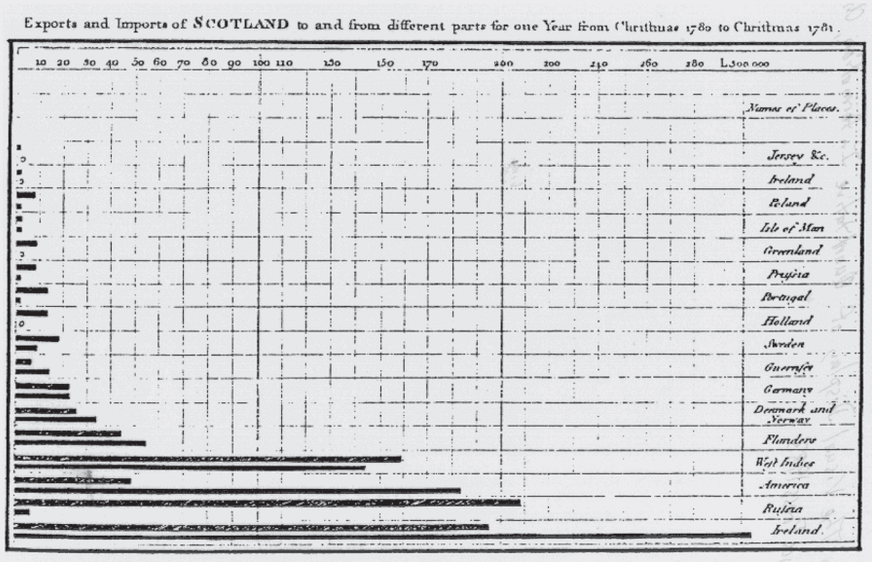


Here is the first known instance of a bar chart, taken from William Playfair's *Commercial and Political Atlas*, published in 1876. A bar chart uses the proportions of marks to encode quantities. Multiple values are plotted against a common axis, and optical comparisons create relationships. Here, Playfair describes the value of his invention:

> Information, that is imperfectly acquired, is generally as imperfectly retained; and a man who has carefully investigated a printed table, finds, when done, that he has only a very faint and partial idea of what he has read; and that like a figure imprinted on sand, is soon totally erased and defaced. The amount of mercantile transactions in money, and of profit or loss, are capable of being easily represented in drawing, as any part of space, or as the face of a country; though, till now, it has not been attempted. Upon that principle these Charts were made; and while they give a simple and distinct idea, they are as near perfect accuracy as is anyway useful.[1]

Bruno Latour begins his essay "Drawing Things Together" by describing another drawing on the beach. We are asked to imagine La Pérouse travelling through the Pacific for Louis

XVI. He stands on the beach of an island or peninsula that he calls Sakhalin. The natives inscribe for him a map in the sand, which he copies down into his notebook. La Pérouse is surprised to learn that Sakhalin's residents understand geography quite well. What Latour asks us to consider here is not the power of the map *per se*, but the power of the notebook. While the waves will wash away the inscribed map within a few hours, the notebook (and all of the technologies of proportion, projection, and bookbinding that transcribing a map in a notebook entails) allows this map to be transported. And therein lies its true power. Latour calls this the "mobile immutable."[2]

Ideas about the earth's surface can be fixed on a (loose or exacting) grid, put into relationship with another, and, finally, moved from the site of inscription to another location. The bar chart is a link in this chain of technologies,[3] allowing two different pieces of information to be superimposed on a single axis.

Latour points out that the history of scientific discovery is almost always simultaneously a history of new imaging technology. Science depends fundamentally on evidence. That is, it depends on mark-making, developing new dyes, new methods of fixing images, measuring, and recording. And reciprocally, the forms of representation that gain wide acceptance are those that support the extraction of new resources: "We do not find all explanations in terms of inscription equally convincing, but only those that help us to understand how the mobilization and mustering of new resources is achieved."[4]

What's more, Latour suggests that those who traffic in representations and paperwork—*the mere secondary images of things, the indexes of things*—are, despite their mild-mannered profiles, the most powerful people in the world:

> More precisely we should be able to explain, with the concept and empirical knowledge of these centers of calculation, how insignificant people working only with papers and signs become the most powerful of all. Papers andsigns are incredibly weak and fragile. This is why explaining anything with them seemed so ludicrous at first. La Pérouse's map is not the Pacific, anymore than Watt's drawings and patents are the engines, or the bankers'

