

CHAPTER ONE

THE JUSTIFICATION FOR PRESENTING DATA EFFECTIVELY

LEARNING OBJECTIVES

After reading this chapter, you will be able to:

- Contrast weak and effective data presentation
- Articulate the basic steps of how the brain retains information
- Pinpoint where in that process the graphic design cues are useful
- Position data presentation within the web of related fields

When you need to convince your colleagues that their data presentations need a bit of sprucing up, this is the chapter to surreptitiously place in their mailboxes. This chapter discusses why it is so critically important for us to learn about better data presentation. You probably already know some of this intuitively. For example, you were bored during a presentation as the speaker read the text off his slides, or you struggled to keep alert while dragging through a report and peeked ahead at how many more pages of narrative awaited you, or you wasted time trying to decode a cluttered graph and your eyes glazed over.

For a speaker and author, the eye glaze is like the kiss of death. When you see it happening to members of your audience, you know that you have 3 . . . 2 . . . 1 . . . yes—an audience checking their email messages. Whichever end of the exchange you are on, you understand the importance and necessity of a presentation that attracts and maintains interest.

Dissertation in a Nutshell

I looked at the extent of graphic design use in evaluation reports, which I gathered from a national repository. With an extensive literature review of cognition-based design theory and the iterative input of a panel of graphic design experts, I pulled together a checklist of graphic design best practices, as applied to the context of evaluation and research reports. A version of the checklist can be found in Appendix A of this book and is downloadable in the online companion.

I trained a group of raters and then asked them to apply the checklist to a culled sample of the evaluation reports. The results probably will not surprise you too much. The reports scored high on those checklist items that are default settings found in most word-processing programs.

The reports scored lowest on the presence of graphics. Graphics, in this case, refers to pictures, diagrams, charts, and graphs. Yes, some reports had no graphs at all. Others that continued to rely on default settings produced cluttered and miscolored graphs that caused confusion for readers.

In fairness, there were actually several reports whose authors really got it right and produced engaging materials that lured readers to scroll through, regardless of report length.

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So, those were the main findings of the study, but in the process of conducting it we discovered something else: We used interrater reliability to look at how closely the trained raters matched my scoring of the sampled reports. The score was high. In other words, with some training and maybe a splash of predisposed interest, people can learn what great (and not-so-great) data presentations look like. Some folks like to claim that I have some innate talent or creativity, but I do not think that is true. Creating great data presentations is a skill that can be learned. You can do it, too.

How is it that most of us can relate to the irritation of sitting through weak data presentations, but there is still so much weak data presentation in the world? Well, old habits are hard to break. Many of us who have come up through an academic pipeline have been drilled with our departments' required style manuals, which seemed to point toward pages and pages of prose, or the painful construction and formatting of graphs and figures. In turn, some of us found our way to government positions where PowerPoint templates and colors were mandated, and clearance departments had the final say in the look of all reports. And most of us are better at critiquing bad design than we are at envisioning what an effective data presentation looks like. This book is your new style guide, your step-by-step resource on how to make your work more memorable. But don't worry—these steps are still aligned with the major academic style guides and with the U.S. government's guidelines around universal accessibility. We're good to go. So, let's go.

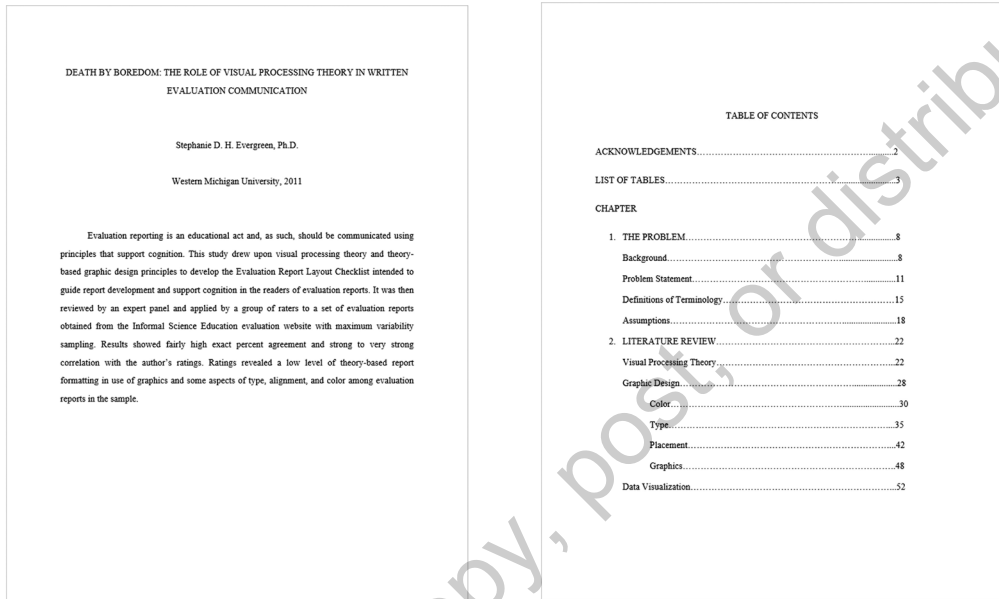
What Does Effective Data Presentation Look Like?

It seems that it is always easier to spot weak presentations than to organically develop effective data presentation. It may be useful to walk through a few examples.

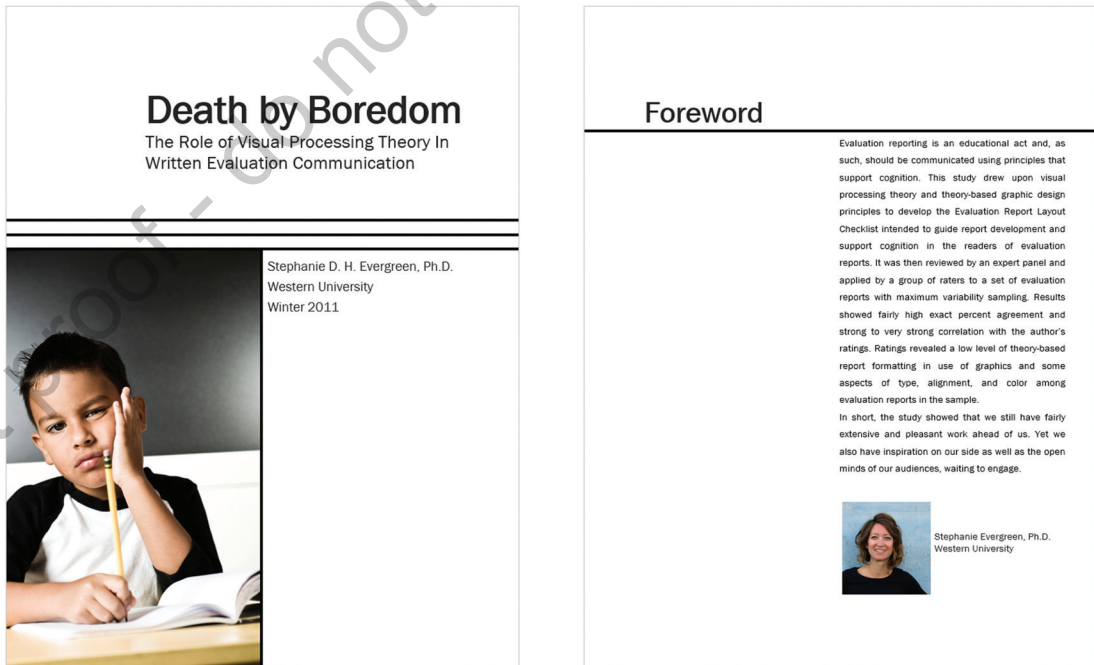
Reports

Familiar, isn't it? If you haven't guessed, we are looking at the first two pages of a report. Indeed, the first page is pulled exactly from my dissertation. I followed the university's dissertation formatting guidelines with precision—and if you have ever been in a similar situation you know that at times the guidelines can appear more

Figures 1.1 and 1.2 Cover and second page of a weak report



Figures 1.3 and 1.4 Cover and second page of an effective report



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mysterious than the study itself. On examination, there are several elements that actively prevent a reader from engaging with the text. The title, for example, is set in all caps, which makes it difficult to read at length (and aren't they all lengthy?). The centered alignment adds another layer of reading difficulty. Then when the reader whips past the first page to get to the content, she is met with, well, the table of contents (pages of them, in my case). Page numbers are misaligned. It is a mess. With just these first two pages, the reader now understands that if she chooses to continue to read, making any sense or meaning out of the report is going to take work. Ultimately, this type of reporting does not engage the reader. It is weak. Now, let's contrast that a bit.

Notice any changes? Of course you do! While I left some of the healthy white space on the cover page of the weaker version, I added a photograph of a bored child. At a glance, the photograph is interesting, engaging to a viewer, relatable, and works hard to communicate the author's point. Now, I understand that a graduate college never allows a dissertation submission with a photograph on the cover. But then again, few people outside the graduate college, and an applicant's advisers, ever read the dissertation in the condition it is submitted. For outside audiences, you should adopt the flexibility to repackage your study to make it more appealing, interesting, and memorable. As we discuss later on, graphics are a great way to do just that.

