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Cross-Disciplinary Exchanges

An Interview with Edward R. Tufte

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Widely read in many areas, including technical communication, Edward R. Tufte is arguably the preeminent authority on data and statistical visualization. His influential book, *The Visual Display of Quantitative Information* (1983), appeared over two decades ago. Since then, two additional books, *Envisioning Information* (1990) and *Visual Explanations* (1997), along with a provocative, critical essay on Microsoft's PowerPoint (2003) software, have established Tufte as one of the most visible of thinkers in a rapidly growing field.

Although many may refer to this field as "information design," Tufte, as he indicates in this interview, has come to prefer the name "analytic design." That name reflects Tufte's focus on visual displays that serve as evidence. Although much of his early work addressed statistical evidence reasoning, Tufte has since moved to the realm of visual evidence more broadly conceived. As he explained during the interview,

> A big intellectual move in my work and my teaching came together in *Envisioning Information*, which I think is the most original of the books, the most theoretical. It essentially opened the entire world of visual evidence up so evidence was no longer statistical graphics—it was the whole world of seeing and thinking, bringing together how seeing and therefore thinking could be intensified.

The intellectual tradition with which Tufte's ideas are most clearly aligned is not rhetoric or even human factors theory. Rather, it is cognitive science. His principles of visual display are predicated on the idea that excellence in visual design is largely realized through the creation of graphics that correspond with the mental tasks they are meant to support. So, as he argues, "If the thinking task is to under-

stand causality, the task calls for a design principle: 'Show causality.' If a thinking task is to answer a question and compare it with alternatives, the design principle is 'Show comparisons.'"

His emphasis on identifying design principles that support cognitive tasks has led him to distance his work from other arenas that also deal in design, such as marketing, propaganda, and commercial production for mass markets. Rather than spending time thinking about how design works in arenas such as these, Tufte opts to study designs that are primarily meant to help people reason about data and how the data may be used. As he said, "At their best, graphics are instruments for reasoning."

This focus has led Tufte to become a harsh critic of design practices that obfuscate rather than reveal. He is noted, for example, for coining the term "chartjunk" to label graphic design elements that decorate thin data or complicate complex data. The value he places on eliminating superfluous design elements, however, should not be confused with an overarching emphasis on simplicity. Most of the examples he deals with in his books are sophisticated designs that exemplify rich, complex data and ideas. For example, he examines how graphics can best represent multivariateness in time and space. In this vein, his study of designs that escape what he calls the "flatland" of ink on paper and that consequently reveal things about the three-space of the physical world is just one example of how his work advances a high-level conversation about design.

As he discusses in the interview, Tufte's goals are ambitious. He is ultimately interested in exploring design principles that are rooted in nature rather than the contextual variations of culture, language, and so on. Consequently, he draws on examples from a variety of cultures, time periods, and locations. Rather than focusing primarily on the obvious and unique characteristics of those examples, he explores what they can tell us about design principles that seem to transcend individual circumstances. Tufte is careful, however, to distinguish between his speculative inquiries into design practices that appear to function universally and his advice to designers about their day-to-day work. He emphasizes in the interview that he has no intention of producing a "laundry-list type of book—how to do this and that—a guidelines-type book." As he clarifies in his concluding statement in *The Visual Display of Quantitative Information*, designers should always thoughtfully deviate from the principles discussed in his work when those principles will not yield the desired results.

In practice, Tufte is a strong advocate of designers and design critics becoming engaged as public intellectuals. Through his own work in design, he has shaped both public and organizational thinking and problem-solving related to the two space shuttle disasters that occurred in the last two decades. Likewise, he has joined and helped shape the ongoing public discussion about the implications of Microsoft's dominance in the software industry by focusing attention on the cognitive implications of the widespread presentation application, PowerPoint. This type of engagement with public issues is complemented by his frequent contribu-

tions in *The New York Times* and other media as a commentator on data and design issues. At a more local level, he is actively involved in preserving open spaces for wildlife and public use around his community of Cheshire, Connecticut.

