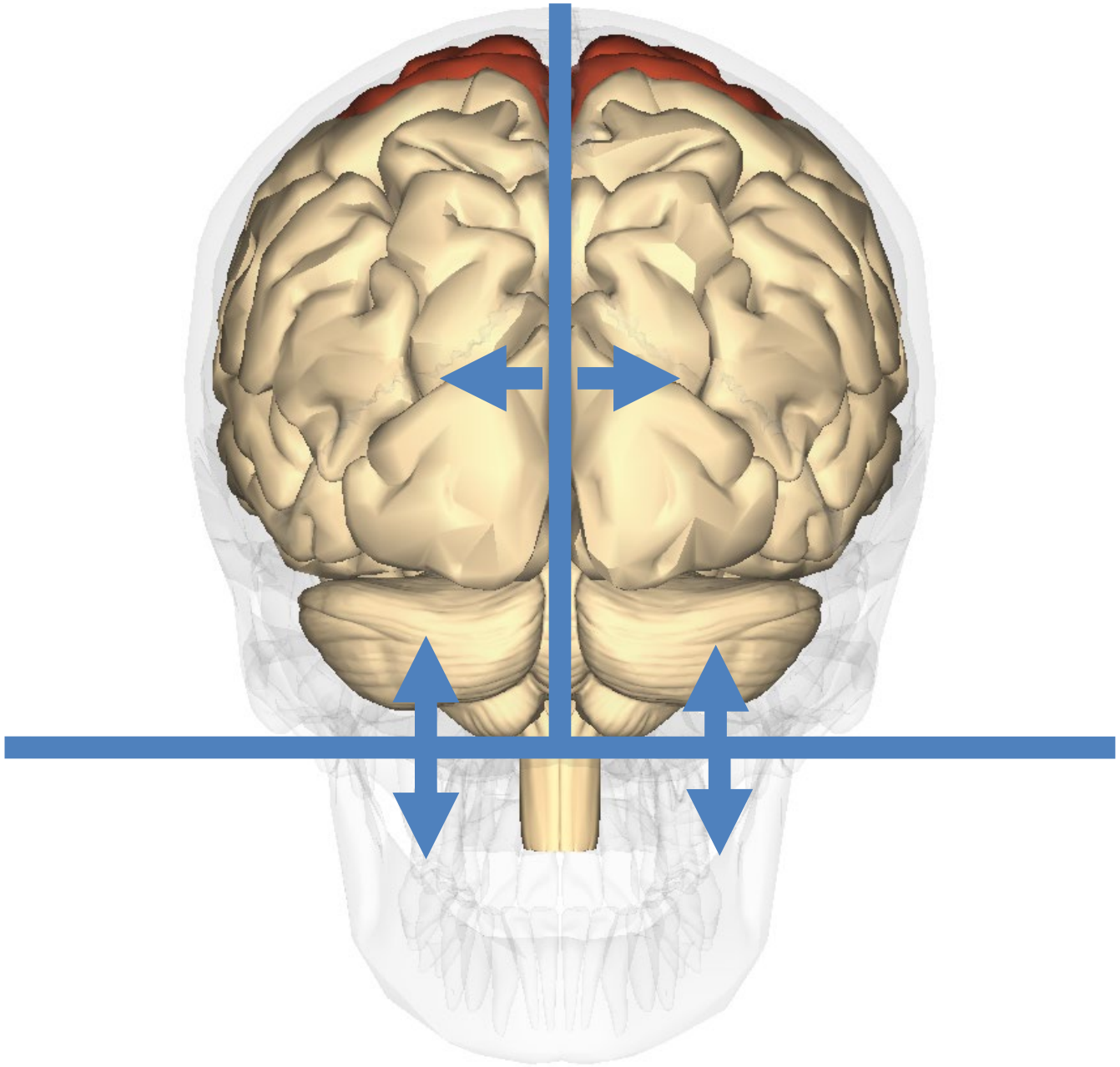


Source: Simons & Levin (1998)

Source: Moran Cerf (2015)

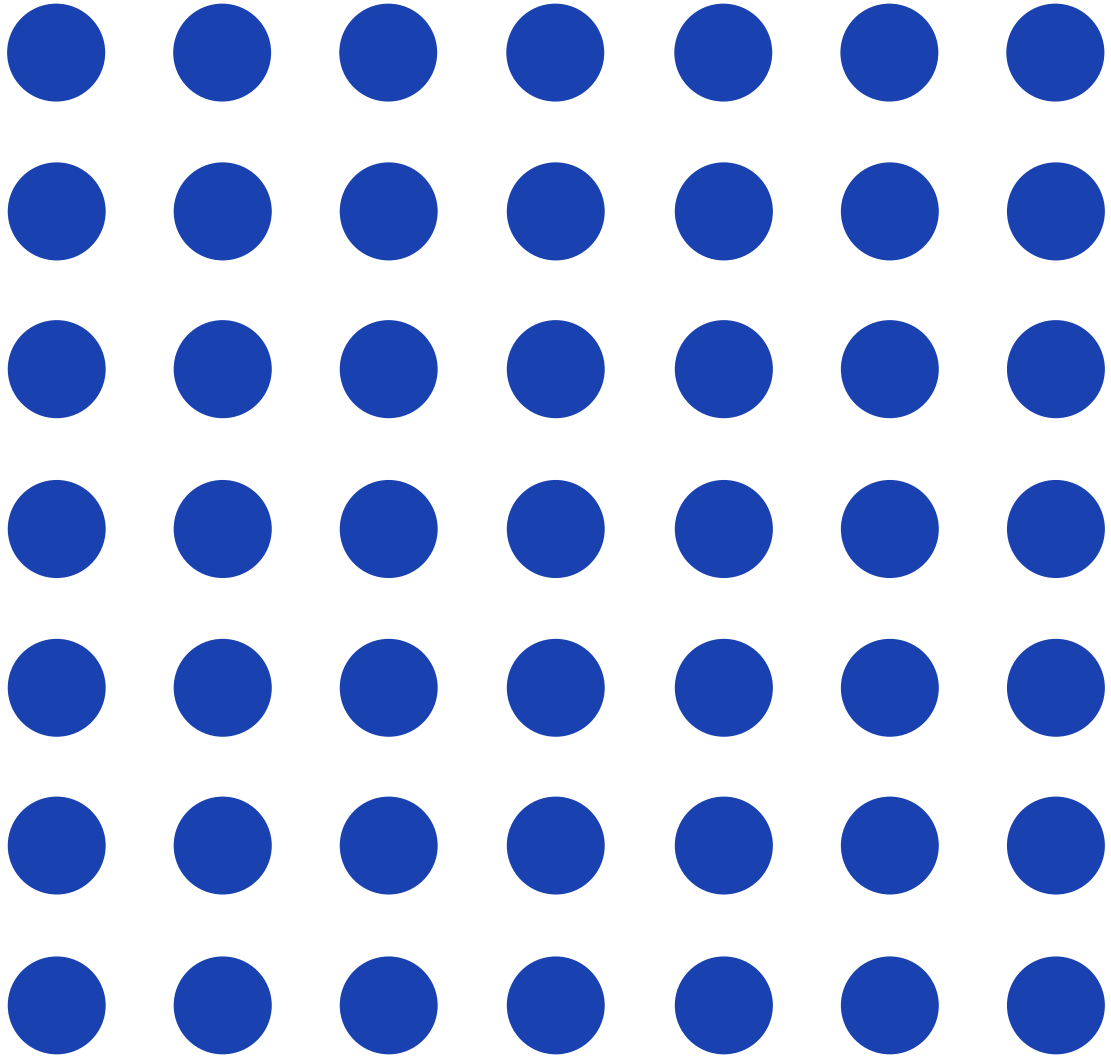


(Anatomography, 2012)