> exchange rates are the economies, or the theorems of topology are "the real world." This is precisely the paradox. By working on papers alone, on fragile inscriptions which are immensely less than the things from which they are extracted, it is still possible to dominate all things, and all people…It is not only because they look exclusively at maps, account books, drawings, legal texts and files, that cartographers, merchants, engineers, jurists, and civil servants get the edge on all the others. It is because all these inscriptions can be superimposed, reshuffled, recombined, and summarized, and that totally new phenomena emerge, hidden from the other people from whom all these inscriptions have been exacted.[5]

The ability to take the *extracted* mark and superimpose it *with others* is where the power of inscription hits its multiplier. Unexpected power lies in the world of clerical administration, in the filing cabinet, the database.

INDEXING

Last year, the *Harvard Business Review* declared data scientist to be the "sexiest job of the 21st century."[6] Indeed, if you scan an article from the business or technology section of a major newspaper this year, you're as likely as not to encounter an article announcing the rise of Big Data and the data scientist, a new profession that makes sense of that data using the unprecedented tracking and counting abilities of our digital interactions to inform decision-making. This character uses statistics to improve and predict everything from personal activity to political results and corporate behaviour. This figure holds the same kind of symbolic power over our present age as "the engineer" held over the modernists.

Latour offers us a helpful way to think about the source of Big Data's power—not just in the increased ability to acquire marks, but specifically in their increased portability. This may seem nearly self-evident, but it's worth remembering that quantification is useful not because it converts the world into numbers *per se*, but because those numbers are the medium that allows us to seamlessly compare one thing to another. While the data scientist depends on those who produce the marks; the proper field of this character is in the filing cabinet, not the survey.

The fundamental quality of a commodity is that it is fungible, that is, it can stand in for any of its kind and be converted into any other thing. The market treats its instances as equivalent, or nearly so, with no regard to who produced them: "From the taste of wheat it is not possible to tell who produced it, a Russian serf, a French peasant, or an English capitalist."[7] That interchangeability is achieved most fully when the commodity is transformed into another via money, hence the equation: C–M–C (Commodity-Money-Commodity). It is this transferability that is the essence of capitalism.

Quantification and commodification go hand in hand in methods of creating equivalency and exchange. And both depend on visual technologies of inscription. It is litte surprise that the majority of visualization innovations are also part of the history of finance and economics.

Inscription allows anything to be transported, projected on the same axis as another. Of course, there are certain rules. Not every piece of data can be usefully compared to any other. This is what the data scientist purports to offer: the expertise necessary to convert far-flung bits of data and project them into a single space, that is, to make this information "actionable."

We are told that the rise of Big Data is in large part due to the new floods of information available to us. And, as more and more human activity takes place in the digital domain, it becomes easier and easier to harvest quantitative information automatically. Keystrokes, mouse clicks, and minutes spent become automatically tracked; portable sensors proliferate; computer vision improves—the digital world voraciously consumes more and more of the analog. At data visualization conferences, data artists talk about information as a passive medium; not a technique, but a kind of raw natural resource, like stone in a quarry. It becomes tempting to imagine that qualitative description is just a matter of resolution and bandwidth. As the number of simultaneously holdable points of data grows, we get closer to an exact portrait of the world.

But, in fact, the opposite impulse is just as true: as streams

of data grow in number and in complexity, a second urge arises: the desire to decrease data's resolution and its dimensionality. Experts produce (and consumers pay a lot for) *indices* of data, instead of the data itself. This is what the data scientist is hired to do.

At this point, it's worth mentioning that in the last few years I've found some of my work lumped into this field of data visualization. The examples that follow are drawn from recent projects. A little over a year ago, I was asked to help map and visualize the American Human Development Index, a domestic index adapted from an international measure called the Human Development Index (HDI).

The HDI is a single number from 0 to 10 created in 1990 by the Pakistani economist Mahbub ul Haq, and published by the United Nations Development Programme.[8] The number functions as a kind of report card for the world. At regular intervals countries are assessed and given an HDI score. The HDI was designed "to shift the focus of development economics from national income accounting to people-centered policies." The HDI is a summary index that looks at Life Expectancy at birth, median income, and literacy, and is designed to supplant GDP as the measure of a country's "development." Though the index follows directly from the Nobel laureate Amartya Sen's work to distinguish economic well-being from human well-being, the two famously disagreed on the initial design of the HDI. Sen favoured a multiplicity of indicators to reflect the rich variance of the world, but Haq (successfully) argued that a simple composite measure of human development was absolutely necessary to convince the public, as well as academic and policy audiences. Sen eventually agreed with this strategy, conceding that a single number would have a much better chance of supplanting GDP as the primary indicator of a country's "development." The goal of the index is to shape policy discussion, and it has been remarkably successful in its short life thus far.

