Before there was reading there was seeing. *Visible Language* has been concerned with ideas that help define the unique role and properties of visual communication. A basic premise of the journal has been that created visual form is an autonomous system of expression that must be defined and explored on its own terms. Today more than ever people navigate the world and probe life's meaning through visual language. This journal is devoted to enhancing people's experience through the advancement of research and practice of visual communication.

If you are involved in creating or understanding visual communication in any field, we invite your participation in *Visible Language*. While our scope is broad, our disciplinary application is primarily design. Because sensory experience is foundational in design, research in design is often research in the experience of visual form: how it is made, why it is beautiful, how it functions to help people form meaning. Research from many disciplines sheds light on this experience: neuroscience, cognition, perception, psychology, education, communication, informatics, computer science, library science, linguistics. We welcome articles from these disciplines and more.

Published continuously since 1967, *Visible Language* maintains its policy of having no formal editorial affiliation with any professional organization — this requires the continuing, active cooperation of key investigators and practitioners in all of the disciplines that impinge on the journal's mission as stated above.

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Charles Bigelow and Kevin Larson
Guest Editors

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Contents

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Visible Language

50 2

Reflecting on 50 years of typography

Charles Bigelow and Kevin Larson,
Guest Editors

This year we are celebrating 50 years since *Visible Language* began. Typography has always been a major focus of the journal — its original name was *The Journal of Typographic Research*. The field of typography has radically changed since the journal's debut in 1967:

Digital technologies have supplanted analog;
Electronic media have disrupted print;
e-books compete with paper books;
Hot-metal type foundries have disappeared along with manufacturers of hot-metal composing machines;
Digital type foundries have merged into conglomerates;
Small firms have sprung up to offer new typefaces and typographic designs for new forms of literate media — web sites, apps, e-books, displayed on computers, phones, watches.

Everyday readers who would not have thought about fonts a half-century ago, are now aware of and passionate about fonts and typography. Yet, for all those changes, more people are reading, and perhaps reading more than ever, with the same human eyes as before, so studies of legibility and reading have gained new prominence and importance. For this special issue we are happy to focus on some advances in typographic research during the past 50 years.

Over the history of the journal, scientific research of typography has always been a popular topic. Two issues in 1981, guest edited by psychologist Keith Rayner, are filled with classic scientific papers. The most cited paper in *Visible Language*'s history is a 1971 paper by Philip Gough titled "One Second of Reading", which proposed a model of the steps that a reader must accomplish during a single second of reading. One of this issue's guest editors (Larson) was lucky enough to have studied under Gough. This special issue continues in this tradition with articles on scientific studies of reading by Sofie Beier, Jonathan Grainger, and Gordon Legge.

The other guest editor (Bigelow), has a long history with *Visible Language*. He was a student of the journal's original designer, Jack Stauffacher, when it began, and was a guest editor in 1985 for a special issue of

"Computer and The Hand in Type Design," proceedings of a 1983 seminar at Stanford University. A second issue of those proceedings was cancelled, but two of the unpublished papers were retrieved with the generous assistance of the Cary Graphic Arts Collection of Rochester Institute of Technology, and are at last published here. These papers are fascinating archaeological digs into the early history of digital type: the first all-digital type foundry, by Matthew Carter; the invention of a spline and bitmap font editing program on early personal workstations, by Patrick Baudelaire.

Typography is a diverse field, and while we wish we could have included more topics in this issue, we are proud of those that appear here: Barbara Beeton and Richard Palais write about the TeX typesetting system for mathematics; Ryan Lee and Jeanne-Louise Moys analyze English versus Chinese layout in Hong Kong newspapers; James Mosley investigates the history of the now ubiquitous commercial @ sign.

There are also three special features in this issue. The first is a celebration of the lives of some of the typographic luminaries who helped bring this journal to prominence: Fernand Baudin, Edward Catich, John Dreyfus, Adrian Frutiger, Jean Larcher, Alexander Lawson, Robert Middleton, G. Willem Ovink, John W. Seybold, Miles Tinker, Merald Wrolstad, and Hermann Zapf. The second special feature is the result of a survey conducted of the top 50 typography books written in the last 50 years. And, in another instance of typographic time travel, we publish a recent letter to the *Visible Language* editor from type designer Steve Matteson, writing in reply to a 1968 letter to *The Journal of Typographic Research* from Hans Schmoller, renowned Penguin book designer.

Acknowledgements and Thanks

We appreciate the generousity of the Cary Collection for giving us access to the Baudelaire and Carter materials, and for their scanning of the texts and images, for which they waived fees. Personally, we wish to thank Amelia Hugill-Fontanel, the Associate Curator, and Steven Galbraith, the Curator.

"The Rochester Institute of Technology's Cary Graphic Arts Collection is one of the country's premier libraries on graphic communication history and practice. The collection's holdings include primary and secondary resources on the development of the alphabet and writing systems, early book formats and manuscripts, calligraphy, the development of typefaces and their manufacturing technologies, the history and practice of papermaking, typography and book design, printing and illustration processes, bookbinding, posters, and artists' books."

We also wish to thank Stan Nelson for permission to use his photograph of the French type mould of his own manufacture on the title spread of Matthew Carter's article.

The Xerox Alto Font Design System

Patrick Baudelaire

Guest Editor's Note

This article is from a talk given at Stanford University in 1983 at a seminar for the Association Typographique Internationale (ATypI). It describes pioneering digital font software developed at the Xerox Palo Alto Research Center in 1974. Built for prototype personal workstations, the software uses mathematical curves called "splines" to define the outlines of letter shapes that are converted to bitmaps (pixel mosaics) for use on computer screens and digital printers. This spline-bitmap model is used today for the screens of nearly all computers, smart phones, ebooks, and other text displays. Previously unpublished, the manuscript appears here as digital font archaeology – a glimpse of concepts from four decades ago that became the technology of much that we read today. We are grateful to Patrick Baudelaire for permission to publish it as he wrote it in 1985 and to the Cary Graphic Arts Collection of Rochester Institute of Technology for providing scans of the original manuscript and images in its collection.

Charles Bigelow

Keywords

font design, typography, letterform, software design, splines, bitmaps

Introduction

The Xerox Alto font design system was designed and built around 1974, at Xerox PARC's Computer Science Laboratory, initially as an experimental tool for helping in the production of digital typefonts for a growing number of prototype xerographic laser printers and display devices with very diverse resolution characteristics. At that time, it would have been presumptuous to imagine that the same system, only slightly adapted, would be in regular use, some ten years later, as a font digitization system for the Xerox printer product line.

Despite its daily usefulness, the system today [1985] shows sure signs of obsolescence in its performance and many of its implementation details, in both software and hardware. By current standards, however, it still performs quite well, and this endurance is a tribute to the quality of the overall design by Robert Sproull and to the remarkably advanced concepts incorporated in the Alto computer.

I will not attempt in this paper to present a comprehensive and detailed description of the operation of the system, which is fully described in a user's manual [1]. I prefer to give simply an overview of the system, trying to bring a critical eye on the design and the implementation of the software, a point of view now facilitated by time and distance. Before going further, it is important to stress that the system discussed here is an internal system, not a Xerox product, and that all the opinions expressed here are strictly those of the author and only engage himself.

General principles and overall organization

In the Alto system, as in several other systems [2], font production is basically a two-step process, resting on the geometrical representation of a character in outline form.

The process is illustrated in Figure 1. It is implemented by two main computer programs. FRED is an interactive graphics program used for defining the geometric outline of characters as mathematical spline curves. PREPRESS is used for creating automatically the appropriate digitized character in the form of a matrix of dots, for a given point size and a given printer (a process called scan-conversion). It is also used for touching up by hand the resulting dot matrix, also called a bitmap. (The DRAW program showed in Figure 1 is marginal to the process.)

The whole software was programmed for the Alto experimental workstation, a strikingly original personal computer, designed and built at Xerox PARC [3]. Its general size, performance and configuration (including a high resolution graphics display) made it well suited for interactive graphical

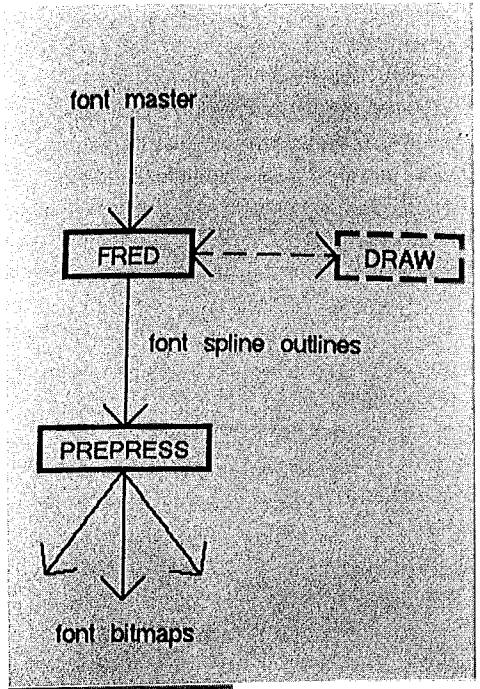

Figure 1.

The two-step process for producing digital typefonts.

interactions and friendly user interfaces relying on visual feedback. It has been the forerunner in a well-followed design trend of high-powered computers which has led to such recent products as the Apollo and Sun computers, the Xerox Star, Apple Lisa office workstations, and the Apple Macintosh personal computer.

With the exception of a television camera for scanning type artwork and its associated computer interface. the equipment configuration (portrayed in *Figure 2*) is the standard desk size Alto station in its more recent extended memory version (Alto II), featuring:

standard keyboard;

the now popular table top pointing device called the mouse ;

one or two disk drives with removable cartridges:

a connection to the Ethernet local network. allowing direct communication with printers and file storage servers:

a black and white graphics display. with a resolution of 600 by 800 dot.

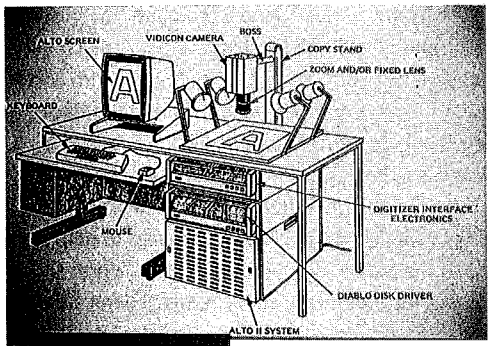

Figure 2.

The Alto workstation equipped with a television camera.

Overview of FRED

FRED is primarily an interactive graphics editor for creating and modifying 'images' composed of straight lines and spline curves. In fact, its graphics editing functions are quite general and are not specialized for handling letterform outlines. They include commands for defining, deleting, moving, copying, transforming by symmetry, and redefining lines, curves and pieces of curves. These operations are activated by selection from the main menu and are executed interactively by pointing with the mouse in the drawing area (*Figure 3*).

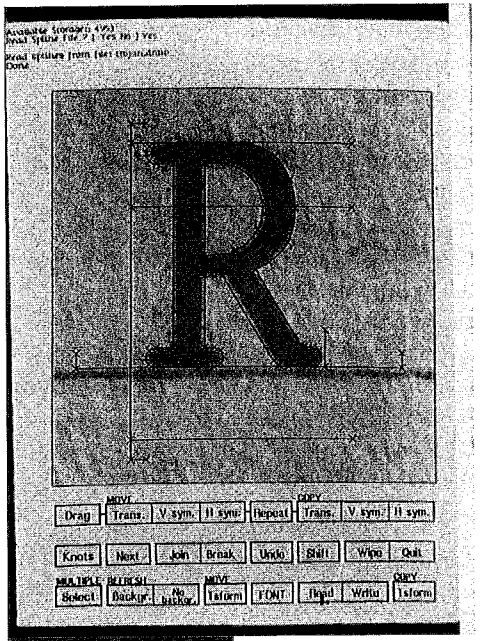

Figure 3.

FRED main menu for constructing a spline outline on a background television image of a character. Interpolating.

In addition, there exist a small number of functions that are more specific to the font design application. First, a television image can be displayed inside the drawing area, the line and curve image being superimposed on this background *Figure 3*). This is used to facilitate replication of character shape by drawing directly on top of a suitably enlarged image of the letterform artwork. This is an alternate solution to tracing the artwork with a stylus on a digitizing tablet. One advantage of the television image method is the constant visual feedback it provides throughout the graphics editing process. On the other hand, the set up requires careful optical and electronic adjustments (the Alto system has provisions for positioning fiducial marks to insure proper relative scaling of all characters shapes within the same set).

There is also a set of commands for specifying various typographical attributes of the character shape: its 'bounding box' (defining width and baseline), its 'code' (such as: R), and its typeface (for instance : Times Roman Italic).

Finally, there are the expected filing functions for saving away or retrieving character shapes. The recommended practice is to group characters of the same typeface in a single or a small number of files to help the bookkeeping for an inescapably fast growing database of fonts, a non-satisfying solution to an often underestimated problem. In this general area of database handling (somewhat side-stepped, since we relied almost entirely on the effective but very simple filing functions of the Alto) one early design decision turned out to be very wise: data files of character shapes, created or manipulated with FRED, are recorded as text files (rather than binary data files) and can thus be printed as well as read and corrected with any text editor. Although the exercise of reading or text editing such a file is certainly tedious, this form made it possible on a number of occasions to recover from difficult situations

The graphics editing functions were designed to be unconstrained by the nature of the application. They deal with geometrical 'objects' such as lines and curves, in a fairly general fashion, without any requirements that they form, at a given moment, a 'meaningful' contour made of connected lines and curves. The same commands are used to create or modify lines and curves: a line is defined by pointing at its two end points: a spline curve is drawn by pointing at a number of control points that define the path followed by the curve (in fact. a line is the simple case of a 'curve' defined by only two points). This somewhat loose handling of the graphical elements making up character outlines offers a degree of generality in the construction process which has some advantages. It allows, for instance, the use of pieces of a character to build other characters (e.g., serifs or strokes), or the utilization of graphical elements as guiding tools or 'scaffolding' in the construction process (marking up the baseline, x-height. cap height. descender height, em width of a typeface, as shown in *Figure 3*).

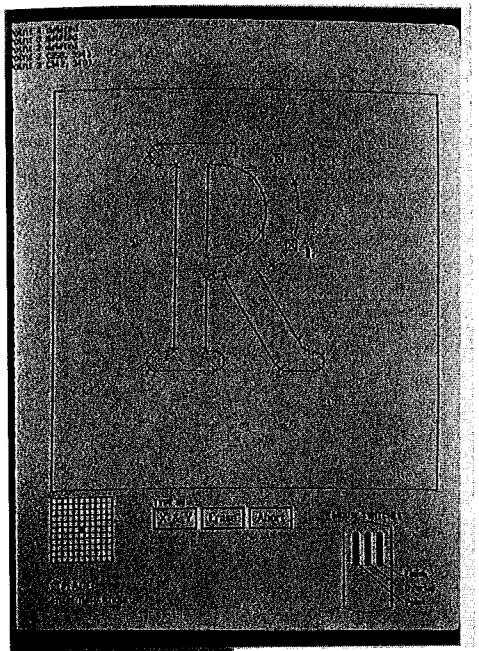

Figure 4.

FRED spline editing menu showing the modification of a character outline.

Another attempt at generality turned out to be, retrospectively, a poor choice. Deleting or modifying a line or curve (by removing, adding or changing control points) is implemented as a single unique command, by which a contiguous set of control points on a curve (including all the cases from one single point to all the points of the curve) is replaced by an arbitrary set of new control points (possibly empty). Although one can easily convince oneself that this method actually provides for all deletion or modification operations, the principle remains somewhat abstract and its application is not always the most efficient.

For instance, it is probably more natural to provide an elementary operation by which a control point is simply 'grabbed' with the mouse and moved to a new position. Similarly, adding a new control point to a curve would be done simply by pointing at the position of this new point, under the assumption that a new point is likely to be in the vicinity of the curve (and not at some arbitrary distance) and therefore that the insertion of this point at the proper place in the sequence of control points is not ambiguous.

FRED does not provide any scaling operation, nor any means of slanting, expanding or transforming geometric shapes in some automated fashion, which was an oversight. Some of these functions are possible with PREPRESS, as part of the scan conversion process (see below), but they would sometimes be useful at the outline design stage. Another graphics

editing program, DRAW [5], built primarily for preparing graphical illustrations and providing some geometric transformations, is sometimes used for this purpose in conjunction with FRED (*Figure 1* and *Figure 5*). This can be qualified, at best, as an afterthought.

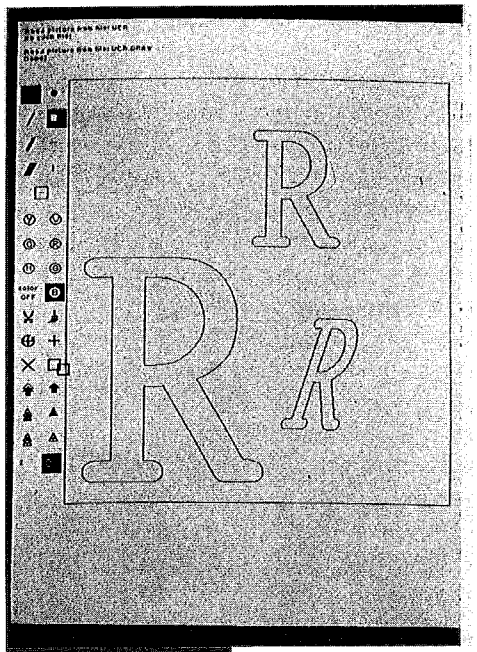

Figure 5.

The DRAW graphics editor used occasionally for geometrical shape transformation.

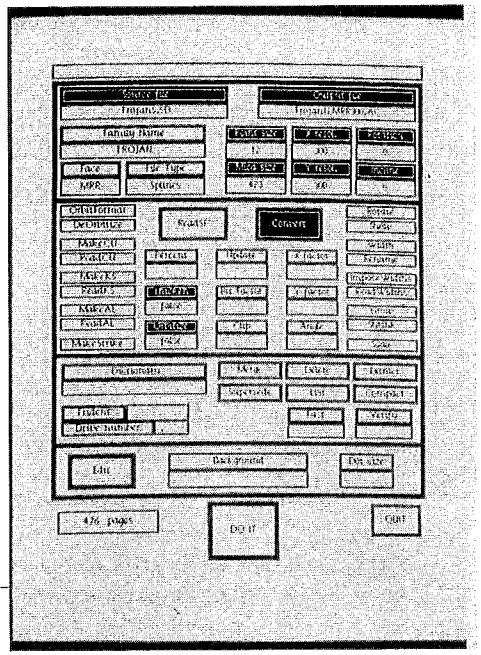

Figure 6.

PREPRESS main menu. set-up for a convert operation to produce a 12 point font bitmap for a 300 dot per inch printer.

Overview of PREPRESS

The second step of the font production process is to generate digitized characters from the spline outlines. This is done by PREPRESS. The program provides two major functions: scan-converting outlines to bitmap and editing bitmaps. It also has a number of bookkeeping functions which are necessary for handling the font database. All the operations are invoked through menu interaction (*Figure 6*). At first glance. the menu appears imposing, but it is actually quite simple to use.

The production of bitmap fonts is an automated process: this is the convert operation (*Figure 6*). It requires, to be fully specified, three parameters. The first two are the point size of the font and the resolution of the display or printing device for which this font is being generated. This determines the actual size of the character bitmap. For more generality,

the resolution in the two directions of the matrix can be different. A third parameter, the rotation factor, defines the relationship between the scanning direction of the device and the writing direction for the font, which determines the particular ordering of dots within the bitmap. It allows the creation of digitized fonts that run horizontally, vertically or at any angle on the display or printed page.

Some geometric transformations are possible during scan-conversion. Slanted characters (poor man's italics) are produced with the incline option. Pseudo-expanded or condensed characters are obtained by application of a scaling factor in the horizontal direction.

PREPRESS also provides a bitmap editor for creating or modifying a bitmap through direct screen interaction. This is used generally for touching up scan-converted characters. Experience showed that, given the straightforward conversion algorithm used in PREPRESS, character bitmaps need to be hand edited if their height is less than
40 to 50 dots (a 10 or 12 point font on a 300 dot per inch printer).

For instance, Figure 7 shows the uncorrected scan-conversion results for a 12 point serif font (Trojan, a typewriter font from a Diablo printer daisy wheel). It exhibits classical scan-conversion artifacts particularly visible on the serifs. To help in the dot editing process, another bitmap character can be displayed as a background. This allows the user to compare different versions of the character (*Figure 8*). More interestingly, one can use a bitmap of much higher resolution (thus free of scan-conversion artifacts) as a guiding pattern (*Figure 9*).

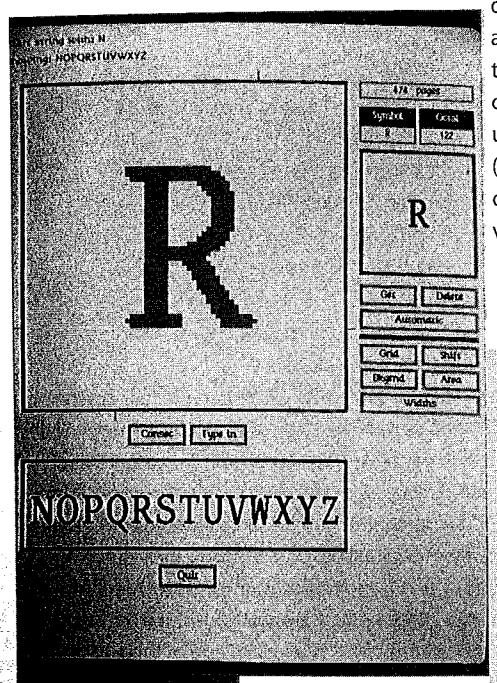

Figure 7.

The PREPRESS bitmap editor showing the uncorrected result of the bitmap conversion (12 point, 300 dot per inch).

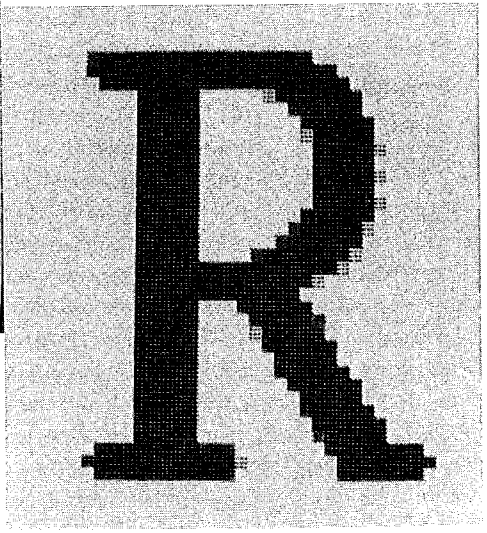

Figure 8.

Superimposed views of the corrected and uncorrected bitmaps: medium gray dots have been removed, light gray dots have been added, dark gray dots are untouched.

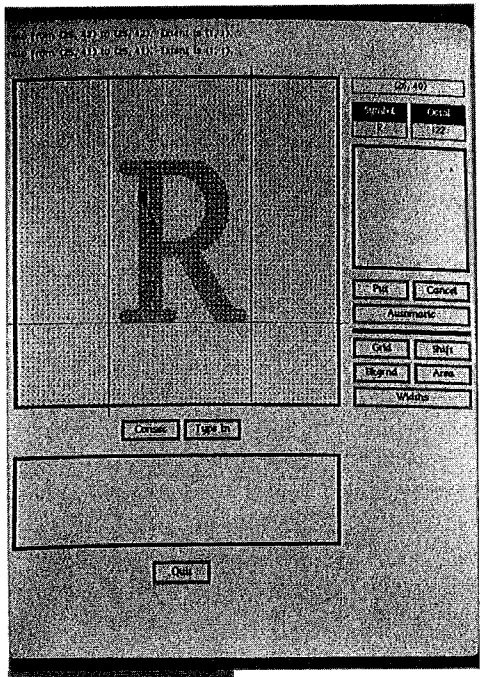

Figure 9.

Using the PREPRESS editor to create a low-resolution bitmap character, with a higher resolution bitmap as a background.

Finally, PREPRESS is used for the rather complex bookkeeping task involved in managing font bitmap databases containing numerous typefaces in many sizes for a variety of printing machines and display devices, as well as the corresponding character width tables that must be used by document formatters for proper typesetting. As is often the case with computer software, the whole bookkeeping chore is amplified by required compatibility with past devices and programs. As a result, PREPRESS is equipped to handle on the order of a dozen different file formats to represent all sorts of font related information, most of which is unfortunately not hidden from the font system's user.

Performance improvements

The Alto font design system was probably one of the earliest fully operational system using spline outlines. It benefited from the nicely integrated (and at that time, unusual) design of the Alto computer, allowing a direct and fine-tuned control of the displayed image from within the application program FRED and PREPRESS. The resulting manmachine interface is, by average standards, reasonably friendly without being very innovative. It relies heavily on direct pointing with the mouse, menus, visual feedback and graphical display of information. However, the overall interface design is still rather conventional: this is one of the areas where the age of the software shows up. It is clear that the user interface could be greatly improved and simplified by following more modern design concepts such as demonstrated in systems such as the Xerox Star and Apple Lisa.

But the general history of this software, with its unforeseen transition from laboratory to production site, did not allow for a cost effective redesign. Moreover, the initial memory limitation on the Alto of 64

kilobytes (for programs, data and the 600 x 800 displayed image) placed some severe restrictions on the design that were not significantly alleviated in the following extended memory versions of the machine, barring a significant reimplementation. As a comparison, current graphical workstations routinely have from 8 to 16 times more memory (512 to 1024 kilobytes).

Modern machines also have finer and faster graphics. Displays of 800 x 1200 dots are now common. The character display area used by FRED is only 500 x 500, without zooming capabilities, the remaining areas of the screen being used for menus. This limits the resolution of the original character outline from which digitized fonts are produced to 500 coordinate units. As pointed out by Charles Bigelow [4,6], this turns out to be below the usual resolution for high quality artwork. On larger modern displays, one could now easily achieve a resolution of 1000 coordinate units, sufficient for representing font masters with accuracy.

By and large the Alto provides the right architecture for this type of application. Its integrated raster-type graphics screen enables the display of an appropriate variety of images: medium quality text, line and curve drawings, and digitized images in bitmap form. Performance improvements would follow naturally from current progress in hardware design.

A word about splines

Lest the non-mathematician reader be left with the somewhat optimistic impression that fitting type outlines by mathematical spline curves is a fully mastered concept, I wish to conclude this overview by a few general remarks about the mathematics of spline fitting.

A spline curve is actually made of pieces of curves that are connected end to end to construct a seemingly smooth single curve. In fact, it is this construction scheme which allows spline curves to approximate arbitrary shapes quite well. However the scheme is not exempt from constraints. In particular, the quality of approximation by splines can be expressed in terms of three desirable properties.

(a) Curvature continuity.

