Cool Infographics

Effective Communication with
Data Visualization and Design

By
Randy Krum

WILEY

Vision trumps all other senses. We learn and remember best through pictures, not through written or spoken words.

—John Medina, *Brain Rules*

1
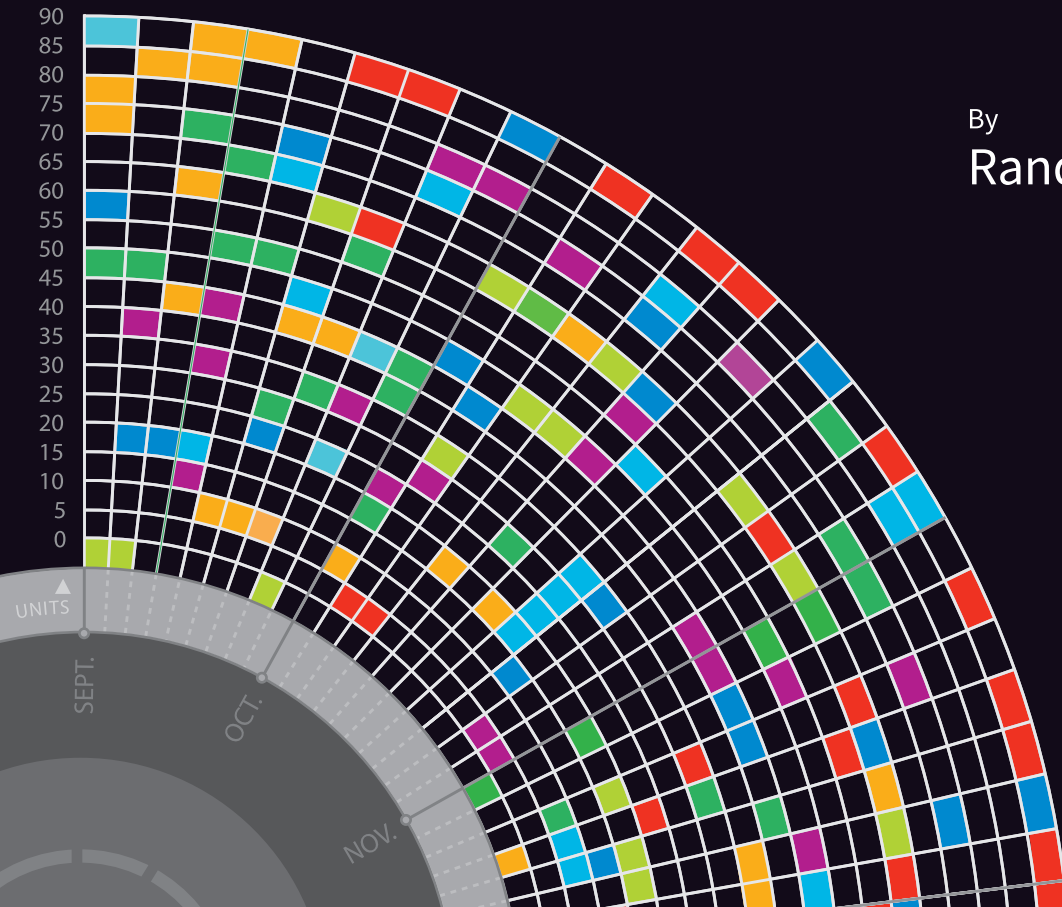
The Science of Infographics

Why do people love infographics?

Humans have been drawing pictures to communicate with each other for thousands of years—from pictograms on cave walls to Egyptian hieroglyphics to ideograms on modern signs (Figure 1-1). People love using pictures to communicate and tell stories because it's hardwired into the human brain.

Infographics and data visualizations are all around us. We are surrounded by visual representations of information—charts, maps, icons, progress bars, signs, posters, diagrams, and online visuals (Figure 1-2). These are all examples of visual communication, but these are not all infographics.

FIGURE 1-1
Altamira bison
cave painting,
ancient Egyptian
hieroglyphics, and
modern signs.

The word *infographic* is used by people to mean many different things. In many cases infographics and *data visualizations* are considered synonymous, but in the world of an infographic designer they mean different things.

Data visualizations are the visual representations of numerical values. Charts and graphs are data visualizations and create a picture from a given set of data. Figure 1-3 shows the price chart of the S&P 500, the NASDAQ, and the Dow Jones Industrial Average since 1950. The reader can easily see the overall upward trend and the comparison between the three data sets. Including the volume chart beneath the price chart, this data visualization creates a picture using at least 80,000 data points.

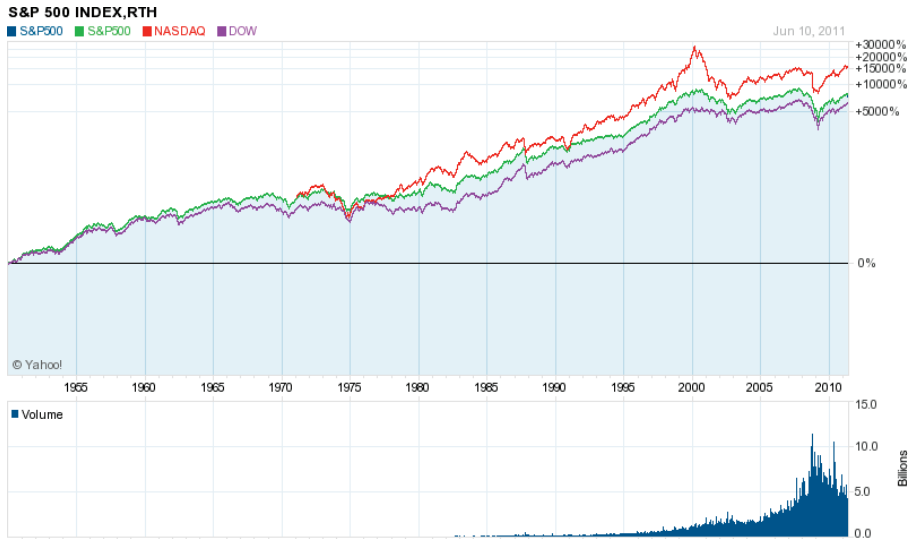**FIGURE 1-2:** Collage of infographics and data visualizations

FIGURE 1-3: Stock price chart

It takes us only seconds to understand the long-term trend, to see the close relationship between the three indices, and to see the significant spikes and falls in the stock market. This visualization easily fits on one piece of paper, a computer screen without scrolling, or a presentation slide. Seeing the entire data set on one page, we can understand the data quickly and with little effort.

