Design and the Elastic Mind
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The Museum of Modern Art, New York
Contents

4
Foreword
Glenn D. Lowry

8
Preface
Barry Bergdoll

14
Design and the Elastic Mind
Paola Antonelli

28
Portfolio 1

46
Applied Curiosity
Hugh Aldersey-Williams

58
Portfolio 2

80
Nanotechnology:
Design in the Quantum Vernacular
Ted Sargent

98
Portfolio 3

120
Critical Visualization
Peter Hall

132
Portfolio 4

150
All Together Now!
Paola Antonelli

162
Portfolio 5

186
Index

189
Photograph Credits

190
Acknowledgments

191
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The Value of Visualization: Three Views

How, then, do we gauge the value of a visualization? Some maps, graphics, and diagrams seem to obfuscate or distort information or bewilder readers, while others have a profound effect on society, changing the course of government policy, scientific research, funding, and public opinion. This vast terrain of legibility—of work diagrams, 3-D mappings, charts, graphics, and browsers—presents something of a navigation problem in itself. Is it an art or a science? In an effort to take stock of the current state of the field, Jars van Wijk, a Dutch and computer science researcher at Eindhoven Technical University, the Netherlands, identifies three prevailing views of visualization: as a technology, as a science, and as an art.

As a technology, information visualization is theoretically aimed at developing new solutions and selecting the best ones, according to the criterion of usefulness. A benchmark of usefulness cited by van Wijk is one of the best-known information graphics in history, physician John Snow's 1854 map charting the location of eighty-three deaths from an outbreak of cholera in central London. Snow revealed that fatalities occurred in a cluster around the water pump at Broad Street, and argued against prevailing wisdom that cholera was an airborne disease—that the pump was contaminated and should be shut down. Both Robinson and Edward Tufte, the writer and publisher of four well-known books on information design, wax lyrical about this graphic, which arguably changed the course of epidemiology and information design. Its apparent efficiency is stunning.

Visualization as an empirical science can be dated to the 1987 publication of an influential paper, "Visualization in Scientific Computing," and is perhaps best characterized by Ware's textbook in Information Visualization, which uses psychological principles of human perception to build a set of rules governing the effective presentation of information. Ware provides a foundation for this view by first tackling the argument that something so arbitrary as the manipulation of images to represent concepts can ever be systematized, making a case for those conventions that are so entrenched in our brains that they have become hardwired.

As we shall see, both the technological and scientific approaches have some limitations. The third view, visualization as an art form, is given the least credibility by van Wijk, who characterizes its goals as the production of images that have "clear aesthetic value" and the pursuit of simple, elegant solutions that provide "intellectual and aesthetic satisfaction." Hilly, currently counters that this is not a line of defense that can "help us to convince our prospective users and sponsors." Such a dismissive account of art might be expected from the computer sciences, but outside the world of peer-reviewed papers and industry-backed research, the art of visualization can be seen
as an important critical counterpoint to the technological and scientific views. As a practice, it might even open up the field.

Technological Determinism? The canonicalization of Snow's map is a good starting point for examining the technological view, which places a great deal of emphasis on technique and the integrity, efficiency, and effectiveness of visualizations. Tuftt focuses on the notion of graphic integrity, frequently redrawing "deceptive" graphics to illustrate how to avoid distorting data in the representation. Revisiting Snow's map in Visual Explanations, he gives an intriguing lesson on how different time-series representations of Snow's data can be used to support a sensationalist version of the tale, which states that immediately following Snow's report the Broad Street pump handle was removed and the cholera outbreak subsided. As Tuftt reveals with his chart of the day-to-day chronology of deaths, the decline had begun before the handle was removed, most likely because Londoners were fleeing the area. Simply reorganizing the death rates by weekly intervals shows a sudden dramatic decline in death rates immediately following the handle's removal. By drawing attention to the possibility that the removal of the water pump was unrelated to the decline in cholera in the area, Tuftt seems to point to a problem in the very myth he is weaving around Snow's map. Is the graphic important because it is a technical paradigm of visual clarity and integrity, or because it is inextricably linked in our minds to the progress of epidemiology? Clearly, if Snow had been wrong about cholera and water, the map would not be a benchmark today. It certainly was not a technical innovation. Medical maps were common in the mid-1800s, and plotting deaths with dots was not a Snow invention. The backbone of the case for cholera as waterborne was Snow's detective work, as revealed in his prize-winning essay on the subject, to which the map was simply an accompaniment. To canonize the map through association is to risk invoking a kind of technological determinism, which suggests that Snow's map alone changed the way we view disease. If in the future Snow were proven to be wrong about cholera, one suspects his map would be quietly dropped from the "infotainment" canon.