The smoothness of a spline curve is achieved by the mathematical requirement that the curve pieces that compose the spline not only be end to end connected, but also have the same slope at their junctions. This minimum property of tangential continuity insures a smooth appearance to the overall spline curve. However it will not produce a uniform variation of the curvature across the junctions of the pieces, an imperfection which the eye can be quite sensitive to. A common example of this effect is the case of a straight line segment (which has no curvature) connecting tangentially to a circular arc (which has constant curvature): the sudden jump of curvature, from zero to some fixed value, may be viewed, in certain applications, as aesthetically

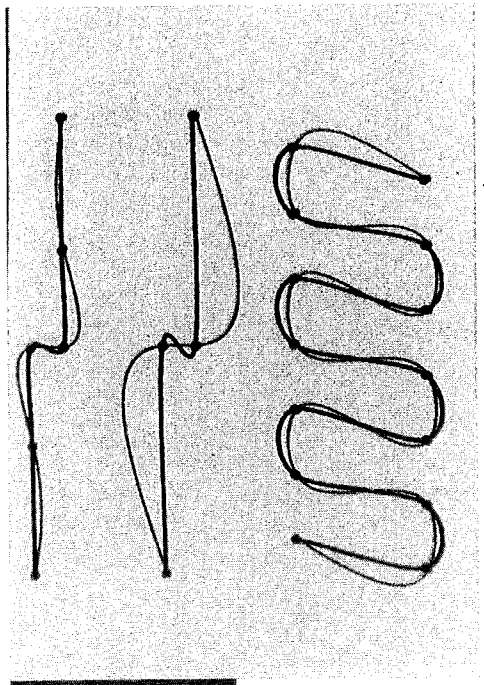

Figure 10A

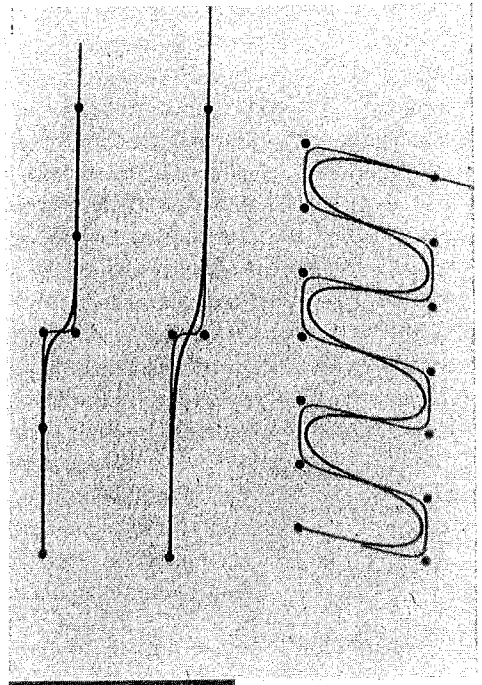

Figure 10B

Different methods for computing spline curves: (A) interpolating, (B) non-interpolating.

undesirable. Therefore it is often imposed as an additional mathematical requirement to a spline fitting scheme that it provide curvature continuity.

(b) Interpolation.

The approximation of a shape by a spline curve is mathematically obtained by specifying a number of control points that will guide the spline along its path. However, one has to choose between two methods. Interpolating splines go through the guiding points, which must therefore be placed directly along the trajectory to be approximated. Non-interpolating splines go in the vicinity of the guiding points, which makes the relationship between the shape of the spline curve and the disposition of the control points somewhat harder to grasp. Although the latter scheme is used extensively in many computer aided design applications, it is often found to be more difficult to master by the designer and less desirable than interpolation.

(c) Locality.

The computation of a spline curve follows directly from the specification of its control points. At this stage, two types of computing methods are

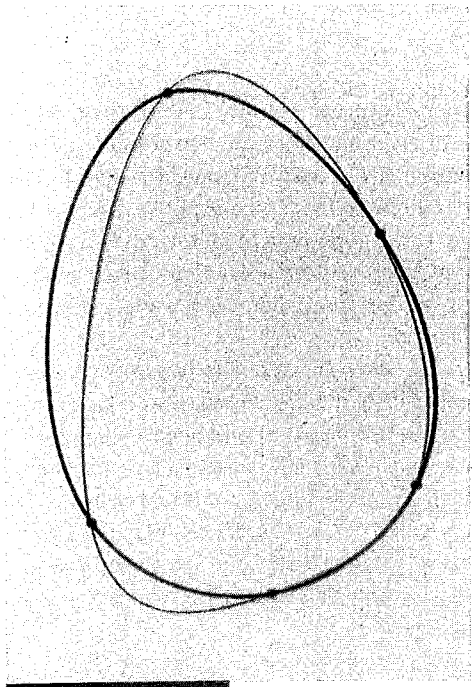

Figure 11.

Comparing the results of two interpolating spline-computing methods.

possible. Non-local splines are computed in one single process from the whole set of control points: therefore, their shape depends on all the control points. Although the influence of a particular control point on the shape of the curve decreases rapidly with the distance, this effect remains noticeable when a long flat stretch is followed by a sharp turn, producing annoying ripples that require iterated corrections of the control points. On the other hand, local splines are computed one piece at a time from a small number of neighboring control points. In addition to being simpler to calculate, they offer an easier control over the detailed shape of the spline.

The case for curvature continuity. interpolation and locality, would seem clear cut if it were not for the unfortunate fact of line that these three desirable properties cannot be satisfied mathematically all at once. As a result, there exist a variety of spline computing schemes that each exhibit at most two of the above properties. A few examples are illustrated in Figure 10. In addition, to complicate the matter even more, several spline computing schemes are subject to variations in which the resulting shape of the curve can be drastically modified by adjustment of various parameters that more or less model the 'tension,' 'stiffness' or 'resilience,' of the curve. For instance, Figure 11 illustrates two different ways of computing natural splines (a non local. interpolating scheme with curvature continuity). It shows how a non-symmetrical distribution of control points around an egg-shaped contour can yield either a nearly symmetric or a dissymmetric curve shape, according to the computation scheme.

FRED uses natural splines of the latter type. One could possibly claim that the first type would have been preferable, as it enforces more regularity and symmetry in shape design. At this point, however, one can safely say that there is probably no unique ideal spline method for character representation, although all existing systems appear to be using interpolating methods. It is certain that all methods require some practice on the part of the font designer in order to master the interactive shape editing process. The idiosyncrasies of each particular spline method, illustrated in Figures 10 and 11, can be in general overcome by the practice of defining a greater number of knots than would be strictly necessary. A better solution could be to do automatic spline fitting of digitized images, as recent work demonstrated [7], manual intervention being limited to adjustment of the resulting shape.

Conclusions

The Alto font system was designed with two main objectives in sight. The first one concerned the issue of a type font representation providing a good quality and a uniformity of appearance over a wide range of devices. This led naturally to the choice of spline outlines. The second objective concerned the production of digitized fonts: the goal was to be able to produce rapidly a large assortment of typefaces for many different experimental devices, by reproducing existing designs. The objective of designing new letterforms was never taken into consideration.

The availability of the Alto computer, with characteristics well matched to display oriented applications, permitted the design of a complete, interactive, self-contained font production system. The result turned out sufficiently efficient and user friendly to warrant an extended life beyond the experimental stage into a production oriented environment. The fact that the system is still being used today confirms its general usefulness and the soundness of its overall design. This should not, however, hide a number of shortcomings and limitations, as well as some obsolescent aspects of the implementation.

Acknowledgements

The general architecture of the Alto font production system, the principle of spline outlines of characters, was designed by Robert Sproull. within the scope of the PRESS printing system. The implementation was shared by Robert Sproull (PREPRESS) and the author (FRED). The original software was improved by Joe Maleson and adapted to a production environment by a team which included Chuck Hains. Ron Pellar. Paul Lam, Kerry La Prada and Ron Gechman.

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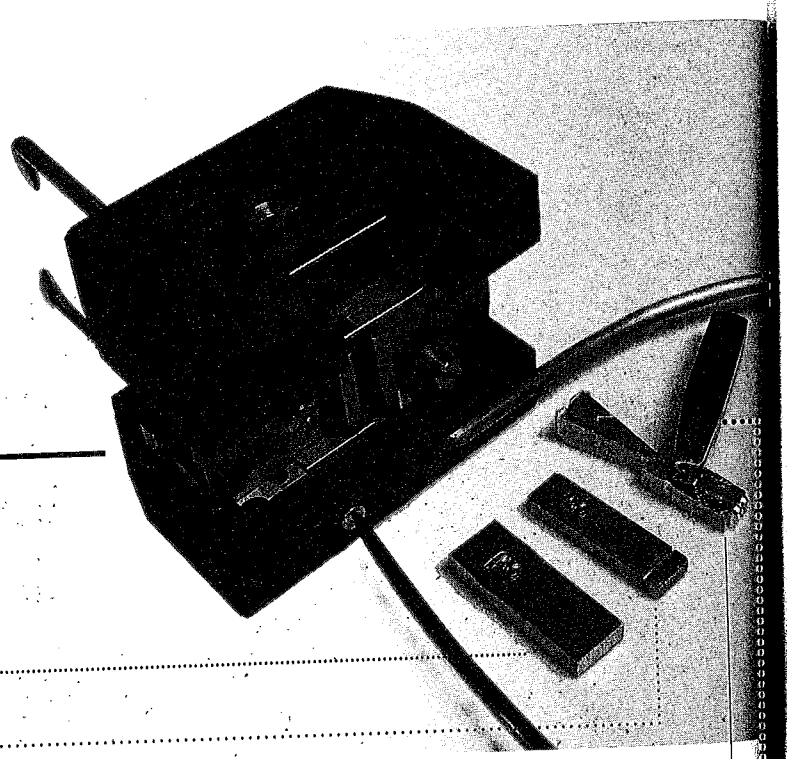
7 M. Plass and M. Stone, "Curve-fitting with Piecewise Parametric Cubics", *SIGGRAPH '83 Conference Proceedings*, Computer Graphics, Vol. 17. No. 3, July 1983.

Author

Patrick Baudelaire is a retired computer scientist and research management executive. He conducted research at Xerox PARC on digital typography and on the practical design of digital fonts. Further in his career, he directed research laboratories at Digital Equipment Corporation and Thomson Multimedia.

French-style type hand-casing mould.
From left to right:



mould assembled

copper matrix struck from punch

matrix justified

cast type (with tang)

steel punch

The Digital Typefoundry

Matthew Carter

Guest Editor's Note

This article is based on a talk given at Stanford University in 1983 at a seminar for the Association Typographique Internationale (ATypI). It describes the first all-digital type foundry, Bitstream, established in 1981. Outlines, rasterizing, bitmaps, optical sizes, weight gradations, low resolutions, optical alignment, pixel editing, grayscaling and other processes and problems associated with digital fonts today are discussed in this early, unpublished 1985 essay by one of the founders of Bitstream. We thank the Cary collection for providing scans of the manuscript and images.

Charles Bigelow

Keywords

font design, typography, letterform, software design, splines, bitmaps

Upper case Didot "B", the font used for titles in this journal, set at 12' in a 300 dpi bitmap file in Photoshop, enlarged here 1000% as an example that the issues discused in this article are still applicable.

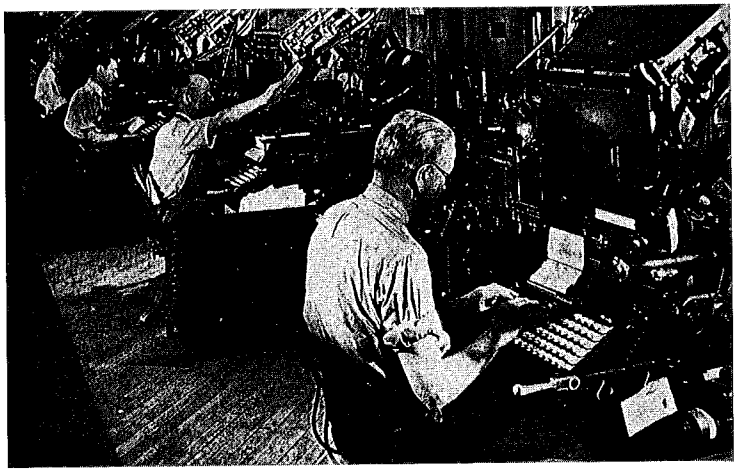


Figure 1

We are nearing the end of the natural life of the typesetting machine as we know it at present [1986]. Its death knell has been sounded by the recent improvement in computers which have become smaller, faster, and more capacious as the cost of their memories has dropped. Typographic computing used to be a matter of manipulating rectangular areas within a larger area - the page - like laying tiles on a floor. Now the same area can be filled with fine sand and every grain controlled independently.

Conventional typesetting systems are really only glorified word processors. The typeset image - the result of the process - is only visible at the end because the type font - the image source - exists only in the output device at its final output resolution.

As soon as the controlling computer is itself fast enough and powerful enough to handle type not just as anonymous characters with separate instructions as to style, size and position but as fully formed images of letterforms, then the font migrates forward from the output device into the heart of the system, the computer. And then type can be seen: played out on a screen or on a non- impact printer before it goes to final output on plotter or platemaker. If you can see it, you can design it. The implication of access to the image in such a system is obvious to the page designer.

Raster image processors (RIPs for short), these controlling computers, have the interesting characteristic that because they deal with images at final resolution they are indifferent to what those images are. They can be type, 2 point, 2 inches, 2 feet; they can as well be line art , half-tones, color separations - in fact any two-dimensional digitally expressed graphic. The RIP sends a stream of digital information to the plotter. It is the separation of the RIP from the plotter that is the key to the integration of text and graphics that is changing our ideas of how words and pictures reach paper, or screen tube.

Imaging systems that handle digital type in final resolution come in many forms: imagesetters for the graphic arts, control screens,

printers for office automation and demand publishing, videotex decoders, slide generators, computer-aided design and artificial intelligence workstations, and personal computers.

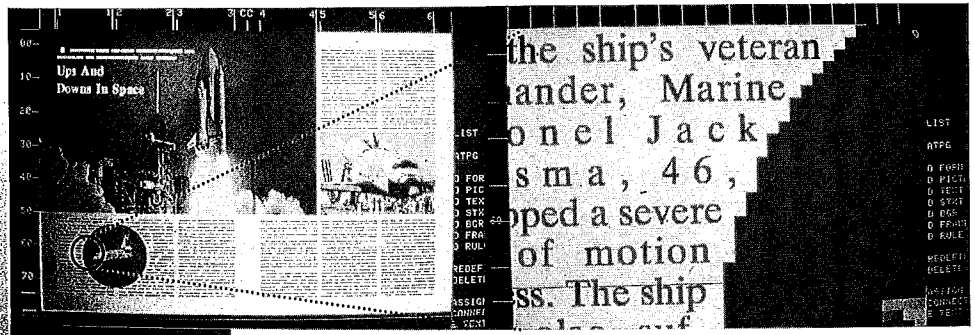
As far as anyone knows, the typefounder's mold was invented by Gutenberg. Its product was cast type. For over 400 years, page make- up consisted of assembly character by character.

The industrialized mold was a late 19th-century invention. Its product was a line of type from a slug-caster. Page make-up now meant assembly line by line (see *Figure 1*).

A phototypesetter produces galleys. For the last 25, years page make-up has meant assembly galley by galley.

Finally, a laser plotter, a machine which places very fine dots very accurately on film, is used to produce a complete page. a broadsheet newspaper page for example, which can be set in under two minutes; text type, display type, line-art, half-tone and scanned-in type are set at a single pass. There is no longer a distinction between type and illustration, between cast type and woodcut, between slug and engraving, and between galley and half-tone negative: these are now integrated in the RIP, in the bitstream fed to the plotter and on the output film.

The output from a RIP can be directed to the control screen of a Scitex Vista terminal where a double-page magazine spread can be formatted. The first element to be put in place on the page is a large full-color illustration chosen from a selection displayed on a secondary screen. The area of the illustration is defined by the cursor. When it is in position, it can be sized and cropped. When the other illustrations are in place, the text stream (from an Atex) is flowed into the available column space, even run around the illustrations if desired. At a large scale, the headline is readable while the text is a simulation. By zooming in on a particular area, the smaller sizes of type become readable. A close up shows the text face run around the illustration.

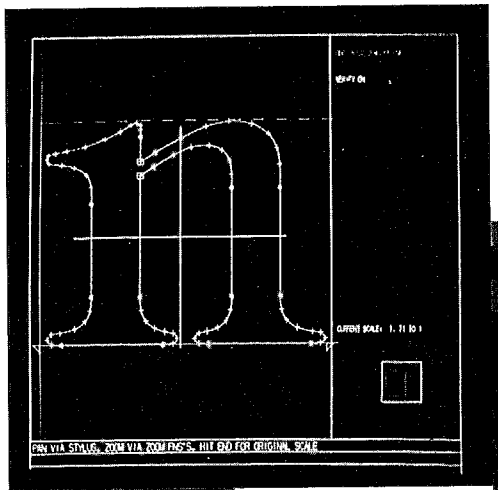


Figurse 2-3

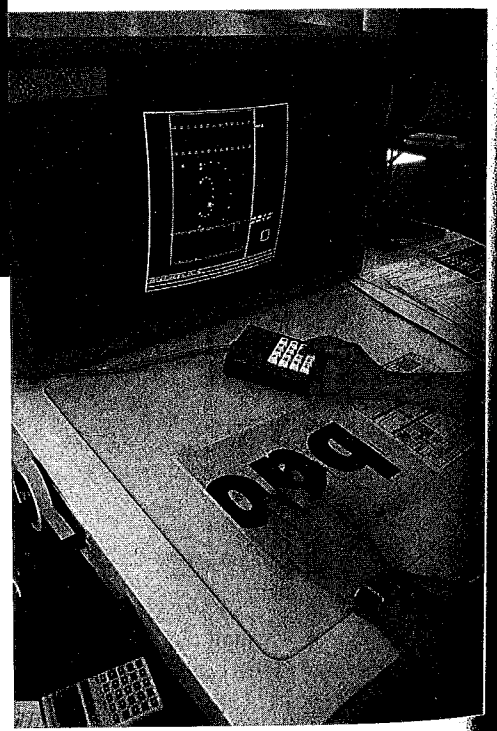
A couple of short lines in Figure 2 and the detail in Figure 3 show that the justification program has letterspaced the type – something an editor or designer might revise at this stage.

Bitstream is a "digital typefoundry"; the phrase is Chuck Bigelow's and is useful to describe a company that makes digital type but not hardware (in the same way that typefoundries sold cast type but not typesetters) as distinct from equipment manufacturers who also make type. Bitstream has six Camex LIP workstations (interactive type design terminals with their own microprocessors). The underlying functional software was written at Camex with much subsequent enhancement by Bitstream's own programmers.

We don't scan characters; we input them through a digitizing tablet with a resolution of 4320 x 4320 lines to the em. This method allows the designers to do any necessary editing of letter shapes at the input stage, while seeing the results on the monitor. We mark significant points around the outline of the character and connect them with straight line segments and circle arcs which are easy to manipulate mathematically and to store. There are many useful software tools and routines available to the designers.

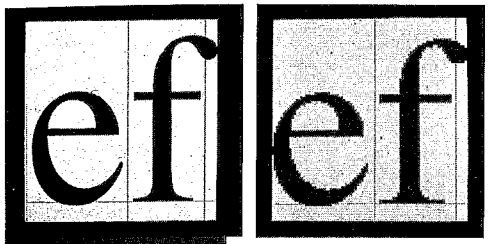


Figures 4-5



It used to take a good three hours to design a letter with pencil on paper, with most of the time spent on execution rather than thought. A well programmed computer workstation, such as the Camex LIP, can drastically reduce the time taken to capture the letterform – to an average of 25 minutes per character at Bitstream.

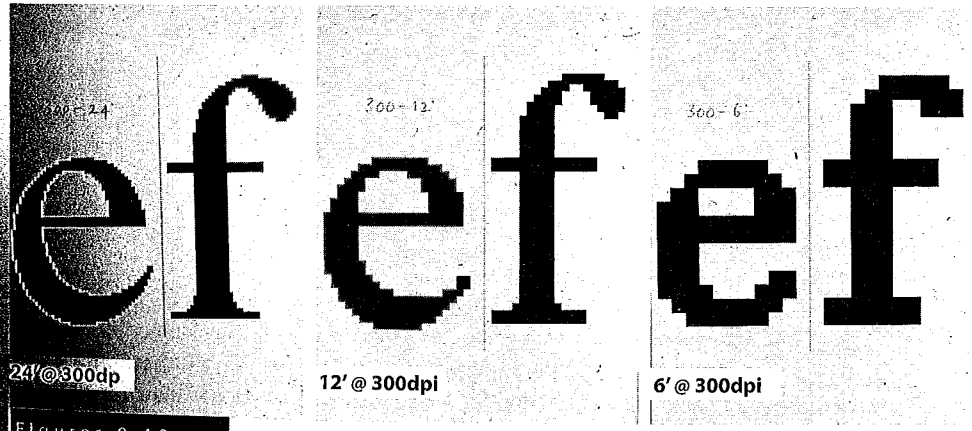
Bitstream's product is type expressed digitally as a definitive outline. Within an imagesetter, the outline will be converted by a RIP into raster form. At high resolution, say above 1000 lines per inch (lpi), the raster patterns at 96 point would be virtually analog in definition (see *Figure 6*); while at 12 point, the outline is starting to appear a little ragged (see *Figure 7*). Since 12 point is fairly small, the eye is unaware of the "jaggies" when they are softened by the roundness of the writing spot and the effects of printing. However, a RIP can equally well feed a low resolution output device such as an electronic non-impact printer designed for the office market .



Figures 6-7

6 left, 96'
7 right, 12'

At a typical resolution of 300 lines per inch, 24 point, 12 point, and 6 point are low-res bitmaps which have more to do with bricklaying than type design. At this scale the addition or subtraction of a single pixel can have a dramatic effect on the letterform, and corresponding care is needed in their design.

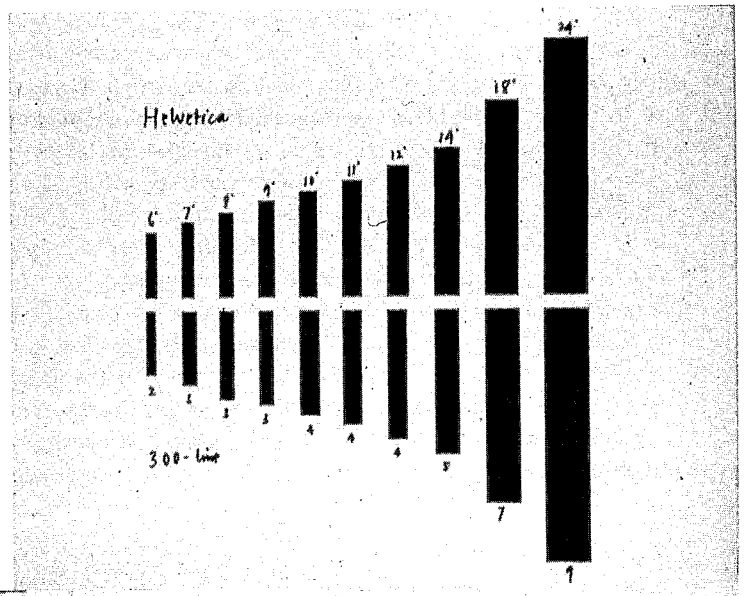


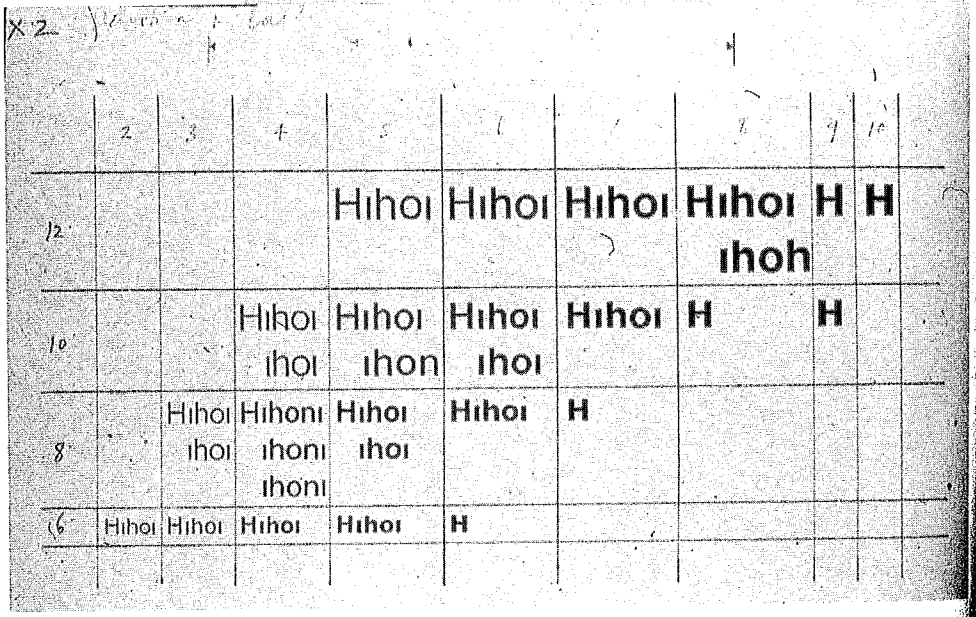
Figures 8-10

8 left, 24' @ 300dpi
9 middle, 12' @ 300dpi
10 right, 6' @ 300dpi

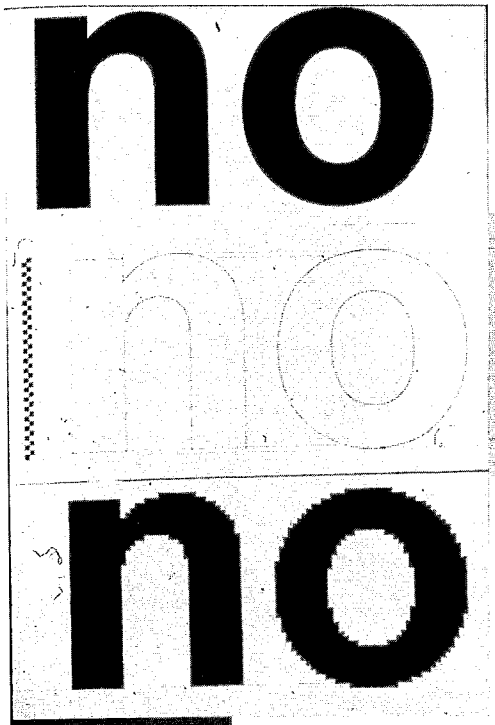
figures 11-12

11 top
12 below





A problem exists in attempting to design an evenly graded series of point sizes at coarse resolution. In the chart in Figure 11, the upper progression plots the analog x-heights and stem weights of Helvetica lowercase as the face was designed. Below is shown the closest match at 300 lpi in the coarse steps imposed by the raster. The uneven gradation at the low end and the middle of the range is obvious. The chart in Figure 12, again of Helvetica, shows all the possible choices at 300 lpi, plotted point size against stem weight.



Figures 13-14

Another problem in adapting type to low-resolution reproduction appears when round letterforms need to be designed slightly bigger than square ones in order to look the same size. At 18 point, 300 lpi, the raster step diagrammed in the ladder at the left of Figure 13, is at exactly the right intervals to represent the difference in height between square and round in the original design. This is not so at 9 point: design and raster do not coincide (Figure 14). The smallest step, one line, is too big. As so often in coarse resolution design there is no perfect answer, the best solution is the least bad.

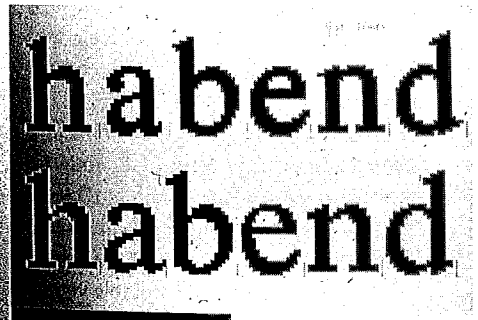


Figure 15

Figure 15 shows a before-and-after comparison. The upper line is the product of an algorithm that has scanned 9 point Times Roman one character at a time and generated a bitmap of each individual letter without considering the relationship between them. The lower word has been edited to make the spacing regular, the weight consistent, and to make common elements repeat.

