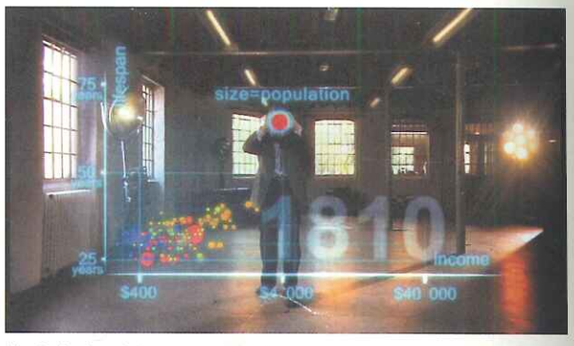
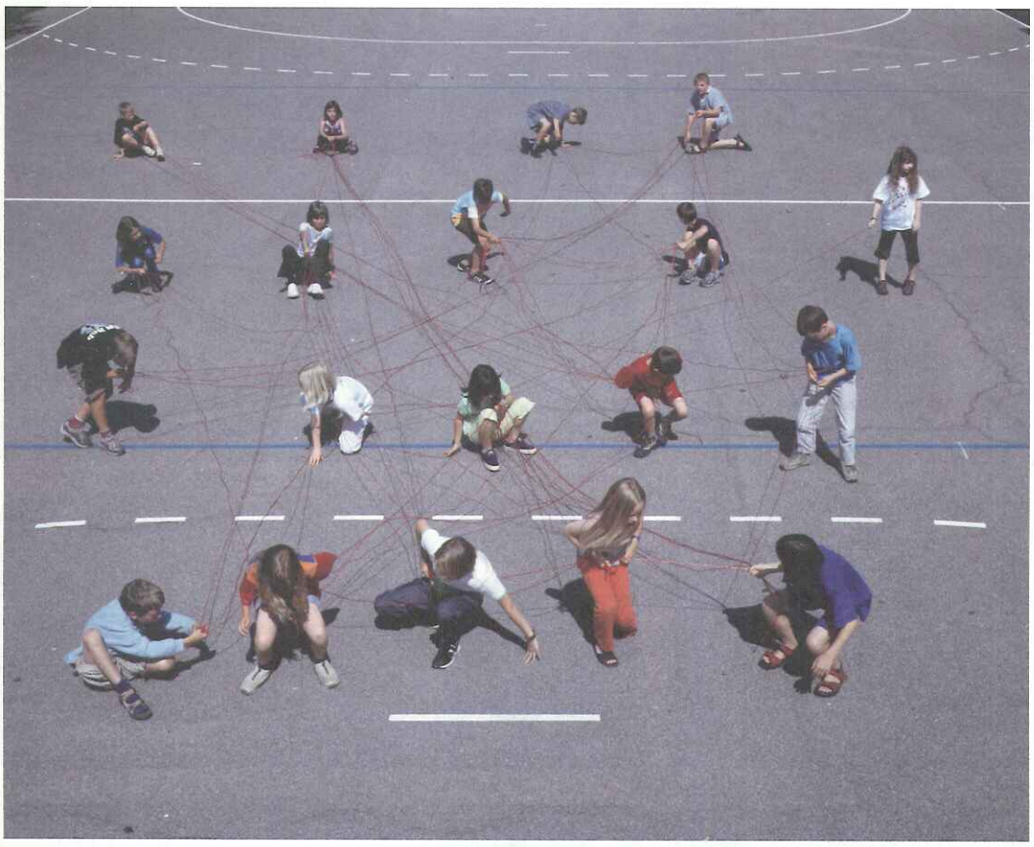
2011
Bubbles, Lines, and String: How Information Visualization Shapes Society

Peter Hall

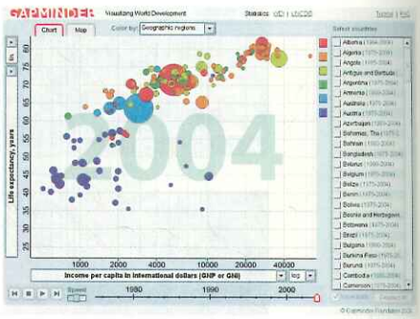


Hans Rosling, Gapminder demonstration from *The Joy of Stats*, 2010 Courtesy Wingspan Productions

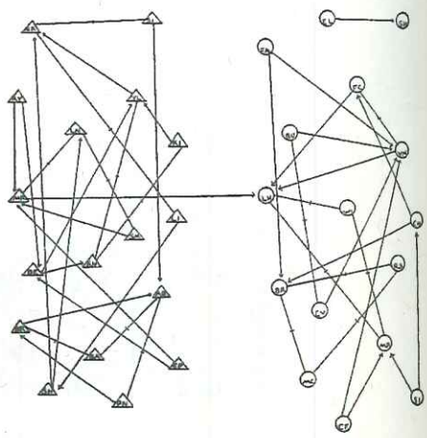
Gapminder
Employing Hans Rosling's Trendanalyzer software, Gapminder was founded in Stockholm by Ola Rosling, Anna Rosling Rönnlund, and Hans Rosling in 2005. Released as the online service Gapminder World, Rosling's software uses animated bubbles to show changes over time in the wealth and health of nations. These statistics truly come to life when Rosling provides his own narration, as seen in the 2010 documentary *The Joy of Stats*. —EL



Uta Eisenreich, *Network-Teamwork Sociograms*, Langmatt School, Zürich, 2002 Courtesy the artist

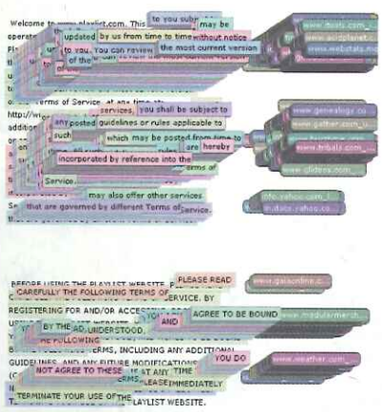


Gapminder Foundation, "Wealth and Health of Nations" presentation using Trendalyzer software Courtesy gapminder.org

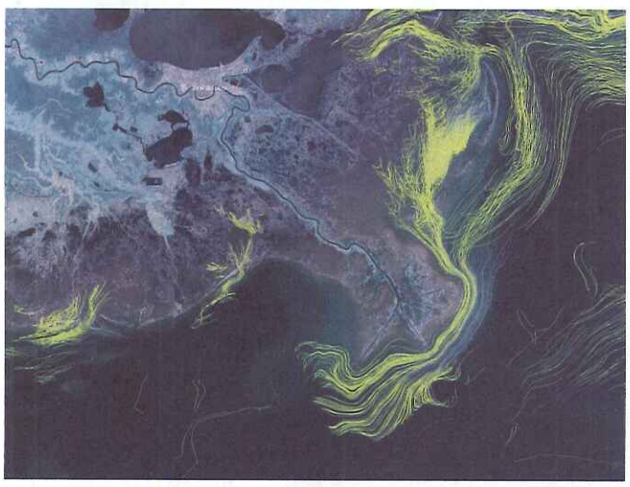


Jacob L. Moreno, *Friendship Choices Among Fourth Graders*, 1934

Sociogram: Friendship Choices Among Fourth Graders
Jacob L. Moreno, a social scientist working in the 1930s, created simple diagrams to visualize relationships within small groups of people. This diagram shows friendships among boys (triangles) and girls (circles) in a group of fourth graders. The diagram reveals how strongly the two groups are separated by gender; only one boy crossed the divide, and not a single girl did. —EL See Linton C. Freeman, "Visualizing Social Networks," 2000



Martin Wattenberg and Fernanda Viégas, Chimera, a search tool that finds repetition in texts and represents them as 3-D "skyscrapers" Courtesy Martin Wattenberg



Adam Kuback and Karla Vega, TACC, UT, Austin, in collaboration with Clint Dawson, ICES, UT, Austin; Rick Luettich, UNC Chapel Hill; and Joseph Westerink, University of Notre Dame, *Visualization of the Gulf of Mexico Oil Spill*, 2010 Courtesy Karla Vega

Data visualization has lately become an unlikely form of mass entertainment. When public health professor Hans Rosling first presented his giant, animated graphs of floating bubbles—challenging popular preconceptions about global life expectancy and family sizes—he was met with whoops and applause at the 2006 TED (Technology, Entertainment, Design) conference. [1] The video of the presentation has since attracted 2.8 million online viewers, making it the seventh most-watched TED talk in the past five years. [2] "The statistics of the world have not been made properly available," argued Rosling. "Animated graphics can make a difference." [3]

Data provides the means by which science progresses, legislation changes, and society advances; data is the enemy of witch hunts, bigotry, and ignorance (not to mention Creationism). But data is always gathered at a certain time with a certain purpose; and to be useful it must be mined, parsed, and presented. Each step of this process involves decisions about what to omit and what to prioritize. Yet the end result, the visualization, carries an authority, timelessness, and objectivity that belies its origins. Curiously, this fact is neglected in the otherwise rich discourse around data visualization and information design. Johanna Drucker has observed that information designers almost entirely ignore what she considered theoretical problems:

"An empiricist assumption that what you see is what is there underpins their practice. The self-evident character of graphic entities—lines, marks, colors, shapes—is never itself brought into question, however much the parameters on which they are generated or labeled might be criticized. That images themselves might be dialectical, produced as artifacts of exchange and emergence, is an idea foreign to the fields of engineering and information design." [4]

Scientific Practice

To explore why the critical discourse of the arts and humanities is conspicuously lacking around visualization requires that we take a meta-view of the contexts in which it is practiced. Visualization might be separated into three categories of practice. The first, and most dominant, is *scientific*. This, the domain of laboratories, supercomputers, and vast monitor arrays, enjoys the funding of the military industrial complex and a sense of societal importance. According to historian Alfred Crosby, "visualization is one of only two factors responsible for the explosive development of all modern science." [5] Computer scientist Toby Segaran argues that "almost every field is becoming more reliant on data analysis for advancement." [6] Examples in the scientific category would include visualizations of galaxy formation, predicted weather and oil spill patterns, and simulations of electron behavior. [7] Typically deploying the terms "data" or "information visualization," scientific visualization fashions itself as a tool of discovery improved through scientific method. The implicit assumption is that the tool allows us to explore the data, without bias. Adopting industries are described by one classic textbook in the field as those driven by continuous innovation and repeated discovery: "pharmaceutical drug research, oil-gas exploration, financial analysis and manufacturing quality control." [8]

To engage in the scientific discourse around visualization requires familiarity with—if not higher degrees in—mathematics, statistics, computer science, and cognitive psychology. But even the most cursory glance at the literature reveals a positivist discourse driving questions of visual form, grounded in principles of human cognition. Is the visualization appropriate for the data? How does the visualization fare in terms of usability issues? How does the (universal) human brain respond to visualization *x* as opposed to visualization *y*? [9]

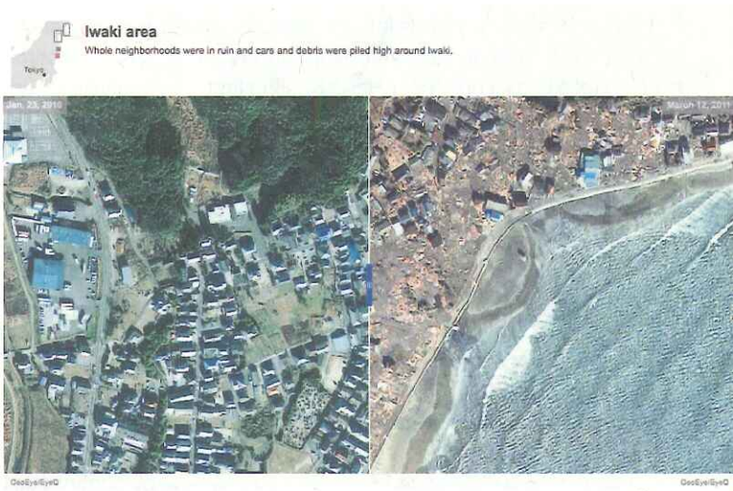
Journalistic Practice

The second category is *journalistic*. A response to the information tsunami, and driven by a moral or commercial obligation to inform or entertain, projects in this category strive to make data visible and accessible. Whereas the scientific category is characterized by large datasets and various means of discovering new patterns, the journalistic category seeks to simplify and explain those datasets. As New York Times Graphics director Steve Duenes put it: "It is our job to edit, condense and reduce." [10] Traditionally the domain of information designers whose task is to scrape, shape, and frame existing data, rather than mine and parse new data, this category has lately shifted from static forms to quite advanced interactive web-based formats that allow the public to explore data for themselves. The New York Times Graphics Department provides paradigmatic examples of journalistic information design, as made evident in its fast turnaround of maps and graphics illustrating the hurricanes, tsunamis, oil spills, and wars of the past decade. Freelance journalist and designer David McCandless, meanwhile, develops visualizations that provide a meta-layer of commentary on other visualizations, such as his "billion dollar o-gram," which seeks to put military expenditure, oil revenue, foreign aid, and charitable donations in context through comparison. His revelation, after mining and visualizing Facebook data, that more couples split up around spring break and Christmas than other times of the year, might be described as journalistic entertainment visualization.