Notice that the title is larger rather than in all caps. It stands out as the most important text on the page and is now more legible. The subtitle is bumped down to its own line. On the second page, I replaced the table of contents with a slightly more intriguing foreword. It is short, increasing the likelihood that people will read it, and it contains the personal touch of my picture.

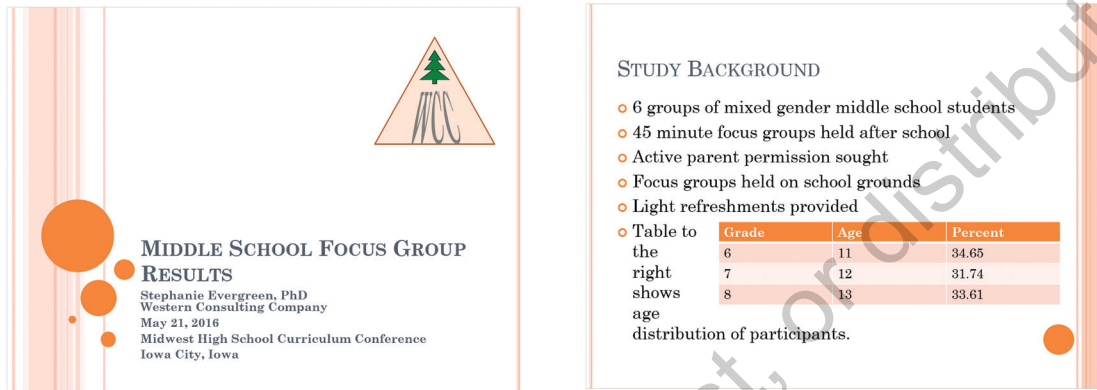
If you had the choice to flip through either of these reports on your lunch break, I feel certain that you would pick the effective one.

Slideshows

Of course, this range of quality in data presentation exists in all dissemination formats. Home slides like this one are pretty common fare.

It is likely that you instantly recognize this design as a slide template, one of the default options that come preloaded in slide software programs like PowerPoint. Communicating "default" is probably not what we seek when we are trying to engage an audience with our work. On close inspection, you'll notice that there is also a bit of uneven spacing happening in the chunk of text at the bottom of the cover slide. The company logo is somewhat plastered in the upper right corner. The font, as we discuss later, is inappropriate for slide projection.

Figures 1.5 and 1.6 First and second slides from a weak slideshow



On the interior slide, shown on the right, there is simply too much text. The table is full of numbers that take a lot of cognitive processing to understand. The alternating banded rows further interfere with legibility. Imagine trying to weed through this slide while the speaker is reiterating the points verbally. This is a great way to lose an audience by just the second slide of a talk. How could these slides work better?

Figures 1.7 and 1.8 First and second slides from an effective slideshow



In this version, a large, relatable image draws in the viewer on the home slide. It gives a much clearer indication of the subject of the presentation to audience members who may be milling around the room before they find their seats. Obvious

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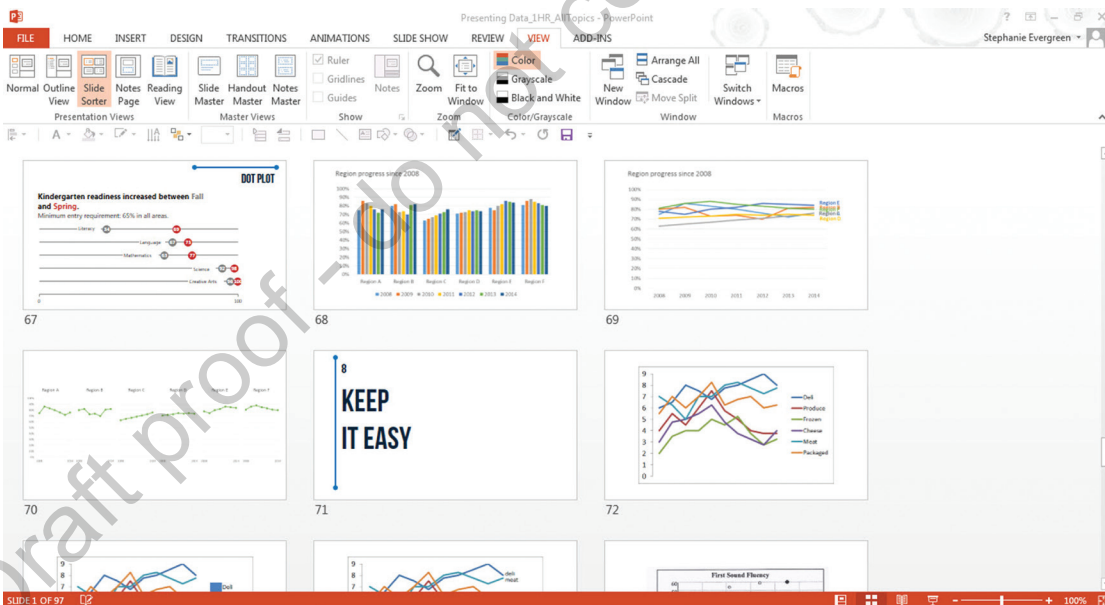
information (like the name of the conference and the date of the presentation) is removed to declutter the slide. The font is larger, and the sans serif style is much easier on the eyes, particularly when projected.

The interior slide now visualizes the logistical description that had been text based in the weak slides. The diagram communicates in an instant what the table did not. At this point it looks as if critical details, such as the fact that the focus groups were mixed gender and that we served snacks, are gone, but they really are not. It is just that those details come from the speaker, who is the proper center of attention. Effective data presentation with a deck of slides means that the visuals are a support tool, not a replacement for the speaker.

And this is why rad presenters never give out their slides. The thing is, if the presenter has done a great job, you really don't want the slides. No, really, you don't.

A long long time ago, Garr Reynolds taught me that if someone can look at your slideshow and tell all the things you are going to say, there's no need for you, as the speaker. The content and value of the talk should come from the presenter's mouth, not the projector. The slides by themselves will be pretty useless. Here's a screenshot of a current slide deck, in slide sorter mode:

Figure 1.9 Slide sorter view shows many slides at once



Doesn't provide much value, does it? That's the idea! I need to be there, as the speaker and the value giver, in order for the slides to make sense.

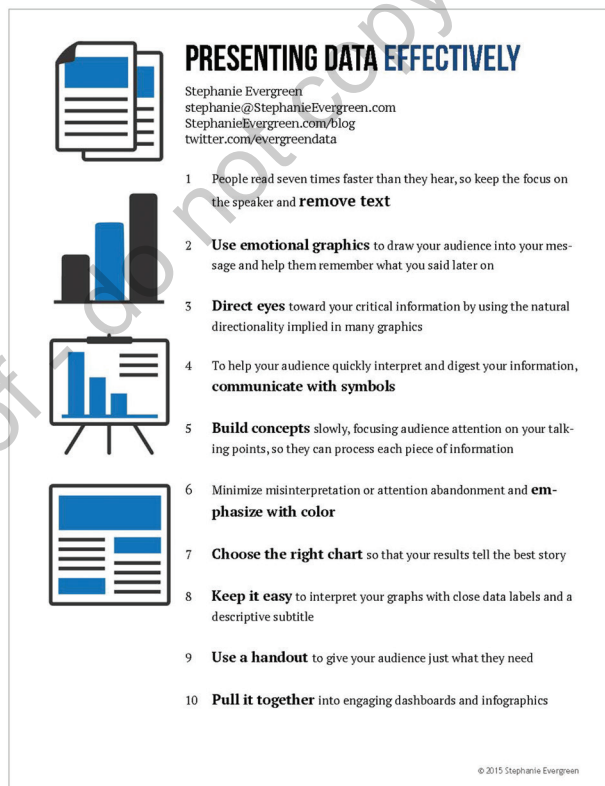
Moreover, I often have slideshows with 300+ slides in them. I go through them so quickly an audience member would never know how thick my deck is. But that's another reason you really don't want to print out my slides.

I hear you talking back to this page right now, saying something like “But I want a reminder of what you said to jog my memory when I get back to my office.” Of *course*, darling! I'm not going to leave you hanging. Any speaker worth her salt will have a handout that accompanies the talk.