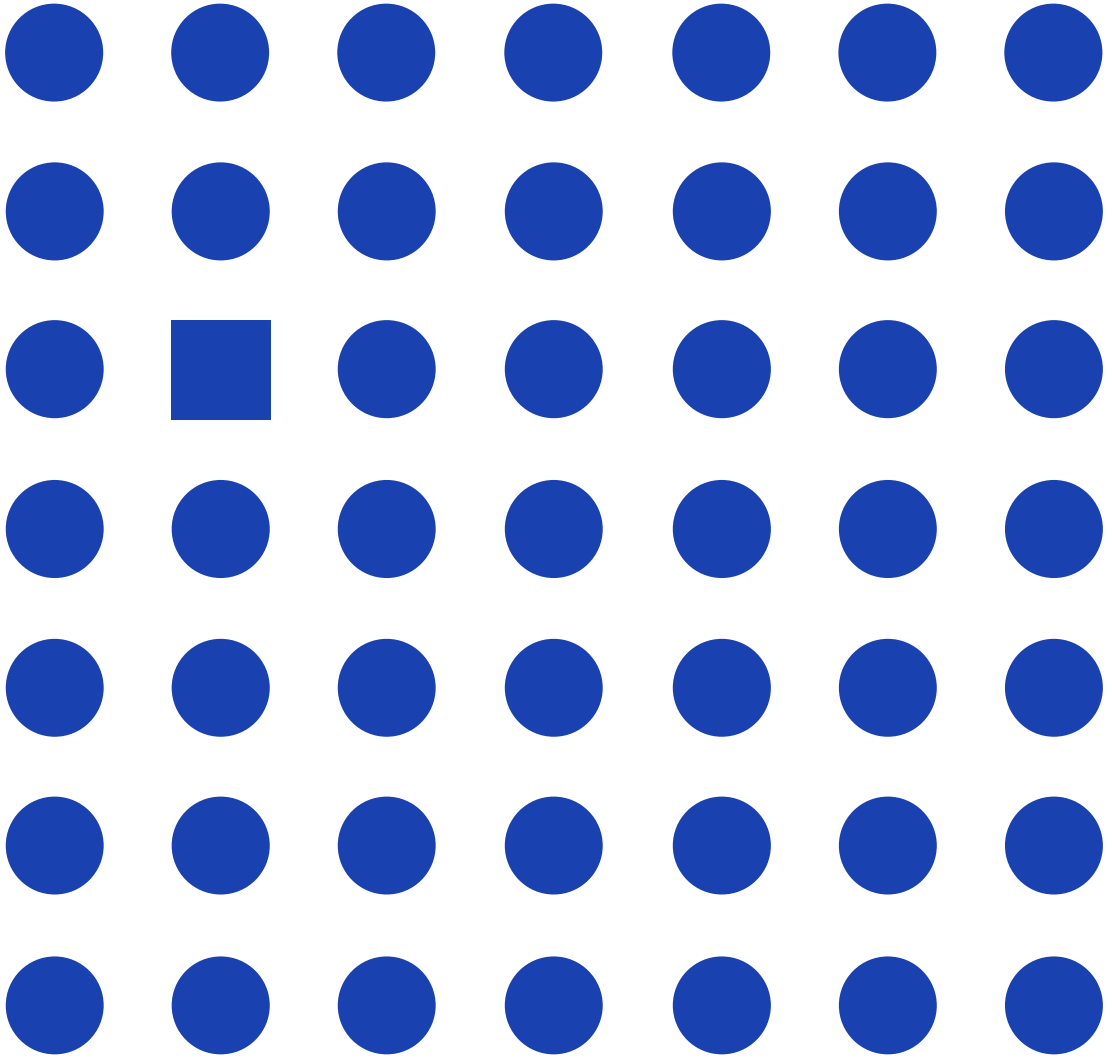
(Anatomography, 2012)

Our brains are programmed to detect differences



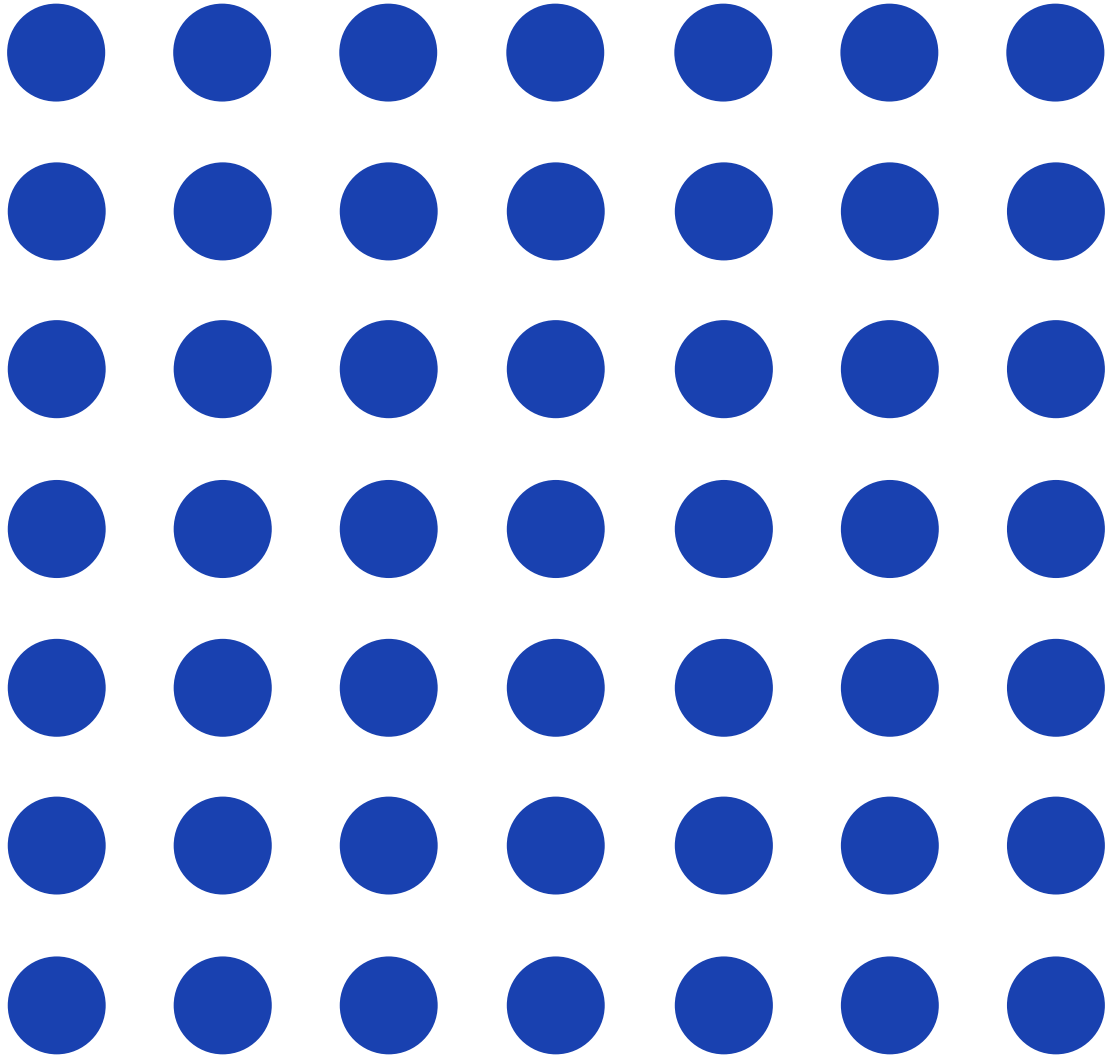
Source: Adapted from Werzowa, Johnson, Lanahan, and Shillum.

Our brains are programmed to detect differences



Source: Adapted from Werzowa, Johnson, Lanahan, and Shillum.

Our brains are programmed to detect differences



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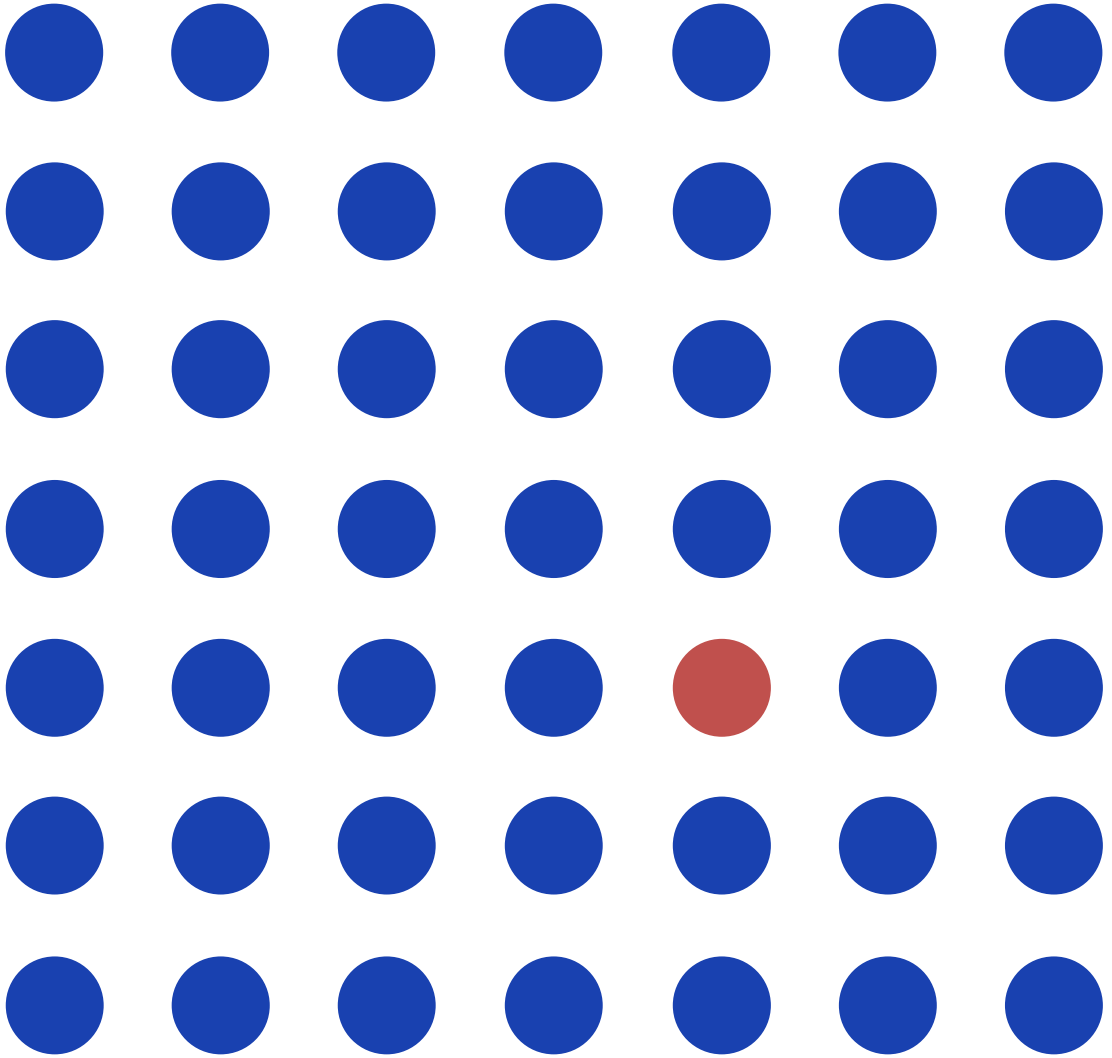