This is an efficient way to communicate data. Data visualizations can be very space efficient by visualizing a large set of numbers in a small space. By designing a visualization that displays all of the data within the readers' field of view, this enables us to see the entire data set with minimal eye movement without scrolling or flipping between pages.

If we looked at a spreadsheet with 80,000 values instead, how long would it take us to get a general understanding of the market?

In 2001, Dr. Edward R. Tufte, one of the pioneers of modern data visualization and professor emeritus of political science, statistics, and computer science from Yale University, clearly explained this phenomenon when he stated, "Of all methods for analyzing and communicating

statistical information, well-designed data graphics are usually the simplest and at the same time the most powerful."[1]

This screen shot (Figure 1-4) from the StockTouch app on an iPad is another example of a good data visualization design. The top 100 largest U.S. stocks are shown from nine different market sectors. In this view, the companies from each market segment are organized in a spiral pattern from largest (in the center) to smallest. Each stock is color coded based on its stock price performance over the prior 12 months, but the time period is adjustable with the slider on the right. The shades of green show stock prices that have increased, and shades of red show prices that have decreased.
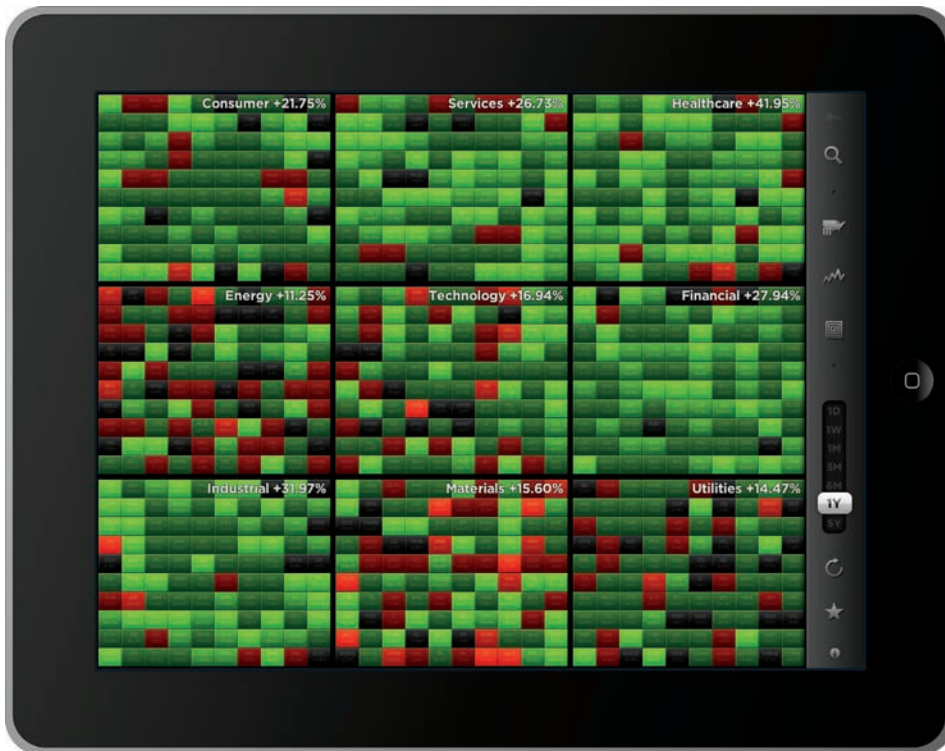

FIGURE 1-4: Heatmap visualization of stock price changes

coolinfographics.com/Figure-1-4

Source: StockTouch iOS app, Visible Market, Inc.

Whether it's a new definition or an additional definition of the term *infographics*, its use now implies much more than just a data visualization. Up until recently, a common definition for infographics was simply "a visual representation of data"; however, that definition is outdated and is more indicative of data visualizations. Originally derived from the phrase *information graphics*, infographics was a term used in the production of graphics for newspapers and magazines.

Today, the use of the word infographics has evolved to include a new definition that means a larger graphic design that combines data visualizations, illustrations, text, and images together into a format that tells a complete story. In this use of the word, data visualizations by themselves are no longer considered to be complete infographics but are a powerful tool that designers often use to help tell their story visually in an infographic.

This new definition of infographics is used consistently throughout this book. and data visualizations are meant as a separate design element used within the design of infographics. The art of data visualization is a huge topic about which many books have been written and is taught in many university classes. For the purposes of this book, they are not synonymous.

As shown in Figure 1-5, charts were the primary design element used to create the infographic, *Could You Be a Failure?* The designer, Jess Bachman (byjess.net), combined data visualizations (line charts), along with text, illustrations, and a photo of a Sharpie marker into this complete infographic design. The overall design is considered to be one infographic that uses many data visualizations in its design.

