Visualization has been around for centuries, but it is relatively new as a field of study, and experts in the area haven't even decided what exactly visualization is yet. Should it be used for only analysis? Is visualization specifically for quantitative insights, or can you use it to evoke emotions? At what point does visualization—a field deeply rooted in, well, visual things—become art?

The answers to these questions vary between who you ask. The questions have created heated debates within and in between subject areas, and this is just amongst the academics and practitioners.

I was on a consulting gig at a large, data-centric organization because it wanted to inject more visualization into its work. It wanted the public to know what it was doing and wanted to improve its existing work in reports and data summaries, along with tools within the organization.

So I was in a meeting with about 40 people, which was a diverse group of marketers, developers, and statisticians. The group worked on a variety of projects, from quick, made-for-blog graphics to interactive data exploration tools. We were discussing an online application, and part of the group felt there should be more editorial content on what the data was about, whereas another part insisted that any interpretation should be left to the users. A few others leaned toward graphics that looked like abstract paintings. The ideas for visualization were all over the place, and a long argument ensued.

They were all right. Everyone argued in support of visualization for a specific purpose and insisted that others' visualization had to fit the same criteria, even if the others designed applications for different reasons and with a different audience in mind. They approached visualization as if it were a monolithic thing that had a defined set of rules. This might have been true a century ago (or not), but visualization has grown into more than just a tool. Visualization is a medium: a way to explore, present, and express meaning in data.

Rather than disjoint categories that work independently from others, you can think of visualization as a continuous spectrum that stretches from statistical graphics to data art. There is visualization that is clearly one or the other, but there are many works that are a blend of both and can't be put in a bin. Where statistics, design, and aesthetics find a balance is where a lot of the best work comes from.

This is not to say that the blend is always best, nor are statistical graphics better than data art, or vice versa. They all serve their own purposes and should be judged by how well they achieve their goals. You don't critique a documentary

in the same way you might judge a slapstick comedy because you go in with different expectations and a different mindset. Similarly, you don't expect a romance novel from a textbook or complain about how unfunny a television crime drama is.

A series of comical pie charts shouldn't be put under the same microscope as visualization research, unless those pie charts happen to be part of research on how people react to comical pie charts. If so, I would like to read that paper, because I'm sure it's hilarious.

Note: There are rules and design suggestions for visualization. These are fine, but you can't just blindly follow them. Consider goals and applications.

Again, this is not to say that you should be less critical of funny graphs or data art than you are of exploratory visualization. People examine comedy and art all the time. Just know what you're critiquing.

ANALYSIS AND EXPLORATION

William Playfair is credited with inventing many of the traditional chart types used today: the line graph, the bar chart, and the pie chart. In 1786, Playfair published the first bar charts in *The Commercial and Political Atlas*, which showed progress via indicators such as imports and exports, as shown in Figure 2-1. Figure 2-2 shows one of the first pie charts. These charts were handmade on paper, of course.

It's hard to believe that as late as the 1970s this was how people looked at data—by hand. In John Tukey's seminal *Exploratory Data Analysis*, published in 1977, he described how to darken the shade of lines by using a pen instead of a pencil. Such a technique seems ancient now. The good news is that technology advanced, and Tukey continued to innovate with what became available.

In line with the improvements of technology, the volume of data and availability has increased dramatically, too, which in turn gave people something new to visualize (and new jobs and fields of study). Because remember: There is no visualization without the data.

In 2001, Wikipedia (the collaborative, online encyclopedia) launched, and as of this writing has 35 million registered users. Anyone can edit Wikipedia entries, so when someone starts an article, it can grow and shrink as others add and delete information. This creates a dynamic within every article, especially as individuals argue over what should and shouldn't be written.

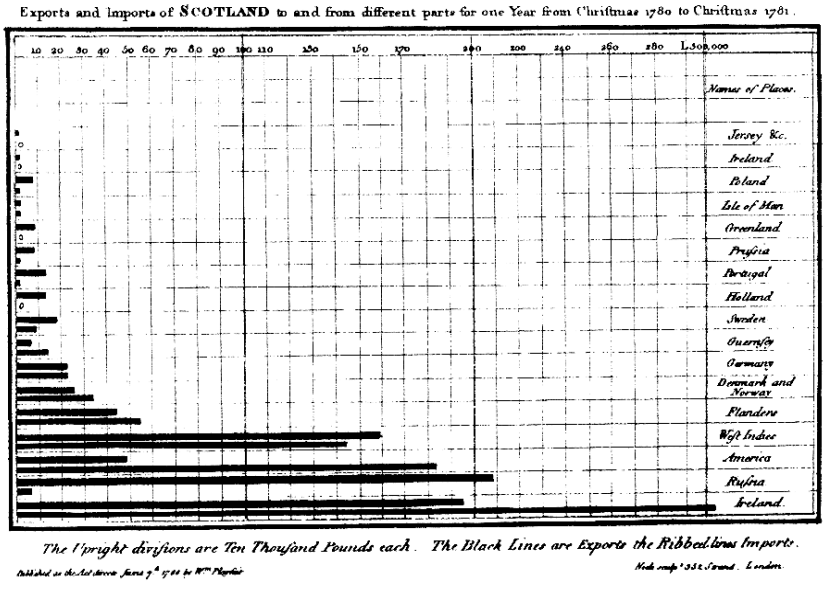


FIGURE 2-1 *Bar chart from* The Commercial and Political Atlas *by William Playfair*

The fun starts when you look at the event history for articles, which is freely available via the site. Fernanda Viégas and Martin Wattenberg explored this concept in 2003 with *History Flow*, a tool that enables you to explore the history of any Wikipedia entry over time.

As shown in Figure 2-3, the visualization looks like an inverted stacked area chart, where each layer represents a body of text. As time passes, new layers (encoded with different colors) are added (or removed), and you can see the change in overall size via the total vertical height of the full stack.

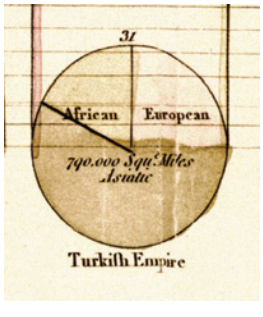


FIGURE 2-2 *William Playfair created the pie chart for* Statistical Breviary *in 1801*

Notice the zigzag pattern and the seemingly random sections of black? The former shows debate between users, and the latter is when someone deleted a portion of the article, either because of a disagreement or a user is just in it for the lulz.

The most interesting aspect of *History Flow* is the changes over time for each article. When events occur in real life, it's hard to see the big picture because you're so focused on a single event. As a Wikipedia user in a heated debate, your main concern is what the opposition just did and then you figure out how to react, but when you take a step back to see the overall changes after the fact, it's likely you'll see something interesting.

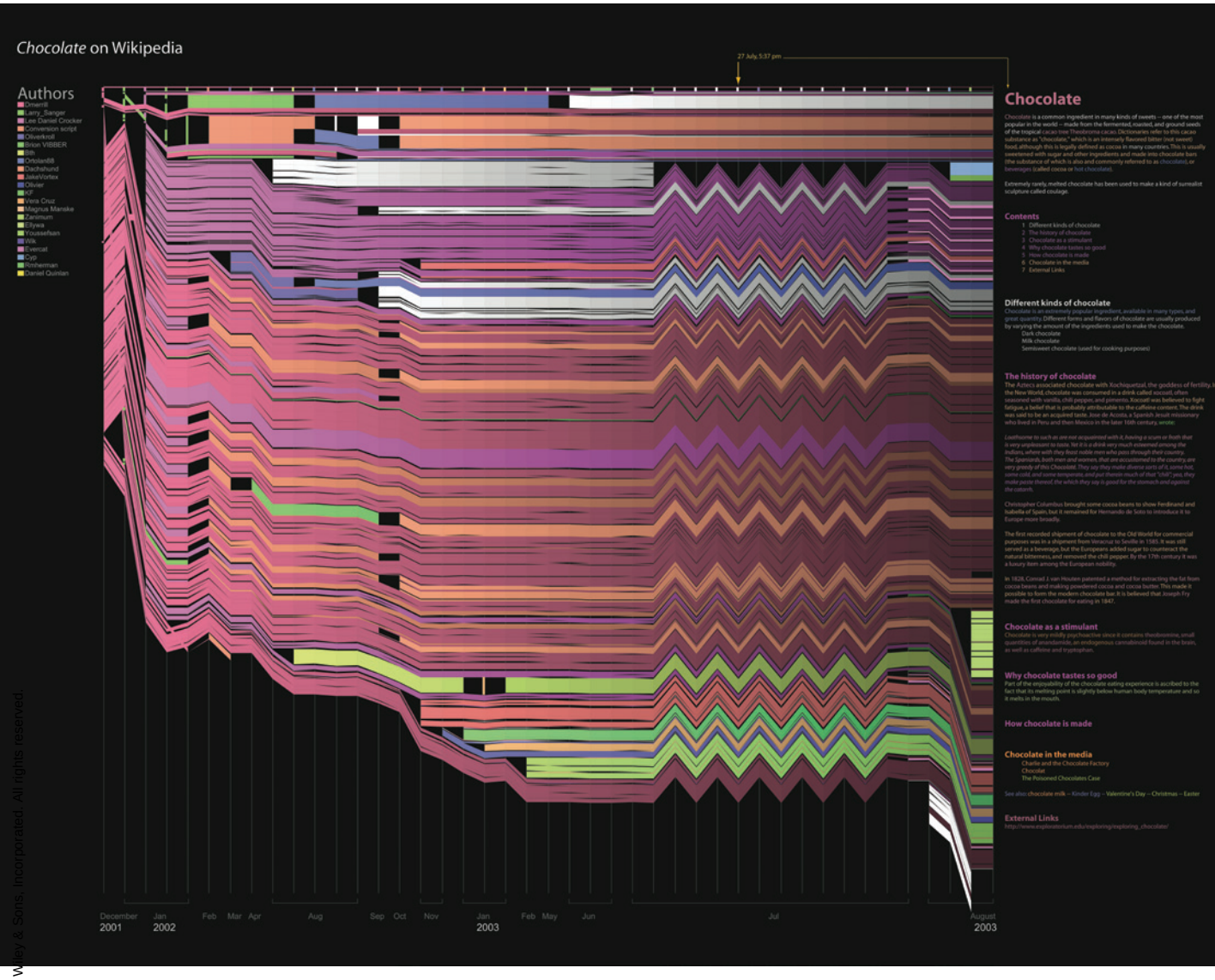


FIGURE 2-3 History Flow *(2003) by Fernanda Viégas and Martin Wattenberg, http://hint.fm*

Note: Although Wikipedia is an encyclopedia, because it's always changing, you can also easily relate activity to current events, such as times of unrest or shifts in political power.

The World Bank provides countrywide data in an easy-to-download format to help you gain an understanding on the progress of the world. Figure 2-4 (an interactive I made to look at life expectancy over the years for different countries) shows an overall increase for most regions; but at the same time, big dips indicate wars and times of struggle in some places. You can, for example, see the Bangladesh Liberation War in the 1970s, the Iran-Iraq War in the 1980s, and the Rwanda Civil War in the 1990s. There's a smaller dip for Iraq in early 2000. Selectable regions and countries enable you to highlight specifics.

From a methodology point of view, both *History Flow* and the life expectancy charts are a modified stacked area chart and multiple time series, respectively. The data makes them interesting, but pre-Internet, these numbers would have been harder to come by, if they existed at all.