Source: Adapted from Werzowa, Johnson, Lanahan, and Shillum.

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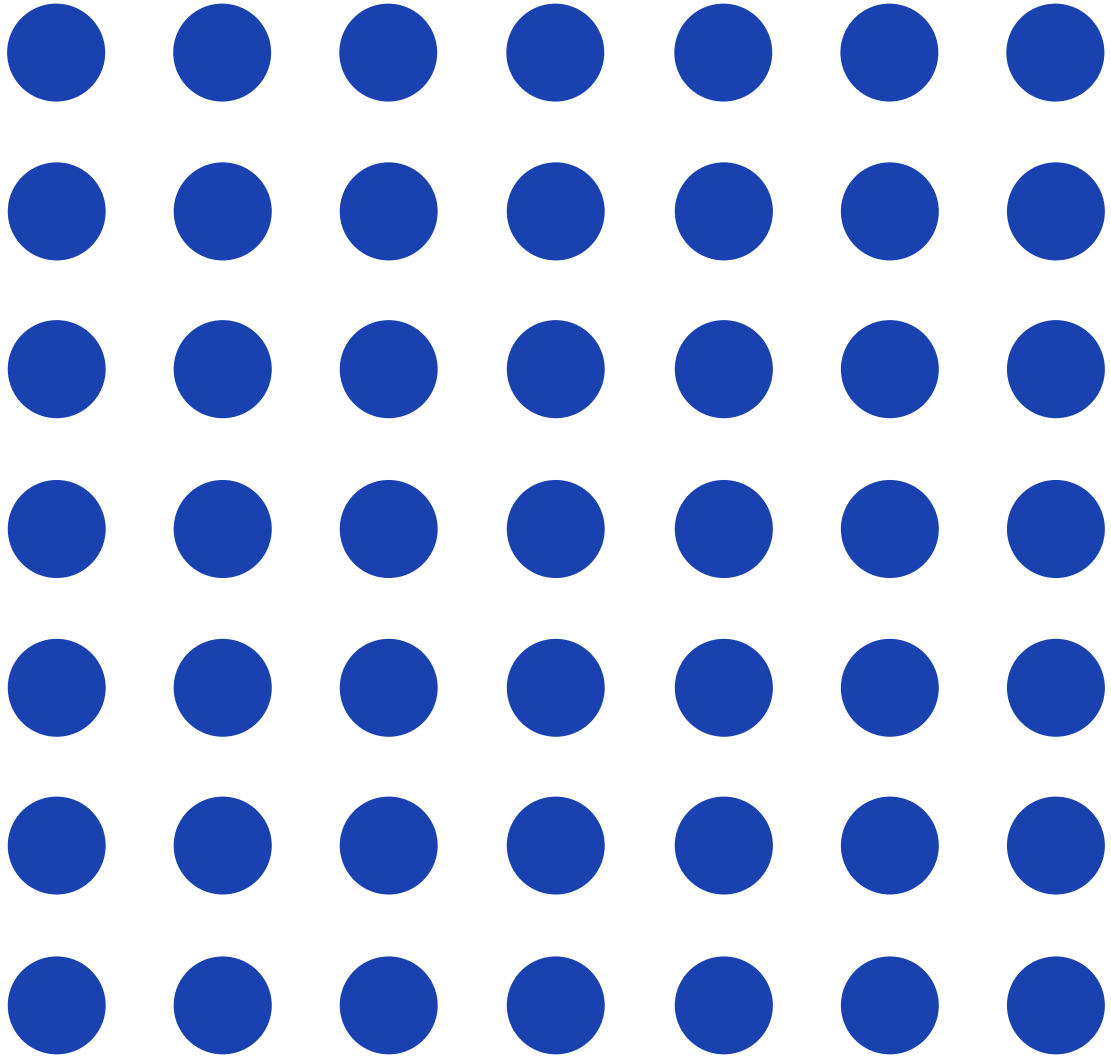
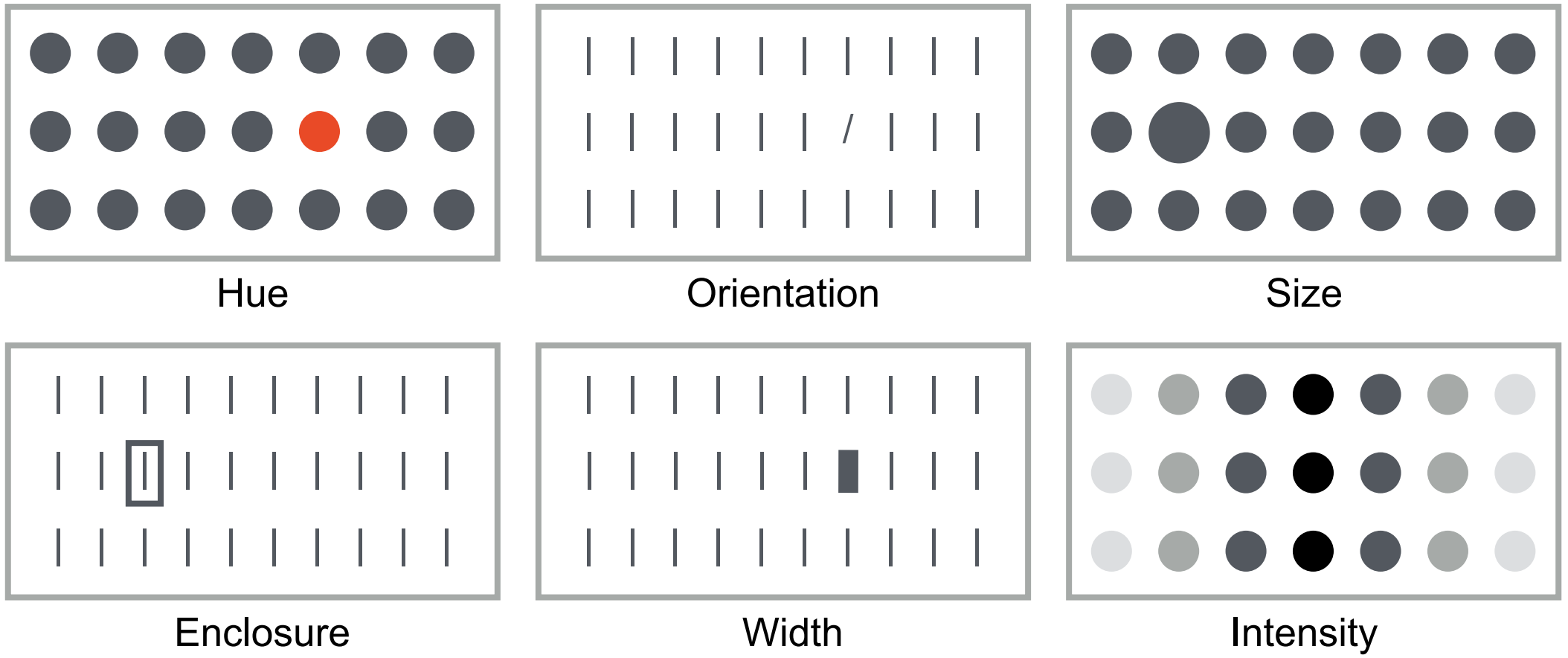