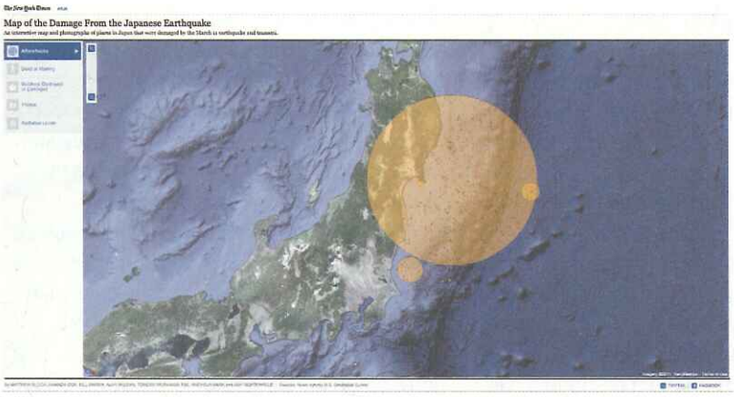
Rosling's Gapminder software for animating global health data began as an educational tool (to make university students use and understand statistics to acquire a "fact-based" world view), but is ultimately a journalistic means to inform and transform public opinion. "Visualization and animation services that unveil the beauty of statistics for wide user groups may induce a paradigm shift from dissemination to access," Rosling has argued. "Data provided in animation format is well suited to tell stories using television and webcasts." [11] Martin Wattenberg's search tool uses simple computation methods to find repetition in texts, which are represented as 3-D "skyscrapers" over the text body. Teaming up with journalist Chase Davis, Wattenberg set Chimera to work to find "clone laws"—legislation prewritten for elected officials by corporations or partisan groups. They found, for instance, that a law passed in Minnesota matched a law passed in Alaska exempting firearms made and sold in-state from federal regulations—"not exactly word for word but many, many passages," noted Wattenberg. [12] Googling the most distinctive passages led to a website promoting the Firearms Freedom Act, a chilling reminder that the laws of this country are not written by legislators but by special interest groups. Discussion of formal issues in this category tends to be dominated by the standards codified by authorities such as Edward Tufte, Donald Norman, and Ben Shneiderman. Examples will be familiar to any designer: Static information graphics should aspire to transparency, objectivity, and an absence of "chartjunk" (Tufte), and interactive visualization should aspire to visual consistency, informative feedback, a sense that the user is in control, and simple error handling (Shneiderman). [13]

Artistic Practice

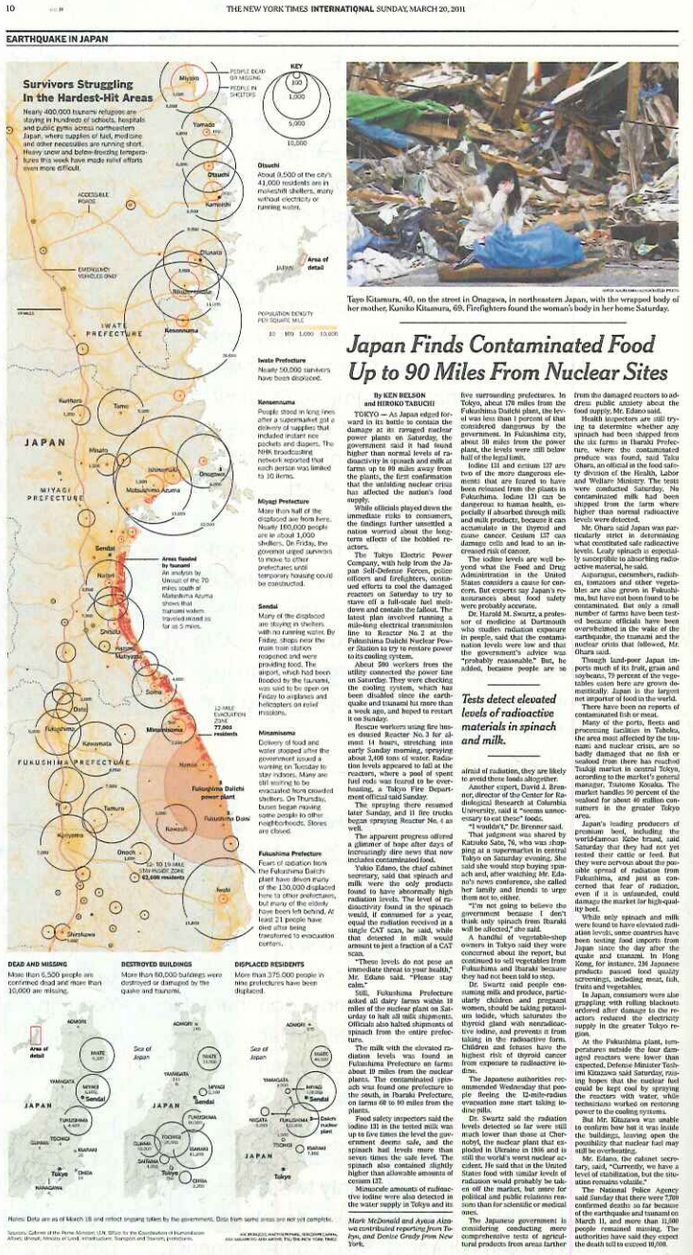
The third category is *artistic*. Generally misunderstood by the scientific community as cosmetic or frivolous, the art of visualization nevertheless has an important cultural role, reinforced by historical precedent. Artistic visualization, much like thousands of years of art before it, reflects



Alan McLean, Kevin Quealy, Matthew Ericson, Archie Tse, and Jason Alvich, "Satellite Photos of Japan, Before and After the Quake and Tsunami," *New York Times*, 2011 Courtesy the *New York Times*



Matthew Bloch, Amanda Cox, Bill Marsh, Alan McLean, Tomoeh Murakami Tse, Haeyoun Park, and Amy Schoenfeld, "Map of the Damage From the Japanese Earthquake," *New York Times*, 2011 Courtesy the *New York Times*



Tayo Kitamura, 40, on the street in Onagawa, in northeastern Japan, with the wrapped body of her mother, Kuniko Kitamura, 69. Firefighters found the woman's body in her home Saturday.

Japan Finds Contaminated Food Up to 90 Miles From Nuclear Sites

By KEN BELSON and HIROKO TABUCHI

TOKYO — As Japan edged forward in its battle to contain the damage at its ravaged nuclear power plants on Saturday, the government said it had found higher than normal levels of radioactivity in spinach and milk at farms up to 80 miles away from the plants, the first confirmation that the unfolding nuclear crisis has affected the nation's food supply.

While officials played down the immediate risks to consumers, the findings further unsettled a nation worried about the long-term effect of the hobbled reactors.

The Tokyo Electric Power Company, with help from the Japan Self-Defense Forces, police officers and firefighters, continued efforts to cool the damaged reactors on Saturday to try to stave off a full-scale fuel meltdown and contain the fallout. The latest plan involved running a mile-long electrical transmission line to Reactor No. 2 at the Fukushima Daiichi Nuclear Power Station to try to restore power to its cooling system.

About 300 workers from the utility connected the power line on Saturday. They were checking the cooling system, which has been disabled since the earthquake and tsunami hit more than a week ago, and hoped to restart it on Sunday.

Rescue workers using fire hoses doused Reactor No. 3 for almost 14 hours, stretching into early Sunday morning, spraying about 3,408 tons of water. Radiation levels appeared to fall at the reactors, where a pool of spent fuel rods was found to be overheating, a Tokyo Fire Department official said Sunday.

The spraying there resumed later Sunday, and 11 fire trucks began spraying Reactor No. 4 as well.

The apparent progress offered a glimmer of hope after days of increasingly dire news that now includes contaminated food.

Yukio Edano, the chief cabinet secretary, said that spinach and milk were the only products found to have abnormally high radiation levels. The level of radioactivity found in the spinach would, if consumed for a year, equal the radiation received in a single CAT scan, he said, while that detected in milk would amount to just a fraction of a CAT scan.

"These levels do not pose an immediate threat to your health," Mr. Edano said. "Please stay calm."

Still, Fukushima Prefecture asked all dairy farms within 18 miles of the nuclear plant on Saturday to halt all milk shipments. Officials also halted shipments of spinach from the entire prefecture.

The milk with the elevated radiation levels was found in Fukushima Prefecture on farms about 18 miles from the nuclear plants. The contaminated spinach was found one prefecture to the south, in Ibaraki Prefecture, on farms 68 to 90 miles from the plants.

Food safety inspectors said the iodine 131 in the tested milk was up to five times the level the government deems safe, and the spinach had levels more than seven times the safe level. The spinach also contained slightly higher than allowable amounts of cesium 137.

Minuscule amounts of radioactive iodine were also detected in the water supply in Tokyo and its five surrounding prefectures. In Tokyo, about 170 miles from the Fukushima Daiichi plant, the level was less than 1 percent of that considered dangerous by the government. In Fukushima city, about 39 miles from the power plant, the levels were still below half of the legal limit.

Iodine 131 and cesium 137 are two of the more dangerous elements that are feared to have been released from the plants in Fukushima. Iodine 131 can be dangerous to human health, especially if absorbed through milk and milk products, because it can accumulate in the thyroid and cause cancer. Cesium 137 can damage cells and lead to an increased risk of cancer.

The iodine levels are well beyond what the Food and Drug Administration in the United States considers a cause for concern. But experts say Japan's reassurances about food safety were probably accurate.

Dr. Harold M. Swartz, a professor of medicine at Dartmouth who studies radiation exposure in people, said that the contamination levels were low and that the government's advice was "probably reasonable." But, he added, because people are so

Tests detect elevated levels of radioactive materials in spinach and milk.

afraid of radiation, they are likely to avoid these foods altogether.

Another expert, David J. Brenner, director of the Center for Radiological Research at Columbia University, said it "seems unnecessary to eat these" foods.

"I wouldn't," Dr. Brenner said.

That judgment was shared by Katsuko Sato, 76, who was shopping at a supermarket in central Tokyo on Saturday evening. She said she would stop buying spinach and, after watching Mr. Edano's news conference, she called her family and friends to urge them not to, either.

"I'm not going to believe the government because I don't think only spinach from Ibaraki will be affected," she said.

A handful of vegetable-shop owners in Tokyo said they were concerned about the report, but continued to sell vegetables from Fukushima and Ibaraki because they had not been told to stop.

Dr. Swartz said people consuming milk and produce, particularly children and pregnant women, should be taking potassium iodide, which saturates the thyroid gland with nonradioactive iodine, and prevents it from taking in the radioactive form. Children and fetuses have the highest risk of thyroid cancer from exposure to radioactive iodine.

The Japanese authorities recommended Wednesday that people fleeing the 12-mile-radius evacuation zone start taking iodine pills.

Dr. Swartz said the radiation levels detected so far were still much lower than those at Chernobyl, the nuclear plant that exploded in Ukraine in 1986 and is still the world's worst nuclear accident. He said that in the United States food with similar levels of cesium would probably be taken off the market, but more for political and public relations reasons than for scientific or medical ones.

The Japanese government is considering conducting more comprehensive tests of agricultural products from areas farther from the damaged reactors to address public anxiety about the food supply, Mr. Edano said.

Health inspectors are still trying to determine whether any spinach had been shipped from the six farms in Ibaraki Prefecture, where the contaminated produce was found, said Taku Ohara, an official in the food safety division of the Health, Labor and Welfare Ministry. The tests were conducted Saturday. No contaminated milk had been shipped from the farm where higher than normal radioactive levels were detected.

Mr. Ohara said Japan was particularly strict in determining what constituted safe radioactive levels. Leafy spinach is especially susceptible to absorbing radioactive material, he said.

Asparagus, cucumbers, radishes, tomatoes and other vegetables are also grown in Fukushima, but have not been found to be contaminated. But only a small number of farms have been tested because officials have been overwhelmed in the wake of the earthquake, the tsunami and the nuclear crisis that followed, Mr. Ohara said.

Though land-poor Japan imports much of its fruit, grain and soybeans, 75 percent of the vegetables eaten here are grown domestically. Japan is the largest net importer of food in the world.

There have been no reports of contaminated fish or meat.

Many of the ports, fleets and processing facilities in Tohoku, the area most affected by the tsunami and nuclear crisis, are so badly damaged that no fish or seafood from there has reached Tsukiji market in central Tokyo, according to the market's general manager, Tsutomu Kosaka. The market handles 50 percent of the seafood for about 40 million consumers in the greater Tokyo area.

Japan's leading producers of premium beef, including the world-famous Kobe brand, said Saturday that they had not yet tested their cattle or feed. But they were nervous about the possible spread of radiation from Fukushima, and just as concerned that fear of radiation, even if it is unfounded, could damage the market for high-quality beef.

While only spinach and milk were found to have elevated radiation levels, some countries have been testing food imports from Japan since the day after the quake and tsunami. In Hong Kong, for instance, 236 Japanese products passed food quality screenings, including meat, fish, fruits and vegetables.

In Japan, consumers were also grappling with rolling blackouts ordered after damage to the reactors reduced the electricity supply in the greater Tokyo region.

At the Fukushima plant, temperatures outside the four damaged reactors were lower than expected, Defense Minister Toshimi Kitazawa said Saturday, raising hopes that the nuclear fuel could be kept cool by spraying the reactors with water, while technicians worked on restoring power to the cooling systems.

But Mr. Kitazawa was unable to confirm how hot it was inside the buildings, leaving open the possibility that nuclear fuel may still be overheating.

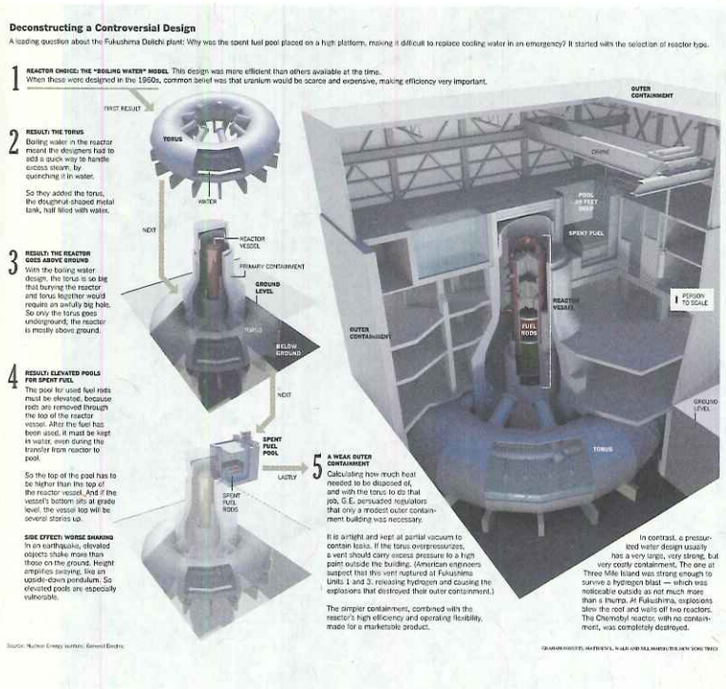
Mr. Edano, the cabinet secretary, said, "Currently, we have a level of stabilization, but the situation remains volatile."