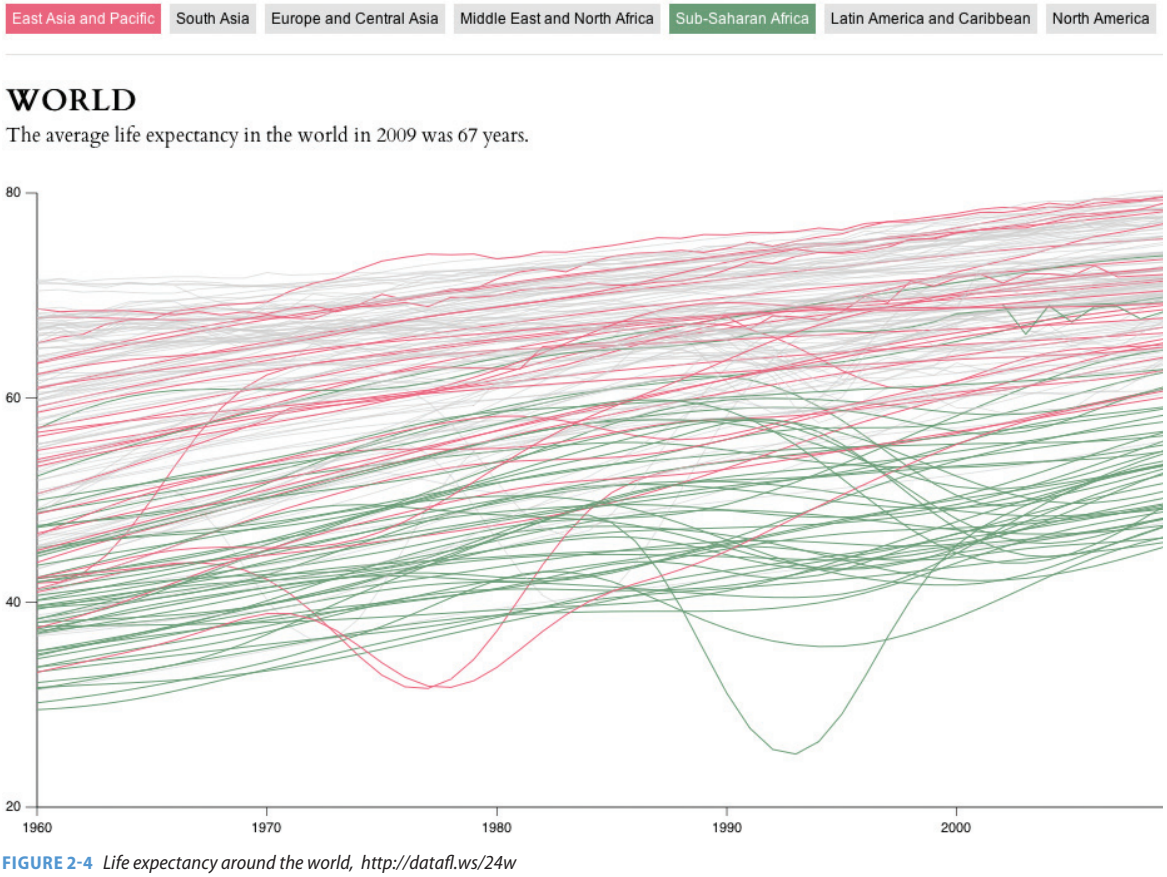


FIGURE 2-4 *Life expectancy around the world, http://datafl.ws/24w*

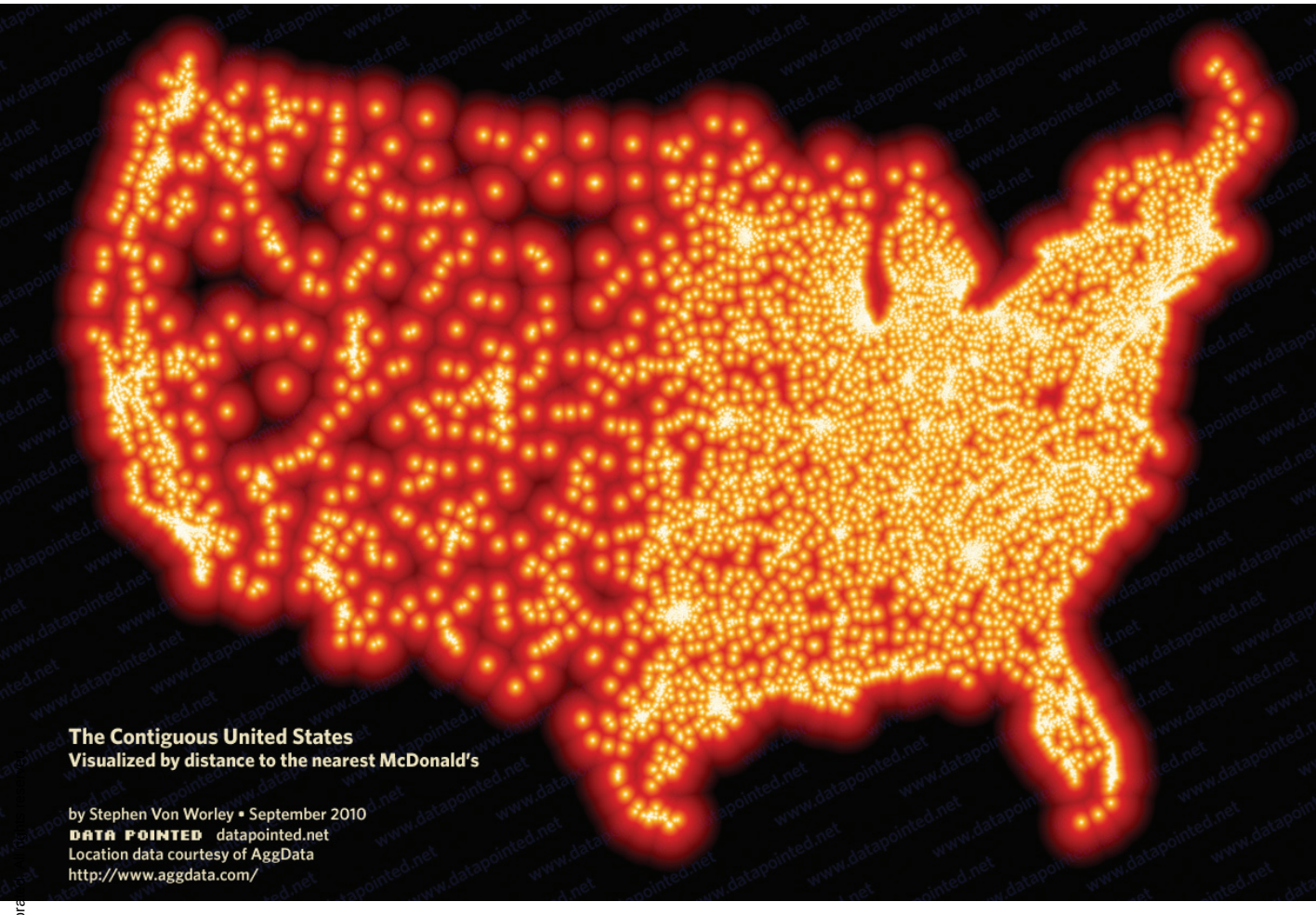
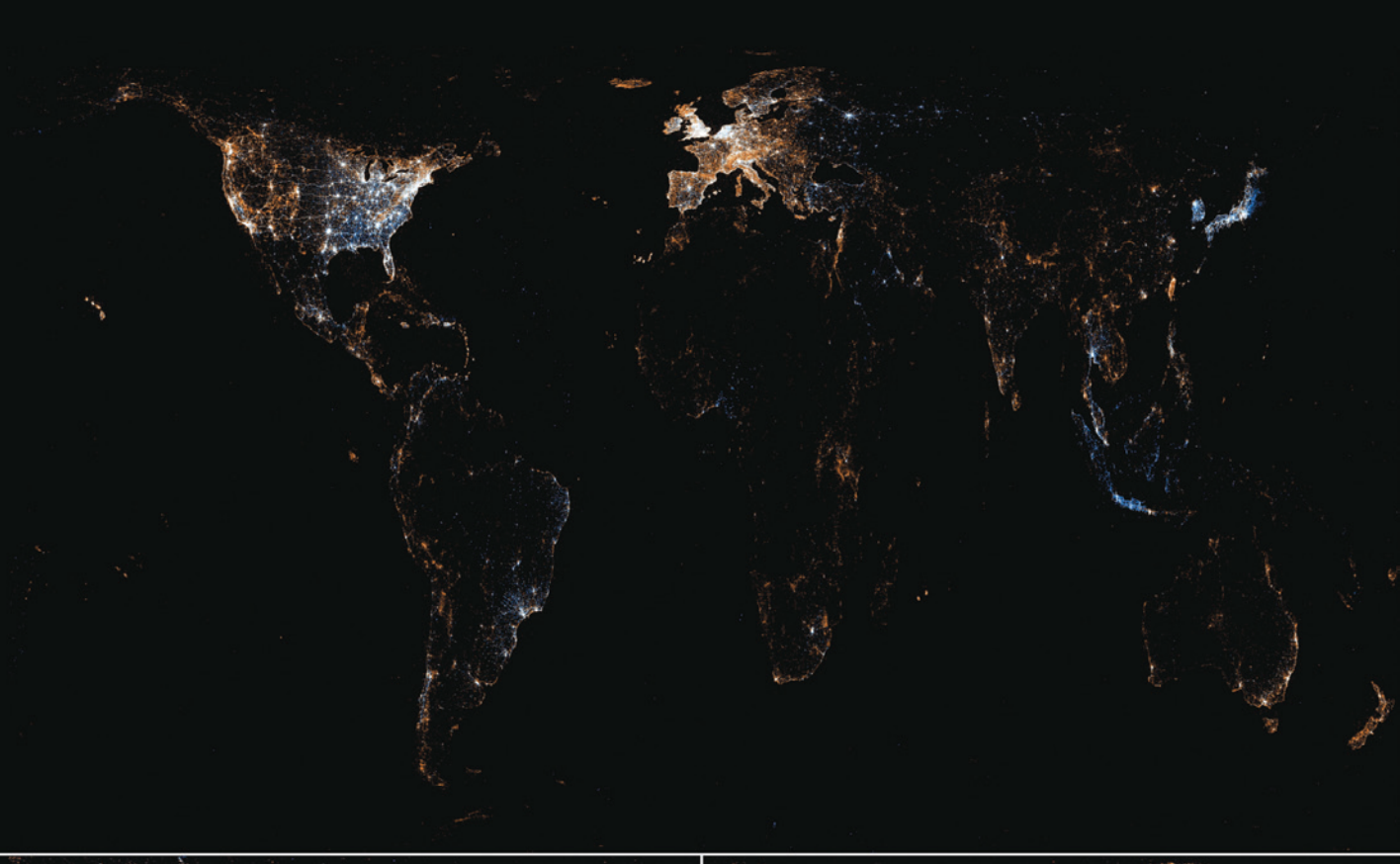


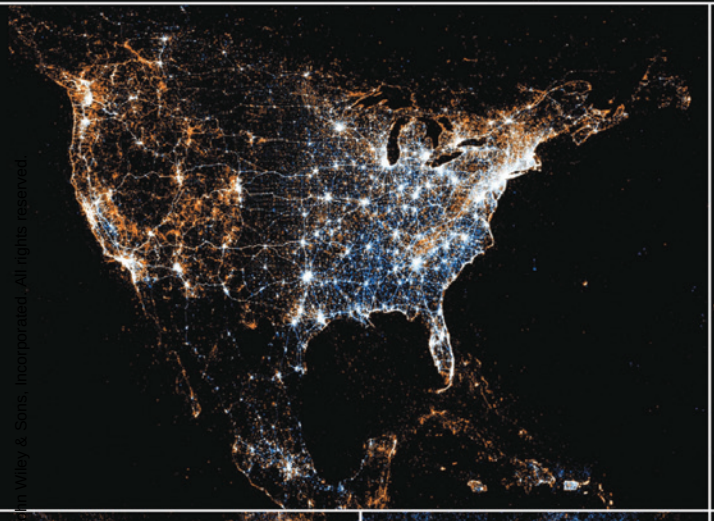
FIGURE 2-5 Distance to McDonald's *(2010) by Stephen Von Worley, http://datafl.ws/24y*

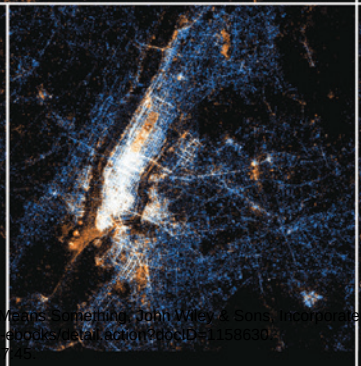
Now it seems like you can find data on almost anything if you look hard enough. Using a ready-to-use, comma-delimited file, Stephen Von Worley calculated the distance to the nearest McDonald's everywhere in the contiguous United States and mapped it. As shown in Figure 2-5, the brighter an area, the less time it'll take to grab a Big Mac.

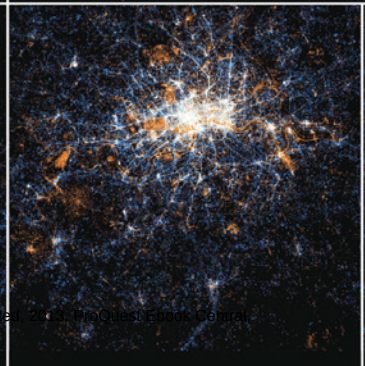
Even newer, social media sites, such as Twitter and Facebook, continue to flourish, which provide a new source of information on what people are talking about and concerned with. Data is readily accessible via the application programming interfaces (API). Photo-sharing site Flickr also has an accessible API. Eric Fischer combined data from Twitter and Flickr in his series of maps titled *See Something or Say Something*, shown in Figure 2-6.

FIGURE 2-6 *(following page)* See Something or Say Something *(2011) by Eric Fischer, http://datafl.ws/2ba*









Blue dots are locations where people tweeted, red dots represent places where people took Flickr photos, and white dots represent where people did both. So you can see where people usually tweet (say something) or take a picture (see something). It's a simple idea with great execution and beautiful results.

From an even wider point of view—from space—NASA uses satellite data to monitor activity on Earth. For example, Figure 2-7 is a snapshot from an animation that shows components of the water cycle: evaporation, water vapor, and precipitation. The data feeds into atmospheric models, which allows you to see significant changes over time for the planet.

Perpetual Ocean, also by NASA, uses similar data and models to estimate ocean currents, as shown in Figure 2-8. It might remind you of Vincent van Gogh's painting *The Starry Night*.

How amazing is that? Large amounts of data make that possible. Of course, new data types in growing volumes demands new tools to explore beyond pen and paper.

Note: See also the animated world map from NASA that shows a decade of fires: http://datafl.ws/2bb.

TOOLS

The introduction of computers changed how you can analyze and explore data. You can make a lot of charts in a few seconds, view data from many angles, and sift through more complex datasets than those who had to chart manually. There are also more data exploration tools than ever before. Microsoft Excel is still the software of choice in many offices, which can work for a lot of jobs, but the methods that people want to use and the depth they want to explore is changing.

Tableau Software is one of the more popular desktop programs that enables you to visually analyze your data. Everything is done via a click interface, so no programming skills are required, and it can handle a healthy amount of data at once, so you're free to roam. Tableau Public enables you to build visualization dashboards and share them online.

There's also desktop software to visualize specific types of data. For example, ImagePlot by Software Studies Lab at California Institute for Telecommunication and Information Technology (Calit2) enables you to explore images. You can do this with other software, but ImagePlot specializes in handling millions of images at once and can place them in a two-dimensional space to analyze aspects of a collection, such as color or volume.

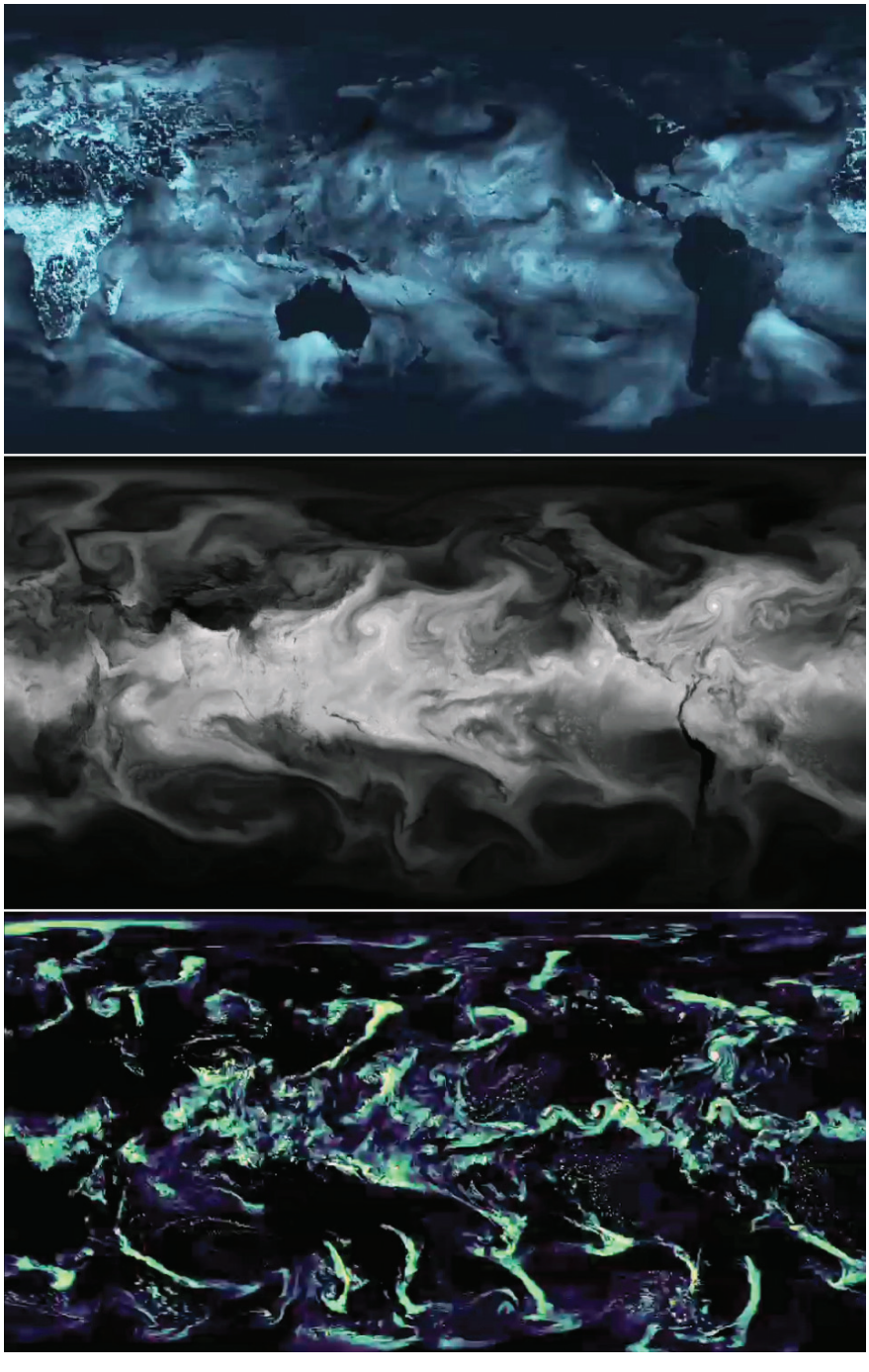


FIGURE 2-7 *Components of the* Water Cycle on a Flat Map *(2011) by NASA/Goddard Space Flight Center Scientific Visualization Studio, http://svs.gsfc.nasa.gov/goto?3811*

This specialization is a current theme in visualization development. It's easier and more efficient to build tools to handle specific data types than try to develop software that handles everything imaginable.

Gephi is the go-to open source software to visualize networks and systems. It's "like Photoshop for graphs." Whenever you see a static graph with a lot of nodes and edges, it was most likely created with this software. On the desktop, you can easily explore and interact by clicking and dragging, and you can export images when you find something interesting.

Treemap, developed by the Human-Computer Interaction Lab at the University of Maryland, enables you to explore hierarchical data via said treemaps. Originally created by Ben Shneiderman in 1990 to visualize the contents in a hard drive, the software, shown in Figure 2-11, is now more flexible, interactive, and free to use for noncommercial use.

For static, statistical graphics, my personal favorite is R in combination with Adobe Illustrator. R is the statistical computing language of choice, which has recently gained steam in the data community, and Illustrator is a program that a lot of designers use.

As you venture out to visualization for the web, the programming skill requirements seem to increase, but there are a lot of packages to help ease you into the area. It's not drag-and-drop simple, but developers have learned that providing a lot of examples get people to use their software, which is great for everyone.

Note: See Chapter 7, "Where to Go from Here," for more on tools and programming for visualization.

A few years ago, online visualization was almost all in Flash, but that has since faded. It's all about JavaScript and HTML5 these days. Again, there are a lot of libraries, but Data-Driven Documents (D3) by Mike Bostock, Raphaël by Dmitry Baranovskiy, and the JavaScript InfoVis Toolkit by Nicolas Garcia Belmonte are your best bets for starting. You can of course always upload static images online, but loading visualization native in the browser brings the added benefit of graphics that can update based on current data. Programming in JavaScript also allows you to incorporate interaction and animation, which can add another dimension to data exploration and presentation.

