

Information Graphics: A Celebration and Recollection

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Every decade, it seems, there are valiant standard-bearers for effective visual communication of data, information, and knowledge, of facts, concepts, and emotions, who arise and publish guidebooks for business people, computer and information-technology professionals, and others who have not been exposed to the philosophy, principles, and techniques of information design and information visualization.

Currently, Edward Tufte [Tufte] and Richard Saul Wurman [Wurman] in the past decades have been promoted in the media and garnered attention from the general public, having demonstrated unusual entrepreneurial zeal and showmanship in promoting their publications. One benefit is, to be sure, increased attention by the business world and by the general public to information design and information visualization.

What is to be lamented is lack of awareness by the general public and even by visual design/graphic design professionals of the many people who have published usable, useful, and appealing books and publications in decades past. Although William Playfair and others introduced chart-making innovations in the 18th century, the rise of the computer and specifically computer graphics systems in the mid-1960s both raised the amount of (poor) information graphics produced and the need for improving its communicative quality. My own work as a graphic designer working with computers began in 1966 and accelerated with a summer internship at AT+T Bell Telephone Labs, Murray Hill, NJ, where I programmed a (crude) desktop publishing system for the Picturephone™. Not until a variety of fonts, color, and bit-mapped graphics on screen and on paper dominated the technology could much be done. Desktop publishing emerged in the early 1980s. It is now about 25 years since I introduced the concept of information-oriented graphic design to the computer graphics world during my plenary opening panel of SIGGRAPH 1980. It is perhaps fitting that we celebrate others' prodigious efforts to catalogue, describe, design, explain, and recommend the best ways to show data, information, knowledge, and, yes, wisdom.

What follows is an idiosyncratic, eclectic, abbreviated celebration of works published over the past 80 years on the topic of information graphics, or information visualization, comprising documents in my own library collected over the past 40 years. By no means academically rigorous or complete, nevertheless, I hope this review will awaken interest in the work of those who have gone before and inspire those who come next. I apologize in advance to those fellow designers and analysts whose contributions I have not mentioned.

Before beginning our tour, I introduce quickly the notion of an information-visualization development process. The actions of this process include plan, research, analyze, design, implement or produce, document, and evaluate. For the most part, we shall be discussing analysis and design.

Compendia

Several authors have published massive encyclopedia of most forms of charts. Perhaps the best known is the *Semiology of Graphics* by Bertin [Bertin] from 1984, originally published

earlier in French and perhaps following in the historical tracks of the French Encyclopedists who wished to catalogue and illustrate all knowledge (in advance of Google). His illustrations are small and the descriptions are spare, with minimal guidelines, but he covers in 432 pages most possible means for showing information. A similar compendium is the equally extensive, 446-paged *Information Graphics* by Harris [Harris], whose cramped pages are filled to the brim with small illustrations and detailed, but very brief descriptions and explanations of most chart and diagram types. At the other end of the compendium spectrum is the massive 886-page *Encyclopedia of Business Charts* by Carlsen and Vest [Carlsen and Vest]. This book presents one chart per page with only a brief 1-2 pages of text occasionally offering any description or design guidance. While all of these documents are weighty and, therefore (perhaps) authoritative, they are not elegant. Nevertheless, the Bertin and Harris books, especially deserve to be on a professional information designer/visualizer's reference book shelf, assuming that one still reads or looks at books.

Some Oldies but Goodies

Attempting to inform the business world about the value of good information graphics is a decades-old campaign. Perhaps the best known efforts are those of the Isotype-related movement in Europe, especially Otto Neurath and his associates in Vienna in the 1920s, who promoted the use of pictographic charts [Twyman].

Some other publications of note are Brinton's *Graphic Methods for Presenting Facts* [Brinton] from 1920, which is primarily a textual exhortation to use charts, maps, and diagrams more effectively. The look of the text and images reveal its basis in the engineering world. Similar in nature from six decades later is Schmid and Schmid's *Handbook of Graphic Presentation*, which originated in 1954. Like Brinton, the book has much text, but less, and also includes many basic, engineering-like illustrations. The audience for both books is probably engineering departments and possibly business groups.

A lovely document is Goslin and Goslin's *Don't Kill the Goose* from 1939. The publisher's cover end-flap advises us that the Goslins have "specialized in devising new methods of presenting serious subjects in the belief that vividness, interest and accurate analysis can go hand in hand." The text of this book seeks to present information about the US economy, production, consumption, markets, trends, and other key indicators for the interest of both producers and consumers. Throughout the book, 39 Isotype-influenced charts, some of them full-paged, illustrate the key ideas of the text. This attempt, to educate business professionals and the general public, has its precedents in the publications of the US Census Bureau in decades and even centuries earlier. The effort continues over the following decades by individual authors and governmental offices, as I shall describe briefly below.

