The Mind Is Not a Camera, The Brain Is Not a VCR

Some **psychological guidelines** for designing charts and graphs

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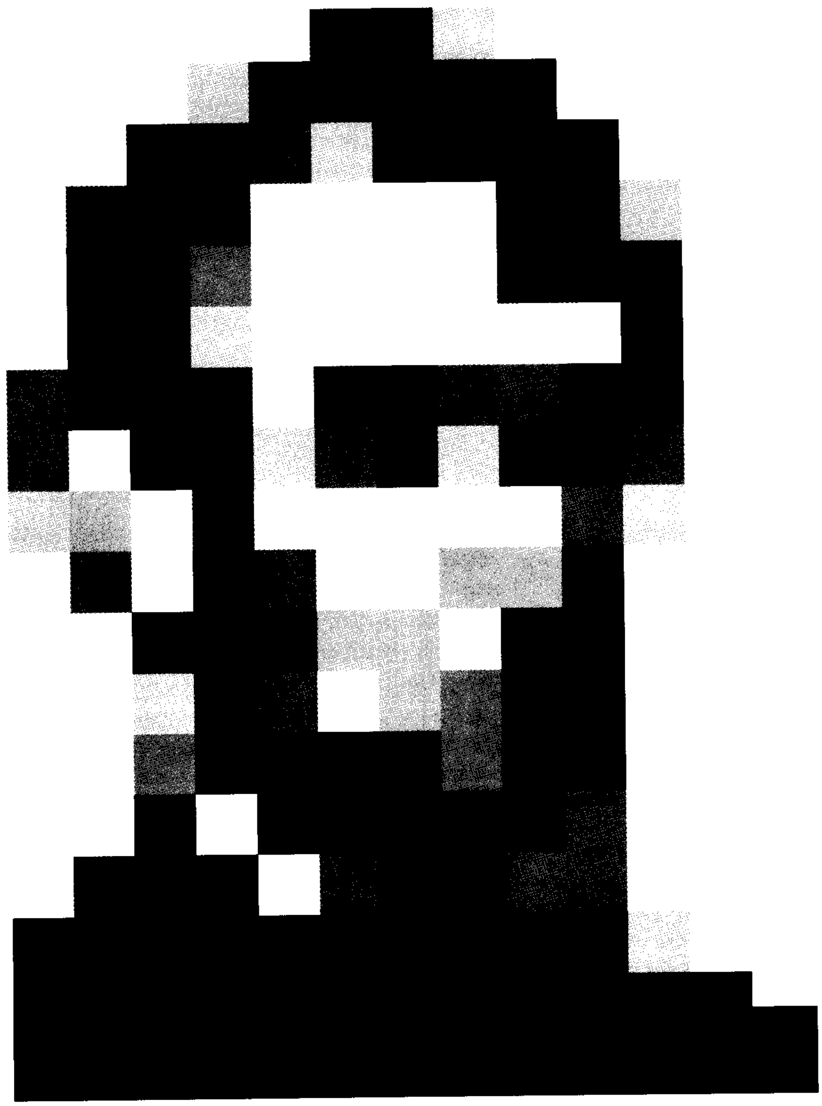
The emblem of the information age is the information graphic. The use of snappy color charts and graphs in newsmagazines, an innovation often ascribed to *Time* magazine's Nigel Holmes, has spread to special-interest magazines, journals, national newspapers (*USA Today* and a host of imitators), local dailies, television news, even Ross Perot's "infomercials" and Jay Leno's sketches. This accelerating trend has been fueled in the past decade by technological developments such as PostScript, desktop publishing, color prepress, and graphical user interfaces. Today, more than anything else, the multicolor bar graph is a symbol of a publication's membership in the big leagues.

If you catch a designer or editor in a moment of candor and ask why he uses information graphics, you might hear him admit to simply following the fashion of the day. More likely, though, you'll hear one or more of these answers: Infographics are eye-catching, they have "instant impact," they simplify complex ideas, they give information an aura of "scientific" credibility, they are easier to digest, or that a picture is worth a thousand words (and usually takes up less space).

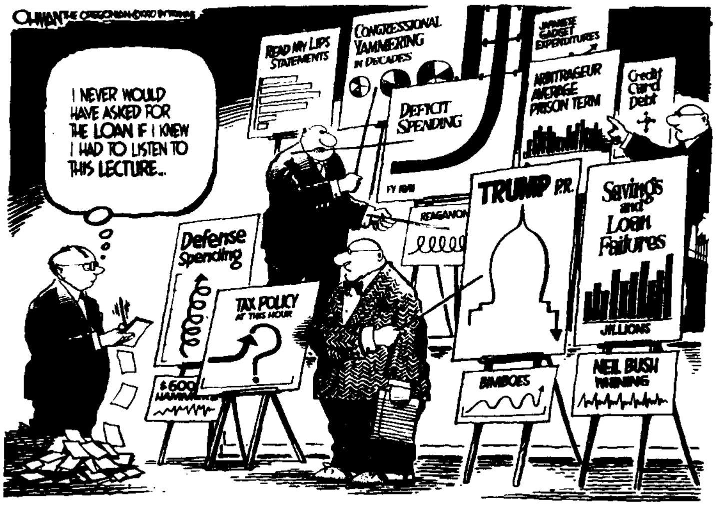
In fact, the Chinese adage places a value of *ten* thousand words on a single picture, but it does not take great insight to realize that only a well-drawn picture is truly worth its ink in words. After all, text has proven its power to express ideas over several millennia, whereas the modern information graphic was invented about two centuries ago, and its full possibilities have yet to be realized. At times, our prodigious ability to produce attractive graphics outstrips our knowledge of how to design and use them well. The result is a glut of beautiful ciphers—incomprehensible images clogging the information stream and *impairing* our understanding of the world and the issues that matter to us.