A Professor Emeritus at Yale University, Tufte taught for thirty-two years, first as Professor of Politics and Public Affairs at Princeton University and then as Professor of Political Science, Statistics, and Computer Science at Yale University. With a BS and an MA in statistics from Stanford University and a PhD in political science from Yale, he also holds honorary doctorates at a number of colleges and universities. He has also held fellowships from the Guggenheim Foundation and the Center for Advanced Studies in Behavioral Science. He is currently a fellow of the American Academy of Arts and Sciences and of the American Statistical Association.

Tufte maintains an active teaching career with his one-day workshops held throughout the United States. As a consultant, he has worked on data design and statistical matters for print and television news organizations, corporations, and a range of government agencies, including the U.S. Census Bureau, the Centers for Disease Control and Prevention, the National Science Foundation, and NASA. He is the founder and owner of Graphics Press, which for the last 20 years has published his works on design. In addition, Tufte is author of *Political Control of the Economy* (1980), *Data Analysis for Politics and Policy* (1974), and, with Robert A. Dahl, *Size and Democracy* (1973).

MAJOR PUBLICATIONS BY EDWARD R. TUFTE PRODUCED BY GRAPHICS PRESS

2003 *The Cognitive Style of PowerPoint* (essay)

1997 *Visual Explanations: Images and Quantities, Evidence and Narrative*

1997 *Visual and Statistical Thinking: Displays of Evidence for Making Decisions* (booklet)

1990 *Envisioning Information*

1983 *The Visual Display of Quantitative Information*

EVIDENCE AND AESTHETICS IN DESIGN

TCQ: You have a new book coming out this year: *Beautiful Evidence*. Could you tell us about this project and its relationship to your earlier work?

Tufte: The title represents what I have been thinking about for seven or eight years now—issues of scientific evidence and issues of beauty. The leading edge in evidence presentation is in science; the leading edge in beauty is in high art. To see the future of analytical design, read *Nature* and *Science*, which routinely publish the remarkable visual work of practicing scientists (who have enormous amounts of data, who are bright and well funded, and who often have something to tell the world). *Beautiful Evidence* follows a growing concern in my work: assessing the quality of evidence and of finding out the truth. The other side is that sometimes displays of evidence have, as a byproduct, extraordinary beauty. I mean beautiful here in two senses: aesthetic or pretty but also amazing, wonderful, powerful, never before seen. In emphasizing evidential quality and beauty, I also want to move the practices of analytical design far away from the practices of propaganda, marketing, graphic design, and commercial art.

The commonality between science and art is in trying to see profoundly—to develop strategies of seeing and showing. This seeing is not about "Aren't these pictures of molecules beautiful?" Rather, the point is to recognize the tightness between seeing and thinking on an intellectual level not just a metaphorical level. That tightness is expressed in the very physiology of the eye: the retina is made from brain cells; the brain begins at the back of the eye. Seeing turns into thinking right there.

TCQ: How does this connection between seeing and thinking play itself out in *Beautiful Evidence*?

Tufte: *Beautiful Evidence* is about the theory and practice of analytical design. The purpose of analytical displays of evidence is to assist thinking. Consequently, in constructing displays of evidence, the first question is, "What are the thinking tasks that these displays are supposed to serve?"

The central claim of the book is that effective analytic designs entail turning thinking principles into seeing principles. So, if the thinking task is to understand causality, the task calls for a design principle: "Show causality." If a thinking task is to answer a question and compare it with alternatives, the design principle is: "Show

comparisons." The point is that analytical designs are not to be decided on their convenience to the user or necessarily their readability or what psychologists or decorators think about them; rather, design architectures should be decided on how the architecture assists analytical thinking about evidence.

In the book, I lay out eight principles of analytic design that derive from this theoretical base, and then I show how these principles lead to a set of new designs and favorite old designs that try to set standards for most all evidence displays. The book includes displays called sparklines/wordgraphs, a new way to show time series data. There is also material on an old idea now called mapped images, as well as displays on parallel mapping, causal arrow-linking lines, cladistic diagrams, and evolutionary trees. There are ideas about how time series, flow charts, and all scientific images should be redone. Another long chapter concerns rhetorical ploys in evidence presentations—ploys such as saying, "Our results are conservative" or "Our results are significant at the .000001 level"—a kind of self-congratulation by the researcher. There are probably about twenty of these rhetorical ploys.