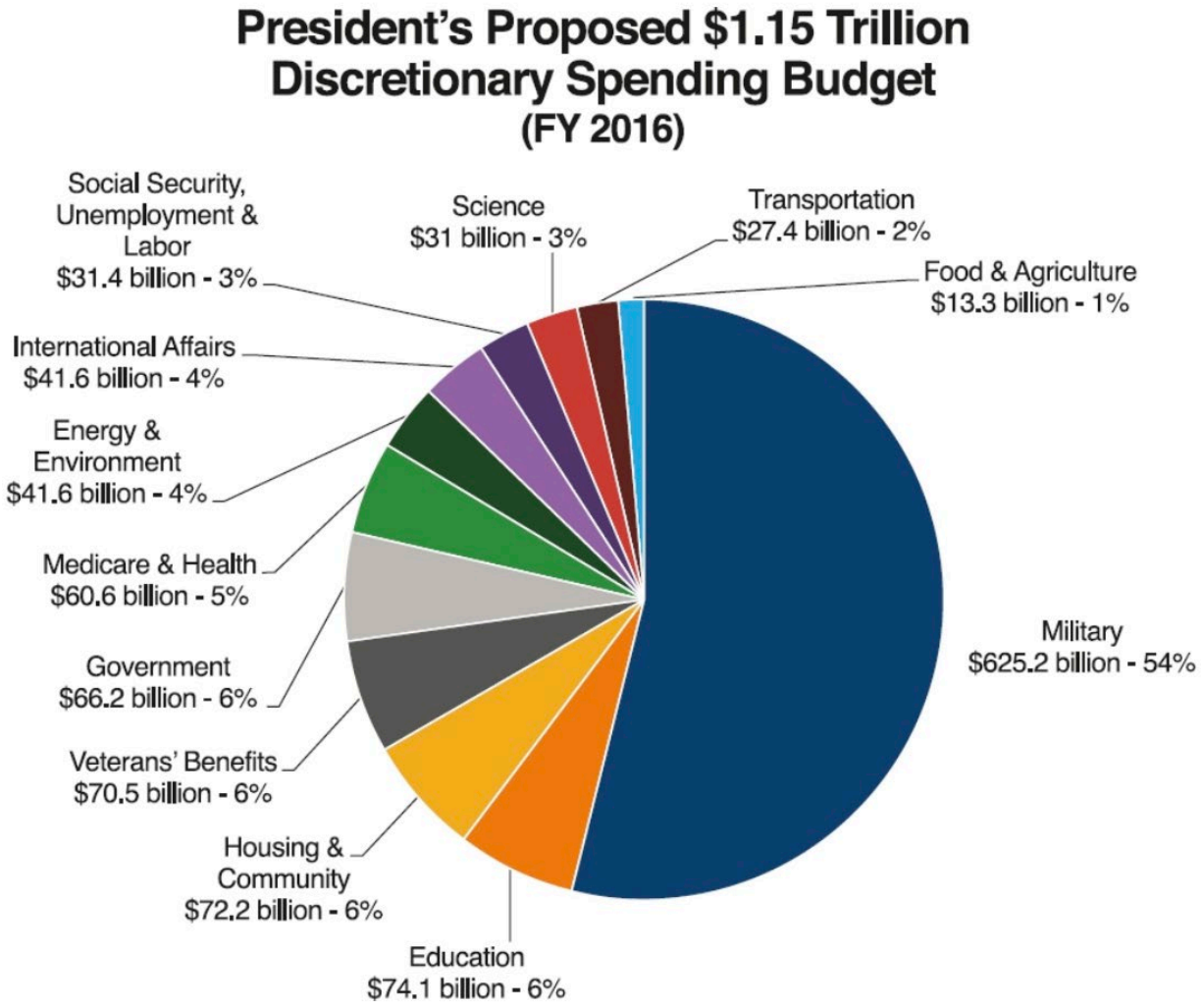
Source: Adapted from Werzowa, Johnson, Lanahan, and Shillum.

There are a host of pre-attentive attributes available



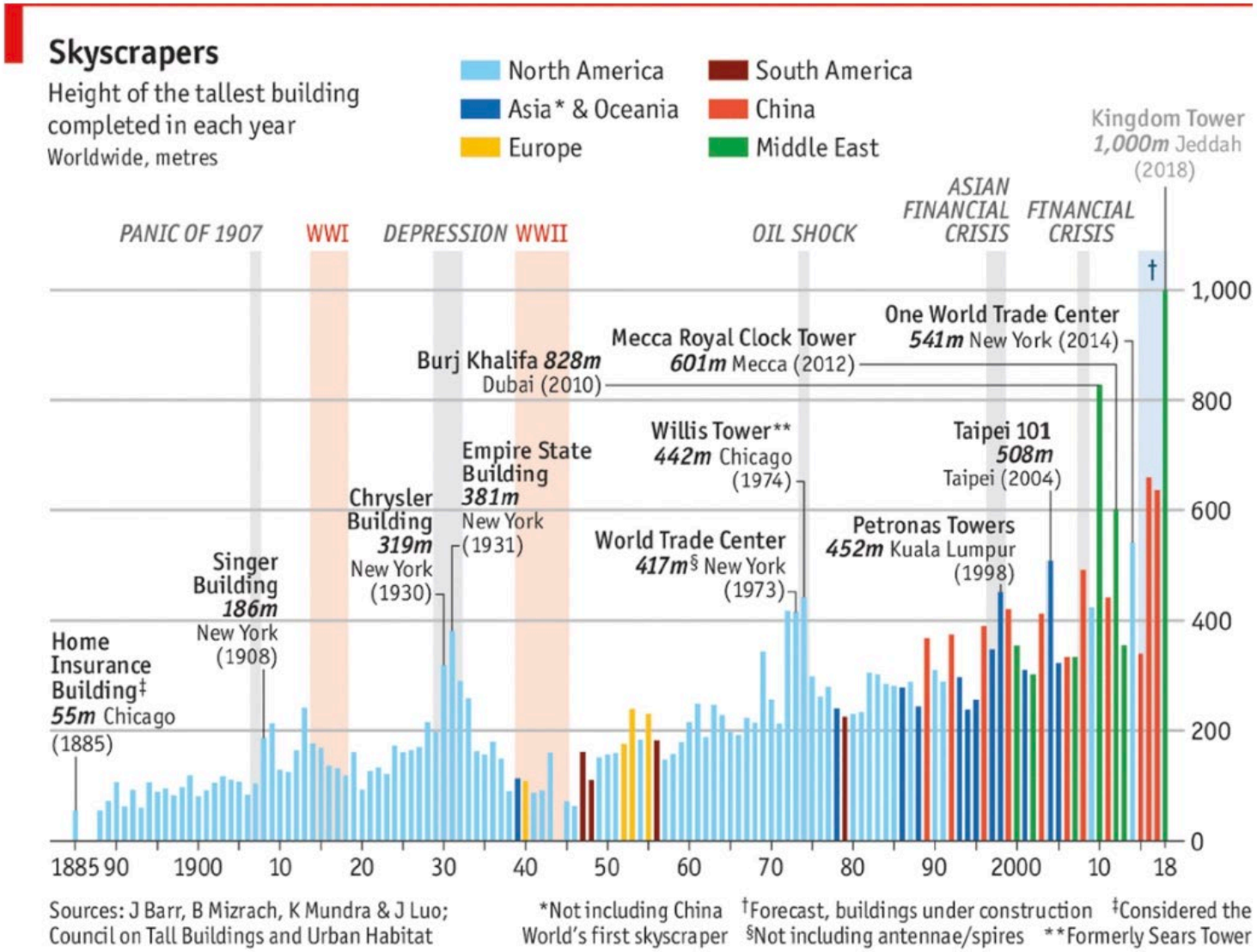
Source: Adapted from Isabel Meirelles, “Design for Information.”

This seems so obvious. But then why do we still make graphics like this?



Source: Adapted from Scott Berinato, "Good Charts: The HBR Guide to Making Smarter, More Persuasive Data Visualizations."

Or like this?



Source: Adapted from Scott Berinato, "Good Charts: The HBR Guide to Making Smarter, More Persuasive Data Visualizations."

Or, for God's sake, like this?