Some ways of preventing the medium from obscuring the message can be found in experimental psychology, the scientific study of perception, memory, and thought. The experimental approach to understanding behavior is a multifaceted enterprise, but some of its findings can be distilled into principles that are easy to understand and can be applied to your own work every time you set out to produce a new infographic—whether it is a chart, graph, map, diagram, table, or any other visual display of information.

Some of these recommendations will seem intuitive and commonsensical, whereas others may strike you as a bit strange until you see them demonstrated and use them yourself. Let's focus on what may be the most common misconception in infographic design, the idea that the human mind is a passive recorder of what it sees, a sort of information sponge that simply soaks up whatever we show it—once we have grabbed its attention in the first place, of course. This is simply wrong.



Why is this image easier to make out when it's blurred? See the section on "Texture channels," on page 37.



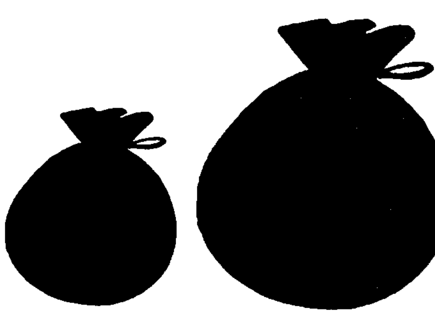
Although its topical references are dated, this 1990 cartoon portrays well the overwhelming profusion of graphs and charts in contemporary life.

The mind is not a camera, the brain is not a VCR—and a moment's reflection on your own experiences should convince you that human visual perception is a more subtle process than record, rewind, play back.

Ask yourself why, although you readily notice a gain of five pounds on a thin person, you normally overlook it on someone who is overweight. Or why you see reflectors on a dim highway or geese flying overhead as connected rows or formations, even though they're really isolated objects. And how it is that former athletes literally "see" much more when watching the Olympics than do people who are seeing a sport for the first time. Like breathing or walking, these phenomena are so natural that we normally give them no thought. But they are direct consequences of the way our eyes and brains work. Unlike cameras and VCRs, our minds are constantly and actively organizing and making sense of the visual world. Effective information graphics will take advantage of the strengths and avoid the weaknesses of human cognitive abilities.

Here are a few specific principles that should be useful in your work.

To most people, the moneybag on the right doesn't look twice the size of the one on the left—but it is. Beware of using area to display the precise relationship between quantities.



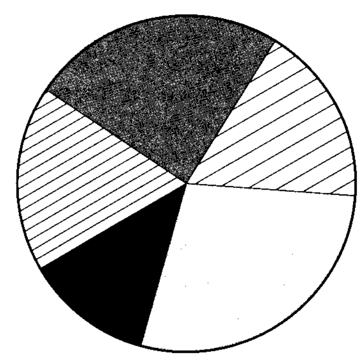
The eye is automatically drawn to change.

Brain cells are "difference detectors." What excites our neurons is not the *absolute* magnitude of a stimulus but its *relative* magnitude—that is, the *difference* between visual elements is what stands out. Our attention is automatically drawn to the parts of a visual display that are different, and our minds reflexively assume that these most salient aspects of a display have special significance. So, when designing charts and graphs, be careful to make changes mean something.

For example, in a pie graph of mostly black and white slices, a single red slice will command our notice and memory, so it had better correspond to the most important information you want to present. This principle helps to explain why gaudily decorated graphs are difficult to understand: our attention is constantly being pulled away from the information towards the content-free parts of the display—which, ironically, were put there to attract our gaze in the first place.

Our minds aren't good at precisely comparing areas.

The basic principle of a bar graph is to use the relative lengths of straight lines to represent quantities. This works well because our minds perceive the lengths of lines quite accurately; if you show someone a one-inch line next to a two-inch line, she will say that it is about half as long as its neighbor. But what works for length fails for area: people perceive areas as being smaller than they actually are, and this tendency is greater as the size of the area increases. So, if you present two circles, one twice the area of the other, the large one will



The frequencies of these two diagonal-line fills differ by less than 2 to 1, so they're processed by the same "channel." As a result, they're hard to distinguish, and it's hard to focus on one without the other intruding.

seem to be less than twice as large as the small one. The same is true with volume, except that the distortions are even greater. Therefore, use area or volume to show quantity only when what you want is rough ordering (that is, to show that one thing is larger or smaller than another). If you want your viewers to receive an accurate impression of the differences, use length instead.

Perception works in "channels."

One of the most important ways in which the visual system differs from a camera is in the number of "lenses." A camera normally has one, but the brain operates as if it has several lenses, known in the literature as *channels.* In each aspect of visual perception—such as color, shape, or texture—the brain perceives information through several channels. The most important fact about these channels is that we are compelled to pay attention to all the information processed by a single channel, and can only untangle it with effort. This has several important implications for graphing.