The National Police Agency said Sunday that there were 7,700 confirmed deaths so far because of the earthquake and tsunami on March 11, and more than 11,000 people remained missing. The authorities have said they expect the death toll to exceed 10,000.

Mark McDonald and Ayaka Aizawa contributed reporting from Tokyo, and Denise Grady from New York.

Joe Burgess, Haeyoun Park, Sergio Peçanha, Aya Sakamoto, and Archie Tse, "Japan Finds Contaminated Food Up to 90 Miles From Nuclear Sites," *New York Times*, March 20, 2011 Courtesy the *New York Times*

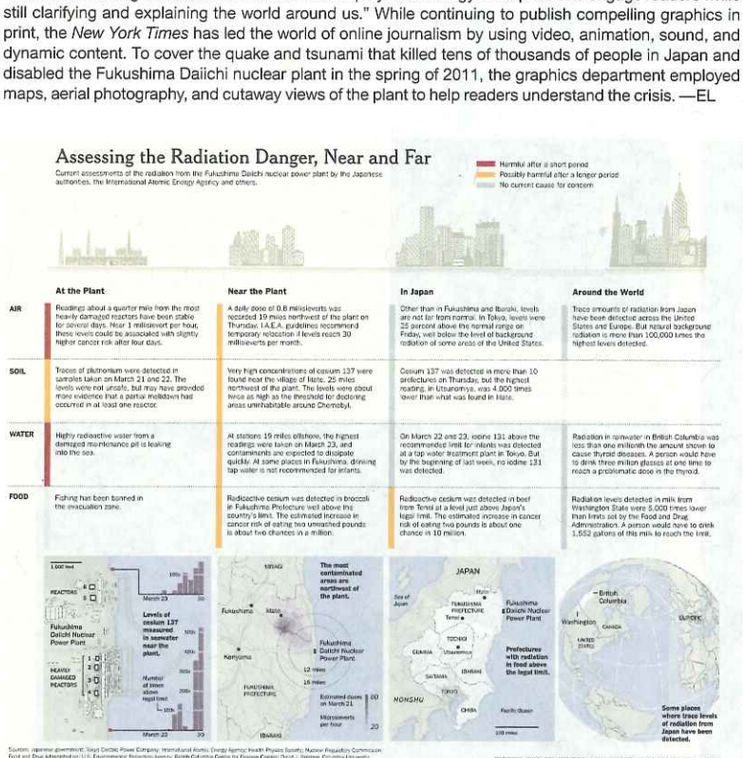
Peter Hall



Graham Roberts, Matthew L. Wald, and Bill Marsh, "Deconstructing a Controversial Design," *New York Times*, March 20, 2011
Courtesy the *New York Times*

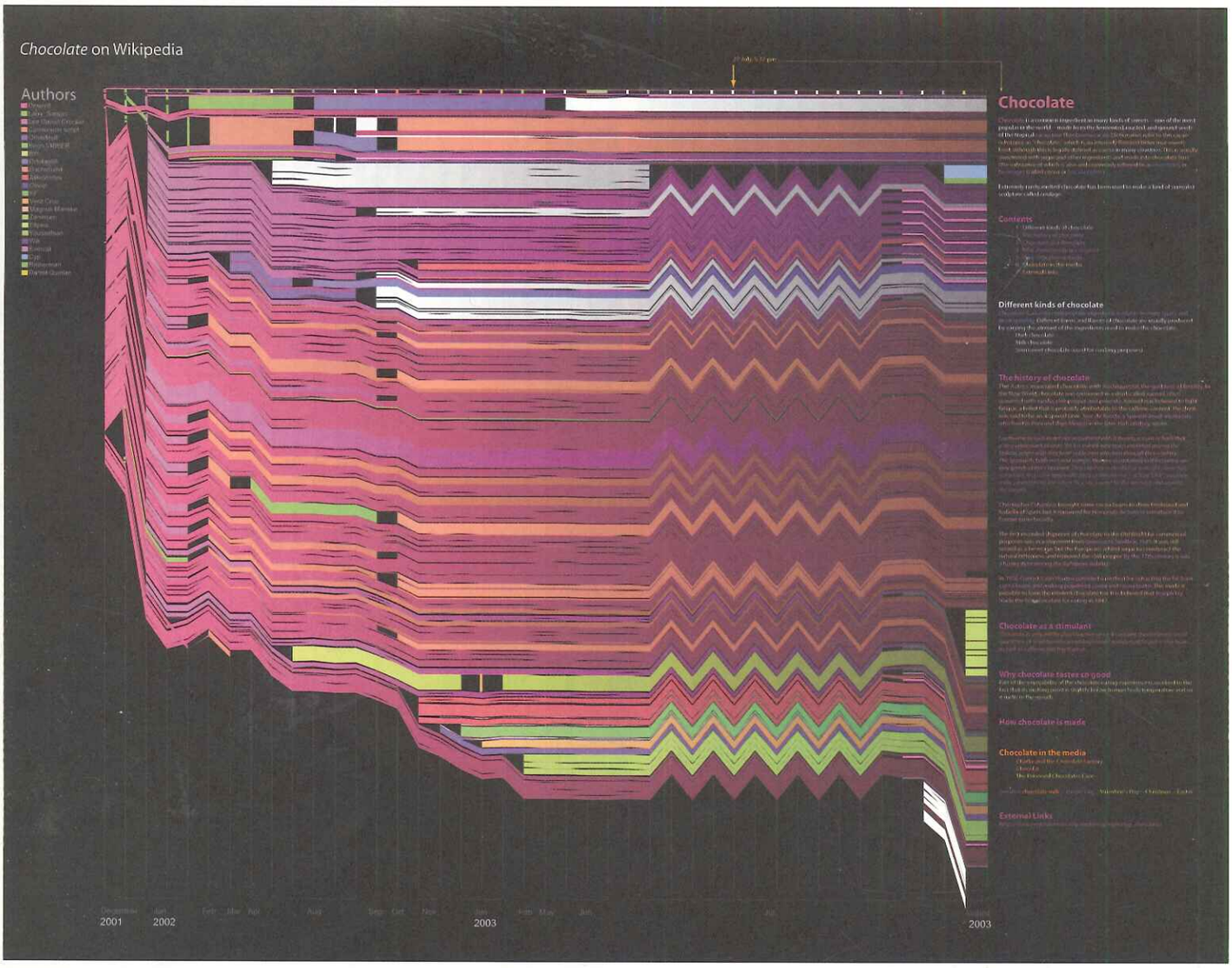
New York Times Graphics Department

A multi-skilled team makes up the graphics department at the *New York Times*: journalists who understand visualization as well as people trained in statistics, cartography, programming, and 3-D software. According to graphics director Steve Duenes, "We're journalists. We are drawing on the traditions of the *Times* and creating a direction on the web that employs technology to surprise and engage readers while still clarifying and explaining the world around us." While continuing to publish compelling graphics in print, the *New York Times* has led the world of online journalism by using video, animation, sound, and dynamic content. To cover the quake and tsunami that killed tens of thousands of people in Japan and disabled the Fukushima Daiichi nuclear plant in the spring of 2011, the graphics department employed maps, aerial photography, and cutaway views of the plant to help readers understand the crisis. —EL

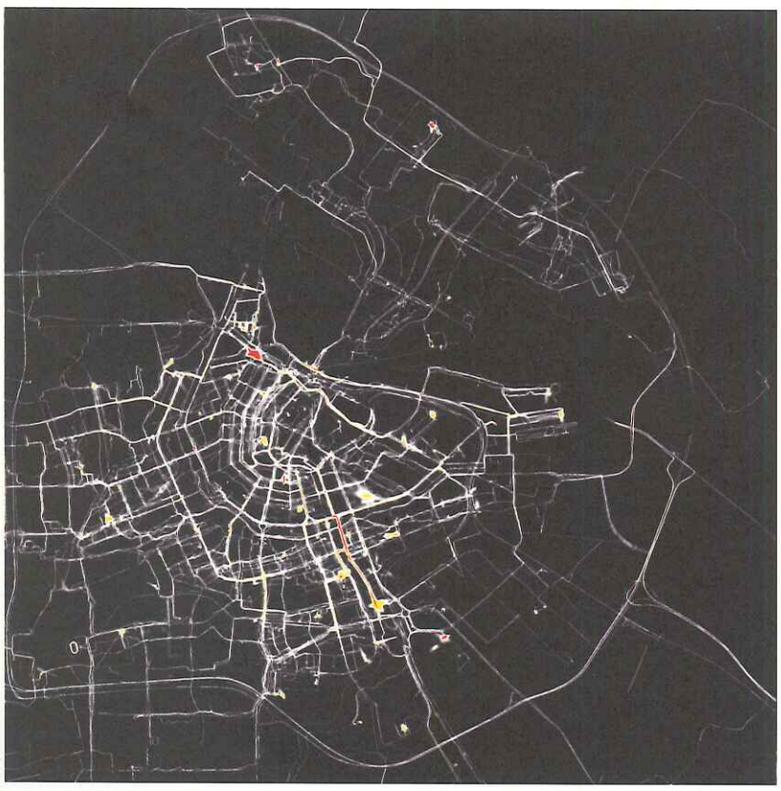


Joe Burgess, Amanda Cox, Sergio Peçanha, Amy Schoenfeld, and Archie Tse, "Amassing the Radiation Danger, Near and Far," *New York Times*, April 3, 2011 Courtesy the *New York Times*

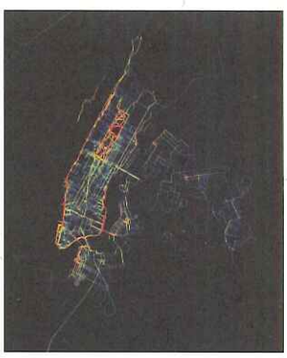
New York Times Graphics Department, "In Japan Reactor Failings, Danger Signs Are Seen for U.S. Plants," *New York Times*, May 18, 2011 Courtesy the *New York Times*



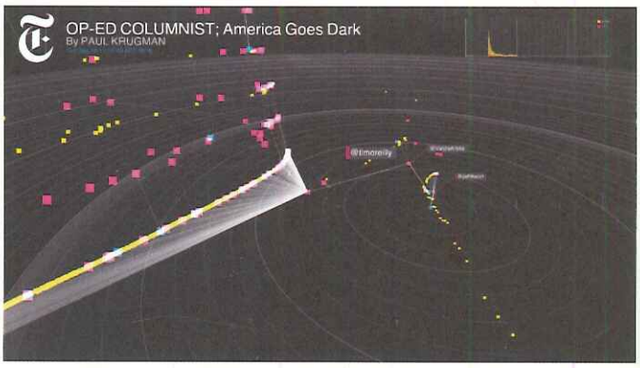
Martin Wattenberg and Fernanda Viégas, *History Flow*, 2003 Courtesy the artists



Esther Polak, Jeroen Kee en Waag Society, *AmsterdamREALTIME*, 2002 Courtesy the artists



Cooper Smith, visualization of 1,000 runners' routes in Manhattan using Nike Plus, 2011
Courtesy Cooper Smith



Jer Thorp, *Cascade*, 2011 Courtesy the artist and the New York Times R&D Group

on cultural conditions. Its specific subject is our current preoccupation with data, a development of what critic Benjamin Buchloh called the "aesthetics of administration" that concerned the conceptual artists of the postwar years: "the operating logic of late capitalism and its positivistic instrumentality." [14] Artistic visualization's role is to bring to light and challenge the prevailing assumptions behind the rhetoric, and to offer new, alternative modes of representation. It is the only category of the three in which form, line, and color are not evaluated solely in terms of usability issues.

Absence of Critique

Examples of visualizations from all three categories can be found on popular blogs such as *Information Aesthetics* (infosthetics.com; started by data visualization and architecture professor Andrew Vande Moere in 2004) and *Visual Complexity* (VisualComplexity.com; started by user experience designer Manuel Lima in 2005). Both sites are cheerleaders of the dazzling and richly diverse array of visualizations produced by professionals and amateurs these days, but neither carries the kind of critical discussion called for by Drucker, the "who made it, for whom, and for what purpose—ideology 101." [15] It is difficult not to see the reductivism in many of the visualizations rendering human communication as a thousand dots and veins of wispy color on black backgrounds, as if messy life had finally been conquered, sorted and re-arrayed as exquisite form.

Intricate flowerlike arrangements of frequently used terms in the *New York Times* by Jer Thorp, for example, were the first in a series of projects made by the digital artist for the newspaper's research and development lab. The question "for what purpose?" is initially difficult to answer, since zoomable interfaces of thousands of word constellations don't immediately suggest incisive analysis. Thorp's more recent Cascade project for the *Times*' R&D group, however, which tracks readers' tweets and online sharing habits with colored squares linked by thin gray lines shown through multiple alternative views, reveals a clear agenda in a promotional video. "Perhaps most importantly," asks the voice-over, "how can the *Times* use this information to expand its impact in the conversation, to maintain its position as a news and information leader?" The visualization, arguably, is less a research inquiry into the nature of information sharing than the territorial surveillance of a media battlefield.