However, the best infographics tell complete stories. Infographics have become more like articles or speeches than charts. Their purpose can be categorized into the same three objectives as public speaking: to inform, entertain, or persuade the audience. They have introductions to get readers' attention, so the readers know why they should take the time to read the infographic. They end with conclusions and calls to action, so the readers have some indication of what they should do with the information they have just learned.
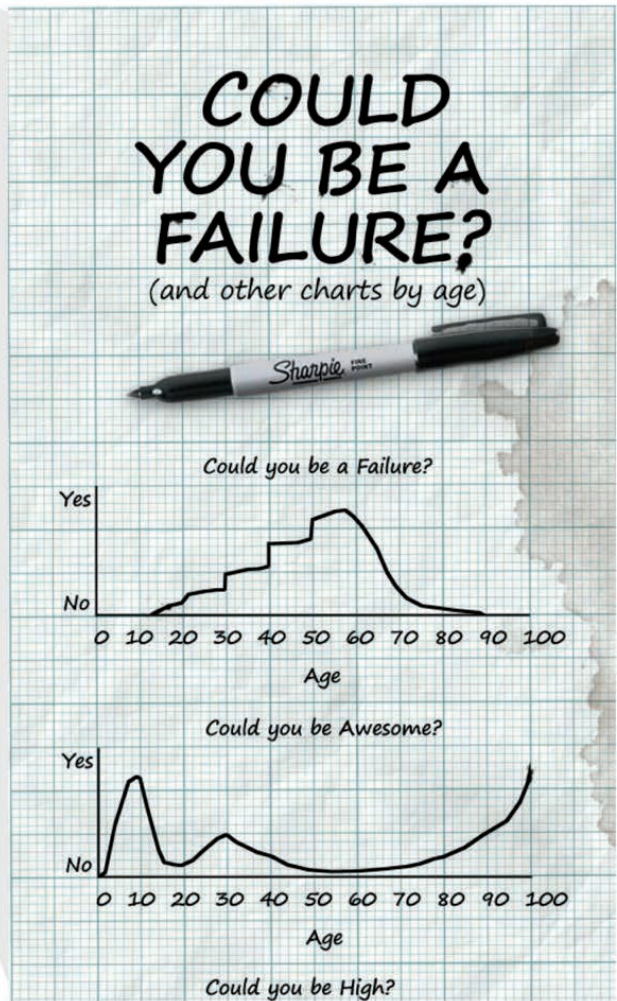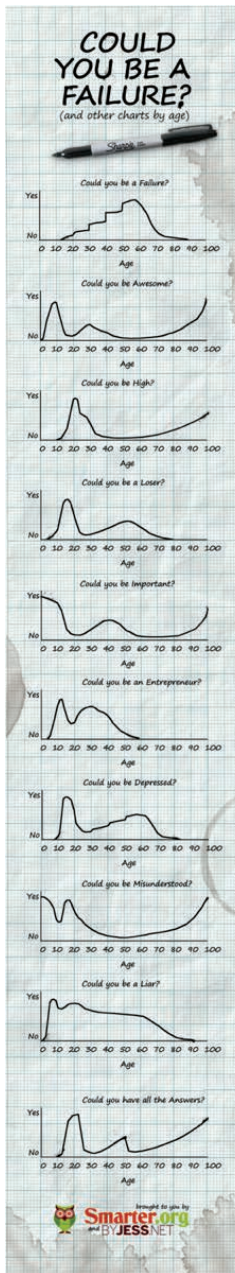
FIGURE 1-5: Infographic design made from 10 data visualizations

coolinfographics.com/Figure-1-5

Source: Could you be a Failure? *from Jess.net and Smarter.org*

This is how many would-be designers end up designing bad infographics. Many designs simply put a bunch of data visualizations on the same page without a cohesive story. They include all the data available, instead of choosing only the data relevant to a central storyline. The process of good infographic design is about storytelling and not about just making your data visualization pretty or eye-catching.

The term infographics is also becoming mainstream. Thirty years ago, the word was only used by art directors and print publications, but the Internet has changed that. Figure 1-6 (based on data from Google Insights for Search) shows that the last 3 years (2010–2012) has seen extraordinary growth in people searching for the term *infographic*. The Internet is turning infographics into a household word.

FIGURE 1-6:
Growth of search for the term infographic

Explosive growth of the search term "**infographic**" has been more than 20 times in the last 3 years.
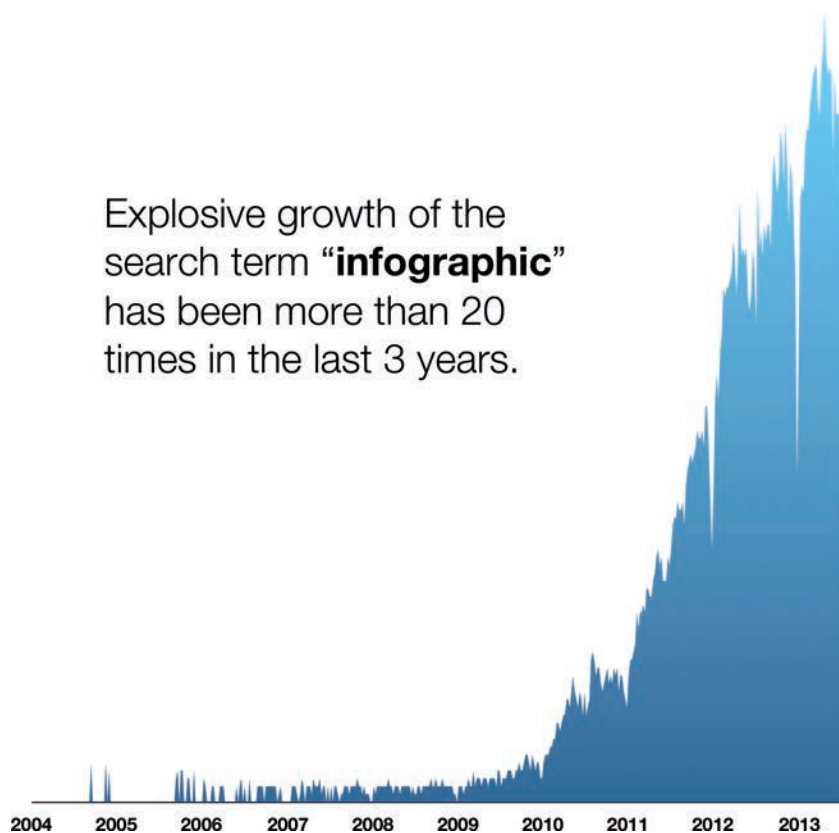
Information Overload

We are all confronted with an immense amount of data and information every day—news, advertisements, e-mail, conversations, text messages, tweets, books, billboards, signs, videos, and of course the entire Internet. The challenge we face is to filter out the junk, focus on the relevant information, and remember the important stuff.