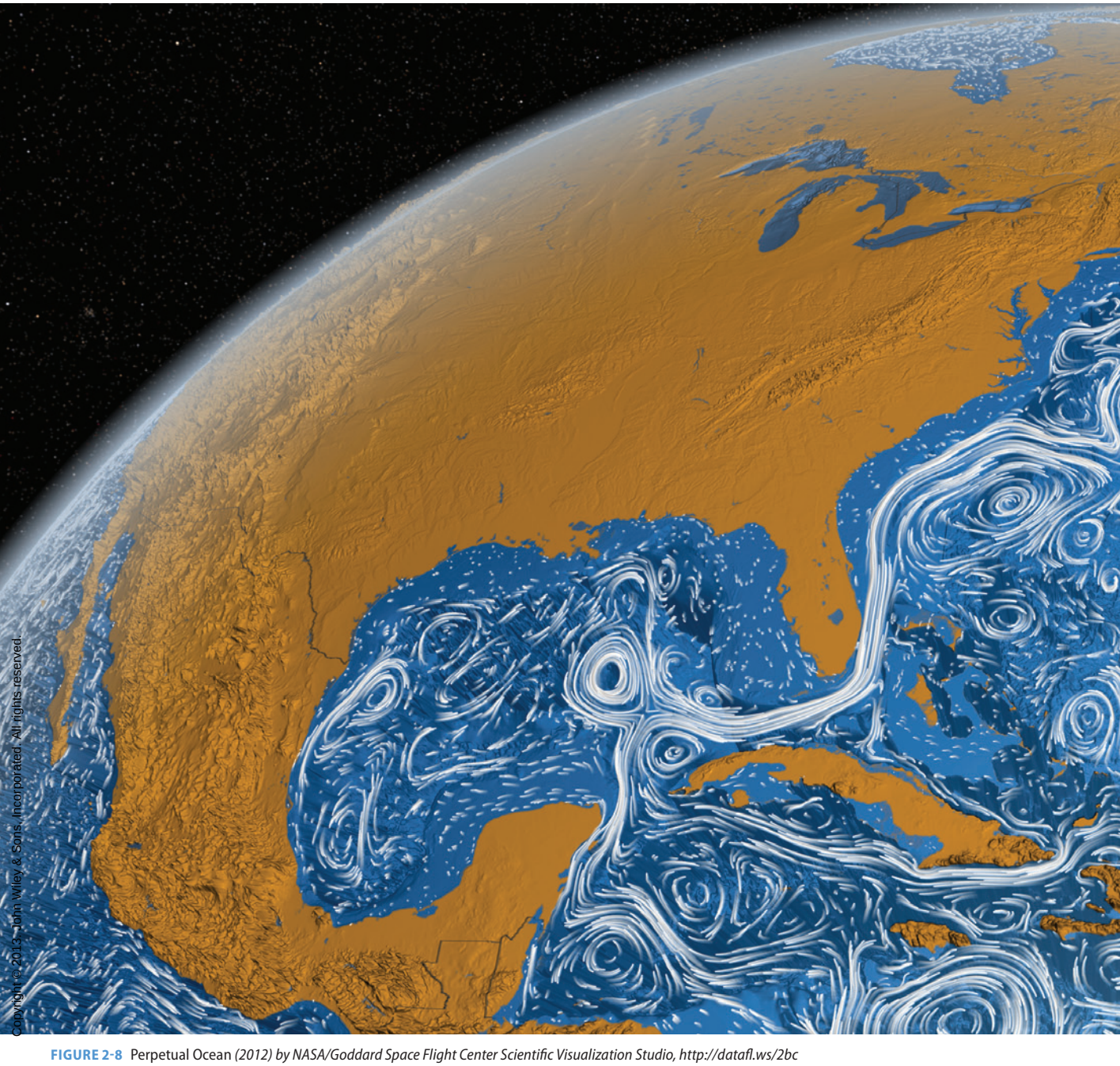
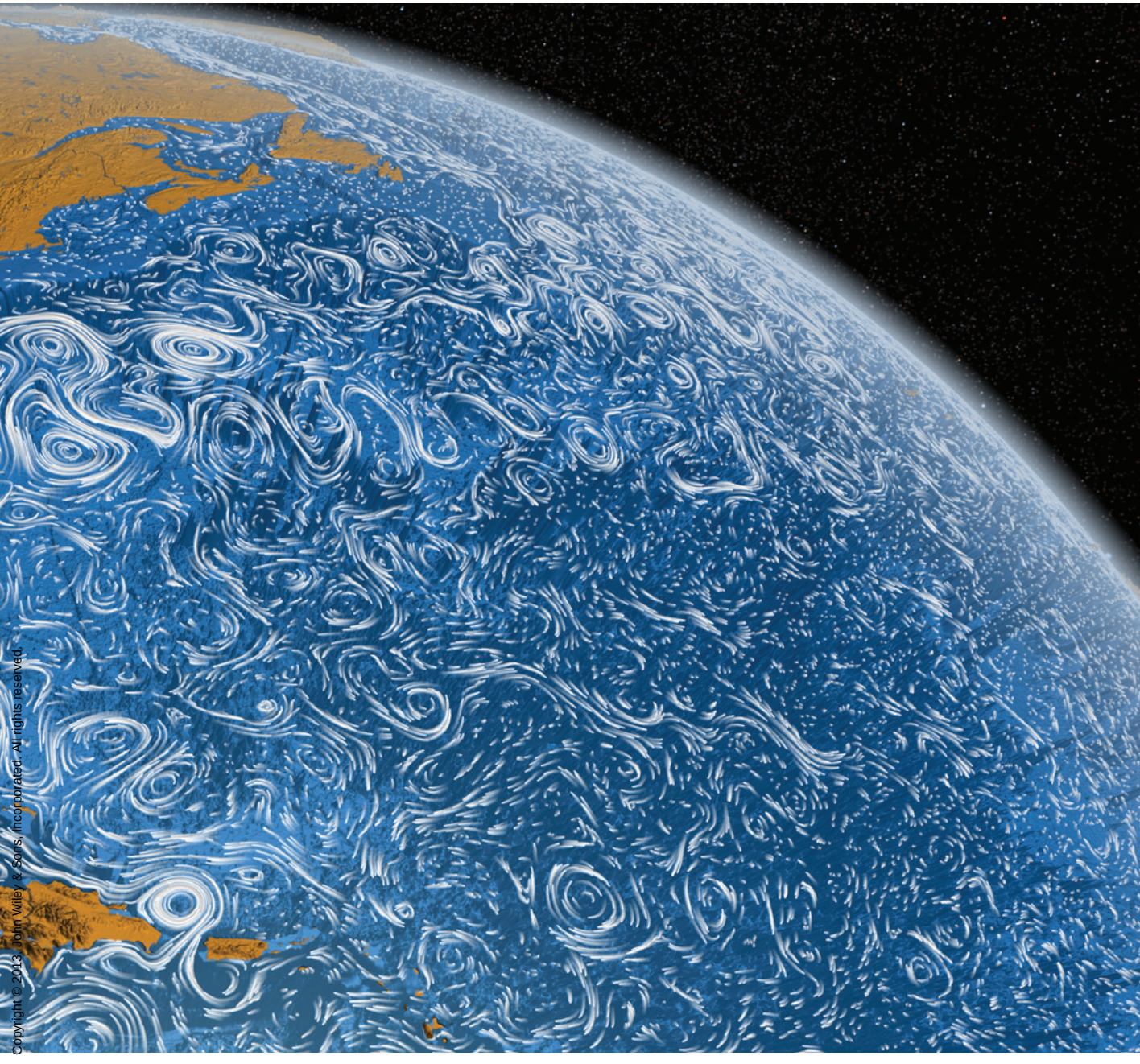


FIGURE 2-8 Perpetual Ocean *(2012) by NASA/Goddard Space Flight Center Scientific Visualization Studio, http://datafl.ws/2bc*



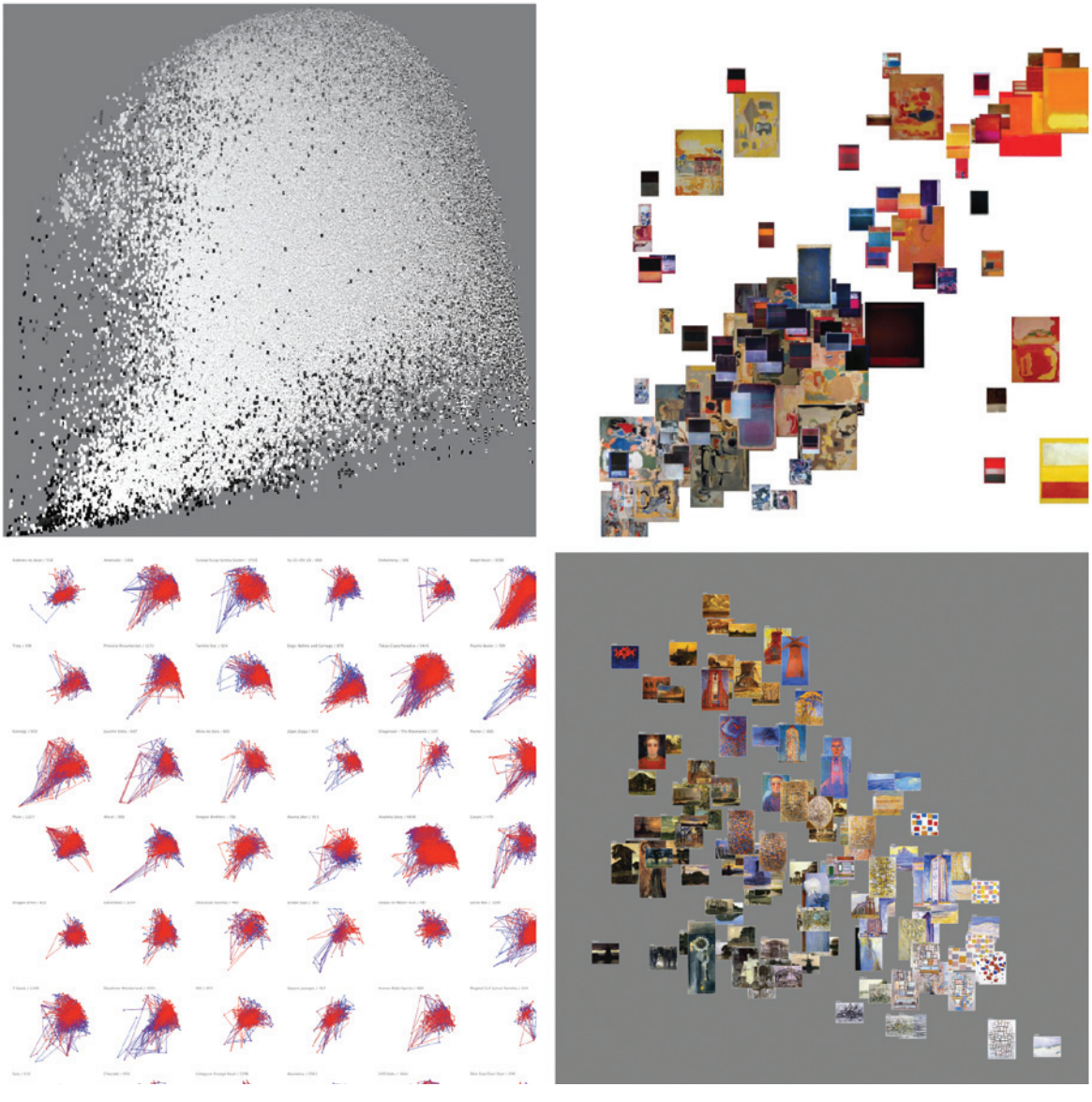


FIGURE 2-9 *ImagePlot by Software Studies Lab at California Institute for Telecommunication and Information Technology, http://datafl.ws/24x*

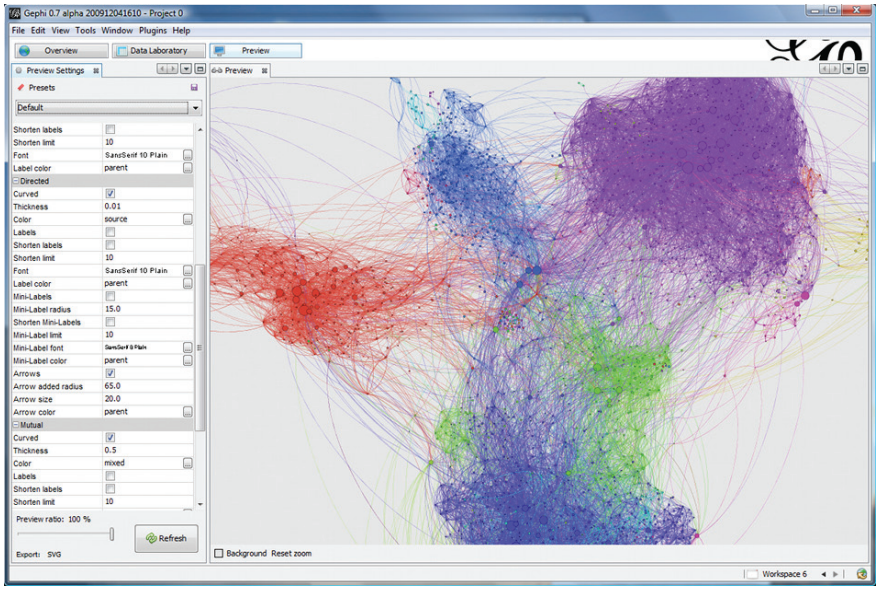


FIGURE 2-10 *Gephi, http://gephi.org*

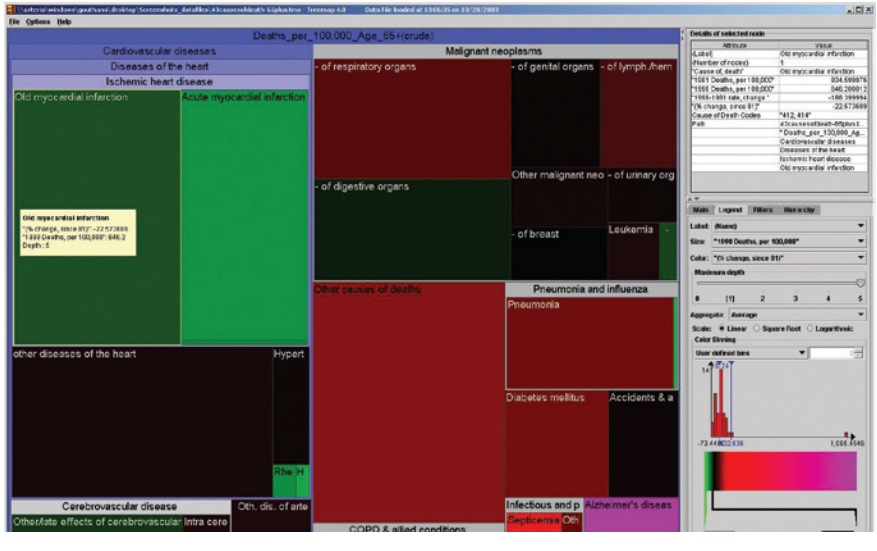


FIGURE 2-11 *Treemap by the Human-Computer Interaction Lab at the University of Maryland, http://www.cs.umd.edu/hcil/treemap/*

INFORMATION GRAPHICS AND PRESENTATION

When you explore your data, you gather your own insights, so there's no need to explain interesting facets of the data to yourself. But when your audience of one increases to more than that, you must provide guidance and context for what the data is about.

Often, this has little to do with accompanying graphics with long, detailed essays (or dissertations) and more to do with carefully placed labels, titles, and text to set up readers for what they're about to see. The visualization itself—the shapes, colors, and sizes—represent the data, whereas words can make your graphics easier to read and understand. Attention to typography, contextual elements, and logical layouts also lend to an additional layer of information on top of raw, statistical output.

A common saying in visualization design is to "let the data speak." It means to visualize your data (or information) and then get out of the way, which works great when the data is familiar and the patterns are obvious.

For example, Patrick Smith used a minimalist approach to describe mental disorders, such as obsessive-compulsive disorder, depression, and narcolepsy, as shown in Figure 2-12. He used basic shapes that are relatively small compared to the space available on each poster, but the isolation lends to the seriousness of the conditions.

Coffee Drinks Illustrated, shown in Figure 2-13, by Lokesh Dhakar is a nice example of how small enhancements to basic charts can provide readers a connection. Stacked bars for each drink form the core of this graphic, and labels tell you what each bar represents. Dhakar also includes the name of each coffee drink, making the content simple to read. The coffee mug and steam illustration around each bar graph sets the context immediately.

The True Size of Africa by Kai Krause communicates its point by rotating countries away from their geographic orientation to fit inside Africa, which is explained in the lead-in, as shown in Figure 2-14. You typically view Africa to be a relatively smaller continent, based on the Mercator projection used in online maps. However, in reality, Africa is much larger by area. The title makes this obvious, and smaller maps and tables provide details.

