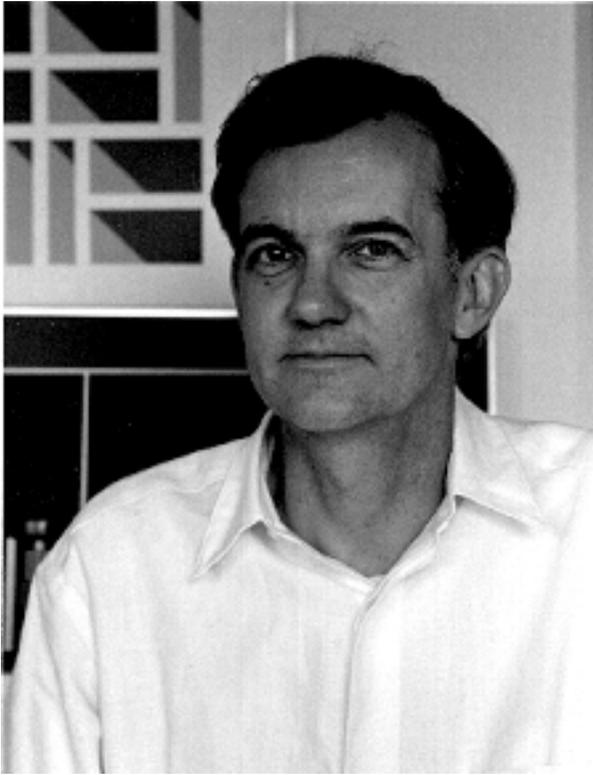


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Edward R. Tufte

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Computer Literacy Bookshops Interview, 1994-1997

Prof. Tufte has long been one of our store's favorite authors, a writer whose intellect and books receive unanimous raves from those familiar with them. In one of the more unusual honors given him, The Utne Reader featured Tufte in a 1995 article '100 Visionaries Who Could Change Your Life', listing him with leading figures from politics, the media, and other walks of life.

I've twice had the privilege of interviewing Tufte. The first time was in 1994, over sushi and sake, after a talk at our San Jose store in which he passed around his personal copy of an original Galileo manuscript. The second time was in January 1997, when his long-awaited third book came out (reviewed in this issue). I've meshed both interviews together for smoother 'flow'. --- Dan Doernberg

CLB: *You speak of your work as "Information Design"... please tell us about that field.*

Tufte: The wonder of Information Design is that I can write a book in 1990 and the main intellectual hero is Galileo. What other field can make that statement?! That's the joy and wonder, a kind of miracle,

of this field. There are all these things that are extraordinary in terms of content, and they are extraordinary in terms of their visual quality. Some of them are as beautiful as any painting, and they also happen to be about real things. Nobody had really seen that before. Both the incredible aesthetic, and the fact that the underlying frame is content-based.

My discovery is that the same basic design strategies have occurred again and again, in widely different fields and throughout the various countries and centuries--- text-figure integration of the scientific notebook, small multiples, various kinds of data compression, micro/macro design (like the Vietnam Veterans' Memorial)... There is some kind of universality, almost like Chomskian grammar, that comes with the human package. I don't say a wired solution. But something in this interaction of the problems people are thinking hard about and the human eye-brain system is producing this commonality of five or six solutions. My contribution is to identify those solutions, give them names and explain why they work well.

Whether it's in 17th century Italy or 20th century Silicon Valley, they happen again and again. I have a lot of material in *Envisioning Information* from Japan; what it mainly illustrates is that a totally different culture, much more quantitative and also much more visual, found the same solutions.

CLB: *Noise-to-content ratios and the like...don't they vary from culture to culture?*

Tufte: The "curse of dimensionality" is rooted in basic human experience, because anything interesting is probably in hyperspace.... and to understand something complex we need to get that complexity into our mind. So one part is due to the nature of the problems, the other part is due to the nature of the human eye-brain system. And those two things have nothing to do with time or with language or country. I think the problem, as I've jokingly remarked, is universal among n-dimensional beings; instead of "Escaping Flatland", the people who live in the n-dimensional world write books whose first chapter is called "Escaping n-1 Land", because they are bitching about the same kind of thing we are; "We live in a multivariate world of n+20 dimensions and here we only have n+20 minus one."