A more recent example of putting undue emphasis on an information graphic can be found in the brouhaha that greeted the "hockey stick" graph showing temperature change over the last one thousand years. First published in the magazine Nature in 1998, the graph was included in the United Nations Intergovernmental Panel on Climate Change Third Assessment Report, in 2001, and wirt large in Al Gore's 2006 film, An Inconvenient Truth. It earned its nickname from its shape, depicting relatively level temperatures for nine hundred years followed by a sharp upturn in the last ninety years. Based on proxy evidence from tree rings, ice cores, coral records, historical records, and instrumental data, the graph points the finger squarely at human activity as the cause of global warming. Opponents of this argument contend, however, that the visualization was derived by using a particular statistical convention that favored production of the hockey stick form. By focusing on one decontextualized graphic, and side-stepping the overwhelming body of evidence linking human behavior with climate change, right-wing critics were able to muddy the waters of the argument. (Incidentally, this tactic effectively overshadowed other statistical conventions that achieved the same hockey stick shape.) A paper published in Nature in 2005, to cite one example, found using proxy evidence from stalagmites and lake sediments—the latter part of the twentieth century to be the warmest period in two thousand years—

Effective visualizations, a barometer of the technological view, is also an unreliable test of visualization. Consider a set of graphics produced by the New York Times to accompany a report in April 2002 on the vulnerability of New Orleans's flood-control system (pp. 126-27). A shaded relief map using a twenty-fold vertical exaggeration (albeit a tuftt no-no) effectively shows the changes in terrain around New Orleans, highlighting the critical role of the levees in protecting land (shaded red) at sea level or below. A cross section of the same area reveals the water levels of the Mississippi River and ocean in relation to the land. An aerial view shows the potential path of a "worst-case hurricane." And, finally, three flooding scenarios show the city in various states of submersion. Although the case for preventive measures was clearly and efficiently spelled out, the visualizations, like others published ahead of Hurricane Katrina, had little or no effect on policy. Its value is contingent on hindsight, as a vivid artifact of an institutional failure to heed well-documented warnings.

The Science of Visualization For Ben Fry, who worked at MIT and Harvard University's Broad Institute developing dynamic visualization tools for genomics researchers, the current oversight of Tuftt's approach is its failure to address situations in which data is complex and undergoing continuous change—a situation that often calls for the user to interact with the data. Fry finds certain advantages in the scientific empirical approach laid out by Ware, specifically as a strategic counter to the current impulsion to begin a visualization with the data itself. With vast data sets like the human genome, it becomes crucial for research teams to ask themselves, before the visualization stage, what they are trying to show. "Storytelling winds up being the crux of this," says Fry. "Most often I work with people coming from the engineering or science side, and there's a
Nothing's Easy for New Orleans Flood Control

Vulnerable Site for a Metropolis

The Worst-Case Hurricanes

Evaluating the risks of severe weather, scientists apply computer simulations to predict the effects of hurricanes and other natural disasters on coastal communities. These simulations help officials prepare emergency plans and allocate resources. The goal is to minimize the impact of such events on human life and property.

Floating Scenarios

The science of flood control is complex and ever-evolving. Engineers and scientists must continuously refine their models to account for changes in climate and population. In the wake of past disasters, there is a growing emphasis on proactive planning and adaptive management to ensure resilience in the face of future challenges.

cool = low, red = hot = high, He quickly realized a crucial cultural difference between the sciences and the trading floor when his client said, "How let me understand this? Being in the red is good?"