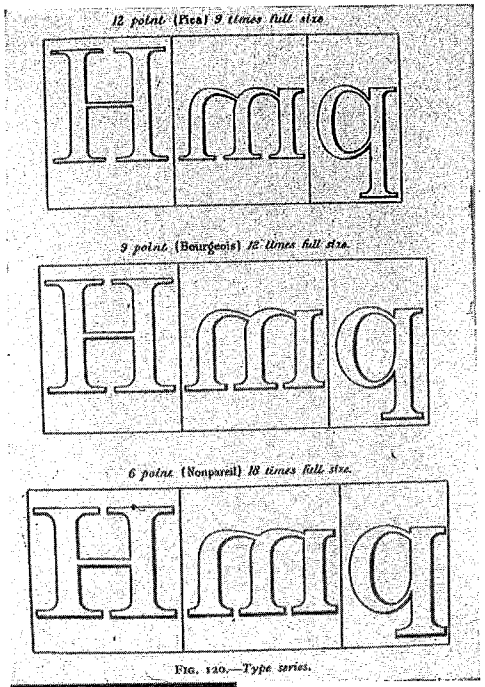


Figure 16

Figure 16, taken from Legros and Grant's *Typographical Printing Surfaces* published in 1916, shows a comparison between 6, 9 and 12 point in foundry type. It is clear that the proportions of face to body vary as a function of point size – the smaller the point size the larger the face in proportion.

If, for example, one compares the lowercase alphabet lengths of Linotype Primer, a finely planned foundry type series, one finds that 6 point, far from being 50% of 12 point, is in fact 64Y. This practice, the non-linear scaling of small sizes, has fallen out of use in photocomposition – the 6 point is now 60% of 12 point, with the result that it is too small, too light, and too hard to read.

In low-resolution typography where the lack of pixels at small sizes makes the construction of clearly articulated letterforms extremely difficult, the time-honored idea of increasing the proportion of face to body has been revived in the interests of legibility.

One example shows bitmaps for a 6 point type at 240 lpi with photocomp proportions (i.e. the face size is 50% of 12 point), and the bitmaps have been produced by a simple conversion from outline to raster without any form of compensation or correction. The results are horrible: stem weights fluctuate, hairlines and serifs have failed.

Another example is a different 6 point type (from the same outline source and the same 240 line printer) was produced with an algorithm that increases the face size by 20%, regularizes stem weights and side-bearings, and preserves the finer elements. The bitmap conversion was done 'on the fly' without any manual intervention . Other examples show 9 and 10 point by the same programmed method. These are preliminary test runs, the product of a collaboration between Symbolics and Bitstrearn that has resulted in an automated bitmap editing program now running on a Symbolics 3600 workstation at Bitstream.

In converting an outline into a bitmap, the position of the image with respect to the raster is critical. Figure 17, using one of the routines within the Symbolics program, shows the same outline (a 9 point "n," blacked in for clarity) and the same raster grid are shifted laterally to give three very different bitmaps. In two of the positions the sidebearings on either side have been locked to a raster line causing obvious and unacceptable variations in weight between the two upright stems of the "n." In the third case the letter has been centered on the grid to give a better bitmap. The lateral displacement that has given these three drastically different bitmaps is very

Figure 17

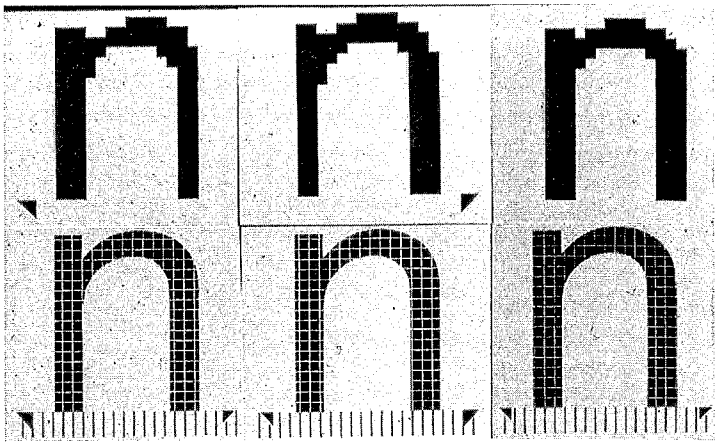
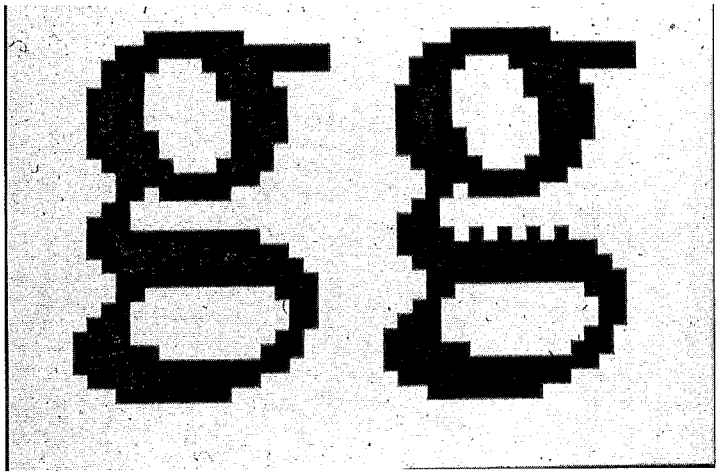


Figure 18



slight – less than half the raster pitch. It is the task of the program to cause the optimum fit of image to raster and to force even stem weights.

Figure 18 illustrates a design technique that has come to be known as half-bitting. At a thickness of four lines, the horizontal stroke in the middle of the "g" is too heavy. At three lines it would be too light. By omitting every other pixel, an impression of an intermediate weight – 3 1/2 lines – is created at the output resolution of 300 lpi.

Another image-to-raster technique was developed to improve the definition of letter arms on video screens of coarse resolution such as standard television receivers. Pioneering work was done by Wendy Richmond at MIT: adding two tones of grey to the bitmap to achieve a degree of subtlety impossible in plain black and white. The choice of tone in each cell is determined by what percentage of its area is occupied by image and what by ground. The resulting letter is constantly updated and visible to the designer at actual screen size in the lower part of the editing screen.

Figure 19 shows a sample of grey- scaling done at Atex: a lowercase "e" in black and white, with tones of grey added. Similarly, a few characters from a single-bit font are shown in Figure 20 with the same letters in a 4-bit version in Figure 21, giving far higher definition from the same screen.

Figure 19

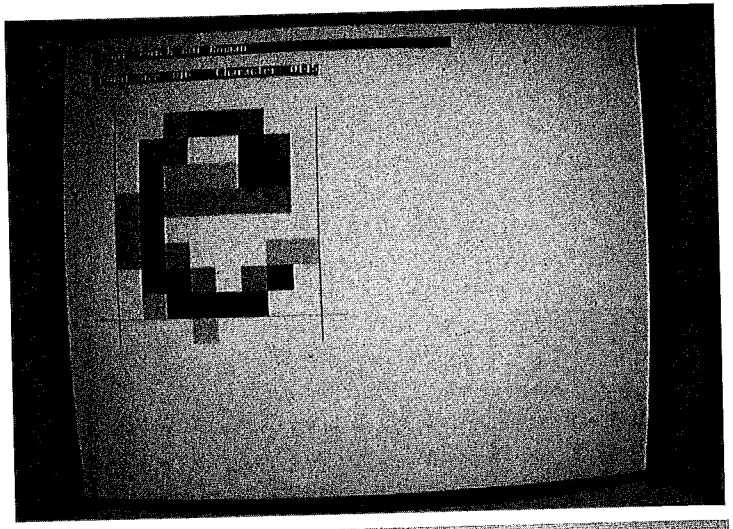


Figure 20

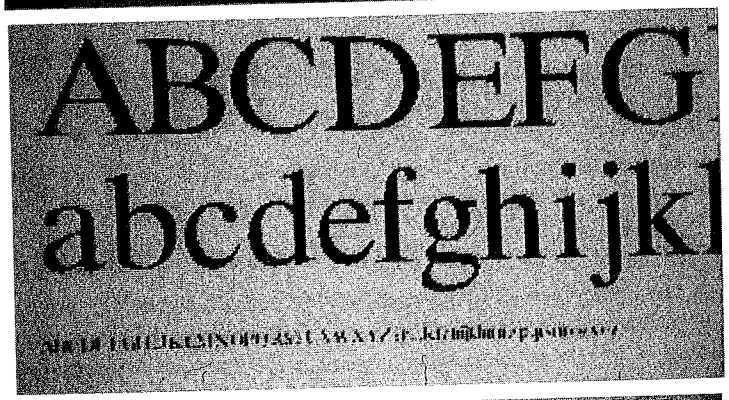


Figure 21

The importance of these techniques for combatting the effects of low output resolution (automated bitmap editing, half-bitting, greyscaling) is that they convert the outline into a truly resolution independent font. Instead of storing separate fonts for each output device, a single outline can reside in the RIP and serve all applications.

Author

Matthew Carter is a type designer with 60 years' experience in typographic technologies, ranging from hand-cut punches to computer fonts. After a long association with the Linotype companies he was a co-founder of Bitstream Inc. in 1981, a digital type foundry where he worked for ten years. Carter is now a principal of Carter & Cone Type Inc., designers and producers of original typefaces, in Cambridge, Massachusetts.

Carter's type designs include ITC Galliard, Snell Roundhand and Shelley scripts, Helvetica Compressed, Olympian, Bell Centennial, ITC Charter, Mantinia, Sophia, Big Caslon, Big Moore, Miller, Roster, Georgia, Verdana, Tahoma, Sitka and Carter Sans.

two letters: 1968 & 2016

In the January 1968 issue of the Journal of Typographic Research, *the single letter to the editor was from renowned book designer Hans Schmoller. After leaving Germany in 1937, Schmoller spent most of his career in England at* Penguin Books, *where he became chief book designer after Tschichold and later head of production.*

(*Journal of Typographic Research*, volume 2, no. 1, January 1968, page 103)

To the editor:

Frutiger's article in the July 1967 issue [Typography with the IBM Selectric Composer Vol. 1 No. 3] prompts the following warning.

He expresses his pride at having been concerned with the design of the IBM Selectric Composer version of Univers. The designer's task is to make new technologies his servant, and he must not allow them to be his master; otherwise we are back in the darkest nineteenth century. If the electronic giants are given the chance to have their way and if people like Frutiger allow themselves to be swept along by this juggernaut, then let us at least be honest and admit that the product of such an alliance cannot be good. All it can hope to be is less bad than if no capable designer at all had been involved. Every other claim is cant.

Hans Schmoller
Penguin Books, Ltd. England

Visible Language *recently received this reply to Schmoller from type designer Steve Matteson, who has created several dozen digital typefaces for* Monotype, Microsoft, Google, *and other firms.*

Dear Hans,

I'm a big fan of your work. When I graduated from RIT in 1988, my typography teacher, Archie Provan, gave me a copy of the Monotype *Recorder* about you ["Hans Schmoller, Typographer, His Life and Work", New Series No. 6, April 1987]. I refer to it often.

I'm writing back to you from a new century of text brightly lit with crisp, illuminated pixels. My life in typography has been "swept along by this juggernaut", as you so well put it in 1968. Change has been swift and remarkably chaotic - from the methods used to set a page of text to the very definition of what a "page" is. The technologies for making and using type have had at least 4 revolutionary changes in less than my 30 year career. Much of the time these technologies have had well-intentioned, design-savvy people at the helm - attempting to get the best from aesthetically limited technologies involving cathode rays, lasers, toners, e-inks, LEDs and software subroutines.

As Type has found itself caught up in modern consumerism, the reader is still, too often, subject to the non-aesthetic, popularity-based judgment of engineers and developers. Readers are tasked with reading a certain sans serif (whose name almost rhymes with sciatica) under conditions that strain legibility and taste to their limits. With an unprecedented number of other choices available, one can only believe that laziness guides the decision makers whose goal should have been to serve the reader.

There are a few distinguished designers and engineers who have endeavored to make the best possible presentation of text in current times: pushing screen and printer resolutions higher; creating or implementing types designed specifically for unique reading conditions; and researching the effect of letter design on legibility. Aesthetics may finally catch up to technology in the forward-plunging juggernaut, and true experts are becoming part of this confluence. Typography is becoming part of the mainstream dialog, and the raised awareness also raises expectations of quality.

This raised awareness has set off a growing backlash against technology and a resurgence in interest in "the old ways" of doing things. Appreciation of letterpress, hand lettering and calligraphy is on the rise. As Fred Goudy put it, "The quality of taste revealed in the great printing of the past is the outcome of … simplicity in form."

Stripping away the layers of technology and consumerism reveals a simple aesthetic touch that is now finding new reverence which stirs the imagination of what is possible and can now be used as a new measure of beauty and functionality.

Steve Matteson

user input:

```
\sqrt{b^2}
```

TEX output:

$$\sqrt{b^2}$$

Communication of Mathematics with TEX

Barbara Beeton
Richard Palais

Abstract

Mathematics publication has changed radically over the past 50 years, for both authors and publishers. What once required a skilled compositor to produce can now be accomplished, with the aid of computers and software, directly by authors. One key component of this change is the TEX typesetting program. This software, designed by a mathematically discriminating computer scientist and made freely available, is now in operation on nearly every computer system in common use.

Keywords

open source, composition of mathematics, symbols (math and technical notation), fonts for math and science, mathematical typesetting software, composition software, mathematical symbols in Unicode, TeX, TeXbook, Knuth, amstex, STIX, AMS-TeX, AMS-LaTeX, LaTeX, TUG (TeX Users Group)

Introduction

Until about the early 1960s, most published mathematics was typeset professionally by skilled compositors working on Monotype machines. As this form of "hot-metal" composition became less readily available, on account of both cost and the fact that skilled compositors were retiring and not being replaced, "enhanced" typewriters began to be used to prepare less prestigious publications. Phototypesetting ("cold type") began to appear gradually, although it was more expensive than typewriter-based composition, and generally not as attractive in appearance as professionally prepared Monotype copy.

By the mid-1970s, Monotype composition was essentially dead. Donald Knuth, a professor of computer science at Stanford University, was writing a projected seven-volume survey entitled *The Art of Computer Programming* (*TAOCP*). Volume 3 was published in 1973, composed with Monotype. By then, computer science had advanced to the point where a revised edition of volume 2 was in order but Monotype composition was no longer possible. The galleys returned to Knuth by his publisher were photocomposed. Knuth was distressed: the results looked so awful that it discouraged him from wanting to write any more. But an opportunity presented itself in the form of the emerging digital output devices—images of letters could be constructed of zeros and ones.[1] This was something that he, as a computer scientist, understood. Thus began the development of TEX.

The problem

Mathematics as a discipline depends on its own arcane language for communication. Prior to the ubiquitous availability of personal computers, the options for communicating mathematical knowledge were limited to face-to-face contact, preferably with a writing surface handy, although conventions developed to enable intelligible telephone discussion, personal letters (at least bits of which required handwritten notation), or formal publication. The last mode required a highly skilled compositor, working either with traditional hand-set type or with a hot-metal typecaster, or a combination of the two.

The gold standard for typeset mathematics in the mid-twentieth century was the Monotype typecaster [PhR, PhH]. The audience was relatively small, and the work exacting. Since mathematical notation is essentially multi-level (see *Figure 1*), the Linotype, the linear-type workhorse for newspapers and most book publishing, was not up to the task. Only a

1 Not literal 0's and 1's, but binary digits representing tiny dots on a surface that represent "no ink" and "ink".

Quadratic formula

```
\[
  x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}
\]
```

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Maxwell's equations

```
\begin{align*}
  \vec{\nabla} \cdot \vec{B} &= 0 \\
  \vec{\nabla} \times \vec{E} + \frac{\partial B}{\partial t} &= 0 \\
  \vec{\nabla} \cdot \vec{E} &= \frac{\rho}{\epsilon_0} \\
  \vec{\nabla} \times \vec{B}
    - \frac{1}{c^2} \, \frac{\partial E}{\partial t} &= \mu_0 \vec{J}
\end{align*}
```

$$\begin{aligned}
\vec{\nabla} \cdot \vec{B} &= 0 \\
\vec{\nabla} \times \vec{E} + \frac{\partial B}{\partial t} &= 0 \\
\vec{\nabla} \cdot \vec{E} &= \frac{\rho}{\epsilon_0} \\
\vec{\nabla} \times \vec{B} - \frac{1}{c^2} \frac{\partial E}{\partial t} &= \mu_0 \vec{J}
\end{aligned}$$

Another system of equations

```
\newcommand{\gammaurad}[1]{%
  \frac{\gamma u_{\text{rad}}^{} \bar{\lambda} a_{\text{eff}}^2}{2I_1 {#1}}\,}
\begin{align*}
  \frac{d\phi}{dt} &= \gammaurad{\omega \sin \xi} G(\xi, \phi)
                      - \Omega_{\mathrm{B}} \, , \\
  \frac{d\xi}{dt} &= \gammaurad{\omega} F(\xi, \phi)
                     - \frac{\sin \xi \cos \xi}{\tau_{\text{DG}}^{}} , \\
  \frac{d\omega}{dt} &= \gammaurad{}
    \bigl[ \gamma H(\xi, \phi)
          + (1 - \gamma) \langle Q_\Gamma^{\text{iso}} \rangle \bigr] \\
  &\phantom{{}={}} - \frac{\omega \sin^2 \xi}{\tau_{\text{DG}}^{}}
    + \frac{\omega \sin^2 \xi}{\tau_{\text{drag}}^{}}
    - \frac{\omega}{\tau_{\text{drag}}^{}}
\end{align*}
```

$$\begin{aligned}
\frac{d\phi}{dt} &= \frac{\gamma u_{\text{rad}} \bar{\lambda} a_{\text{eff}}^2}{2I_1 \omega \sin \xi} G(\xi, \phi) - \Omega_{\text{B}} \, , \\
\frac{d\xi}{dt} &= \frac{\gamma u_{\text{rad}} \bar{\lambda} a_{\text{eff}}^2}{2I_1 \omega} F(\xi, \phi) - \frac{\sin \xi \cos \xi}{\tau_{\text{DG}}} , \\
\frac{d\omega}{dt} &= \frac{\gamma u_{\text{rad}} \bar{\lambda} a_{\text{eff}}^2}{2I_1} \left[\gamma H(\xi, \phi) + (1 - \gamma) \langle Q_\Gamma^{\text{iso}} \rangle \right] \\
&\quad - \frac{\omega \sin^2 \xi}{\tau_{\text{DG}}} + \frac{\omega \sin^2 \xi}{\tau_{\text{drag}}} - \frac{\omega}{\tau_{\text{drag}}}
\end{aligned}$$

Figure 1

Samples of display math using TEX input and output.

few suppliers would take on such work, and mathematical composition was always considered "penalty copy".[2]

For the first half of the twentieth century, a mathematical work for publication began as a manuscript, either handwritten or partially typewritten (the text) with mathematical symbols inserted with pen and ink. A typescript was typically prepared by a secretary: senior faculty had their own personal assistant, junior members relied on departmental staff. Often the secretary primarily responsible for manuscript preparation had a typewriter with special capabilities, greatly reducing the need for manual insertions.

Various mechanical advancements improved the visual quality of manuscripts, and documents intended for limited audiences or quick distribution, such as lecture notes or proceedings of meetings, were often published from such copy. The Varityper and IBM Selectric Composer, two enhanced typewriters with interchangeable type heads (and type styles emulating traditional printing typefaces), in the hands of a skilled typist, were capable of producing quite readable output, with character sets for typical mathematical notation and variant type sizes needed for accurate representation of sub- and superscripts. What they generally lacked was an easy mechanism for justifying lines, an easily recognizable characteristic of typeset copy; justification was possible, but it always required a second pass, which was usually not fully automatic. Nonetheless, as prices increased for hot-metal composition, even some traditional journals began to use this method of preparing copy for the printer.

Investigation into photocomposition began in the late 1940s, with production-capable machines in use in the 1950s. The earliest machines flashed a light through a negative image of a character to produce an image on photographic media. By the mid-1960s tools were in place to convert marked-up copy from codes punched on paper tape into images, at least for ordinary text. But mathematics was still too complicated and mostly beyond the capabilities of this technology. A few machines, manually operated, did have the capability of varying font size and baseline, similar to what was possible with Monotype composition, but their use was not widespread.

More capable imaging devices based on CRT technology provided the necessary flexibility. By the mid-1970s, several commercial systems were available that could produce acceptable mathematics output, but there was nothing remotely available to or usable by an individual mathematician. All required skilled input operators, as the quality of the output was in some cases dependent on input consistency.[3]

2 Since mathematical composition was so exacting and time consuming, most compositors preferred to take on easier work that was more lucrative; even though mathematical work was charged at a higher price per page, the compositor suffered a penalty for accepting it.

3 According to one anecdotal report, the appearance of the same notation differed in two chapters input by different individuals; the system used for that project was one in which the positioning of symbols in displays was manually adjusted by the person doing the input.

The situation was ripe for improvement when the galleys of the re-set volume 2 of *TAOCP* reached Knuth.

Analysis of the problem

What Knuth did next is described nicely in his lecture on the occasion of his receiving the Kyoto Prize in 1996 [KnK]. Publication of the photoset volume 2 was halted, and Knuth sought out the best examples he could find of the mathematical typesetter's art. He chose three: Addison-Wesley books, in particular the original *TAOCP*; the Swedish journal *Acta Mathematica*, from about 1910; and the Dutch journal *Indagationes Mathematicae*, from about 1950.

To develop rules for proper spacing in mathematics, he writes

> *I looked at all of the mathematics formulas closely. I measured them, using the TV cameras at Stanford, to find out how far they dropped the subscripts and raised the superscripts, what styles of type they used, how they balanced fractions, and everything. I made detailed measurements, and I asked myself, "What is the smallest number of rules that I need to do what they were doing?" I learned that I could boil it down into a recursive construction that uses only seven types of objects in the formulas.*
> [KnQ, pp. 364–365]

Growing pains

The initial implementation of TEX began in October 1977 and was complete in May 1978. This tool was at first intended just for use by Knuth and his secretary to produce future volumes of *TAOCP* of which he could be proud. As a trained mathematician, he designed the input so that it would be meaningful in its raw form to another mathematician, but would also be easy for a secretary to type. Symbols would be input by name, e.g., \gamma, as would the structural components of a document, e.g., \chapter or \section, as opposed to the prevailing compositor's approach of marking changes by font and type size. (The latter approach is still evident in the design of many word processing programs, although it's usually hidden from the person entering the text.) TEX was designed to be used as a batch process, although interactive entry is possible, so the output isn't seen until the file has been processed; it is decidedly not "WYSIWYG". It was not contemplated that TEX would become a commercial product; instead, it would be made freely available.[4]

4 TEX is recognized as one of the first major pieces of "open source" software. Only one restriction has been requested: that only the author be allowed to make changes to the original, and that if changes are made, the name TEX not be used, but the derivative renamed. The rationale for renaming is to avoid confusion, so that if, in 50 years, someone processes an old file with TEX, the results will be the same as they were when that file was new.

In January 1978, Knuth delivered the Josiah Willard Gibbs lecture to the annual meeting of the American Mathematical Society (AMS). The lecture, entitled "Mathematical Typography" [KnM], began "Mathematical books and journals do not look as beautiful as they used to." Armed with copious examples, both good and bad, and a firm sense of how best to present mathematical notation so that it is intelligible (at least to those who are familiar with its use), Knuth presented a view of how computers can serve to replace the vanishing expertise of traditional compositors and restore the appearance of technical publications to their former glory. In addition to the discussion of proper presentation of mathematical notation, the lecture introduced a companion tool, Metafont, for production of the needed fonts.

The chair of the AMS Board of Trustees, Richard Palais, was in the audience. Since the AMS was one of the publishers suffering from the technological transition, TEX sounded like the solution to many problems. An arrangement was set up for a group of AMS representatives to spend a month at Stanford and learn TEX, "bring it back and make it work". This group consisted of one staff member from each of the AMS offices (Barbara Beeton from headquarters and Rilla Thedford from Mathematical Reviews) and three mathematicians: the aforementioned Richard Palais; Robert Morris from the University of Massachusetts, Boston, who had extensive computer experience; and Michael Spivak, who had a proven ability to write cogent textbooks. The charge was to develop methods for dealing with the typical publication cycle and to write an interface and instruction manual for end users as well as production staff.

As one of the AMS representatives, Beeton gathered a number of "good bad examples" that she knew would be encountered in production because they already had. This turned out to be good preparation: several of these examples turned up later in *The TEXbook* [KnTB] and as new features added to the program itself.[5]

The TEX program was duly brought back to the Providence office of the AMS, installed, and initial implementation of useful procedures was undertaken.[6] The first applications were light on mathematical content; polishing of the extended instruction set for use by mathematicians (AMS-TEX) and writing of its user manual [SpJ] were still underway. Also, in the interim, extensive changes were made in the program to provide features not in the first iteration (known now as TEX78). These changes included

5 Since Knuth's primary goal was to complete *TAOCP*, he assigned the trademark "TEX" to the AMS, to keep himself free of legal concerns.

6 In fact, things were rather more complicated. First, a new computer was needed; a DEC-System 20 was chosen to match the hardware Knuth was using at Stanford. Communicating updates, a rather frequent occurrence since TEX was still under active development, was accomplished via ARPANet file transfer to MIT, where Palais put it on a tape that he drove to Providence.

(1) enhanced manipulation of "boxes" (the containers for printed characters) and surrounding spaces and (2) an increase in the number of fonts that could be used as well as improved methods for manipulating them. The resulting version, known as TEX82, is the basis for today's program. At the same time, the language in which TEX was written was changed, from one that was in limited use to one with a solid history of use in teaching programming.[7] As it had been from day one, the software remained free to use and adapt. Having achieved his goal of a system that met his needs, Knuth returned to his work on *TAOCP*.

Contributing to TEX's growing popularity was the emergence, starting in the mid-1980s, of personal computer systems and their rapid adoption by technically minded individuals. This was TEX's natural audience, and implementations of TEX on these personal machines proliferated.

By the end of the 1980s, a growing user population in Europe was becoming increasingly frustrated with the difficulties in handling non-English texts. TEX required arcane combinations of characters to represent accented letters rather than the single pre-accented forms provided by European keyboards. Also, the compound input forms could not be properly hyphenated. A persuasive group of German users sat down with Knuth at the 1989 TEX Users Group meeting to discuss this lack. This meeting resulted in the extension of TEX to accommodate natively accented letters on input and proper hyphenation in processing.[8]

Communicating mathematics

The basic TEX system comes with a functional toolkit of typographic functions and one (quite extensive) family of fonts. This is necessary for the typesetting of mathematics and other technical material, but many users did not find it sufficient. Development has occurred in several areas, not all involving TEX.

Document structuring

While AMS-TEX formatted complicated math displays admirably using descriptive commands, it lacked the ability to automatically number equations and sections of a document and the means for cross-referencing. Another

7 In the process of upgrading from TEX78 to TEX82, Knuth refined the technique that he has called "literate programming". Using this approach to programming, code is interspersed with explanatory text, with the results (more) intelligible to a reader. (Both the TEX and Metafont programs have been published in this form as part of the series *Computers & Typesetting* [KnCT].) Knuth has said that he considers literate programming to be a more important contribution to software than TEX.

8 This became version 3. Effective with this version, the version number has been incremented by one decimal digit with every upgrade, converging to the numeric value of π; Knuth has requested that, at his death, TEX should not be updated further, and the version frozen as "π".

user instruction set, LaTeX (devised by Leslie Lamport,[9] a former student of Palais), did provide those features, although it lacked the mathematical refinements of AMS-TeX. The AMS, responding to pressure from authors, arranged to have the math-formatting facilities of AMS-TeX rewritten to operate within the LaTeX paradigm; the result was called AMS-LaTeX, comprising two parts, amsmath and the AMS document classes.[10]

Fonts

Font development has been driven by the availability of personal computers and laser printers and the growth of the World Wide Web, as well as by the desire for variation in type styles available for TeX.