There are people, and books, that argue that the great discoveries are in fact visual, based on visual imagery. They have quotes from Einstein, and quotes about microbiologists who are pretending to be molecules, thinking like a molecule and being visual. . I always thought that was a bit self-serving. But plainly, all of our non-symbolic information, and some of our symbolic information, is coming via that channel. The visual shouldn't be the prisoner of the artists. And especially in data-rich sciences like meteorology or nuclear physics, which generate tremendous amounts of information, the only way you can think about it is to see it. That's the most efficient channel, the high resolution channel.

CLB: *Fifty pages of data in tables doesn't do the trick!*

Tufte: The only way to see it is to see it.

The main elements in Information Design are (1) you have to be able to see and (2) you have to be able

to count. And those skills seem to be nearly orthogonal; very often, speaking only somewhat facetiously, my graphic designers can't count and my statisticians can't see! In my graduate level class I pair both kinds of students together, so they can get things together.

There are a lot of people in the world who can see a lot better than I can, and there are a lot of people who can count a lot better than I can, but there aren't quite so many who can do both. I got my BS and MS in Statistics (Stanford) and my Ph.D. in Political Science (Yale); the day I finished my dissertation I started painting... art... even when I was a young, scrambling assistant professor I spent two or three days a week painting. I did it for no reason, just that I was always quite visual.

I used to write about elections, which have dates, and they go out of date very quickly. I used to write about things filled with proper nouns like "Gerald Ford." That's not exactly forever knowledge. I want to write books that are forever. Not to be immortal, but books that aren't a prisoner of dates and proper nouns, or transient proper nouns. Information Design is wonderful. It's not corrupt and smarmy and filled with proper nouns the way politics was; it's ideas and principles and theory, and things that will last. I try in my teaching to do the same thing. I tell my students; "I'm not trying to teach cookbook quantitative analysis, I'm trying to give you some principles, some forever knowledge." I make the distinction between technocratic and short-run on the one hand, version 3.0 vs. 3.1 for example, and forever knowledge, i.e. principles about Information Design. The really good stuff is indifferent to what country it is, or what century it is.

A wonderful thing about my work in Information Design is that it gives me access to anything in the world, all kinds of interesting things... and I can make a little contribution sometimes. When I worked on a medical interface, I wore a doctor's white coat, so I strolled all around the New Haven hospital and looked at how medical records were kept. So I saw that world. I certainly would never want to live in that world, but it sure is interesting to see it. Sotheby's had a Russian Space auction, where they auctioned off satellites and other things I bought a diagram, a visual diary, that two cosmonauts made while they were spending 93 days in space. That diary is in *Visual Explanations*.

CLB: *Why did they choose a visual diary? Why not text?*

Tufte: Because it's a scientific graph showing curves and dates, a graph with a lot of parallel time series. It has their plan of what they were going to do (e.g. take a space walk), and that part was written on the ground; then they have what they actually did when they were up there. They were up 93 days and the previous record (Skylab) had been something like 80 days, so they put "Skylab!" on the graph when they beat the record. And they have Russian mother's day on it... So I get to learn about, and interview, the cosmonaut who did it. Gregor Gretchko is his name, and he is in his 50's now. He did it 20 years ago. So I've been in that world too.

Visual Explanations also has a chapter called 'Explaining Magic' co-authored by a professional magician I collaborated with, so I'm also in the world of magic. If you can explain a magic trick you can explain most anything!

There are so many wonderful and interesting things in the world that...maybe I have a short attention span too.

CLB: *Did you always have an interdisciplinary bent?*

Tufte: Well my mother was a professor of English (now Emeritus) at the University of Southern California, and very interested in the 17th century... I think some of that comes from her scholarship and her interest in old things. I don't care, at all, what century it's from. Things I care about are free from time and country.