Other projects illustrate how the formal languages of experimental artistic visualizations are quickly absorbed and put to work for commercial purposes. Student Cooper Smith's recent visualization of Manhattan running routes registered by 1,000 runners using the Nike Plus online synchronization service recalls the earlier, 2002 experimental project by Esther Polak to render a "live" map of Amsterdam by equipping sixty residents with GPS tracer units hooked up to a central server. Where Polak sought to describe the city as it is experienced by its residents, drawing from the anti-rationalist legacy of postwar psychogeography, Smith's well-intentioned aggregation reinforces a collusion of corporate (Nike) and military (GPS) interests: running is no longer just running, but measured, collated, and compared, tagged with personal targets and simulated rewards.

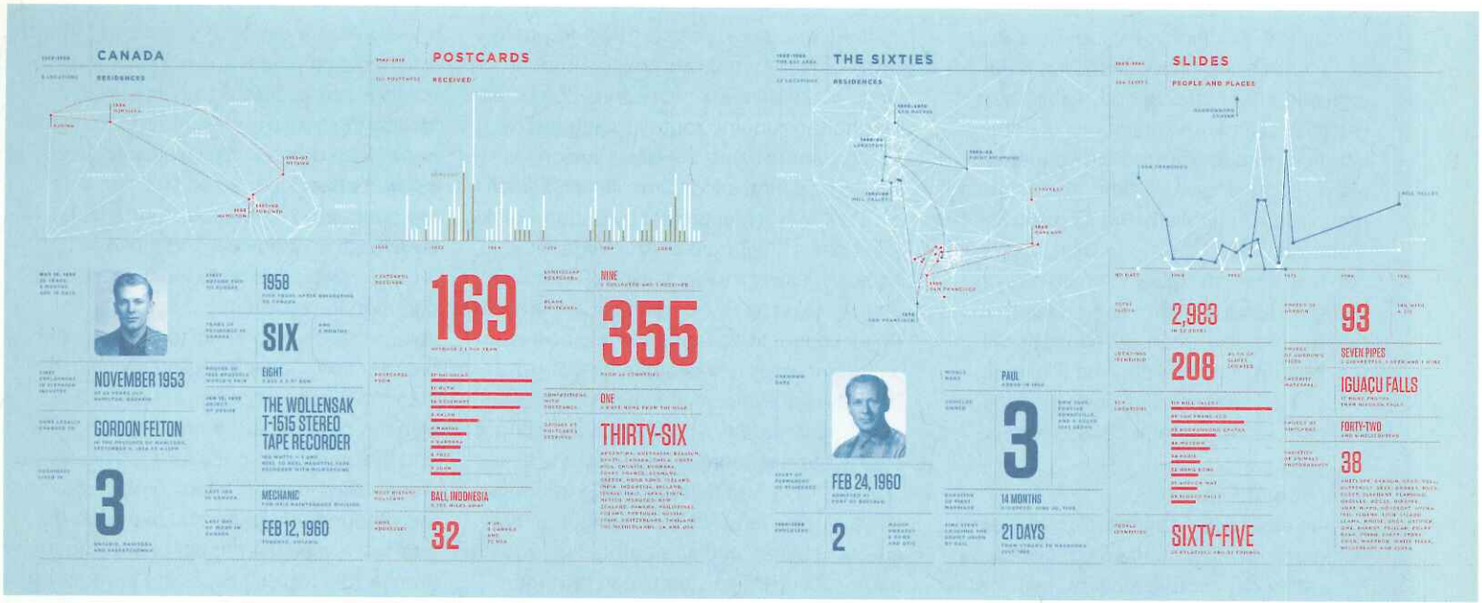
Critical Cartography

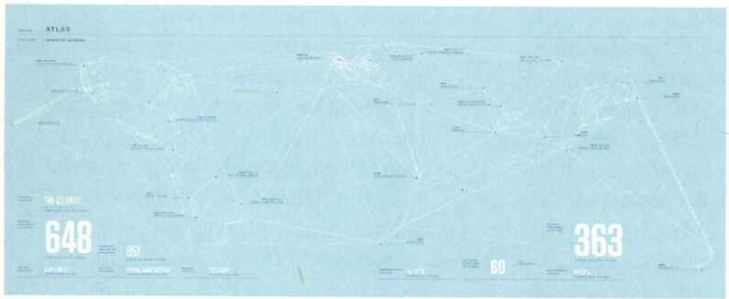
The lack of critical discourse around visualization seems all the more glaring given the critical toolkit applied to maps and cartography, which blossomed during the postwar years. An exhibition at the British Library and associated television series on the history of cartography delved into this rich vein of scholarship in 2010. [16] Behind the history of the map is what Jeremy Crampton describes as a "whole series of engagements in politics, propaganda, crime and public health, imperialist boundary-making, community activism, the nation-state, cyberspace and the Internet. That is, mapping has a politics." [17] That thematic maps—the precursors of infoviz—and statistics emerged in the early nineteenth century as "technologies of management" is no coincidence. Political systems, legislation, and the core of our cultural values are all integrated with these technologies. Rather than simply describe a preexisting world, these technologies, in their methods of framing, selecting, and predicting, *make up* a world. [18]

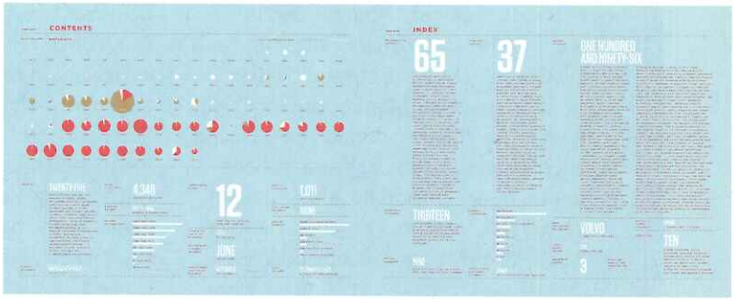
The cartographic scholar J. B. Harley famously noted that the key to decoding a map was to look for its "silences"—maps "exert a social influence through their omissions as much as by the features they depict and emphasize." [19] In the same way, today's network maps and maps of Internet activity reveal their territorial imperatives through what is left out. Maps of the Internet coming from computer research labs in the late 1990s, for example, were frequently shown with a blank backdrop as if to suggest that the network were somehow detached from real space, perhaps adrift in a vast terra incognita of potential security breaches or, alternately, lands yet to be wired. [20] A diagram of "subject matter experts," produced by management consultant and network analyst Valdis Krebs in 2008, is meant to help us identify the fragile nodes in a company's knowledge domain. It depicts people as colored boxes connected by lines: they are connected if one goes to the other for expertise or advice, and those with many arrows pointing to them are sought out often for assistance. The nodes are colored by their potential to leave/exit the organization. Conspicuously "silent" in the diagram are assumptions about the rate of transfer of knowledge around a network and the working atmosphere. Obviously, a work environment in which people share knowledge freely in pursuit of a shared goal will lessen the impact of a key figure (the "border router") departing the network, compared with an environment in which long-entrenched employees harbor their knowledge as a form of power. The missing information from Krebs' map may ultimately provide the key to the functioning of the network, to the extent that a map of the mood of the network may be more useful. [21]

An alternative *artistic* network map brings such absences to light. Artist Uta Eisenreich's "Teamwork Sociogram," produced with children at Langmatt School in Zürich, takes the form of a series of photographs of the children in the schoolyard, linked to each other by pieces of colored string. Red strings, for example, were linked by the students in response to the question: If you were allowed to invite three classmates to your birthday party, who would they be? The effect of the photographic series is to reveal not the breadth or security of a network, but its fragility; to remind us that the nodes on a network diagram are not uniform squares but people; to hint that, in analyzing a network, it is the node that knows how it is connected. The project references the content of the 1930s social network maps of psychiatrist Jacob Moreno, which sought to identify the structure of groups based on affections rather than roles. [22] But whereas Moreno's and Krebs' diagrams are highly abstracted nodes and lines, Eisenreich's network map is photographic, connoting the ephemeral nature of social ties, and indeed, network maps.

Recent scholarship has demonstrated that our conventions for representing the passage of time are inextricably tangled with a post-eighteenth-century view of time as a sequential line. [23] Temporality is a big problem for the network map; the authority of the line-and-node diagram implicitly suggests that the network depicted is fixed in time. As one group of sociologists has

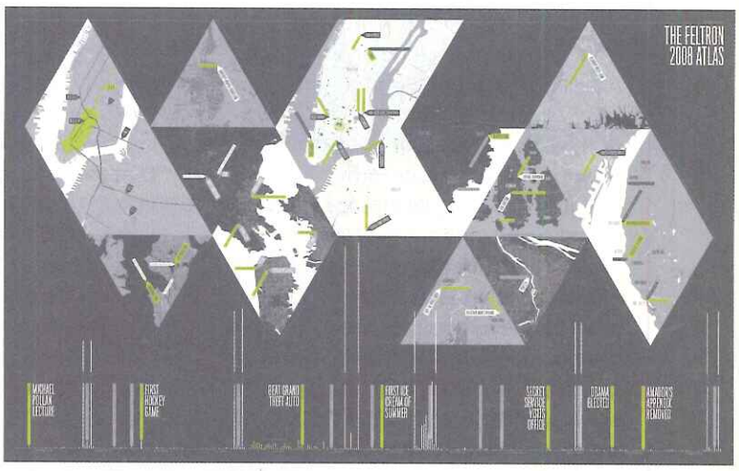


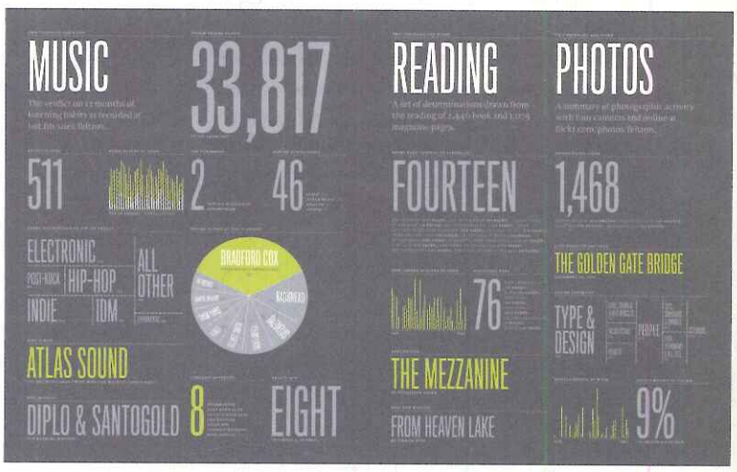




Nicholas Felton, *2010 Feltron Annual Report*, 2011 Courtesy the artist

Ryan Case and Nicholas Felton, Daytum, 2008 Courtesy Daytum





Nicholas Felton, *2008 Feltron Annual Report*, 2009 Courtesy the artist

Archeology of Ourselves

Nicholas Felton began producing annual reports about various activities he had engaged in over the previous year in 2005, which he published under the moniker "Feltron" in the form of a printed annual report. Beginning with such data as the number of songs listened to, miles flown, books read, restaurant visited, types of foods eaten, and so on, he began to form a composite portrait of his life, expressed in various charts and graphs of his design. Felton's project recalls the work of Charles Madge, Tom Harrison, and Humphrey Jennings, who created Mass-Observation in 1930s Britain that used observers to record the everyday behaviors of average citizens. Unlike Madge and Harrison's third-party reportage, Felton typically relies instead on self-recording, reporting, and interpretation of data. In 2008, he developed Daytum with Ryan Case, a website and software application that helps you track your personal data more easily. In 2009, he asked acquaintances to complete surveys about him that formed the 51,445-word data set that begat that year's report. In 2010, he conducted an investigative project not about himself but his father's extensive travels over the course of his life, which Felton reconstructed using passports, photos, calendars, receipts, and correspondence. Through his *Annual Reports*, Felton has expanded Madge and Harrison's concept of an "archeology of ourselves," giving it graphic form and obsessive detail. —AB

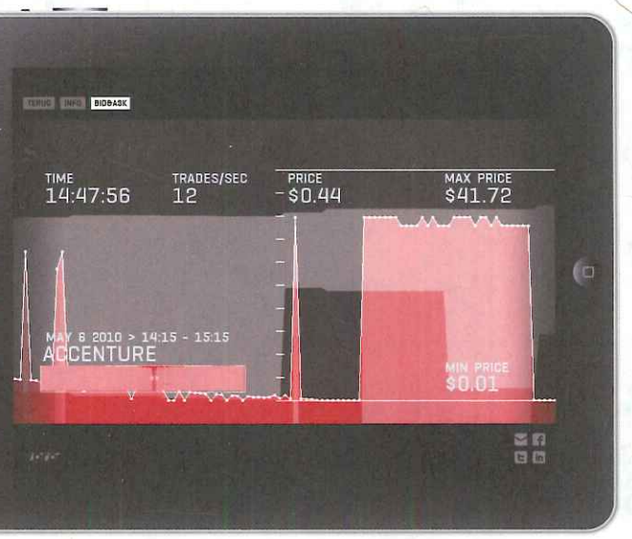
Peter Hall

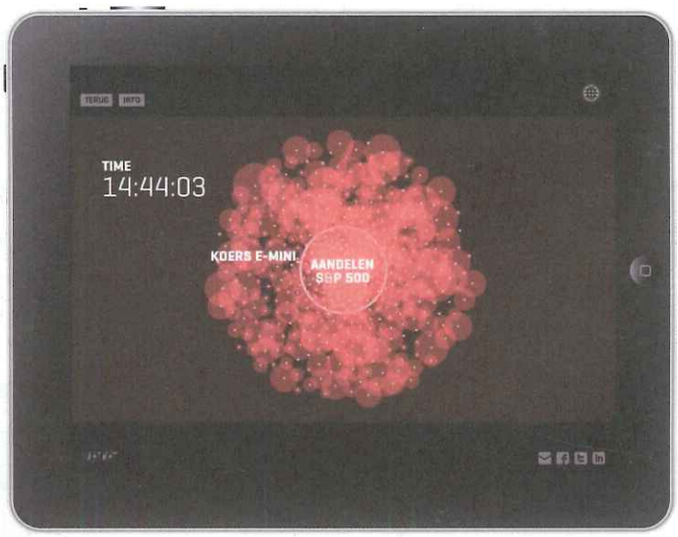
Analytics

by media theorist Lev Manovich in 2007, the concept of cultural analytics can be seen as the consequence of ever-increasing computational power to manipulate enormous amounts of data in real e ability of advanced visual interfaces to explore these datasets, and the desire of researchers to explore such resources in new ways. No longer limited to advanced scientific research, such tools and s can be applied to areas of social and cultural interest forming the arena of digital humanities. As Manovich and his team at the University of California, San Diego, relate: "New super-visualization gies specifically designed for research purposes allow interactive exploration of massive media collections which may contain tens of thousands of hours of video and millions of still images. Re- rs can quickly generate new questions and hypotheses and immediately test them. This means that researchers can quickly explore many research questions within a fraction of the time previously to ask just one question. ¶ Computational analysis and visualization of large cultural data sets allow the detailed analysis of gradual historical patterns that may only manifest themselves over tens ands of artifacts created over a number of years. Rather than describing the history of any media collection in terms of discrete parts (years, decades, periods, etc.), we can begin to see it as a set s, each showing how a particular dimension of form, content, and reception changes over time. In a similar fashion, we can supplement existing data classification with new categories that group artifacts which share some common characteristics. For instance, rather than only dividing television news programs according to producers, air dates and times, or ratings, we can generate many grams clusters based on patterns in rhetorical strategies, semantics, and visual form. In another example, we can analyze millions of examples of contemporary graphic design, web design, motion s, experience design, and other recently developed cultural fields to create their maps, which would reveal if they have any stylistic and content clusters." —AB See "Cultural Analytics," *Software Initiative* blog, lab.softwarestudies.com, 2011