Use the Workings of Visual Perception to Your Advantage

Design dataviz with the message you want communicated in mind

Devote yourself to keeping your audience's advanced brain (i.e., prefrontal cortex) as still and quiet as possible

Build pre-attentive attributes into your visualization to efficiently connect your message to your audience

Keep in mind that successful dataviz results from more than the use of color, shading, and other pre-attentive attributes

References

Anatomography. (2012). *Frontal lobe—Posterior view* [Online image]. CC BY-SA 2.1

Simons, D. J., & Levin, D. T. (1998). *Real-world change blindness from Simons and Levin* [Video file]

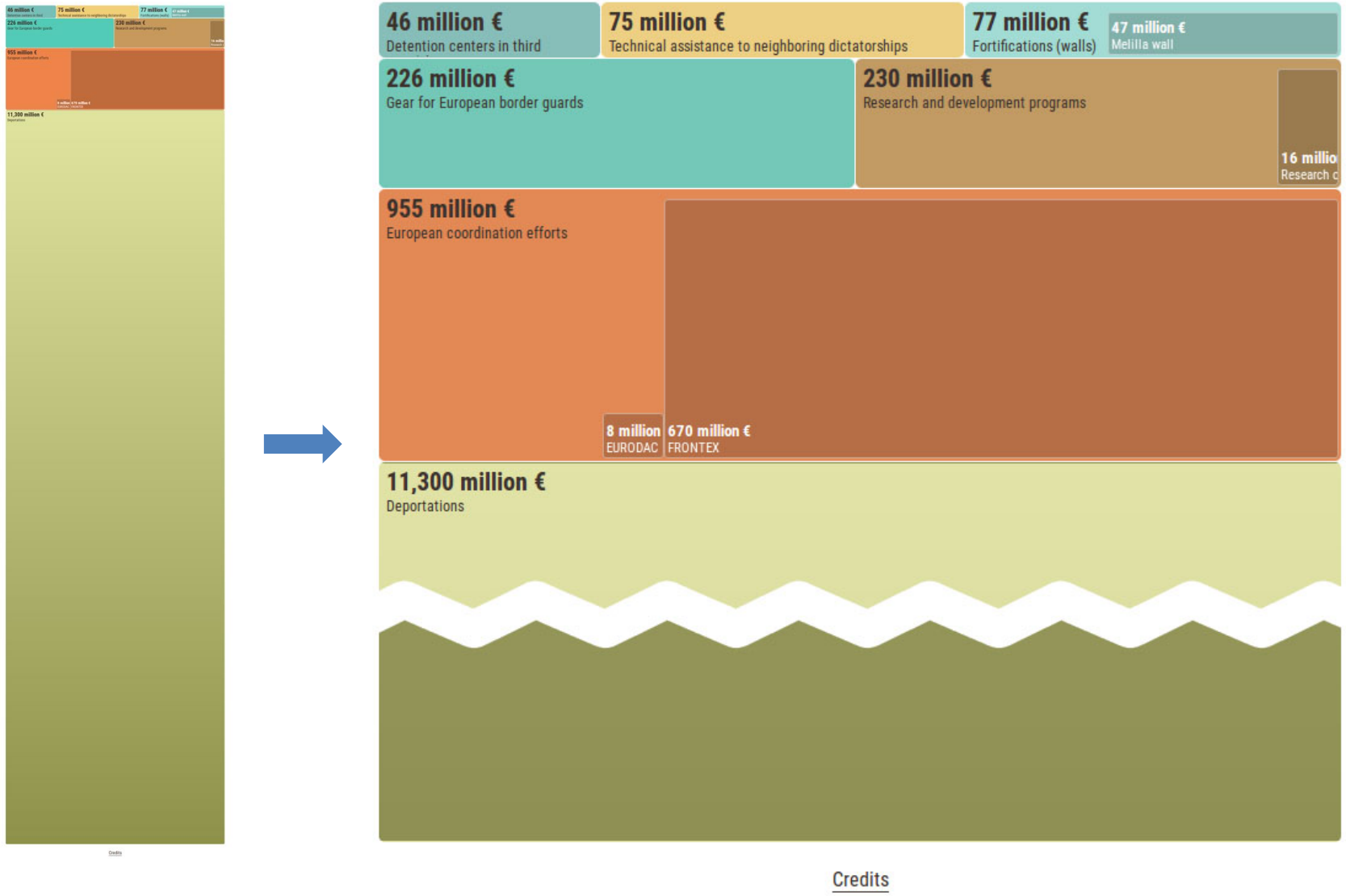
Module 1 Lesson 4

Evaluating the Effectiveness of Dataviz

Evaluating the Effectiveness of Dataviz

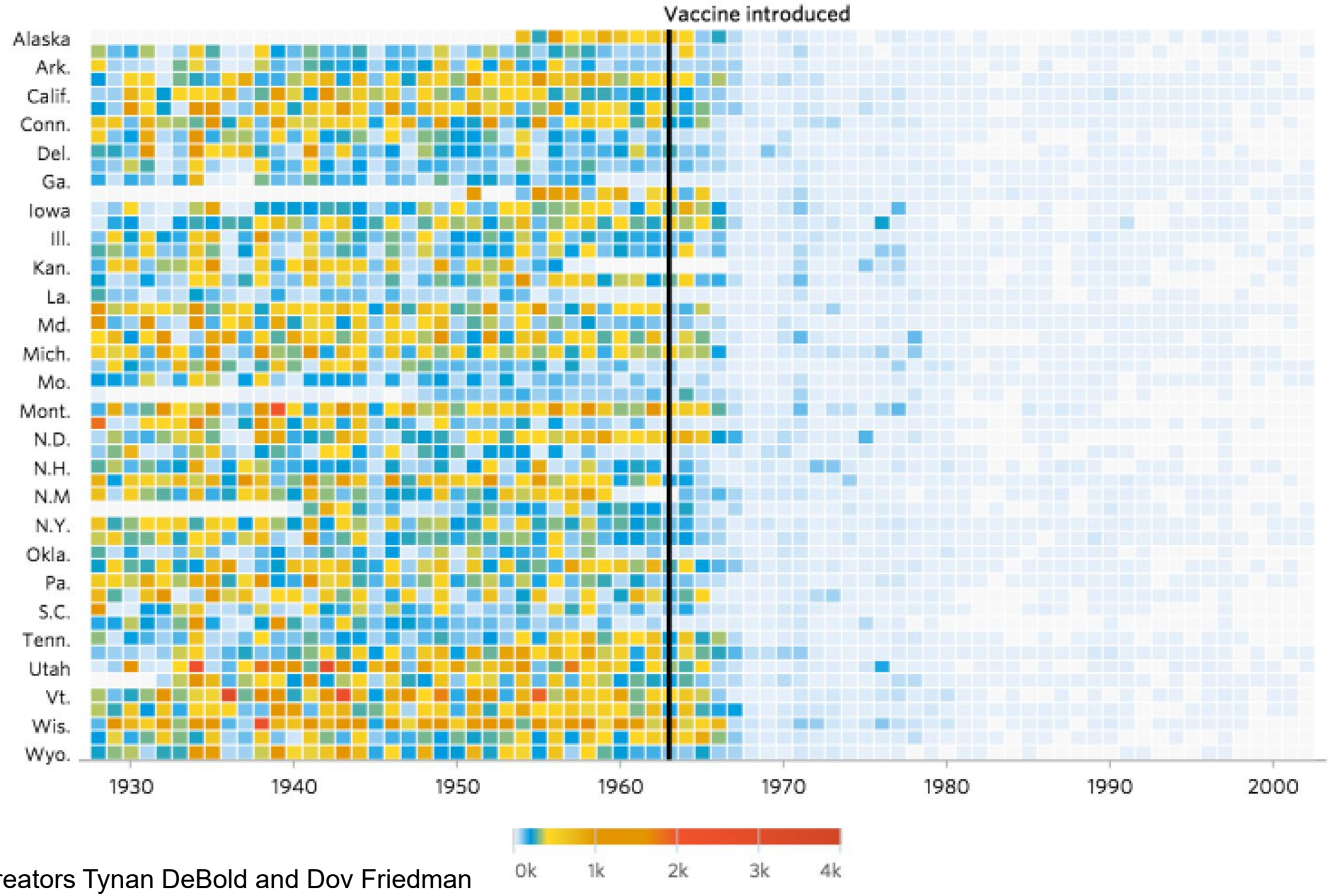
Creating effective, impactful, and good-looking dataviz requires a successful blend of several key elements