Handouts

A handout is a short, condensed version of all the key points, URLs, and references mentioned in the slideshow. It may even have tiny visuals that match the slideshow to visually cue the audience member's memory. The handout is a useful support for viewers' efforts to put in place the things they learned in the talk. Here's a current handout that belongs with the slide deck above:

Figure 1.10 A handout is a useful summary of a talk

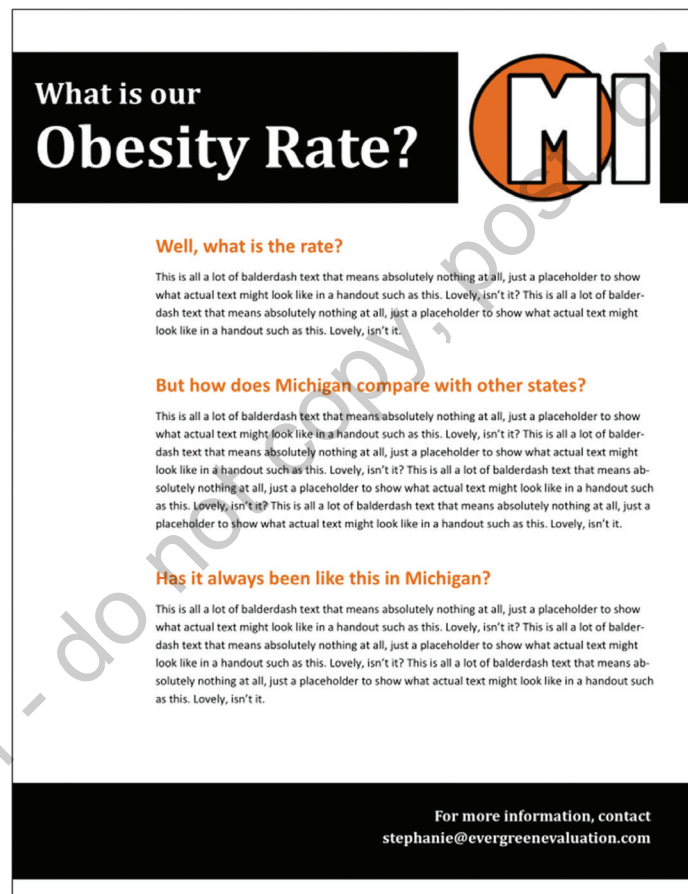


Audiences like handouts because they are, well, handy. They summarize the key points, free up the audience to listen, and look really great pinned to an office wall.

You have a few choices when it comes to the kind of handout you distribute.

Option A is a detailed handout where you have pasted in the key points from your notes.

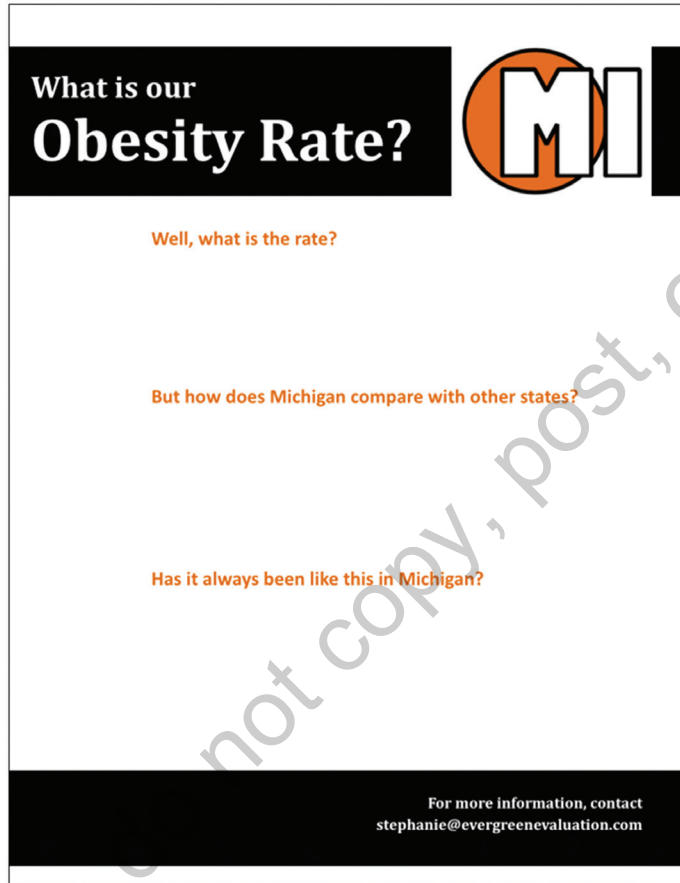
Figure 1.11 A detailed handout contains your notes



You'll tell the audience, "You are welcome to take notes but I have a handout for you with all of my key points that I will pass out as you exit." Why as they exit? So that your audience members do not read your handout instead of listening to you speak.

Option B is a semiblack handout where you have pasted in just your main topic areas, leaving plenty of empty space for audience members to take their own notes.

Figure 1.12 With a blank handout, audience members construct their own takeaway points

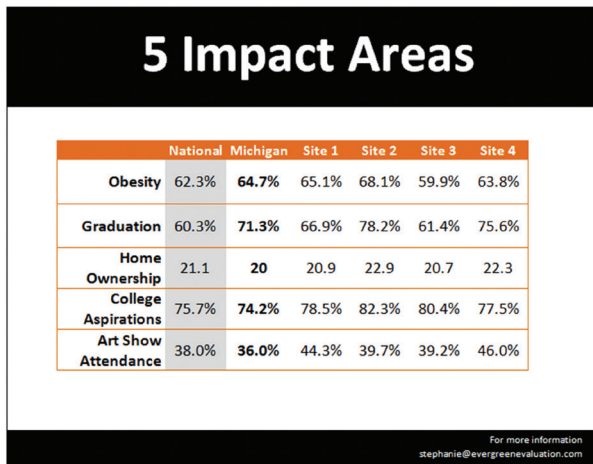


You will want to include in the handout any URLs, references, or resources—anything you wouldn't want the audience to have to copy from a slide. But the rest of the handout leaves each audience member the room to construct a document that will be most helpful after the workshop. This handout works best when you know each person will take away different lessons from your presentation.

Sometimes I'll create a hybrid of these two options, leaving the handout fairly empty but typing in some of my key points.

Your choice between these two handout options will hinge a bit on your audience needs. A CEO, for example, probably does not want to create her own handout. She wants you to give her one that already has all the detail. On the other hand, certain groups can't just sit and listen. Teachers are a great example of this kind of crowd (I know, I used to be

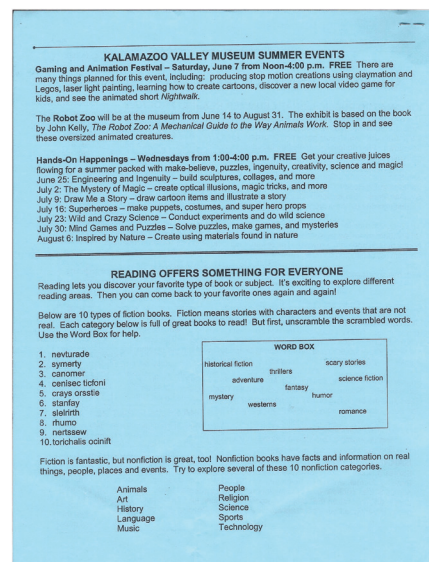
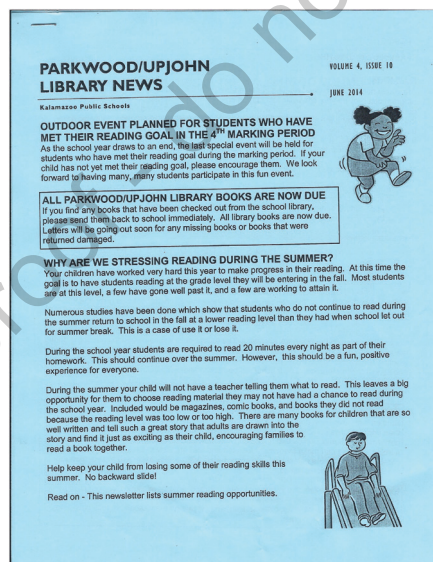
Figure 1.13 Put dense material on a handout



and gives them a resource for getting more information if they need it. You should aim for something that they will want to hang on their walls.

Or refrigerators. I know this isn't exactly a presentation handout, but I think it illustrates my point. This flyer came from my kid's school. It probably looks pretty similar to what you retrieve from your kids' backpacks too.

Figures 1.14 and 1.15 Weak handout



Source: Kalamazoo Public Schools.

On the back of the newsletter, you can see that the story at the top is about the events happening at the local museum over the summer. That same day, we also received the museum's flyer.

Figure 1.16 Effective handout

SUMMER 2014 HANDS-ON HAPPENINGS

KalamazooVALLEY[™] Museum

FREE! THE CREATIVE SPIRIT
WEDNESDAYS 1–4 pm, FROM June 25–August 6
Get your creative juices flowing for a summer packed with make-believe, puzzles, creativity, ingenuity, science, and magic!

JUNE 25 Engineering and Ingenuity
Build sculptures, create collages, and more.

JULY 2 The Mystery of Magic Create optical illusions, magic tricks, and tools of the trade.

JULY 9 Draw Me a Story Draw a variety of cartoon items and illustrate your story.

JULY 16 Superheroes Make puppets, costumes, and superhero props.

JULY 23 Wild and Crazy Science Conduct experiments and try your hand at wild science.

JULY 30 Mind Games and Puzzles Solve puzzles, make games, and figure out mysteries.

AUGUST 6 Inspired by Nature Create using materials found in nature.

JUNE 25–AUGUST 6

CHALLENGER EXPERIENCE **COMET MINI-MISSION**

WEDNESDAYS AT 12:45 & 1:30 pm
Young children and their grown-ups lift off from Earth, dock with a space station, and return to Earth—all in 20 minutes! Children under the age of 13 must be accompanied by a parent or guardian. \$3 per person.

WEDNESDAYS AT 3:00 pm
This 45-minute session in the spacecraft simulator will fly you to rendezvous with a comet. Ages 8 and up. Each child aged 8–11 must be accompanied by a partner 12 years or older. \$3 per person.