CLB: *Tell us more about Visual Explanations now that it's done.*

Tufte: It has a long title, perhaps because it took me 7 years to write: *Visual Explanations: Images and Quantities, Evidence and Narrative*. It shows more of my own work than usual: a supercomputer animation of a thunderstorm, a design for visualizing the history of medical patients or any other complex dynamic history, some of my own designs for computer interfaces and information sites, and even some underwater photography! But the other 300 images are the wonderful work of other people. There's the cosmonauts' diary, the magic chapter... there's a lot of work on decision graphics, how to look at information to reach important decisions. One of my case studies examines in detail the charts and graphs used in deciding, wrongly, to launch the space shuttle Challenger in January 1986.

CLB: *Here's your description of your books: "The first book, The Visual Display of Quantitative Information is about pictures of numbers. The second book, Envisioning Information, is about pictures of nouns at least on some days, that is, a map or an aerial photograph shows a lot of nouns lying on the ground. And the new book, Visual Explanations, is about pictures of verbs; how to show motion, dynamics, mechanism, explanation, cause and effect." What suggested this arrangement to you?*

Tufte: I didn't realize it when I started. The number/noun/verb structure was intuitive for a long time. I guess I realized pretty much in the beginning of the new book that I was interested in dynamics, and cause-and-effect, and motion--- verbs--- and I knew I had some new things to talk about. A big part of it was that I did some animations, scientific visualizations, at the National Center of Supercomputing Applications, and making things move was obviously about verbs.

CLB: *Do you have any plans for new editions of the first two books?*

Tufte: I've thought of it. Occasionally I've tried to intervene in the first book, and it's like breaking a vase! It's done, it's coherent, and I've pretty well decided I could never undo it. *Envisioning Information* is an incredibly complex interwoven structure--- that could never be touched. It's technically so hard to print that book, and to produce it. To have to go into it would be so disruptive... it would be like throwing a hammer onto a computer chip, the detail of interrelationships and the crudeness of an intervention. So I'm not going to touch them. I may borrow a chapter or two, here and there, but they're done, and I said exactly what I meant and I still believe it, it's still all the truth...

In my pre-Information Design days, I would look at a book and I'd say, "You know, it's time for a second edition of this book on Political Economy, and you know what I'm going to call it, I'm going to call it, 'I Told You So.'" If you're going to call it 'I Told You So', you're not saying anything new, and that's a good sign that it's time to move on.

CLB: *What influenced you to switch your studies from Statistics (BS and MS) to Political Science? Was it the milieu of the 60's?*

Tufte: No, I was always interested in politics, and I was always interested in numbers, and my statistical work was in epidemiology, which is people and surveys and detective work and somewhat quantitative. I think education is largely about finding the two or three people who are really intellectually exciting to you. My career reflects that. For me, there was a statistician (Lincoln Moses) and a political scientist (Ray Wolfinger)--- both were at Stanford. I don't think I was mathematically smart enough to make any kind of mathematical contributions to statistics. Ironically, I've come to this indirect route, made the visual contributions. I would never have been a Fellow of the American Statistical Association if I had stuck with mathematics, that's for sure! I cared a lot about political issues. But they lack, notoriously lack, in the aesthetic. I mean it's a smarmy, punch in the gut, smarmy, short-run, filled-with-proper-nouns-and-dates kind of field, unless you do political theory or something. Somebody gave me the idea of proper nouns. They would say "This is a book filled with proper nouns and dates." Somebody once called historians "One damn thing after another", and the writing of history likewise! That's actually quite insightful.

CLB: *You aren't interested in history at all?*

Tufte: No, I'm not. I'm interested in old things and new things, but I'm not particularly interested in who did what first, or development. Because it is one damned thing after another. It's unconceptual.