Informing Ourselves, Informing Others

Helping others, or ourselves, to make better decisions has been a challenge since people came together socially for commerce, protection, and action. Naturally, governments have sought to inform their leaders and, in some circumstances, the community at large. An unusually interesting example of such publications for the benefit of the public is the monthly chartbook of social and economic trends, STATUS [US Dept. of Commerce], which was published in the mid-1970s. After the rise of computer graphics display, even with simple vector images and poor typography from mainframe computers, it was nevertheless possible to transform data with significantly less effort into charts, maps, and diagrams. At that time,

many documents were prepared for the Vice-President of the United States, Nelson Rockefeller, who was dyslexic, as many public documents attest. Because of this factor, computer-based charts and diagrams were especially useful for reporting information to him. To my understanding, the producers decided to re-use the documents in a public document, and, hence, STATUS was born. The monthly publication contained rather well-designed, large (sometimes one per 8.5 x 11 page) multi-color line charts, bar charts, area choropleth maps, etc. for most major indicators of the economy. Alas, with the change of government in 1976, the publication came to an untimely demise.

The efforts to produce this document were described in a paper presented at the 1976 American Statistical Association. This and other papers were later published in a valuable document *Graphic Presentation of Statistical Information* [US Department of Commerce]. This publication includes innovative means of presenting multivariate data, that is, multiple dimensions of data within one area of a chart, map, or diagram. Such publications were an example of the ferment and innovation taking place with the spread of computer-graphics display technology (e.g., Chernoff faces were invented around this time, which presented data in the form of varying human faces [Chernoff]). Another example of the era is the chart book *US Working Women* [US Department of Labor' from 1975 that contains approximately 60 somewhat basic, but powerful, full-page (8.5 x 11) color charts. Significantly, the charts contain lengthy titles at the top of the page that make clear the data elements and a secondary text at the bottom of the page that explains the significance of the chart. For example, Chart 47, which consists of four very large segmented 100% bar charts is titled "Women in the labor force by age and years of school completed, March 1974" with an explanation, "Young women workers have had more formal education than their older counter-parts." These publications signaled major innovation and progress in providing information visually to the general public. As an indicator of the era, in 1981-82, I was a Staff Scientist at Lawrence Berkeley Laboratory's Computer Science and Mathematics Department (they had no position for or concept of graphic designers working in a research laboratory at that time). I design-directed the first texts, tables, charts, and maps produced semi-automatically via Xerox 9700 laser printers for the US Department of Labor that were made available to the general public using data from the 1980 Census. In effect, I became a graphic design/information designer for approximately one million pages that were produced automatically for the first time and made available through the National Technical Information Services (NTIS).

An example of this type of document from a decade later is the American Profile Poster authored/developed by Stephen J. Rose [Rose] and designed by Dennis Livingston and Kathryn Shagas. The book contains 30 straightforward black-and-white tables, but the included 22 x 34 inch multi-color poster presents a complex "dashboard" composite of charts that seeks to show quickly and effectively, as the subtitle of the book clarifies, "who owns what, who makes how much, who works where, and who lives with whom." Isotype-like pictograms populate many of the books pages and the poster.

Let's be frank. Although significant progress had been made in technology, information design and information visualization was not on everyone's lips, even those of professional graphic designers. As the members of the information design and information visualization communities (two distinct cultures combining different societies, professions, objectives, reward-systems, and personalities) well know, we are a small, dedicated community, where, consequently, many know many in the field, and we often slip into the habit of preaching to the choir.

The limited impact, to my mind, was well illustrated by Richard Saul Wurman's and my attempt to organize the first-ever international competition of information visualization in 1976. Funded by a grant from the US National Endowment for the Arts, Design Arts Program, we were able to offer the winners several thousand dollars in prize money for outstanding depictions of our chosen subject matter: the US national energy inflow and outflow diagram. The essential data and technical-engineering diagram were available. We sought to encourage designers in finding a way to make this important, some would argue crucial, information visible, meaningful, and impactful. We were prepared to exhibit the winners and runners-up at the Art Center in Pasadena in California. We advertised throughout the USA and abroad in design publications and elsewhere. Alas, there were less than a handful of entries, and we had to cancel the event.