One font family that originated in the need for robust output from low-resolution laser printers is Lucida by Kris Holmes and Charles Bigelow. Bigelow was on the Stanford faculty during part of the TeX project development, and Lucida has, from the very beginning, included a large complement of math symbols as needed by TeX users.

Desire to give mathematicians the ability to communicate on the Web was the driving force behind the STIX project.[11] In the first phase of this project, a comprehensive list of math symbols was compiled from lists submitted by the STIpub member organizations and submitted for addition to Unicode. The bulk of additions became available with Unicode 4.0 in 2003, comprising several thousand symbols, including several variant alphabets (e.g., Fraktur and script) needed to discriminate between different variables as defined in mathematical contexts.

Version 1 of the STIX fonts (based on Times) was released in 2012, and final polishing of version 2 is underway.

Possibly influenced by the STIX work with Unicode,[12] Microsoft added mathematics support to Word 2007[13] along with the newly designed

9 Lamport went on to win computer science's prestigious Turing Award in 2014, for reasons not related to LaTeX. (Donald Knuth had received the award in 1974.)

10 A document class is a set of macro commands that define the structuring of a document (e.g., a book or article). A class is written in such a way that page size and layout, elements such as chapter and section headings, and the style of bibliographies are easily adapted to conform to the specs for a particular publication. Then all that remains for an author is to invoke the class (\documentclass{pubname}) to produce the document in the desired style.

11 Scientific and Technical Information eXchange (http://stixfonts.org) is a project sponsored by STIpub, a consortium of five professional societies/technical publishers and a major commercial publisher of technical books and journals. This work is still going on, as new symbols are devised by scientists and symbols previously overlooked are uncovered.

12 One of the Unicode Technical Committee members who helped to shepherd the STIX request through to acceptance was a Microsoft software design engineer, Murray Sargent, who was also a key participant in the implementation of mathematics support in Microsoft products.

13 The design of mathematics support owes a great deal to TeX. Microsoft engineers met with Knuth in 2003 to study his methods [Sa].

Cambria font [MH]. Cambria is the first OpenType font (OTF) to make use of the OTF Math table. Indeed, the OTF Math table was created specifically for Cambria, and many of its parameters are recognizable as parallel to the TeX font paradigm.

The Web

XML was developed as a Web-aware application of SGML. Even for SGML, there had been an effort to standardize the names of math symbols as a "public entity set", and this drew heavily on the names assigned for TeX and AMS-TeX. This vocabulary was taken into XML and its technical daughter MathML. Work has continued in this area to maintain parallel naming, insofar as possible, between the two "languages".

Since MathML is not as easily comprehended by humans as TeX, translation conventions and software have sprung up to allow input using TeX notation, which is familiar to mathematicians. Another Web presentation tool, MathJax, has emerged to allow in-line math to be delivered natively on-screen (without the use of bitmap inclusions, which are not scalable, or PDF); again, the input notation is essentially TeX although it is rarely entered directly by a human author.

Non-technical applications

Since TeX was designed as a hardware-independent batch process, it is capable of being used in repetitive contexts to prepare personalized form letters, invoices, bank statements, train schedules, catalogs,...; the list goes on and on. The original output format is compact since it contains only the identification of glyphs and their location on the page; thus it can be archived compactly (along with one copy of each needed font and other repetitive content such as logos), an important feature to comply with legal requirements for some documents. Most such uses are "invisible" to those not familiar with the relevant workflow, but they are extensive, especially in Europe.

Remaining limitations

One area that has not yet seen a satisfactory method of presentation is accessibility—the ability to translate TeX input to an audio output that is readily understandable by a trained mathematician with visual limitations. Part of the problem is that, for best results, an author must think ahead about such use and restrict the way that notation is used; most authors can't be bothered, even if they *are* aware of the problem. Someone may find a credible and easily applied solution, but to date, it's still a quite hard problem.

Conclusion

The most lasting effect of TEX is separate from the software itself: TEX's vocabulary has become the *lingua franca* of mathematics. Knuth's design of a linearly coded stream for representing math has withstood the test of time and has been adopted into other software without any substantial redesign. TEX itself is one of the few pieces of software from that period still in wide use.

Since the input is plain text, it is not affected by (most) upgrades to the processing system, and it is hardware independent; the same input will yield the same output, modulo the availability of identical fonts. Knuth's original goal of creating a system that would enable him to typeset his life's work, *TAOCP*, with the same high quality shown by the first edition of volume 1 and remain consistent regardless of how many years have elapsed has been achieved admirably.

Unless something totally unforeseen materializes that is simpler to use and produces results of equally high quality without the need to unlearn the basics of mathematical discourse itself, the situation is likely to remain very much the same in the coming decades.

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Authors

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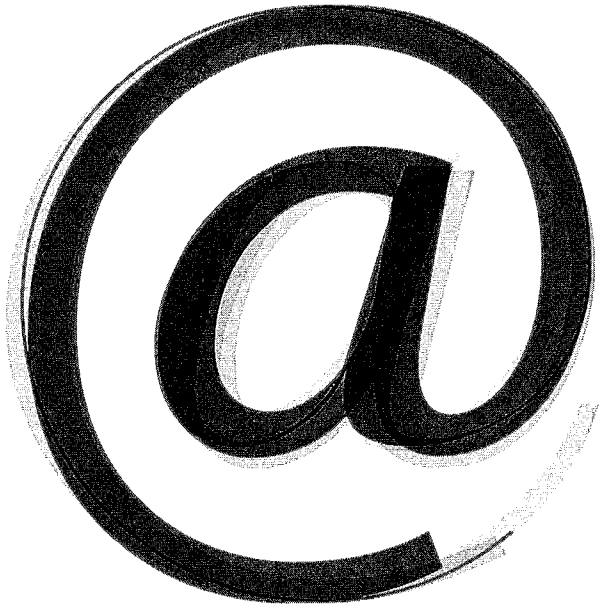
Richard Palais was the Founding Chair of the TEX Users Group. He was a member of the AMS Board of Trustees from 1972 to 1981 and its chair from 1977 to 1979. He is professor of mathematics emeritus at Brandeis University, and since 2004 he has been on the faculty at the University of California, Irvine.



Commercial at @

James Mosley

Abstract

This article is the reprint of an October 6, 2013 blog posting on the history of the "commercial at" sign.

Keywords

design history, typography, font design

The "commercial at," the character @, has needed more historical investigation for some time, and indeed I have drafted many texts on it without posting them. This was not so much because the Wikipedia article on @ was seriously defective. It does, as one might expect, supply a great deal of what is needed. But the published information has failed to settle some of the puzzling details that we have some right to expect would have been resolved by now.

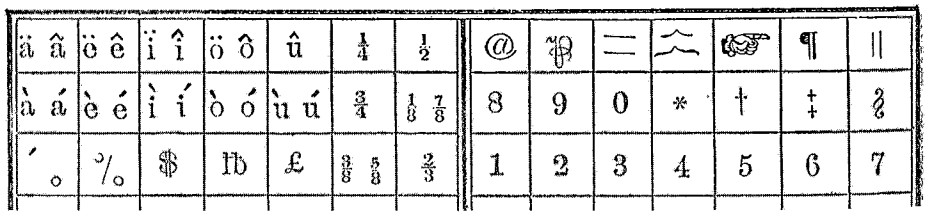
In his mostly excellent brief history for a non-professional readership, *Ancient Writing and Its Influence* (1932), the palaeographer B. L. Ullman rather rashly remarked,

> The national hands which grew out of cursive preserved a still greater number of ligatures. The Carolingian hand suppressed most of them... But some of them were too well established and therefore have persisted to this day. The most important of all was that of et, introduced into formal writing by half uncial. We use it in English for "and", the equivalent for Latin et, and call it "ampersand" ("and per se and") a name that arose when this character was placed at the end of the alphabet and was recited with the other letters: "x, y, z, and, per se [by itself] (the character standing for) and". This has taken on many different forms in different styles of writing and printing, but nearly all are based on the old & and the italic &. ... Other ligatures still in use are ae (æ) ... There is also the sign @, which is really for ad, with an exaggerated uncial d.

The "lay" or arrangement of types in the compositor's case, although it had mostly become fairly standardized, tended to vary in some of its details from printing-house to printing-house, according to the kind of work that was chiefly set there. The abandonment of long s and its ligatures in about 1800, which had occupied nearly twenty sorts of the roman and italic fonts, freed up some space in the case. The 1892 edition of *Practical Printing* by John Southward showed a series of non-alphabetic characters in its example of an "improved" upper case which had not been in a normal case earlier in the century.

figure 1

Practical Printing, 1892



These, shown above, in the top three rows of the upper case, included not only @ and the mostly redundant "per cent" character %, but

also the pound sign £, the dollar $, and also types for the calligraphic "per" and for lb (the pound weight). These were all needed for use in commercial jobs like the printing of catalogues of goods for sale. The & was included in one of the small boxes at the left hand side of the lower case, which had long been its traditional place. The lb character with its cross stroke became obsolete, but it is worth noting that it was used throughout the 29 volumes of the 1911 edition of the *Encyclopaedia Britannica*, set on the Monotype machine.

Many of these characters migrated to the typewriter, which was introduced as a commercial machine for use in offices. No significant domestic market for it was imagined by its original makers, just as the first makers of computers notoriously could not believe that there might be a domestic market for their product. The "commercial characters" were not found on every early typewriter, but it seems to be agreed that most of them, including @, had been placed on typewriters by the early twentieth century, and thereafter few typewriter keyboards lacked them. For this reason, these symbols were unquestioningly adopted by the makers of computer keyboards, who were rigidly bound by tradition.

The "per" symbol (which was admittedly a rather elaborate design) failed to get onto the normal typewriter keyboard and has faded from memory. However, one symbol that did, although few users of computers had any idea what it was for and how to use it, was of course @. Since it appeared to be both universally available and largely useless, it was adopted, as we know (the event has been well-documented), for use with the internet and with email. And although it has been a nuisance to the designers of fonts, who have rarely found its form easy to adapt to match traditional letters, there seems little likelihood that we shall get rid of it easily. The @ we have is rooted in the commercial handwriting of the 19th century.

If this is the case, we are entitled to ask why this is and where and when did it begin to be used? Surely this is a question that it should be easy enough to answer.

Since the question was of no interest to academic historians of writing or typography, enthusiastic amateurs entered the discussion, scattering a profusion of badly-informed ideas. Not long ago, the blogosphere seemed to be full of their excited chatter. Here is some of it, from Italian and Spanish blogs:

> Scoperta! la @ è italiana! (Discovery! The @ is Italian!)
>
> La chiocciola @ di e-mail è una invenzione tutta italiana. (The @ is a wholly Italian invention.)
>
> ¿Creó un sevillano la @? (Did a Sevillian create the @?)
>
> Sevilla utiliza la @ como reclamo turístico. (Seville uses the @ as publicity for tourism.)

La arroba no es de Sevilla (ni de Italia). (The @ is not from Seville, nor from Italy.)

La @ ya se utilizaba en 1448 en Aragón. (The @ was already in use in Aragon in 1448.)

It would be churlish to spoil their evident enjoyment of such stuff. (Googling will bring up plenty more examples.) We can only hope that they lead to lines of enquiry that are frankly more worth pursuing.

One of these is the claim that the @ stood for the amphora, the vessel for wine or oil that stood for a unit of measurement known to Greeks and Arabs, and that the Anglo-Saxons (commercial rivals from England and the USA) eventually stole the symbol for their own use. The other line, worth pursuing because it has left its trace in current usage, is that the @ stands for arroba, a unit of weight and capacity of Arabic origin, long used in the Spanish-speaking world, which was only eliminated by the adoption of the metric system. Arroba is still the Hispanic word for @.

I have no intention here of raking through among the embarrassingly cute terms that are currently used for the @ in other languages by writers who have stumbled on it for the first time, like the chiocciola (snail) in Italian – see above – or the "monkey"s tail" (Dutch), or the eymologically dubious arrobase that is used for some reason in France. Most of the discussion in circulation is dismally facetious and credulous.

Still, since there is usually some basis underlying many myths in current circulation, one purpose in offering this post (which I hope will soon be rendered obsolete) is to identify these myths and to distinguish between them.

I said that Ullman was rash in appearing to link the use of @ to &, saying that both symbols were "still in use", though in justice to him, one must note that – unless one takes his reference to "uncial" literally – he did not assign an early manuscript use to it (as at least one online source has accused him of doing). The ampersand did indeed arrive in current use in the 15th century with the revived Carolingian hand of humanism, and it was adopted for their types by Italian printers like Jenson. It is sometimes a delightful design, which has attracted some major punchcutters, but one should note that it was unwise of the BBC in 2012 to let an enthusiast attempt to trace its history on its Radio 4 (of all unsuitable non-visual media). In that context it should have been noted that the inspirational punchcutter was Granjon rather than Garamont, and that the old Roman "Tironian" shorthand symbol for "and" (looking a bit like the figure 7) was not a ligature of e and t, and although it remained in common use in gothic script and types, it (and they) faded eventually from use.

But what about the @? When did it enter into use in commercial writing? Like most people, I suspect, I thought it had been normal English usage in business papers for some centuries. Then I tried to find examples. It was not easy. I found nothing from the 17th century. One of the earliest convincing examples I have found was something – but hardly more than an ill-defined scribble – in the papers of William Strahan (1715–1785), whose prosperity among contemporary printers in London was commonly supposed to be due to his exemplary business methods. The example that follows is simply my rough sketch from a document of 1739 (Add. MS 48800, f. 17v) among the Strahan Papers in the British Library.

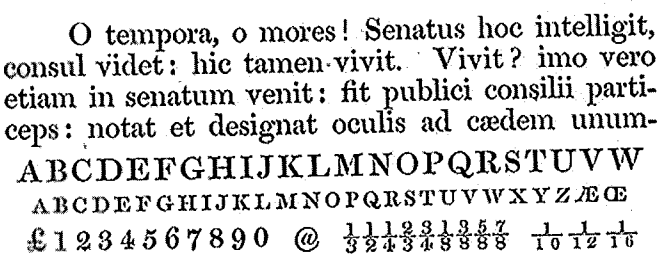
figure 2

author's drawing from writing of William Strahan, 1739

It is the earliest example that I have found. Thereafter (but much later and far more slowly than I had thought), the symbol did indeed begin to be adopted in British practice for "at a certain price" or "at a rate of". This example of the @ as a printing type, which is the first that I have found anywhere, is in a specimen of the Miller typefoundry in Edinburgh, 1822.

figure 3

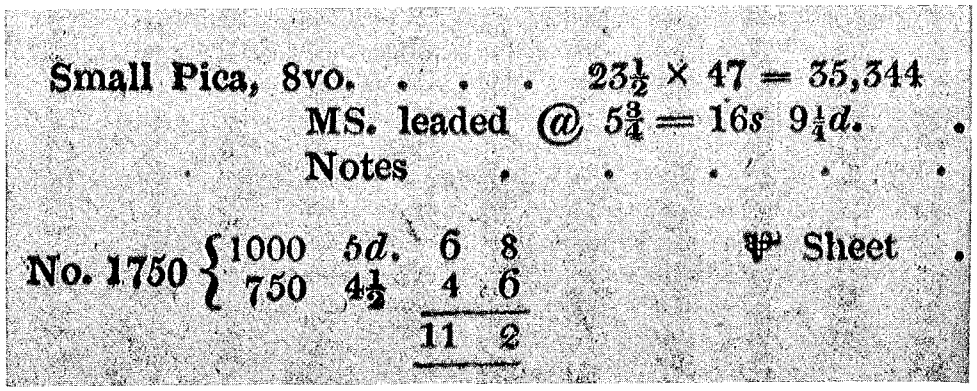
Miller typefoundry, 1822



It can be seen again in an English manual of printing (T. C. Hansard, *Typographia*, 1825), in a passage reproducing handwritten book-keeping. (Notice, too, the use here of a typographical version of the symbol for "per".)

figure 4

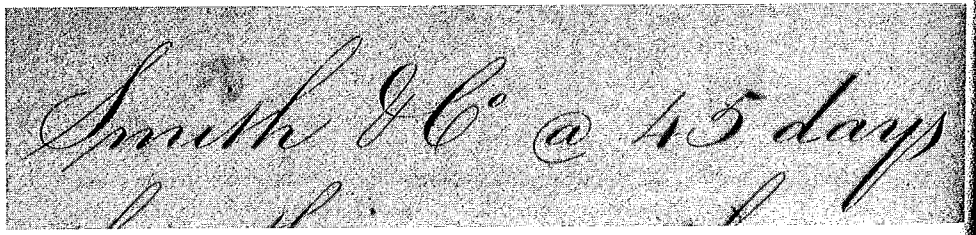
Typographia, 1825


Small Pica, 8vo. . . . $23\frac{1}{2} \times 47 = 35{,}344$
MS. leaded @ $5\frac{3}{4} = 16s\ 9\frac{1}{4}d.$
Notes . . . . . .
No. 1750 { 1000 5d. 6 8 ℔ Sheet .
750 $4\frac{1}{2}$ 4 6
11 2

Here, finally, is an example of @ in a British handbook of instructions for book-keeping, C. Morrison, *Practical bookkeeping*, Edinburgh, 1838. It is very nicely drawn, but its date is quite late.

figure 5

Practical bookkeeping, 1838


Smith & Co° @ 4/5 days

What about the Spanish connection? In 2000 there was a flurry of excitement about the "discovery" of the early use of @ by an Italian academic. The source was Professor Giorgio Stabile, of La Sapienza university in Rome, who was engaged on an article for the Treccani encyclopedia, one of the enterprises that Google and Wikipedia have to some extent displaced for use in our current research.

Stabile let it be known to some friends in the media that in the course of his researches into commercial documents he had found an early use of @ in the correspondence of some Italian merchants based in Seville in 1536. This discovery made news, and it still generates some excitement in journals that should know better, like the *New York Times* and the *Guardian*, who keep obsolete links alive to Stabile and his important researches.

It would have been satisfactory if Professor Stabile had been more candid about the source of his "discovery". To his credit, he did later acknowledge that his "research" among original documents consisted in this case of finding an example in a well-known, well edited and well illustrated published collection of commercial correspondence that had been made some decades before by Federigo Melis, Documenti per la storia economica dei secoli XIII–XVI, con una nota di Paleografia Commerciale di Elena Cecchi. Firenze: Olschki, 1972 (Istituto Internazionale di Storia economica "F. Datini" Prato, Pubblicazioni – Serie I. Documenti, 1). The documents that Stabile claimed to have found are illustrated on pages 214–215, and the originals are among the Strozzi papers in the Archivio di Stato, Florence.

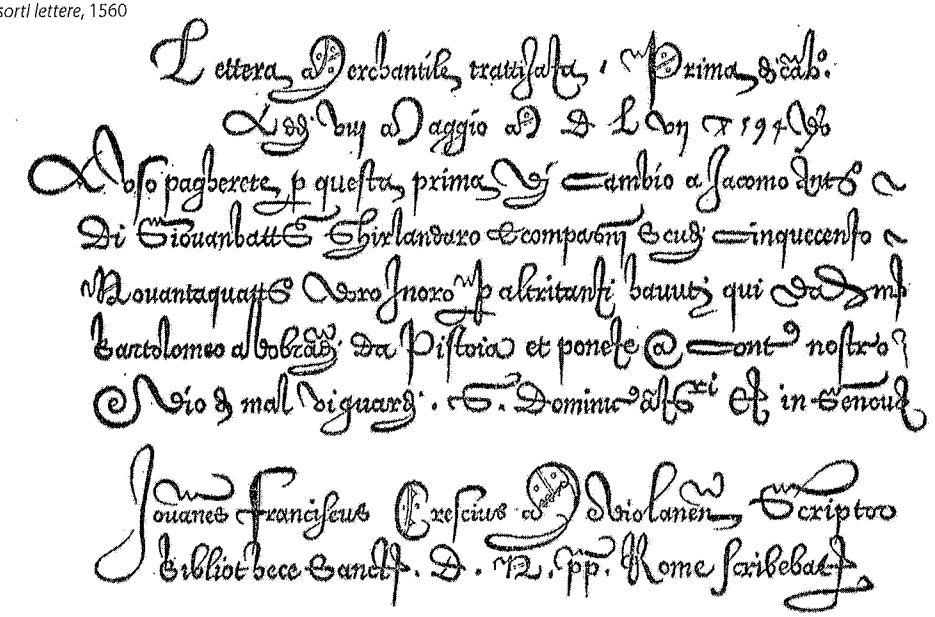
Stabile explained that the symbol @ in this text stood for containers of wine measured by the unit known as the amphora, and he suggested (but without providing sources) that this was a widely-used Mediterranean unit of measurement. He might have added – but he did not – that in several of the commercial letters shown in his book by Melis, the @ is also commonly used for the date, in phrases like "Ad di 20 di gennaio" (on 20 January), which takes it closer to its later use in business documents. He made no reference to its more general use in contemporary Italian commercial handwriting or the scrittura mercantesca, on which, as its title shows, a useful appendix in Melis's book was contibuted by Elena Cecchi.

How far did the historians of writing contribute to the story? For writing of the Italian Renaissance they gave most of their attention to the cancellaresca corsiva, the official "chancery hand" derived from the humanistic cursive of the 15th century which was shown in a well-known series of printed handbooks of the 16th century. All the same, in several of these handbooks an example of the gothic commercial hand, the mercantesca, was often to be found at the back. There is in fact a little handbook of the hand by Eustachio Celebrino, an associate of the writing master Tagliente, Il modo di imparare di scrivere lettera merchantescha, 1525, but it does not appear to include examples of the use of @.

The earliest example of the @ character that I have found in an Italian writing book is in a document in the commercial hand in a letter dated 8 May 1557, a woodcut at the end of the first publication of Giovanni Francesco Cresci, the Essemplare di scrivere più sorti lettere, published in Rome in 1560, with the phrase, ponete @ conto nostro – "put [the sum] to our account".

figure 6

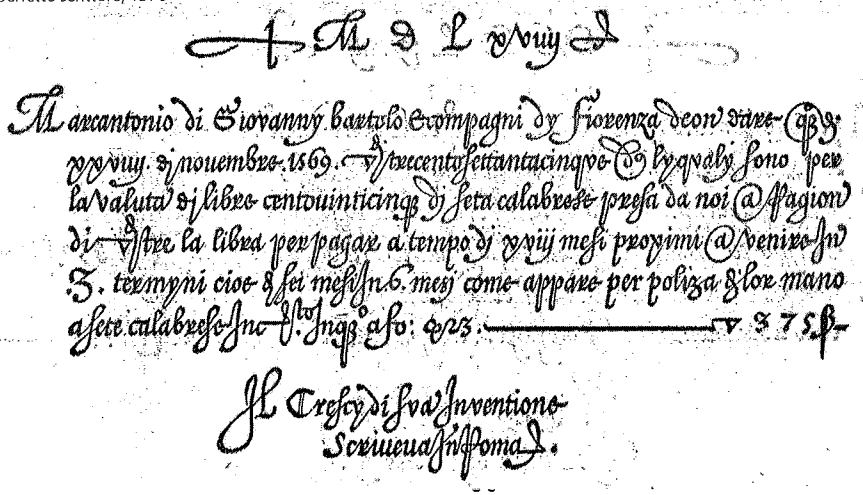
Essemplare di scrivere più sorti lettere, 1560



And here is the @ again in a document dated 1569 in Cresci"s Il perfetto scrittore of about 1570: la valuta di libre centouinticinque di seta calabrese presa da noi @ Ragion di [scudi] tre la libra per pagar a tempo dj xviij mesi proximi @ venire (the value of a hundred and twenty-five pounds of silk from Calabria, obtained from us at a rate of three scudi per pound, to be paid within eighteen months).

figure 7

Il perfetto scrittore, 1570



From these examples, there seems little doubt that the @ was in regular use in more or less its later sense of "the commercial at" in Italian documents of the 16th century. If it disappears from later writing books, this is probably because they were not much concerned with the gothic commercial hands. There are intermittent examples that have been published online of later French and Spanish handwritten usage, but very few with reference to specific, dated documents of which the present whereabouts is clearly specified. For the arroba, that term of Arabic origin, the later Spanish character in printing was indeed @, but it seems to me that this usage may simply be the result of borrowing "Anglo-Saxon" type, since by 1900 the @ was widely available from typefounders in Europe and in North America. We need far more authenticated examples of its use (and its meaning) in earlier, dated handwritten documents.

I ought to add a final illustration of the @ in the type specimen of J. B. Clement-Sturme in Valencia, 1833, details of which are given in the admirable list of Spanish type specimens by Albert Corbeto (Catalogación y estudio de las muestras de letras impresas hasta el año 1833), published in 2010. The @ (with a design that is based on a roman a) is used to give the price of the type by weight, the unit being the arroba: Precio di cada @ castellana, 162½ Reales.

figure 8

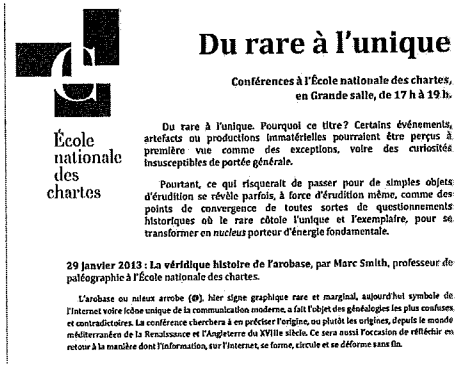
J. B. Clement-Sturme, 1833

I am sure that there is much documentation that can be done by the many researchers who trawl through the innumerable business records that survive in major collections. I hope that, in the course of their work, they will spare a thought for historians in other fields, and save some well-documented images for us that will fill in the many gaps that exist and which still frustrate the fulfilment of our wish to complete the story.

Addendum

This informal article began with a reference to discontent with the confused, often badly informed and sometimes chauvinistic sources of information that frustrated my own attempts to understand where this symbol came from and what it has meant. It made me doubt whether I should add yet another contribution to the debate.

figure 9



École nationale des chartes

Du rare à l'unique

Conférences à l'École nationale des chartes, en Grande salle, de 17 h à 19 h.

Du rare à l'unique. Pourquoi ce titre? Certains événements, artefacts ou productions immatérielles pourraient être perçus à première vue comme des exceptions, voire des curiosités insusceptibles de portée générale.

Pourtant, ce qui risquerait de passer pour de simples objets d'érudition se révèle parfois, à force d'érudition même, comme des points de convergence de toutes sortes de questionnements historiques où le rare côtoie l'unique et l'exemplaire, pour se transformer en *nucleus* porteur d'énergie fondamentale.

29 janvier 2013 : La véridique histoire de l'arobase, par **Marc Smith**, professeur de paléographie à l'École nationale des chartes.

L'arobase ou aleux arrobe (@), hier signe graphique rare et marginal, aujourd'hui symbole de l'Internet voire icône unique de la communication moderne, a fait l'objet des généalogies les plus confuses et contradictoires. La conférence cherchera à en préciser l'origine, ou plutôt les origines, depuis le monde méditerranéen de la Renaissance et l'Angleterre du XVIIIe siècle. Ce sera aussi l'occasion de réfléchir en retour à la manière dont l'information, sur l'Internet, se forme, circule et se déforme sans fin.