It's a push-pull problem. We are actively seeking information, and at the same time, companies and advertisers are pushing their information at us.

The Rise of the Informavore

The first part of this problem is that people are constantly looking to find new information. In a real sense, we are our own enemy. We are confronted by most of the information because we look for it. The simplified reason for this is that we want to be better informed so we can make better decisions.

In 1983, George A Miller[2], one of the founders of the field of cognitive psychology, coined the term *informavore* to describe the behavior of humans to gather and consume information (Figure 1-7). It was later popularized by philosopher Daniel Dennett[3] and by cognitive scientist Steven Pinker[4]. Miller states, "Just as the body survives by ingesting negative entropy, so the mind survives by ingesting information. In a very general sense, *all higher organisms are informavores.*"

In 2000, technology writer Rachel Chalmers[5] wrote, "We're all informavores now, hunting down and consuming data as our ancestors once sought woolly mammoths and witchetty grubs." She wrote that description as part of her article on how researchers at Xerox's Palo Alto Research Center in California were investigating how people find information on the Internet by using anthropology to compare them to the foraging habits of early humans. Here's the condensed version: The results were that the two behaviors were similar.
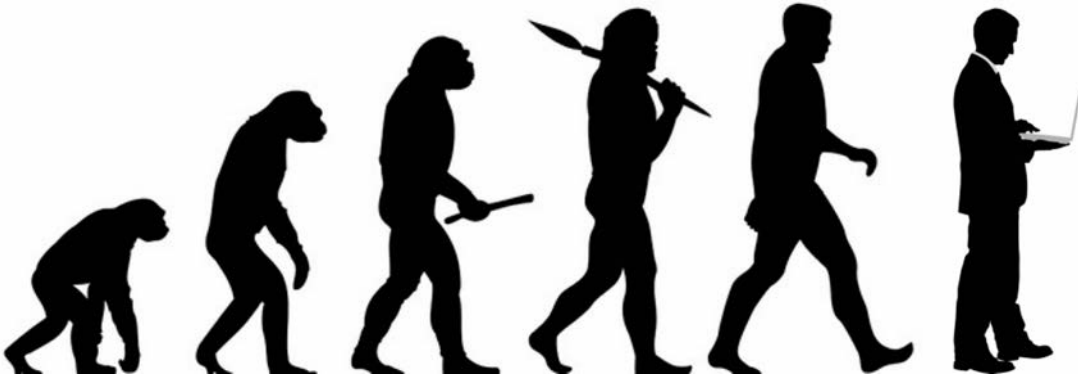
FIGURE 1-7: The evolution of the informavore

This behavior of hunting for information is not new. Humans have been driven to gather new information since before recorded history. It's a major reason that humans have not only survived, but also have developed the advanced civilization that exists today. How to grow better crops, how to build better weapons, and how to survive the winter, successfully hunting for more food, killing invading enemies, and so on. Our species thrives because we are constantly learning and improving.

There is also an immense amount of pressure to make better decisions. Why do people still make poor choices when this massive library of human knowledge is available? For example, people are pressured to research products before making purchase decisions because price comparisons, promotional offers, star ratings, customer reviews, expert recommendations, feature comparisons, and third-party testing results are easily available.

Part of this behavior is that people want to be perceived by others as having made good, well-informed decisions. It might take days to decide which is the best, new microwave to buy because we respond to this pressure by doing more research. We need more data, so we go looking for it.

The Rise of Big Data

We live in the Information Age. People have more information at their fingertips than at any time in history, and this problem is going to get worse (or better, depending on your point of view). It's like putting a starving man in a Las Vegas buffet restaurant. We see this growth in data all around us; however, it's hard to quantify how much information we see every day.

On average, we are exposed to the information equivalent of 174 newspapers every day (assuming an 85-page newspaper). This research by Dr. Martin Hilbert[6] at the University of Southern California looked at the state of information capacity in 2007, and the results represented an incredible growth when compared to the information equivalent of only 40 newspapers per day in 1986 (Figure 1-8).

Another way we can estimate the sheer magnitude of information is by measuring the amount of data that moves across the Internet. First, here's a quick reminder of how data is measured. In Figure 1-9, the tiny yellow square in the bottom-left corner represents 1 gigabyte of data (a single pixel on the computer screen). The larger, blue square represents 1 terabyte of data, and the big, purple square represents 1 petabyte. Each square is 1,024 times larger than the previous square.

Estimates from 2008 are that Google was processing 24 petabytes of data each day[7] and that the entire written works of mankind, from the beginning of recorded history, in all languages would be a total of 50 petabytes.[8]

With the size of a petabyte in perspective, the Cisco Visual Networking Index[9] makes more sense. Figure 1-10 shows you the historical Internet traffic that has been measured and leads up to the future projection of more than 120,000 petabytes per month by 2017.

Information equivalent of 174 newspapers per day

Up from only 40 newspapers in 1986
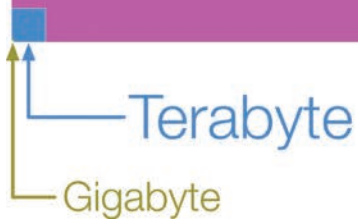
FIGURE 1-9: The size of a petabyte