Of course, indexing is a one-way transformation, a "lossy"

form of compression: it turns a myriad of indicators into one, and the factored indicators cannot be determined from the index. This compression gives the HDI both its fragility and its power. The simplicity of the number makes it immediately graspable and thus politically expedient. Are things getting better or worse? Going up or down? The goal of such an index is to make the stream of data we now live in actionable. Thus, if policy-makers don't have time to evaluate numerous indicators, they can still understand the trajectory of a place at a glance.

Similar indices are proliferating in the commercial sphere. Everything from home prices to the Dow Jones, the livability of a city, or its suitability for dating comes with an index. These indices are published or distributed at various price points and with varying levels of transparency. The HDI employs a self-consciously transparent methodology. While you cannot instantly convert the index into its sub-indices, they are readily published alongside the HDI. Meanwhile, many commercial indices hold their sub-indices as trade secrets, even guarding their calculation methods internally. The proof of their veracity is, I suppose, their effectiveness over time.

Take for example the mapping software company Environmental Systems Research Institute (ESRI).[9] It traffics in the production of mapping software, but also the collection and distribution of massive sets of geographically located data. Most industries that deal with the earth's surface (which is to say, most industries) use ESRI's products in some capacity, whether for siting oil pipelines, managing forests, or producing traffic counts.

Part of the business of a group like ESRI is to provide data to organizations and corporations that are making decisions about where to locate things in *the future*, for instance where to open a Best Buy or close a Wawa. For a business hoping to locate or move something, the product they are buying is not the location of the thing (as you might consume on your smartphone) but the location of *you*, and just as importantly, some information about the *kind of person you are*: your stated

and revealed preferences, your habits and associations.

To this end, people are produced and filtered into demographic categories. ESRI is not alone in this type of demographic market segmentation. Product like ESRI's "Tapestry," Experian's MOSAIC, or Claritas' PRIZM all function in much the same way. Tapestry abstracts individual households into 66 demographic categories, each with a ranked number, and an easy-to-remember, sometimes questionable name, like "Social Security Set," or:

> Rank 08 "Laptops and Lattes": With no home-ownership or child-rearing responsibilities, residents of Laptops and Lattes neighborhoods enjoy single life in the big city. Most households are singles who live alone or with a roommate. The average household size remains constant at 1.8. The median age is 38.7 years. Although most of the population is white, Asians represent 10.4 percent of the total population (almost two-and-one-half times the national level).[10]

These segments are further consolidated into LifeMode and Urbanization Groups, and this data is offered to customers in a variety of pricings and packages.

So, the middleman between the surveyor and the decision-maker has a unique responsibility: to choose the right forms to superimpose, to apply the right transformations and to frame the right patterns to produce a mobile immutable that is, above all, actionable. This chain of transformations provides the basis of knowledge about whether or not a site is desirable. Do enough "laptops and lattes" live within a five-minute drive time? Are they spending enough of their disposable income on a comparable good?

It is easy to see how this conception literally moves from a physical reality to a set of abstractions, is made actionable, and results in a series of decisions that have physically real consequences. Let me suggest the formulation, P–A–P (Physical-Abstraction-Physical). For example, the conceptual category "Laptops and Lattes" registers a series of understandings about the character of a place which lead to the construction of a new place. "Laptops and Lattes" demands an actual place where you can buy a latte and plug in your laptop. The map of the world becomes the world.