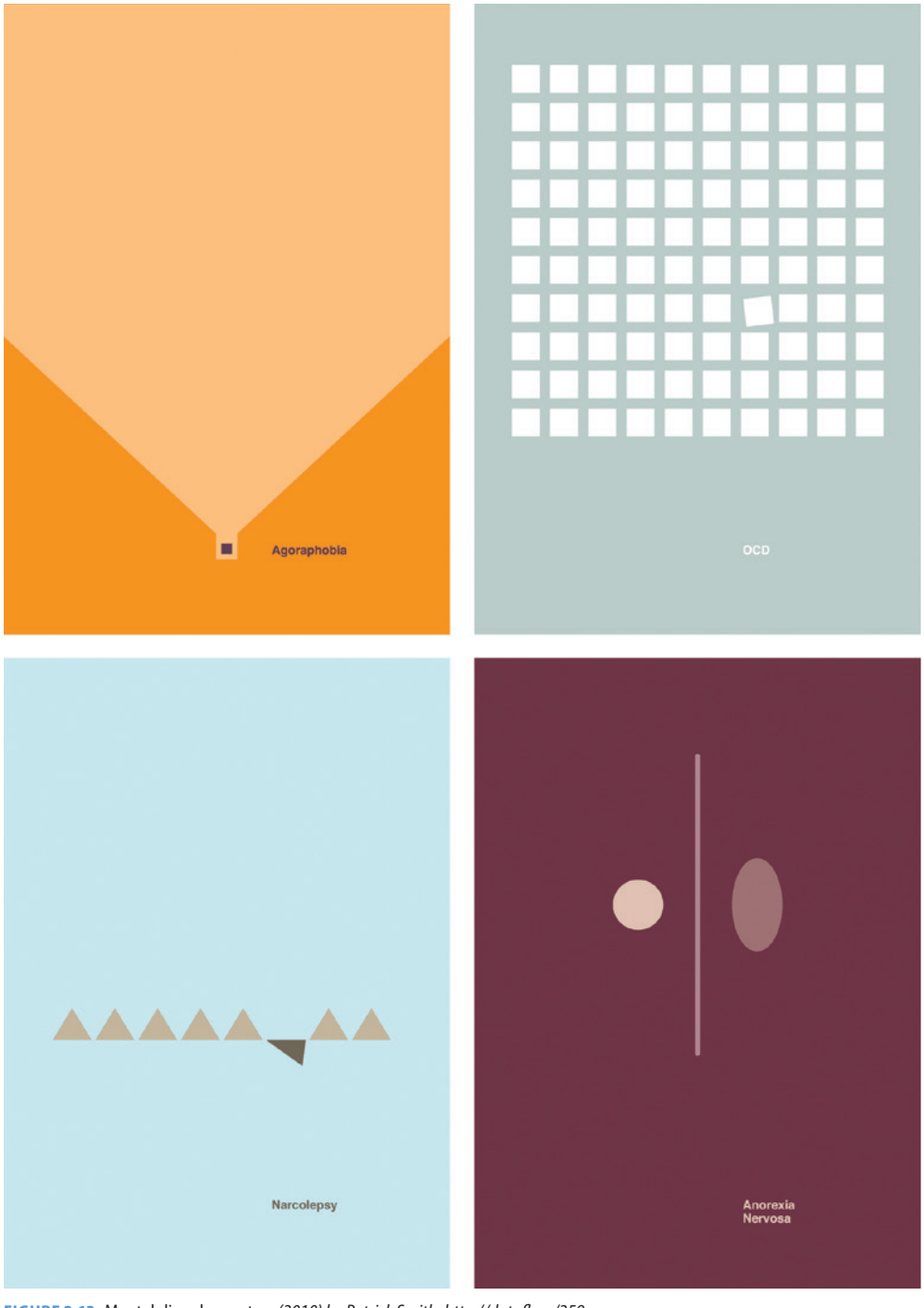


FIGURE 2-12 Mental disorder posters *(2010) by Patrick Smith, http://datafl.ws/259*

FIGURE 2-13 Coffee Drinks Illustrated *(2007) by Lokesh Dhakar, http://lokeshdhakar.com/coffee-drinks-illustrated/*

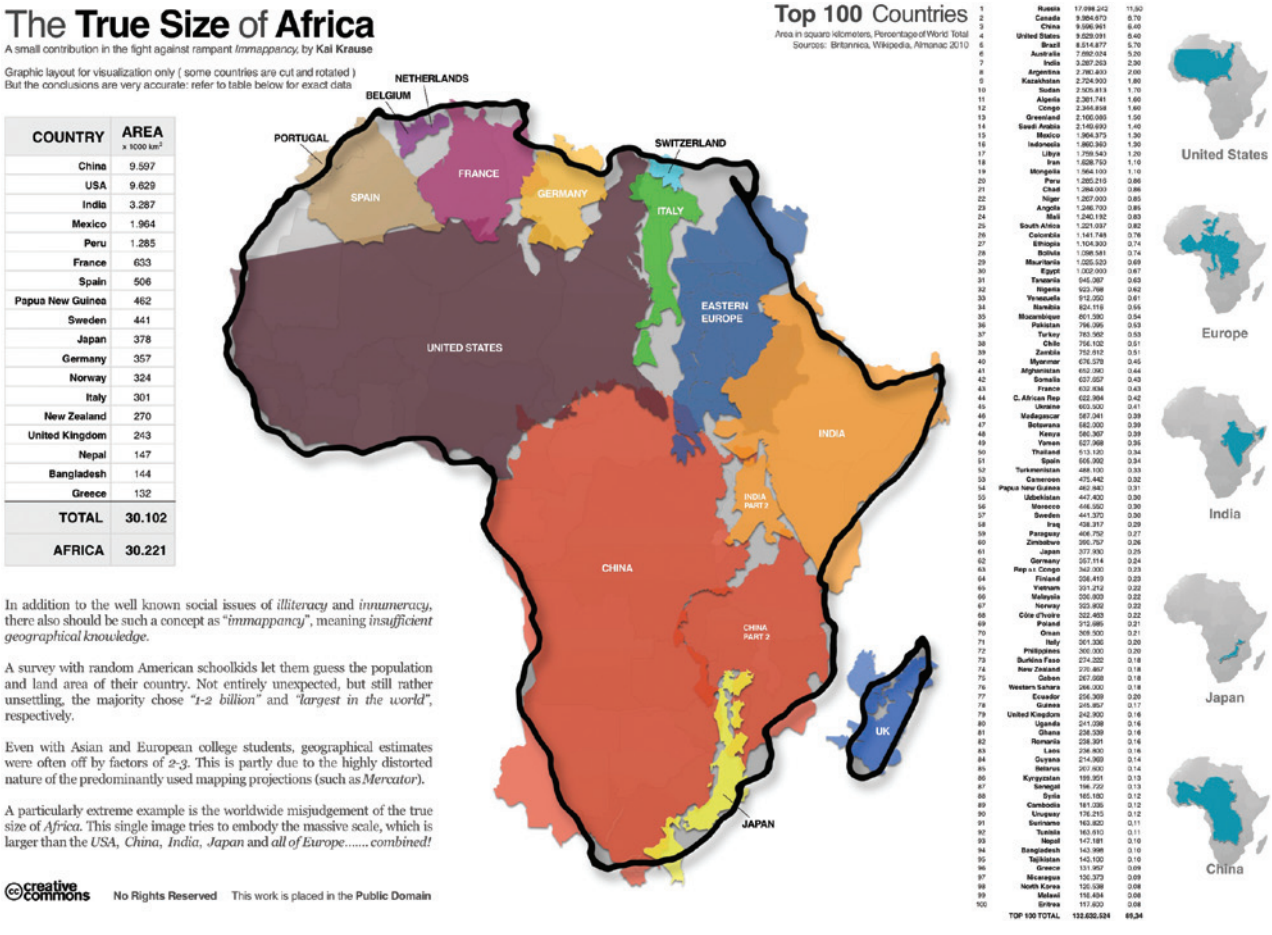


FIGURE 2-14 The True Size of Africa *(2010) by Kai Krause, http://datafl.ws/12t*

There's an easy takeaway from each of these figures because you're familiar with the data and the message is clear, but more often, the data is unfamiliar and the patterns are only obvious after someone points them out to you. That's when storytelling and data narratives come into the picture.

STORYTELLING

As a medium, visualization has developed into a great way to tell stories. News organizations are learning to do this well in a budding field known as data journalism. (This is perhaps where Tufte's chartjunk and data-ink ratio suggestions are most applicable.) Actually though, it's just good analysis and reporting.

For example, when the Deepwater Horizon oil rig exploded in the Gulf of Mexico April 2010, which led to gallons of oil, in the hundreds of millions, spilled into the ocean, *The New York Times* graphically reported several facets of the 3-month accident. This provided context for how the oil spill was playing out, what was affected, and why the spill happened. Looking back on the interactive series now, well after the initial spill, the graphics are still informative and will be for years.

Note: See the in-depth interactive on the oil spill by *The New York Times* at http://datafl.ws/254. You can also find more of their work at http://datafl.ws/2bd.

Digital Narratives, a project by Microsoft Research that demonstrates their Rich Interactive Narratives (RIN) technology, experiments with combining various types of media—video, audio, and text—with visualization that users can interact with. The great thing about the project is that an author can string media together and add a vocal component so that a piece plays as a continuous narrative. A user can pause a narrative at any time to interact with the visualization on the screen.

For example, as shown in Figure 2-15, an author might verbally describe a visualization, and users can pause to interact with the visualization within the

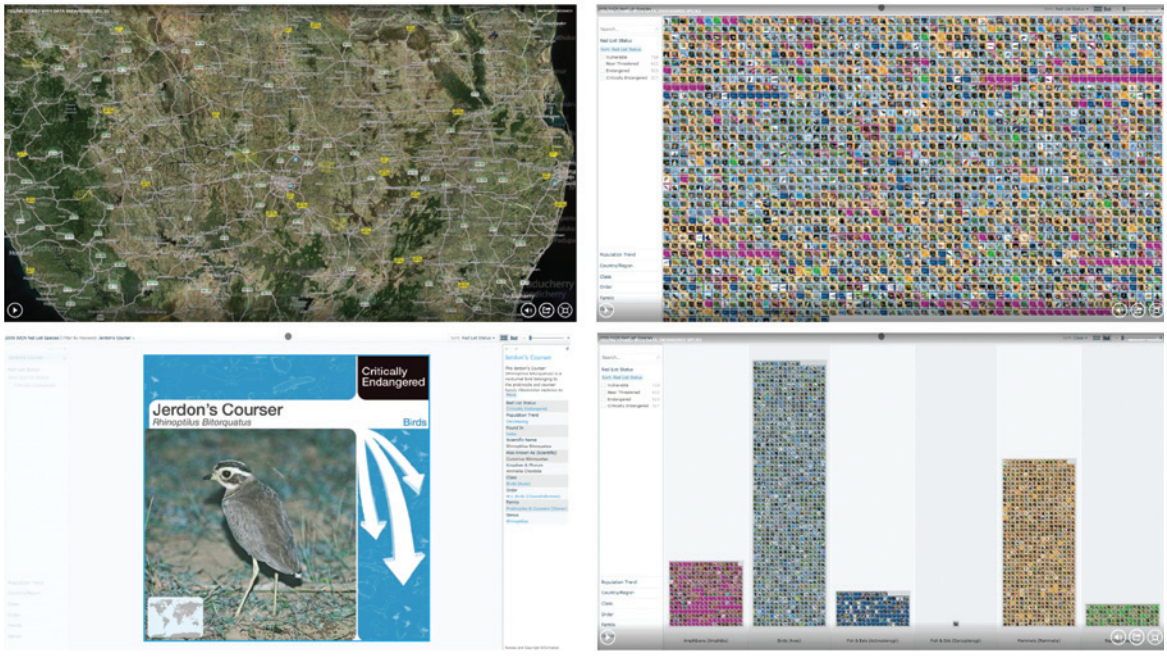


FIGURE 2-15 Digital Narratives *(2011) by Microsoft Research, http://www.digitalnarratives.net/ and http://datafl.ws/2be*

media and explore the data themselves (and resume the story when they're done interacting).

Visualization not only lends itself well to narratives but also communicating and clarifying ideas. Maybe you just want to get a quick point across—data vignettes, so to speak. After all, one of the main selling points of visualization is that it helps you digest a lot of information at once.

Flowcharts, for example, are straightforward ways to communicate process and decision making. You start in a state and then move to adjacent states as you answer questions. Eventually, you end up in a state that helps you make a decision. For example, *So You Need a Typeface* by Julian Hansen, as shown in Figure 2-16 helps you choose the right typography based on task and preference.

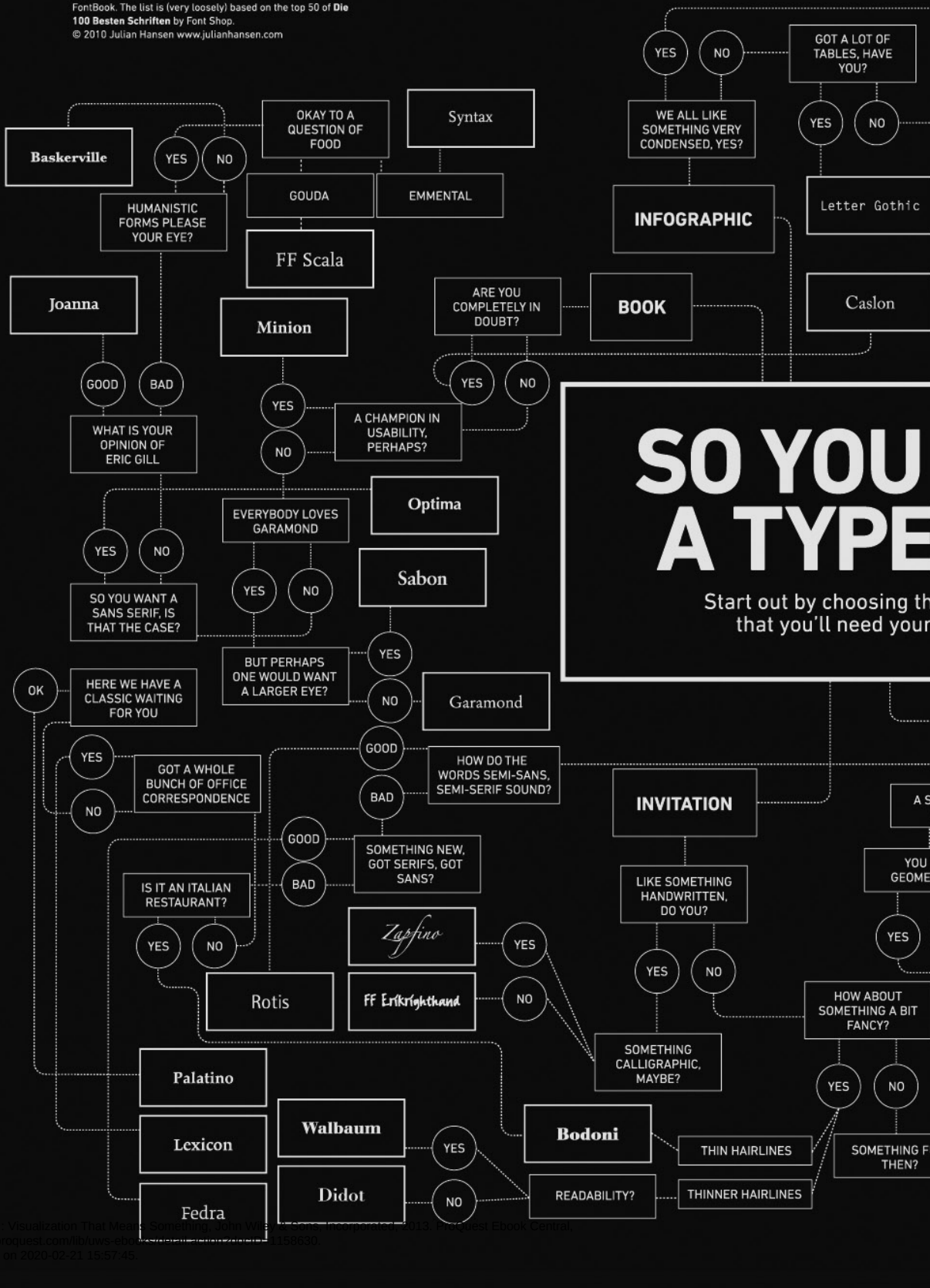
Sometimes you want to see an entire process, such as Michael Niggel's flowchart that maps all possible outcomes to *Choose Your Own Adventure #2: Journey Under the Sea*. If you're unfamiliar, the *Choose Your Adventure* books are divided into sections, and at the end of each section, the author provides choices for where to go next. The goal is to stay alive, so it's kind of like a game. As a whole, the flowchart, shown in Figure 2-17, represents the book's complete storyline. FYI: Most likely you'll die.

Information graphics can also cover topics close to the heart. As shown in Figure 2-18, *What Love Looks Like* by Louise Ma is a chart series that conceptualizes what love looks like. Love is a complicated feeling that can be hard to describe in words, but Ma's charts are beautifully poetic in describing the emotion's many facets, focusing both inward and outward.

Notice that Ma doesn't use actual data. Rather, she uses abstract trends and patterns to illustrate miniature stories. Matthew Might uses this to great effect in *The Illustrated Guide to a Ph.D.* shown in Figure 2-19. It was made directed toward graduate students (and of course struck a chord with me right away), but it applies to everyone who's learning and wants to push their field forward, regardless of whether you're in an academic setting, office, or at home.

