

Edward R. Tufte

Visual Explanations

Images and Quantities, Evidence and Narrative

Graphics Press • Cheshire, Connecticut



Relying on the links of parallelism, well-crafted multiples provide high-resolution views of complex material. Illustrations of postage-stamp size are indexed by a category or a label, sequenced in time like the frames of a movie, or gathered along a fresh dimension not contained in each small element. For a broad range of problems in presenting numbers and images, small multiples will serve quite well. Since many slices of information are displayed within the eyespan, alert viewers may be able to detect contrasts and correspondences at a glance—uninterrupted visual reasoning. And some multiples, like good graphics of all kinds, are worth more than a glance; careful viewing may reveal subtle differences among the elements.

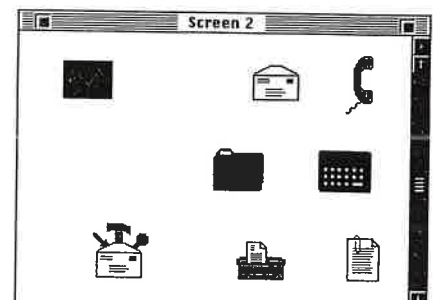
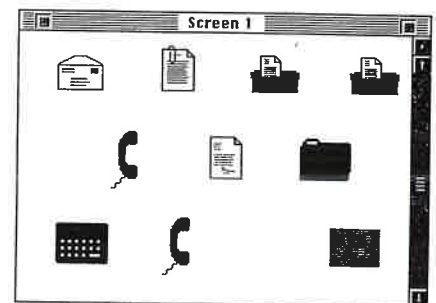
Fine distinctions in letterforms, for example, appear in the panel at near right: ten geometric constructions of the letter A, published from 1460 to 1529. These compass-and-rule constructions, developed in the Italian Renaissance, attempt to rationalize and make uniform the early inscriptional Roman letters (the Trajan Inscription was hand-painted and then cut into stone in 112 A.D.). The lines lay out a geometry for the systematic production of an entire alphabet. This methodical geometry is sometimes broken, however, in order to draw elegant brushlike curves of variable stroke-width; for these A's, perhaps a few of the serifs are fudged.

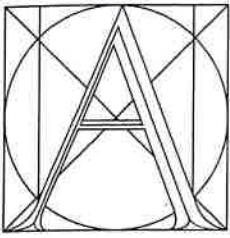
At far right, a redrawn panel of ten letters repairs several flaws in the original panel at near right. In the original, three A's are filled and seven are not, thereby creating two distinct—and meaningless—visual clusters (which vanish in the redrawing). Accidental communalities in design can easily induce false groupings in the eyes of viewers, who are often busy searching for visual hints that help to boil down, organize, group, and otherwise make sense of multiple images. False clusterings can result from inexpert use of color; for example, the icons of the upper computer screen here form two spatial clusters, the reds and the blues. Yet the only thing the members of each cluster have in common is the accident of their color, as viewers mistake the decorative tints for real information. Also, since multiples are distributed over time as well as space, false *temporal* clusters (the green sequence between screen 1 and screen 2) can arise as we move from image to image.⁶

The original panel of A's contains another flaw: the grids and the outlines of the letters are at the same visual level, with nearly equal line-weights throughout. In the revised panel, the construction lines are calmed down and differentiated (again, the smallest effective difference). We now see more clearly locations of the cross-bar, curls of the serifs, and thick-thin relationships among the strokes. Supplementing the redrawn letters are quantitative measures of stroke-thickness relative to the side of the square (ratios of 1:12 to 1:8 and corresponding proportions of .083 to .125), a matter of aesthetic controversy among 15th and 16th-century architects of letterforms.

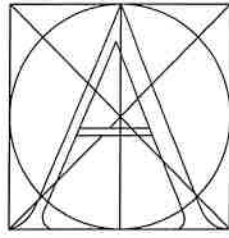
Sources for original set of ten letterforms in the near-right panel: *The Alphabet of Francesco Torniello da Novara* (1517), introduction by Giovanni Mardersteig (Verona: Officina Bodoni, 1971), shows the six Italian alphabets (three filled-in and three not, as in their first publication) with bibliography at pp. xxvii–xxviii; Stanley Morison, *Fra Luca de Pacioli* (New York, 1933), p. 23, shows Schedel, Dürer (at 1 to 10) and Tory. Dürer (at 1 to 9) is reproduced from p. 134 of Albrecht Dürer, *Institutiones geometricae* (Paris, 1532), the first Latin edition of *Unterweysung der Messung* (Nuremberg, 1525). Mardersteig's and Morison's sources are (with variants in spelling of names): Damiano da Moyle, *Alphabetum* (Parma, 1480); Sigismondo Fanti, *Theorica et practica de modo scribendi* (Venice, 1514); Felice Feliciano, *Felice Feliciano Veronese: Alphabetum Romanum*, ed. Giovanni Mardersteig (Verona, 1960); Luca Paciolo, *Divina Proportione . . .* (Rome, 1540); Francesco Torniello, *Opera del Modo de Fare le Littere Maiuscole Antique* (Milan, 1517); Jeoffroy Tory, *L'art et science de la proportion des lettres* (Paris, 1529); and Giovann Baptistia Verini, *Luminario* (Tusculano, 1526).

⁶ Aaron Marcus, *Graphic Design for Electronic Documents and User Interfaces* (New York, 1992), p. 86.