The Flash Crash

May 6, 2010, at 2:42 pm the Dow Jones Industrial Average began to plunge more than 300 points with another 600 point drop in the next five minutes, loosing nearly a 1,000 points. By 3:07 pm, the market had regained most of the loss. It was the second largest point swing—1,010.14 points—and the biggest one-day point decline—998.5 points—on an intraday basis in Dow Jones Industrial Average history. The cause of the crash, according to a Securities and Exchange Commission (SEC) report of the incident, was the ill-timed use of automated trading algorithms from one particular firm. Others have remarked that this trade was merely the trigger of the crash, and that the underlying causes of the use of such superfast transactions and the lack of marketplace safeguards were not addressed. VPRO, the Dutch television company, produced a documentary by Marije Meerman entitled *Money & Speed: Inside the Black Box* to explain what happened that day. The companion TouchDoc app for devices such as the iPad was designed by Catalogtree and merges their information graphics and data visualizations with cinematic storytelling to create a compelling hybrid of the immersive and the analytical. —AB

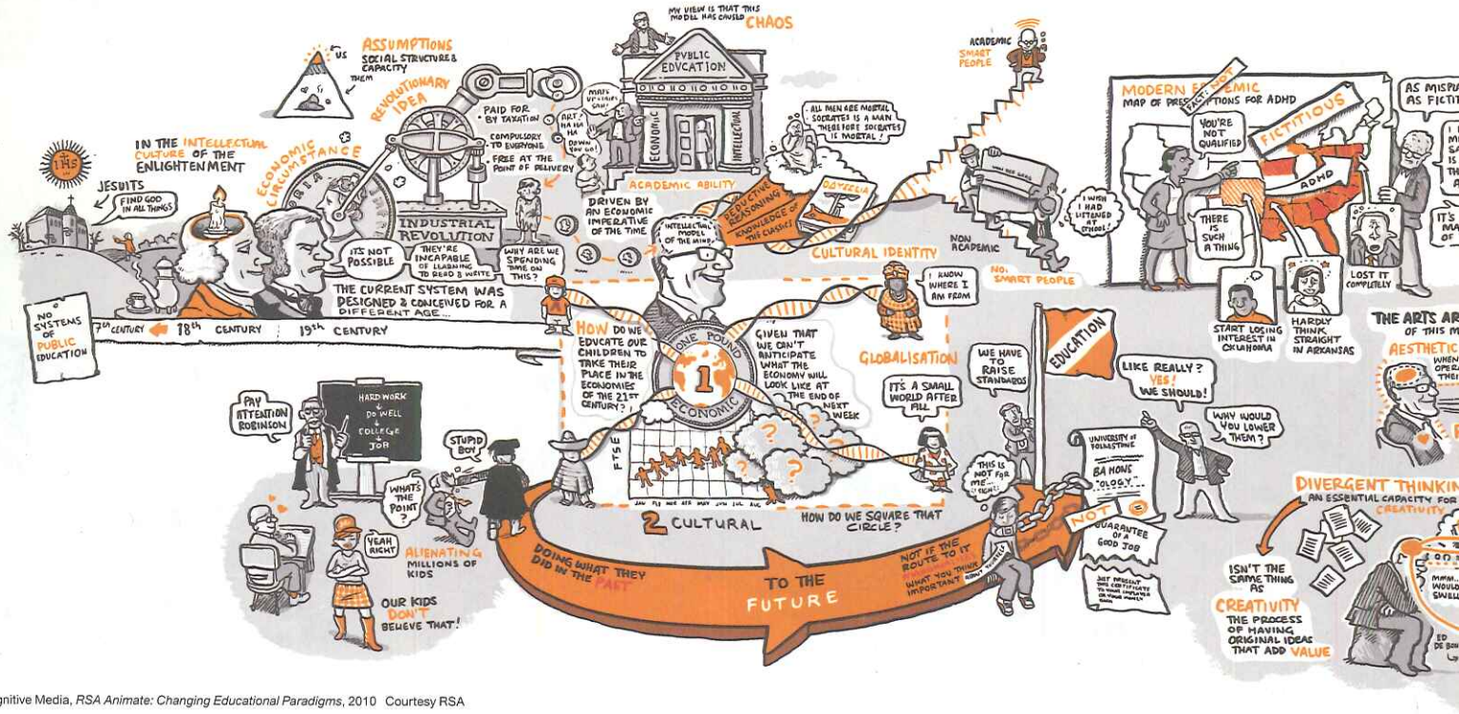




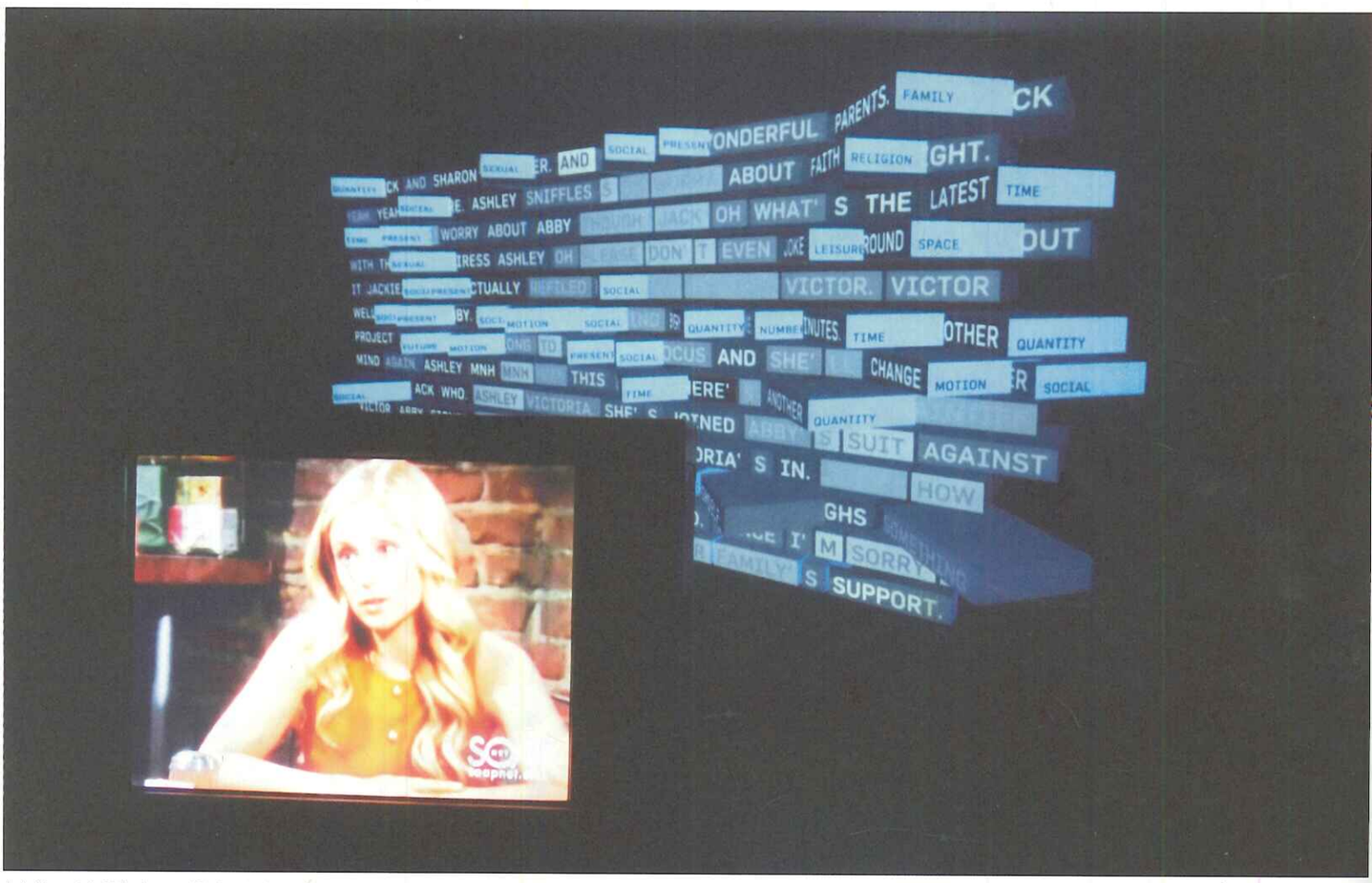
ross and Joris Maltha in collaboration with Marije Meerman, Lutz Issler, and Jorn van Dijk, *Speed & Money: Inside the Black Box*, 2011 Courtesy Catalogtree

Video Scribing

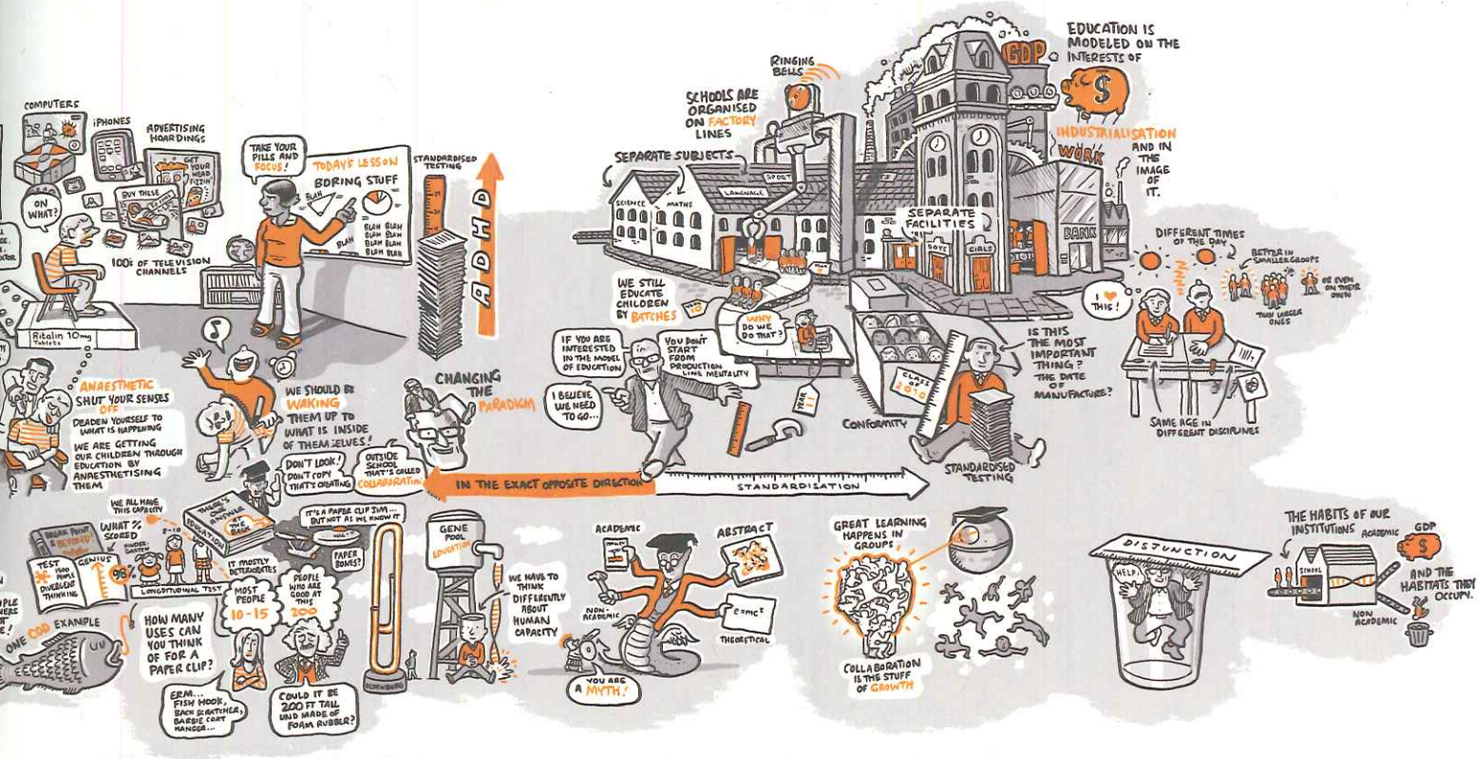
Sir Ken Robinson's lecture, "Changing Educational Paradigms," is one of many such talks by leading thinkers that take place at the RSA in London, whose formal name is the Royal Society for the Encouragement of Arts, Manufactures and Commerce. The RSA is an organization dedicated to shaping thinking and action around issues of social progress. It began working with the firm Cognitive Media to transform these lectures into animated videos using whiteboards and markers, and in the process conceived of a new area of media practice called video scribing. As the name suggests, a visual transcription of a talk is created using animated illustrations that follow the actual lecture soundtrack. Video scribing is a combination of hand-drawn illustrations, stop-motion animation, videography, and sound editing. A result of talented artists and technicians, the RSA Animate video treatment has proven to be an extremely popular and engaging form that merges entertainment and education, delight and information. —AB