FIGURE 2-16 *(following page)* So You Need a Typeface *(2010) by Julian Hansen, http://julianhansen.com*

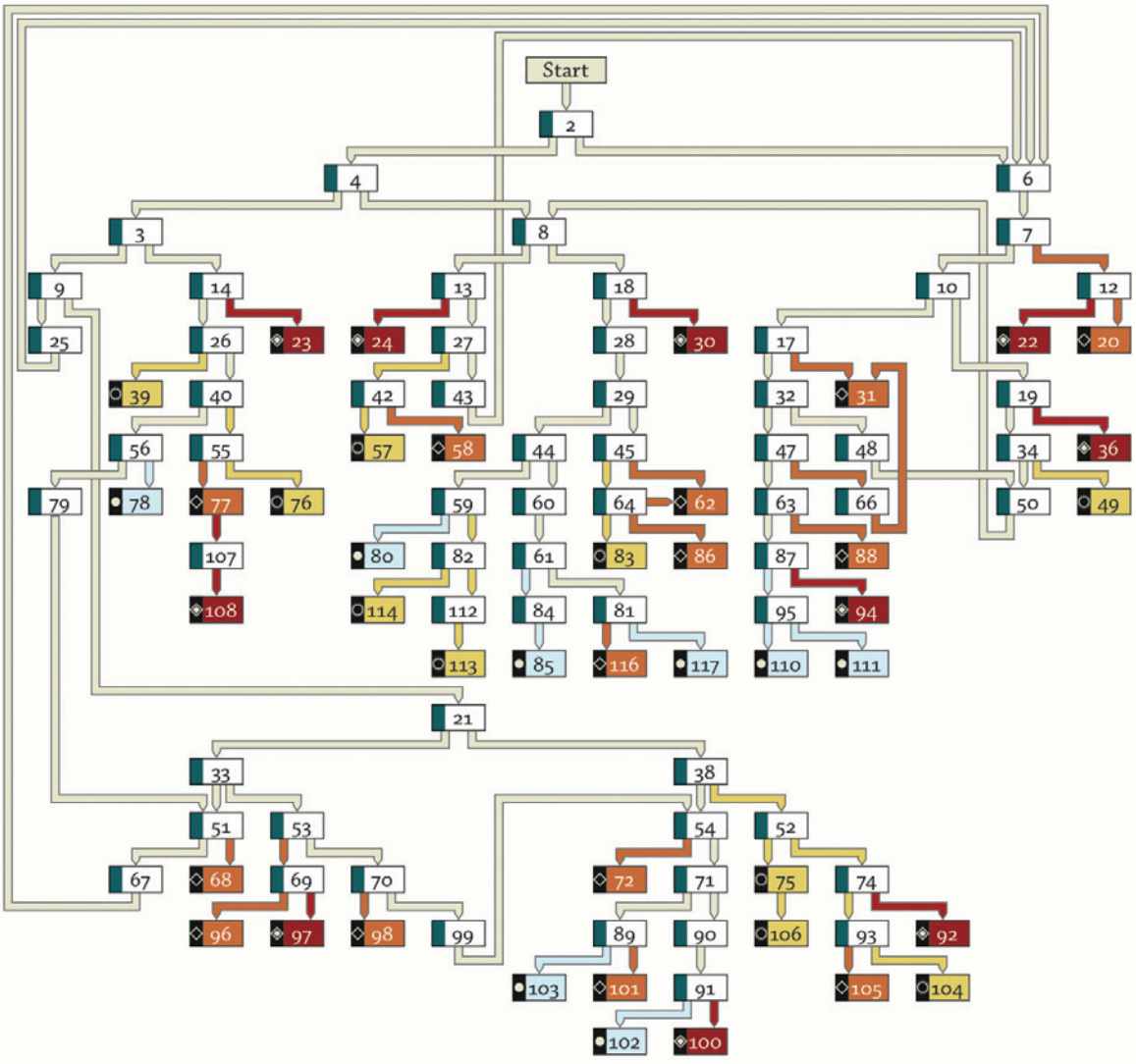
SO YOU NEED A TYPEFACE is a project by Julian Hansen. It's an alternative way on how to choose fonts (or just be inspired) for a specific project, not just by browsing through the pages of FontBook. The list is (very loosely) based on the top 50 of **Die 100 Besten Schriften** by Font Shop.



Choose Your Own Adventure #2: Journey Under the Sea

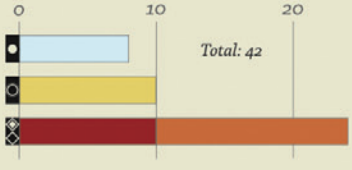
Analysis of paths and outcomes

Michael Niggel — 2009-07-31



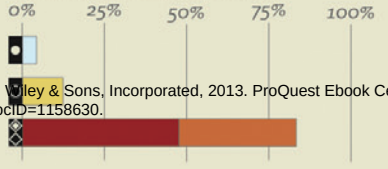
Page Sequence

Number of Endings



Chance of Outcome

Given an equal chance of selecting each choice and same choice is not made twice if encountered



Path Data

	steps	choices
Shortest path	5	3
Longest path	∞	∞

Key

- Normal Page
- Ending: favorable
- Ending: neutral
- Ending: unfavorable
- Ending: unfavorable, death
- Normal path (possible favorable result)
- Favorable path
- Neutral/unfavorable path
- Unfavorable path
- Unfavorable path, results in death

Although the illustrations aren't flashy, the idea drives the series forward, which shows you don't need a lot of bells and whistles to get people to look. The same goes for data. Worthwhile data makes graphics worth looking at. It drives data stories forward.

FIGURE 2-17 *(facing page)* Analysis of paths and outcomes *(2009) to* Choose Your Own Adventure #2 *by Michael Niggel, http://datafl.ws/6p*

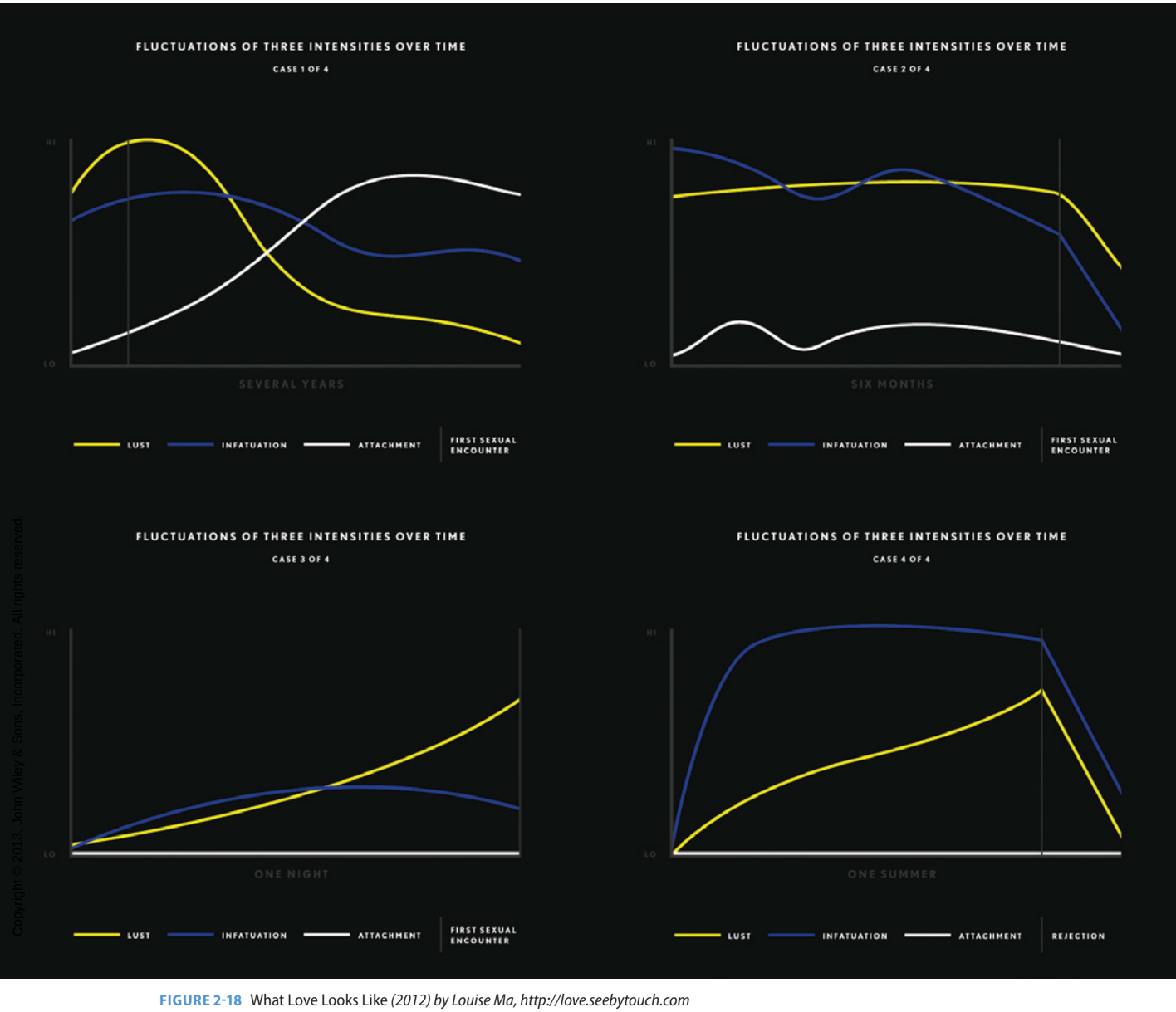


FIGURE 2-18 What Love Looks Like *(2012) by Louise Ma, http://love.seebytouch.com*

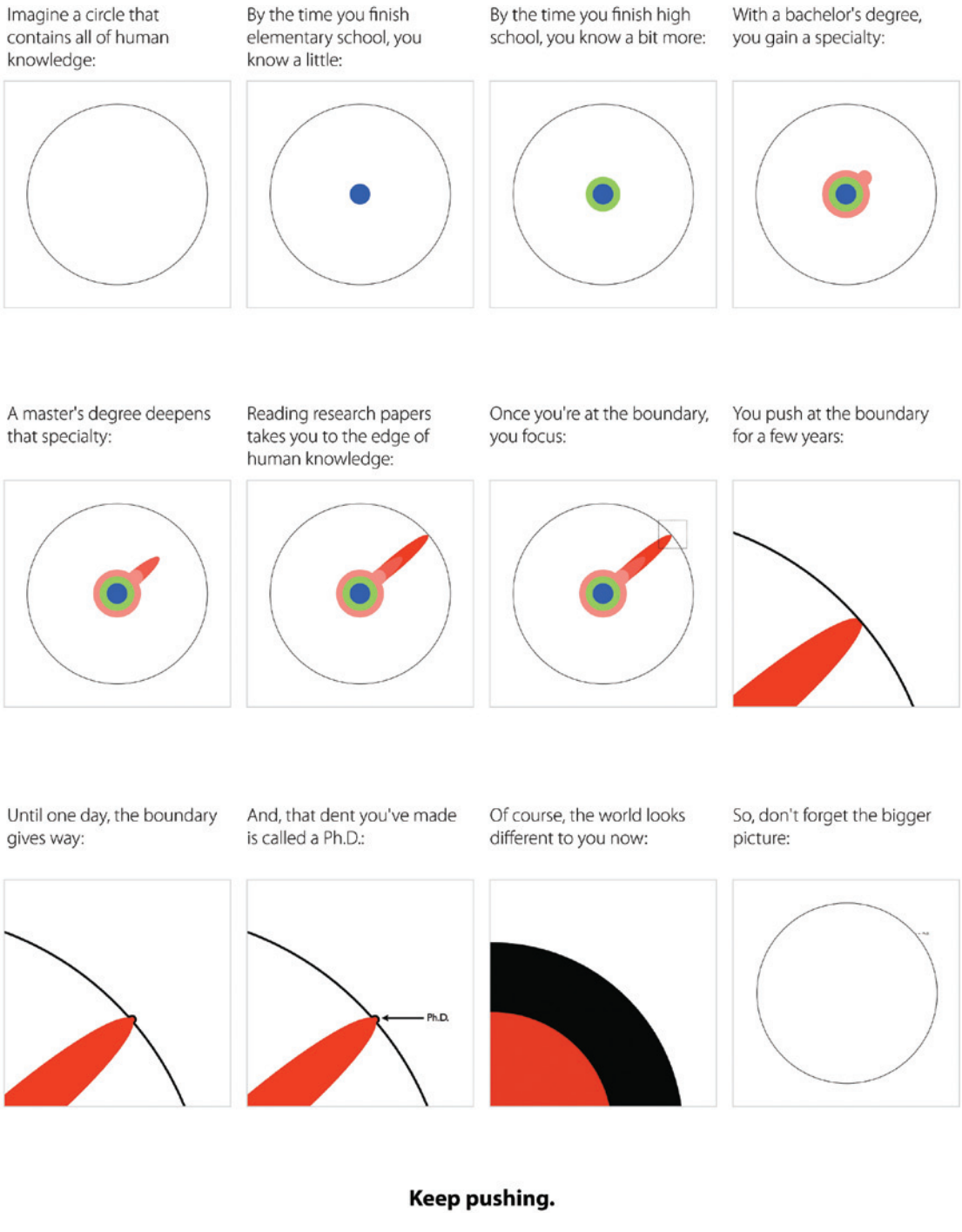


FIGURE 2-19 Illustrated Guide to a Ph.D. *(2010) by Matthew Might, http://datafl.ws/25c*

ENTERTAINMENT

Approaching the middle of the visualization spectrum, I start to lose people rooted in the analysis side. I might have already lost you at the end of the last section. This is when reader attention, engagement, and happiness tend to grow more important and useful for the task than minimizing chartjunk and increasing data-ink ratios. Although the latter is still important, people tend to relate with the former more readily.

Some might feel antsy or scoff at the work that follows (I do still call myself a statistician, so I can relate.), but there is value in visualization that isn't a traditional, just-the-facts chart. There is value in entertaining, putting a smile on someone's face, and making people feel something, as much as there is in optimized presentation. Obviously, you don't embed a comic within a business dashboard, but an entertainment-based publication? That's not so crazy.

> *"All of the great chartmakers make me feel something: alarm, wonder, surprise, joy ... something. Even, I think you might argue in the case of something like dashboard design, calm."*
>
> *—Amanda Cox*

The definition split has a lot to do with use of the visualization label. In research and academia, visualization is typically a data exploration tool that requires precision and visual efficiency. You look at data, understand what you can, and then quickly move on to another part of the data. Visualization researchers hope to generalize their results to be used with similar data types and situations.

Practitioners, on the other hand, tend to design and create on a case-by-case basis. They certainly draw from past work and experience, but often the goal is to design a tool, interactive, or single graphic tailored to a dataset.

Because this dataset-tailored visualization is more visible, and academic research can feel out of reach, the general public thinks of visualization mostly of the former and less of the latter. The general public considers visualization to be anything that places numbers in a graphical context, and you're either someone who completely resists this, or you embrace it. There's no in between, and I have yet to meet anyone who shifted to the other side.

I embrace it.

Taxonomies and frameworks are important to advance research, if only to make it easier to discuss topics, but from a practical standpoint, the definition of visualization or what you call your work has little to do with what you make. Even while working with potential clients, a quick glance at a portfolio makes it easy to see what you do.

Who knows what visualization will be in 10 years? After all, a web search for visualization only 10 years ago returned results for a mental exercise to set goals and calm your nerves.

HUMOR

Along the same lines as Ma's charts about love, a genre of graphs have popped up in recent years used to tell jokes. They seem to stem from everyone's love (that is, hate) of PowerPoint presentations, starting as satire and morphing into a chart subclass.

Jessica Hagy was one of the first to do this online with her blog *Indexed*, which she started in 2006. As shown in Figure 2-20, Hagy uses line charts and Venn diagrams to communicate observations and ideas. Even after several years of regular updates, Hagy's cards never fail to make me smile. Sometimes she explores complex ideas and other times simple observations, but the hand-drawn sketches seem to lend a dose of clarity that only charts can provide.

Although *Indexed* is in its own genre that's some hybrid of reports and satire, charts have found their way into comics, too. For example, *Doghouse Diaries* often uses charts to make people smile. In Bed Cartography, shown in Figure 2-21, the odd sleeping zones of one's significant other are described. Dog and cat areas are not shown, nor is the child scared by nightmare.

Manu Cornet caricaturized organizational charts for major technology companies in his comic *Bonkers World*, as shown in Figure 2-22. They range from the strict, top-down structure at Amazon.com to Facebook's seemingly self-managed, small groups.

Taking it down to the human level, don't forget *The Trustworthiness of Beards* by Matt McInerney, who mapped beard types against a range of trustworthy to disastrous, as shown in Figure 2-23. Never trust a werewolf, no matter how hunky or shirtless he might be.