Fry's efforts to simplify and enhance standard genome representations with interactivity played a part in speeding the research behind two scientific papers—one that compared the catalogue of all known human genes with that of closely related species, with a view to eliminating aberrations and reducing the overall gene count (humans are estimated to have between twenty- and twenty-five thousand genes); and another aimed at simplifying how researchers identify genes in several species. The authors among the genes linked to diseases like cystic fibrosis or conditions like lactose intolerance. As Fry sees it, Ware's perception-based approach unpacks techniques that graphic designers might consider intuitive, such as a hierarchy of visual nodes for attracting the eye, with motion at the top followed by color, size, and shape. "Knowing things like that is important," says Fry, who observes that the first impulse of someone producing a visualization might be to want to match categories of data with colors. Color, however, is one of the first things the eye picks up. According to Fry, "You have to ask yourself whether the categories are the most interesting thing about this data, because if they're color-coded it's what's going to attract the most attention."

Visualization becomes a more slippery science when we get closer to ware's distinction between narrative and literal, or decontextualized and culturally learned conventions. The hardwired and culturally learned conventions, the hardwired, or "sensory" aspects of visualizations, he argues, derive their power from being well designed to stimulate the visual sensory system (such as pattern recognition). "Arbitrary" conventions derive their power from how well they are learned. Ware admits, however, that the two aspects are closely intertwined, and that the arbitrary between them is fuzzy. For any given example we must be careful to determine which aspects of the visual coding belong in each category. This is easier said than done. The use of red to symbolize danger, for example, might seem to be some hard-wired, but in ware's own example, an Asian student working on a system for visualizing a hard disk file system for file retrieval, the student noted that the word red means "danger" to him. In ware's own view, the example of the red light in the visual perception system is a good one, although it did not figure in Wasserman and Ware's considerations.

In an equities valuation tool he was creating in 1989 for the global finance firm Lehman Brothers, Fry's initially used a standard scientific heat map (black =
specialized, with submitted work often consisting of incremental progress. "It is not always clear that these incremental contributions have merit, and reviewers are getting more and more critical."  

The Art of "Viz" as Critical Practice
Perhaps false ground and incremental progress are indicators that a discipline has argued itself into a corner. An expensive science would surely allow for alternative theoretical approaches, just as a technological approach benefits from a meta-perspective. Here, van vliet's characterization of art as the production of self-rationalized aesthetic objects that bring intellectual delight merits a little rethinking. Instead, we align the art of visualization with the art of urban planning and architecture; we open up a potentially fruitful comparison. Both urban planners and architects aim at the production of spaces with clear aesthetic value, yet this is only part of the reason that their users and sponsors are convinced, to use van vliet's wording. Their services are enlisted in order to take part in a process, to "reformulate what already exists," as landscape architect James Corner argues in his essay "The Agency of Mapping": "what already exists is more than just the physical attributes of a terrain (topography, rivers, roads, buildings) but includes also the various hidden forces that underlie the workings of a given place."  

Among these, Corner lists several forces indicated in the exploration of the canonic visualizations above historical events, local stories, economic and legislative conditions, and political interests. If we follow Corner's lead and imagine the art of visualization as a creative process concerned with not just the finished artifact but the framing, gathering, connecting, and arraying of data, then we can also imagine it as a critical practices and, in reformulating a terrain of knowledge as well as experimenting with new and alternative forms.  

Drawing from Gilles Deleuze and Félix Guattari, Corner uses the notion of the rhizome and the burrow for their nonhierarchical and expansive way of connecting points from the middle rather than the beginning or end. Corner finds a paradigm of such "rhizomatic" mapping in a project also lauded by Tufts Charles Joseph Minard's narrative diagram of Napoleon's ill-fated march on Russia during the winter of 1812-13. The map elegantly brings together facts such as the diminishing size of the French army, its movement, the terrain, locations and times of battles, weather, and the passage of time in one predigital "datacape," printed in 1855. More than telling a story, writes Corner, "the map conditions how places on the land have come to exist in new relationships precisely through the vector of an event." He qualifies his praise by noting that the Minard map is a "closed system" that invites only a linear read. According to Corner, a rhizomatic map would be more multivariat and open: "Indeed such a map might not "represent" any one thing at all rather it might simply array a complex combination of things that provides a framework for many different uses."  