However I am glad that I did, because it has led me to discover a substantial body of work that will do much to clear up the confusion. In January 2013 Marc Smith, Professor of Mediaeval and Modern Palaeography at the École nationale des Chartes, the leading institution in its field in France, gave an illustrated lecture on the @ in French, a link to which can be found on YouTube [https://www.youtube.com/watch?v=zZLWtvfSqCY]. He has published a summary of his lecture in a printed journal in France (Graphê 55, July 2013), and he plans to put its substance into a book. One hopes that it will include a generous selection from the many images of documents, handwritten and printed, some of which are familiar but most of which are wholly unknown, that accompany the lecture.

At the heart of his argument is the question of the arroba, the unit of weight (and capacity) of twenty-five pounds that was a part of Spain"s heritage from its arabic past until the metric system overtook it. One meaning of @ in Spain and Portugal, and to some extent in France, was indeed the arroba, but it stood for many other things too. Professor Smith shows that it was something of an all-purpose abbreviation for many words beginning with a, like avoir. In one of his documents, in French, dated 1391, it is used for initial "an". The current French term arrobase appears to be simply based on the Spanish plural arrobas. But he notes, as I have done, that English speakers belatedly adopted a continental variant of an accented form of a as "à", tending to use it where it was a convenient way of saving space by not writing "at" in full. As a universal term, he appears to be content with the anglophone commercial at.

As a palaeographer, Marc Smith was well qualified to find and to interpret the many early documents in which @ has appeared. But his researches have been wide-ranging, and he has done good work among handbooks for book-keepers, typefounders" specimens, several from Spain, beginning with Pedro Ifern, 1793 (but he shows a rather crude example, possibly cut on wood, in the Ortografía de la lengua castellana of the Real Academia Española, Madrid, 1754), collections of commercial correspondence, and typewriters. He offers the Caligraph No. 2 Commercial of 1883 as an early machine with a key for @. For French typefounders, with an eye on their neighbouring market in Spain, the @ stood for arroba. He has found a type for an English @ in Patrick Kelly, *Elements of Book-keeping*, 1805. [various dates, needs to be checked, CB]

Since he does not substantially differ from the suggestions I make in my own text, I am inclined to leave it more or less as it was posted, but anyone wishing to take the matter further and stand on firm ground must turn to his account of his own extensive researches, and follow them as they progress. One hopes that they will.

JM 11 October 2013

Author

James Mosley was the Librarian of the St Bride Printing Library (London) from 1958 to 2000. A founding member of the Printing Historical Society in 1964, he was the first editor of its Journal. He has written on a wide range of printing and typographic history, including The Nymph and the Grot: the revival of the sanserif letter. He received the 2003 American Printing History Association award for his contributions to printing history. He has taught at the University of Reading and the University of Virginia Rare Book School. He blogs printing historical essays at Typefoundry [typefoundry.blogspot.com].

research question:

which is more legible, sans serif or serif?

past method:

compare two different typefaces (example) –

one sans serif - Helvetica
one serif - Times

results:

inconclusive

improved method:

compare one typeface in two versions,

Lucida sans serif
Lucida serif

results:

serif version in smaller sizes resulted in slower reading rate

(Morris el al. 2002)

Letterform Research: an academic orphan

Sofie Beier

Abstract

This paper looks into the history of letterform research and discusses why the discipline has yet to make the big break within design research. By highlighting two of the most popular focus areas (letter distinctiveness and the role of serifs) and by discussing various forms of methodological shortcomings, the paper suggests that future research into letterforms should (1) draw on results from the field of reading research (2) be based on test material informed by design knowledge and (3) move away from the former tendency of looking for universal answers.

Keywords

design research, research methods, legibility, readability, typography, design

Introduction

At the early days of the journal *Visible Language*, initially *The Journal of Typographic Research*, the journal made a substantial effort in trying to inform the design community about relevant research findings on typography. At its tenth issue, the editor Merald Wrolstad (1969) reflected on the state of letterform research, finding the field flourishing in as different areas as psychology, education, engineering, highway safety, cartography, and many more. However, in relation to the typographical community, Wrolstad saw that letterform research was what he called an 'academic orphan' as it did not have an established academic home. The downside of this, he argued, was that the direction and progress of the research was completely dependent on other disciplines and that those disciplines focused on research problems related to their own area of interest and were not looking at letterforms per se, which is what is relevant for the design community.

Six years on, learning theorist Michael Macdonald-Ross and designer Robert Waller (1975), published a critical paper, which thoroughly explained why they believed designers did not benefit from the findings generated in the field of legibility research. In a review of some of the most influential studies of the early 20th century (e.g. Pyke, 1926; Paterson & Tinker, 1940; Luckiesh & Moss, 1942; Burt, 1959; Tinker, 1963), Macdonald-Ross and Waller identified a number of flaws or 'systematic defects' as they called them.

One such flaw was that it was difficult to see the day-to-day relevance in some of the most popular experimental questions. Here the authors criticized the tendency among researchers to choose topics that are easily tested in a laboratory setting, instead of looking into the problems that typographers face in practice. They further raised the problem, which has also been mentioned by other critiques of legibility research (Lupton, 2003; Lund, 1995; Sless, 1981), that it is impossible to isolate one variable as typographical variables always interact. Additionally, Macdonald-Ross and Waller criticized the fact that many experiments are presented in journals without reproduction of the test material, which makes it difficult for the reader to judge whether other variables might have influenced the findings. To suggest a more fruitful direction, Macdonald-Ross and Waller recommended that legibility researchers make greater use of the tacit know-how of designers.

15 years later, Robert Waller (1990) continued the discussion in his paper "Typography and Discourse" where he complimented the work of Herbert Spencer and colleagues at the Royal College of Art for combining the skills of psychology and design and for the fact that their studies had relatively modest and realistic goals.

Established in 1966 and continuing for 16 years, Herbert Spencer's Graphic Information Research Unit, initially known as the Readability of Print Research Unit, focused among other topics on how various forms of reproduction methods affected the legibility of type and layout. In the 60s and 70s, relevant areas to look into were poor quality printing and the effect of show-through, photocopies and thinning-down or thickening-up of the type, microforms, and videotext displays. In addition to this, the group also worked with matters of directional signage and labeling at libraries and museums (Reynolds, 2007, 1979). What characterized the research direction was that their work was funded externally from organizations such as the British Library and The British Post Office. These organizations had specific questions they wanted answered. Combined with the fact that several members of the group had a background in design, it likely made the work easily transferable into real life design situations. This way of working was atypical for the time. 20th century legibility researchers often had a background in psychology or engineering, and their work was driven by an aim to identify a set of universal rules that could be transferred into any typographical situation or context.

A popular research topic was to test a number of different typeface styles, and rank them according to the most legible (for examples see Tinker, 1944; Pyke, 1926; Roethlein, 1912). There are several problems with such an approach. First the findings only inform us on the relationship between these specific typefaces, and teach us little about any other typeface styles; second, different test methods produce different findings and third the results of testing one reading situation cannot always be transferred into another reading situation, as put by typography writer Walter Tracy in the 1980s:

> As some academic writing shows, the absence of practical experience of type gives rise to a tendency to treat all types as equal and similar in nature, purpose and function. In short, there is a failure to recognise the different roles of type faces (Tracy, 1986, p. 27).

The early researchers investigated the affect of various typefaces on reading, without necessarily drawing on relevant knowledge on typography (for more on this see Beier & Dyson, 2014). Greater awareness of the perceptual and cognitive aspects would have provided the researchers with useful clues on more prolific topics to investigate, instead of repeating the same form of studies again and again. Today, the focus of the majority of reading research still lies within the field of psychology; however, the main area of interest has over the years moved away from the comparison of typeface style, size, and layout to a focus on the cognitive mental processes that lies behind the action of reading, with focus areas such as: dyslexia, the process of word recognition, eye movement, and how to teach reading. Neither the early approach of an often uninformed focus on typographical matters nor the present approach of solely looking into the cognitive process of reading are ideal for producing findings that can fully enlighten the typographical community. In that sense, the problems raised by editor

Merald Wrolstad almost half a century ago are still problems. It can hence be argued that the discipline of letterform research within design is still an academic orphan, with relatively few researchers having designers as their main target audience.

Another possible reason for the discipline's lack of appropriate development might be related to designers over the years having a general lack of interest in the topic. In his book *The visible word* from 1968, Herbert Spencer stated, "Some typographical designers and printers shun legibility research because they regard it as a threat to their freedom of action" (Spencer, 1968, p. 6). Later in 1999, typography writer Rick Poynor described a meeting with a couple of London designers. The duo was devoted to the Swiss school of typography and explained to Poynor that they rarely read the text they laid out. Poynor went on to express his personal dislike with reading text set by this team of designers, finding their typography hard to read and uninviting. Based on his own observations, Poynor concluded, "type designers and typographers have poured scorn on the very idea of legibility" as "the scientific approach seems fundamentally hostile to the mysteries of the creative process" (Poynor 1999, p. 14). Other designers are well informed about the scientific findings, however choose to ignore them. One such example is designer Jason Santa Maria (2014). In an attempt to explain the mechanism behind the reading process, Santa Maria presents several theories as being valid in spite of these same theories being disproven by research. In the comment section, Santa Maria recognizes this yet explains that regardless, he finds the theories he presents most compelling.

In 1981, *Visible Language* published a special issue on *Visual Cues in Word Recognition and Reading*, which was edited by psychologist Keith Rayner. In the introduction, Rayner concluded that research into the visual factors involved in reading, often has not involved much communication between researchers interested in reading and the graphic designers who set text to print (Rayner, 1981, p. 125). As he acknowledged that none of the authors of the issue had a background in design, Rayner found that several of the papers had a direct relevance to designers, with their focus on eye movement and the visual cues that may influence reading. In more recent time, several publications have also aimed at informing the design community about relevant research findings on the visual processing of letters and words (Thiessen et al., 2015; Beier & Dyson, 2014; Lonsdale, 2014; Dyson, 2013; Beier, 2012), and a number of other publications have aimed at informing psychologists and vision scientists on the role of typography matters in reading (Keage et al., 2014; Sanocki & Dyson, 2012; Legge & Bigelow, 2011). Furthermore, several of the larger commercial organizations working with digital technology have lately shown interest in implementing reading-related scientific findings in their products. Among these, the reading mode for Microsoft's OneNote (Chansanchai, 2015), which has added new functions for syllable marking, syntax marking, and crowding reduction, all based on data from the reading psychology community. Such usage of reading research opens up for a deeper relationship and collaboration between researchers from the fields of psychology and design.

To continue this positive development, and to expand the discipline and move away from the status as an academic orphan within design research, it is essential to give space to both applied and basic research. While applied research can produce findings that can be implemented directly in new designs, basic research can continue to focus on the cognitive processes of reading and hence produce the necessary findings for the applied research to be able to ask the right research questions.

As earlier mentioned, different test methods produce different findings, as is demonstrated in the legibility ranking of a range of typeface styles by Miles A. Tinker in 1944. Instead of viewing this as an indicator of the shortcomings of legibility studies as a whole, it proves the notion that different reading situations put different demands on the typefaces applied. For example, type viewed in the center of the visual field at great distances tend to blur (Liu & Arditi, 2001; Hess et al., 2000) a phenomenon called crowding, or counter interaction; the same is seen in type viewed in the peripheral part of the visual field (Pelli et al., 2007; Chung et al., 1998; Bouma, 1970) as is the case in running text. Furthermore, running text typically presents a greater number of letters to the reader at once than do type for signage. All these, and many more factors, influence the legibility of a typeface in different ways. It is therefore not possible to identify the best legible typeface or the best way of testing legibility. Keeping in mind that when designing experiments that target specific typographical questions, it is essential to choose test methods that relate to the reading situation under investigation. In other cases, where the question relates to a more fundamental understanding of the process of reading, the various methods of short exposure might be more appropriate, as these methods tend to have a greater sensitivity to variations in the performance of participants.

Next, we will take a closer look at two of the most popular focus areas within letterform research and reflect on what we know and how to approach the discipline to further minimize the methodological shortcomings in the future.

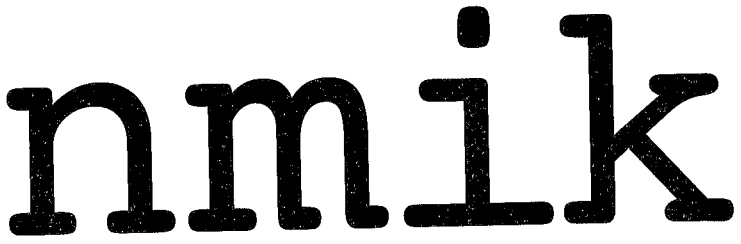
Letter distinctiveness

A popular research topic of the 20th century was to identify the most common misreadings between different letter pairs within a specific typeface (Mueller & Weidemann, 2012). A comparison of some of these findings (Beier, 2012) demonstrates that different typefaces result in different forms of misreadings. As an example, the typeface Courier results in frequent misreading between 'n' and 'm' (Bouma, 1971), while the same is not the case with the typeface Futura (Geyer, 1977). The obvious explanation for this is that due to the monospaced features, the Courier 'm' is much narrower than

the same letter in other typeface. The misreading likely occurred because participants expected the letter 'm' to be wider than the letter 'n'. The typeface Courier is further designed with large dominant slab serifs, so it may be that these could have influenced the identification of letters in ways that would not happen in typefaces of less dominant serifs (Figure 1).

Figure 1

The typeface Courier is monospaced, which means that the letter 'm' is unusually narrow and the letter 'l' is unusually wide.



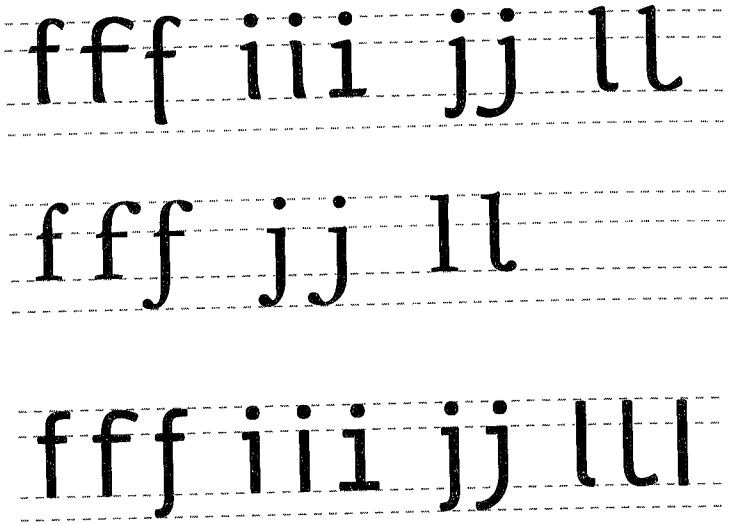
A collective examination of the findings, do, however, indicate a greater misreading between lower-case letters of no extenders ('e', 'c', 'a', 's', 'n', 'u', 'o'), lower-case letters of narrow width ('i', 'j', 'l', 'f', 't'), upper-case letters of round features ('O', 'Q', 'G', 'C', 'D'), upper-case letters of diagonal strokes ('X', 'Y', 'K', 'V'), and upper-case letters of vertical strokes ('M', 'N', 'H') (Beier, 2012). Such observations come as no surprise as these letters groups also contain the letters of the alphabet that have the most attributes in common. Fiset and colleagues (2008) have confirmed the notion in demonstrating that when identifying individual letters of the typeface Arial, readers focus on the attribute of the letter that separates it from other visually related letters, such as the cross bar of the 'e' making it different from 'c' and 'o', and the space between the dot and the stem of the 'i' making it different from 'l'. However, to sufficiently inform the discipline of letterform research, none of the above-mentioned studies can stand alone, as they only look at the matter by testing one typeface style. It is therefore difficult to say whether the findings are transferable to other typeface styles as well.

Fox and colleagues (2007) have tested the legibility of the lower-case letters, numbers, and symbols of 20 different typefaces. Applying a method of short exposure, where the characters were displayed in 10-point font size, the researchers found that the letter 'e' of the typefaces that had a crossbar placed up high, was less legible than the typefaces where the letter 'e' had a crossbar placed in the perceptual center. To compensate for the differences between typefaces, features such as x-height, letter weight, and stroke contrast were each treated as independent factors in the analysis.

Another way of meeting the methodological shortcomings of the comparison of different typeface styles is seen in a study by Beier & Larson (2010), testing different letter variations within the same typefaces (Figure 2). By applying such a method, it should be easier to isolate specific variables for investigation. The study in question found that for distance reading, the identification of individual narrow letters is improved when letters are designed with wide shapes, that a one-storey 'a' is less legible

Figure 2

Letter variations within three different typefaces (from top) Spencer, Pyke and Ovink, designed by Sofie Beier. The study found that at distance reading, wide versions of narrow letters were read at greater distances than narrow versions (Beier & Larson 2010)



than a two-storey 'a', and that a curvy spine of the letter 's' appear to be more legible than a diagonal spine. The investigation included 2-5 variations of each of the tested letters within the typefaces. To fully explore the matter of letter distinctiveness, upper-case letters should be investigated as well as other kinds of lower-case letter variations. Further, only two test methods were applied, one measuring the maximum distance of identification and one measuring the identification in the peripheral view of short exposure. A focus on identifying the most legible letter-skeleton for different reading situations is a huge area within letterform research that will benefit from more research based on suitable methodologies.

In a thorough review of exiting research that apply psychophysical techniques in the study of letter perception, Grainger and his colleagues (2008) concluded that there is convincing evidence suggesting that letters are identified via their component features. The majority of research into understanding reading further indicates that we read in a parallel operation of a bottom up process of the identification of the individual features and wholes of the letters and of a top down process where we draw on a mental lexicon of syllables, words, and sentence structures that we have encountered before (McClelland & Rumelhart, 1981; Rumelhart & McClelland, 1982). Such research produces the theoretical background to direct letterform research towards identifying the most differential letter features; however, it further opens up for a second focus area of maximizing the legibility of the letters in combination within words and sentences. A relevant angle would be to study the regularity-effect (Sanocki & Dyson, 2012). The phenomenon identified as font tuning (Dyson & Beier 2016; Walker, 2008; Gauthier et al. 2006; Sanocki, 1991, 1992) finds that readers tend to "tune into" the specific features of a given typeface, which makes it easier to read text set in one typeface instead of a mix of typefaces. This indicates that characters within

a typeface need to share a common foundation for readers to tune into the type. Future studies that focus on the balance between letter distinctiveness and letter and word regularity would greatly contribute to the field of letterform research.

Recently, cognitive psychologist Kevin Larson and type designer Matthew Carter published parts of the substantiated experimental research carried out in relation to the development of the typeface family Sitka (Larson & Carter, 2016). More than aiming at producing scientific findings, the focus of the project was to inform the design of the typeface family Sikta. As part of the design process, the research group studied participants' recognition of different character variations when presented at short exposure on screen. The stimulus was displayed both as single letter and as the middle letter in a sequence of three letters. Among the findings, the research group showed that open counters of letters such as 'a', 'e', 'c', and 's' perform better when flanked by others and that narrow letters like 'f', 'j', and 'i' produce different misreadings depending on whether they are flanked by other letters or are presented in isolation. This difference in performance between letters presented in isolation and letters presented in groups could benefit from further research as well.

ans serif and serifs

Another highly popular research topic is to try and settle the dispute of whether sans serif or serif typefaces are the most legible. In his PhD thesis from 1999, Ole Lund identified 72 studies on the matter, where the majority was published in the 20th century. The approach in the past has typically been to compare two different typefaces, say Helvetica and Times Roman, and then, based on this comparison, make an overall conclusion about the role of serifs on letterforms. The validation of such comparisons is obviously difficult to defend as two different typeface styles often vary on so many other aspects than just the serifs. In a valid study of the influence of serifs, the serifs consequently should be the only difference between two tested typefaces. This matter was taken into consideration when *Visible Language* in 1971, published the paper "Why Serifs are Important" (Robinson et al. 1971). The test stimuli were dot matrix letters in two sizes, with a version with serifs and a version without serifs. In the small sizes the two variations only varied on the presence or absence of serifs, while the serif letters in the larger size had a higher stoke contrast than the sans serif letters. The serifs were, however, on all letters highly exaggerated. To identify the function of serifs, the authors employed a computer model, which they argued simulates the human visual system. By processing the letter stimuli through the computer software, the researchers concluded that "serifs perform an important function in preserving the original image of a small letter in a perceptual system with horizontal and vertical line detectors" (Robinson et al. 1971, p. 358). Viewed in a historical perspective, it is evident that the researchers overstated the computer's ability to simulate human perception, and as later argued by Lund (1997) the study appears to be built upon a "chain of theoretical assumptions while purporting to rely on physiological facts" (Lund 1997, p. 93). The interpretation of the findings was hence somewhat dubious.

In 2002, mathematician Robert A. Morris and co-authors looked at the speed of reading sans and serif typefaces by a method of Rapid Serial Visual Presentation. One of the authors was the type designer Charles Bigelow. For the study, Bigelow and Kris Holmes had designed new versions of the typeface family Lucida (Figure 3), with one major variation between the two tested fonts being the presence or absence of serifs. The stimuli were in two sizes, 40 pixels and 160 pixels. With participants placed at a 4 meters distance from the screen, the study showed that the serif version of Lucida in the small size resulted in slower reading rate, with no difference at the larger size. By applying test material originating in the same typeface family, the researchers ensured that the findings are related to the serifs.

Figure 3

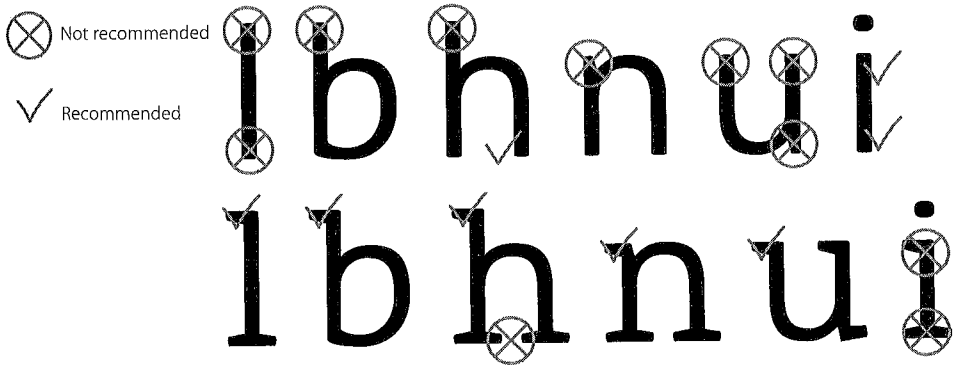
Designed by Kris Holmes and Charles Bigelow, these variations of the typeface Lucida were developed for the investigation, so that the main difference between the two styles lies in the presence or absence of the serifs (Morris et al. 2002).

hamburgefonstiv
hamburgefonstiv

More recently, *Visible Language* published yet another paper on the topic of serif legibility (Beier & Dyson, 2014). As in the study above, the test material was designed within the same typeface family so that the only difference between the two tested typefaces was the presence or absence of serifs. However, instead of investigating the overall effect of serifs, this study focused on the effect serifs have on distance recognition of letters in isolation and found that under such reading conditions, serifs

Figure 4

Beier and Dyson (2014) found that serifs on the vertical extremes tend to improve distance legibility of single letters.



play a positive role when placed on the vertical extremes (Figure 4, above). This finding is interesting in that it opens up the idea that the effect of serifs might vary depending on their placement on the letters, and hence hybrid typefaces mixing elements from sans serif and serifs styles could be beneficial under certain reading conditions. It is here worth noticing that the study by Morris and colleagues that found serif letters in small point sizes to cause slower reading, was based on word representation, while the study by Beier and Dyson that found higher recognition of some serif letters, was based on single letter representation. It could be that serif typefaces when set in words are more affected by visual crowding than sans serif typefaces. An interesting question is how the serifs on vertical extremes will perform when the letters are tested in words and how Lucida with serifs will perform if tested with a wider spacing setting or with the letters in isolation. Further, the Beier and Dyson study only looked at the lower-case alphabet; how do serifs affect the individual legibility of the upper-case alphabet? Future studies focusing on such questions would greatly contribute to the discussion of the serifs' function.

nclusion

It appears that the infrequent collaboration of scientists and designers is the main reason why letterform research has suffered as an academic orphan. Although the lack of typographical understanding has resulted in methodological shortcomings in the past, the diverse contribution of knowledge from different research traditions has in fact let to the development of better experimental approaches.

By presenting findings that can be applied in practice, a number of recent studies indicate a positive development by finding that 1) certain letter skeletons will lower the legibility of the letters, 2) flanked letters have different influence on the legibility of letter skeletons, 3) serifs slow down reading rate when words are viewed at distance in small point sizes, and 4) serifs placed at the vertical extremes improve legibility when letters are viewed in isolation at distance. As there is no universal answer that can be attributed to all reading situations, these studies focus on relative narrow research questions, which collectively, can contribute to the overall understanding of letterform research, and individually, can focus on the details under investigation.

To produce findings that are relevant for the practicing designer, scientists benefit from consulting designers in the development of the experiments. While designers can contribute with design skills, they cannot always contribute with scientific rigor. Hence, researchers will profit from adopting a methodological approach that ensures both control of critical typographical variables and scientific validation. An interdisciplinary collaboration where scientists provide valid test methods and analysis and designers identify relevant research questions and develop test materials, will enable a project to reach more informed findings than what the two fields would be able to produce in isolation. Through such interdisciplinary collaborations, letterform research will be able to grow out of its current identity as an academic orphan, and develop into a full member of the academic research society.

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Sofie Beier is a type designer and associate professor employed at the School of Design under The Royal Danish Academy of Fine Arts, where she is the head of the MA programme in Type & Wayfinding. She holds a PhD from the Royal College of Art in London and is the author of the book "Reading Letters: designing for legibility". Her current research is focused on improving the reading experience by achieving a better understanding of how different typefaces and letter shapes can influence the way we read. Several of her typefaces have been published through Gestalten Fonts, among these the Karlo and the Ovink families. The typeface Karlo received a Creative Circle Bronze Award in 2015.

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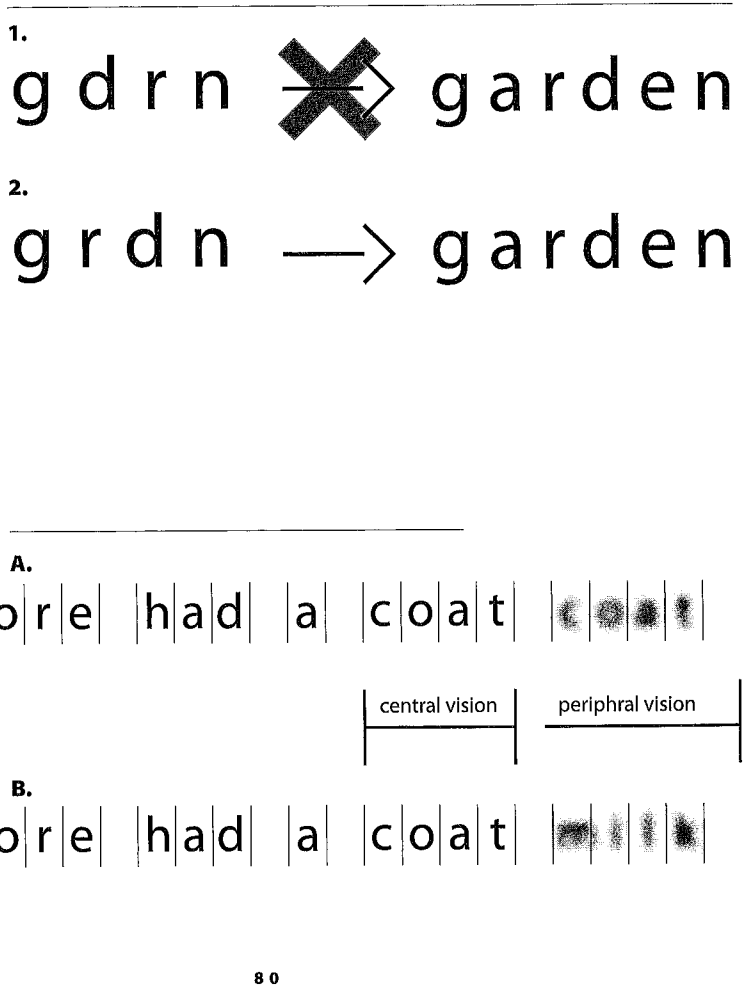


Orthographic Processing and Reading

Jonathan Grainger

Abstract

I will argue that processing letter identities and letter positions occupies a central interface between visual and linguistic processing during reading. This is primarily due to the fact that reading words in languages that use an alphabetic script is essentially letter-based. Information about letter identities and letter positions provides the gateway to whole-word written representations, to morphemes such as prefixes and suffixes, and to sound based representations. I will first summarize work on letter identification processes before describing mechanisms for parallel letter processing during single word reading. Finally, I will describe recent work demonstrating parallel processing of written information spanning several words during sentence reading.