SPECIAL WEDNESDAY PLANETARIUM SHOWS
Planetarium shows for families, offered during Summer Hands-On Happenings. All shows are \$3.

COSMIC ZOO 11:00 am
Orion the Hunter is now Orion the Zookeeper in this interactive family show that tours the constellations.

ONE WORLD, ONE SKY 1:00 pm
Join Big Bird, Elmo, and their Chinese friend, Hu Hu Zhu, and explore the sky they share.

SPACE PARK 3:00 2:00 pm
Travel through an amusement park that spans the Solar System.

DAWN OF THE SPACE AGE 3:00 pm
Trace the origins of space exploration from the launch of Sputnik in October 1957 to the first Moon landing in 1969.

ROBOT ZOO
JUNE 14–AUGUST 31
Banned: the business names of complex, trained robots to discover they real animals work!

KalamazooVALLEY[™] Museum
230 North Rose Street
Kalamazoo, MI 49007
269.373.7990 | 800.772.3370
www.kalamazoomuseum.org
Find us on Facebook
Follow us on Twitter

FREE GENERAL ADMISSION
Monday–Saturday 9 am–5 pm
Sunday + Holidays 1 pm–5 pm
Closed: Thanksgiving, Christmas Eve, Christmas Day, and Easter

The Kalamazoo Valley Museum is operated by Kalamazoo Valley Community College and is governed by its Board of Trustees. KV

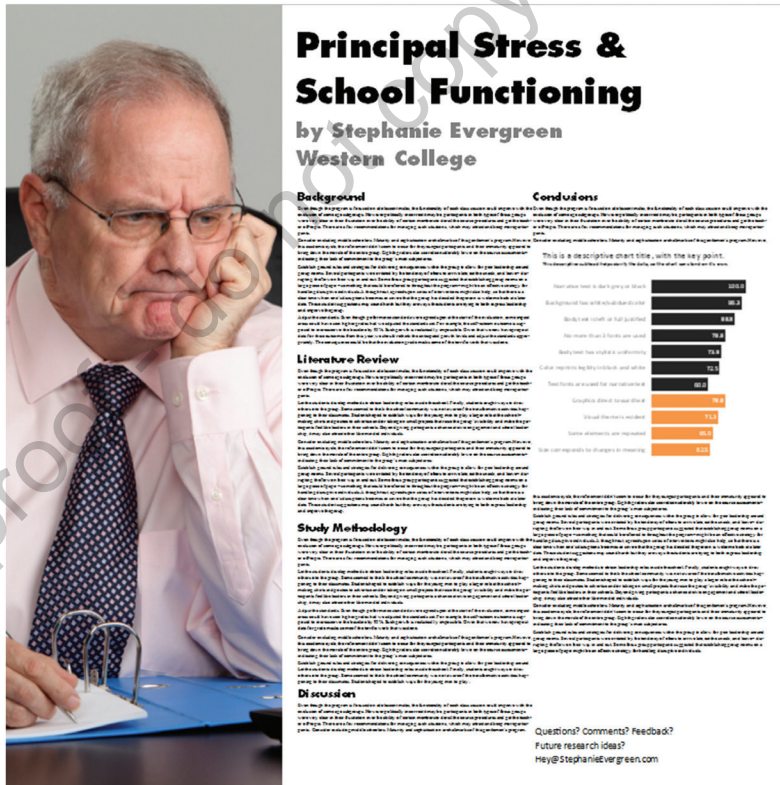
Source: Kalamazoo Valley Museum. Image of little girl with painted hands © iStockphoto.com/hannamonika.

One of these landed on my refrigerator and one of them went into my recycling bin. I'm sure you can see the differences that make a difference. While both use images of children, the school's flyer uses cheap-looking clip art while the museum's has an actual photograph that looks fun and engaging. Both handouts use color. The school's handout is printed on blue paper, probably under the assumption that the paper color would make it stand out from all of the other junk that comes home with

Research posters are usually at least 3.5 feet wide and 3.5 feet tall. The poster shown here has been shrunk to the extent that you can't read the text. But you are familiar with the general layout of a poster where narrative text is used to explain the background, literature review, methods, analysis, and discussion of a study. Posters are usually intended to stand alone and to deliver the entire message without a speaker to elaborate. Yet this poster cannot explain the study because it is impeding efforts to engage and communicate.

While relevant to the topic, the background picture obscures the text and renders it somewhat illegible. Imagine trying to read the text that rests on top of the principal's patterned tie. Yikes! The average conference-goer will not even bother. The table covering the principal's face is also oddly placed, and with its white background, it is a literal bright spot to a viewer, sticking out more than anything else on the poster. The table's encapsulation inside a box further contributes to its prominence. With this level of emphasis, whatever is in that table better be the key take-home message.

Figure 1.18 Effective research poster



Research posters are difficult to master. Poster designers often have to balance the competing needs of large text that is readable at a distance and up close. The poster size itself allows for much more space than we are used to in a research paper, and thus compels a desire to add some visual interest. At play are also poster guidelines dictated by the conference, such as a minimum font size. Now, mix in the tendency to want to detail the entire contents of the related research paper, and that is how we end up with posters like the above example. Still, it is possible to work within all of those parameters to develop a more effective data presentation.

Creating this version of the poster required very few changes. It uses the same fonts, font sizes, and photograph of a disheartened principal, yet it conveys the key message more clearly. Good poster design can and should incorporate some visual imagery; it just should not hide behind text. Here, it is off to one side, resulting in a better view of both the photograph and the text. Rather than a table, which feels a bit like it is just more text, the revised poster includes a graph of the key findings. However, the sizes of the photograph and the graph mean that some of the poster's space is no longer available for the study narrative. That's okay—there is still plenty of space to relay most necessary details for an onlooker to comprehend the study procedures.

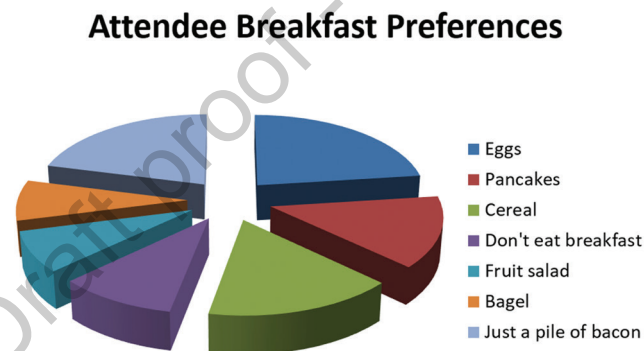
Data Displays

Let's look at data displays, since they tend to make an appearance in each of the methods of presentation addressed above.

If you've been anywhere near the discussions around data visualization in the past few years, then you know that pie charts are a bit of a flash point. Some people

think that there is no better way to express parts of a whole. Other people assert that pie charts are fairly useless because humans are pretty terrible at judging angles. Of course, that specific problem is compounded when the pie chart is rendered in three dimensions, as in Figure 1.19. Research in this area is quite clear—three-dimensional data displays slow down interpretation and often lead to inaccurate comprehension. In addition, this display uses the default color scheme of Microsoft Excel, where each slice of the pie is

Figure 1.19 Weak data display (3-D pie chart)



Source: © 2012. Reprinted with permission from the American Evaluation Association.

assigned a different color. How well will the distinctive colors hold up when the display is reproduced in black and white? Many organizations save on costs by printing in black and white (and yes, many people still print!), which means that we have to devise more effective data presentation methods.

Several adjustments make the display of these same data more effective. In Figure 1.20, the data are represented by a bar chart instead of a pie chart, because humans are much better at roughly assessing length than they are at perceiving angle. Bar charts are easier to decode. Also, the bars are ordered from the greatest to the least to make that decoding process even more straightforward. The graph now has a more descriptive title and an explanatory subtitle. In a sense, the study authors have taken a stance on the analysis in the study—created a story to tell. Previously, in the weak example, the data were simply presented. Even if the authors had an opinion, it was left up to the viewer to interpret the data and decide what was important. The problem with presenting data in that manner is that it assumes that the average viewer takes the time to engage with the data and has the mind-reading ability to pull out the most pertinent elements that relate to the author's points. Those are quite large assumptions. Communication with stakeholders is clearer and more effective when the graph's key points are highlighted. The viewer can always disagree, and all the data are there with which to do so; nothing is hidden. This format just respects the time and energy of the audience and relays the data directly. In the effective example, the key message is both stated in the title and made obvious by the changes in the bar colors such that the less important points are a light gray and the point that illustrates the message pops out the most.

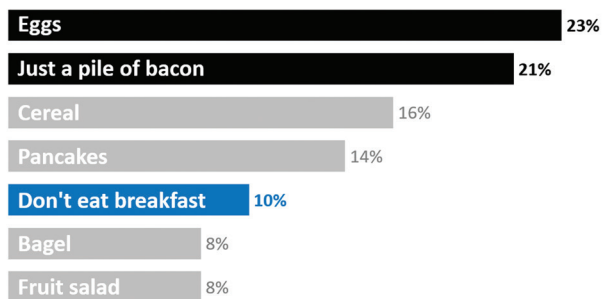
Dashboards (and Dashboard Reports)

Dashboards are intended to give the 30,000-foot view of an organization's key performance indicators on one page full of data displays, for fast assessment by CEOs and directors. The idea is that the decision makers have the data they need at their fingertips. One-pagers sure are nice, as just discussed in the context of handouts, and there's a lot of pressure to get all the important data onto a one-page dashboard. Dashboards are so hot these days they'll burn you. I mean it. I've

Figure 1.20 Effective data display (bar chart ordered greatest to least)

Breakfast preferences focus on protein.