Nevertheless, steady progress was made in the public and the professional design and analysis communities coming to understand the importance of well-designed forms, tables, charts, maps, and diagrams. A much more positive sign was my being invited by the organizers of the 1980 Association for Computing Machinery's (ACM's) Special Interest Group for Graphics and Interaction (SIGGRAPH) conference to chair and speak at the opening plenary event of the conference. Among others I invited was Mervyn Kurlansky from the United Kingdom, who was a respected graphic designer and later President of the International Council of Graphic Design Associations (ICOGRADA) community. On this occasion, we had an opportunity to introduce information-oriented graphic design to about 2,000 of the world's leading computer graphics programmers. Many in the audience and in the tutorial I presented on the subject, went on to found their own companies, like James Warnock who founded Adobe, and others who came to work at George Lucas' studios, Disney studios, and other film, advertisement, mapping software, business graphics software, and other companies. Because of my own interest in informing the computer graphics community, I prepared a general guide *Graphic Design for Electronic Documents and User Interfaces* [Marcus, 1992] with a specific chapter on charts, maps, and diagrams in 1992, similar in spirit to my monograph a decade earlier [Marcus, 1983] that I published for the National Endowment for the Arts, Design Arts Program, "Managing Facts and Concepts," to inform graphic designers of the coming revolution in information display.

Guidelines and Recommendations

What many people in different areas of business and professional practice have needed, with increasing frequency are "how to" guidelines and recommendations. These are at a higher level than instructions for manipulating graphics editing tools. They involve insight into philosophies (like "less is more" or the universal applicability of usability defined by the International Standards Organization in Switzerland as "effectiveness, efficiency, and satisfaction"), principles, and timeless, tool-independent techniques. Many such documents have appeared throughout the past four decades, although not all are well known. Some preceded the computer graphics revolution, others were concurrent, and still others followed the rise of the first computer graphics systems.

One of the first such guidebooks I encountered, at the end of my own graduate education as a graphic designer, was William Bowman's excellent, but long out-of-print *Graphic Communication*, first published in 1968. Bowman was for a time at Xerox PARC. This document, the pages of which were half text, half illustration, covered a wide range of visual communication techniques, including technical illustration, charts, maps, and diagrams. The

text was erudite, articulate, and informative. The illustrations, many of them simple manual drawings, were elegant and effective.

A relatively little known book, to my knowledge, is the surprisingly attractively designed and reasonably well-illustrated *Handbook of Basic Graphs: A Modern Approach*, by Cecil H. Myers of the University of Minnesota, Duluth in 1970. The subject was strictly charts, e.g., 40 pages on line charts. The book's layout uses a wide-column, flush-left, ragged-right Times Roman text, which is very simple, elegant, and readable. The illustrations are, well, reasonably designed engineering-chart images, but they are quiet and effectively displayed.

A. Jean MacGregor published in 1979 a very brief, but simple and effective guide for use within the University of Toronto, but it found interested readers elsewhere. I used to show and recommend this booklet to my students when teaching at Princeton in the 1970s and to my world-wide tutorial audiences in the 1980s. I found her illustrations quite minimal, elegant, and powerful. As she says in the Introduction on page 5, "Five simple one-idea illustrations in a series are more easily understood than one which is over-crowded and hard to read....[The book] is intended to provide the information needed about when to use and how to design charts and graphs, how to achieve legibility, how to prepare graphics for specific media, and how to use various types of graphic aids to make the job easier. While it is directed to the teacher or scientist who must prepare [one's] own teaching material, [the author hopes] that professional artists or photographers will also find it useful." Well and succinctly said.

Anders Vinberg [Vinberg] and Alan Paller [Paller, Szoka, and Nelson] of Integrated Software Systems Corporation, or ISSCO, as it was commonly known, an early leading business-graphics software company based in San Diego, were familiar proponents of good chart design in the business graphics world of the early 1980s and into the early 90s. They often presented at the National Computer Graphics Association (NCGA), a computer-technology-based, business-oriented cousin to the academic Special Interest Group (of the Association for Computer Machinery) for Computer-Human Interaction (SIGCHI), SIGGRAPH, and the Human Factors and Ergonomics Society (HFES) conferences. The two authors published two lengthy brochures on designing good charts, which cannot but have educated, trained, and motivated many business people starting in the world of presentations, data mining, executive information systems, and other computer-graphics facilitated displays. Their texts went beyond simple how-to-use the software tools. They reached into subjects of right-brain thinking, graphic design, and communication effectiveness. I remember in particular ISSCO's demonstration of how one could manipulate graphics for different rhetorical purposes using the same data, e.g., to minimize sales slow-down troubles to stock-holder meetings or to maximize sales achievements to prospective customers. While the text and illustration layout were far from "graphic-designer friendly," they nevertheless presented important considerations for anyone designing information graphics.