Just as capitalism, Marx suggests, turns C–M–C on its head to get M–C–M, where the Commodity becomes just a station on the way for Money to turn itself into more Money, today's culture of big data turns P–A–P into A–P–A: Abstraction begets more abstraction, Big Data begets more data, but robs us of some surplus value along the way. But, just as we cannot reasonably "turn our back" on capitalism, neither can we turn our back on "quantification."[12]

YOU MIGHT NOT BE INTERESTED IN DATA, BUT DATA IS INTERESTED IN YOU

In his essay "Sampling and the Politics of Representation in the US Census 2000," the political geographer Matthew Hannah introduces a provocative concept: Statistical Citizenship. He argues that filling out a census form has more concrete consequences for your experience of government than voting. Your participation (or non-participation) in the census might determine your congressional district's shape, the eligibility point for affordable housing in your city, the availability of funding for after-school programming at your school district, the distribution of Federal Block Grants to your block. He presents a conundrum: minorities and those without the required paperwork for proof of residency have historically grounded motives to distrust government, and they have a reasonable interest in "hiding" from the census, or at the least an understandable justification for ambivalence and indifference. And yet, being made visible is in fact likely to have at least one set of direct and concrete positive consequences.[13]

If this is true of political representation, it is even more true of your representation as a row in an urban planner's, real estate marketer's, or demographer's MySQL database. The challenge we are left with as individuals is not whether or not we want to appear as abstractions, but how. Does refusing to join Facebook or participate in market research effectively allow us to "opt out," or is it the statistical equivalent of merely refusing to vote?

As designers and statisticians, we are challenged to produce better models, abstractions, segmentations, and indexing technologies, and to critically shape the ways these open or close possibilities. Clearly there are better and worse forms of abstraction, generalization, and grouping. Is there such a thing as a utopian self-monitoring? Utopian data-viz?

Part of the supposed power of the market is its ungraspability. In the ideological battle between the planned and the unplanned economy, the advantage of the "free" market is that its operation is unimageable. It has no central vantage point; its mechanism is the invisible hand. And yet, every market agent's goal is to approach, asymptotically, the ideal of perfect information—the "overview."

Here is one such "central vantage point:" the control chamber of CYBERSYN, the experimental information system that Salvador Allende installed to run the Chilean economy after being elected to power in 1970. It consisted of a network of linked TELEX Machines that continuously fed information from key industries to a series of hubs for monitoring and decision-making, simplifying Chile's economy into seven indices, visually represented on daily slides.[14]

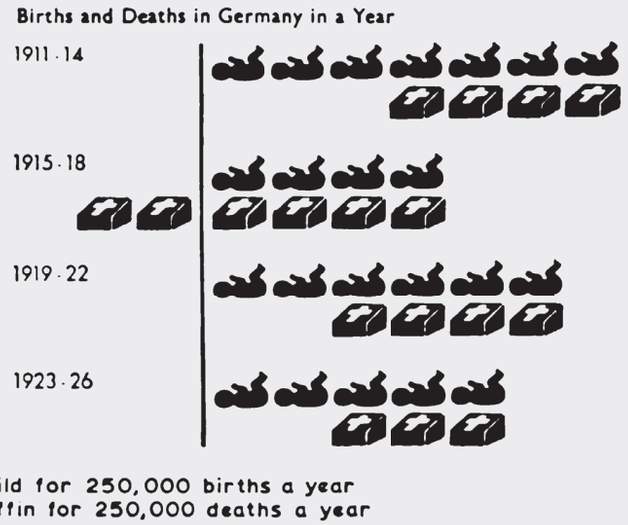
The system was intended to be a democratic, technical solution to the problems of a planned economy. Nested feedback loops operated at multiple levels, from the individual worker to the entire state. The CYBERSYN operations room was designed to support conversations between non-experts. Seven swivel chairs were arranged in a circle to facilitate democratic voting and discussion. The interface was intentionally limited to a few large buttons that controlled slide projectors. The project was developed from the thinking of Stafford Beer and the cybernetics movement, which imagined that the future of the world would hinge on the ability of systems to self-regulate and create feedback loops.

There's no evidence that it worked or didn't work, and the operations room was destroyed under Pinochet. But the image is instantly compelling. Today it resembles nothing so much as a Bloomberg terminal.[15] Do big pictures increase or decrease our autonomy and agency within a system? Can a central vantage point be made available to all?

Another central vantage point worth revisiting is Otto and Marie Neurath's Gesellschafts und Wirtschaftsmuseum in Vienna, produced and operated in the late 1920s. The Neuraths (with collaborator Gerd Arntz) are now best known for the production of Isotype (the International System of Typographic Picture Education) and the fundamentally rationalist, positivist project of creating representative icons.[16] The influence of these is easily detected in both "universal" wayfinding signage and the relatively recent proliferation of infographics. It seems relevant to connect these figures back to their origins in a larger social and political project. The Neuraths were anarchists interested in helping workers imagine their place in the industrialized economy, which operated at too large a scale for any individual to understand without special aids, and Isotype figures were intended as a tool in a system of popular education.