Such rhetoric risks encouraging data-driven rather than story-driven visualizations. But it also provides for radical experimentation in the sort practiced by Nastali Jeremjenko, a design engineer and "techno-architect," in Jeremjenko's OneTrees project, for example, reinvisions of the city's trees as environmental sensors. In 2003 she and Two San Francisco-based nonprofit groups planted cloned pairs of Paradox trees around the Bay Area in order to register the different social and environmental conditions in the various locations. A map of the OneTrees locations, produced with experimental architecture practice Terrasvart, juxtaposes a U.S. Geological Survey landsat. 7 aerial image of the Bay Area with "lay knowledge," such as the locations of bike trails, common hawk flight paths, and the habitat of the endemic song sparrow. The implicit critique is of culturally entrenched hierarchies of information, which, for example, prioritize satellite views and overlook institutional knowledge over the knowledge of ordinary people.  

Jeremjenko's provocations attempt to call into question the legitimacy of the entire barrage of scientific procedures, presenting disruptive juxtapositions and very unscientific instruments (such as trees, toy robotic dogs). A more conventional project—though a potentially more disruptive one—was begun by architect and artist Laura Kurgan at the Columbia University Spatial Information Design Lab in 2008. Working with the Justice Mapping Center, Kurgan and Columbia graduate students have been mapping data from the criminal justice system. They have been looking not at where crimes were committed, as is common, but at the home addresses of the people incarcerated as a result of the crimes. Citing the term "million dollar blocks," the research collaborative that put their maps together estimated the disproportionate number of prisoners come from a very few neighborhoods in the country's largest cities, to the extent that some states are spending in excess of a million dollars a year to incarcerate the residents of single city blocks. A description of the project, named Architecture and Justice, concludes with a discussion of implications: "guided by the maps of Million Dollar Blocks, urban planners, designers, and policy makers can identify those areas in our cities where, without acknowledging it, we have allowed the criminal justice system to replace and displace a whole host of other public institutions and civic infrastructures...what if we sought to undo this shift, to refocus public spending on community infrastructures that are the real foundation of everyday safety, rather than criminal justice institutions of prison migration?"  

Potentially, architecture and justice does offer a new kind of benchmark for critical visualization.
It utilizes many of the principles espoused by Tuft and Ware, efficiently and effectively conveying a clear, succinct story. As a critical mapping, it challenges current thinking by reformulating what already exists. It uses the master’s tools—the aerial view, the crime map, and crime data—to reveal a street-level view of the city not a crime epidemic but a view of civic infrastructure that necessitates the inclusion of a distant exlosure—prisons and jails.

In his first book, Tuft introduced a guideline with which to judge statistical representations that he called the "tell factor": the ratio of the size of an effect shown in the visualization to the size of the effect in the data. But as the Architecture and Justice project reminds us, the data itself is not neutral. It is collected for a reason, and presented and processed for specific purposes. In other words, "There is no such thing as raw data." Cartography historian Denis Cosgrove once advised attendees at a mapping conference to "always make maps always question maps." The same should be said of information visualization.

Laura Karpen, Eric Cadora, David Ranfort, and Sarah Williams, Spatial Information Design Lab, Graduate School of Architecture, Planning and Preservation, Columbia University, Architecture and Justice from the Millet Dollar Violence project, 2016. ESRI Model (Geographic Information System) software.
Edward Marcotte (American, born 1967) and Alex Adal (American, born 1976)
Center for Systems and Synthetic Biology (est. 2003),
The University of Texas at Austin (USA, est. 1883)
Protein Homology Graph 2004
bioinformatics.icb.utexas.edu/cgi/gallery/Large Graph Layout (LGL) software

The sequencing of a genome is central to molecular biologists' understanding of the basic makeup of every living organism. The goal is to appreciate how this information can be combined to constitute a uniquely characteristic being, whether a human, a plant, an animal, a bacterium, or a virus. The calculus necessary to compile and interpret this enormous quantity of data can be supported only by ever-increasing computer capabilities, which become much more effective when coupled with good visualization design. The Protein Homology Graph is one example of this. To measure homology—the similarities between genes in different organisms that are so strong they point to a common evolutionary ancestor—Edward Marcotte and Alex Adal compared the sequences of 140,000 known genes; after nearly 21 billion comparisons were performed, 1.5 million homologies were established. Marcotte and Adal then used software to present this data as an immense web of relationships in which each point represents a single gene and genes in the same family are connected by lines. Genes that share homologies are placed near each other, creating constellations of points. Larger groupings designate larger gene families.

