

Recommendations for Your Data Visualization Bookshelf

Stephen Few

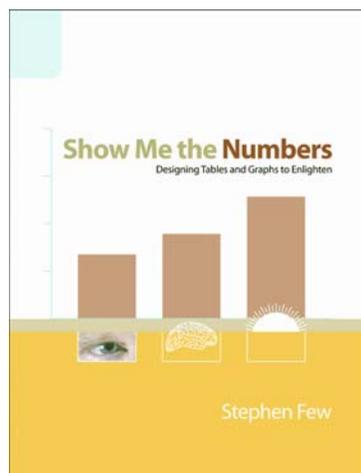
February 14, 2006

Over the years that I've been involved in data visualization, I have collected a number of books on the topic. Not every book in my library is great, but a few stand out as particularly useful for businesspeople who wish to become experts in using visualizations to analyze and communicate quantitative data. I have intentionally not included most of the books that focus on the visualization needs of scientists and statisticians. A few books that venture in this direction have been included, however, because they provide a great deal of general content that is extremely worthwhile, such as those by Edward Tufte and William Cleveland.

Fundamentals of Graph Design

I will begin the list with those books that cover the fundamentals of graph design for the communication of quantitative business information.

Even though it will appear self-promoting, I unapologetically recommend my own book, *Show Me the Numbers: Designing Tables and Graphs to Enlighten*, as the best available resource on the design of graphs (and tables) for communicating quantitative business information. As someone who has been involved in the business intelligence industry for many years, I am intimately aware of the needs of businesspeople who must make sense of quantitative information and then communicate what they learn to others. This book was specifically written as a simple, yet comprehensive resource for the practical needs of this audience in the language of this audience. The material is designed to support a rich learning experience and includes exercises to support this process.



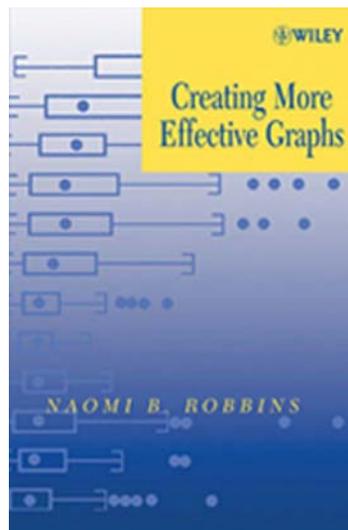
Show Me the Numbers: Designing Tables and Graphs to Enlighten
Stephen Few, Analytics Press: Oakland, CA, 2004

Chapters:

- Introduction
- Numbers Worth Knowing
- Fundamental Concepts of Tables and Graphs
- Fundamental Variations of Tables
- Fundamental Variations of Graphs
- Visual Perception and Quantitative Communication
- General Design for Communication
- Table Design
- General Graph Design
- Component-Level Graph Design
- Design Solutions for Multiple Variables
- The Interplay of Standards and Innovation

Another book on graphing fundamentals that I recommend, *Creating More Effective Graphs* by Naomi Robbins, ventures further than mine into the presentation of scientific research, drawing extensively from the work of William Cleveland. One of this book's chief objectives is to make the work of William Cleveland more accessible to non-scientists and non-academics.

When I initially discovered Naomi's work a few months ago, I was delighted. There are few independent writers and consultants who specialize in data visualization and know how to apply it to the practical needs of business. There is plenty of room in our field for multiple experts, and I appreciate the collegial relationship that we have begun to build. There is a great deal of overlap between Naomi's book and my own, and much consistency in the principles that we teach. Despite these similarities, her book features good material that I do not cover, or cover less extensively.



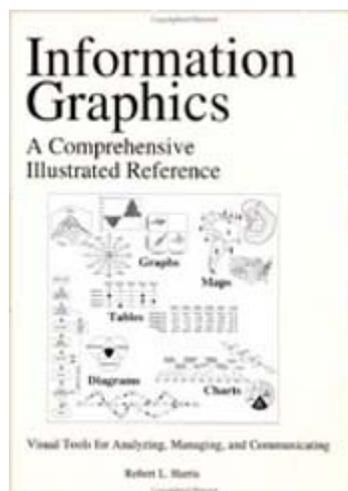
Creating More Effective Graphs
Naomi B. Robbins, John Wiley and Sons, Inc.: Hoboken, NJ, 2005