CLB: *A final historical question then. Galileo, your intellectual hero, discovered many of these principles, but they were then lost and forgotten for over 350 years. Why do you think that happened?*

Tufte: Well, never underestimate the effects of professional segregation. It's true in the academic world, it's true in the business world. The socialization of people into a field and the consequent narrowing of what they can see or think about or do. The way people succeed early on in the intellectual field is by focusing, and in fact doing more and more about often less and less. But by focusing. Once they have status and they are tenured, it's hard to give that strategy up. My view is that there are so many interesting things in the world... if I have a chance to see or explore them, I'm going to do it. And, one of the great places to do that from is a big city university, one that has a good library, and a lot of smart people, and a lot of valuable technology.

Another factor is that the kind of usual analytic principles that we find in science or in computing, principles like maximization, optimization, hard headed thinking.... have not been used in the field of design. Not to put too fine a point on it, but in intellectual terms, graphic design has not been a rigorous

field. And yet it possesses this wonderful tradition of typography and color and seeing and layout--- these great tools! But in graphic design, those tools are in the service of short-run client needs, e.g. doing annual reports. What I have tried to do is steal those tools away without the ideological baggage of graphic design (e.g. posterization, annual reports), and then apply them to scientific materials and scientific data. Show their importance.

CLB: *How did you get "back" to the visual realm after *Statistics and Political Science*?*

Tufte: In the mid-1970s, while at Princeton, I gave a statistics course to a dozen journalists who were visiting the school. I thought "Well, journalists have to know about statistical graphics...", so I prepared a collection of readings, with a section on statistical graphics. The literature was thin, grimly devoted to explaining use of the ruling pen and to promulgating "graphic standards" indifferent to sensible quantitative reasoning. Soon I started writing up some ideas about my growing collection of graphics. Then John W. Tukey, the phenomenal Princeton statistician, suggested that we give a series of joint seminars. Tukey had opened up the field in the mid-1960s, as his brilliant technical contributions made it clear that the study of statistical graphics was intellectually respectable and not just about pie charts and ruling pens. This focused my mind, since I had to talk for two hours every other week to the students in front of John Tukey! The seminar proved reassuring: I had something to say. Those seminars led to my first book, *The Visual Display of Quantitative Information*, and changed my life, all to the good.

CLB: *When you wrote book #1, did you know that there were books #2 and #3 waiting to get out?*

Tufte: The last thirty years I've always had a next book, it has never been a question. I always think "I wish I could get this current book done because I really want to do the next one."

CLB: *You mentioned scientific visualization earlier. Did that field deserve all the attention it received in the early 1990s, or was it something of a fad then?*

Tufte: I think that it's very solid work. I think it's much more solid than a lot of cyberchat, more solid than "virtual reality" [1994-Ed.]. You see, the superlinear stuff has a reasonable scientific base to it, real content. The great problem is that the material has to be published in real scientific journals, not in supercomputing journals, and that is always the big test.

That's a very important point. The serious contribution of technology is how it enables us to learn something about the world, not how many it sells... In other words if something is to matter, it matters more than the difference between release 3.1 and 3.0. Whether a tool comes to matter depends on whether it makes the payoff of helping us learn something new. Otherwise, to me, it is useless. It may not be useless for making money or for something like that, but in terms of its forever contribution.

In the computer world there is such powerful marketing pressure... and the necessity to do better this quarter than every other previous quarter... and to do that forever! Those sorts of pressures are utterly

indifferent to whether this tool has any long- un value in discovering how the world wor ks. And so, the acquisition of the latest release is not that it gives us more insights in working out some intellectual puzzle, but rather that it's a matter of being up to date, or of status, or that if you don't do it your system is going to crash. And o there is this incredible remark which a guy from Wired told me, that there are only two industries which refer to their customers as users, drugs and computers. "I've just got to have release 7.2", right!