When it comes to visualizing vast amounts of data, the Internet is an irresistible subject of study. As it has grown, so has the challenge of accurate measurement and modeling of its topology. Numerous Internet maps exist, some strictly functional and diagnostic (such as the Internet Mapping Project initiated by Diet Laha in 1998), others more “atmospheric,” meant as dynamic snapshots of a universe in continuous expansion. Young Hyun (American, born 1973)
Cooperative Association for Internet Data Analysis, San Diego
Supercomputer Center (est. 1997), University of California, San Diego (USA, est. 1960)
Vaurus graph visualization tool 2001-02
Java and Java3D software

In mathematics and computer science, a graph is a set of points or nodes connected by lines that can be considered equivalent in either direction (from A to B equals from B to A). In a directed graph, or digraph, each direction is instead considered distinct and called a direct arc or link. Digraph analysis has a wide set of applications as a deductive tool, especially in the social sciences, where points often stand for individuals and arcs as relationships between them. Vaurus clearly illustrates the results of a digraph analysis for particularly large amounts of data, optimally with a few hundred thousand nodes.

Applied to the Internet, these visualizations allow us to appreciate the complex world of Internet connectivity. By sending probes to several hundred thousand IP addresses every day, researchers can actively measure both topology and average round-trip time (RTT)—the time interval between the moment a probe is sent and the moment a response is received—across a wide cross-section of the Internet. The graph shown here depicts a single cycle of measurements, originating on February 25, 2003. Different colors identify each link's RTT, with cyan being the fastest and red being the slowest (and likely showing poor or problematic connection;)
Lila Straussfield (American, born 1964) and James Nick Sears (American, born 1980)
Pentagram (UK and USA, est. 1972)
"Rewiring the Spy" illustrations/applet for the New York Times Magazine
December 3, 2006
jamestsears.com/applets/spies
Illustrator, Acrobat, and Processing software

Understanding connections in the vast landscape of information often requires a new way of looking. On December 3, 2006, the lead story for the New York Times Magazine, penned by Clive Thompson, discussed the challenge of analyzing and interpreting information about terrorism and coordinating its exchange among various intelligence organizations. For the article, information designers Lila Straussfield and James Nick Sears programmed an applet in which keywords—in this case names of terrorists or terrorist events—are connected by spring-like links, which become stronger and more animated with the frequency of the word's interconnection in a database. The resulting visualizations can be rotated in three dimensions to reveal new viewpoints. While for the purpose of the story the designers used the Internet as the source database, the model could also be adapted by government agencies using their own classified databases.

Aaron Roblin (American, born 1982)
Department of Design and Media Arts, School of the Arts and Architecture, University of California, Los Angeles (USA, est. 1986)
Flight Patterns 2006
users.design.ucla.edu/~roblin/work/fee
Processing, Maya, and After Effects software

Celestial Mechanics is a project launched in 2005, visualizes the pressing patterns of the myriad flying objects-satellites, aircraft, balloons-that are at any time hovering around the earth. The work, which combines science, statistics, and art, was meant to be shown in a planetarium. Flight Patterns is a flight corollary to the project, one which also shows the informative and aesthetic potential of this type of visualization. As Aaron Roblin explains it, "Aircraft data collected by the Federal Aviation Administration was parsed and plotted to create animations of North American travel paths. Through visual traces of airplanes, one gets an eye-popping sense of the changing dynamics of traffic in the skies above, as well as insight into the geographies and substructures guiding the network."
Jonathan Harris (American, born 1979) ofumber 27
(USA, est. 2002)
Sep Khour (American, born 1977)
We Feel Fine: An Exploration of Human Emotion
In Six Movements 2005
wefeelfine.org
Perl, MySQL, Java, PHP, and Processing software
People often use the Internet to express and share emotions
and to connect with others. The website We Feel Fine has been
harvesting human feelings from blogs since 2005. Every few
minutes, the system searches the world's newly posted blog
texts for occurrences of the phrases "I feel" and "I am
feeling," and then captures as much of the full
sentence and tags the feeling expressed in that sentence,
including the age, gender, and geographical
distribution of the entry as well as the local weather conditions
that day the sentence was written, resulting in a database
of several million feelings (increasing by about fifteen to
twenty thousand new feelings each day). The site's designers
have experimented with six visualization systems, which they
label "movements." Each one has its own efficacy and beauty.