Billion Dollar-o-Gram

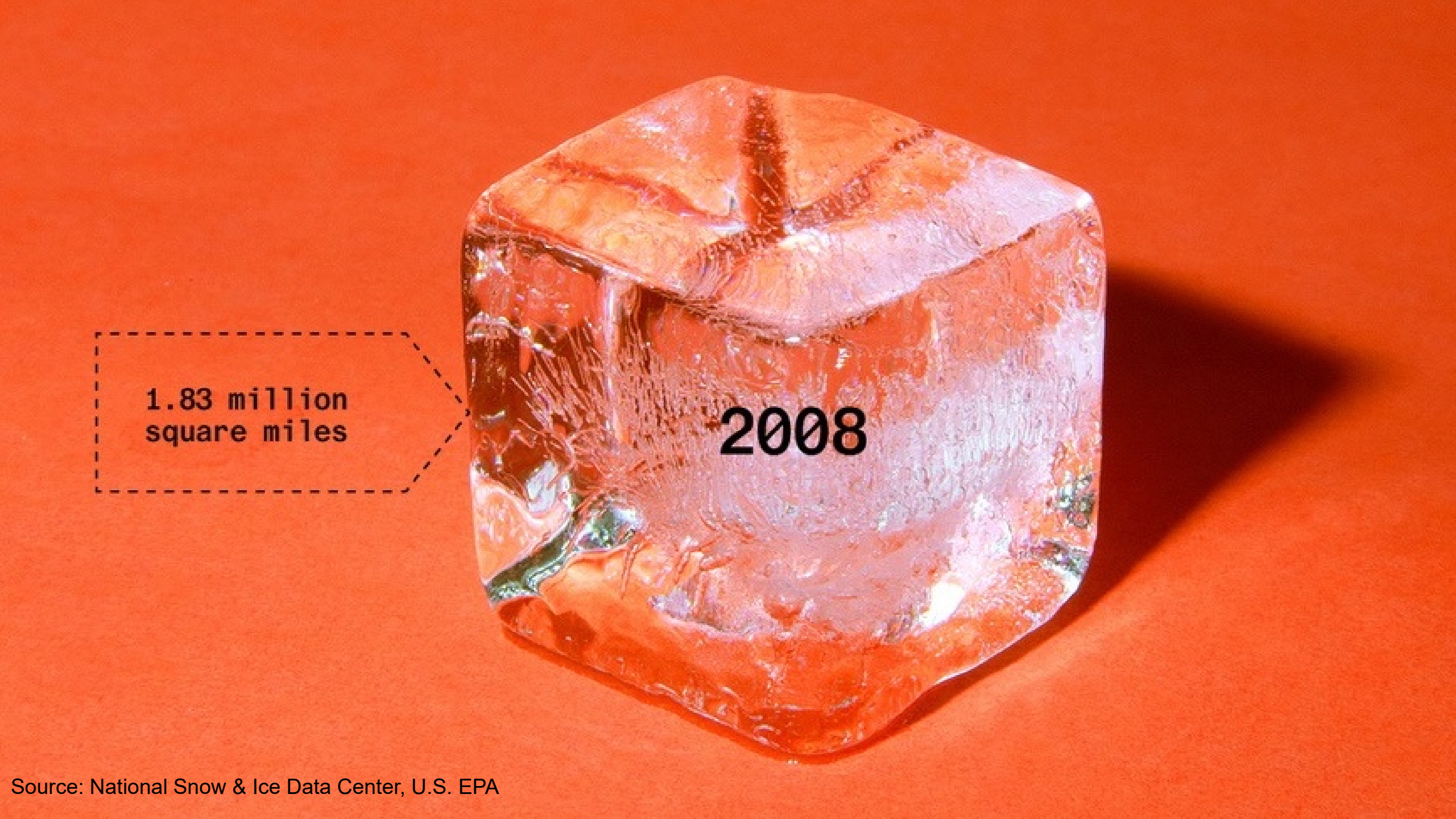


Source: Open Budgets EU's "Billion Dollar-o-Gram" generator

Measles

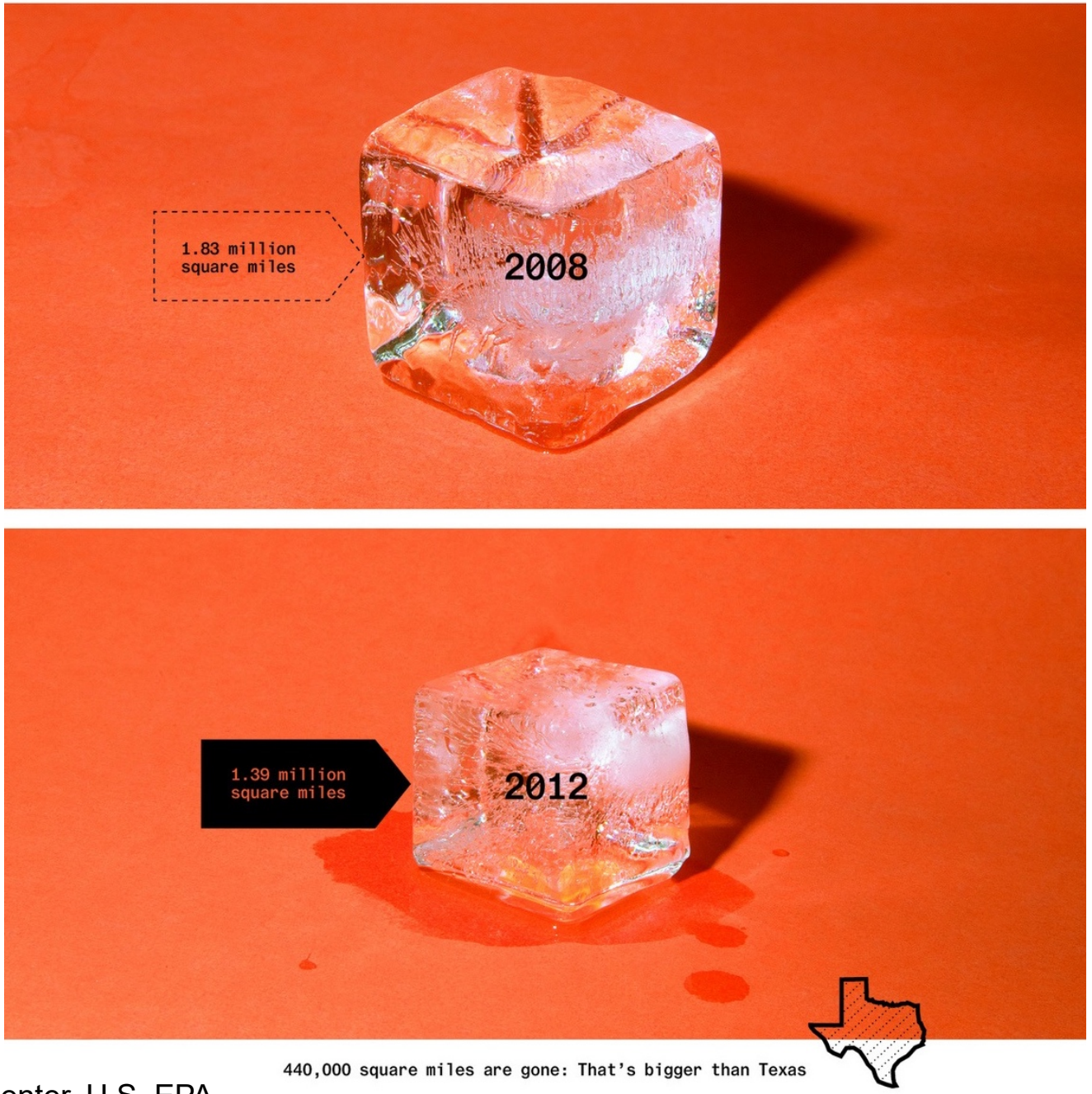


Source: WSJ and creators Tynan DeBold and Dov Friedman



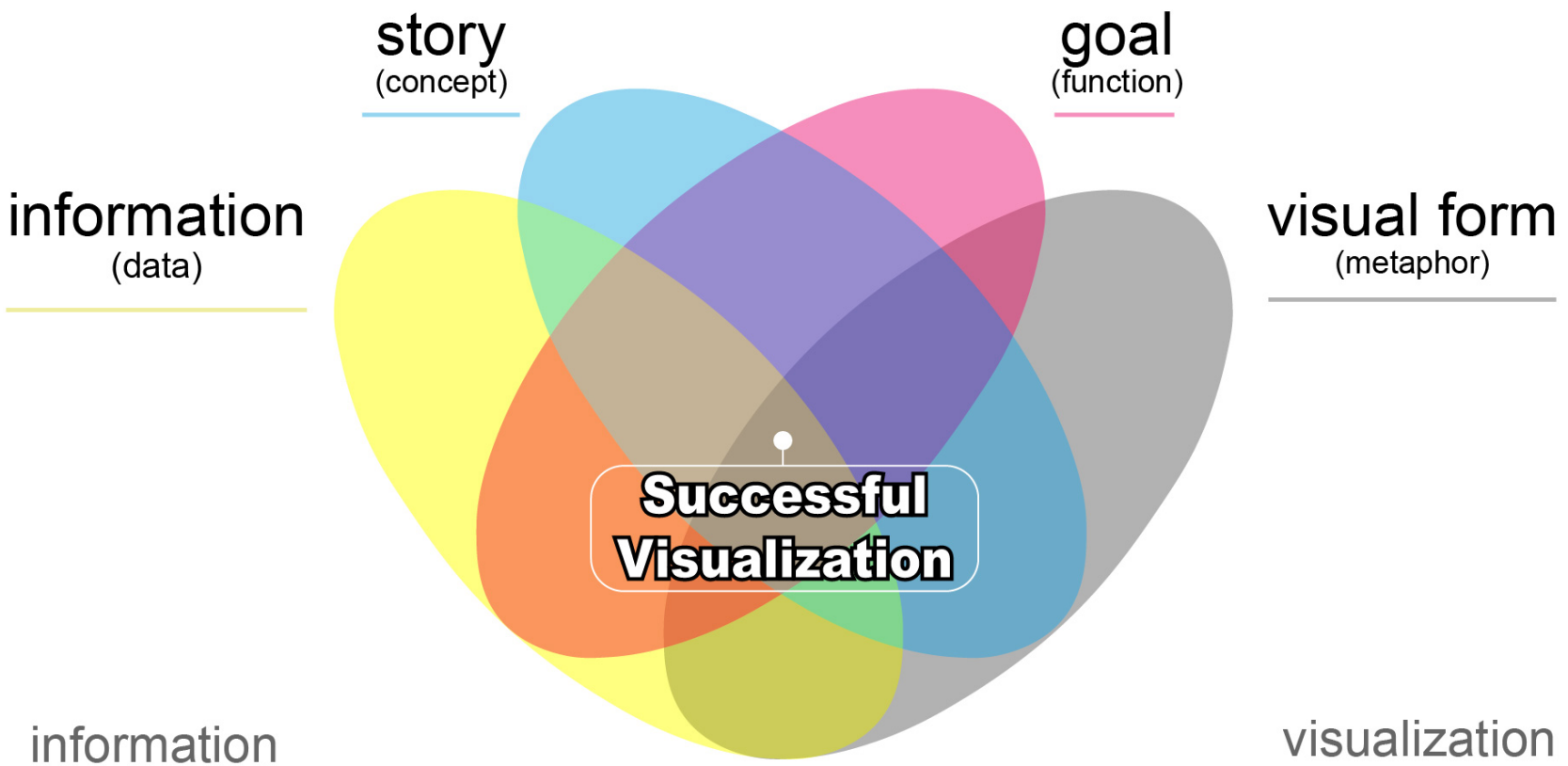
Source: National Snow & Ice Data Center, U.S. EPA