In the Isotype system of pictographs, proportion and duplication took Playfair's bar chart and married it to re-

presentational abstractions: it was designed to clarify and make both sums and qualities equally readable in the chart. Indeed, today's data visualizer or data scientist could do worse than re-read Marie Neurath's text "The Transformer," which imagines the making of marks as an activity inherently linked to a social and political project. ❍



ENDNOTES

1 William Playfair, *The Commercial and Political Atlas and Statistical Breviary* (Cambridge: Cambridge University Press, 2005), xiv.

2 Bruno Latour, "Visualisation and Cognition: Drawing Things Together," *Knowledge and Society: Studies in the Sociology of Culture and Present* 6 (1986): 1–40.

3 Edward Tufte, perhaps Playfair's greatest booster, notes that in the bar graph, the chart surpasses the map, because the graphic is "no longer dependent on direct analogy to the physical world…This meant, quite simply but quite profoundly, that any variable quantity could be placed in relationship to any other variable quantity, measured for the same units of observation." See Edward Tufte, *The Visual Display of Quantitative Information* (Cheshire, CT: Graphics Press, 1983), 46–47. In typically breathless style, Tufte goes on to say that, "The relational graphic—in its barest form—is the greatest of all graphical designs." While this last claim is obviously absurd and unprovable, the power of this deep abstraction is worth noting.

4 Latour, "Visualization and Cognition," 6.

5 Ibid., 30.

6 Thomas H. Davenport and D.J. Patil, "Data Scientist: The Sexiest Job of the 21st Century," *Harvard Business Review*, Oct 1, 2012.

7 Karl Marx, *A Contribution to the Critique of Political Economy*, trans. N.I. Stone (Chicago: Charles H. Kerr & Company 1911), 20. Ironically, today we might argue that you can indeed taste the difference between Russian and French wheat.

8 See Mahbub ul Haq, "Defining and Measuring Human Development," in *Human Development Report 1990* (New York: United Nations Development Program/Oxford University Press, 1990), 9–16.

9 Full disclosure, last year I consulted on an interface design project for the company.

10 See ESRI, *Tapestry™ Segmentation Reference Guide* (Redlands, CA: ESRI, 2011), 31. This may or may not be descriptive of *Scapegoat*'s readership.

11 Karl Marx, *Capital: A Critique of Political Economy, vol. 1.* ed. Ernest Untermann (New York: The Modern Library, 1906), 163–174.

12 I remember as an undergraduate political theory student, scoffing at the students in the political science department. "Quants" we would call them, disparagingly.

13 Matthew Hannah, "Sampling and the Politics of Representation in the 2000 Census," *Environment and Planning: Society and Space* 19, no. 5 (2001): 515–534. Hannah's essay mostly deals with the controversy between "direct count" and "sampling" census methods, a battle that became directly partisan (as those who might escape the census optics are more likely to be statistically "represented" by sampling, rather than by direct count.)

14 See Eden Medina, "Democratic Socialism, Cybernetic Socialism: Making the Chilean Economy Public," in *Making Things Public*, eds. Bruno Latour and Peter Wiebel (Cambridge, MA: MIT Press, 2005), 708–719.

15 A Bloomberg Terminal is a multi-screen computer system leased to financial services professionals by Bloomberg L.P., used to analyze real-time market data and place trades.

16 Marie Neurath and Robin Kinross, *The Transformer: Principles of Making Isotype Charts* (London: Hyphen Press, 2009).

BIO Rosten Woo is a designer, writer, and educator living in Los Angeles. He is co-founder and former executive director of the Center for Urban Pedagogy (CUP), a New York-based non-profit organization dedicated to using art and design to foster civic participation. His work has been exhibited at the Cooper-Hewitt Design Triennial, the Venice Architecture Biennale, Netherlands Architectural Institute, Storefront for Art and Architecture, Lower East Side Tenement Museum, and various piers, public housing developments, tugboats, shopping malls, and parks in New York City. He has written on design, politics, and music for such publications as the *Village Voice*, *Rolling Stone*, *City Limits*, and *Metropolis Magazine*. His first book, *Street Value*, was published by Princeton Architectural Press in 2010.