Colin Levin (American, born 1972) of Carnegie Mellon
University (USA, est. 1990)
Ksenia Neigan (American, born 1972) of Google (USA, est. 1998)
Jonathan feinberg (American, born 1972) of IBM Research
(USA, est. 1714)
The Dumpster (Valentine's Day) 2006
twitter.com/commissions/dumpster
Java software
The pain of a relationship ending mixed with the angst of
disappearance is requisite material for pop songs, stories,
and magazines. Building on the idea that the web holds an
endless repository of humanity, The Dumpster, an interactive visualization
site and sink, uses real-life examples from the blogs of
American teenagers drawn from the Internet to provide
a snapshot into the romantic lives of teens in 2006. The site,
launched on Valentine's Day, 2006, uses postings extractively
drawn from millions of blogs in which the phrases "broke up" or
"dumped me" appeared.

W. Bradford Paley (American, born 1918)
Digital Image Design Incorporated (USA, est. 1994)
TextArc 2005
www.textarc.org
Java software
One of the main characteristics of visualization design is its
capacity to use beauty and elegance as a path to clarity and analysis. W. Bradford Paley is one of the foremost experts in
the communication of great amounts of data and his renowned
tool TextArc is used to conduct structural analysis of
text. Every line of text from a book (in this case, Alice in
Wonderland) is plotted in a circle. TextArc's function is to
provide an analysis of the text unencumbered by literal interpretation. As Paley explains, it is "a tool designed to help people
discover patterns and concepts in any text by leveraging a
powerful, underused resource: human visual processing.
TextArc exposes the nature and style of a document content....It taps into our pre-attentive ability to scan for
brighter (here, more frequent) words, compare sizes, and
the eye read those words....The eye and mind is all for ideas,
then follow the ideas down to where and how they happen in
text." TextArc has several features and visualization options, one of which is shown here.
Designed by Casey Reas and Dan Fry, formerly of the Aesthetics + Computation Group at the MIT Media Lab, Processing is an open source "programming language and integrated development environment (IDE) built for the electronic arts and visual design communities" based on Java language. Simple enough to be picked up by nonprogrammers and yet sophisticated enough to be used for high-level design, architecture, visualization, and animation projects, Processing has already had a significant impact as a powerful and inspiring design tool. Presented here are only a few of the many new experiments that Processing has sparked.

Demetri Tyler (American, born 1973)
Interactive Telecommunications Program (est. 1979),
Tisch School of the Arts, New York University (usa, est. 1965)
Hypothetical Drawings about the End of the World 2006
www.demetrietyler.com/hypotheticaldrawings
Processing software

Demetri Tyler's Hypothetical drawings about the End of the World are large-format social landscapes inspired by online conversations that contain argumentative and divisive language. These exchanges are found all over the web by using a Bayesian filter similar to that employed to identify spam e-mails. The images are created using a set of algorithms based on the designer's drawings. The purpose of the work, in the designer's words, is to investigate "the idea that as communities continue to become defined more by common ideologies than common geographies and as ideological contrasts become further exaggerated as a result, we become less able to identify with each other...In other words, the more we choose to spend our time conversing with people who are interested (or worried) about exactly the same things that we are, in relatively tiny but globally dispersed communities, the more we feel like the rest of the world is just plain crazy."
For those who have dreamed of being able to see other people’s thoughts, Martin Wattenberg and Marek Walczak’s Machine—a thinking machine—against which you can play a game of checkers, as a good starting game. In a game against Machine, the machine’s evolving thought process becomes visible on the board before you: all of the computer’s possible future moves are sketched on screen as it plays. Wattenberg and Walczak explain, “A map is created from the traces of literally thousands of potential futures as the program tries to decide its best move.” These traces reveal the invisible lines of force—the power of thought—that emerge when the very act of thinking is made visible.