Chapters:

- Introduction
- Limitations of Some Common Charts and Graphs
- Human Perception and Our Ability to Decode Graphs
- Some More Effective Graphs in One or Two Dimensions
- Trellis Graphics and Other Ways to Display More Than Two Variables
- General Principles for Creating Effective Graphs
- Scales
- Applying What We've Learned: Before and After Examples
- Some Comments on Software
- Questions and Answers

Encyclopedic References

Every field of expertise needs a good encyclopedic reference. The only such reference that I've seen for data visualization, *Information Graphics: A Comprehensive Illustrated Reference*, is thankfully excellent. Robert L. Harris includes every means of graphically displaying information that you can imagine from A to Z, including non-quantitative diagrams (Gantt Charts, process flow diagrams, etc.). I often pull my copy from the shelf to look up obscure references that I run across in my work.



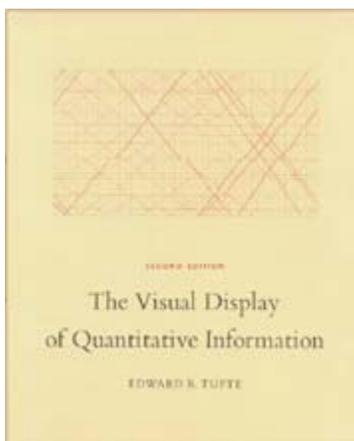
Information Graphics: A Comprehensive Illustrated Reference
Robert L. Harris, Oxford University Press: New York, NY, 1999

Advanced Data Visualization

In this section, I will list books by two authors, who have both served as important pioneers to the field of data visualization: Edward Tufte, probably the best known expert in the field, and William Cleveland, the person who provides the most comprehensive graph design guidelines for the scientific and academic communities.

Edward Tufte labors over his books with great love and manages to publish a new one about every seven years. Later this year he'll be coming out with his newest major work, *Beautiful Evidence*. His best known book is his first, *The Visual Display of Quantitative Information*, published in 1983. Much of my early inspiration, which eventually led me to write *Show Me the Numbers*, came from Tufte's first book and a desire to apply his visual design principles

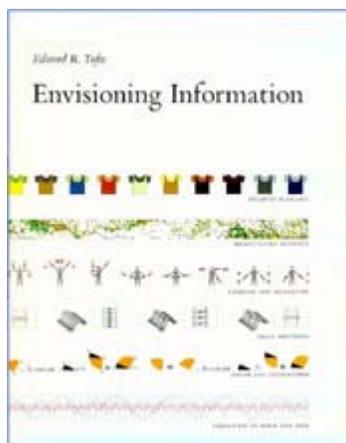
to the practical needs of business. All three of Tufte's books are beautifully designed and eloquently written. They belong on every information designer's bookshelf.



The Visual Display of Quantitative Information
Edward Tufte, Graphics Press: Cheshire, CN, 1983

Chapters:

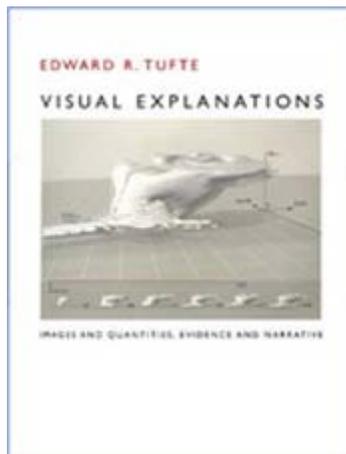
- Graphical Excellence
- Graphical Integrity
- Sources of Graphical Integrity and Sophistication
- Data-Ink and Graphical Redesign
- Chartjunk: Vibrations, Grids, and Ducks
- Data-Ink Maximization and Graphical Design
- Multifunctioning Graphical Elements
- Data Density and Small Multiples
- Aesthetics and Technique in Data Graphical Design



Envisioning Information
Edward Tufte, Graphics Press: Cheshire, CN, 1990

Chapters:

- Escaping Flatland
- Micro/Macro Readings
- Layering and Separation
- Small Multiples
- Color and Information
- Narratives of Space and Time