One in ten fellow attendees **do not consume** adequate energy for their first meal of the day.

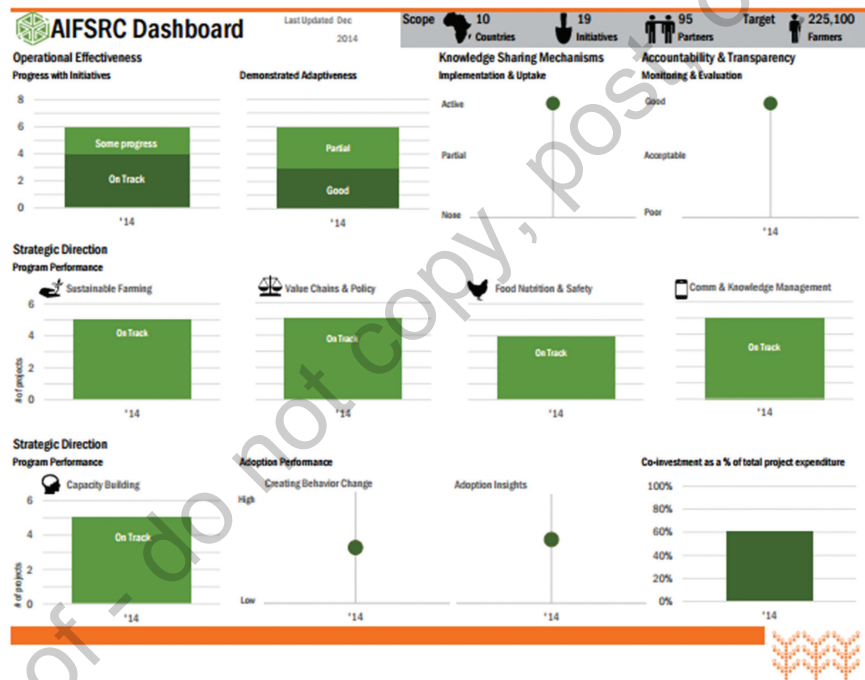


Source: © 2012. Reprinted with permission from the American Evaluation Association.

consulted with dozens and dozens of clients on dashboards, and through all of that experience, I've discovered that dashboards can actually undermine good decision making.

Don't get me wrong. I understand the need for a succinct compilation of performance data on key indicators. It sure beats a 200-page slide deck. But in the race away from the lengthy tomes of the past, I think the pendulum has swung too far. These days, the dashboard trend is to try to cram everything important onto a single page. I've done it for clients! Here's one:

Figure 1.21 A possibly perfectly fine data dashboard



Source: Reprinted with permission from the Australian Centre for International Agricultural Research.

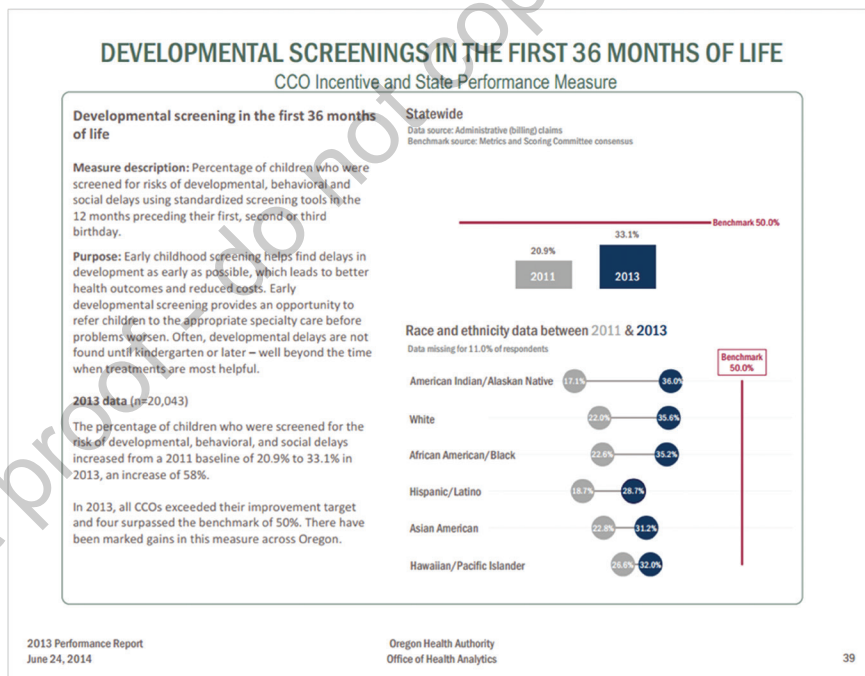
As far as I know this client is operating perfectly well with this dashboard. I have taken many, many clients to this place. And they generally feel good about the design. But sometimes I'll get the quietly concerned email from the people in my tribe, my fellow research nerds: "Um, Stephanie? This looks elegant, but we had major data collection issues in Q3 and that's not obvious in the dashboard and I'm concerned that if the Board sees this they aren't going understand the caveats." These are legitimate concerns.

People are driven primarily by their eyeballs. People want to look at the graphs and, if the graphs are strong on design and readily understood, be able to take actions based on the graphs. And this is when the research team freaks out. What about the context? What about how the measurement on this metric changed three times? Yikes, please don't make decisions off of this quite yet.

But the modern conceptualization of a dashboard leaves little room for those extremely important narrative points of interest. This is the downfall.

As opposed to a single-page dashboard, let's loosen up to a dashboard report. A while ago I edited a journal article written by my friend Veronica Smith (2013), in which she outlines the difference. Where a dashboard is a single page of visualized metrics, a dashboard report is a multipage document with one or two visualized metrics per page and healthy room for narrative. It's the pendulum swinging back toward the middle, but not nearly so far as those 200-page text-heavy doorstep reports. Here's one page from a dashboard report I produced with some long-term clients, the Oregon Health Authority:

Figure 1.22 One page from a possibly more effective dashboard report



Source: © 2013. Reprinted with permission from the Oregon Health Authority.

You can see we are reporting two metrics here, and they are accompanied by a text box that holds helpful explanation. It isn't a burdensome amount to read; it doesn't even fill up the left-hand side of the page. But it gives the research team enough space to say their piece and feel comfortable sending the data off to the decision makers. Dashboard reports balance out high-quality visualizations and a tiny bit of narrative so everyone can sleep well at night.

Regardless of our fields, positions, or geographic locations, we are all in the business of presentation. The way we package our words and our data is reflected in our audiences' perceptions of our quality, credibility, and trustworthiness. These sets of examples reflect the obvious differences and stark contrast between weak and effective data presentation. Everyone is tired of the current models of data presentation precisely because they are weaker and do not engage viewers or increase the likelihood that they'll be able to recall the information presented. Effective data presentation creates a shortcut to audience comprehension.

What Makes Data Presentation *Effective*?

This section may be the most important part of the entire book. I am going to devote some space here to describing the science of communication. Often, my workshop participants, full of excitement and inspiration, try to take fresh ideas back to their home organizations and universities, only to find that no one listens; someone says something like "We don't have time to worry about making things pretty." One workshop attendee who worked in academia said that if a faculty member does not use bullet points and text-heavy slides, she is seen as unprofessional and unscientific. By far, this resistance from the uninitiated is one of the most common areas of concern for my workshop participants. Our strongest justification for evolving our reporting is based in being aligned with how the human brain operates and how people retain information. If our hard work is to draw attention, make an impact, and convince others to take action (e.g., award funding), then communication can no longer be presented in the weak style of the status quo. An effective data presentation may look pretty, but the true goal is to support audience cognition.

Visual processing theory describes the way the brain perceives and interprets what the eyes see. Graphic design incorporates the science of visual perception in creating designs that better attract viewer attention. What follows is a supremely oversimplified primer on visual processing theory, how information ultimately gets retained in the mind of an audience member, and how effective data presentation assists in that retention process.

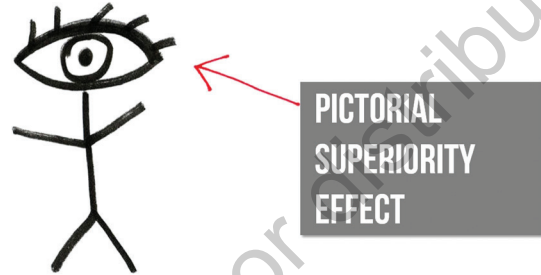
Pictorial Superiority Effect

Rather than delay the suspense, let's jump right to the main point: We get our information about the world primarily through our eyes. Certainly, we have other sensory organs that feed information to our brains. But the reality is that vision dominates. Today's researchers refer to this as the *pictorial superiority effect*, a term so difficult to work into a conversation that it clearly comes from academia. The pictorial superiority effect essentially reminds us that what the eyes see always wins, even if we intentionally try to confuse our senses. Large parts of our brain and brain activity are devoted to visual processing (Stenberg, 2006).