Ben Fry (American, born 1975) Distellianap (Pac-Man) 2004 BenFry.com/distellianap Processing software

Ben Fry’s Distellianap is a visualization of the code and data found in a Pac-Man Atari 2600 cartridge. Fry began “showing” code with his Dismo project of 2003, in which he rendered graphically both the executable code of some early computer games and the data sections that are used to store images or game scenarios, highlighting not only the mathematical instructions, but also the commands that would direct jumps to different locations in the program. In Distellianap, Fry explains, the code is listed as “columns of assembly language, most of it either math or conditional statements (if x is true, go to y).” Each time there is a “go to” instruction, a curve is drawn from that point to its destination. When a byte of data (as opposed to code) is found in the cartridge, it is shown as an orange row a solid block for a “1” or a dot for a “0.” With both Dismo and Distellianap, Fry’s intent is not to analyze the software but rather to celebrate its elegance with an equally graceful portrait of it.
When comparing the genomes—and thus the exact order of the three billion adenine (A), cytosine (C), guanine (G), and thymine (T) letters—of two different organisms, single letter changes can be found every few thousand letters and are at times very significant. These variations are called single nucleotide polymorphisms, or SNPs, and are often found in consecutive sets that are easily rendered in blocks. Ben Fry's isometric blocks image represents blocks in the genetic profile of three different populations: the top row shows a group of humans from Africa; the middle row depicts groups with Western European ancestry; and the bottom row represents a group of Japanese and Han Chinese individuals. "The vertical height of each column is proportional to the number of people in each group that has one or another SNP. Some SNP clusters are much larger than others," Fry explains. "And the colors in each row depict one of only two distinct possible for each single letter change, the most common in dark red and the less common in a paler color." As in many of Fry's other visualization experiments, diagrams are used to provide both an instinctive gauge and a progressive in-depth analysis of a given statistical topic.
The mapping and tagging of information rely on the increasing capacity and decreasing size of computer chips and other data reservoirs. The High Capacity Color Barcode, developed by Microsoft Research engineering director Gavin Jancke, is a new barcode system capable of holding much more retrievable information than current UPC codes. It is composed of triangles of eight different colors arranged from left to right. The new barcode will be useful not only to vendors but also to consumers, who will be able to scan the barcode and obtain such information as product ratings, promotions, and pricing.

Anab Jain (Indian, born 1976) and Alex Taylor (British, born 1969)
Microsoft Research Cambridge (UK, est. 1996)
Objects Incorporated, RFID and Body Readers
Concept, 2003–ongoing

Anab Jain and Alex Taylor imagine a future in which radio-frequency identification (RFID) tagging will be found everywhere—objects, plants, animals, even people wear RFID tags. People may carry around sensors to explore the RFID world landscape. In this fictional project, people will be able to access data and redesign the RFID at will, both with actual acquired information that will add a new layer to reality and a new narrative, fantastic ones.

Riquel Mora (Spanish, born 1974)
Design Interactions Department (est. 1995),
Royal College of Art (UK, est. 1837)

Smart Tapes
paper and adhesive tape, 2 x 3 7/8 x 5 (10 cm)

Memory Envelope
paper and adhesive tape, 8 5/8 x 4 3/8 x 22 (11 cm)

Relying on the latest developments in organic electronics—which studies conductive polymers as opposed to the traditional non-carbon-based copper and silicon—and on methods of using nanotechnology to print dynamic electronics, Riquel Mora explores ways to create processors, displays, and batteries on surfaces as flat and flexible as paper. "Objects will wear technology instead of carrying it inside," explains Mora. "The technology will become their skin." In Smart Tapes, a range of electronic components (such as processors, batteries, speakers, and displays) are printed on adhesive tapes, allowing a user to "enhance an existing product, make it smart, or create a new one." Memory Envelopes and Memory Probes are mailing envelopes and add-ons that record and display their journey, offering their own narrative memory.
Raúl Cárdenes-Osuna (Mexican, born 1969)

Torodal (Mexico, est. 1995)

LRPT (La Región de los Pantalones Transfronterizos)

Prototype, 2005–06

Global positioning system, MaxScript, and 3d MAX software

"LRPT is a document of urban ethnography that proposes a new form of cartography for the transborder region between Mexico and the United States," explain the members of Torodal, an architecture and art collective based in Tijuana, Mexico. The designer chose five people settled on either side of the border and developed different "transborder clothes" for each of them. A GPS tracking system was integrated into the garments, which stain from Torodal’s Toro Vestimenta clothing line that addresses transborder identity and interaction. For five days, as the participants moved through the Tijuana-San Diego region, Torodal tracked their locations, velocities, and fuel consumption. The results from the collected data track the participants’ migration on a topographic urban/natural structure where the geographic and political boundaries are left unmarked.