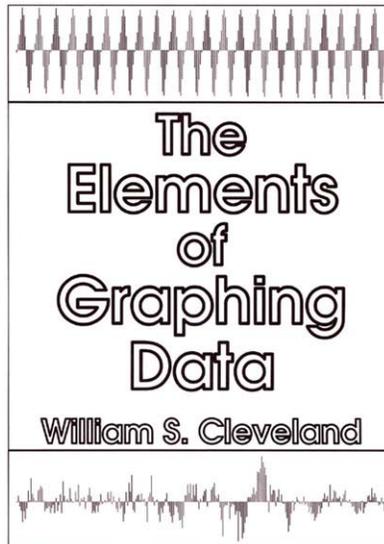
Visual Explanations

Edward Tufte, Graphics Press: Cheshire, CN, 1997

Chapters:

- Images and Quantities
- Visual and Statistical Thinking: Displays of Evidence for Making Decisions
- Explaining Magic: Pictorial Instructions and Disinformation Design
- The Smallest Effective Difference
- Parallelism: Repetition and Change, Comparison and Surprise
- Multiples in Space and Time
- Visual Confections: Juxtapositions from the Ocean of the Streams of Story

For those of you who want to delve into more sophisticated ways of presenting quantitative data and have a solid base in statistics, the books of William Cleveland are outstanding. His examples focus primarily on presenting the results of statistical analysis applied to scientific research. *The Elements of Graphing Data* carefully presents Cleveland's graph construction principles and methods in great detail.



The Elements of Graphing Data
William S. Cleveland, Hobart Press: Summit, NJ, 1994

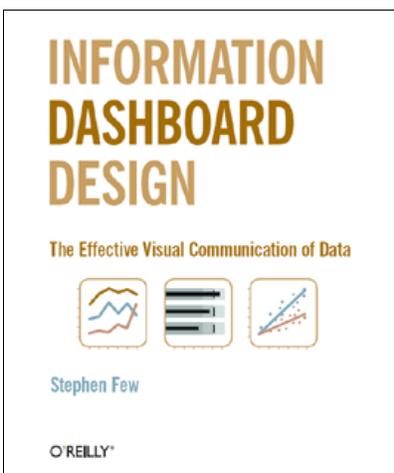
Chapters:

- Introduction
- The Power of Graphical Data Display
- The Challenge of Graphical Data Display
- Principles of Graph Construction
- Clear Vision
- Clear Understanding
- Scales
- Graphical Methods
- Logarithms
- Residuals
- Distributions
- Dot Plots
- Plotting Symbols and Curve Types
- Time Series
- Scatterplot Matrices
- Coplots of Scattered Data
- Statistical Variation
- Graphical Perception
- Superposed Curves
- Color Encoding
- Order on Dot Plots
- Banking to 45°
- Correlation

Dashboard Design

Thus far, the relatively new topic of visual dashboard design has only been addressed by one book, my own brand new publication, *Information Dashboard Design: The Effective Visual Communication of Data*. This book builds on the principles that I teach in Show Me the

Numbers for the construction of tables and graphs by addressing the challenges one faces when tasked with combining a great deal of disparate data on a single screen in a manner that doesn't end up looking like a cluttered mess. To learn about the uses and benefits of dashboards and how to conduct the implementation process, get a copy of Wayne Eckerson's *Performance Dashboards: Measuring, Monitoring, and Managing Your Business*. To learn how to design dashboards for rapid and clear information delivery, my book is the ticket.



Information Dashboard Design: The Effective Visual Communication of Data
Stephen Few, O'Reilly Media, Inc.: Sebastopol, CA, 2006

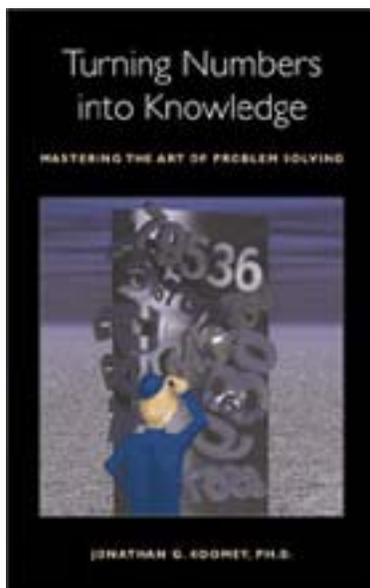
Chapters:

- Clarifying the Vision
- Variations in Dashboard Uses and Data
- Thirteen Common Mistakes in Dashboard Design
- Tapping Into the Power of Visual Perception
- Eloquence Through Simplicity
- Effective Dashboard Display Media
- Designing Dashboards for Usability
- Putting It All Together

Complementary Skills

To effectively display quantitative business information, you must know a bit about numbers themselves. You can easily get yourself into trouble if you do not understand a few simple statistical concepts. Quantitative data can be confusing and misleading if it is not handled with care. For instance, failing to take inflation into account when presenting monetary data across time can give a skewed impression of events, or using units of measure that most people cannot get their heads around can leave them spinning. Two books in my library address these issues in a manner that is practical, interesting and accessible.

The first book that I recommend on this topic is *Turning Numbers into Knowledge* by my friend and colleague Jonathan Koomey. After years of coaching data analysts in the proper use and presentation of numbers, Jonathan put the lessons that he found himself teaching again and again into a single delightful book.

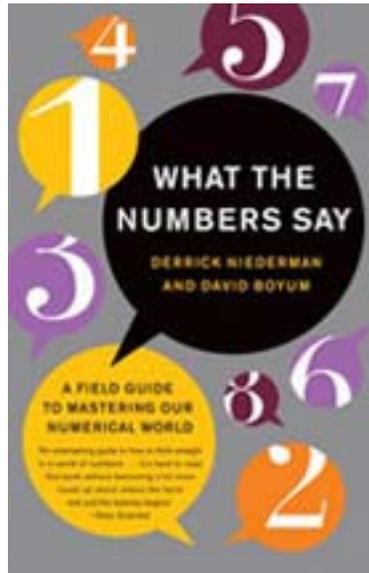


Turning Numbers into Knowledge: Mastering the Art of Problem Solving
Jonathan G. Koomey, Ph.D., Analytics Press: Oakland, CA, 2001

Sample chapters:

- Things to Know
- Information, Intention, and Action
- Peer Review
- Be Prepared
- Get Organized
- Build a Toolbox
- Put Facts at Your Fingertips
- Assess Their Analysis
- The Power of Critical Thinking
- All Numbers Aren't Created Equal
- Question Authority
- Distinguish Facts from Values
- Create Your Analysis
- Be a Detective
- Tell a Good Story
- Use Forecasts with Care
- Show Your Stuff
- Know Your Audience
- Document, Document, Document
- Use Numbers Effectively in Oral Presentations

The other valuable book on quantitative data, *What the Numbers Say*, was written by Derrick Niederman and David Boyum, who do a great job of revealing the “old-fashioned logic, not advanced mathematical tools” needed for most quantitative reasoning and presentation.



What the Numbers Say: A Field Guide to Mastering Our Numerical World
Derrick Niederman and David Boyum, Broadway Books: New York, NY, 2003

Chapters:

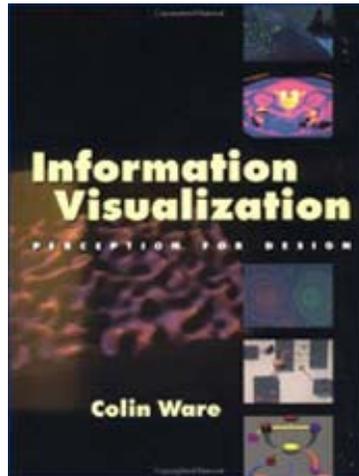
- The Quantitative Information Age
- The Ten Habits of Highly Effective Quantitative Thinkers
- For Good Measure
- Playing the Percentages
- Gaining Perspective
- Throwing a Curve
- Taking Chances
- The Proof Is in the Numbers
- A Peace Offering for the Math Wars

Visual Perception

Obviously, data visualization is a visual means of presenting information. To visualize data effectively, you must understand a few things about how people see and how they make sense of what they see. Two books stand out as excellent sources of what we know about visual perception and how that knowledge can be applied to data visualization.

The best general reference on this topic is definitely Colin Ware’s, *Information Visualization: Perception for Design*. He surveys all of the important scientific research in visual perception and describes how the discoveries of this research can be applied to the presentation of data. As a scientist, Ware includes explanations and evidence that we non-scientists might find

difficult to follow, but the book is filled with many important facts about visual perception that are presented in a language that we can all understand. If you are like me and enjoy learning how things work and why, you need this book.