Keywords

linguistic processing, letter identification, letter processing, letterform recognition, typography, orthographic, reading

Reading words: from inkmarks to ideas[1]

Words are the building blocks of reading in written languages that use word spaces, and in those languages that use an alphabetic script, letters are the building blocks of words. When reading, the eyes fixate the majority of words in the text, and typically only once. This implies that readers are getting a foveal glimpse (for about a quarter of a second) of most words in the text and that the essence of skilled reading behavior is contained in the processing that is performed during that glimpse. Therefore, quite understandably, explaining how literate adults read single words has been one of the major goals of experimental psychology since the very inception of this science (Huey, 1908).

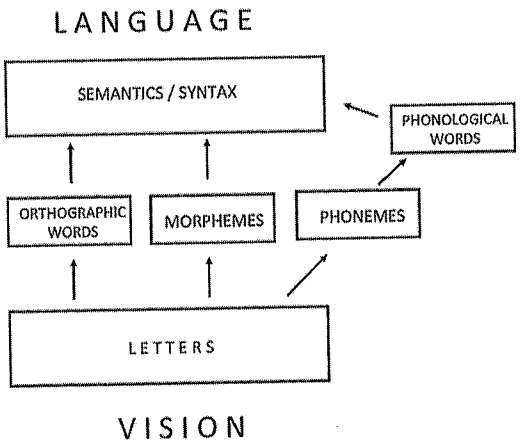
The process of silent word reading (reading for meaning) minimally requires two types of codes: **orthography** (knowledge about letter identities and letter positions) and **semantics** (knowledge about the meanings of words). The process of reading aloud minimally requires an orthographic code and a **phonological** (knowledge about the sounds of words) code in order to generate a pronunciation. Although no more than two codes are necessarily required for each task, it has become increasingly clear that all three codes (orthography, semantics, and phonology) are involved in both silent reading and reading aloud. This has led to the development of a generic architecture for word recognition that emphasizes the key role for cross-code interactions (e.g., Grainger & Ziegler, 2008; Siedenberg & McClelland, 1989). Much research on single word reading to date has therefore focused on the processing of semantic, phonological, and **morphological** (knowledge of word parts that carry meaning like prefixes and suffixes) information, while largely ignoring orthographic processing. This research bias was also exaggerated by an undue focus on the process of reading aloud as opposed to silent reading for meaning. The last decade, however, has been to witness to a surge in interest for basic orthographic processing during reading; the present article aims to summarize some key findings from this recent research.

The importance of understanding orthographic processing for understanding reading in general can be best appreciated when considering the written word as both a visual object and a linguistic entity. From this perspective, single word reading is a combination of visual object identification processes and linguistic processing, with orthographic processing acting as the key interface between the two. Orthographic processing allows generic visual processing mechanisms to make contact with the linguistic processing that is specific to word stimuli compared with other kinds of visual object. This contact is established via three types of mapping: 1) letters - to - phonology - to - meaning; 2) letters - to - morphology - to - meaning; 3) letters - to - words - to - meaning (see *Figure 1*).

1 Title of an excellent book on the topic edited by Sally Andrews (2006).

Figure 1

Orthography as the interface between visual and linguistic processing.



2. Letter-based word recognition

There is a general consensus today among reading researchers that for languages that use an alphabetic script, visual word recognition is letter-based (see Grainger, 2008, for a summary of the arguments).[2] That is, visual feature information is used to obtain information about the word's component letters, and a word's identity is mainly derived from information about letter identities and letter positions as opposed to word shape information that might be gained, for example, from ascending and descending letters in lowercase text. There is one key computational argument against a major role for holistic word-shape information in reading: it is more efficient to solve shape invariance at the level of individual letters (N=26) than at the level of whole words (N≈30,000). Shape invariance refers to our ability to recognize words (and other kinds of visual objects) independently of the precise visual format in which they are presented (e.g., lowercase vs. UPPERCASE; `courier font` vs. *handwriting font*). The standard explanation for this ability is that we identify visual objects via abstract representations that enable different kinds of visual information to make contact with the same object identity. Figure 2, adapted from Grainger and Dufau (2012), illustrates the computational argument for letter-based word recognition.

It could, however, be argued that storing different exemplars for lowercase and uppercase words is not a major computational cost and that the vast majority of fonts used in printed text vary little in terms of overall word shape. Our ability to read words in a very unusual and unfamiliar format (i.e., under extreme distortions of word shape) is there-

2 It should be noted that ever since Cattell's (1886) observation that word naming is easier than letter naming (a "word superiority effect"), it was generally thought that written words were identified using holistic word-shape information, because it was not obvious how word recognition could be letter-based if it is harder to read letters than to read words (I will refer to this as "Cattell's conundrum"). This theoretical position was instrumental in erroneously guiding educational practice for teaching reading for the better part of the 20th century.

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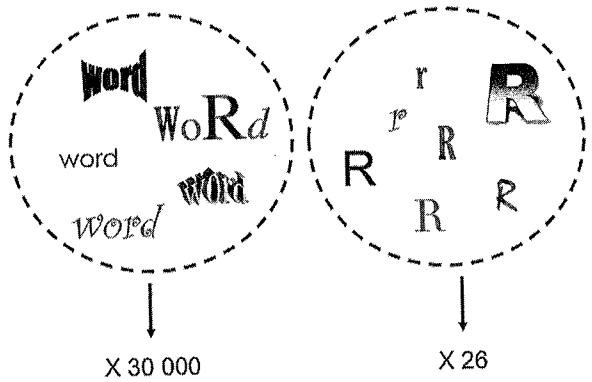


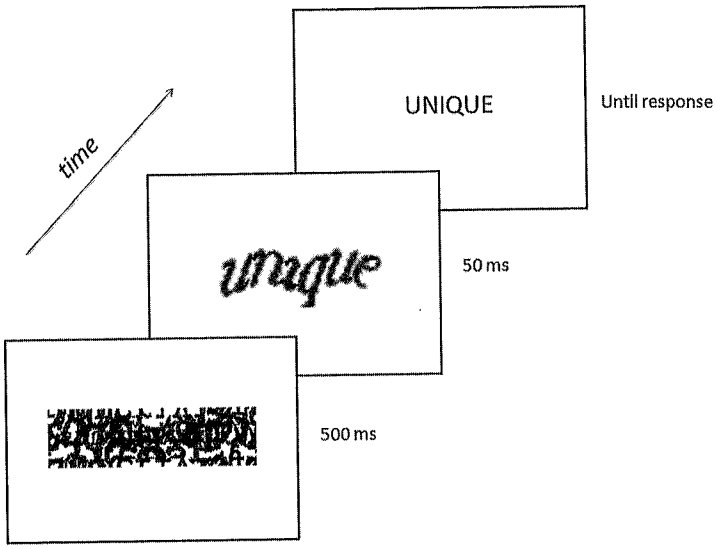
fore a key finding in this debate. One example here is our ability to read CAPTCHAs (Completely Automated Public Turing test to tell Computers and Humans Apart) when prompted to do so on an Internet site that is checking whether we are a human or a machine. These distorted versions of words are easily read by humans (see *Figure 3* for an example), but discourage brute force explorations into databases given the very large number of possible distortions. Most important is that we have shown that our ability to solve such extreme cases of shape distortion is achieved automatically without resort to slow inferential processes. This was demonstrated in a study by Hannagan, Ktori, Chanceaux and Grainger (2012), where we asked subjects to perform a word/nonword classification task with undistorted targets preceded by subliminal CAPTCHA primes, that could be the same word as the target or not (*Figure 3*). Repetition priming (i.e., faster and more accurate responses to target words preceded by primes that are the same word vs. a different word) was found for CAPTCHA primes. This finding suggests that shape invariant orthographic representations are being computed automatically and very rapidly and are therefore in line with our proposal that shape invariance is solved at the level of abstract letter representations, which would be less affected by the CAPTCHA distortions than hypothetical word-shape representations would be (see Chauncey, Holcomb & Grainger, 2008, for converging evidence obtained with masked priming and electrophysiological recordings, and Gil-López, Perea, Moret-Tatay & Carreiras, 2011, for a similar result with handwritten words).

There is, nevertheless, some empirical evidence that word shape information might influence skilled word reading in certain situations.[3] Thus, for example, Perea and Rosa (2002) found an advantage for lowercase compared with uppercase words in a simple lexical decision task, but only for relatively unfamiliar words. Another example was provided by

Evidence for so-called "logographic" reading in beginning readers is one example of the use of word shape
rmation. However, I follow the general consensus in seeing this as a transitional phase that is rapidly abandoned as
nt orthographic processing develops and reading vocabulary increases (Share, 1995). Nevertheless, I acknowledge that
ain brand names could be examples of such logographic reading in adults (see Perea et al., 2015).

Figure 3

Masked priming with CAPTCHA primes and normal print targets (Hannagan et al., 2012). CAPTCHA prime stimuli are briefly presented and preceded by a pattern mask (formed of a random combination of segments extracted from different CAPTCHA stimuli for more effective masking of these stimuli). Target words (and nonwords) are presented in normal format and remain on the screen until participants press a response key to indicate whether the target is a word or not (lexical decision task).



Lété and Pynte (2003) who manipulated the "shape frequency" of written words, defined as the number of other words that shared the same ordering of ascending (A), descending (D), and neutral (N) letters. Thus a word like elephant would be coded as NANDANNA, and its shape frequency would correspond to the number of other words with the same shape code (see Walker, 1987). Lété and Pynte (2003) found an effect of shape frequency on lexical decision latencies to a set of relatively long (7-9 letters) low-frequency French words, such that words with rare shapes were easier to recognize than words with frequent shapes (which were composed uniquely of neutral letters).[4] This analysis points to a possible explanation for the lowercase advantage reported by Perea and Rosa (2002) in reading Spanish words, given that information about consonant-vowel status (ascenders and descenders can only be consonants) might be particularly useful for reading in a syllabically structured language like Spanish. In other words, prior research claiming to provide evidence for a role for word shape information in reading, might actually have been showing how letter shape information can facilitate certain **sublexical** (smaller than a word) processes such as consonant-vowel classification (see Chetail & Content, 2012, for a demonstration of such influences on visual word recognition).

In the remainder of this article we will assume that most of the information used by skilled readers to silently read words for meaning concerns information about abstract (i.e., case and font independent) letter identities and information about letter positions (i.e., orthographic information). However, before beginning our examination of letter-based reading, it should be noted that the solution to Cattell's conundrum (how can we read words via their constituent letters if it is harder to read individual letters than

4 However, see Paap, Newsome, and Noel (1984) for a failure to find an effect of shape frequency.

to read words?) was provided by theoretical advances (e.g., McClelland & Rumelhart, 1981) showing how a word can be identified from the combination of partial information available at the level of each of its constituent letters (see Grainger, 2008, and Grainger & Dufau, 2012, for further details about the "word superiority effect" and its interpretation).

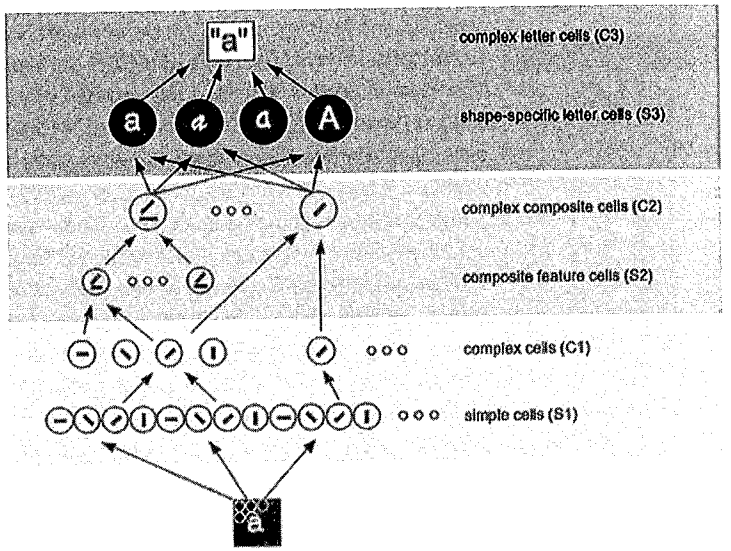
Letter identification: From pixels pandemonium

Letter-based word recognition requires processing of letter identities and letter positions. In this section, I first review current knowledge with respect to the processes involved in letter identification before examining work on letter position coding in the following section. According to Grainger, Rey, and Dufau (2008), it is the seminal work of Oliver Selfridge (Selfridge, 1959; Selfridge & Neisser, 1960) that laid the foundations for a cognitive theory of letter perception. In Selfridge's "pandemonium" model, letter identification is achieved by hierarchically organized layers of feature and letter detectors. Support for such a hierarchical organization was provided at that time by neurophysiological studies of the cat visual cortex (Hubel & Wiesel, 1962), and over the years, a general consensus has developed in favor of a generic feature-based approach to letter perception. One key guiding principle here is that isolated letter perception is just a simplified case of visual object recognition (e.g., Pelli et al., 2006). Therefore, our knowledge of visual object perception, much of which has been derived from neurophysiological studies of non-human primates, should help constrain our knowledge of letter perception in humans. This general principle is exemplified in the model presented in Figure 4. This figure shows a blueprint for a model of letter perception (Grainger et al., 2008) adapted from a classic account of object recognition (Riesenhuber & Poggio, 1999; see Dehaene, Cohen, Sigman, & Vinckier, for an extension of this approach to visual word recognition). What is the evidence in favor of such an approach, and what might be the nature of the sub-letter features involved in letter identification?

The confusion matrix is the traditional method used to hunt for features. In a typical experiment used to generate a confusion matrix, isolated letters are presented in data-limited conditions (brief exposures and/or small visual angle and/or low luminance and/or masking), and erroneous letter reports are noted. Error rate (e.g., reporting F when E was presented) is hypothesized to reflect visual similarity driven by shared features. An analysis of the pattern of letter confusions was therefore expected to reveal the set of features used to identify letters. There are more than 70 published studies on letter confusability (see Mueller & Weidemann, 2012, for a review), and some have formed the basis of concrete proposals of lists of features for letters of the Roman alphabet, mainly consisting of lines of different orientation and curvature (Gibson, 1969; Geyer & DeWald, 1973; Keren & Baggen, 1981). Two more recent studies have applied arguably improved methodologies for measuring the complete similarity space of Roman letters (Courrieu, Farioli, & Grainger, 2004; Mueller & Weidemann, 2012).

Figure 4

Adaptation of Riesenhuber and Poggio's (1999) model of object identification to the case of letter perception (Grainger et al., 2008). Information about simple visual features (lines of different orientation at precise locations in the visual field) extracted from the visual stimulus is progressively pooled across different locations (complex cells) and feature combinations (composite cells) as one moves up the processing hierarchy.



Another line of research has applied Gosselin and Schyns' "bubbles" technique (2001) to explore the nature of the critical features for letter perception. The classification images obtained by Fiset et al. (2007) for 26 lowercase and 26 uppercase Roman letters in Arial font revealed several important pieces of evidence. First, on average only 32% of the printed area of uppercase and 24% of lowercase letters was used by observers to identify letters, and the greatest proportion of useful information was apparent in the 2-4 cycles per letter frequency band, in line with estimates from critical-band masking studies (Solomon & Pelli, 1994). Second, the analysis revealed that terminations were by far the most diagnostic piece of information for letter identification, with intersections and horizontal lines providing further significant sources of information for uppercase letters. For example, the letter W was mainly distinguished from other letters by the presence of two terminations, one in the upper left corner and the other in the upper right corner. Finally, computational modeling has revealed that the diagnostic features used by human observers closely match those extracted by a simple two-layered associative network trained to identify letters from a pixel input (Hannagan & Grainger, 2013).

Parallel independent ter processing

Although the debate is still ongoing, another general consensus that has arisen among reading researchers over the years is that orthographic processing of written words by skilled readers is performed in parallel across all letters of the word, within the limits imposed by visual acuity and crowding (e.g., Adelman, Marquis, & Sabatos-DeVlto, 2010; McCelland & Rumelhart, 1981). Parallel processing of letter identities is therefore thought to be the basis of efficient orthographic processing and reading, but how is this achieved? One solution is to align a set of individual letter detectors, such as described in the previous section, in order to form a horizontally arranged bank of letter detectors that can operate in parallel. This is the starting point of Grainger and van Heuven's (2003) model of orthographic processing, and has been retained in more recent developments of this approach (Grainger & Ziegler, 2011; Grainger, Dufau, & Ziegler, 2016). This account of orthographic processing during single word reading is shown in Figure 5.

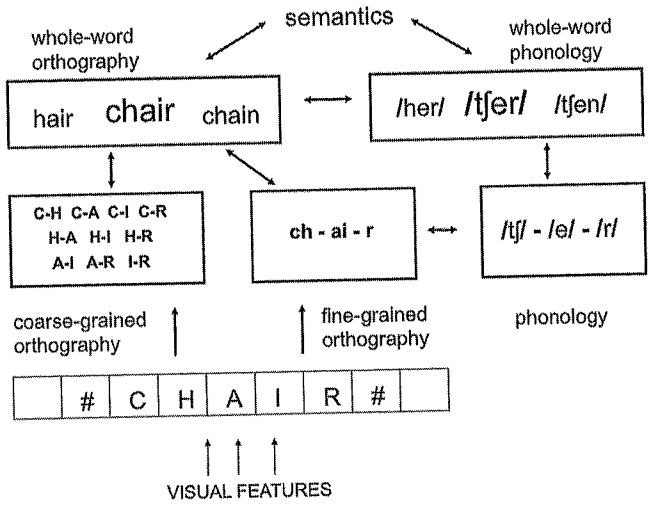


Figure 5 describes the mapping of visual information onto whole-word orthographic representations. From there, the whole-word orthographic representations connect to the meaning of words. Sublexical orthographic representations between visual representations and whole-word representations differ in terms of how positional information is encoded for letters. Indeed, one central hypothesis in this approach is that the initial encoding of letter position information is achieved using gaze-centered coordinates. That is, when looking at the word *table* with eye fixation on the letter |b|, the letter |t| is coded as being located two letter positions to the

ure 5

al-route approach to ographic processing nger & Ziegler, 2011). nk of location-specific, -centered letter ctors (bottom) send ation forward to two s of sublexical location- iant orthographic esentations: 1) *coarse-ned* representations code for the ence of informative r combinations in absence of precise tional information, 2) *fine-grained* esentations that e for the presence of uently co-occurring er combinations.[1] coarse-grained code imizes the mapping rthography to antics by selecting er combinations that the most informative h respect to word ntity, irrespective etter contiguity. fine-grained code imizes processing via *chunking* of frequently occurring contiguous er combinations such complex graphemes d affixes that are used access phonological d morphological presentations respectively orphology is not shown re to avoid clutter – see jure 1).

The terms oarse-grained" and ne-grained" refer to the ecision with which letter- -word order information encoded: either flexibly oarse-grained) or precisely ne-grained).

left of fixation. As noted by Grainger and Ziegler (2011), the "hard problem" in orthographic processing is therefore to understand how such location-specific gaze-centered orthographic representations are transformed into location-invariant word-centered representations. In order to read the word *table* it is important to know where the letter |t| is in the word, not where it is on the retina.

There are several different ways that one can code for within-word letter position (see Grainger, 2008, for a review, and Davis, 2010, Gomez, Ratcliff, & Perea, 2008, for different approaches). Here we build on a solution first proposed by Mozer (1987) and further developed by Whitney (2001) and Grainger and van Heuven (2003). In this particular solution, within-word letter position is coded by an unordered set (a bag) of **n-grams** (ordered letter combinations) while allowing for non-contiguous combinations that respect relative position in the word (such as C-A, C-I, in the word "chair", see *Figure 5*). In the simplest version of this approach (i.e., a bigram model), the contiguous and non-contiguous ordered letter combinations are referred to as open-bigrams. In the approach to orthographic processing described in Figure 5, there are two different types of constraints that affect processing along the two orthographic processing routes. Both types of constraints are driven by the frequency with which different combinations of letters occur in written words. On the one hand, frequency of occurrence determines the probability with which a given combination of letters belongs to the word being read. Letter combinations that are encountered less often in other words are more diagnostic of the identity of the word being processed. In the extreme, a combination of letters that only occurs in a single word in the language, and is therefore a rarely occurring event when considering the language as a whole, is completely informative with respect to word identity. On the other hand, frequency of co-occurrence enables the formation of higher-order representations (chunking) in order to diminish the amount of information that is processed, via data compression (i.e., explaining away). Letter combinations that often occur together can be usefully grouped to form higher-level orthographic representations such as multi-letter graphemes (<th>, <ch>) and morphemes (ing, er), thus providing a link with pre-existing phonological and morphological representations during reading acquisition (see *Figures 1 & 5*).

The coarse-grained orthographic representations in this approach bring a certain amount of flexibility to the way that within-word letter position information is represented. Indeed, the concept of open-bigrams was initially developed (Grainger & van Heuven, 2003; Whitney, 2001) to account for specific phenomena observed in the behavior of skilled readers, that pointed to the need for flexible coding of letter position information (see Grainger, 2008, for a review). One such phenomenon, observed using the popular masked priming technique (Forster & Davis, 1984), is referred to as relative-position priming, whereby word identification is improved by the prior brief presentation of an orthographically related

prime stimulus formed of a subset of the target word's letters that maintain their correct relative position in the stimulus (e.g., "grdn" as a prime for "garden").[5] Crucially, transposing the two inner letters of the prime stimulus (e.g., "gdrn") cancels the priming effect measured relative to a completely unrelated prime stimulus (Peressotti & Grainger, 1999). Furthermore, providing absolute position information (e.g., "g-rd-n") does not increase priming effects (Grainger et al., 2006; Grainger & Holcomb, 2009).

The kind of coarse orthographic coding shown in Figure 5 accounts for these findings by the fact that in prime stimuli like "grdn", all of the prime's bigrams are contained in the target "garden", whereas a prime stimulus like "gdrn" provides evidence for one bigram (D-R) that is not present in the target. It is interesting to note, however, that while this research was being performed and the notion of flexible coding of letter position information being developed, an interesting email started to circulate in 2003. This is the "Cambridge University" email[6], according to which "it deosn't mttaer in waht oredr the ltteers in a wrod are, the olny iprmoetnt tihng is taht the frist and lsat ltteer be at the rghit pclae. The rset can be a toatl mses and you can sitll raed it wouthit porbelm. Tihs is bcuseae the huamn mnid deos not raed ervey lteter by istlef, but the wrod as a wlohe." There are two important points to note with respect to this anecdotal evidence. First our ability to read such text was a key prediction of models that use flexible within-word coding of letter position, such as the open-bigram scheme (Grainger & Whitney, 2004), and this prediction has been supported by hundreds of laboratory experiments run since then (e.g., Perea & Lupker, 2004; Rayner, White, Johnson, & Liversedge, 2006; Schoonbaert & Grainger, 2004; see Grainger, 2008, for a review). Second contrary to the claims of the Cambridge University email, our ability to recover word identity from such transposed-letter stimuli constitutes key evidence for letter-based word recognition and evidence against the use of more holistic information.

. Letter-specific processing?

Within the general framework of neuronal recycling theory (Dehaene & Cohen, 2007), learning to read involves the adaptation of general purpose visual processing mechanisms to the specificities of written words. That is, the mechanisms employed to identify everyday objects, such as tables and chairs, must be adapted to the special nature of written words as visual objects that also need to be identified for the purposes of efficient print-to-meaning translation during skilled reading. Within the account of orthographic processing described in section 3, there are two issues at odds with

See Carreiras, Duñabeitia, and Molinaro (2009) for a discussion of the role of consonant-vowel status in lative-position priming effects.

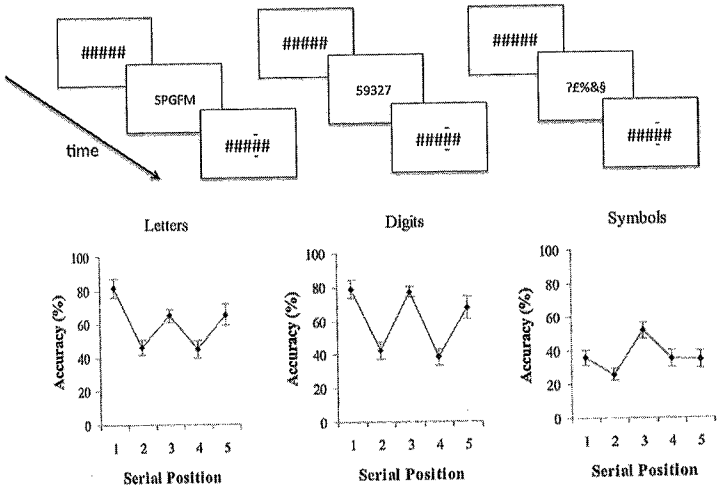
This email claimed to report on research performed at Cambridge University, but no such research had in fact een carried out at that university at that time.

basic visual object processing: 1) the hypothesized specialized bank of gaze-centered letter, and digit, detectors and 2) the mechanism used to code for within-word letter positions. In this section I will examine the evidence in favor of such letter-specific processing.

First of all, the constraints of parallel letter processing are thought to impose changes at the level of location-specific letter representations in order to reduce crowding and optimize information uptake. Following Tydgat and Grainger (2009), we would argue that letters and digits are processed alike at this level, via a horizontally aligned bank of letter/digit detectors (Grainger & van Heuven, 2003). This is because reading words and numbers can be optimized by parallel processing of the component letters/digits. It is this level of processing that is affected by visual factors such as visual acuity and crowding; the evidence suggests that letters and digits are indeed processed in the same way at this level. This evidence was obtained in experiments where subjects were asked to identify a single character in a string of 5 characters with eye fixation on the central character (Tydgat & Grainger, 2009). In Tydgat and Grainger's (2009) study, the 5 characters were presented very briefly (200 ms), and subjects had to indicate the identity of a single character that had just been presented at a specified location (see *Figure 6*). In experiments like this, accuracy is typically highest at the first, central, and final positions for letters and digits. Symbols and simple shapes, on the other hand, show maximum performance at the central position, and performance tends to decrease from the center outwards (see also Mason, 1982; Hammond & Green, 1982). This pattern of results is shown in Figure 6.

Figure 6

Results of Tydgat and Grainger's (2009) study comparing identification of letters, digits, and symbols within a string composed of the same elements. Subjects see a briefly presented string in between two pattern masks (#####) and have to indicate which character was present in the string at the location cued by the horizontal bars (4th position in the examples).