I use the Macintosh [1994-Ed.] because I'm visual. The hassles of all these damn releases, and synchronization, and compatibility, and conflicts... are just enormous! When I write a book, I try to get it right. It sometimes takes me a printing or two to g t it right, but I don't print editions wi th four significant digits. I got a thing in the mail the other day, it was Adobe Illustrator Release 5.1 update. That's four significant digits deep, 5.1 update! What the hell are they doing? Why wasn't 5 right, why wasn't 5.1 right? That's a kind of mark ting insanity. I mean, for an organizatio n as good as Adobe to be sending something like that out... To me, it's really an expression of contempt for people buying the material, and for their own craft.

CLB: *Do you feel it's planned obsolescence, or just a matter of slow progress?*

Tufte: I don't know, but why not just get it right? There are lots of people who are expected to get it right the first time, or maybe the second time at best. Sometimes you have to. So why not do it here? It's a curious and odd thing that they can get awa with that. I stabilized my writing compu ter about three years ago. It works the way I want it, why screw around with it anymore? I decided never again! But upstairs, on my graphics system, I try to keep up, and I get this stuff in the mail, 5.1 update, and you say, "What's going on here?"

CLB: *Have you enjoyed your consulting work with computer companies? I'm guessing that that work is a bit removed from issues of forever knowledge.*

Tufte: Well I've worked for IBM and Hewlett-Packard and Sun... I found the applied issues interesting and they provoked theoretical concerns. I found that Product Managers are brilliant at deflecting the occasional outside interventions of people like me. hey go to Product Manager school! When yo u talk to a Product Manager as a consultant, you find products under development are in one of two states--- either too early to tell, or too late to change. I would say, "Maybe we should do something about the type." The Product Manager would say, "I'm un er a real lot of deadline pressure on thi s, we can't be late on it again." The translation of that is "It's too late to change." Or I would ask "What are you thinking about here on your color selector, what are your colors like?" (a very important thing, an interesting design problem). They say " ell, we're working on it, but we really h aven't....", I translate that to "Too early to tell." And what it means is that at Product Manager school they learned that the time is never ripe for external advice! It's a way absolutely of deflecting consultants who obviously don't have the persistence and patience to stay on that.

I guess what I'm saying is that marketing drives so much of what goes on, rather than anything that we

should care about. I do a lot of marketing too... I think it's the responsibility of public intellectuals to advance their ideas, to make sure that everybody hears about what's being thought. You can't leave that up to anybody else, because you know it better than anybody. But the idea that the whole enterprise is driven by the short-run market considerations is very... it's probably in some ways almost pessimal for long run theoretical progress in the field.

That's a nice word, "pessimal" as the opposite of optimal. Like a Pradopessimal solution, that's where everybody is worse off... or you can have an algorithm that pessimizes, makes everything worse. That word was actually invented by my roommate at Stanford in 1963 or 1962...

CLB: *Does your work contain some algorithms, some... beginnings of implementable techniques?*

Tufte: Yes, there are ideas about optimization, maximizing certain things, quantifying, assessments of graphics in terms of their data density... there are ideas that could be systematized in a somewhat mechanical way.

CLB: *Do you expect that in years people will be able to take a graphic and run it through some kind of analysis software?*

Tufte: Yes, I've been waiting for people to do that for a decade now.

CLB: *You feel that if someone sat down to take a stab at it...*

Tufte: Oh, I know exactly what to do.

CLB: *You do?*

Tufte: Uh huh. The people who approached me have either been venturesome capitalists (a carefully chosen phrase!), or people who wanted me to also invest in this enterprise, and become a manager, and do things I'm not interested in. So there has never been the right mix of things where I could give a computer expression of my work.

CLB: *That would be an exciting toolset to have!*

Tufte: I'm astonished that nobody has ever done it. Partly I'm difficult to work with, and partly they're conservative. I said to one computer guy "Okay, the two of us will work this out, and we'll do some designs that are right, and then we'll ship my books with the software." He asked what the books cost to produce, I told him, and he said "Why, that would triple my costs, I couldn't do that." He'd be selling a \$200 or \$500 or \$800 software package that costs \$9.00 on the margin, and he's worried it's going to cost \$30 on the margin! There are a lot of venture capitalist types who say "Let's work something out", but I've never been satisfied with the scenarios.