Information Visualization: Perception for Design, Second Edition
Colin Ware, Morgan Kaufmann Publishers: San Francisco, CA, 2004

The other book that I recommend in this category is *A Field Guide to Digital Color* by my friend and colleague Maureen Stone. As the title suggests, this book is all about color, not a general treatise on visual perception. Because color is so important to the effective presentation of data and so often misused, this book is definitely worth having. Maureen has thought a great deal about appropriate color choices for data presentation to get the most from this powerful attribute of visual perception.



A Field Guide to Digital Color
Maureen C. Stone, A K Peters, Ltd.: Natick, MA, 2003

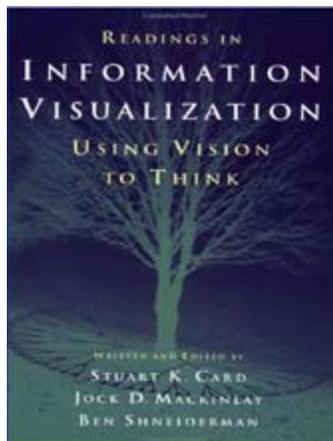
Chapters:

- Color Vision
- Color Appearance
- RGB and Brightness—Fundamental Concepts

- Color in Nature
- Color Reproduction
- Color Image Capture
- Additive Color Systems
- Subtractive Color Systems
- Color Management Systems
- Color in Computer Graphics
- Color Selection and Design
- Color in Information Display

Visual Data Analysis

Whereas the previous categories have focused on using visualization to communicate data, this final category focuses on how visualization can help us think about the data. Many powerful visualization designs and interaction techniques for discovering meaningful patterns, trends and exceptions and making sense of them have been developed by researchers, especially in the last 20 years, primarily at universities. Interactive, computer-based visualizations extend our ability to explore and understand data in ways that would otherwise be difficult or impossible. The results of this research are beginning to find their way more and more into commercial software today and are ushering in an entirely new level in our ability to achieve business intelligence. The best introduction to findings and inventions of information visualization research is *Readings in Information Visualization: Using Vision to Think*, by three prominent innovators in the field: Stuart Card, Jock Mackinlay, and Ben Shneiderman.



Readings in Information Visualization: Using Vision to Think

Stuart K. Card, Jock D. Mackinlay, and Ben Shneiderman, Morgan Kaufmann Publishers: San Francisco, CA, 1999

Chapters:

- Information Visualization
- Space
- Physical Data
- 1D, 2D, 3D
- Multiple Dimensions > 3
- Trees
- Networks

- Interaction
- Dynamic Queries
- Interactive Analysis
- Overview + Detail
- Focus + Context
- Fisheye Views
- Bifocal Views
- Visual Transfer Functions
- Alternate Geometry
- Data Mapping: Document Visualization
- Text in 1D
- Text in 2D
- Text in 3D
- Text in 3D + Time
- Infosphere, Workspace, Tools, Objects
- Internet and Infosphere
- Information Workspaces
- Visually Enhanced Objects
- Using Vision to Think
- Applications and Implications

Only the Core

These books will serve as a good core set of resources for your work in data visualization. They are certainly not the extent of what you will add to your library if you catch the fever and become eager, as I have, to find everything you possibly can on the topic. Perhaps you will even reach the point where you're willing to fork over \$300 or more to get your hands on a used copy of Jacques Bertin's *Semiology of Graphics* and find yourself browsing the obscure corners of dusty bookstores hoping for a glimpse of an old volume by William Playfair. If you do, welcome to the club.

About the Author

Stephen Few has worked for over 20 years as an IT innovator, consultant, and teacher. Today, as Principal of the consultancy Perceptual Edge, Stephen focuses on data visualization for analyzing and communicating quantitative business information. He provides training and consulting services, writes the monthly *Visual Business Intelligence Newsletter*, speaks frequently at conferences, and teaches in the MBA program at the University of California, Berkeley. He is the author of two books: *Show Me the Numbers: Designing Tables and Graphs to Enlighten* and *Information Dashboard Design: The Effective Visual Communication of Data*. You can learn more about Stephen's work and access an entire library of articles at www.perceptualedge.com. Between articles, you can read Stephen's thoughts on the industry in his blog.