Apparently I knew at an early age what I wanted to be when I grew up because I actually studied this topic when I was in fourth grade. We had to devise an experiment for our school science fair. I ran a taste-test experiment, where I poured three identical glasses of cola. I left one glass as is, dropped red food coloring into the second glass to give it a red tint, and added green food coloring to the third glass. Then I called my friends over and made them taste each glass (this was before concerns about the potential germ proliferation caused by sharing glasses). Across the board, my friends thought that the red cola was cherry flavored and the green cola was disgusting. What the eyes see always wins, even though scent and taste should have made the experiment obvious.

This example is not just fourth-grade foolishness, either. In his book *Brain Rules* (2008), John Medina retells how French researchers at the University of Bordeaux conducted a similar experiment on a more sophisticated set of subjects, wine sommeliers, which must be the best job in the whole world. Wine sommeliers are the people who judge wine competitions. However, it is not easy to become a wine sommelier. There are dense textbooks to study and challenging tests to pass that assess learned knowledge about wine and wine history and determine the extent of the sensitivity of the tester's palate. Wine sommeliers have extremely well-refined smell and taste abilities. These people can detect that a peach orchard was growing 200 years before the vineyard was planted on the same grounds. They can actually pick up the peach flavor and aroma in the wine. As an acknowledgment of their talents, they wear a special pin on their lapels identifying their superhuman powers. It's amazing. Anyway, back to the study where the researchers at the University of Bordeaux (right!) obtained white wine and tinted it red with dyes and food coloring. Then they gave it to the wine sommeliers. You can probably guess what happened. When the wine sommeliers were

Figure 1.23 The pictorial superiority effect essentially means our brains are led by our eyes



asked to describe the wine to the researchers, even though their noses and mouths were screaming “White wine! White wine!” they used the language of red wine in their descriptions. Vision wins.

The pictorial superiority effect is exactly what we can use to our advantage in effective data presentation. This effect is what allows us to move information along the memory continuum to catch the reader’s eye, focus the reader’s attention, and affix in the reader’s memory. Let’s talk about how the pictorial superiority effect works in three stages along the memory continuum.

Figure 1.24 We have always had the pictorial superiority effect

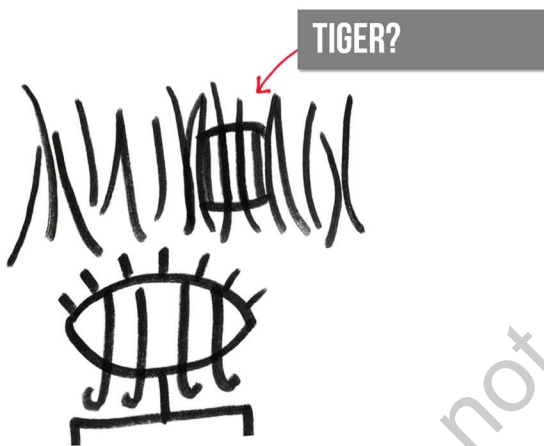
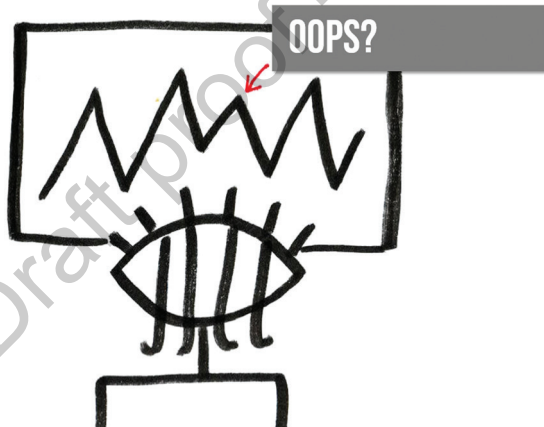


Figure 1.25 We can apply the pictorial superiority effect to our research reporting



Early Attention

As far as anyone knows, this visual dominance has always been a human trait (except, of course, in cases of individuals who are blind at birth). To a large extent, it is this effect that has advanced our survival as a species to date. Humans are naturally skilled at scanning the horizon, looking for food, or mates, or danger. We are adept at noticing patterns in our environment and spotting abnormalities in those patterns.

In fact, we are so awesome at using our eyes to take in information, our brains do not even have to be cognitively engaged for the process to work. When something just catches our eye, it is tapping into our earliest stages of attention, an activity that is so subtle that some researchers call this stage **preattention** (Callaghan, 1989; Ware, 2013). This process occurs without focused energy on the part of the viewer.

Effective data presentation makes use of this early attention function.

A lot of graphic design operates in this stage. Emphasis techniques like color, alignment, motion, orientation, and size grab a viewer’s early attention. Visual cognition research reveals that capitalizing on the pictorial superiority effect boosts the audience’s ability to recall information. However, in order for information to be available for recall, it

must be stored in the brain's long-term memory, which is Stage 3. Information moves from Stage 1, early attention, to Stage 3, long-term memory, along a path that can be a bit tricky, but graphic design helps it get there.

Working Memory

Now to discuss the tricky part of that path—working memory.

Working memory is what we use when something has caught our eye and we decide to bring it into mental focus, to contemplate it, and to engage our cognitive energy. Working memory is where we wrestle with information to understand and process it so that it can eventually be assimilated into long-term memory. But the problem is that working memory is like a sieve. It is weak, can't wrestle for long, and can't wrestle with much. Research shows we hold only three to five chunks of information in working memory at any one time, and even that number varies depending on the environmental context (Baddeley, 1992; Cowan, 2000; Xu & Chun, 2006). If a subject is in a stressful or distracting atmosphere, even three chunks of information cannot be handled at once. When a viewer's working memory is overloaded, it drops some chunks of information, and then misunderstanding or frustration results (Woodman, Vecera, & Luck, 2003).

Enter graphic design. Although working memory has limits on its cognitive load, graphic elements can reduce the overload by doing some of the thinking for the reader. By visually organizing and emphasizing information, graphic design makes it more accessible, increasing the reader's capacity to engage with the words and data.

By virtue of this process, richer chunks of information are actually created, which in turn enables the viewer to essentially handle a larger cognitive load at one time (Shah, Mayer, & Hegarty, 1999). By paying attention to format, color, and font

Figure 1.26 Avoiding the overload of working memory is a key tenet behind effective design choices

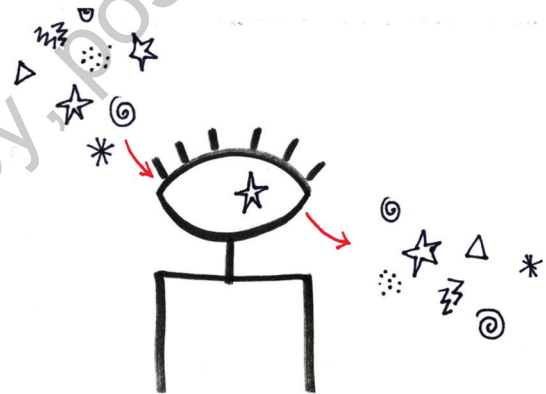
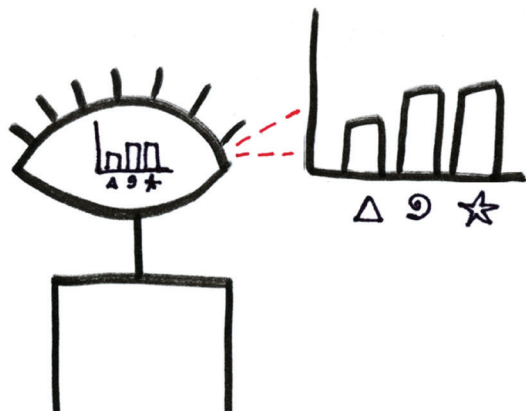


Figure 1.27 Organizing information makes it easier to comprehend



choices, we assist readers in encoding our information and grappling with it; this is how comprehension occurs. The more engagement, the more that passes through the working memory checkpoint, the more information that stays in long-term memory.

Long-Term Memory

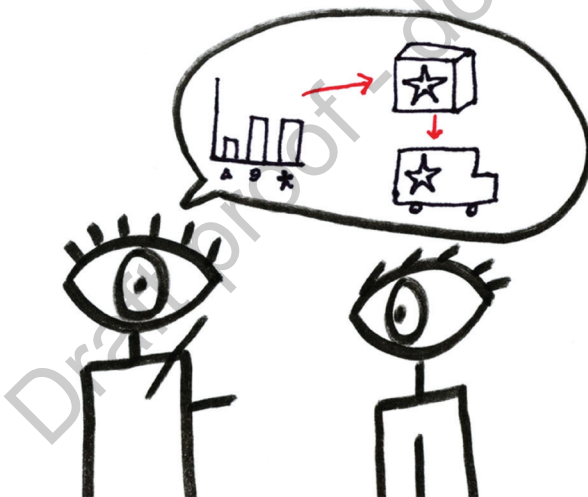
The last stage is long-term memory. When information is received into long-term memory, it can be recalled later on, retold to others, and combined with other ideas—to evolve into something even more amazing.