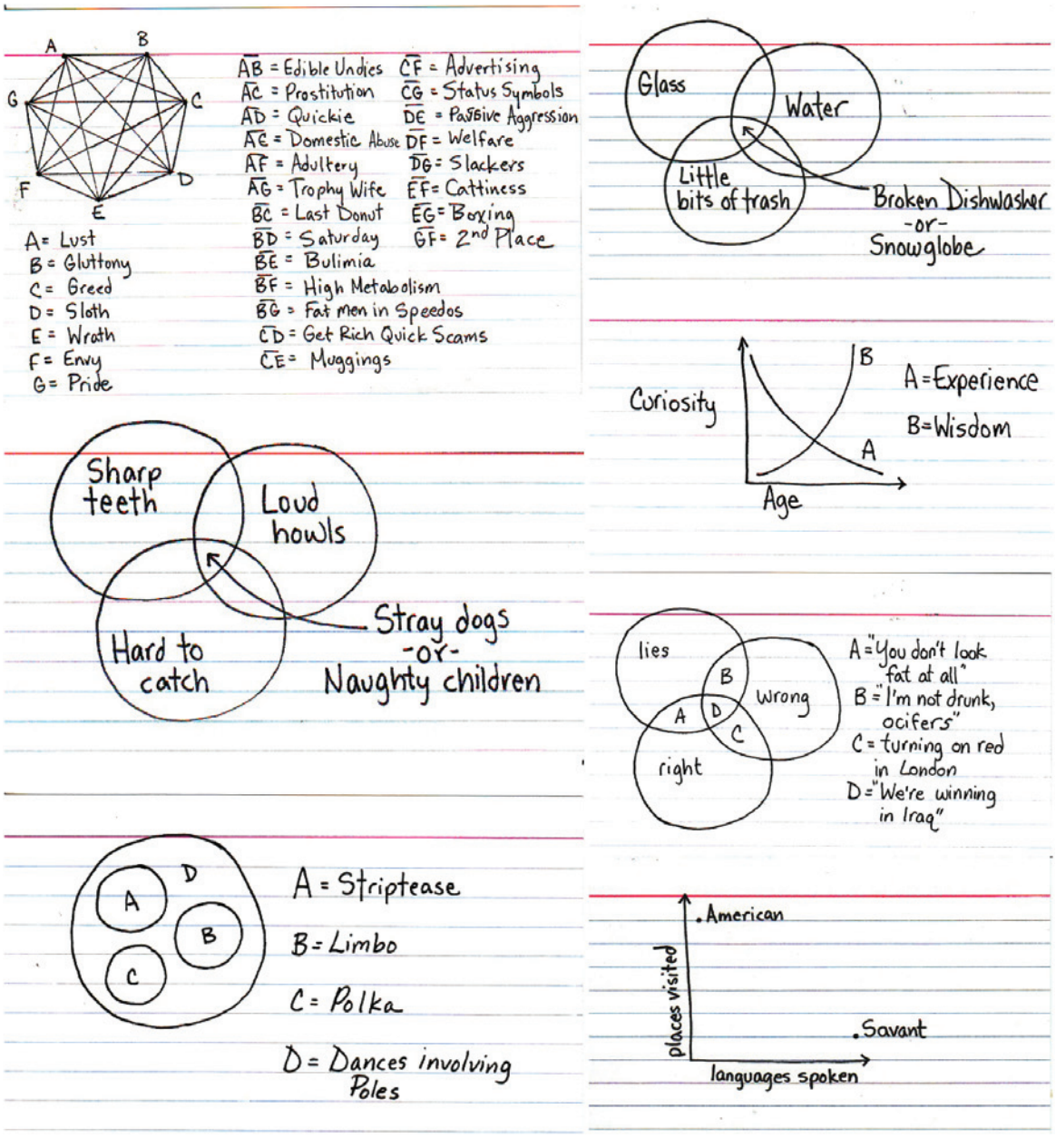


FIGURE 2-20 *Selected cards from* Indexed *by Jessica Hagy, http://thisisindexed.com*

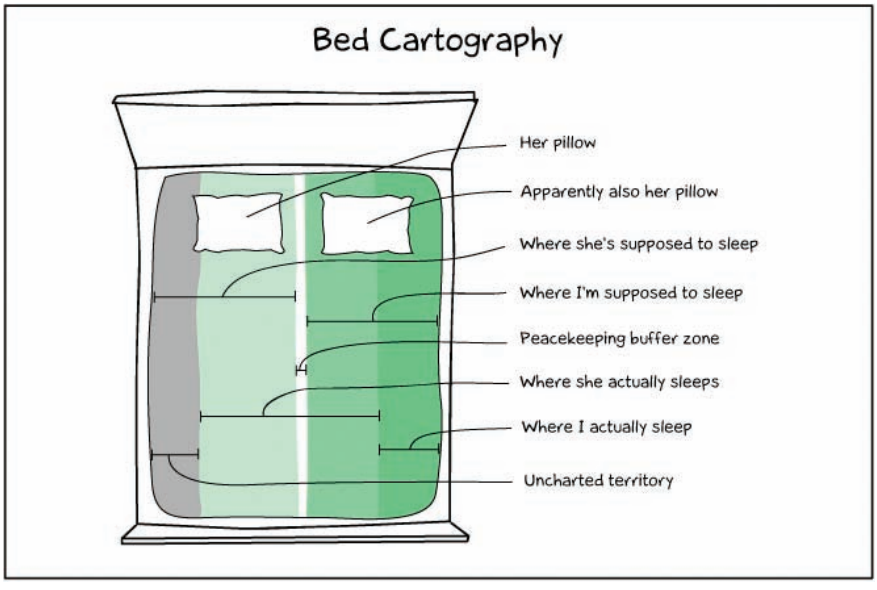


FIGURE 2-21 Bed Cartography *(2012) from Doghouse Diaries, http://thedoghousediaries .com/3586*

FIGURE 2-22 The Trustworthiness of Beards (2010) by Matt McInerney

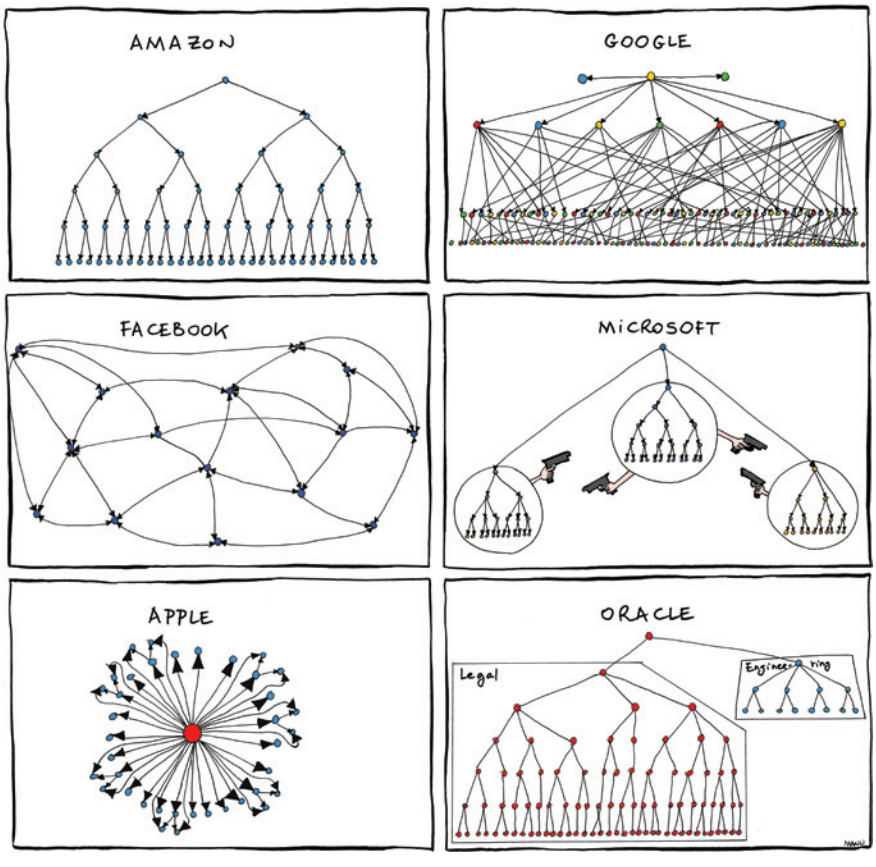


FIGURE 2-22 Organizational Charts *(2011) by Manu Cornet, http://www.bonkersworld.net/organizational-charts/*

Whether you call these graphics visualization or put them in a category of their own, there are a lot of things to learn here that apply to traditional visualization. Why do so many people like these graphics? What is it about these graphics that resonates with readers and makes them want to share with others? Does color and readability play a role? How about layout? Some researchers have tried to answer these questions, but so far, they've only scratched the surface.

DATA ART

Now enter the right side of the spectrum, where the imagination runs wild, data and emotion drive together, and creators make for human connection. It's hard to say what data art is exactly, but the work is often less about decision making and more about a relationship to the numbers—or rather what they represent—to experience data, which can feel cold and foreign. Data art is made of the stuff that analysis and information graphics could often use more of.

In 2012, with the Olympics in London starting in a few months, artists Quayola and Memo Akten translated athletic movement, which in itself can be beautiful, to generative animation in *Forms*, as shown in Figure 2-24. On a small screen a video plays of an athlete, such as a gymnast or a diver, floating and spinning in the air. On a large screen, generated particles, sticks, and poles move along accordingly. Sound accompanies the movement to make computer-generated shapes seem more real.

There are no axes, labels, or grids. Instead, it is like real-life activities taking on different forms. As shown in Figure 2-25, Jason Salavon, a Chicago-based artist, used MTV's compilation list for the "greatest music videos of all time," compressing each video to its average colors. You lose the music, but you get a sense of theme and flow from the colors in chronological order.

Graphic designer Frederic Brodbeck did similar work in *Cinemetrics*, which derived movie data—color, motion, and time—to create a "visual fingerprint" for each, as shown in Figure 2-26. Each segment represents the color and time in a part of the movie, and in the animated version, segments move back and forth according to the amount of movement in the segment.

FIGURE 2-24 Forms *(2012) by Memo Akten (http://memoakten.com/) and Quayola (http://www.quayola.com/), https://vimeo.com/37954818*

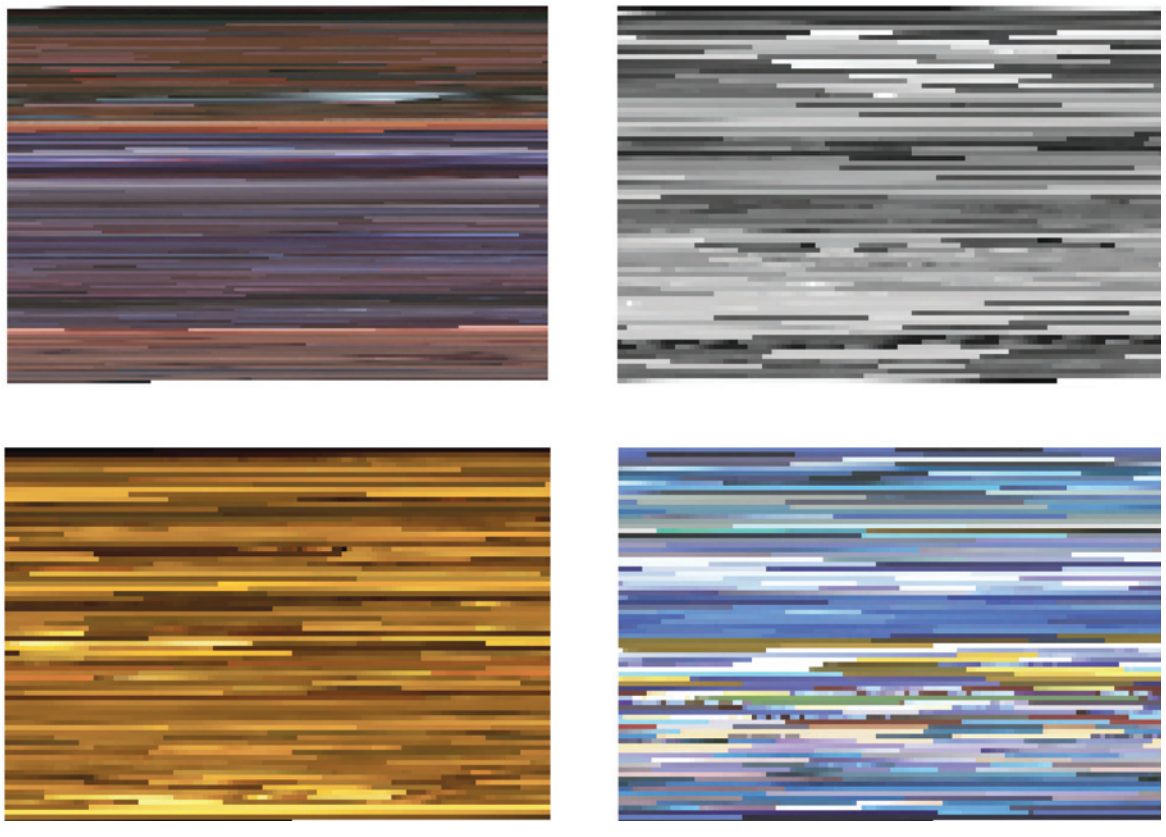


FIGURE 2-25 *Thriller, Vogue, Smells Like Teen Spirit, and Express Yourself from* MTV's 10 Greatest Music Videos of All Time *(2001) by Jason Salavon, http://salavon.com/work/MtvsTop10/*

A History of the Sky, shown in Figure 2-27, by artist Ken Murphy also reconfigured our traditional view of time and space; however, instead of movies, the sky was used as the source of inspiration.

Murphy installed a camera on the San Francisco Exploratorium's roof and programmed the camera to take a picture every 10 seconds for a year. Instead of stringing all the pictures together on a single continuous timeline, Murphy played all the days at once on a 24-hour timeline. In a few minutes, you can see how the length of days change and how the weather fluctuates for a year.

What if the data source is invisible? How are you supposed to visualize it? As shown in Figure 2-28, Timo Arnall, Jørn Knutsen, and Einar Sneve Martinussen fashioned a measuring rod with Wi-Fi sensors and small lights to visualize the networks that we use every day in *Immaterials: Light painting WiFi*. In any given

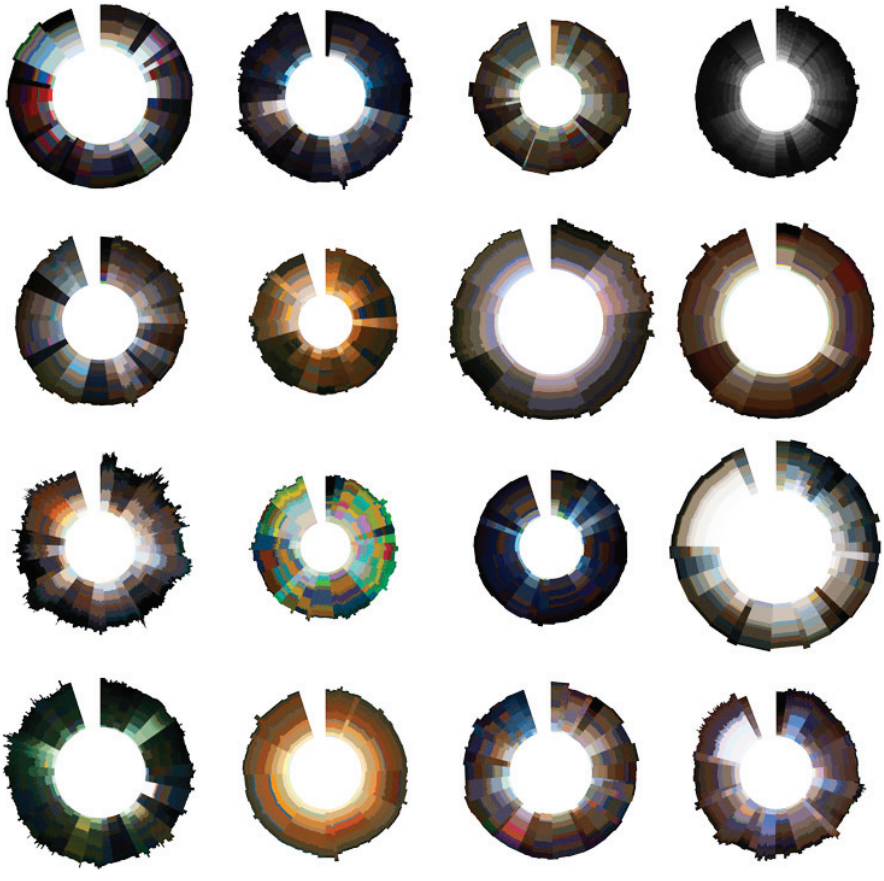


FIGURE 2-26 Cinemetrics *(2012) by Frederic Brodbeck, http://cinemetrics.frederic brodbeck.de*

position, the rod displays signal strength as a bar, so the better the signal, the more lights that flash. This, combined with long exposure photography, *Immaterials* paints a picture of Wi-Fi signals in a physical space.