TCQ: When will the book be finished?

Tufte: The first three books took me seven years each. This one might take me a little longer. I am not sure. Authors are worse than home construction contractors in their stupendous optimism about when something will be done. The book is already long, and I still have quite a bit to say.

TCQ: Your comments on analytic design suggest that its important principles are not dependent on culture. Several examples in your work, however, are drawn from Asian and specifically Chinese and Japanese sources. Do you have any specific interests in Japanese or Asian design practices as opposed to those in the United States or Europe? Or do you find culture to be a useful way of categorizing design practices?

Tufte: My wife and I took our extended honeymoon in Japan in 1985 and lived there for a little while. The intellectual idea was to go to the farthest away, highest resolution, technically advanced culture—that is, to increase the variance of our seeing. That time in Japan was an enormous help in creating *Envisioning Information*. It opened up the scope of my work to include completely fresh images.

In *Beautiful Evidence*, I am now writing about some Chinese images, but again the point is not to go to China but to go where people

were printing with new movable type centuries before Gutenberg—and integrating text and image.

TCQ: How did you decide to self-publish your books on design?

Tufte: In 1975, when Dean Donald Stokes of Princeton's Woodrow Wilson School asked me to teach statistics to a dozen journalists who were visiting that year to learn some economics, I annotated a collection of readings, with a long section on statistical graphics. The literature here was thin, too often grimly devoted to explaining use of the ruling pen and to promulgating "graphic standards" indifferent to the nature of visual evidence and quantitative reasoning. Soon I wrote up some ideas. Then John Tukey, the phenomenal Princeton statistician, suggested that we give a series of joint seminars. Since the mid-1960s, Tukey had opened up the field, 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.

After moving to Yale University, I finished the manuscript in 1982. A publisher was interested but planned to print only 2,000 copies and to charge a very high price, contrary to my hopes for a wide readership. I also sought to design the book so as to make it self-exemplifying—that is, the physical object itself would reflect the intellectual principles advanced in the book. Publishers seemed appalled at the prospect that an author might govern design.

Consequently I investigated self-publishing. This required a first-rate book designer, a lot of money (at least for a young professor), and a large garage. 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 and typography. 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 that the book advocated. To finance the book I took out another mortgage on my home (back then at 18 percent). 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?

THEORY AND RESEARCH

TCQ: The idea of universal principles is central to your work on visual displays. Would you elaborate on the universality that you suggest is seminal to the human experience?

Tufte: I do believe that there are some universal cognitive tasks that are deep and profound—indeed, so deep and profound that it is worthwhile to understand them in order to design our displays in accord with those tasks. These tasks are understanding causality, multivariateness, and comparison.

The speculative part of my work is that these particular cognitive tasks—ways of thinking analytically—are tied to nature's laws. That is to say, nature's laws are causal; they reveal themselves by comparison and difference, and they operate at every multivariate space/time point.

My idea here is that, inasmuch as certain cognitive tasks and principles are tied to nature's laws, these tasks and principles are indifferent to language, culture, gender, or the particular mode of information that is provided. There is an analogy here with Chomsky's theory of language: that certain rules of language—or in my case, cognitive tasks—come built in.

This high-level speculation about universality is not central to a theory of analytical design. The key argument is that *cognitive tasks should be turned into design principles*. The argument depends on the statement, "The point of analytic design is to assist thinking."

TCQ: You have discussed elsewhere (your 1994 and 1997 Computer Literacy Bookshop interviews with Dan Doernberg) your interest in "forever knowledge" and writing books that reflect such knowledge. Your principles and your speculations about universality, it appears, are part of your contribution in this area. Could you elaborate on the meaning of "forever knowledge" and the significance of this idea to you?