In order for new information to be encoded in the brain, it must be incorporated into existing schemas. If you're like me, you probably haven't heard the phrase "existing schemas" since high school biology class. This phrase refers to our mental models or our belief systems about how the world works. Again, effective data presentation assists this process because graphics are particularly good at activating those existing schemas. When we add visuals to verbal explanations, readers generate 65% more creative transfers and applications of knowledge (Mayer, 1997). That is why so many of us are better at remembering faces than names, and at navigating using landmarks rather than street names. We are visual beings.

Now, there are a host of other factors that help us retain information for the long haul. We have probably all been in situations where we remembered something for two days only to forget it after two months. Individual experiences, culture, emotion, and even exercise can play into the health of our brain's storage capacities (Medina,

2008). As students, researchers, and data presenters, we do not have complete control over those aspects for each of our audience members, but we can own our part in this recall process. Effective data presentation, where we use graphic visualization to emphasize information, speeds the acquisition of that information and reduces the opportunity for misinterpretation (Johnson, 2014; Stenberg, 2006). Because it is so important, here is that statement again: When we adopt the principles discussed in this book, we help our audiences to engage with our work more quickly, and we reduce their errors. These end results are precisely what we want to encourage among those stakeholders listening to or reading our findings.

Figure 1.28 Effective data presentation is retained in long-term memory



Even though some elements of this discussion of visual processing theory have been linearized and oversimplified, the time and effort expended on intentional data presentation are justified. With the research cited above leading the way, we can make clear to our colleagues, professors, supervisors, and clearance departments that our energies are not wasted. The end result is increased audience understanding. If we are not working toward that end, why are we engaged in our work in the first place? The true waste of our own effort, our funding sponsorship, and our audience's time and attention occurs when we retreat back to weak status quo communication, because the audience will choose to mentally check out (or check their email).

What Do I Need to Develop Effective Data Presentation?

The research-based principles I detail in this book can move us from the weak presentation to the effective. Additionally, they can elevate the effective presentation to the beautiful, useful, and inspiring. I present the tools and ideas you need to achieve these wonderful goals, supported by the required tools of your good cheer and open-minded disposition.

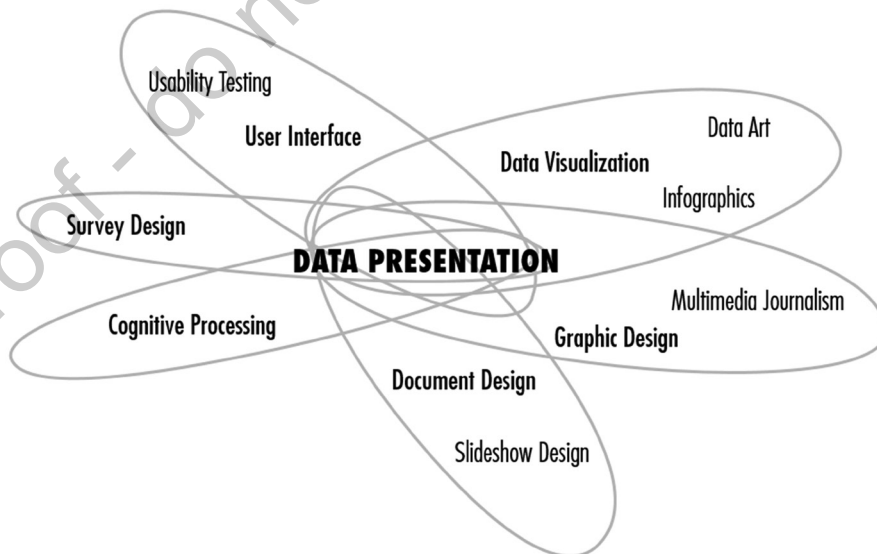
However, it is important that you know what this book does not address: your content. It does not discuss how you write reports, how well you have designed your study, or the strength of your references; I assume you have all of that under control. Instead, it does discuss how your information gets used by your audiences. In *Utilization-Focused Evaluation* (2008), legendary evaluator Michael Quinn Patton points out a set of findings produced in 1995 by the U.S. General Accounting Office (now the Government Accountability Office) on what happens to evaluation reports. The GAO examined the dissemination paths of several major federally funded program evaluations in its study *Program Evaluation: Improving the Flow of Information to the Congress*. This study probably doesn't sound like a nail-biter, but Patton notes that the report's main finding was that evaluation information does not get very far, despite the significant funding poured into evaluations and the high profile of many of the programs under scrutiny. His point is that we can take strides to make evaluation ultimately more useful by engaging stakeholders throughout the process of the study, ensuring the study examines aspects of importance, and delivering the report to decision makers in time for them to use the information as evidence. But let us tack on to this list of utilization strategies the role of effective data presentation. That same GAO report has these details buried inside: "Lack of

information does not appear to be the main problem. Rather the problem seems to be that the available information is not organized and communicated effectively.” It goes on to say, “Information did not reach the right people, or it did, but it was in a form that was difficult to digest” (p. 39). So you see, this book is not about the quality of your content; you are the expert in that area. This book is about organizing that content and communicating it in more digestible and effective ways. Here is what you need.

A Disciplinary Positioning

In addition to learning some concepts around visual processing theory, you should also know how this book fits in with its larger field of study. Knowing this is important to your development as an effective data presenter, because it will tell you where to look for new research and opportunities. And this way, you have more tidbits to share at the next cocktail party when people ask you what you are reading. Data presentation sits at the intersection of closely related fields like usability testing, user interface design, graphic design, journalism, and document design. All of these areas fall under the broad umbrella of information design.

Figure 1.29 Stephanie’s classification of the fields influencing data presentation, all of which could be referred to as information design



Without a doubt, even more information design subdisciplines will evolve into legitimacy in the years to come. Here, for the purposes of this book, we focus on data presentation, which encompasses both the layout of our written descriptions of data and the graphic displays of them using data visualizations as well as research-based effective practices from other areas under the information design field. Data visualization has already split into two fields: data visualization that is used for analysis, and that which is used for presentation, which is the focus of this book. (As of this writing there is a slight resurgence in discussion among thought leaders trying to clarify this divide—see Gelman & Unwin, 2012.) I think an illustration will help diagram these relationships, as I see them intersecting around data presentation.

The ideas from the hybrid zone of data presentation apply to many dissemination formats. In fact, each chapter in the remainder of this book introduces effective practices and applies them to a span of dissemination products you normally use—reports, research posters, slideshows, and the like—and each chapter includes a section that overlays those same principles on data displays themselves.

Shouldn't these topics be split into two volumes—one on reports and one on data visualization? Definitely not. In my studies of evaluation reports, I have often come across published tomes in which all of the graphs and tables are grouped into the appendices. So even if we have engaging, inspiring data visualizations, they cannot be very effective unless we also address reporting as a whole. As I will illustrate, the same basic principles apply to the reporting medium and the graphs it contains. Thus, we borrow bits and scraps from many other sources to bear on the work we present in higher education, nonprofits, government offices, and wherever and whatever your location. Information design may not be your main field, but in this process you will become a bit of an interdisciplinarian (that is the 50-cent word to throw around at cocktail parties).

Necessary Software

If it is not obvious already, this book is not written for graphic designers, as they would probably find this discussion boring very quickly. If you have a degree in art, you would likely enjoy arguing over the nuances of some of my points (and we can do that, but you have to buy me a coffee first). What you need to know is that this book was developed as a support tool and reference guide for the student scrambling to make a good impression, the social worker engaged in street intervention, the community college faculty member teaching students how to build wind turbines, and the nonprofit executive saving the world with long hours and a tiny budget. People

like you. I wrote this book to help my friends and colleagues, who hold down day jobs (which often extend into the night) and know that kicking their presentations up a notch is going to be a game changer.

That is why all of the examples and demonstrations included in these chapters use software and tools most people already own and can navigate fairly well. You don't have to know any new tools to apply the principles discussed here. I mainly work in Microsoft Office 2013 (and while I wish I were getting some paid product placement for telling you that, instead I am just being honest). In the online companion to the book, Open Office and Google Drive are also included, as many people, especially those on very small budgets, are moving to these free platforms. I do not work very often with sophisticated graphic design software, because the learning curve is usually too high and the files are not easily opened by my peers, colleagues, supervisors, and clients. This book illustrates how to use the tools you already own in more effective ways. You probably will not be able to quit your day job to become a professional graphic designer, but you will be able to make a more compelling case out of your work.

My intention is to help you use the tools you already have to make more compelling data presentations so that you can better convince your stakeholders of the worth of your work, secure more attention and funding, and make the world a better place. Please contact me and let me know about your victories after you have implemented the many suggestions included here.

How Do I Navigate This Book?

Chapters 2 through 5 represent the four practical groups of graphic design principles that emerged from my research. Chapter 2 starts us out where my research showed we are the weakest—graphics. This chapter discusses how to locate great graphics, how to tell if they are actually great, how to think about the different types of graphics needed for research and evaluation, and what each communicates to the reader. Chapter 3 introduces the main varieties of typefaces and outlines when the use of each variety is appropriate. The chapter specifically reviews how type can help organize your data presentation and ease engagement for a reader. Chapter 4 is about the proper use of color for legibility, decoration, and spotlighting critical information, including how to locate effective color palettes and then alter the color settings in your software. Chapter 5 illustrates how to arrange the different components (e.g., your text, photos, graphs) into a cohesive unit. It also details how to justify text, how wide columns should be, and even why deleting the legend in your

graph increases impact. In Chapter 6, I pull everything together and share some tips on how to make data presentation design more efficient. I also rearticulate the justification that underpins our efforts to communicate effectively. Throughout, the guiding ideas shaping each chapter are applied to reports, slideshows, handouts, research posters, dashboards, and data visualizations. And at the end of each chapter are lists of some of my favorite online resources and activities to help extend your thinking even further.