A later example of the irrational exuberance that people felt about chart, map, and diagram design is found in the early 1984 guidebook by Nigel Holmes [Holmes], then an influential graphic designer at *Time* magazine. Within its pages appear almost every form of illustrated bar chart, "fever" chart, pie chart, and table. The broken link between visual syntax and semantics is well-illustrated on the book's own cover, which shows slightly comical, absurd choices of liquor bottles as a vertical bar chart, a pictogram person with red "Fever" line charts across his face, and a slice of cherry pie in front of him on a table (the reference to tables, displayed no doubt with a groan from any audience). Holmes years later repudiated

his earlier approach and mentioned that too many younger graphic design professionals were being influenced by this book and his work. He lamented that they were designing charts that might look intriguing but conveyed little or no semantics.

Another of the early proponents of better business graphics was Irwin M. Jarrett [Jarrett], who produced several books, papers, and presentations on his own unique designs for financial charts. He too, was a frequenter of NCGA conferences, among others.

Lately, Stephen Few, Principal of Perceptual Edge, a consulting firm, has taken up the role of educator, gentle gadfly, and promoter of better tables, charts, and diagrams. His two books [Few] of 2004 and 2006 are good introductions that survey the field. His older and more fundamental book *Show Me the Numbers* is a “practical and commonsense guide” that one can use in business. Note the focus on business, as opposed to scientific/technical, academic, consumer, design, and other specialized realms. The bottom line, appropriately, is that “more skilled presentation of information will help you and your business to prosper.” This book seeks to assist in that effort. From what I can judge, it probably succeeds.

The scope of the content covers the essentials of communication through tables and charts. He seeks to convey quantitative data and their relationships, especially those that summarize; a key challenge for the busy professional. All of the fundamentals are stated succinctly, such as when to use tables and when to use charts, definitions of charting types, and even a brief history of chart-making. Deviation charts, correlation charts, scatter plots, line charts, bar charts, and others all have their brief moment on stage. They are defined and demonstrated, and advice is given for their best presentation attributes.

I looked for the signs of wise practice and found them: He rightly denounces the pie chart as an ineffective means of information display (because it is hard to judge angular relationships and hard to label things in a readable manner around a circle). He also notes that 3D versions of charts are not likely to be effective: too much visual clutter without contributing to significant communication.

The latter chapters focus on details of arrangement, labels, color, highlighting, all of the nuances that make for superior graphic design. The illustrations are simple, basic, and clear. The text layout and titling of the book has the same Spartan style. I recommend it to all who seek such advice.

The second book, *Information Dashboard Design*, takes us to the next level. Some may remember the days of “executive information systems” in the early 1990s. Today, the scope of analytical software, able to do sophisticated data mining, can turn up all kinds of things based on the metrics and algorithms supplied by software engineers. Stephen Few remains skeptical about the user-friendliness of the many over-hyped dashboards that seek to assemble just the right amount of scope and detail that can give people insight into key structures and processes of business.

The author shows and comments on a dozen complex business-based dashboards shown in large images. Then he proceeds to dissect what makes for good visual displays that can show information needed to achieve specific objectives in a single computer screen display. All of the good techniques discussed in the first book must now work together with multiple charts and tables assembled to provide a single view.

He notes in one table the typical varieties of possibly measuring “What’s currently going on.” They include all the detailed measurement of orders, market share, revenues, expenses, profits, system usage, etc., that are collected by the managers of sales, marketing, finance, technical support, fulfillment, manufacturing, human resources, information technology, and Web services. The range is daunting. The time frames can vary enormously, from quick snapshots of the moment to long historical perspectives. With no industry standard for how these items are to be assembled, laid out, annotated, colored, labeled, or designed (e.g., bar chart vs. line chart), no wonder that many are poorly done. He rightly eschews useless decoration among other contributors to conceptual and perceptual clutter.

As with his earlier book, the second half focuses on details of typography, color, “chunking” information, etc. All of the techniques are described in simple, clear, readable text, punctuated, as in the earlier book, by questions posed to the reader. What the author is providing is professional guidance related to a myriad of components that must be assembled into one complex display.