Tufte: The idea of trying to create things that last—forever knowledge—has guided my work for a long time now. Back when I did research in political economy, I used to write books filled with proper nouns and dates—proper nouns like "Gerald Ford" and dates like "the 1976 election." Such work does not have a very long shelf life because there will be new elections and because people can act on and change the knowledge we gained about systems like political economy.

My scholarship changed in the 1970s while I was at the Center for Advanced Study of the Behavioral Sciences at Stanford. Robert Merton, the great sociologist, was also there. He taught me a great deal about scholarship. It began when he looked over a manuscript of what ultimately became my book on political economy, *Political Control of the Economy.* Bob did a lot of editorial commenting and was a wonderful editor and kind critic, one-on-one. Near a completely undistinguished paragraph I had written, Bob wrote "an echo of Veblen," a distinguished social theorist. What this said to me was not that the paragraph was good, but rather "Why don't you try playing in the big leagues?"—that is, to do work that might last for a long time.

That thought has made an enormous difference to my work. It allowed me to escape the scholarship of reprints and of last month's research journal. It transformed my sense of audience—I was not writing for the dean or a few of my colleagues; I was writing for something very different. It freed up my thinking to be able to have ideas from 1610 and not just from 2004. Such a realization allowed me to see much more of the world. It also sets a rather grand goal, which is to try to do work that will last a long time.

It took me about a year and a half to make *The Visual Display of Quantitative Information* more universal. My next book, *Envisioning Information*, was entirely written in the universalizing spirit. It is hard to tell what country that book is from by looking at the examples. If anything it looks like it might be from Japan. That is probably because I have learned so much from Japanese graphics, but it also points to my realization that certain ideas about design, seeing, and thinking show up all over the place.

PEDAGOGY

TCQ: As someone who has devoted much of his career to teaching—both within the university and in other settings such as your one-day workshops—you obviously have ideas about the practice of education. What is your approach to teaching?

Tufte: The goal is to provide analytical tools that will last students a lifetime. A practical part of my teaching is to provide demonstrative, hands-on experiences. I bring physical objects like O-rings or the books of Galileo, Euclid, and Newton. The idea is to actually see the things that we are talking about. I think these methods and my style

are successful with at least some students. I like to give every student every day lots of pieces of paper, many handouts. For years I had a Xerox machine in my living room, running away the night before my lecture.

Along with thirty-two years of being a professor at Princeton and Yale, I also greatly enjoy teaching out on the road. I go about one week a month on tour and give a one-day course. This has been going on now for twelve years; 120,000 people have attended the one-day course. This does get the word out.

Another aspect of teaching is the public, open office-hours forum on my website—an *Ask E.T.* forum where people write in questions and I try to answer them. And then other people write in to correct me. The URL is <www.edwardtufte.com>. That has been really quite something. There are 600 threads up there now. This forum is a way to provide custom, personal answers or to post thoughts that I want to get out into the world. For example, when *Columbia* went down, a month later I posted an analysis at *Ask E.T.* My analysis eventually was published in the *New York Times* and in the report of the commission investigating the *Columbia* accident. So the forum is not only to answer questions, but it is also to get things out quickly on the Internet.

TCQ: As you must know, there has been a great deal of talk about visual literacy in education. What is your response to this emerging movement?

Tufte: I have often given talks and been introduced with, "This is the Disney Foundation Memorial Lecture Series on Visual Literacy. Professor Tufte will speak today on visual literacy." I just have to go ahead and give my regular talk because I have no idea what that means. Better than "visual literacy" is "evidence reasoning." There is plenty of philosophizing about texts and images, but that distinction does not make any difference to the evidence. Evidence should not be differentiated by the mode of production. Word, number, image—it is all evidence.

AUDIENCE

TCQ: What limits would you place on the overarching cognitive principles you emphasize for visual displays? For example, you often mention in your books the intended audience or different uses for vi-

suals. How does audience—and the varied contexts for producing and interpreting visual displays—fit into your thinking?