What is the Bottom Line?

The three phases of visual processing guide the choices of graphic designers so that their work has a greater likelihood of being encoded in long-term memory. For the rest of us, these skills better clarify our data presentations and support subsequent audience understanding.

The eyes win. People read much faster than they speak. Simultaneous listening and reading, which is common in slideshow presentations, overloads working memory. In the end, this means that the audience does not comprehend the content very well, because their brains are trying to do too many things at once. Presenters often further exacerbate the distractions by adding cartwheeling animation to their slides. This method of presentation literally interrupts the audience's attempts to make meaning.

That is not the only place where we get in our own way. As you might have suspected when I was talking about assimilating new information into existing schemas, the more hard-and-fast our existing schemas, the more new information struggles to find a home in long-term memory. In addition to the steep learning curve, this struggle is another good reason for us to be wary about the use of visualization tools that can make fancy, artistic diagrams. The research in this area repeatedly shows that when the viewer (young or old) is unfamiliar with the type of display, she spends cognitive energy just trying to understand the display rather than decoding the data it is attempting to communicate (Chen & Yu, 2000; Shah et al., 1999). Interpretation slows. Accuracy wanes. The result is that viewers just give up. Super data nerds like me are drawn to curious displays, but in those cases we are more interested in the novelty than we are in the data. Those types of displays tend to showcase the programming expertise of the graph maker

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in place of supporting audience cognition. Viewers and their brains far prefer simpler displays (Robertson, Fernandez, Fisher, Lee, & Stasko, 2008). This book is not designed to teach you how to make your data look like a sunflower or a cracked windshield; rather, it discusses in depth how to make better use of the tools and displays you already know well.

At their core, the techniques in this book can be summarized into two basic strategies: simplification and emphasis. Moving from weak to effective data presentation involves stripping out nonessential information and then adding back in selective emphasis to bring attention to meaning. In the presentation examples earlier in this chapter, the weak varieties had several things in common. They were cluttered, too full of trivial details, and contained unrelated graphic splash. The effective presentation examples were pared down to the critical information, with key graphic elements in place to support the reader's attention.

Presenting data effectively involves combining the strong content you already possess, the software and Internet access you already own, the willingness to be understood and useful (I am confident you have that, too), and the adoption of the accessible strategies contained in the rest of these pages. However, I want to give you fair warning: What this book shows you, you can't unsee—begin thinking about presentations in this way, and you cannot go back. You still have the option of returning this book to its shelf right now. But this is your last chance. After this, you will always notice weak presentation and know how to make it better. Are you prepared for that inevitable outcome? Are you ready? Me, too.

Key Points to Remember

The desire is not just to look good. Looking good is the natural outcome of communicating data in line with the way people think about and retain information.

- Information uptake occurs in three phases: early attention, working memory, and long-term memory.
- Graphic design elements and techniques draw attention, help a viewer digest information, and boost the viewer's recall of that information later on.
- Effective data presentation uses design principles built around graphics, typeface, color, and arrangement to support engagement with our research products.

How Can I Extend This?

The exercises below involve websites and activities that can reinforce the concepts presented in this chapter. Do keep in mind that the Internet sources listed can change at a moment's notice. If the URL provided here is not functional, try searching on the keywords to find related material or the website's new location.

Check Out

The International Institute on Information Design's website (<http://www.iiid.net>) has helpful and authoritative definitions for the bevy of jargon floating around and tons of free user-friendly white papers and books. Download for offline geek-out sessions. Also, take a peek at the list of skills and competencies that information designers need. You'll be surprised to find that you probably already possess these qualities.

The debate around what is data art and what is useful for communication began with the 2008 blog post "5 Best Data Visualization Projects of the Year," by Nathan Yau (<http://flowingdata.com/2008/12/19/5-best-data-visualization-projects-of-the-year>). Andrew Gelman, more of a statistician, disagreed with Yau's picks, saying they were not functional for many and were too artistic in their display. Several years later, the discussion is still alive, with Gelman and Unwin's (2012) paper on the difference between what they call "information visualization" and statistical graphs. It is healthy and normal to debate such ideas when a field is under rapid development. Read up on both sides to help you figure out where you stand.

Stephen Few's thoughtful discussion "Data Art vs. Data Visualization: Why Does a Distinction Matter?" (<http://www.perceptualedge.com/blog/?p=1245>) is also a must-read. His point is that data visualization's purpose is to communicate. While I often daydream about making a 6-foot column chart out of clay, our goal in visualizing data should be to support the audience's attention to make meaning from our work. Thus, the types of data displays in this book are not art.

Chris Lysy's cartoons (<http://freshspectrum.com>) are also worth checking out. Chris is an evaluation researcher at Westat, and his cartoons are about evaluation, engaging stakeholders, presenting data, and more. Hand-drawn on his iPad, they encapsulate the organic, familiar feel that illustrations of that type tend to communicate.

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Try This

A sincere thank-you to the anonymous person who sent me a preview copy of Don Moyer's *Napkin Sketch Workbook*. In it, he depicts the importance of working with our strong visual literacy skills and walks the reader through how to make simple hand-drawn sketches. The sketches that appear throughout this chapter are inspired by Moyer's lessons. Try this example from his book: Illustrate the organizational structure of your department, using little stick figures as necessary. Then use circles or some other technique to demarcate the people clustered in various working groups or miniprojects. Notice how the illustration is much more concise (despite how messy you might believe it to be) than the narrative text it would take to explain that diagram and the mental processing energy required to understand such a paragraph.

As I did with the cola experiment I conducted in fourth grade, you can illustrate the dominance of vision among a group of colleagues or classmates using a classic experiment that demonstrates what is known as the *Stroop effect*. In this test, the subject reads off the names of different colors that are listed on the screen, but the words are cast in colors that are different from the colors named. Go to <http://faculty.washington.edu/chudler/words.html> to take the Stroop effect test or print out the cards to test and time others. It is harder than you think!

Where Can I Go for More Information?

Baddeley, A. (1992). Working memory: The interface between memory and cognition. *Journal of Cognitive Neuroscience*, 4(3), 281–288.

Callaghan, T. C. (1989). Interference and dominance in texture segregation: Hue, geometric form, and line orientation. *Perception & Psychophysics*, 46(4), 299–311.

Chen, C., & Yu, Y. (2000). Empirical studies of information visualization: A meta-analysis. *International Journal of Human-Computer Studies*, 53(5), 851–866.

Cowan, N. (2000). The magical number 4 in short-term memory: A reconsideration of mental storage capacity. *Behavioral and Brain Sciences*, 24, 87–185.

Gelman, A., & Unwin, A. (2012). *Infovis and statistical graphics: Different goals, different looks*. Retrieved from <http://www.stat.columbia.edu/~gelman/research/published/vis14.pdf>

General Accounting Office. (1995). *Program evaluation: Improving the flow of information to the Congress* (GAO/PEMD-95-1). Washington, DC:

Author. Retrieved from <http://www.gao.gov/products/PEMD-95-1>

Johnson, J. (2014). *Designing with the mind in mind: Simple guide to understanding user interface design guidelines* (2nd ed.). Waltham, MA: Morgan Kaufmann.

Mayer, R. E. (1997). Multimedia learning: Are we asking the right questions? *Educational Psychologist*, 32(1), 1–19.

Medina, J. (2008). *Brain rules*. Seattle: Pear Press.

Patton, M. Q. (2008). *Utilization-focused evaluation* (4th ed.). Thousand Oaks, CA: Sage.

Robertson, G., Fernandez, R., Fisher, D., Lee, B., & Stasko, J. (2008). Effectiveness of animation in trend visualization. *IEEE Transactions on Visualization and Computer Graphics*, 14(6), 1325–1332.

Shah, P., Mayer, R. E., & Hegarty, M. (1999). Graphs as aids to knowledge construction: Signaling techniques for guiding the process

of graph comprehension. *Journal of Educational Psychology*, 91(4), 690–702.

Smith, V. S. (2013). Data dashboard as evaluation and research communication tool. *New Directions in Evaluation*, 2013(140), 21–45.

Stenberg, G. (2006). Conceptual and perceptual factors in the picture superiority effect. *European Journal of Cognitive Psychology*, 18, 813–847.

U.S. Department of Health and Human Services. (2006). *The research-based web design and usability guidelines* (enlarged/expanded ed.). Washington, DC: Government Printing Office.

Ware, C. (2013). *Information visualization: Perception for design* (3rd ed.). Waltham, MA: Morgan Kaufmann.

Woodman, G. F., Vecera, S. P., & Luck, S. J. (2003). Perceptual organization influences visual working memory. *Psychonomic Bulletin & Review*, 10(1), 80–87.

Xu, Y., & Chun, M. M. (2006). Dissociable neural mechanisms supporting visual short-term memory for objects. *Nature*, 440, 91–95.