FIGURE 1-10:
Global Internet
traffic growth

**Global Internet Traffic Growth
(Petabytes/Month)**

Over 120,000
Petabytes/Month
in 2017

125,000

100,000

75,000

50,000

25,000

1990   1995   2000   2005   2010   2015

Visual Networking Index, Cisco, 2013
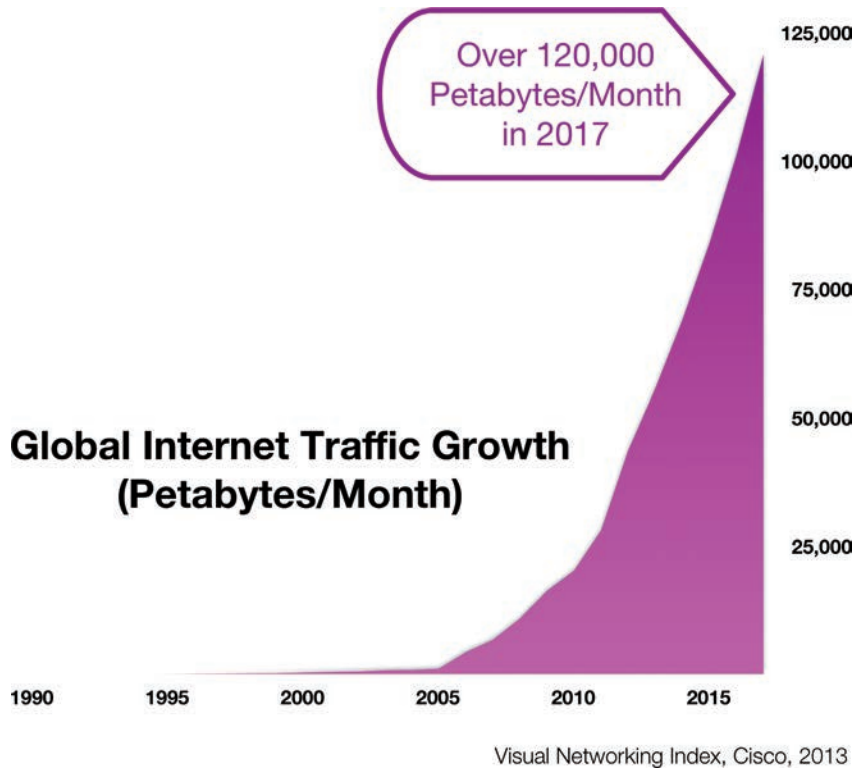
The amount of data available in the modern world can be measured in many ways, but they all indicate that it will continue to increase.

Why Infographics Work

So, how can we cope?

There are a number of reasons why visual information is a more effective form of communication for humans. The main reason is that vision is the strongest form of input that we use to perceive the world around us. In his book *Brain Rules*, developmental molecular biologist John Medina states, "Vision is by far our most dominant sense, taking up half of our brain's resources."[10]

Studies estimate that between 50–80 percent of the human brain is dedicated to forms of visual processing,[11][12] such as vision, visual memory, colors, shapes, movement, patterns, spatial awareness, and image recollection.

Pattern Recognition

Humans are pattern recognition machines. Yes, this comes from the evolution of a survival instinct. To survive, humans needed to see a situation and react appropriately in mere seconds. We can see the scene from the photo in Figure 1-11, recognize the lion hiding in the grass, understand the mortal danger we may be in, and start running away in a fraction of second.

FIGURE 1-11: Lion hiding in the grass

Visualizing data taps into this pattern recognition ability and significantly accelerates the understanding of the data.[13] You can look at a chart of data presented and understand it quickly by seeing the patterns and trends. This is a much faster way to comprehend information compared to reading numbers, comprehending the math, and then imagining in your mind how the numbers relate to each other.

The human ability to see patterns and trends quickly is the major reason why data visualizations are so powerful as components of infographic design.

The Language of Context

Data visualization is the language of context, which is all about showing multiple values in comparison to each other to provide context for the reader. If we see a number in text by itself, we don't know how to understand it.

Figure 1-12 shows a numeric value in text by itself. In isolation, the brain doesn't know how to comprehend this value. Is it big or small, good or bad, increasing or decreasing? You don't know. If no context is provided, your brain tries to provide context from your own experiences. You may think: *There are a lot of digits, so it looks like it might be a big number. I know there are about 500 kids in my son's school, so this number sounds very big in comparison!"*

This is the baggage that an audience brings with them. If the designer doesn't provide context to help understand the value, the audience will make up their own. Chances are good that it won't be how the designer intended the audience to interpret that data. To communicate clearly, the context needs to be provided to them.

We can't effectively visualize a number all by itself. The bar chart in Figure 1-13 has only one bar and it doesn't provide context to the readers either.

There are approximately

2,267,233,742

global Internet users

FIGURE 1-12: A text number by itself has no context. [14] [15]

Global Internet Users
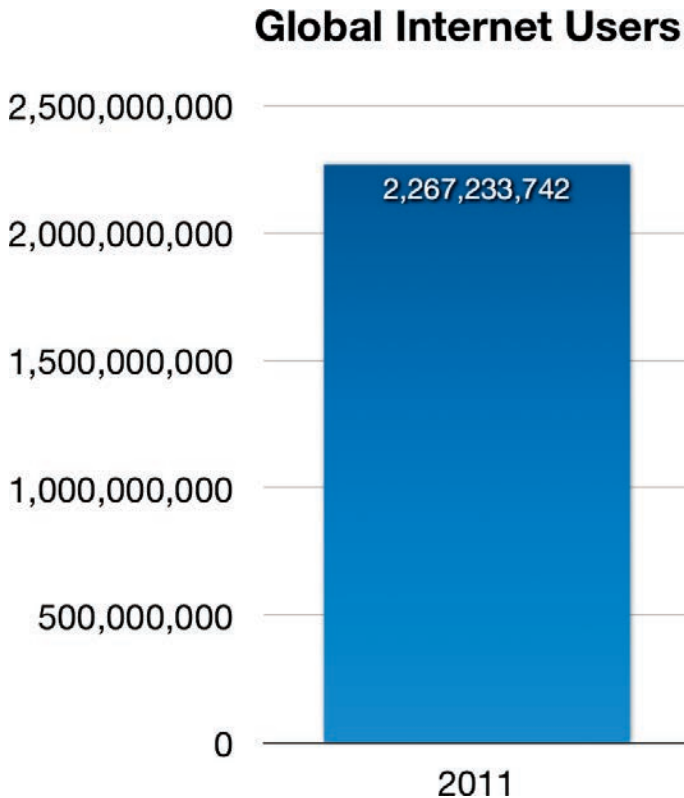
FIGURE 1-13:
A bar chart with only one bar doesn't provide context.