Tufte: When most people begin their advice about communication, their first grand principle is "know your audience." In practice, that statement too often leads toward underestimating the quality and interests of the audience. The know-your-audience philosophy can be a big step down the road to pandering to the audience. I think sometimes if we anticipate too much the characteristics of the reader, we are going to censor ourselves or change our work—and I think all too often wrongly. The way a lot of people are shut up is by anticipating what they think others will say about them, and in fact all those others don't really care. It is this self-censoring derived from some model of the audience (or of a "they") that I think is harmful in a good many situations.

On the other hand, it is important here to distinguish between advice I give to myself or strategies that I use in my own work and those strategies that apply to other people's situations. My own point of view is similar to that of Gore Vidal: "Let the writer write and let the reader read." For my part, I can try to reduce the noise in the communication and try to be civil, but the most important thing of all is to say what I have to say.

It is a very different situation if you are designing a product, designing for mass consumption. My high and noble principles are meant for making my own work and have little to do with what makes for a successful commercial product.

Having grown up a bit, I try to get out of first-person singular when giving advice. It can be dangerous to listen to authors about how to write or establish communication; they can only say what has worked for them or how they work. With an N of 1, a sample size of 1, the variance is infinite. You never get more variance reduction than when you go to $N = 2$. So maybe others had better think a bit about the audience, at least in some regards.

The part of my work on visual designs where situation and audience come into play to some extent is in trying to reduce impediments to learning.

THE PUBLIC INTELLECTUAL AND ETHICS

TCQ: In your work, you seem to be very concerned with ethics and civic responsibility—with making a difference in the world. Your work

certainly has influenced public discussion about things such as the space shuttle disasters, elections, news graphics, and PowerPoint. Would you talk about your inclination to be involved in these public discussions?

Tufte: My father worked for governments all his life as an engineer and public works director. My mother worked as a professor. So there is a family tradition of teaching and public service. We want one's thoughts, ideas, and values to have consequences. I also have a bachelor's and master's degree in statistics, where the work tended to be largely bio-statistics, medical statistics, and epidemiology. As a result, I think some of the people who best capture my values are from the Centers for Disease Control because they represent a mix. They work in public service, and they work with evidence. Their work involves a kind of a mix of physical laws and human uncertainty—the uncertainties we have about human things. It is policy, it is intervention, it is causal. People there make sacrifices to do that work for the public good.

There is a proselytizing quality to my work; the standards and principles probably come from genes and education.

At its heart, my work is about how to think clearly and deeply, using evidence, and all that has to pass through some presentation state. In writing about the display of evidence and presentations of evidence, I am also writing about how to reach credible conclusions. Entangled in that is a strong ethical component that shows up in the first book about the lie factor in graphics and encouraging the mass media to stop lying about data. When you say that graphics lie, that means you believe that there are truths, or things that are a lot closer to the truth than what is being said in the lying graphics. I am certainly not an intellectual relativist, nor a moral relativist. I hope that I am generous and tolerant, but certainly on the intellectual side I think that there are discoverable truths, and some things that are closer approximations to the truth than others.

TCQ: And this has led you to engage in broader public discussions?

Tufte: This is one reason that I wrote the essay on PowerPoint, because I thought that too many PP presentations were not about truth and evidence. They were about power and marketing. That essay suggests PP, because of its cognitive style, is a moral or an ethical issue because PP so strongly enforces a certain type of cognitive style, which is not truth oriented but rather marketing oriented.

In my work, there is an effort to raise standards—by admiring excellence, saying that there are things that are good and there are things that are bad, so get out and tell the world about it.

TCQ: What are the consequences of your willingness to engage in such public discussions?

Tufte: Public discussions are part of what it takes to make changes in the trillions of graphics published each year. You have got to get the word out; there is nothing like being in *The New York Times* or on the slashdot website to get the word out.

A curious consequence is that I have become a minor celebrity. I have a hint of what a real celebrity must go through every day—a flood of interesting, encouraging, importuning, angry, weird, scary communications. I am not sure quite how to respond to all this. Now and then I ungratefully mutter Bob Dylan's remark: "Just because you like my stuff doesn't mean I owe you anything."