Although these works were made for an art exhibit or to decorate people's walls, it's easy to see how they could be useful to some. For example, an athlete or coach might be interested in perfecting movement, and visual traces can make it easier to see patterns. *Forms* might not be as straightforward as, say, motion-capture software that replays exact movements, but the mechanics are similar. Likewise, filmmakers could use *Cinemetrics* to study use of color and movie dynamics, and engineers might find signal strength in a physical space helpful in research to improve Wi-Fi technology.

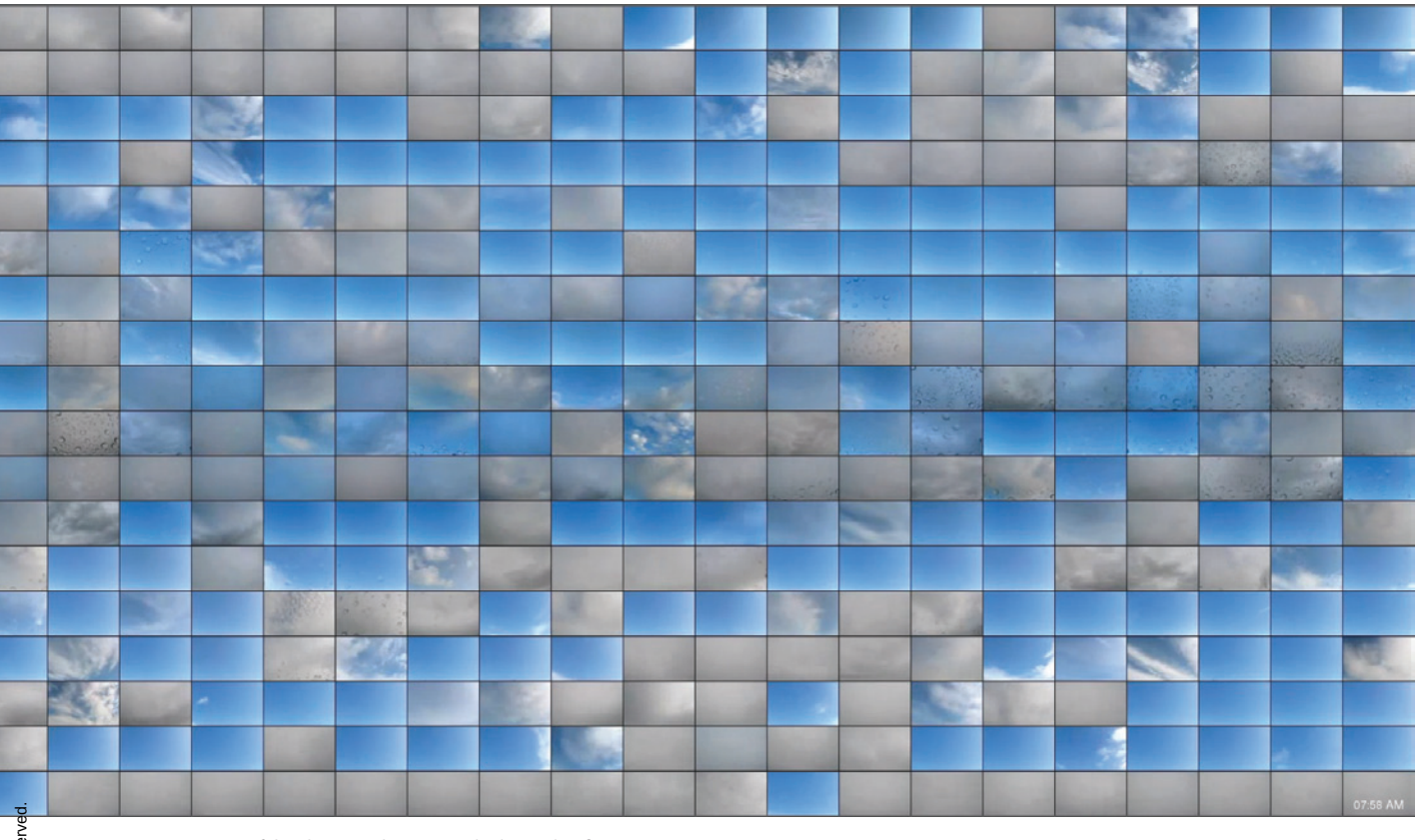


FIGURE 2-27 A History of the Sky *(2011) by Ken Murphy, http://datafl.ws/25s*

Again, this brings you back to, "What is data art?" Or more important, "What is visualization?" It's a medium with a wide range of applications. There are genres of visualization within a spectrum, but there are no clear-cut boundaries (which there doesn't need to be). Like movies, which can be both a documentary and a drama or even a comedy and a horror, a visualization work can be art and factual.

For example, Stamen Design, known for both practical and beautiful interactive maps, put an artistic spin on geography with its experimental *prettymaps*, shown in Figure 2-29. They mapped freely available, community-generated data from Flickr, Natural Earth, and OpenStreetMap, which provided six layers of data. Mapped separately, the geography looks standard, but when you map them all at once with semi-transparency, you get something else.

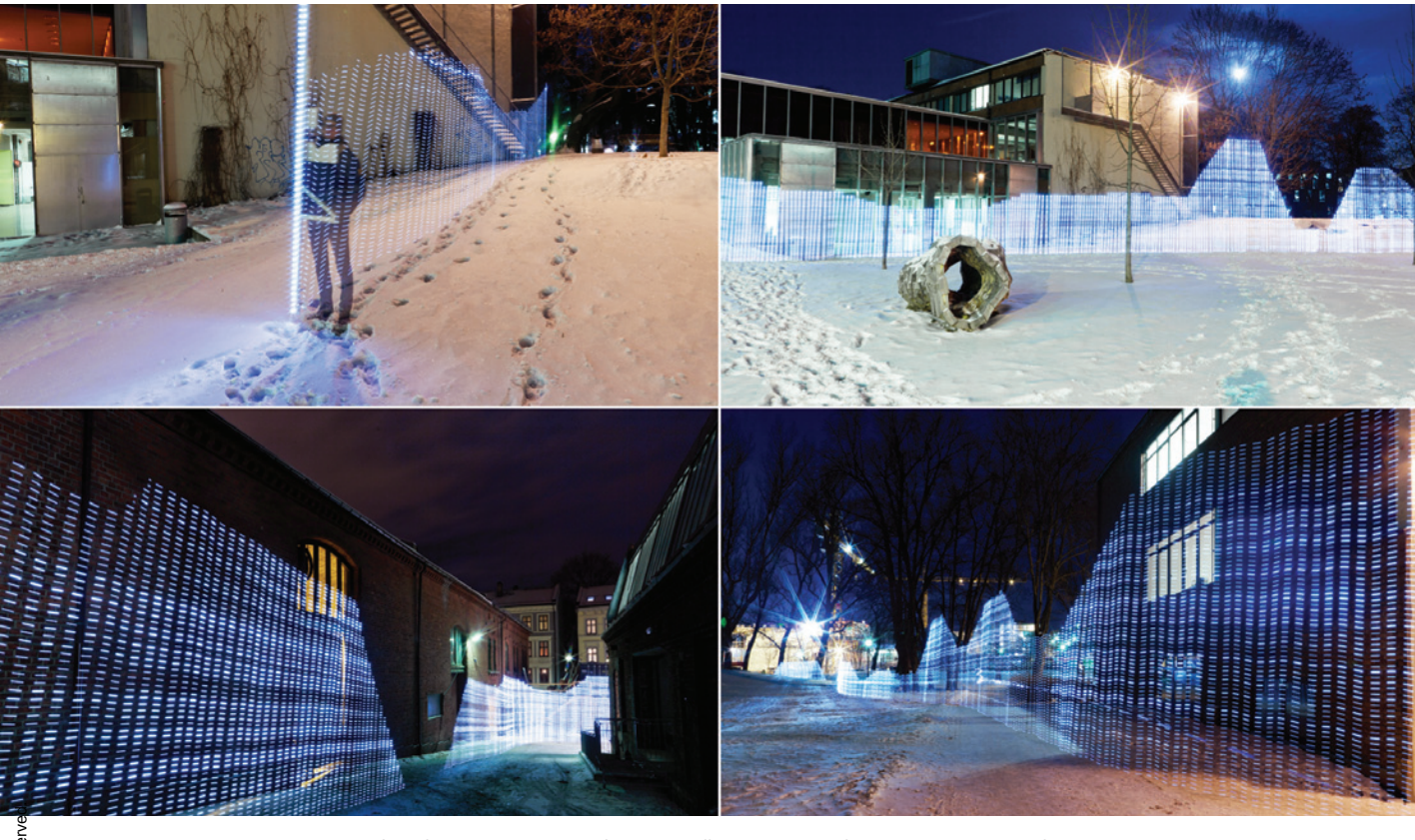
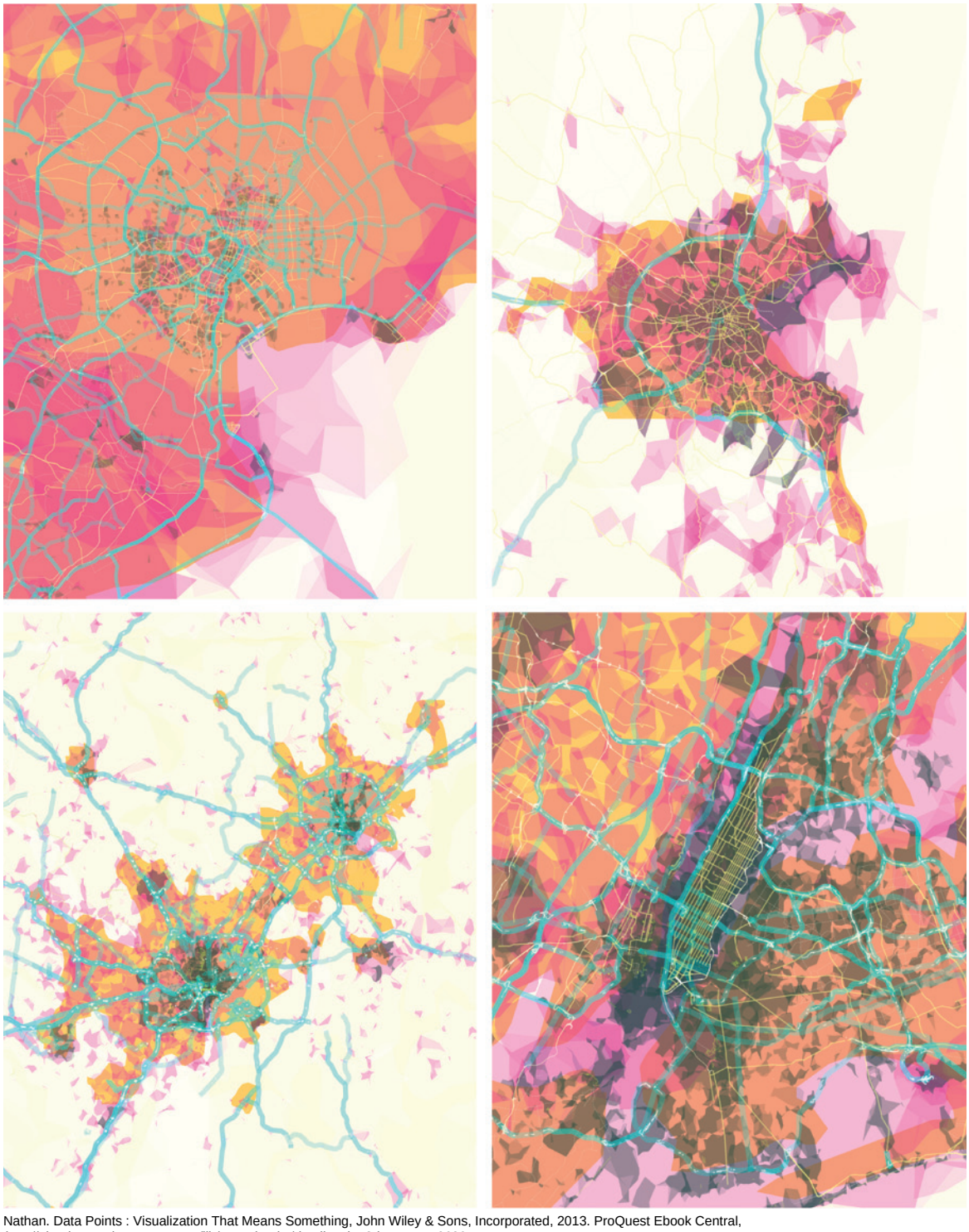


FIGURE 2-28 Immaterials: Light painting WiFi *(2011) by Timo Arnall, Jørn Knutsen and Einar Sneve Martinussen, https://vimeo.com/20412632; Photo by Timo Arnall*

Real data sources are used and they are mapped geographically, but by combining all the sources and using less traditional aesthetics, the appearance of the geography seems to change.

In *Wind Map*, another work by Fernanda Viégas and Martin Wattenberg, who use visualization as both a tool and expression, wind patterns flow across the United States, as shown in Figure 2-30. The forecasts are updated once per hour from the National Digital Forecast Database, which you can explore by zooming and panning. You can also mouse over flows for wind speed and direction. The more concentrated and faster the streams on the map, the greater the forecasted speed.

FIGURE 2-29 *(following page)* prettymaps *(2010) by Stamen Design, http://prettymaps.stamen.com/*



The map could be useful to meteorologists who study wind patterns or to educators who teach weather concepts, but Viégas and Wattenberg consider it an art project. To see the environment as a living, breathing thing is certainly something beautiful to see.

FIGURE 2-30 *(following page)* Wind Map *(2012) by Fernanda Viégas and Martin Wattenberg, http://hint.fm/wind/*

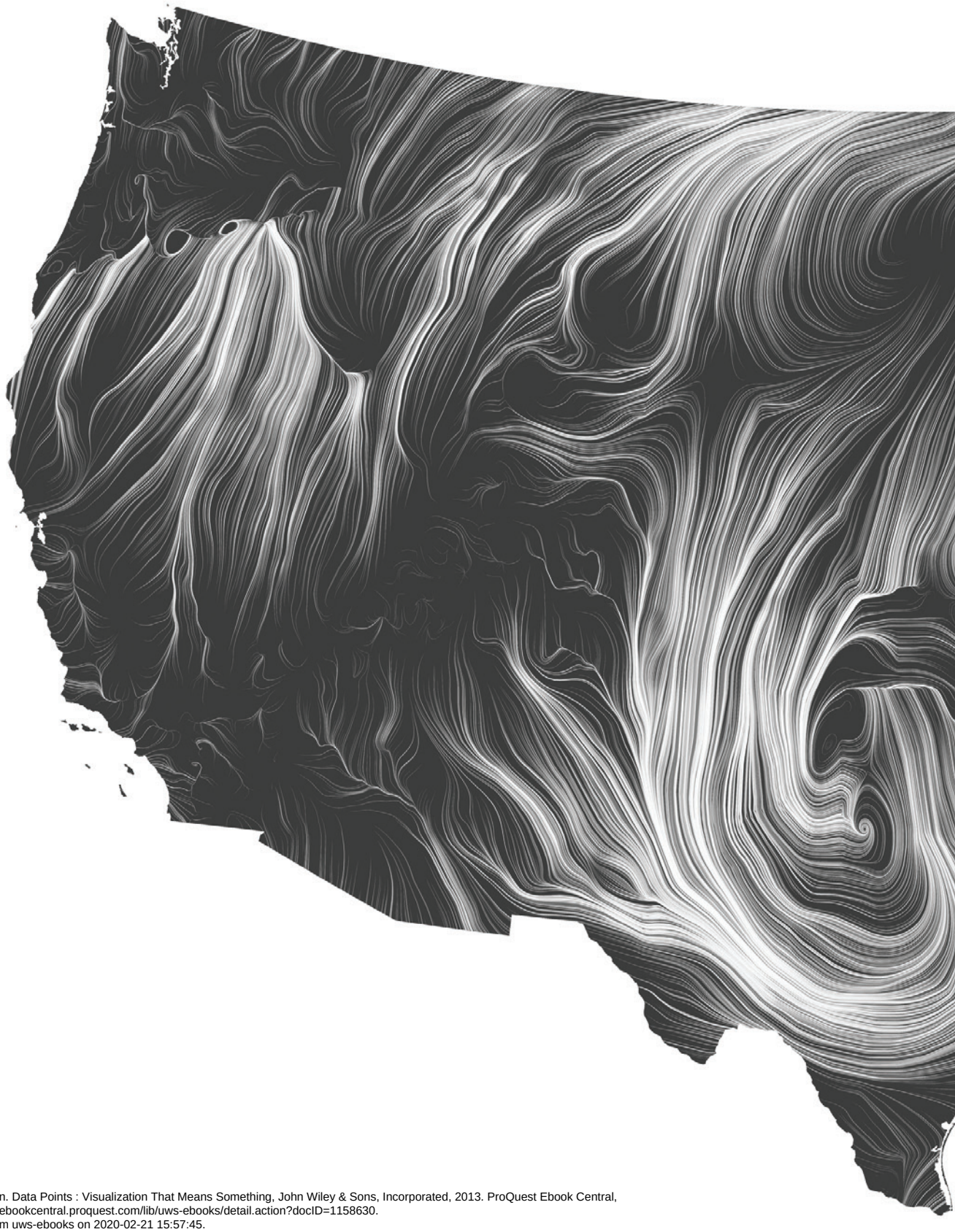
I Want You To Want Me, by Jonathan Harris and Sep Kamvar, shown in Figure 2-31, is an installation that was commissioned by New York's Museum of Modern Art. Like DuBois' map (shown in Chapter 1, "Understanding Data"), Harris and Kamvar's piece uses data collected from online dating sites, which captures how people identify themselves and who they want to be with. *I Want You To Want Me* parses profiles and extracts sentences that start with "I am" or "I am looking for" and represents each sentence with a balloon floating in an interactive sky. Each balloon carries the silhouette of an animated person, almost as if each represents an individual's floating hope to find an ideal partner. (The piece, by the way, was installed on Valentine's Day.)