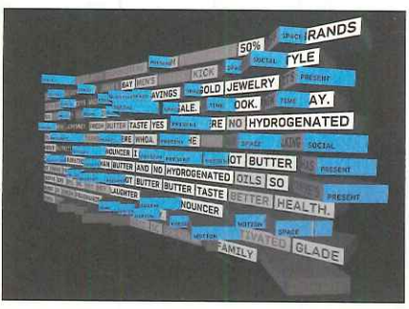


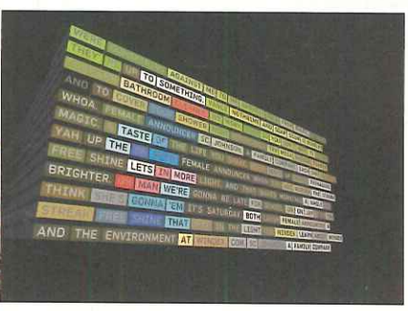
Cognitive Media, *RSA Animate: Changing Educational Paradigms*, 2010 Courtesy RSA

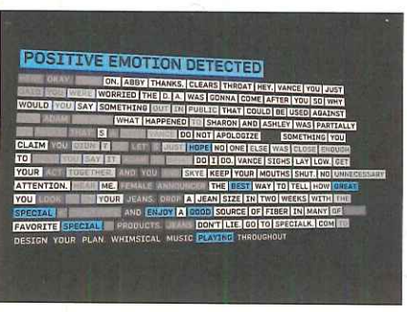


Justin Manor, John Rothenberg, and Eric Gunther, *Set Top Box*, 2010 Courtesy Sosolimited



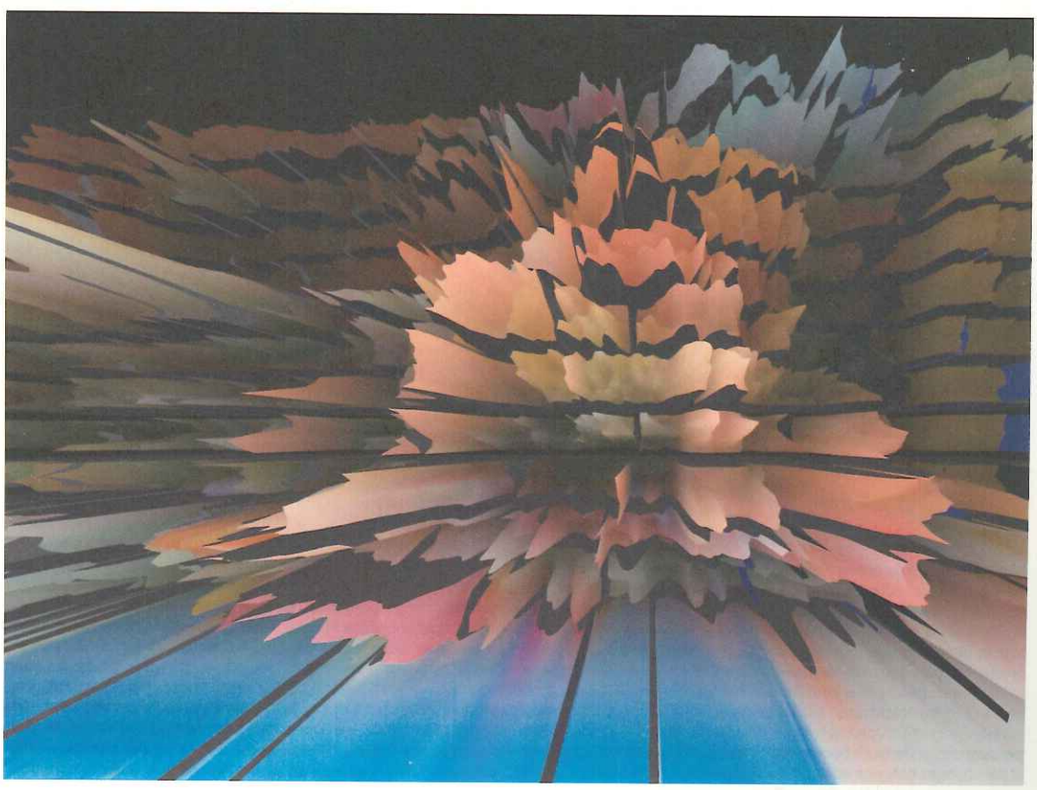






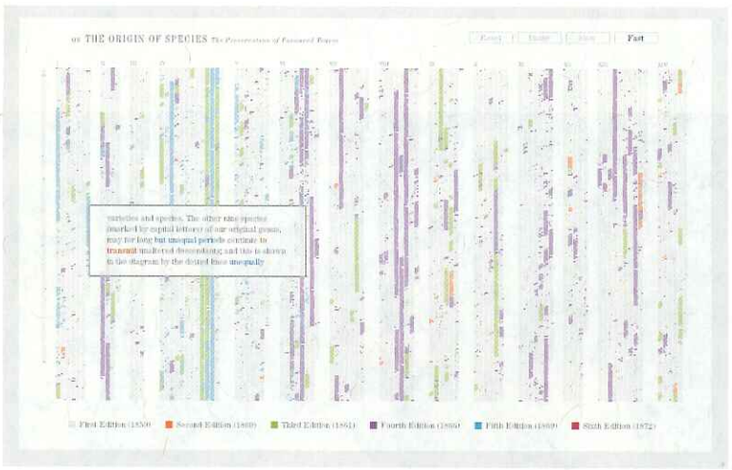
Set Top Box

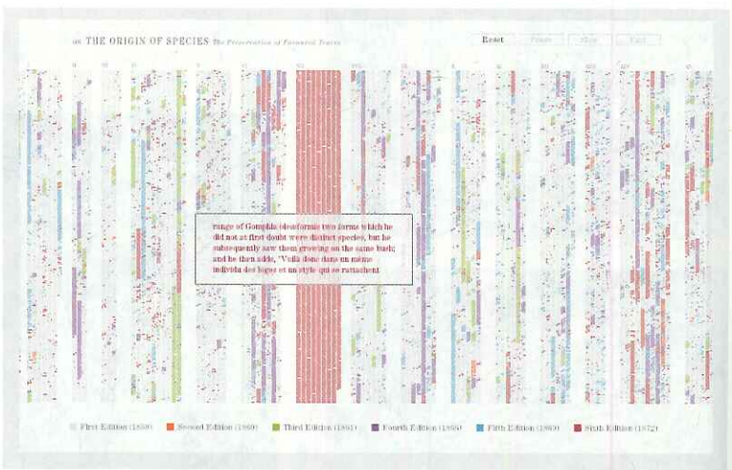
The Boston-based design and technology studio Sosolimited has turned automated reading into an art form. Their project *Set Top Box* filters real-time television programs into dynamic typographic animations, generated on the fly in response to the closed-caption transcript. Custom software combs through the text for emotional and thematic content, transforming the verbal soundtrack into a multilayer audiovisual concoction. According to Sosolimited, "The effect is a floating typographic life form—fed by, performed by, and eternally making sense of, the television." —EL



Justin Manor, John Rothenberg, and Eric Gunther, *Set Top Box*, 2010 Courtesy Sosolimited

Ben Fry, *On the Origin of Species: The Preservation of Favoured Traces*, 2009 Photo: James Brady Courtesy the artist

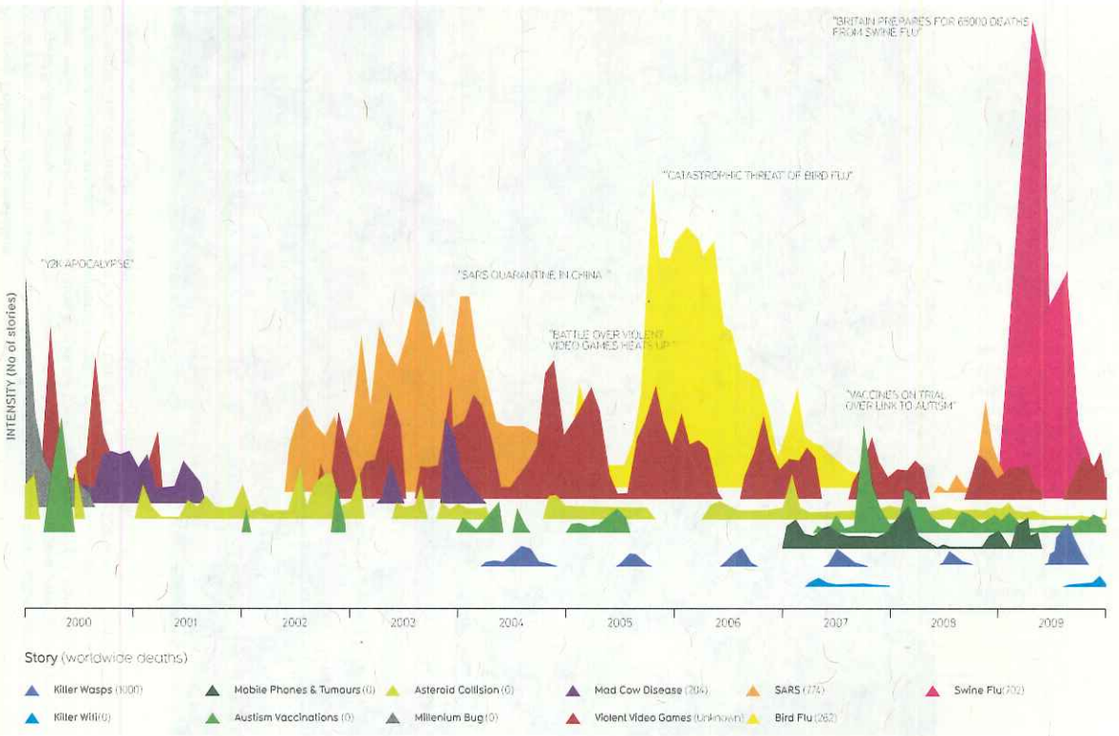




Ben Fry, *On the Origin of Species: The Preservation of Favoured Traces*, 2009 Courtesy the artist

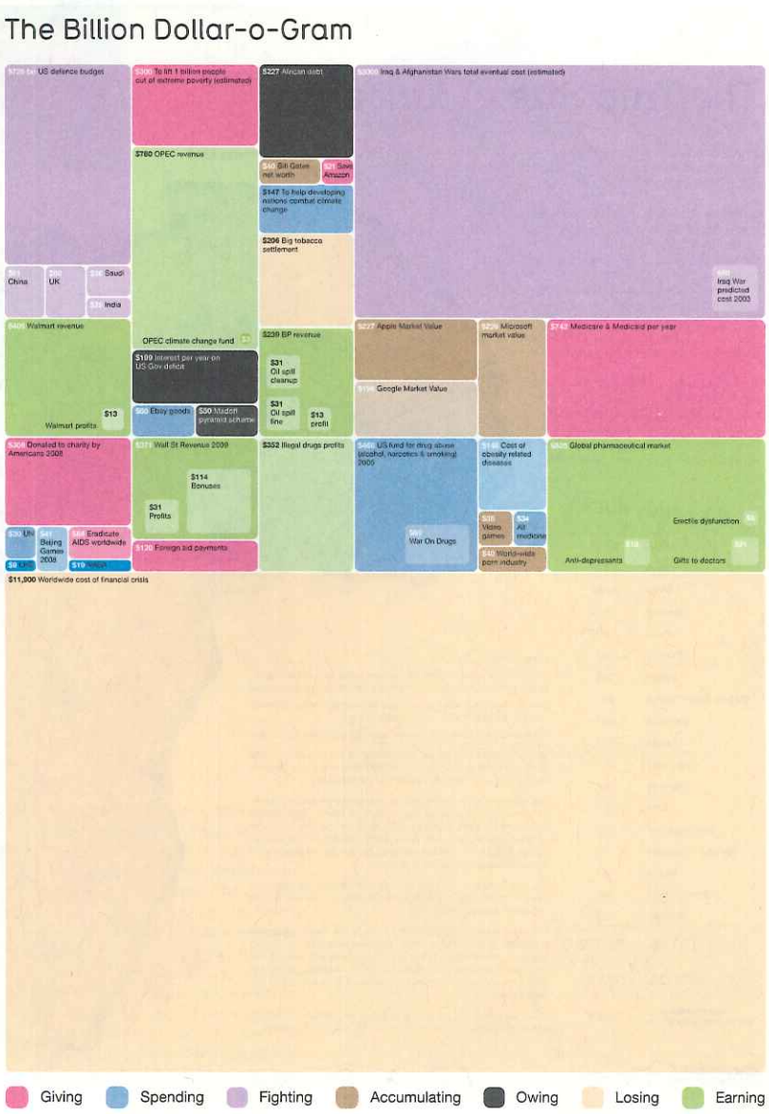
On the Origin of Species: The Preservation of Favoured Traces