TCQ: Ethics in business and the corporate world have been featured prominently in national news stories over the last few years. From your perspective, what are the implications of these events for technical communicators and designers?

Tufte: For those going into the corporate world, the key choice point is *where* you go to work. You had better, for example, see what clients the company has. Once you start working for the company it is probably too late. The socialization is strong, and the masking of responsibility is strong, so that it is probably a little bit late and a bit hard to ask people to change jobs because we don't think the companies they work for are doing the right thing.

It is straightforward for me to be ethical, responsible, and kind-hearted because I have the resources to support that. I have a lot of privilege and plenty of resources that enable me to try to do good. I admire President Kennedy's thought: "To whom much is given, much is expected." I have always felt that with success comes a responsibility to use one's success for the purposes of good. It is a perfectly natural feeling.

TECHNOLOGY

TCQ: In much of your recent work, you have addressed connections between digital technologies and visual displays. You have, for example, talked about computer displays as being very limited because of their low density and low resolution.

Tufte: I wouldn't say *very* limited; they are getting better. I am happy with my Apple Cinema monitor. It would be good if someday the type on computers looked like real type. With some resources you can break the resolution problem, getting a Cinema monitor or multiple monitors. Power users, in their offices, have multiple monitors to get more things up. They put the administrative debris on one screen, and they have the real stuff on another. So we are not prisoners entirely of the low resolution and the fact that interface designers steal away space that should go to our content.

TCQ: How does this connect with limitations imposed by software, or what you have called elsewhere the "cognitive style" of software?

Tufte: I think it is important for software to avoiding imposing a cognitive style on workers and their work. Excel does not have a cognitive style. Word does not have a cognitive style. Nor does PhotoShop, QuarkXPress, or Adobe Illustrator. On the other hand, PowerPoint has a distinct cognitive style, and Windows has a commercial attitude.

TCQ: What about the Internet?

Tufte: Probably the only generalization about the Internet is that there is none, which is to say that users can have nearly any experience they desire. Internet users are not prisoners—they are responsible for their experience since they can generate nearly any experience they wish (other than an in-depth historical analysis).

TCQ: Do you yourself have some guidelines that you employ when you are making decisions about whether to use paper or a computer display? You have spoken passionately about paper.

Tufte: I like paper for its permanence, its high resolution, its portability, and its physicality. I find the computer screen rather limited when I put some of my book material on it. My books are written to the double-page spread. On a computer screen, it is hard for most people to even see a complete single page. The more I work on the computer, the more I appreciate the amazing qualities of the book, particularly the way books support high-speed and also high-resolution scanning.

Ultimately, I guess my guideline would be to use everything you can to get the word out, remembering that often various display methods can be used in parallel.

TCQ: You have talked elsewhere about the inordinate influence that programmers have over interfaces. What alternative would you advocate?

Tufte: One model is outside-in design, wherein the interface is first thoroughly specified, completely independent of the technology. Once that interface is established, then you go to technology and say, "Please, can you help me do this?" Software is too often created the other way around. There are all these technologies around desperately looking for some kind of problem to solve. Instead, they should be saying we have a content problem, and we need to find a solution for that content problem.

These days, the operating system, the browser, and e-mail are overrun with marketing experiences. All of this stuff—the OS, the apps, and the marketing experience—reduce the content resolution of the screen by about half. And none of it is necessary; it is simply serving the economic needs of the computer companies. Users in fact never need to see an operating system or applications for that matter. Users should never have to come to the computer and say, "Oh, good. I'm going to open PhotoShop today, and that is going to be my big accomplishment." You come to work on an illustration, to work on an image, to work on a document.

CONSULTING AND THE WORKPLACE

TCQ: Over your career, you have worked as a consultant for many companies and organizations. In the 1990s, you talked about some frustration in working as a consultant in technology companies.

Tufte: For a while I did a great deal of consulting—from 1970 to about 1990. As a consultant, I learned about companies and how they work, and about computing and design. My difficulty was that it was hard for me to have any consequences. In other words, I learned a great deal, and they did not learn all that much. It was not a fair exchange. That partly was because maybe I didn't have much to say, and partly because the things that I did say were for one reason or another simply impossible to do.