Real Time Rome 2006

Processing software and cell phone triangulation tracking system

Real Time Rome synthesizes data from communications and transportation networks—for instance GPS information from mobile phones and from public transportation and taxis—into diagrams that help decipher patterns of daily life in Rome. By overlaying mobility information on the geographic references of a city, Real Time Rome reveals the relationships between fixed and fluid urban elements. According to the designers, "These real-time maps expose the dynamics of the contemporary city as urban systems coalesce: traces of information and communication networks, movement patterns of people and transportation systems, and spatial and social usage of streets and neighborhoods." Such maps also demonstrate how neighborhoods are used in the course of a day, how the distribution of buses and taxis correlates with densities of people, how different social groups, such as tourists and residents, inhabit the city, and how urban dynamics are affected by special events. The first map combines different datasets—real-time cell phone data, GPS data, and raster images—in a single interface. The second image shows the movements of mobile phone users during Madonna’s concert in Rome on August 6, 2006.
Ex Officio
Peter Horton
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195

Exhibitions, and Randolph Black, Associate Coordinator of Exhibitions, for working out the complicated administrative details: Raimon Borkz Bancay, Director, Collection Management and Exhibition Strategies, Susan Haney, Registrar, Exhibitions, Allison Hewett, Assistant Registrar, Exhibitions, and Ellic Burke, Project Registrar, for keeping track of the diverse loan terms and Elsie Sparaco, Manager, Collection and Exhibition Technologies, and Jan Eckert, Assistant, Collection and Exhibition Technologies, for helping us keep all our information in order. I would also like to extend thanks to Lindauchsia, and Roger Griffith, Associate Sculpture Conservation, for caring for all the objects.

The installation was indeed a challenge even for our heroic Department of Exhibition Design and Production, Jerry Hauner, Director, and Dana Hun, Production Manager, designed the installation, and their incomparable crew built it, as usual, to perfection. My gratitude goes to them and to Charlie Kalinoski, Media Services Manager, A/V, and to Patsy Director, Technology Services, and his whole team, who performed miracles in order to ensure that the technology worked smoothly and effectively. The exhibition also lives on the web, thanks to the magick touch of Alarea Burna, Betta, Creative Director, Digital Media, and Shannon Darrugh, Senior Media Developer, Digital Media. I also thank Tom Bishop, Director, Exhibition Fundraising Mary Hannah, Associate Director, Exhibition Fundraising and Lauren Stialias, Senior Associate, Exhibition Fundraising, for their strategic development and Membership, for securing the necessary funding, not a negligible feat. I thank also, Executive Director, and Stacie Sapa, Manager of Communications, for brilliantly condensing the whole show to a text that is irrepressibly interesting, and Peter Foley, Director of Marketing, for promoting it.

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Design and the Elastic Mind explores the restless and restless curiosity of human beings and praises design as an expression of creativity and an affirmation of life. For this reason, I would dedicate this book and this show to the late Herbert Maciari, who certainly knew what I am talking about.

Paola Antonelli
Senior Curator, Department of Architecture and Design

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Over the past twenty-five years, in tandem with the introduction of the personal computer, the Internet, and wireless technology, we have experienced dramatic changes in our relationships with time, space, the physical nature of objects, and our own essence as individuals. Design and the Elastic Mind focuses on the responses of designers to the numerous advances in technology, science, and social mores that have characterized the last quarter-century and presents their projects that convert these developments into useful concepts and objects—from nanodevices to full-size vehicles, home appliances to building facades, pragmatic solutions to provocations. Designed by Irma Boom, this book features essays by Paola Antonelli, senior curator of architecture and design at The Museum of Modern Art; design critic and historian Hugh Aldersey-Williams; visualization expert Peter Hall; and nanophysicist Ted Crim.