We often think of scientific ideas, such as Darwin's theory of evolution, as fixed notions that are accepted as finished. In fact, Darwin's *On the Origin of Species* evolved over the course of several editions he wrote, edited, and updated during his lifetime. The first English edition was approximately 150,000 words and the sixth is a much larger 190,000 words. In the changes are refinements and shifts in ideas—whether increasing the weight of a statement, adding details, or even a change in the idea itself. The second edition, for instance, adds a notable "by the Creator" to the closing paragraph, giving greater attribution to a higher power. In another example, the phrase "survival of the fittest"—usually considered central to the theory and often attributed to Darwin—instead came from British philosopher Herbert Spencer, and didn't appear until the fifth edition of the text. Using the six editions as a guide, we can see the unfolding and clarification of Darwin's ideas as he sought to further develop his theory during his lifetime. This project is made possible by the hard work of Dr. John van Wyhe, et al., who run *The Complete Work of Charles Darwin Online*. The text for each edition was sourced from their careful transcription of Darwin's books, and Dr. van Wyhe generously granted permission to use the text. This piece is a simpler version of a larger effort that looks at the changes between editions, and is intended as the first in a series looking at how the book evolved over time. —Ben Fry, benfry.com/traces/, 2009



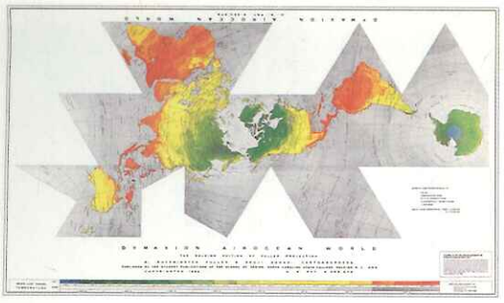
David McCandless, *Mountains Out of Molehills: A Timeline of Global Media Scare Stories*, 2009 Courtesy the artist

Visual Journalism
In their 2001 textbook *Visual Journalism: A Guide for New Media Professionals*, Christopher Harris and Paul Martin Lester defined visual journalism as a term that "expands the professions of photojournalism, reporting, writing, and graphic design." As the news industry seeks to make the most of new technologies, many colleges and universities have started offering coursework or degrees in visual journalism. Information graphics are an important component of visual journalism, along with video and still photography. The visual journalist doesn't merely visualize a body of data, however, but builds a compelling story around it. —EL



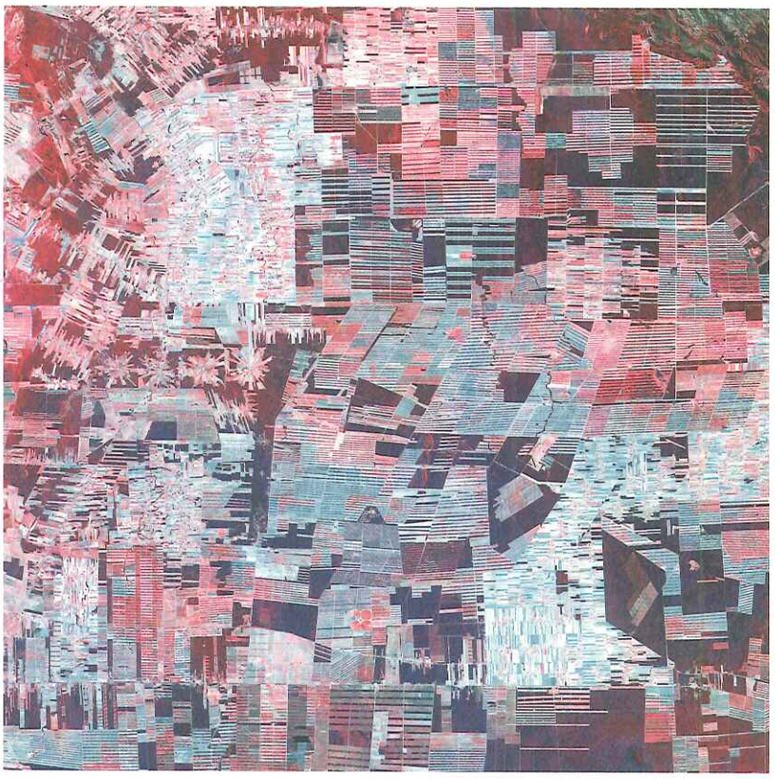
David McCandless, *Billion Dollar-o-Gram*, 2009 Courtesy the artist

Six Rules of Infographics
1. An infographic is, by definition, a visual display of facts and data. Therefore, no infographic can be produced in the absence of reliable information. **2.** No infographic should include elements that are not based on known facts and available evidence. **3.** No infographic should be presented as being factual when it is fictional or based on unverified assumptions. **4.** No infographic should be published without crediting its source(s) of information. **5.** Information graphics professionals should refuse to produce any visual presentation that includes imaginary components designed to make it more "appealing" or "spectacular." Editors must refrain from asking for graphics that don't stick to available evidence. **6.** Infographics are neither illustrations nor "art." Infographics are visual journalism and must be governed by the same ethical standards that apply to other areas of the profession. —*Neiman Watchdog*, Harvard University, published following the assassination of Osama Bin Laden and the worldwide visual media frenzy it inspired, www.niemanwatchdog.org, 2011



Raleigh Dymaxion Map

Buckminster Fuller produced his *Raleigh Dymaxion Map* in 1954 while in North Carolina and teaching at NC State University. Fuller sought to portray all of the major landmasses of the Earth without dividing them and to lessen the kinds of gross distortions to a continent's relative size and shape—for instance Greenland and Africa—that afflicted other planar maps. Although his goal was to produce an equal area map, Fuller did not know exactly how to achieve this elusive objective and lacked today's sophisticated cartographic software tools. Working with cartographer Shoji Sadao, Fuller mapped the sphere of the Earth onto twenty equilateral triangles. The color of landmasses and the shading of the oceans reflect mean low temperatures. The *Raleigh Dymaxion Map*, while imperfect, is a remarkable achievement that fulfilled the basic premise of Fuller's desire to communicate the fact that "there are many ways to see the world." —AB



Once a vast carpet of healthy vegetation and virgin forest, the Amazon rainforest is changing rapidly. This image of Bolivia shows dramatic deforestation in the Amazon Basin. Loggers have cut long paths into the forest, while ranchers have cleared large blocks for their herds. Farming out from these clear-cut areas are settlements built in radial arrangements of fields and farms. Healthy vegetation appears bright red in this image. This deforestation can be found on Landsat 7 WRS Path 230 Row 72, center: -17.35, -62.18. —NASA, *Our Earth As Art*, 2005, earthasart.gsfc.nasa.gov/bolivian.html

U.S. Geological Survey National Center for Earth Resource and Observation Science (EROS), Bolivian Deforestation, August 1, 2000
Courtesy National Center for EROS and NASA Landsat Project Science Office

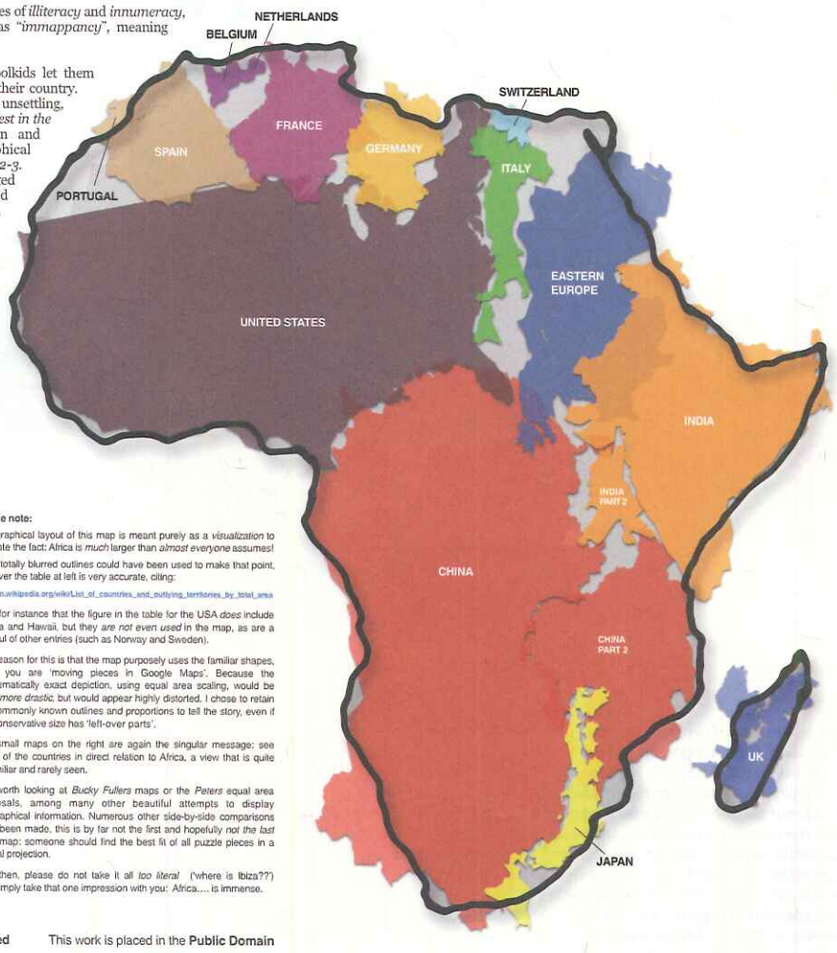
The **True Size** of **Africa**

A small contribution in the fight against rampant *Immappancy*, by **Kai Krause**

In addition to the well known social issues of *illiteracy* and *innumeracy*, there also should be such a concept as "*immappancy*", meaning *insufficient geographical knowledge*.

A survey with random American schoolkids let them guess the population and land area of their country. Not entirely unexpected, but still rather unsettling, the majority chose *"1-2 billion"* and *"largest in the world"*, respectively. Even with Asian and European college students, geographical estimates were often off by factors of *2-3*. This is partly due to the highly distorted nature of the predominantly used mapping projections (such as *Mercator*).

A particularly extreme example is the worldwide misjudgement of the true size of Africa. This single image tries to embody the massive scale, which is larger than the *USA, China, India, Japan* and *all of Europe - combined!*



COUNTRY	AREA x 1000 km²
USA	9.629
China	9.573
India	3.287
Mexico	1.964
Peru	1.285
France	633
Spain	506
Papua New Guinea	462
Sweden	441
Japan	378
Germany	357
Norway	324
Italy	301
New Zealand	270
United Kingdom	243
Nepal	147
Bangladesh	144
Greece	132
TOTAL	30.102
AFRICA	30.221
Just for Reference: The Surface of the MOON	37.930

Please note:

The graphical layout of this map is meant purely as a *visualization* to illustrate the fact: Africa is *much* larger than *almost everyone* assumes!

Even totally blurred outlines could have been used to make that point, however the table at left is very accurate, citing:

http://en.wikipedia.org/wiki/List_of_countries_and_outlying_territories_by_total_area

Note for instance that the figure in the table for the USA *does* include Alaska and Hawaii, but they *are not even used* in the map, as are a handful of other entries (such as Norway and Sweden).

The reason for this is that the map purposely uses the familiar shapes, as if you are 'moving pieces in Google Maps'. Because the mathematically exact depiction, using equal area scaling, would be *even more drastic*, but would appear highly distorted. I chose to retain the commonly known outlines and proportions to tell the story, even if this conservative size has 'left-over parts'.

The small maps on the right are again the singular message: see some of the countries in direct relation to Africa, a view that is quite unfamiliar and rarely seen.

It is worth looking at *Bucky Fullers* maps or the *Peters* equal area proposals, among many other beautiful attempts to display geographical information. Numerous other side-by-side comparisons have been made, this is by far not the first and hopefully *not the last* such map: someone should find the best fit of all puzzle pieces in a neutral projection.

Until then, please do not take it all *too literal* ('where is Ibiza??) and simply take that one impression with you: Africa.... is immense.

Top 100 Countries

Area in square kilometers, Percentage of World Total
Sources: Britannica, Wikipedia, Almanac 2010