Source: National Snow & Ice Data Center, U.S. EPA



Source: National Snow & Ice Data Center, U.S. EPA

McCandless Offers a Thorough Definition of Good Data Stories



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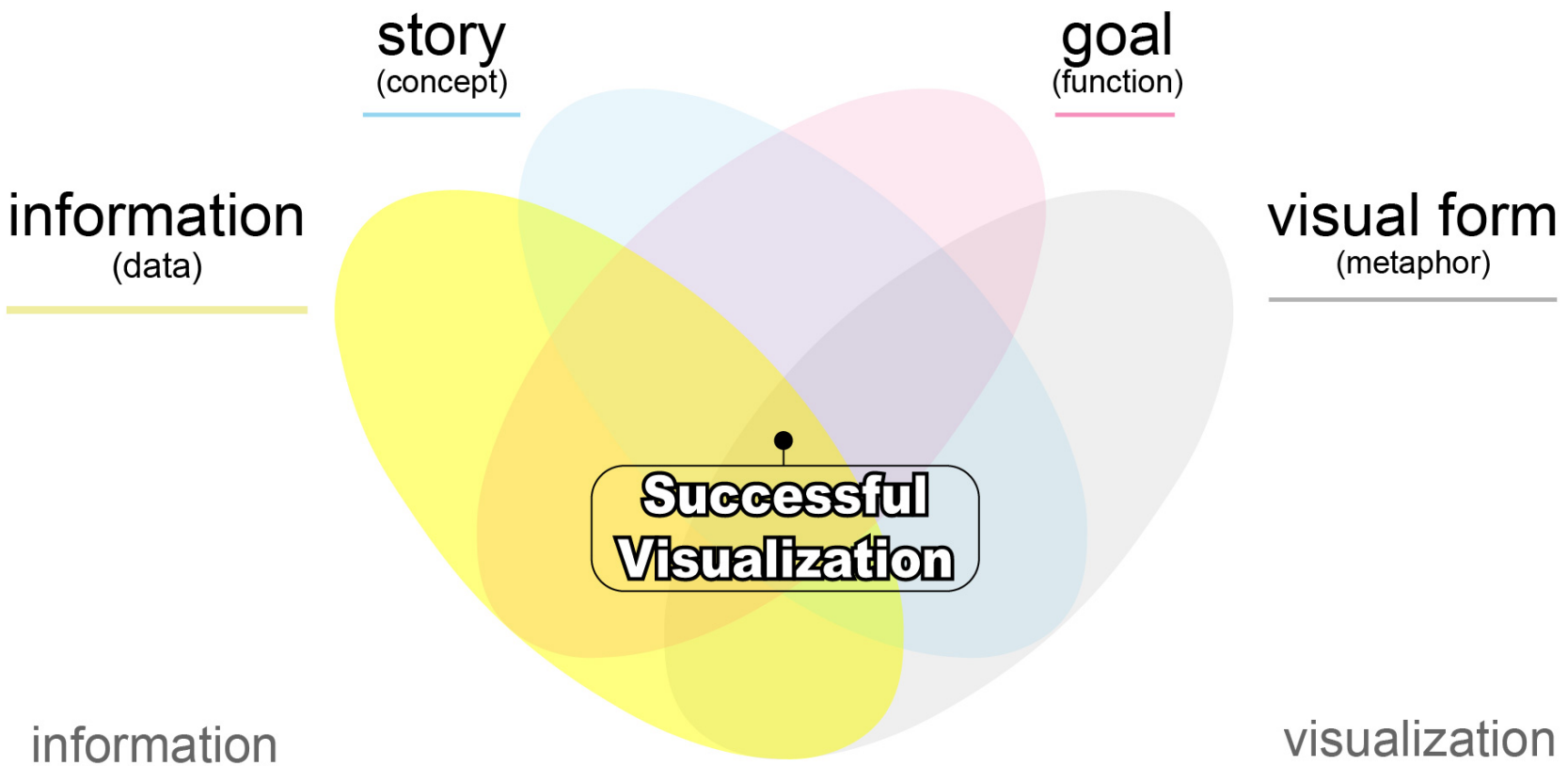
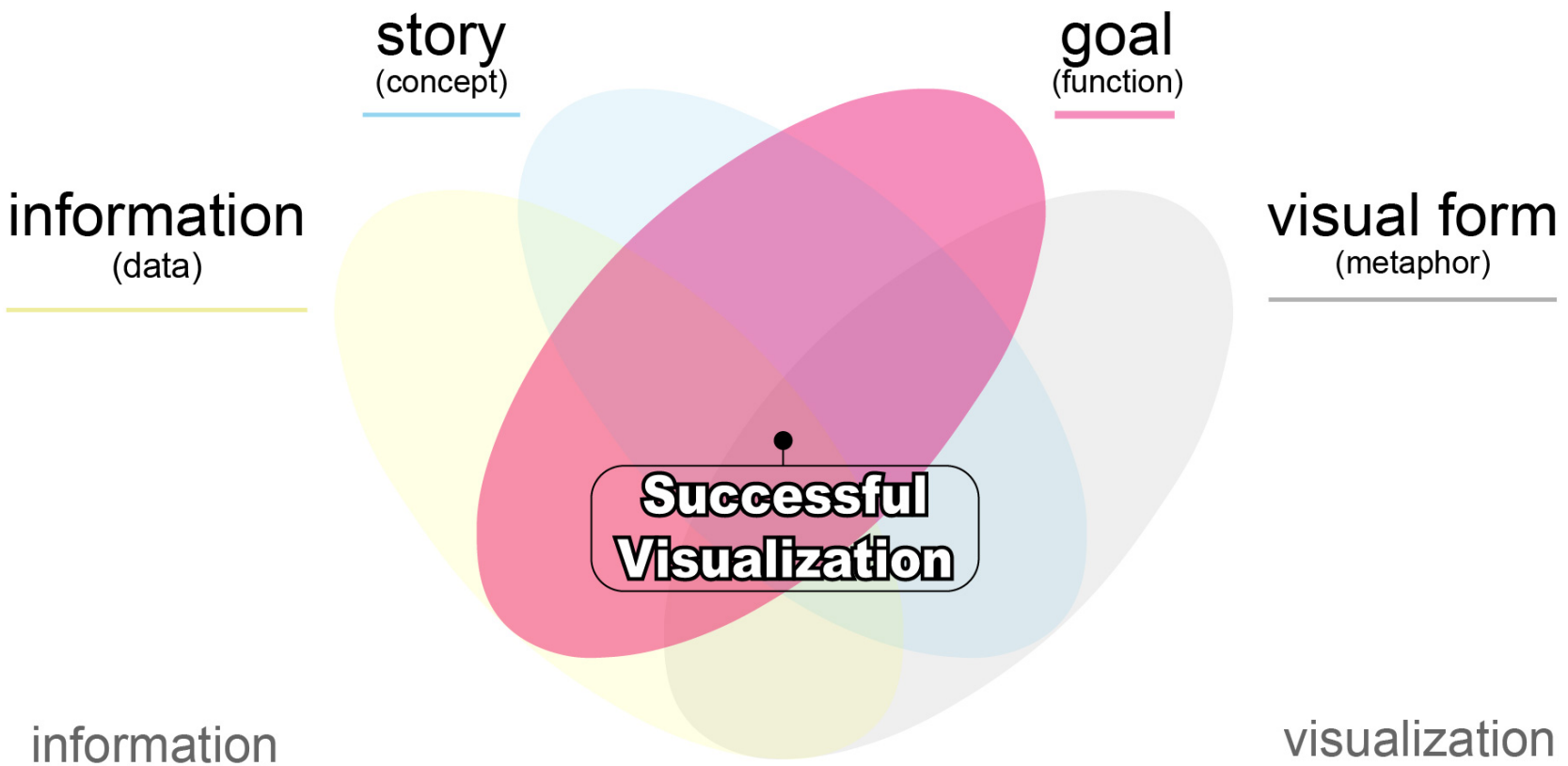