The different serial position functions shown in Figure 6 can be explained by differences in the way crowding affects letters and digits compared with other types of visual stimuli. First of all, the fact that accuracy is higher for the central position compared with the 2nd and 4th positions

in strings can be accounted for by differences in visual acuity as a function of eccentricity (i.e., distance from fixation). This would operate identically for all kinds of stimuli. Key differences arise at the first and last positions in the string, with only letter and digit stimuli showing greatly improved identification relative to the 2nd and 4th positions. This specific pattern can be explained by greater crowding for symbol stimuli, such that a single flanking element suffices to generate almost maximum crowding for symbol targets at the outer positions in the string, whereas letter and digit stimuli would benefit from reduced crowding at these locations (Grainger, Tydgat, & Isselé, 2010). As argued above, the reduced crowding for letters and digits arises from adaptation to the hyper-crowding imposed by the parallel processing of such characters.

Recent research with beginning readers points to a special status of the first letter in words. Indeed, the advantage for outer letters in letter-in-string identification is almost always accompanied by a further advantage for the first letter compared with the last letter in the string (Tydgat & Grainger, 2009; see *Figure 6*). In an unpublished developmental study, we have shown that it is performance in identifying the first letter in strings of random consonants that improves as a function of reading ability, and this increase in performance to initial letters contrasts sharply with the lack of change in identifying simple familiar shapes at the first position in a string of shape stimuli. On the basis of this finding, we have argued that the first-letter advantage seen in skilled adult readers (e.g., Marzouki & Grainger, 2014; Scaltritti & Balota, 2014) results from adaptive mechanisms operating during the process of learning to read in order to prioritize processing of the first letter in words.

Strings of letters and digits might therefore be processed similarly at the level of location-specific character detectors, since visual factors such as acuity and crowding have a similar impact on these stimuli. However, differences in the way these two kinds of stimuli are processed emerge at the next level of processing, where positional information is coded relative to the object (word or number) and independently of where the object is (i.e., knowing that there is a "T" at the beginning of the word, or the digit "5" at the beginning of a number, independently of where the stimuli are in the visual field). Given that only letter stimuli are systematically associated with higher-level familiar objects, we hypothesize that only letter stimuli develop the kind of flexible coding of positional information such as provided by ordered combinations of contiguous and non-contiguous elements in a string. This is simply because such approximate position coding is good enough to know a word's identity with a relatively high probability (Dandurand et al., 2011), but it is not very good for obtaining magnitude information from a number. For the latter, one requires more precise order information, such that the identity of the different digits can be accurately associated with each position in the number. The precision required for number processing is like the precision required for the sublexical translation of print-to-sound during reading aloud. It is therefore the potential use of a more flexible object-centered position code that distinguishes letter-strings from numbers. This leads us to hypothesize, somewhat counter-intuitively, that position coding for strings of letters might in certain conditions (i.e., when object-centered coding is required for the task) be less precise[7] than for strings of less familiar stimuli. Is there any evidence for this?

One paradigm that has proved useful for comparing position coding for different kinds of visual stimuli is the same-different judgment task. In this task, two stimuli are briefly presented in rapid succession, and subjects have to decide as rapidly and as accurately as possible if the stimuli are the same or are different (see *Figure 7*). This paradigm has been recently applied to examine similarities and differences in processing strings of letters, digits, and symbols. In a typical experiment, a subject will see a string of characters such as PGFM for 300 ms, which is immediately replaced one line below by a second string such as PFGM again for 300 ms, and the subject presses one response key for a "same" response and another response key for a "different" response. Recent research has specifically examined response times and error rates to respond "different" to pairs of characters differing by a transposition of two characters (PGFM - PFGM) or differing by the substitution of two characters (PGFM – PDRM). It has been shown (Duñabetia, Dimitropolou, Grainger, Hernandez & Carreiras, 2012) that detecting a transposition change is harder than detecting a substitution change, and that this effect is greater for letter strings compared with both digit strings (e.g., 3842 - 3482) and symbol strings (%&?# - %?&#). The behavioral results of this study are shown in Figure 7 (see Massol, Duñabeitia, Carreiras & Grainger, 2013, for further evidence obtained with the same paradigm).

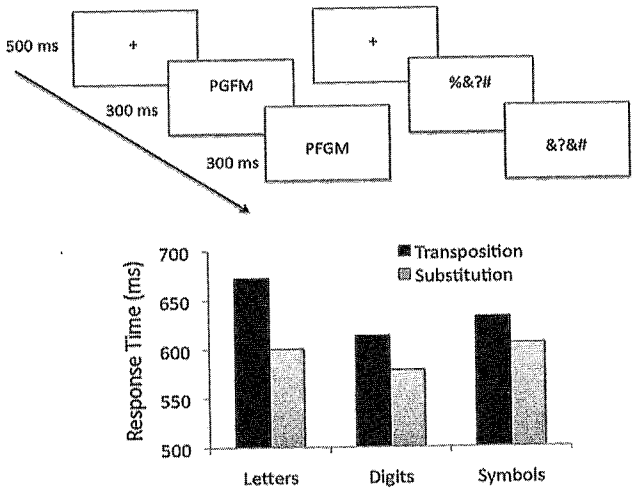


Figure 7

Behavioral results of Duñabetia et al. (2012) and the procedure of the same-different judgment task (decide as rapidly as possible whether the two strings are the same or not) illustrated for letters and symbols (the study also included digit stimuli). The figure shows that it is harder (longer response times) to indicate that two strings are different when the difference is induced by transposing two characters compared with substituting two characters. Most important is that letter strings show significantly greater transposition costs (i.e., the difference between the transposition and substitution conditions) than the other two types of stimuli.

7 An important distinction must be drawn between positional flexibility and positional noise. The hypothesis here is that orthographic processing endows a greater flexibility in position coding for an equivalent amount of noise in the system.

I have argued that the greater transposition cost seen with letter stimuli arises because an object-centered positional code is used to inform responses in the same-different judgment task and that letter stimuli are coded with a more flexible position coding mechanism than other kinds of stimuli. This leads to the somewhat paradoxical situation whereby the most familiar stimuli (most of us read much more than we do arithmetic) generate the poorest performance. The explanation we offer for this pattern of results is cast within the dual-route framework for orthographic processing (Grainger & Ziegler, 2011) shown in Figure 5. Only letter stimuli use relative character position coding, since numbers require precise position coding in order to accurately retrieve magnitude information from a string of digits. The model also predicts, however, that letters and digits are processed by the same machinery at the level of location-specific character detectors, and evidence in favor of this has been provided by experiments using character-in-string identification (e.g., Tydgat & Grainger, 2009; see *Figure 6*).

. Orthographic processing and sentence reading

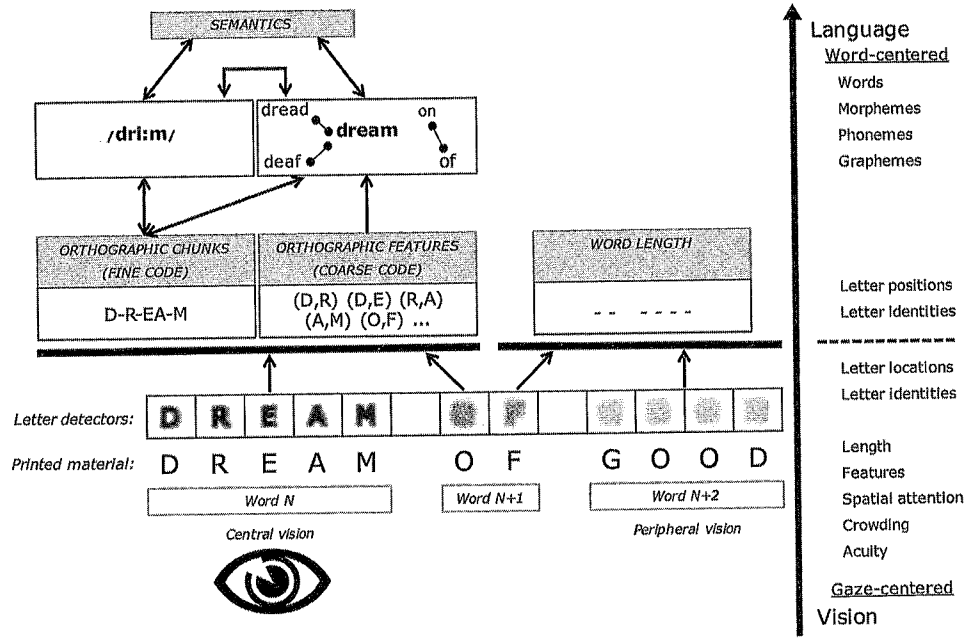
In this final section I will examine how basic mechanisms of orthographic processing, as described in the preceding sections, might happen during sentence reading in preparation for the semantic and syntactic processing that is necessary for sentence-level comprehension.

Grainger et al. (2016) described a theoretical framework for parallel orthographic processing during sentence reading inspired by recent evidence in favor of the spatial integration of orthographic information spanning multiple words. More specifically, this theoretical framework, shown in Figure 8, was motivated by recent findings suggesting that orthographic information extracted from several words in parallel is integrated into a single processing channel. These findings were from eye tracking studies of the influence of parafoveal stimuli on the processing of the fixated foveal stimulus. In one such study, participants read sentences for meaning, and their eye movements were recorded. Unbeknownst to participants, while their eyes move from one word to the next, a key word in a sentence was changed from one word to another just before fixating on the word of interest. Changing text on screen is not easily detected by participants because the change happens during a saccade when it isn't noticed; this is referred to as the *boundary technique* because the word changes when the participant's eye crosses an unseen boundary (Rayner, 1975). The initial word can be manipulated to have certain characteristics or to share certain features with the word it changes to or not. The word it changes to is always the correct word for the sentence.

Figure 8

Architecture for orthographic processing during sentence reading proposed by Grainger et al. (2016). Gaze-centered letter detectors process visual information extracted from several words in parallel within the limits imposed by visual acuity, crowding, and spatial attention. These letter detectors feed-forward information into a single pool of word-centered orthographic representations that enable one word representation to emerge as the best bet given the incoming evidence. This winner-take-all mechanism is implemented via lateral inhibitory connections (lines and filled circles) between co-activated word representations.

Two sentence reading studies using the boundary technique have shown that information extracted from the to-be-fixated parafoveal initial word influences the processing of the word before the unseen boundary (Angele, Tran, & Rayner, 2013; Dare & Shillcock, 2013). This finding is in line with prior observations of *parafoveal-on-foveal* effects during reading (e.g., Dimigen, Kliegl, & Sommer, 2012; Vitu, Brysbaert, & Lancelin, 2004). The key difference with respect to older studies is that the recent studies have shown that orthographic relatedness of the word before the boundary and the initial word after the boundary affects processing of the changed word. In Angele et al.'s (2013) study, participants read sentences such as "the store had a coat / coat …", where the 2nd occurrence of "coat" is replaced by the word "sale" when the eyes leave the 1st occurrence of "coat". Participants were faster at reading "coat" in this context compared with a sentence like "the store had a coat / milk …" (with "milk" being replaced by "sale" when the eyes leave "coat").[8] Using the same method, Dare and Shillcock (2013) found facilitation from parafoveal nonword stimuli after the boundary formed by transposing two letters of the foveal word (e.g., the store had a coat / caot …) compared with a double-substitution control condition (e.g., the store had a coat / ceit …). These results clearly suggest that orthographic information extracted in parallel from the fovea and the parafovea collectively influences the process of foveal word recognition.



8 It is crucial to understand the distinction between these parafoveal-on-foveal effects and parafoveal preview benefits. In parafoveal preview experiments, it is the influence of a parafoveal "prime" stimulus on processing of the word after the unseen boundary. The observed effects therefore reflect ***temporal integration*** of information associated with the same spatiotopic location. Parafoveal-on-foveal effects, on the other hand, reflect the ***spatial integration*** of information before and after the unseen boundary on the word before the boundary.

In order to account for these and related findings, I and others have proposed that there is some form of spatial integration of orthographic information that is extracted in parallel from several words (Angele et al., 2013; Grainger, Mathôt, & Vitu, 2014). Thus, when fixating a word, orthographic information is extracted in parallel from that word and the next word, and this information pooled such that orthographic overlap across the two words facilitates processing of the word being fixated (see *Figure 8*). Further crucial evidence for such spatial integration of orthographic information has been obtained from the novel *"flanking letters lexical decision"* (FLLD) task. In this paradigm, centrally located word and nonword stimuli are flanked by letters located to the left and to the right and separated from the central stimulus by a space. Participants are asked to decide whether the central stimulus is a word or not and can therefore ignore the flanking stimuli. In the first study to use the FLLD task, Dare and Shillcock (2013) found faster lexical decision times to central targets when the flanking letters were the same as in the target: "RO ROCK CK" vs. "DA ROCK SH". More surprisingly, however, they found that the order of the shared bigrams did not matter. Thus lexical decisions to the word ROCK were the same in the following conditions: "RO ROCK CK" and "CK ROCK RO". This key finding rules out an explanation couched in terms of letter migrations induced by positional noise, since if this were the case, priming effects should have been greater with bigrams in the correct order. This result points to spatial integration of orthographic information across word boundaries into a single channel for orthographic processing, as illustrated in Figure 7. Furthermore, Grainger et al. (2014) showed that although bigram order does not impact on flanking letter effects, hence replicating Dare and Shillcock (2013), the order of letters within a bigram does matter. Thus, there was greater facilitation in the "RO ROCK CK" condition than in the "OR ROCK KC" condition that they tested.

Within the framework proposed by Grainger et al. (2016), visibility constraints operating of gaze-centered letter detectors ensures that the most activated word in the single channel is indeed the word being fixated. Nevertheless, there is evidence that skilled readers are capable of keeping track of the spatial locations of different word identities in parallel. Therefore, although orthographic information might be initially pooled into a single channel, as illustrated in Figure 7, the system must be able to keep track of which letters/bigrams belong to which words. This will enable the orthographic processor to output word identities that are tied to a particular position in the phrase/sentence. Sentence comprehension requires access to semantic and syntactic information from the different words in the sentence (when available) and information about the positions of the words in the sentence (or sentence constituent). Whole-word orthographic representations provide access to the semantic and syntactic information associated with words. This orthographic processing module therefore outputs the three key ingredients for higher-level processing: semantic information, syntactic information, and word-in-phrase position.

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Typographic variables for digital low vision reading:

Print size and display size matter: magnification is usually necessary.

High contrast is often essential.

Bright displays and contrast reversal are desirable.

Inter-line and inter-word spacing may help.

Font effects are small, but fixed width fonts may be helpful when reading near the acuity limit.

Reading Digital with Low Vision

Gordon E. Legge

Abstract

Reading difficulty is a major consequence of vision loss for more than four million Americans with low vision. Difficulty in accessing print imposes obstacles to education, employment, social interaction and recreation. In recent years, research in vision science has made major strides in understanding the impact of low vision on reading, and the dependence of reading performance on text properties. The ongoing transition to the production and distribution of digital documents brings about new opportunities for people with visual impairment. Digital documents on computers and mobile devices permit customization of print size, spacing, font style, contrast polarity and page layout to optimize reading displays for people with low vision. As a result, we now have unprecedented opportunities to adapt text format to meet the needs of visually impaired readers.

Keywords

low vision, reading, readability, legibility, digital typography, typography

1 Introduction

The term *low vision* was coined in the 1950s by eye-care clinicians to convey the idea that vision can vary between the extremes of Sighted and Blind. *Low vision* refers to any chronic form of vision impairment not correctable by glasses or contact lenses that adversely affects everyday function. The boundary between normal vision and low vision is sometimes based on the inability to read newsprint at a standard viewing distance of 40 cm (16 inches) with best optical correction. This definition is used because most people with low vision have problems with reading texts designed for people with normal vision (Elliott et al., 1997; Owsley et al., 2009).

Letter acuity is the traditional clinical measure of vision, dating from the eye chart introduced by the Dutch ophthalmologist Herman Snellen in 1862. Four notable values on the Snellen scale of print size illustrate the range of reading vision. A Snellen acuity of 20/20 is the conventional standard for normal vision, and refers to letter sizes at the acuity limit subtending 5 minutes of arc (min-arc) of visual angle.

At a reading distance of 40 cm, an x-height of 0.58 mm subtends 5 min-arc. Typical newspaper print has an x-height of about 1.45 mm, just 2.5 times larger than acuity letters, the font size that a person with 20/20 vision can just barely see. One criterion for low vision is an acuity less than 20/60, meaning the acuity letters for 20/60 vision are more than three times larger than the standard for normal vision, and larger than typical newspaper print. The criterion for legal blindness is 20/200 or less (acuity letters at least 10 times larger than the normal limit). With high magnification, people with acuities as low as 20/2000 (acuity letters 100 times larger than 20/20 letters) can read. This wide range of reading acuities emphasizes that low vision, even very low vision, is compatible with reading, provided that adequate magnification is available.

The World Health Organization (2014) estimated that there are 285 million people worldwide with vision impairment, 39 million blind[1] and 246 million with low vision.[1] These figures include many people in less developed countries whose impaired vision is due to uncorrected refractive errors or untreated cataracts. According to the National Eye Institute (2014), there are between 3.5 and 5 million Americans with low vision, and the number is rising as the U.S. population ages. Because the leading causes of visual impairment in the United States are age-related eye diseases—macular degeneration, glaucoma, diabetic retinopathy and cataract—the prevalence of impaired vision rises steeply with age. Reading poses problems for almost everyone with low vision because the print size in everyday text is too small.

Traditional hard copy reading is not inclusive of people who are blind or have low vision. Marshall McLuhan (1962) in his famous essay

1. The World Health Organization defines people with acuities less than 20/400 as "blind," but, as indicated above, some people with acuities as low as 20/2,000 can read visually, given high magnification.

The Gutenberg Galaxy referred to the invention of movable type as bringing about the "tyranny of the visual."[2] After Gutenberg's invention, hard-copy printed materials became increasingly available and literacy increased. Success in society became highly dependent on the ability to read, requiring good visual acuity. The "tyranny of the visual" has persisted for centuries, and has excluded many people with impaired vision from the literate mainstream. Since not much could be done to make print accessible, low-vision reading received little attention.

In the early 20th century, the concept of "sight saving" was an additional deterrent to reading with low vision. It was thought that use of the eyes would accelerate eye disease; sight should be "saved" and used sparingly. This concept may have originated with the Myope School in London. Children with myopia were thought to be at risk because high myopia could lead to retinal detachment. It was believed that this risk could be avoided by not reading. The sight-saving philosophy held sway in the United States during the first half of the 20th century, and generalized from myopia to low vision (Jackson, 1983). Many children with low vision were not taught to read visually and not prescribed reading magnifiers. Only in the 1960s did "sight saving" begin to give way to a "sight utilization" philosophy in education. The latter emphasizes the importance of optimizing the functional value of low vision.

The association between reading and myopia has long been a topic of study and debate. Causal explanations linking myopia in children to reading have focused on accommodative strain, residual defocus, and the fine detail in text stimuli which lack the distribution of coarse and fine features found in natural images (cf., Wallman & Winawer, 2004). Current intense research on myopia is focused on its increasing prevalence, especially in east Asia where it has reached epidemic proportions. There is recent evidence that time spent outdoors is protective against the onset of myopia, independent of the amount of reading and other indoor activities. One possible explanation is that bright light outdoors stimulates the release of the neurotransmitter dopamine in the eye which in turn inhibits excessive eye growth. (Myopia is a mismatch between the refractive power and the length of the eye.) For a nontechnical overview of the relationship between myopia and outdoor activity, see Dolgin (2015).

The modern electronic era has softened the "tyranny of the visual," first by moving text from hard copy where it is difficult or impossible to read with low vision onto video screens where it can be manipulated visually, and then into digital representations which can be customized. Digital documents on computers and mobile devices permit easy manipulation of print size, contrast polarity, font, color, and layout. High-tech digital image enhancement methods for low vision are also under study (Moshtael et al., 2015).

Digital text can also be converted to auditory or tactile (braille) formats. For example, screen-reading software converts digital text into

2. This quotation was brought to my attention by Cattaneo & Vecchi (2011).

synthetic speech. A major development in nonvisual text accessibility has been the inclusion of synthetic speech software (VoiceOver) as a standard component in Apple's iOS and Mac operating systems.

In short, the migration of text into digital formats brings with it enormous opportunities for enhancing text accessibility for people with impaired vision.

2 From Paper to Screens

Prior to the digital age, the primary method for facilitating low-vision reading was magnification, and the primary technology was optics. Optical magnification continues to be an important part of low-vision reading rehabilitation. Table 1 lists some highlights in the development of low-vision reading technology in the pre-digital era.

Table 1

Some highlights in the history of low-vision reading technology prior to the digital age (adapted from Goodrich et al., 2008).

Year	Event
1270	Marco Polo discovered older people in China using magnifying glasses for reading.
1637	First magnifying aid for visual defects; René Descartes "described a solid glass cone with a plano front surface and a concave back surface."
1829	Louis Braille published his invention of a tactile code for reading.
1908	The Myope School in London was the first class for children with low vision.
1909	Moritz von Rohr, employed by Carl Zeiss, designed a telescopic lens to correct high myopia.
1913	Edward Allen, Director of Perkins Institute, opened the first U.S. class for children with low vision.
1916	The Clear Type Publishing Company produced a series of books in 36 point font.
1924	The American Foundation for the Blind began supplying telescopic lenses and referring clients to eye-care practitioners.
1935	William Feinbloom published "Introduction to the principles and practice of sub-normal vision correction" in the *Journal of the American Optometric Association*
1947	The American Printing House for the Blind began regular publication of large print books.
1969	Samuel Genensky and colleagues at the Rand Corporation reported on their development of a closed circuit television magnifier for low vision.
1976	Eleanor Faye published her book on *Clinical Low Vision.*
1977	Louise Sloan published her book on *Reading aids for the partially sighted: a systematic classification and procedure for prescribing.*

There are three general forms of magnification for reading—enlarge the print size on the page, reduce the viewing distance, and use a magnifier. Some published materials are available in "large print" formats. It is recommended that large print materials should be at least 16 to 18 points

(Arditi, 1999). The vast majority of published material is not available in large print. Even when large-print publication is an option, there are practical limitations on the sizes of pages and books. For this reason, large print rarely exceeds 20 pt. For many people with low vision, 20-pt print provides insufficient magnification.

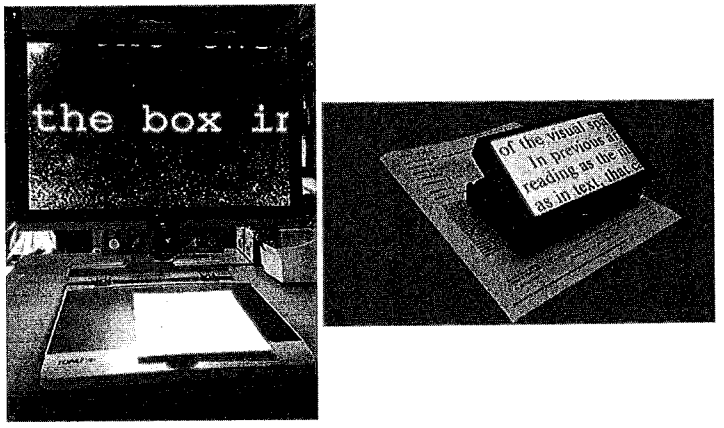
The simplest method of magnification is to reduce viewing distance. Since angular character size (and, correspondingly, retinal image size) is inversely related to viewing distance, reduction of the viewing distance by a factor of N accomplishes N-fold magnification. For instance, viewing the newspaper from 20 cm rather than 40 cm (a factor of two) is equivalent to magnifying print size by a factor of two. But this approach requires the reader to focus for the nearer distance. Young people who have a wide range of accommodation, or people who are myopic (short-sighted), may be able to focus at distances of 10 or 20 cm. Most people, especially older people with presbyopia (the absence of accommodation, encountered by almost everyone over 50), will require a lens to focus print at short viewing distances. Lenses used for this purpose are termed *magnifiers*.

Optical magnifiers for reading come in three general types—hand-held, spectacle-mounted or stand magnifiers that rest on the page. Enlargement of the characters in a local region of text by a magnifier brings about the need to move the magnifier across the lines of text. This process is sometimes termed *page navigation* and imposes demands on eye or head movements and manual dexterity. For reviews of properties and principles for prescribing low-vision magnifiers, see Bailey, Bullimore, Greer and Mattingly (1994) and Sloan (1977).

Optical magnifiers are effective reading aids for people with mild forms of low vision. For people with acuities of less than 20/100, requiring magnification of 6X or more, optical magnifiers become difficult to use because of the restricted field of view and the increasing demands of page navigation.

Figure 1

A. Topaz Desktop Video Magnifier (Freedom Scientific). B. Amigo Portable Low Vision Electronic Magnifier (Enhanced Vision).

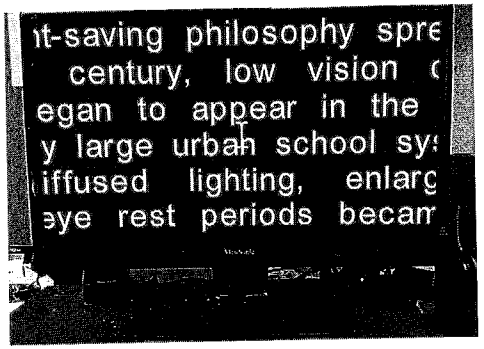


A major step in alleviating the problems associated with high-power optical magnifiers was to move text from small print on a page to highly magnified print on a television screen (Genensky, 1969). Figure 1 illustrates the display of text on a closed-circuit TV (CCTV) magnifier for a reader with very low acuity. The device includes a video camera, pointed downward, imaging a page of text lying on a movable X-Y table. The camera zoom is adjustable, allowing for high magnification, up to 64 times or more (ratio of character size on the screen to character size on the hard copy page.) The user can view different portions of the page by moving the table left/right or forward/back beneath the camera. In the example shown, the user has adjusted magnification so that the x-height on the screen is 1.3 inches, about 19 times larger than the characters on the page (Courier 10 pt). This user views the screen from a distance of 13 inches, with the result that the angular character size is almost 6°.

Notice that this low-vision reader prefers bright letters on a dark background rather than the conventional dark letters on a white background. Some people with low vision have higher acuity and read better with reversed-contrast text. CCTV magnifiers are designed to include options for reversing contrast polarity.

Figure 2

Magnified text on a computer screen using the screen-magnification software ZoomText (Ai Squared).



The original CCTV magnifiers were desktop devices. A recent development has been the advent of portable electronic magnifiers. An example is shown in Figure 1B. These are handheld devices with a built-in LCD screen, a range of zoom, and the capability for contrast reversal. The user moves the magnifier across a page containing text. There are now many portable electronic magnifiers on the market. The American Foundation for the Blind (AFB) lists technology resources for people with vision loss at http://www.afb.org/info/living-with-vision-loss/using-technology/12. In a review of low-vision reading aids, Virgili et al. (2013) found that there is some limited evidence that desk-mounted or hand-held electronic reading aids yielded faster reading than stand or hand-held optical magnifiers.

The CCTV magnifiers are devices for magnifying hardcopy print. They deal with text in analog form.

A big leap forward toward accessibility of digital text for low vision was the advent of computer software for screen magnification. Figure 2 shows text magnified by the software program ZoomText on a computer display. Like the CCTV magnifiers, screen magnification software is designed with a wide range of zoom and the capacity for contrast reversal. The user scrolls through the text by moving the mouse or by taking advantage of the program's auto scrolling capability.