2,500,000,000

2,000,000,000 — 2,267,233,742

1,500,000,000

1,000,000,000

500,000,000

0

2011

Adding a second value for comparison puts the original value into context for the reader. It provides a frame of reference to give the reader a way to understand the magnitude of the original number. Figure 1-14, includes the population of the United States for comparison, using circles to visualize both values.

Now the readers have a way to comprehend the original number by comparing it to something they might be familiar with. They might think: *"The number of global Internet users is more than seven times larger than the total population of the United States. That's a lot of Internet users!"*

There are approximately

2,267,233,742

global Internet users

InternetWorldStats.com
Dec 31, 2011

Approximately

311,591,917

Total people in the U.S.

US Census Bureau (USCB)
July 2012

By providing the second number as a comparison, the designer can control the context that the audience uses to understand the data. Visualizing the two numbers taps into the pattern recognition of the brain, and even if the audience doesn't already know the population of the United States, they can see the comparison between the two values. Context is a powerful tool for the designer.

However, with great power comes great responsibility. *All data visualization is biased.* This upsets a lot of people that want data visualizations to be objective and "true to the data." By putting numbers into context for readers, the designer is shaping the perception of the values. This introduces bias into the data visualization.

The choices a designer makes bring bias to the design. Just by choosing which numbers to include in the visualization for comparison creates some bias in the design. What numbers are left out? How far back in time should data be used to show a trend? How recently was the data collected? All of these choices introduce small and large elements of bias to the design.

Figure 1-15 changes the reference value used to create context to be the estimated total population of Earth.[15] Now the original value appears smaller in comparison because only approximately one-third of the world population has access to the Internet. This changes the reader's perception and understanding of the original value.

Notice the data visualization style is changed between the two examples. In the first visualization, not everyone in the United States has access to the Internet, so they display as two separate circles. In the second visualization, all Internet users are part of the total population of the planet, so the reader can visualize them as a portion of the total in a pie chart.

Designers need to balance two conflicting demands—the need to communicate a message and the need to minimize bias in the design. Designers struggle with this challenge every day.

FIGURE 1-15:
Providing a differ-
ent second value for
context

There are approximately

2,267,233,742

global Internet users

InternetWorldStats.com
Dec 31, 2011

Approximately

7,009,000,000

Total people on Earth

US Census Bureau (USCB)
July 2012

The Picture Superiority Effect

Probably the strongest way that visual systems can benefit us is in
memory retention. People remember pictures better than words,
especially over longer periods of time. This phenomenon is called the
Picture Superiority Effect.

Even without understanding the science behind the concept, advertisers
have known this intuitively for many years. Even in simple applica-
tions such as the *Yellow Pages*, listings that include pictures are more

successful. People are more likely to remember the company advertised if there was an image included in the listing.

This is also the primary reason why companies design logos for themselves, as seen in Figure 1-16. People are more likely to remember the company logo, an illustration representing the company, than the actual name of the company. When it comes to purchase decisions, consumers are more likely to buy products from familiar companies. When buyers are in a store looking at products on the shelf, they are more likely to choose the products from companies they recognize, and logos are more likely to be remembered. Companies know this, and are very careful to design their product packaging to clearly show the company or brand logo.

Starbucks Corporation

Apple, Inc.

The Coca-Cola Company

Nike, Inc.

The Home Depot U.S.A. Inc.

Budwiser, Anheuser-Busch

FedEx Corporation

FIGURE 1-16:
Consumers are more likely to remember a company's logo than the text of the company name

Based on research into the Picture Superiority Effect (Figure 1-17), when we read text alone, we are likely to remember only 10 percent of the information 3 days later. If that information is presented to us as text combined with a relevant image, we are likely to remember 65 percent of the information 3 days later![10]

Combining relevant images with your text dramatically increases how much your audience remembers by 650 percent!

However, it's not just any image. It needs to be an image relevant to the content, which reinforces the message from your data. This works in advertisements, presentation slides, posters, brochures, websites, billboards, and, of course, infographics. A simple text message combined with a relevant image can make a lasting, memorable impression on your audience (Figure 1-18).

FIGURE 1-17:
Picture Superiority Effect
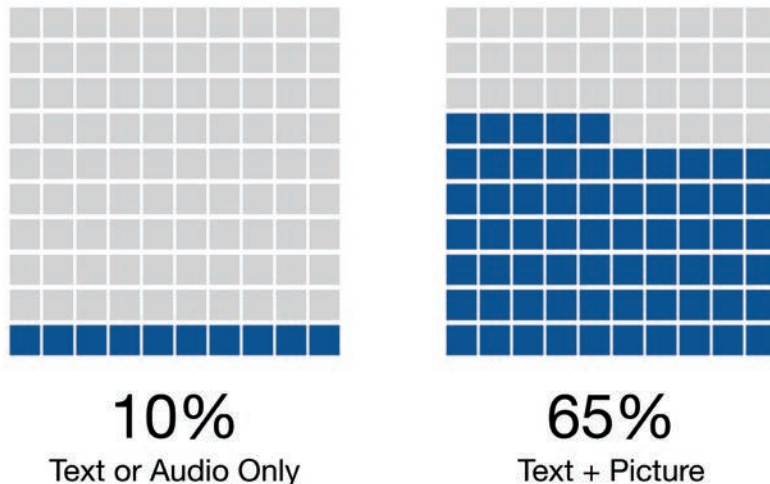
Picture Superiority Effect
Memory retention after 3 days

10%
Text or Audio Only

65%
Text + Picture

Getting information off the
Internet is like taking a
drink from a fire hydrant.
Mitchell Kapor

In 1917, artist and illustrator James Montgomery Flagg designed the still-famous "I Want YOU for U.S. Army" poster (Figure 1-19) that combines a simple text message with a dramatic image depicting Uncle Sam.[16] This poster is still recognizable and remembered almost 100 years later because of the Picture Superiority Effect. Without the image portion, no one would remember these posters at all.