I was, for example, corporate consultant for information and interface design at IBM back when Paul Rand was the graphic design consultant and Richard Sapper was the industrial designer. I did early work on OS2 and Windows back before IBM and Microsoft got their divorce. There were so many constraints in that work. Some guy coming in from out of town, from New Haven, couldn't make much difference in the system. Also, changing a serious, big company like IBM is like trying to change Sweden; it is a mammoth

enterprise. I greatly admire Richard Sapper, who did industrial design for IBM, because he got the whole industrial design process under control. It was really something. And, as a result, IBM did good product design world round. But it was hard for Paul Rand to get graphic design under any kind of control because there was so much of it, or, similarly, for me to get interface design and information design under control.

TCQ: What have been some of your successes as a consultant?

Tufte: In the early 1980s, I was involved in the election and data reporting at the *New York Times*. Some of this work persists to this day.

At IBM, I had some influence on the technical manuals. I worked on getting rid of some of the ticks common in technical writing at the time, like writing in the second person and endless repetition. That was when technical writers or their managers believed that they measured productivity by the page, so that encouraged very fat books, which are not looked at because they are too overwhelming. I should also say that John Carroll at IBM did good work on the minimal manual. I think that was a major contribution. That was also really my big effort at IBM—to try to induce shorter, tighter, high-resolution manuals that had less marketing and were just straightforward.

I also did some consulting work at Bose Corporation that has been written up in articles in *Metropolis* and in *Fortune*. That was successful consulting, perhaps because it was in a small company, and I was close to the top people. My friend Paul Rand had the notion that he would never consult for anybody unless the president of the company called because you don't win out by persuasion but rather by power. So he wanted support from the top in his work. Because the method of governance in companies is not entirely democratic, you are more likely to get your way if you have control over somebody's budget or their promotion, things like that.

TCQ: Do you think that the technical communicators who are employed by corporations could be making more of a difference in the quality of information available today?

Tufte: They can make more of a difference the more resources and more power they have. The more time and the more money spent on technical communications, the better they will be. Too often now they are in effect asked to fix product defects in publications.

Technical writers should have some ability to intervene in the design of these products and say, "This feature you are adding—nobody is going to use it because it is so badly designed that it is going

to be very hard to understand and impossible to explain." The reply will be that this feature is not for users. It is for marketing. I think good technical writing has to be involved with the design of the product itself. Big improvements in technical writing will come from having a well designed and easy-to-use product.

TCQ: What are important issues now in technical communication?

Tufte: One problem from the user's point of view is that any given manual may be perfectly fine, but most of us are confronted with a multiplicity of interfaces. Just start to add up all the interfaces: that stove, this dishwasher, that microwave, those cameras, that cell phone, this and that computer, and so on. All the differences among those interfaces make a difference. While all the interfaces can be perfectly good when viewed individually, in aggregate it is hard to have much retained learning. For example, when I get a new camera, I take it with me on a trip and dutifully work through the manual. I am the master of that camera in two to three hours and take a few good pictures. I put the camera down and come back a month later, and there is little that has been retained. Somehow we need to have interfaces and explanatory explanations of interfaces that lead to retention and avoid interference from the multiplicity of interfaces.

The top level of most product interfaces is quite good these days. The lower-down levels, where the featuritis fungus thrives, are too often jungles.

FUTURE PROJECTS

TCQ: With Graphics Press, a new book in progress, your consulting and workshops, and your ventures into sculpture, photography, and other art forms, you obviously show no signs of slowing down. What are your goals for the future and the projects you are planning?

Tufte: There is *Beautiful Evidence*. A big body of sculpture work going on. There is a book I wrote a long time ago called *Data Analysis for Politics and Policy*, and I am now thinking of doing a second edition—or a new edition—of that for teaching courses in statistics and evidence. I hope eventually to catalog my art and sculpture.

I keep learning and seeing new things.