United States


Europe

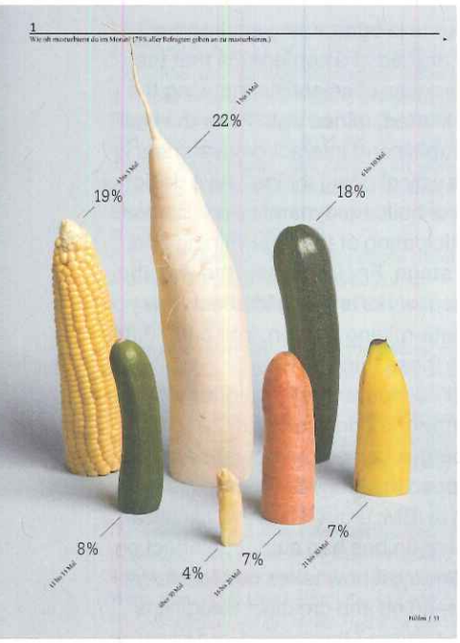

India


Japan

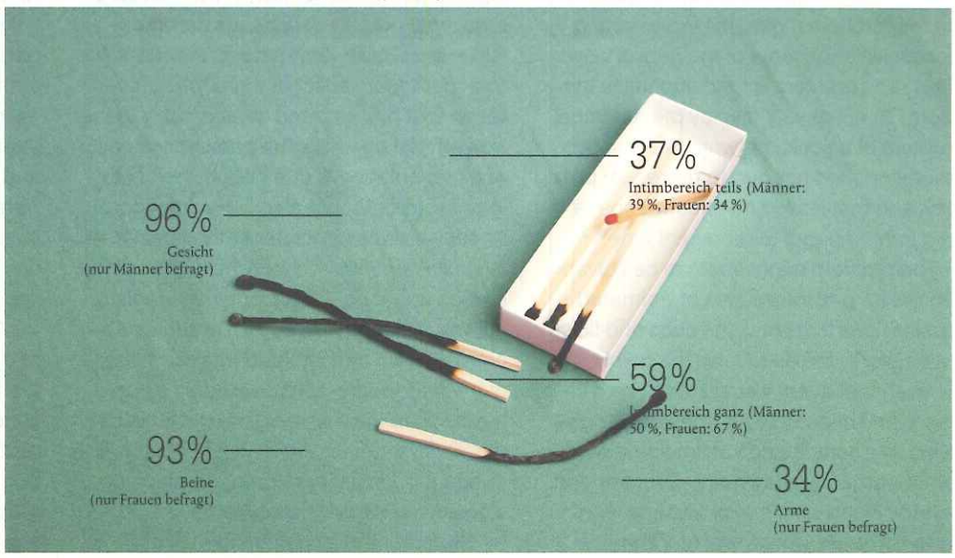

China

		AREA km²	%
1	Russia	17.098.242	11,50
2	Canada	9.984.670	6,70
3	China	9.596.961	6,40
4	United States	9.629.091	6,40
5	Brazil	8.514.877	5,70
6	Australia	7.692.024	5,20
7	India	3.287.263	2,30
8	Argentina	2.760.400	2,00
9	Kazakhstan	2.724.900	1,80
10	Sudan	2.505.813	1,70
11	Algeria	2.381.741	1,60
12	Congo	2.344.858	1,60
13	Greenland	2.166.086	1,50
14	Saudi Arabia	2.149.690	1,40
15	Mexico	1.964.375	1,30
16	Indonesia	1.860.360	1,30
17	Libya	1.759.540	1,20
18	Iran	1.628.750	1,10
19	Mongolia	1.564.100	1,10
20	Peru	1.285.216	0,86
21	Chad	1.284.000	0,85
22	Niger	1.267.000	0,85
23	Angola	1.246.700	0,85
24	Mali	1.240.192	0,83
25	South Africa	1.221.037	0,82
26	Colombia	1.141.748	0,76
27	Ethiopia	1.104.300	0,74
28	Bolivia	1.098.581	0,74
29	Mauritania	1.025.520	0,69
30	Egypt	1.002.000	0,67
31	Tanzania	945.087	0,63
32	Nigeria	923.768	0,62
33	Venezuela	912.050	0,61
34	Namibia	824.116	0,55
35	Mozambique	801.590	0,54
36	Pakistan	796.095	0,53
37	Turkey	783.562	0,53
38	Chile	756.102	0,51
39	Zambia	752.612	0,51
40	Myanmar	678.378	0,45
41	Afghanistan	652.090	0,44
42	Somalia	637.657	0,43
43	France	632.834	0,43
44	C. African Rep	622.984	0,42
45	Ukraine	603.500	0,41
46	Madagascar	587.041	0,39
47	Botswana	582.000	0,39
48	Kenya	580.367	0,39
49	Yemen	527.968	0,35
50	Thailand	513.120	0,34
51	Spain	505.992	0,34
52	Turkmenistan	488.100	0,33
53	Cameroon	475.442	0,32
54	Papua New Guinea	462.840	0,31
55	Uzbekistan	447.400	0,30
56	Morocco	446.550	0,30
57	Sweden	441.370	0,30
58	Iraq	438.317	0,29
59	Paraguay	406.752	0,27
60	Zimbabwe	390.757	0,26
61	Japan	377.930	0,25
62	Germany	357.114	0,24
63	Rep o.t. Congo	342.000	0,23
64	Finland	338.419	0,23
65	Vietnam	331.212	0,22
66	Malaysia	330.803	0,22
67	Norway	323.802	0,22
68	Côte d'Ivoire	322.463	0,22
69	Poland	312.685	0,21
70	Oman	309.500	0,21
71	Italy	301.336	0,20
72	Philippines	300.000	0,20
73	Burkina Faso	274.222	0,18
74	New Zealand	270.467	0,18
75	Gabon	267.668	0,18
76	Western Sahara	266.000	0,18
77	Ecuador	256.369	0,20
78	Guinea	245.857	0,17
79	United Kingdom	242.900	0,16
80	Uganda	241.038	0,16
81	Ghana	238.539	0,16
82	Romania	238.391	0,16
83	Laos	236.800	0,16
84	Guyana	214.969	0,14
85	Belarus	207.600	0,14
86	Kyrgyzstan	199.951	0,13
87	Senegal	196.722	0,13
88	Syria	185.180	0,12
89	Cambodia	181.035	0,12
90	Uruguay	176.215	0,12
91	Suriname	163.820	0,11
92	Tunisia	163.610	0,11
93	Nepal	147.181	0,10
94	Bangladesh	143.998	0,10
95	Tajikistan	143.100	0,10
96	Greece	131.957	0,09
97	Nicaragua	130.373	0,09
98	North Korea	120.538	0,08
99	Malawi	118.484	0,08
100	Eritrea	117.600	0,08
	TOP 100 TOTAL	132.632.524	89,34

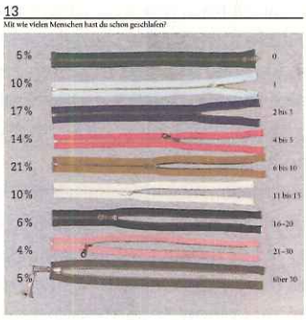
Kai Krause, *The True Size of Africa*, 2010



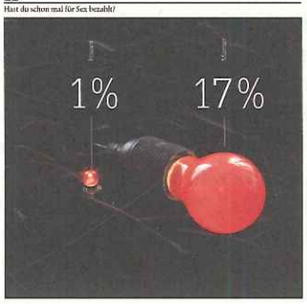
33
Wo rasierst du dich? (84% aller Befragten rasieren sich regelmäßig, 79% der Männer, 90% der Frauen.)



13
Mit wie vielen Menschen hast du schon geschlafen?



22
Hast du schon mal für Sex bezahlt?

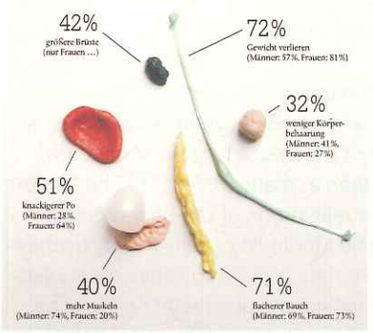


2
Wie würdest du deine sexuelle Orientierung beschreiben?

34
Wie oft im Monat schaust du pornografische Seiten im Internet an? (49% aller Befragten tun dies, 71% der Männer und 26% der Frauen.)

arah Illenberger, "The Great Sex Survey," *Neon Magazine*, 2008 Courtesy the artist

26
Was würdest du gerne an deinem Körper ändern? (36% aller Befragten fühlen sich von sexuellen Darstellungen in Werbung oder Medien unter Druck gesetzt.)



Chartjunk

Coined by Edward Tufte in his book *The Visual Display of Quantitative Information* (1983), the term "chartjunk" refers to unnecessary visual elements used in information graphics that distract the viewer from understanding the underlying data being presented. Examples of chartjunk include extraneous images and illustrations, use of ornaments and typography that call too much attention to themselves, superfluous use of color and gradients, competing visual weight of lines and borders, etc. Arguing for a less-is-more approach, Tufte describes the offending phenomena: "The interior decoration of graphics generates a lot of ink that does not tell the viewer anything new. The purpose of decoration varies—to make the graphic appear more scientific and precise, to enliven the display, to give the designer an opportunity to exercise artistic skills. Regardless of its cause, it is all non-data-ink or redundant data-ink, and it is often chartjunk." Tufte's argument seemed directed at the kind of information graphics being used in *USA Today*, introduced just a year earlier and which featured snapshot surveys of various topical subjects rendered with eye-grabbing illustrations accompanying bar charts and graphs. More recently, researchers at the University of Saskatchewan compared the embellished graphics of Nigel Holmes with the same data set expressed in minimalist terms and concluded: "We found that people's accuracy in describing the embellished charts was no worse than for plain charts, and that their recall after a two-to-three-week gap was significantly better. In addition, participants preferred the embellished charts. Although we are cautious about proposing specific design recommendations, it seems clear that there is more to be learned about the effects of different types of visual embellishment in charts. Our results question some of the premises of the minimalist approach to chart design, and raise issues for designers about how charts are designed and used in different publications and different contexts." —AB See Scott Bateman, et al., "Useful Junk? The Effects of Visual Embellishment on Comprehension and Memorability of Charts," 2010

noted: "Most network images do a poor job of representing *change* in networks, and researchers make do by presenting successive snapshots of the network over time.... The problem is fundamental to the media. To effectively display the relational structure of a social network, at least two dimensions are needed to represent proximity, and that leaves no effective space (on a printed page) to represent time." [24]

The problem might seem to be solvable with the help of interactive or animated visualizations that show the ebbs and flows of a network. This is to miss the point, however, that *every* visualization, be it a fixed frame or selected frames from a given period, is a construction of time produced from a particular viewpoint. Drucker and Bethany Nowviskie's explorations with students at the University of Virginia's SpecLab include experiments at representing time as experiential rather than "unidirectional, homogenous, continuous—none of those things are true in humanistic experience." [25] Europe is mapped according to the difficulty of getting from place to place, a train journey is mapped according to perceived time between stations, and days are mapped according to heavy events and levels of anxiety. The goal is to achieve an "affective" mode of representation, and in so doing, "question fundamental assumptions about how we know what we know."

Situated Visualization

In summary, the critical function of artistic visualization is to call into question the claims of transparency, certainty, and objectivity embedded in the Cartesian language of the genre. It is to insist on the *situatedness* of the observer and the phenomenon being observed. Projects as seemingly innocuous as Nicholas Felton's "personal annual reports," named for an imaginary organization named Feltron, work at this level by impeccably parodying the visual and textual language of the corporate annual report—while conveying elements of the modern-day lifestreamer's narcissism. The 2005 Feltron report quantifies in statistical charts everything from kinds of meals eaten, photographs taken per country visit, and the amount of time spent at work and play by its author. [26]

When the situatedness of a visualization is reinforced, it can be scrutinized as a work of rhetoric, a "matter of concern" rather than a "matter of fact." [27] The "scribing" visualizations of UK-based group Cognitive Media do exactly this by eschewing the tenets of Tufte to achieve a subjective visual means of annotating ideas as they emerge in conference presentations and workshops. Cognitive Media's charming, intriguing marker pen-on-whiteboard drawings, notably of scholars Jeremy Rifkin and Philip Zimbardo, draw attention to a rhetorical aspect of the public presentation that has suffered considerably in the PowerPoint age: that the persuasiveness of a presentation is due not entirely to its logical strength, but also to its emotional appeal and the character of the speaker—in classical terms, not only its logos but its pathos and ethos. [28] If Cognitive Media's informative and visually rich graphics do convey a rich and situated representation of the information as delivered by a particular speaker, then are they not a better paradigm than, say, a flow chart, geometric mind map, rectilinear graph, or table versions of the same information?

Situatedness and contingency are certainly not alien to the language of visualization. Arguably, the sheer fecundity of the field is beginning to shift the ground away from the fixed, objective, atemporal, and totalized visual rhetoric. In visualizing the extensive changes made to Darwin's *Origin of Species* during the course of its publication through six editions, for example, Ben Fry unsettles the idea that scientific notions appear as fixed ideas. [29] In visualizing the changes to specific entries in *Wikipedia*, Wattenberg and Fernanda Viégas zoom in on the disputes and controversies that surround topics that might otherwise seem long since settled. An encyclopedia page becomes a contested territory. [30]

The unaddressed question so far in this discussion is the role of graphic designers in this vast, flourishing field. Clearly designers are at work in all three categories of visualization outlined above, but in increasingly collaborative environments. Traditionally, the designer might produce static graphics, or come in to clean up dynamic visualizations once the hard-core statistical, analytical work and programming were complete. But increasingly, there are designers with programming skills and mathematicians with design skills making inroads into each other's professions. The web-enabled availability of data sources, notably from governments and nongovernmental organizations aspiring to transparency, and the proliferation of free visualization tools and forums—from Many Eyes (visualization platform spawned at IBM) to Gephi (a Paris-based open source consortium)—has brought host of practitioners to the field, designers among them. [31]

Visualization depends increasingly on a cadre of interdisciplinary skills. Fry, codeveloper of the ubiquitous Processing open source programming environment, recently argued at a conference that the typical process of scientists throwing the parsed, filtered, mined data "over the wall" to the graphic and interaction designers is "a terrible way of doing things." As a designer capable of building dynamic visualizations and participating at the data-mining and parsing stage, Fry finds that "the way the interaction works is going to affect how you do the data-mining portion. You can't really separate these things." [32]

At MIT's Humanities + Digital Visual Interpretations conference in 2010, Wattenberg, a trained mathematician who codeveloped the Many Eyes visualization platform at IBM, argued that the visualization explosion has had a curious effect on visual literacy. It now takes two forms, he argued: reading and creating. Reading is "not in bad shape," he claimed, but knowing whether a line chart, pie chart, or a bar chart is the suitable form for the visualization you are trying to make requires a certain amount of expertise. "One of the things I'm hoping is that people can teach each other, that was one of the hopes for Many Eyes."

Visual literacy, however, is not the only skill required for navigating the deluge of data. The list of facets underemphasized or ignored in the dominant language of visualization is long enough to present a worthy challenge to any research group. The perplexing part is that while the art and critical design world has been riffing off the yawning gaps in the infoviz view of existence, the mainstream practice continues to deploy a visual rhetoric that treats data as pure and judges questions of visual form only in terms of a universalist idea of usability. This seems all the more curious when one considers that the art of typography has long since passed through the perceived crisis that clarity of communication would be lost with the loss of the appearance of objectivity.

For visualization to fully mature requires a better cross-fertilization between the three contexts of visualization practice. The journalistic practice of making data accessible and legible has much to teach the sciences; the forms and critiques of artistic practices can inform, question, and reinvigorate the scientific and journalistic ends of the spectrum; and scientific visualization can provide the journalistic and artistic practices some fundamental lessons in rigor. ☒

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