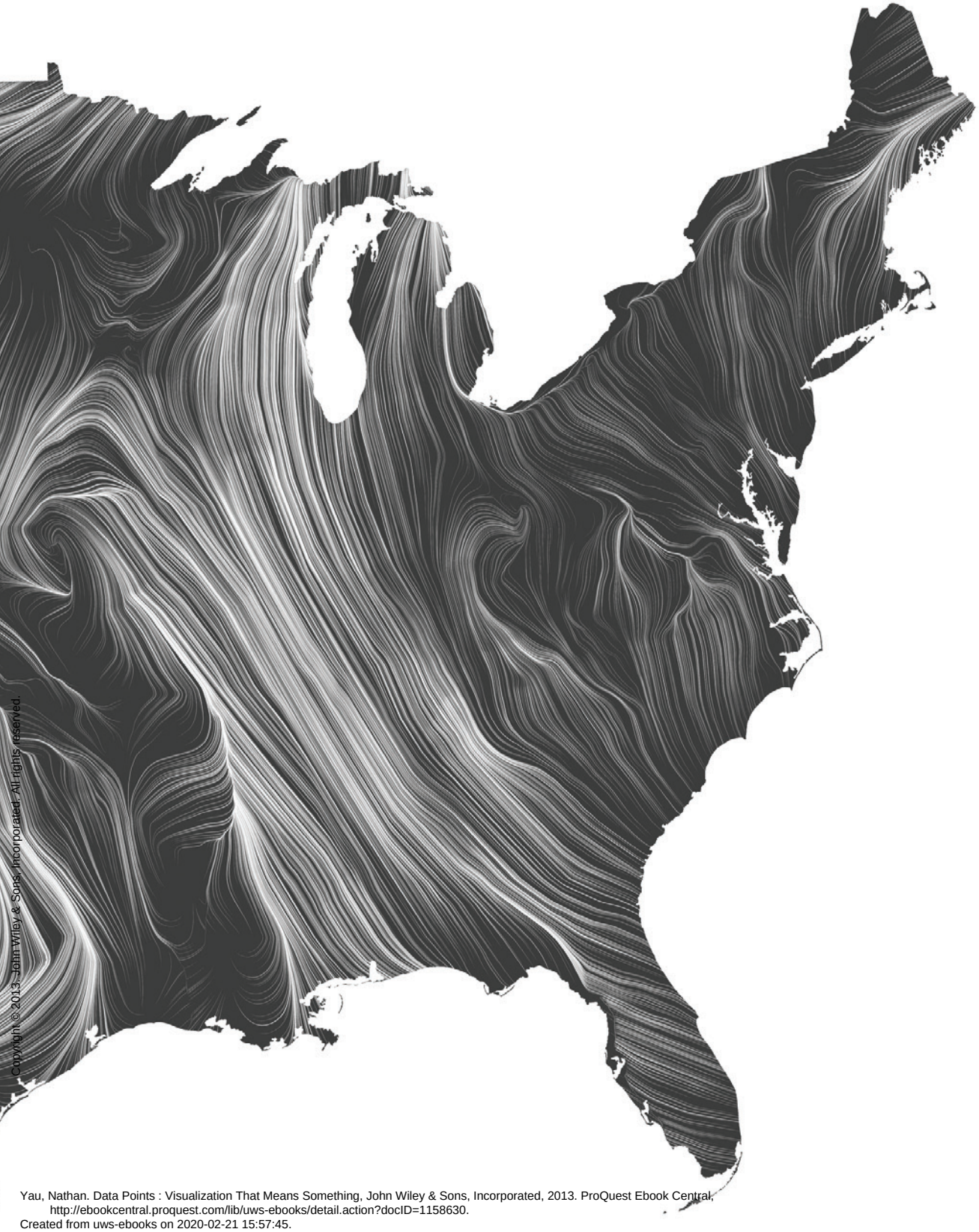
Although there are statistical breakdowns for aspects like top first dates, desires, and turn-ons, *I Want You To Want Me*, installed on a large, high-resolution touchscreen, is like a story that lets you peek in and explore people's search for relationships. You can easily immerse yourself in the data, which is both personal and easy to relate to. It's harder to do that with a traditional graph. That said, the key to high-quality data art, like any visualization, is still to let the data guide design.

THE EVERYDAY

Visualization has also found its way into the everyday, especially because almost all online content is stored in a database. And as people grow more comfortable with interacting on their computers, developers can create interfaces that display more data at once. From the side of those who build applications, this is great because the growing amounts of data require new views that the old ones can't accommodate, and from the consumer side, the experience improves as the data is easier to digest.

In 2004, Marcos Weskamp created *newsmap*, which is a treemap view into Google News, as shown in Figure 2-32. If you go straight to Google News, you get a standard list of headlines, complemented with a thumbnail. Some of the top stories are listed at the top, and recent ones in the right sidebar.





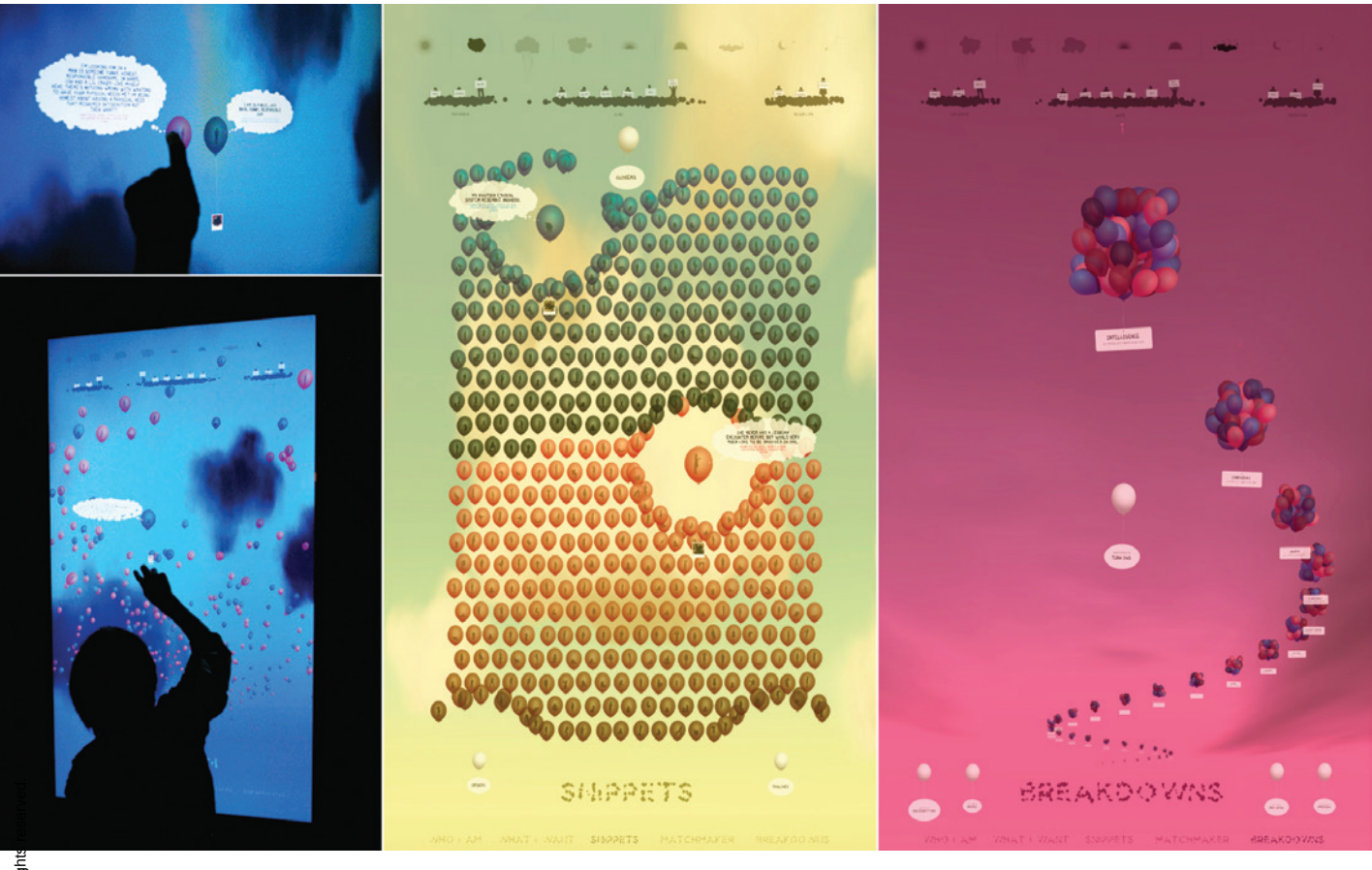


FIGURE 2-31 I Want You To Want Me *(2008) by Jonathan Harris and Sep Kamvar, http://www.iwantyoutowantme.org/*

However, Weskamp's *newsmap* shows headlines sized by popularity, based on a number of related articles. Each rectangle represents a clickable story and is colored by topic, such as world, national, or business. So you get a sense of what's going on in the world at a glance, and there are a variety of options (such as country of interest and time frame) and you can include and exclude topics.

Geographic maps are heavily used as a search tool. Their main use on the web was to look up directions from point A to point B, but as developers add layers of information and integrate deeper functionality, complete applications are developed to provide information and context of areas.

FIGURE 2-32 newsmap *by Marcos Weskamp, http://newsmap.jp*

Google Maps is, of course, the most heavily used because you can look up nearby stores, restaurants, and other businesses, but the application mostly shows only pointers and markers on specific locations. Sometimes, you want to know trends and patterns or just get a general sense of an area, like when you look for a place to live. Trulia, a site that helps you search for real estate, provides useful layers of information other than the properties for sale, as shown in Figure 2-33.

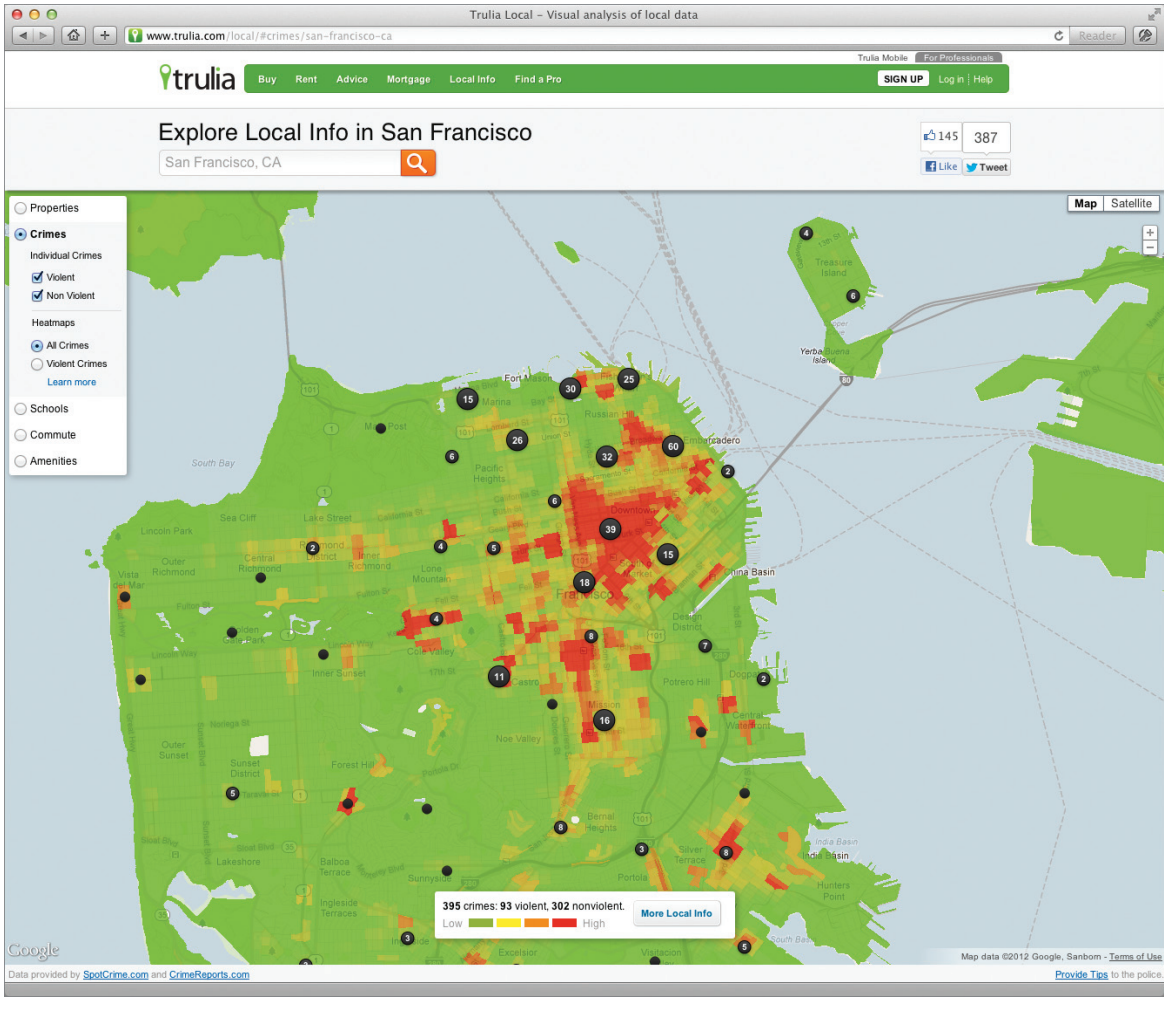


FIGURE 2-33 Trulia Local, *http://www.trulia.com/local*

You can look at crime, violent and nonviolent; filter schools by rating; and see approximate commute times from a given location. The applications helps you make a more informed decision, based on more than just square feet and price, when you buy a house.

Some interfaces completely change how you interact and relate to the data. *Planetary*, by Bloom, is an iPad app that places your iTunes music library into the context of a solar system.

FIGURE 2-34 Planetary *by Bloom, http://planetary.bloom.io/*

Artists are stars, albums are planets that orbit the stars, and tracks are moons that orbit the planets. Instead of a music library to jump to a specific song, your music is transformed into a landscape you can explore and rediscover. And because you use *Planetary* via the iPad's touch interface, the data almost feels tangible.

What happens when data actually is tangible, embedded in a physical object? In 2010, the Really Interesting Group made Christmas ornaments shaped by scrobbles on music site Last.fm, miles traveled according to Dopplr, and apertures used on Flickr, as shown in Figure 2-35. Tada. Instant personalized Christmas gift.

Rachel Binx and Sha Hwang streamlined the process with meshu, a service that enables you to make your own jewelry based on geographic locations. Pick points on a map, and they fabricate your necklace, earrings, or cufflinks out of wood, acrylic, nylon, or silver.

Location data represents where you are, where you've been, and where you're going, so each meshu is like a snapshot of life, that you can wear.

As mobile technology advances, and the gap between digital and physical gets smaller, visualization will play a larger role in connecting the two worlds.

FIGURE 2-35 datadecs *by Really Interesting Group, http://datafl.ws/25v*

FIGURE 2-36 meshu *by Rachel Binx and Sha Hwang, http://meshu.io/*

WRAPPING UP

The definition of visualization changes by who you ask, and as a whole, the breadth of visualization changes every day. As you come across rules and design suggestions for how to present data, be sure to know their context.

In writing, there is grammar and syntax that is good to know, but where you can bend the rules is also important. Certain movie formulas can work, but often the ones that stray are the biggest success stories.

With visualization, draw from previous work and keep guidelines in mind, but don't let it keep you from what works best to achieve your goal and to communicate to your audience. As you've seen in this chapter, your goals and your audience can change dramatically across applications. It's good that visualization is a medium that you can use for a lot of things.