McCandless Offers a Thorough Definition of Good Data Stories



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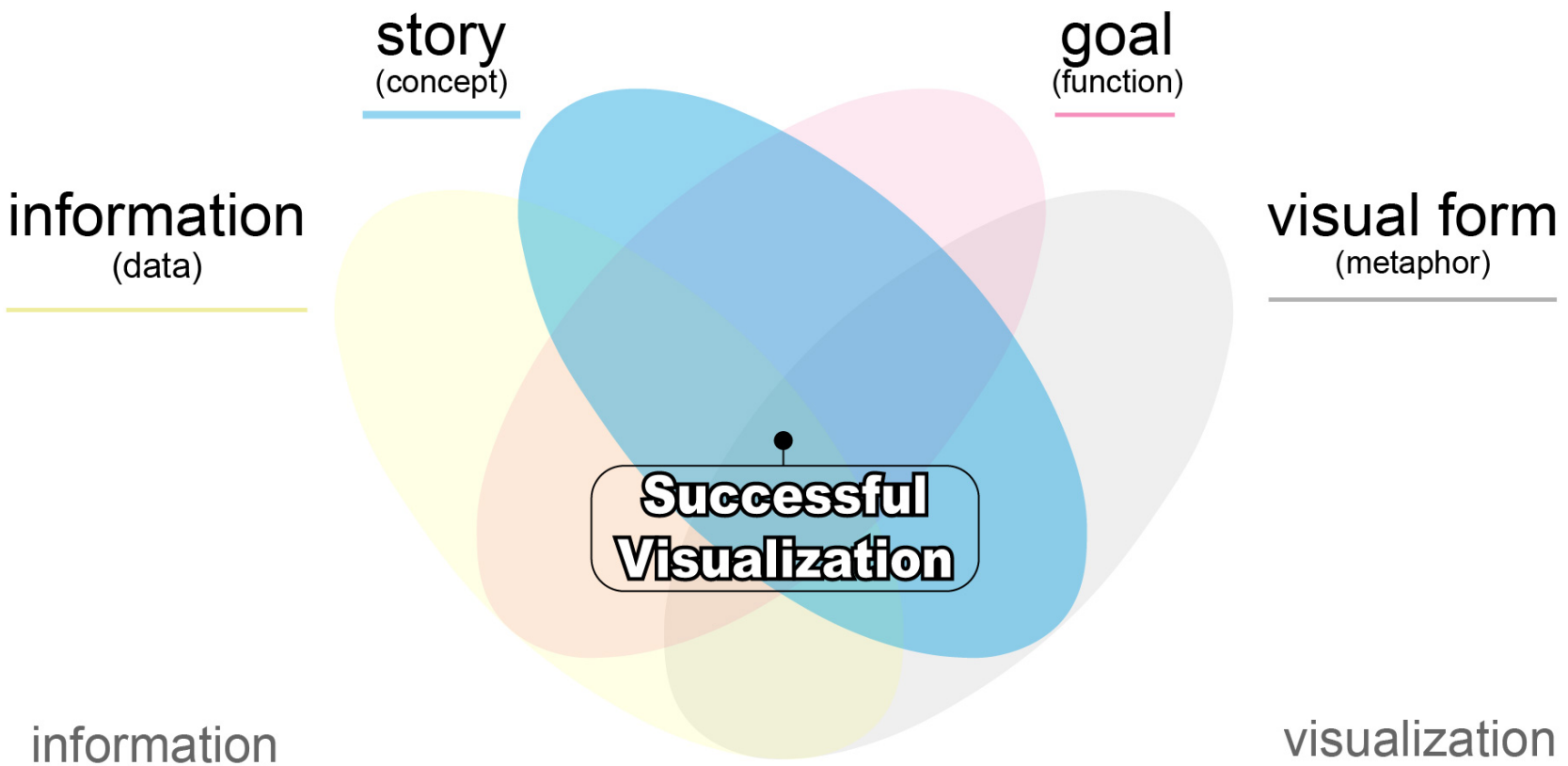
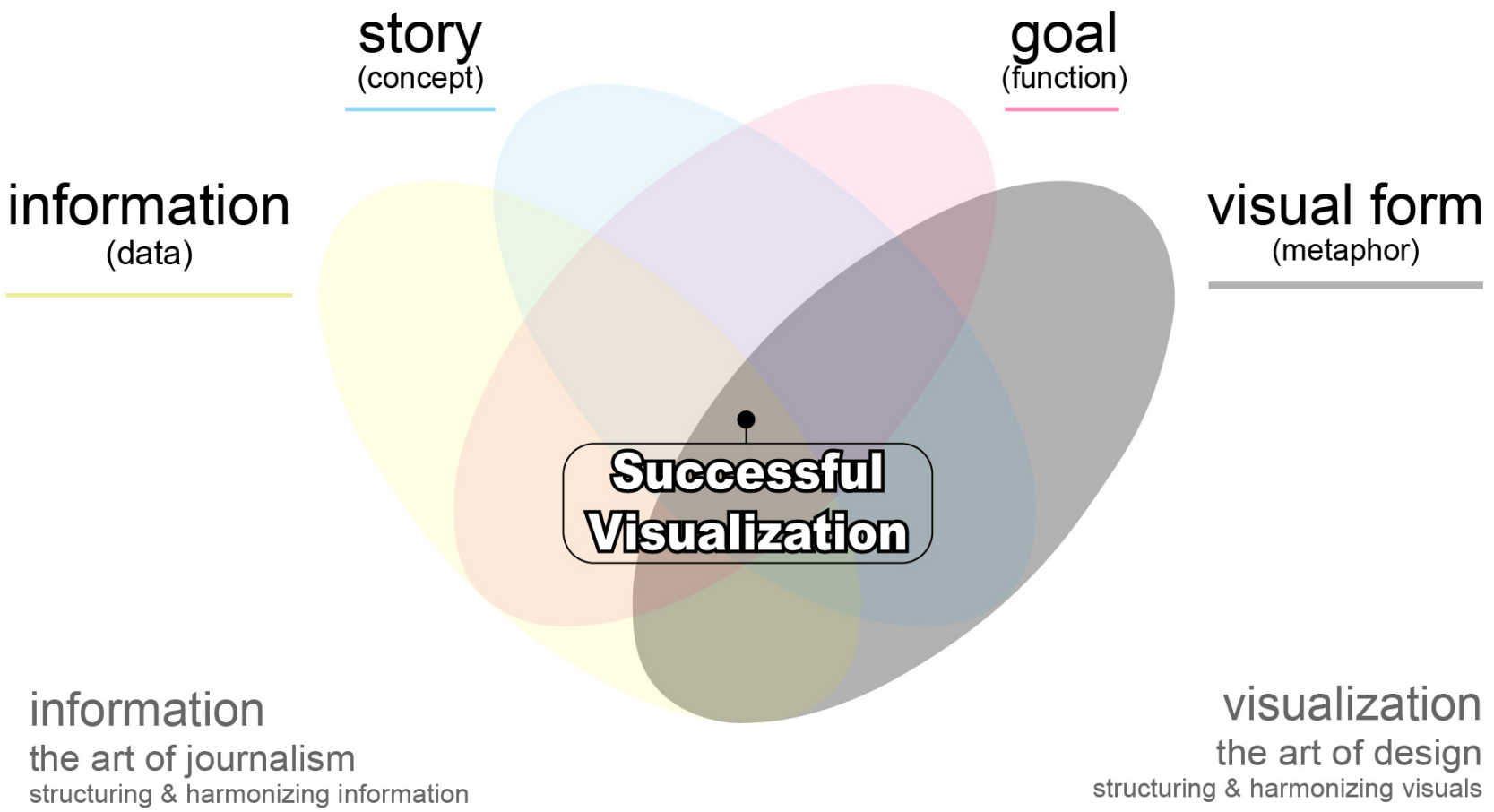


McCandless Offers a Thorough Definition of Good Data Stories



McCandless's Framework Brings Quality to All Dataviz Elements

Provides a clear answer to the elusive question: "What makes a data visualization good?"

Goes beyond simply considering the image to evaluate the entire creative process

Compels the author to pay attention to each individual component of a data visualization

Ensures all the elements come together to form a single, harmonious dataviz

In This Module

Module 1: Pictures You See with Your Brain

Key Concepts

- Studying the history of dataviz
- Understanding today's dataviz tools
- Making connections with visuals
- Evaluating the effectiveness of dataviz

References

Github. (2012). *Open Budgets EU's "Billion-dollar-o-gram" generator* [Online image]