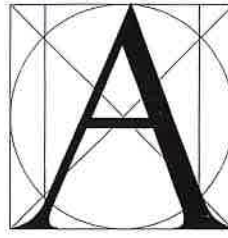




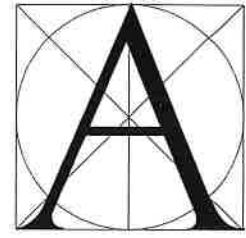
Felice Feliciano,
Città del Vaticano 1460



Damiano Moille, Parma 1480



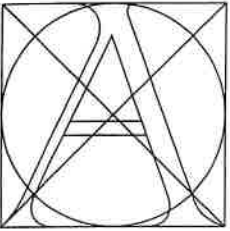
Felice Feliciano,
Città del Vaticano 1460



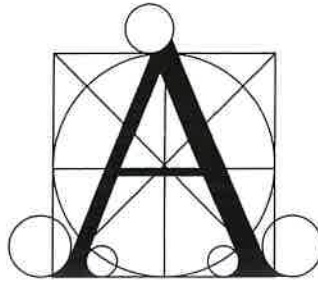
Damiano Moille, Parma 1480

1:10
.100

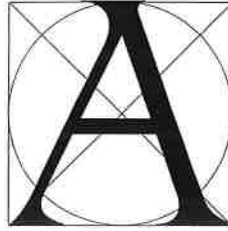
1:12
.083



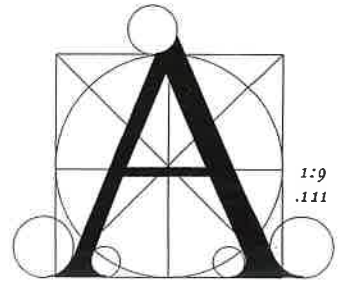
Hartmann Schedel, Munich 1482



Luca Pacioli, Venezia 1509



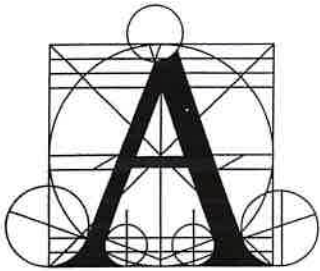
Hartmann Schedel, Munich 1482



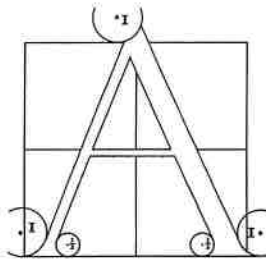
Luca Pacioli, Venezia 1509

1:10
.100

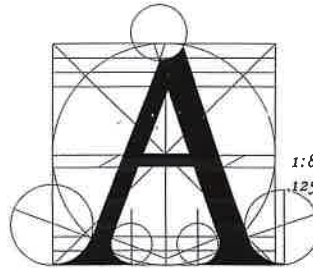
1:9
.111



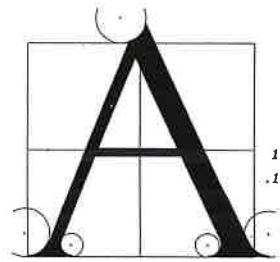
Sigismondo Fanti, Venezia 1514



Francesco Torniello, Milano 1517



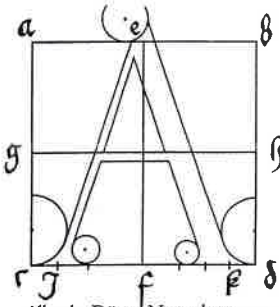
Sigismondo Fanti, Venezia 1514



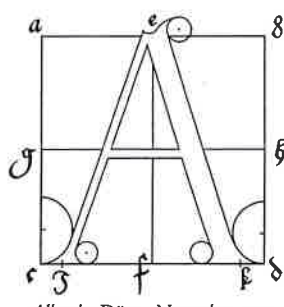
Francesco Torniello, Milano 1517

1:8
.125

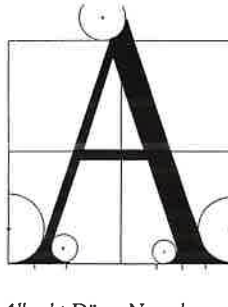
1:9
.111



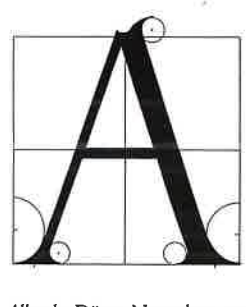
Albrecht Dürer, Nuremberg 1525



Albrecht Dürer, Nuremberg 1525



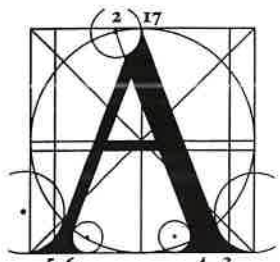
Albrecht Dürer, Nuremberg 1525



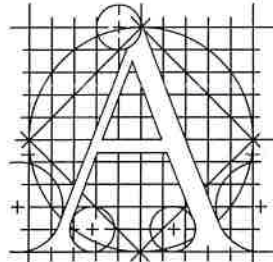
Albrecht Dürer, Nuremberg 1525

1:9
.111

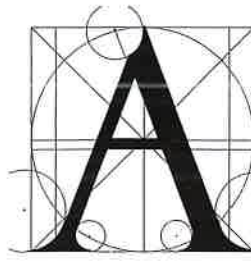
1:10
.100



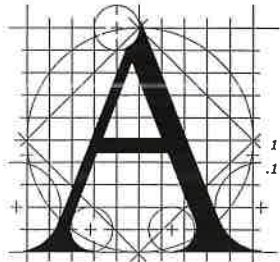
Giovam Baptista Verini, Toscolano 1526



Geofroy Tory, Paris 1529



Giovam Baptista Verini, Toscolano 1526



Geofroy Tory, Paris 1529

1:8
.125

1:10
.100