In infographic design, the Picture Superiority Effect is extended to include charts, graphs, and data visualizations. Infographic designers use data visualizations and illustrations as the visual component of a design to trigger the Picture Superiority Effect, which can have incredible success getting the audience to remember the information presented.

FIGURE 1-19: "I Want YOU" poster from World War I, designed by James Montgomery Flagg

The secret is that the visualization needs to stand out. Just because you include a chart doesn't make a design interesting or memorable. The visualization must be unique and impactful, or it won't be memorable to the audience. Just as seeing a presentation full of similar bar charts can put an audience to sleep, if an infographic designer uses the same chart style over and over again, the audience won't remember the difference between multiple designs. Designers can spend a lot of time working on the design of one data visualization to find a new style or visualization method. This long amount of time focused on one chart design can contribute to why many people mistakenly think that info-graphic design is just about making charts pretty.

In 2010, Sam Loman designed the infographic *Underskin*, shown in Figure 1-20. The design maps eight different systems within the body (Digestive, Respiratory, Arterial, and more) and highlights the major connection points using the visualization style of a subway map. The design was unique and stood out because it wasn't a text list or a bunch of callouts on an image of an actual human body. Even though the sub-way map design style was well known, it had never been applied to this medical topic before, and the design stood out dramatically compared to other medical information sources. Even though it was intended for a medical audience, the design went viral with the general public online on many nonmedical sites such as Gizmodo, Behance, Vizworld, Infor-mation Aesthetics, Neatorama, Flickr, and Cool Infographics.

Loman effectively applied an existing design style to a new set of infor-mation to create a visualization that was new and different. The result-ing design is definitely unique and memorable.
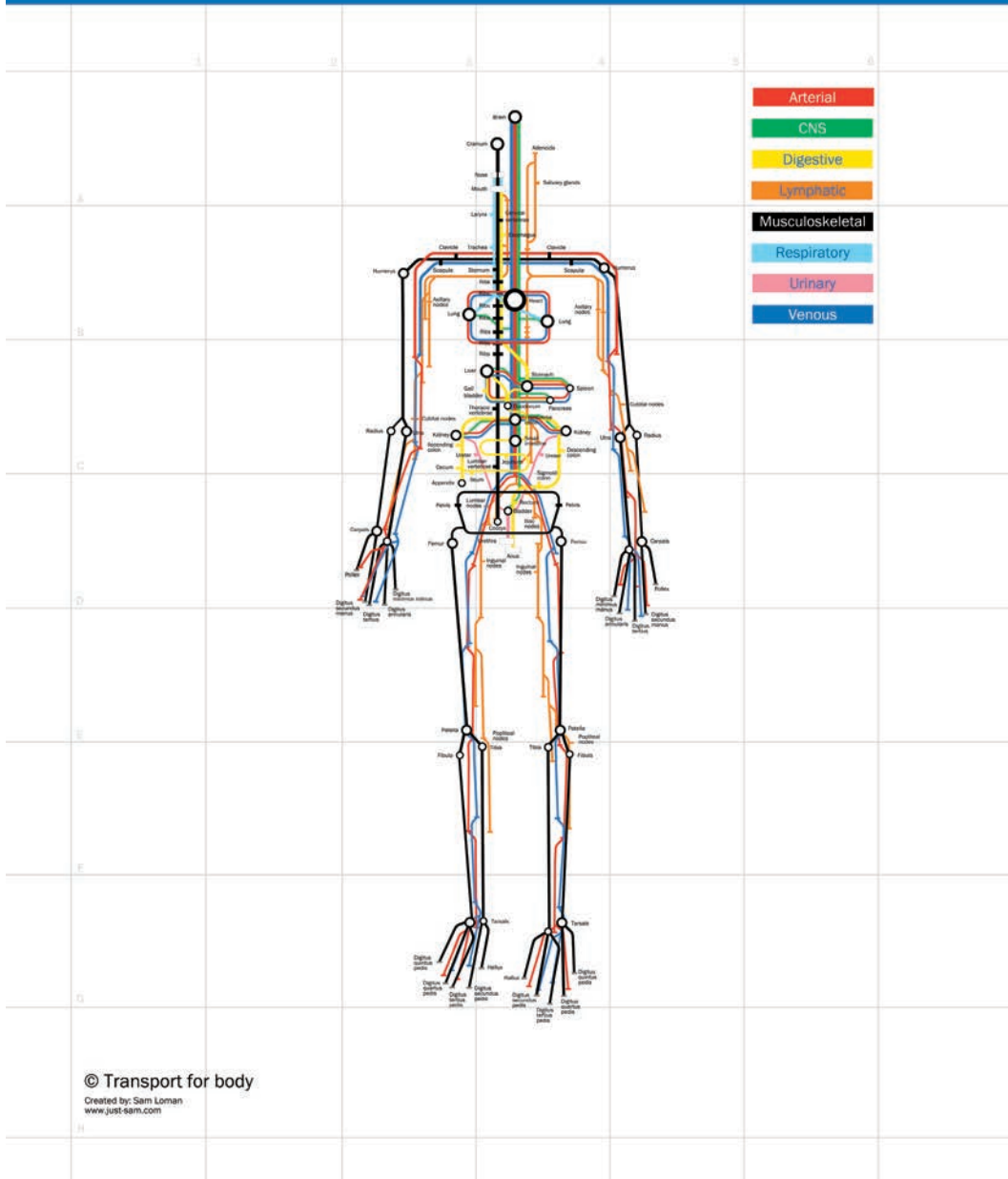
FIGURE 1-20: *Underskin* by Sam Loman