Falsity, Truth, and History

One ought not to conclude without at least a passing reference to Huff’s classic *How to Lie with Statistics* available since at least 1954. The author uses text and some cartoons to warn the reader about worthless or meaningless statistics masquerading as facts and the tell-tale signs for recognizing them. How much more dangerous is it with visual forms of statistics such as tables, forms, charts, maps, and diagrams. It is so much easier to “pull the wool” over one’s eyes. For this reason, one must be especially cautious about misleading viewers through even well-intentioned graphics that nevertheless do a disservice to the reader.

Most commentators on information graphics do not dwell on history, but many interesting tales link these visual forms to the march of events and people in many countries and civilizations. Among those of note is Howard Wainer’s 1997 treatise *Visual Revelations*, subtitled “Graphical Tales of Fate and Deception from Napoleon Bonaparte to Ross Perot.” Some may remember Ross Perot, a presidential candidate in 1992, who was famous for many things, but here for using charts to illustrate his points. He did not succeed in winning the election, but his charts remained as a discussion item at the time and since then. They were not particularly well-designed, or informative, but succeeded in capturing public interest. Wainer rails against misuse of charts when tables or simple sentences suffice, or poorly designed charts. He concludes with cautions about overheads and what we would now call Powerpoint presentations, which have been condemned, somewhat hyperbolically and rhetorically, by Tufte [Tufte, 2003].

Conclusions

Having two well-known, now somewhat iconic popularizers of information graphics like Tufte and Wurman is not a bad thing. But there are limitations. Wurman’s earliest work tended a little to pedagogy, but most of his publications and events have been more oriented to promoting certain favored professionals, including himself, and discussions of technology-related ideas, rather than the “down-and-dirty” discussions of how to do it. Admittedly, many of his group-produced publications have displayed well-designed pages, charts, maps, and diagrams that serve as good learning examples. But not everyone can intuit the principles.

While admiring Tufte's devotion to good production values and taking personal financial risk in producing his early books, one can note that his work has tended to be a patrician's or connoisseur's view of what constitutes good design. He pronounces this chart good and that chart, or presentation slide, bad, even evil. It makes for good press. However, some of his book readers and tutorial attendees are seeking solid advice on how to design, how to make the tradeoffs that inevitably arise in the real world, not just learning that someone else professes to have good taste. Some of the other authors cited here have taken exactly the approach of trying to raise the bar of "good enough" quality (not necessarily and quite different from the peak of the quality pyramid), by providing sound, concrete advice by which the masses might be trained.

In closing, one issue deserves attention. Most of these publications devote themselves to practical insights and powerful presentation of content. One component of the information-visualization development process that tends to be overlooked is evaluation. Almost all of the references cited could benefit by more pages devoted to the techniques of focus groups, heuristic evaluations, expert evaluations, testing, questionnaires, ethnographic studies, and other means to understand what viewers of information need and want, and how to determine their reactions to the designs that are presented to them. There are many books on usability testing and related topics, and many professionals that devote themselves to these techniques, notably, the members of the Usability Professionals Association.

Publications like *Information Design Journal*, *Information Visualization*, and other professional publications have long promoted good information graphics. The American Institute of Graphic Arts has, at last, in the past few years, made an organizational commitment to this topic, which deserves praise. I must acknowledge that they permitted me in the 1970s to stage an exhibit of subway maps from around the world that I collected under a grant from the USA National Endowment for the Arts, Design Arts Program; however, their focus on this area has been minimal over the decades. Even in a recent awards catalogue, the number of information graphics entries was miniscule. Nevertheless, courses in information graphics are arising more and more frequently in university and art/design school curricula. In addition, publishers like Graphis Press, in Switzerland, and others in North America, Japan, and elsewhere, have produced over the past several decades compendia of beautiful information graphics (as noted previously, often weak in testing out the designs to prove their effectiveness). Likewise, Wilbur [Wilbur], and others have presented case studies of information graphics in the past few decades.

We are certainly able to find more awareness and more sources of detailed training, even education, than decades earlier. Just in time, too. The rise of the Internet and social networking mean that graphics are circulated and swapped among professional designers and non-designers more than ever. There is even a slide-sharing Website (<http://slideshare.net>) that was launched in October 2006 that offers Powerpoint, TonicPoint, Adobe Flex, and other resources. Now, more than ever, both producers and consumers need all the help they can get to identify and select good information graphics. Let us remember, and celebrate, the achievements of those who have tread this path before.

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