You need a good manager, and you need some great programmers, and you need some enthusiasts, and I need people who will do what I say. Anybody who's any good won't do that, they'll be doing their own thing. And so when I think about it, my real job in life is to get the next book out.

CLB: *What made you decide to self-publish these books?*

Tufte: I started writing *The Visual Display of Quantitative Information* after the Princeton course with Tukey. In 1977 I moved to Yale. By late 1982 *Visual Display* was ready. A publisher was interested but planned to print only 2,000 copies priced at \$65 per copy (about \$115 in today's dollars). I also wanted to control the design to make the book self-exemplifying, i.e. the book itself would reflect the intellectual principles advanced in the book. Publishers seemed appalled at the prospect that an author might govern design.

CLB: *Hence Graphics Press.*

Tufte: Yes. On the design side, I found Howard Gralla, who had designed many museum catalogs with great care and craft. He was willing to work closely with this difficult author who was filled with all sorts of opinions about design. We spent the summer in his studio laying out the book, page by page. We were able to integrate graphics right into the text, sometimes into the middle of a sentence, eliminating the usual separation of text and image, one of the ideas *Visual Display* advanced.

Control of the words and images on the page, maximizing resolution of images, and pushing the technology are all part of the intellectual expression of my ideas about information design. So the making of the book has become part of the book. Graphics Press is forever a single-author publisher!

It turned out that all self-publishing required was a really good book designer, some money, and a large garage. For capital, I took out another mortgage on my house. This also concentrated my mind, in part because interest rates were 18% at the time. The bank officer said this was the second most unusual loan that she had ever made; first place belonged to a loan to a circus to buy an elephant!

My view on self-publishing was to go all out, to make the best and most elegant and wonderful book possible, without compromise. Otherwise, why do it? If I wanted to mess it up, I could have gone to a real publisher. And I also wanted a reasonable price so that the book would be widely accessible. It all worked out, dreamlike; there are now 245,000 copies in print.

The color work for my second Graphics Press book, *Envisioning Information*, was extremely complicated. For example, one piece of paper went through 23 different printing units, something that no rational publisher would ever do!

CLB: *I noticed that Graphics Press does not have a World Wide Web site; what are your feelings about the Web, about design for the web, etc.*

Tufte: I've done lots of critiques for people, and consulted on some, so I've seen quite a few. The problem with the Web is that it's low resolution in both space and time. In so far as space, the computer screen is an inherently low-res device, that's just a limitation of the hardware. And that resolution is made lower by the design of the images. In so far as time is concerned, well, it's the "World Wide Wait"; the rate of information transfer is very low. The payoff, measured in bits per dollar, is very low relative to the investment in hardware, time, etc. It's another situation where we've replaced one nuisance with another.

I can tell you something else about the poorly produced sites; in their designs, the allocation of space on the screen tends to reflect the distribution of the political power controlling the site. Programmers have a great deal of control, so there are lots of fancy tricks employed... designers control a great deal, so there are elaborate page navigation systems, and elaborate buttons to click on. The result is that content winds up with only a tiny share of the screen, often only 20-30% of the bandwidth! The rest is computer or administrative debris, or over-produced, over-crafted buttons.

Another indication that the over-produced sites are not working is to look at the phoniness of the statistics, their hit numbers, "One million hits to our site!" All those hits are to the home page, and most people never make it to next screens. The numbers drop almost exponentially; 90% never make it to the second page, and 90% of those people never make it to the third page. For Web pages, bare bones design is the way to go.

CLB: *We're about out of time -- thank you very very much. As a last question, are there other writers whose work you particularly like?*

Tufte: My two favorites novelists are Italo Calvino and Evelyn Waugh. Calvino, an Italian novelist who died in the mid-80's, wrote a wonderful book called "Cosmo Comics." Evelyn Waugh, a British novelist, wrote the best book ever written on journalism, called "Scoop". It's so funny and wonderful! I must have read it 20 times.

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