coolinfographics.com/Figure-1-20

Source: Underskin *by Sam Loman*

The Art of Storytelling

Good infographic design is about storytelling by combining data visualization design and graphic design. Many of the good infographics follow a simple three-part story format: introduction, key message, and conclusion, as shown in Figure 1-21.
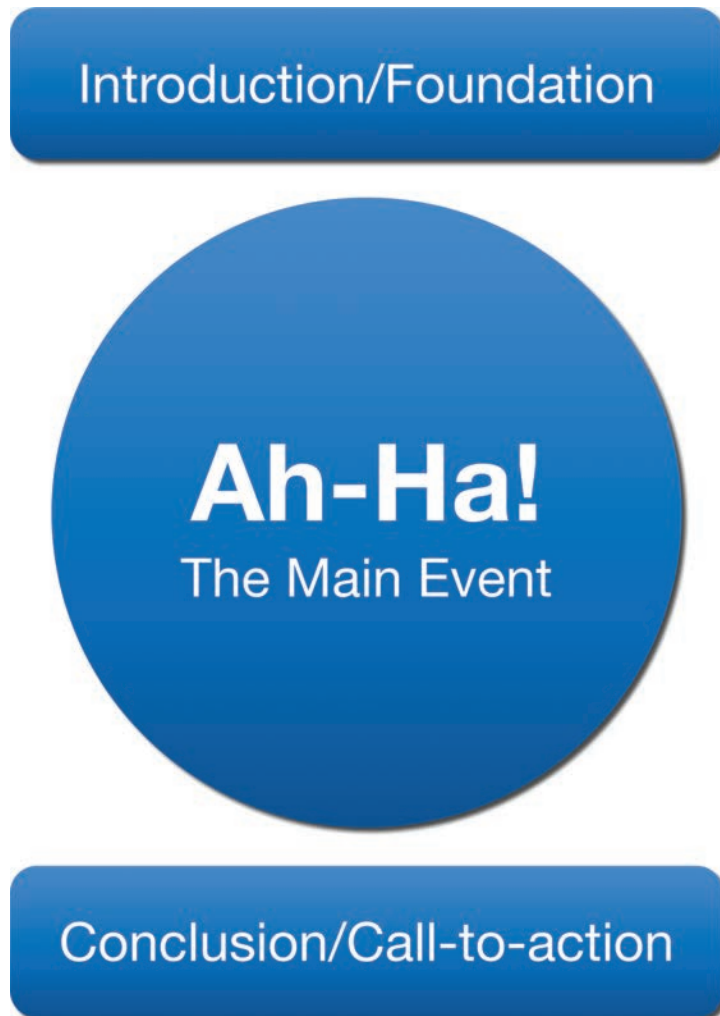

FIGURE 1-21: The three-part story format

Introduction/Foundation

The introduction needs to introduce the reader to the topic of the infographic. What is the infographic about and why should the reader care? This is usually some combination of the title and a brief paragraph of text. This is the designer's chance to tell the target audience that this infographic is intended for them and contains something they will find interesting.

This section also needs to lay the foundation for the information—anything the readers need to understand clearly before they are ready to grasp the main event. Introductions may include a couple data visualizations that help lay the groundwork. Maybe it's a visualization of an entire industry before getting into the details, which helps prepare the reader to be ready to learn something new.

Ah-Ha! The Main Event

For an infographic to be remarkable to the audience, it needs to contain some new, previously unknown piece of information. This is the main event and usually the dominant visual portion of the infographic.

This section is the infographic's entire reason for existence. The information contained here is why someone went to the trouble of designing the infographic. Usually, a large illustration or data visualization is used in this section to trigger the Picture Superiority Effect with the readers. If the audience only remembers one thing from the infographic, the designer wants it to be this main point of information.

Conclusion/Call-to-action

Infographic designs need to have some closure at the bottom where the designer wraps up the message for the reader—just like ending a good speech.

If appropriate, this is where a call-to-action should be included if there is some type of follow-up the designer would like the readers to take after learning this amazing piece of information. Should they visit a website, sign a petition, buy a product, start eating healthier, write a letter to their congressman, or call their mother?

The design should not leave it to chance that they will act appropriately, but should tell the readers explicitly what to do with the nugget of wisdom just bestowed upon them.

Figure 1-22 is an infographic from RothIRA.com that targets a young audience with information about saving for retirement. There is a brief introduction that introduces the character Tom. Some basic assumptions are outlined as foundation information, such as saving $1.00 per day up until age 70.

The main event is the visualization of the tower of stacked beer cases that Tom would be able to afford if he starts saving at age 25. This stack of beer is shown in comparison to two smaller objects: the Statue of Liberty and, the world's tallest building, the Burj Khalifa Tower. By choosing two recognizable objects that are smaller than the Tower of Beer, the design highlights how impressively tall this stack would be.

The explicit call-to-action is the deceptively simple statement: "Learn more at RothIRA.com." The subtle call-to-action is for the reader to start saving for retirement right now.

FIGURE 1-22: The Tower of Beer infographic exemplifies the three-part story format

coolinfographics.com/Figure-1-22

Source: The High Life, Tower of Beer, *RothIRA.com, 2012*

Your data tells a story.
Make it unforgettable with infographics

Cool infographics tell a story visually—an engaging story built with your data. More than just using pictures or colorful charts, infographics create the type of visual representation that your audience will quickly grasp and remember. This innovative guide prepares you for creating compelling infographics for online marketing, business reports, and presentations, as well as designing your own infographic resume.

- Discover what makes infographics work
- Structure information into a simple 3-part story
- Clarify the design process and follow infographic design rules
- Implement an infographic launch strategy to maximize SEO value
- Design a personal infographic resume to market yourself

Visit coolInfographics.com for information about good infographic design, links to design tools, infographic posters, and more

Randy Krum is founder and president of InfoNewt, an infographic design and data visualization company, and the creator of Cool Infographics (coolinfographics.com). He designs infographics for both online publications and internal communications, and consults on building infographic landing pages, social sharing links, infographic SEO, reaching key influencers, and tracking results.

Cover Design and Graphics:
Courtesy of InfoNewt, LLC

Computer Graphics

WILEY

Also available
as an e-book