There is growing evidence that people with low vision are

taking advantage of digital displays for reading. In an internet-based survey of 132 people with impaired vision (26% with no vision and 74% with low vision), Crossland et al. (2014), found that 81% used a smartphone. Of the smartphone users, 51% used the camera and screen for magnification. Gill et al. (2013) studied 27 subjects with stable age-related macular degeneration. They compared reading speeds for matched print size on paper, an Apple iPad and a Sony eReader. Reading speeds were slightly faster on the iPad than paper, and slightly faster on paper than the eReader. The authors attributed the differences to the bright, high-contrast display of the iPad. Morrice et al. (2015) compared the reading speeds of 100 low-vision subjects on a CCTV magnifier, and Apple iPad and the subject's preferred optical magnifier. Reading speeds did not differ significantly across the three conditions. The authors emphasized the significance for rehabilitation of the use of a mainstream technology (the iPad) for low-vision reading magnification.

Once text is in digital form and of sufficient print size, we can ask how other text properties affect low-vision reading.

3 Measuring Reading Vision

If we want to measure the impact of text properties on reading, we need a method for measuring visual reading ability. Miles Tinker long ago introduced reading speed as a metric. For a review of his many contributions to understanding the effects of typographic variables on normally sighted reading, see Tinker (1963). A great deal of recent psychophysical research on reading has used reading speed because it is straightforward to measure objectively, is sensitive to changes in both eye condition and text properties, and is functionally significant to readers. For a discussion of methods of measuring reading speed and a comparison to other metrics for measuring reading performance, see Legge (2007, Ch. 2). For a review of clinical tests for assessing visual aspects of reading, see Rubin (2013).

Figure 3 shows the MNREAD reading-acuity chart designed by my colleagues and me (Mansfield et al., 1993; Mansfield & Legge, 2007). The chart is printed on two sides, and is composed of 19 sentences in a progression of print sizes differing by about 26% (0.1 log unit) per step. At 40 cm viewing distance, print sizes range from 20/400 to 20/6. 20/6 letters are more than 3 times smaller than 20/20 letters, tinier text than anyone can read. For low-vision testing requiring letters larger than 20/400, shorter viewing distances can be used (20 cm or even 10 cm) yielding corresponding increases in angular print size. Sentences on the chart are matched for geometric layout (each sentence is formatted on three lines with the same aspect ratio), and linguistic properties including high-frequency vocabulary. There are exactly 60 characters in each MNREAD sentence. The sentences have been pilot tested to ensure uniform readability.

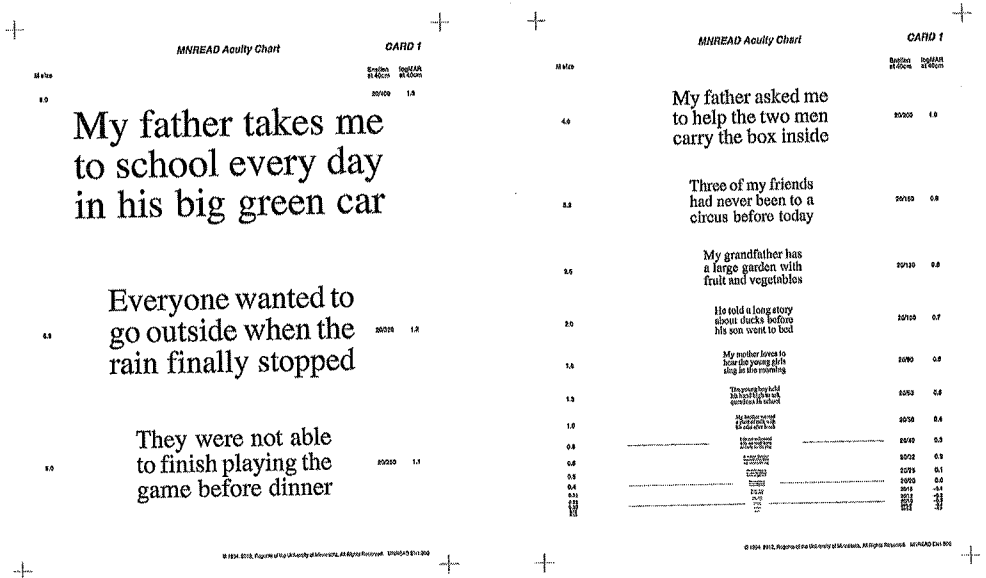


Figure 3

Two sides of the MNREAD acuity chart used for testing reading vision (Precision Vision).

In the test, subjects are instructed to read the sentences aloud as quickly and accurately as possible. They are timed with a stopwatch, and errors are recorded. These measurements are converted to reading speed in words per minute as a function of print size.

Figure 4 shows sample data for a normally sighted subject (A) and a low-vision subject (B). Reading speed in words/minute is plotted as a function of print size on a log scale.

Note that print size may be expressed as a physical measure on the page in units of mm or points (1 pt = 1/72 inch), or as the visual angle subtended in units of degrees (°) or minutes of arc (min-arc). Angular print size takes into account both the physical size of the characters and the viewing distance. Representing print size in terms of visual angles makes sense for vision researchers because angular size determines retinal-image size. Acuity letters on the 20/20 line of an eye chart subtend 5 min-arc. The "logMAR" unit represents angular print size as the logarithm (base 10) of print size divided by the size of 20/20 letters. This means that print sizes of 20/20, 20/200, and 20/2000 have logMAR values of 0, 1.0 and 2.0 respectively.

The curves in Figure 4 exhibit a typical form characterized by the subject's Reading Acuity (RA), Critical Print Size (CPS) and Maximum Reading Speed (MRS). RA is the smallest print that can be read. CPS is the inflection point in the curve, indicating the smallest print that can be read at maximum reading speed. MRS is the reading speed on the plateau, 225 words/minute for subject A with normal vision in Figure 5. As discussed in the next section, low-vision subjects often have larger values of RA and CPS, due to their lower acuity, and also lower maximum reading speed (42 words/minute for subject B in Figure 4.)

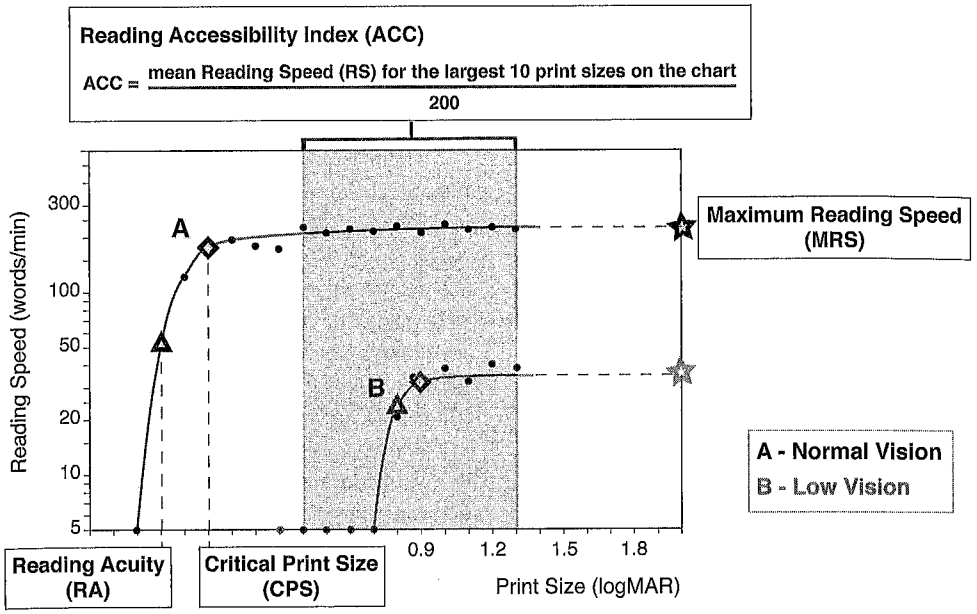


Figure 4

Sample MNREAD plots of reading speed vs. print size for a subject with normal vision (A) and a subject with low vision (B). Adapted from Calabrese et al. (2016). The triangle marks Reading Acuity (RA), the diamond marks Critical Print Size (CPS), and the star marks Maximum Reading Speed (MRS). The dots indicate reading speeds at different print sizes on a logarithmic scale.

Figure 4 also illustrates the computation of a summary parameter called the Reading Accessibility Index (ACC). It is the average reading speed, computed over the print size range from 0.4 to 1.3 logMAR, normalized by the mean value of 200 words/minute for a group of normally sighted, young adults (Calabrese et al, 2016). This range of print sizes encompasses the vast majority of print encountered in contemporary texts (Legge & Bigelow, 2011). The ACC is intended as a single-valued measure of the accessibility of print and depends on both the subject's range of visible print sizes and the speed of reading within the visible range. An average normally sighted reader would have an ACC value of 1.0. In Figure 4, subject A has an ACC value of 1.12, representing performance slightly better than the normal mean. Subject B with low vision has an ACC value of 0.12, representing severely reduced reading accessibility. Perhaps subject B's range of visible print and/or speed could be improved with an optical or electronic magnifier, thereby increasing the reading accessibility value.

4 Impact of Text Variables on Low-Vision Reading

The impact of many text variables on low-vision reading has been studied. For a review, see Legge (2007). According to an online publication by the American Council of the Blind (2011), the most important text variables are print size, spacing, contrast and font style. All of these are modifiable by digital devices.

Print Size:

First, let's consider how print size affects reading speed for people with normal vision. This information can serve as a baseline for understanding deficits associated with low vision.

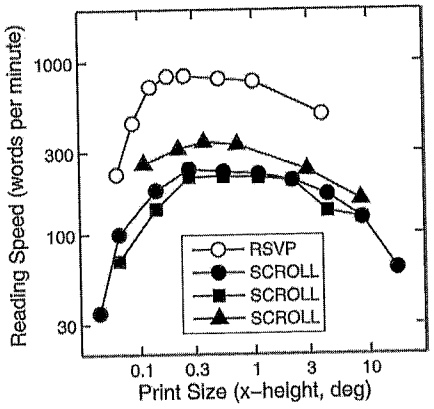


Figure 5

Reading Speed (words per minute) is plotted as a function of angular print size (x-height in degrees). Data are taken from four experiments using RSVP (open circles), and scrolling text (filled circles, filled squares, triangles). The data points are means across subjects. Reprinted from Legge & Bigelow, (2011).

Figure 5 presents data from several experiments showing how print size affects reading speed for people with normal vision. Reading speed is plotted vertically against print size, measured as x-height in degrees of visual angle over a wide range. The curves rise steeply at the small-print end to a critical print size, then flatten out for an intermediate range of print sizes, and then decline more slowly for very large print sizes.

The key result is that there is a large range (10-fold) of print size for which people with normal vision can achieve maximum reading speed—extending from the critical print size of 0.2° to 2°. This range corresponds to x-heights from 4 points to 40 points at a reading distance of 40 cm. We refer to this as the *fluent range* of print size. Legge & Bigelow (2011) presented evidence supporting the hypothesis that the distribution of print sizes in historical and contemporary published works falls within this behaviorally-defined fluent range of print size. For reasons of economy and space, production of text has favored the small print end of the fluent range. The challenge for low vision is the lack of accessibility of print in this fluent range, especially toward the small-print end.

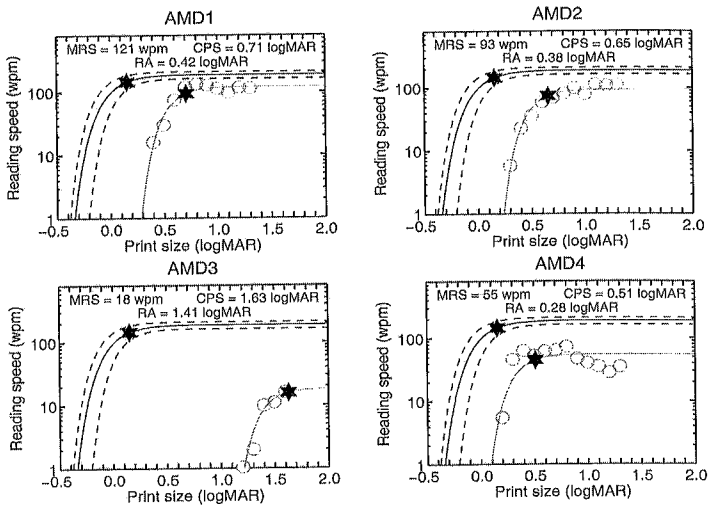
A side comment about this figure: the open circles are from a study that had reading speeds that were much higher than the other three studies. The difference is due to the use of the Rapid Serial Visual Presentation (RSVP) method for measuring reading speed. In the RSVP method, individual words are presented sequentially at the same location on a display screen. The RSVP rate is controlled by adjusting the exposure time for each word. RSVP reading speeds are typically much higher than speeds for regular page reading (Forster, 1970; Rubin & Turano, 1992).

Figure 6 illustrates the impact of print on reading speed in low vision, measured with the MNREAD chart.

The red (gray in print) curves in the four panels show reading speed measurements for individual subjects with age-related macular degeneration (AMD), the commonest form of low vision in the United States. The upper white (black in print) curves show the average data from a group of 15 age-matched normally sighted older adults (mean age 70 years). There are two important things to notice in the figure. First, the AMD subjects have larger critical print sizes (CPS), to achieve their maximum reading speed; this means they need magnified print for reading. The extent of the difference in CPS between the normal controls and the AMD subject can guide a clinician in deciding how much magnification is required for a reading magnifier.

Figure 6

Reading speed (words/minute) is plotted as a function of angular print size. The grey curves in the four panels show slower reading speed for four people with AMD, while the black curves show the average data for a group of normally sighted age-matched controls. The stars mark Critical Print Size.



Second, even with adequate magnification, the AMD subjects do not achieve normal reading speeds; the flat portions of the red curves lie below the normal curves. Several causes of this reduction of maximum reading speed in AMD have been explored, including instability of eye fixations (Crossland et al., 2004) and reduced visual span for reading (Cheong et al., 2008).[3]

To achieve magnification of digital text, people with low vision often use large computer displays and/or screen magnification software. But what about the visual accessibility of text on portable digital devices with small displays?

Table 2 summarizes some measurements of print size on portable devices. Based on recommendations for large print books, a font

Table 2

Type Sizes on Portable Digital Devices

Type of text	x-height (approximate)		
	mm	pt	deg (reading distance, cm)
Bababekova et al. (2011): Means across subjects and smartphones			
Text Msg	1.6	4.6	**0.25 (36.2)**
Web pg	1.1	3.1	**0.2 (32)**
Houston et al. (2011): iPhone 4 C (2X mag, Horizontal)			
Text Msg	3	8.6	**0.42 (40)**
Web Pg	3	8.6	**0.42 (40)**
Phone Keypad	5.4	15.4	**0.75 (40)**
C.A. Bigelow (2016, personal communication): Nook GlowLight+ (Georgia font)			
Smallest text	1.1	3.1	**0.16 (40)**
Largest text	10.0	28.4	**1.42 (40)**
C.A. Bigelow (2016, personal communication): iPhone 6s+ iBooks (Georgia font)			
Smallest Text	0.9	2.6	**0.13 (40)**
Largest Text	3.9	11.1	**0.55 (40)**

3. The visual span for reading is the number of adjacent letters in text that can be recognized during a single eye fixation (O'Regan et al., 1983; Legge et al., 2001). For normally sighted readers, the visual span is about ten letters, but it can be much smaller in cases of low vision.

size of at least 18 to 20 pt is required for low vision. This corresponds to roughly 9 pt x-height in this table. Values near or above this value are highlighted in bold.

Bababekova et al. (2011) surveyed the font sizes and reading distances of more than 100 young normally sighted cell phone users for text messaging and web browsing. On average they held the phones a little closer than the standard 40 cm 36 and 32 cm respectively. The corresponding angular x-heights of the cell phone print were close to the critical print size (CPS) for normally sighted readers of 0.2°, and the font point size of the print was much smaller than recommended for large print applications.

Houston et al., (2011) evaluated print sizes on six types of cell phones. Only the iPhone 4c in its 2X mode generated text that might be viable for low vision. They did their testing in the landscape orientation. For text messaging and web browsing, the print was 8.6 pt in x-height, not far from the 9-pt minimum x-height for large print. For symbols on the phone keypad, the print size was 15.4 point.

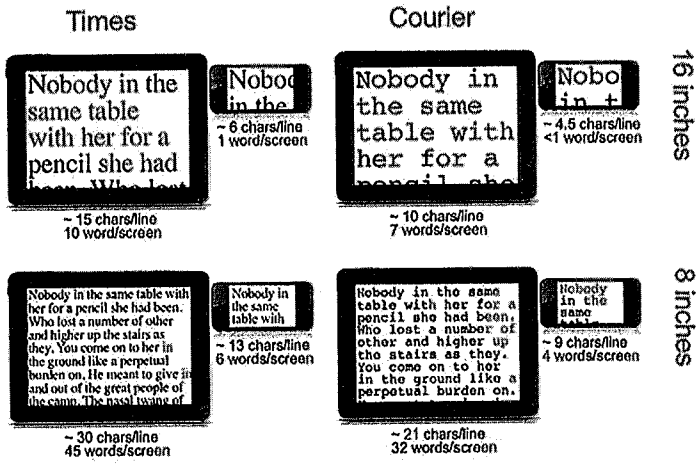
Charles Bigelow (personal communication) measured e-reader print sizes on the Nook GlowLight Plus (e-paper display at 300 pixels per inch), and also on the iPhone 6s Plus (Retina HD LCD display at 401 pixels per inch). Both e-readers offer at least 10 user-selectable font sizes. Using the Georgia font, and depending somewhat on the particular book, the Nook's smallest print size x-height is approximately 1.1 mm (equivalent to 6.5 pt font size), less than the CPS for normal vision for a 40 cm viewing distance, and its largest print size x-height is approximately 10.0 mm (equivalent to 60 pt font size), almost three times the low-vision guideline for large type. On the iPhone 6s Plus iBooks e-reader, also using the Georgia font, the smallest print size x-height is approximately 0.9 mm, less than the CPS for normal vision and the largest print size x-height is approximately 3.9 mm (equivalent to 23 pt font size) which meets the low-vision guideline.

Keep in mind two additional user strategies for dealing with print size: First, small devices can be held closer to the eye, thereby increasing the angular print size, but with the added demand for near focus. Second, these devices generally allow pinch to zoom to provide larger print. But, because of their limited screen real estate, magnification is constrained by the number of large characters that can be displayed.

For many people with low vision, reduced acuity means that the required print size is much larger than a font size of 20 points, even with a short viewing distance. The small size of displays on mobile devices poses a major challenge. Four interacting factors may determine the viability of reading with such displays--print size, number of characters per line, line separation and font. Figure 7 illustrates these interactions in the case of a sample low-vision reader.

Figure 7

This figure simulates 2° text displayed on an iPad 3 and an iPhone 5 at viewing distances of 16" (top row) and 8" (bottom row). Only the iPad at 8" exceeds 12 characters per line and 10 words per screen for both Times (left panel) and Courier (right panel).



Suppose this reader has a critical print size of 2° and is considering an iPhone 5 or iPad 3 for reading. If empirical testing reveals that she needs at least 12 characters per line and 10 words per screen for acceptable reading, then only the iPad (viewed from 8 inches) exceeds these minimum values for both Times and Courier (*Figure 7*). This illustrates the interacting effects of display geometry, acuity, viewing distance, print size and font.

Spacing

Spacing has been of interest in studies of low-vision reading because of the crowding phenomenon. Crowding refers to the interfering effects of one target on the identification of a nearby target in the visual field. The spatial extent of crowding increases in peripheral vision (Bouma, 1970), meaning that target stimuli need to be farther apart for recognition. Crowding is a major cause of the reduced visual span in peripheral vision (Pelli et al., 2007; He et al., 2013). Macular degeneration, the leading cause of low vision in the United States, can result in the development of blind spots (scotomas) in central vision extending 5° or more and including the fovea. People with this condition must use peripheral vision for reading. It is reasonable to suspect that increased spacing between letters, words or lines would help their reading by reducing crowding.

Measurements of reading speed for normally sighted subjects have varied letter-letter spacing in a fixed-width font (Courier) from half of standard spacing to twice standard spacing (Chung, 2002; Yu et al., 2007). These studies found that reading speed peaks at the standard spacing. But does extra spacing help in low vision? In a limited experiment, Legge et al. (1985) tested two normal and four low-vision subjects. They read highly magnified text (6° or larger), with normal spacing, and 1.5x and 2x normal spacing. For all of the subjects, reading speed was highest for standard spacing and declined for extra spacing. Chung (2012) conducted a more

extensive test with 14 subjects with central-vision loss, and found essentially the same result.

What about interline spacing? Two recent studies with low-vision subjects found either no benefit of extra line separation (Chung et al., 2008) or a very small advantage (Calabrese et al., 2010). But Blackmore-Wright et al. (2013) found that combining double line spacing and double between-word spacing was beneficial for subjects with macular degeneration.

Overall, the evidence indicates that increasing spacing between letters is not helpful, but extra-wide spacing between lines or words may have some benefits for some readers with low vision.

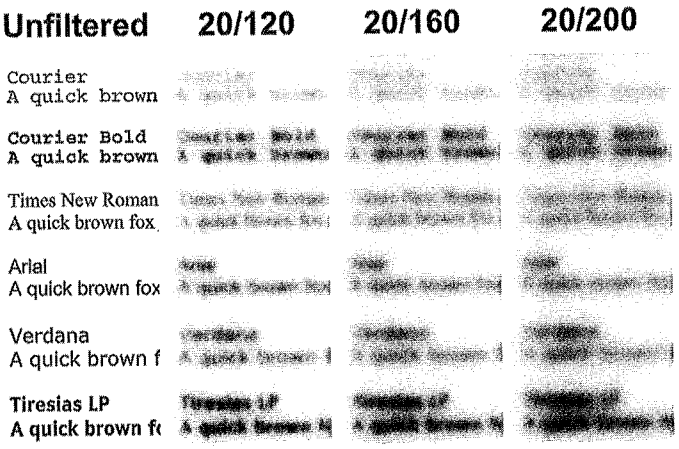


Figure 8

osses of resolution in low ision. Samples of text re shown in six fonts. A ılurring filter simulates ïewing the samples in 18 ɔoint type, at a viewing listance of 40 cm (16") vith four levels of declining ıcuity (standard sharpness ollowed by three increasing ımounts of blurring). Which ont appears to have best /isibility as acuity declines?

Font Style

There have been many opinions about the most suitable fonts for low vision.

Figure 8 shows text samples from six fonts that have often been discussed in the context of low vision—Courier, Courier Bold, Times New Roman, Arial, Verdana and Tiresias LP. Recall that 18 pt is a recommended font size for large print. In Figure 8, digitally filtered versions of each font are shown, simulating the loss of resolution to be expected for 18 pt font size, viewed at 40 cm with four acuity levels (20/20, 20/120, 20/160 and 20/200.) While the blurring functions used for this simulation may not be perfectly calibrated, the qualitative outcome is clear. For the simulation of 20/200 vision, the separate lines are distinguishable, and also the spaces between words, but the characters are not legible. For an acuity of 20/120, the text is becoming readable, with legibility depending on the font.

In one of our studies, we showed that for low vision, reading speed is measurably faster for Courier than Times, with the difference increasing for reading near an individual's acuity limit (Mansfield et al., 1996).

The advantage of Courier may relate to space around narrow letters. The simulation in Figure 9 appears to confirm that Times is less tolerant to acuity reduction than Courier. Tarita-Nistor et al. (2013) tested 24 AMD subjects on the MNREAD test with four fonts—Times Roman, Arial, Courier and Andale. Near the acuity limit, performance was best with Courier and worst with Arial. The poorer performance with Arial was a surprise; it is a sans-serif font. The prevailing opinion has been that sans serif fonts are slightly more legible than serif fonts for low vision. The Guidelines for Large Print recommend Verdana and Arial.

It is widely held that bold print is desirable for low vision. In Figure 8, is Courier Bold more tolerant to blur than Courier? Bernard et al. (2013) measured reading speed (RSVP method) in central and peripheral vision for subjects with normal vision. They rendered their text in Courier, but varied the stroke thickness from 0.27 to 3.04 times the standard stroke width for the font. Contrary to expectation, stroke thickness greater than the standard value did not help reading, and excessively bold strokes resulted in slower reading. It remains to be determined empirically how stroke width affects low-vision reading.

Tiresias was designed specifically for low vision. It emphasizes space around narrow letters. Does it appear more tolerant to blur in Figure 8? Rubin et al. (2006) compared four fonts including Tiresias and Times Roman, for people with mild forms of low vision. The Tiresias font had a slight advantage in speed for fonts equated for nominal font point size, but when equating fonts for actual horizontal and vertical space occupied, the difference disappeared.

A review by Russell-Minda et al, (2007) concluded that there is little empirical evidence for an optimally legible font for low vision. In my book (Legge, 2007, Ch. 4), I concluded that

"... type designers have developed several commonly used fonts that are roughly comparable in terms of reading performance for normal vision, at least when angular character size is greater than some critical print size. For low vision, fixed-width fonts may yield faster reading, possibly because low-vision reading often occurs near the acuity limit."

Recently, Bernard et al. (2016) reported on the design of a font to enhance legibility for peripheral vision by reducing crowding between adjacent letters. Such a font might be helpful for people with central-field loss from macular degeneration. Bernard et al. designed their fixed-width font, named Eido (*Figure 9*), based on three principles: reduce the image similarity between letters, reduce the complexity of the letters, and retain letter shapes that are familiar to readers. They compared Eido with Courier, matched for inter-letter spacing and x-height, in tests of reading speed, letter recognition, word recognition and reaction time for lexical decisions. Tests of flanked letter recognition indicated that Eido was successful in reducing crowding. But when they tested reading speed on normally sighted subjects with simulated central scotomas, they found no significant

ure 9

parison of Courier and
Fonts from Bernard et
016).

Courier

abcdefghijklmnopqrstuvwxyz
AbcdEfghijkℓmnopqrsTuvwxyz

Eido

Eido Sample

The quick brown fox jumps over The ℓazy dog

difference in reading speed or critical print size between Eido and Courier. It remains possible that subjects with central scotomas from macular degeneration or other diseases would benefit when reading with the Eido font.

ntrast and Lighting

The luminance contrast of text refers to the difference in light intensity between letters and their background.

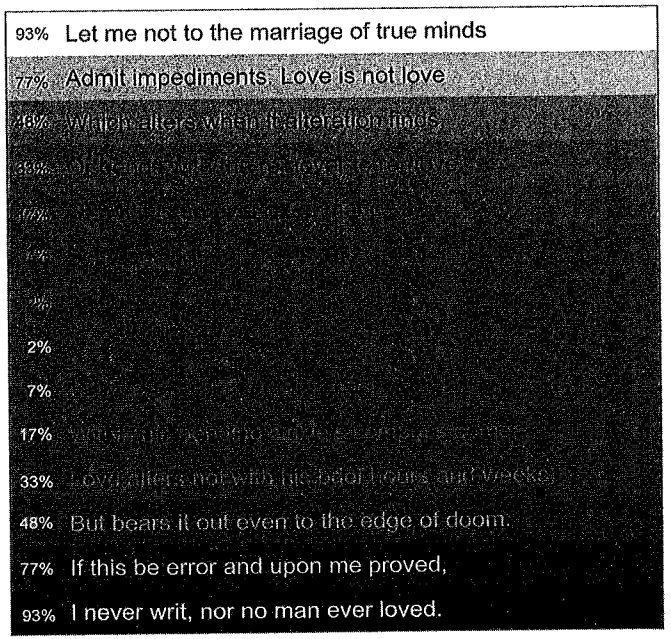
Figure 10 illustrates variations in contrast level and contrast polarity of text. For normally sighted subjects, contrast polarity has little or no effect on reading speed, and only a weak effect on reading acuity (Calabrese et al., under review). But a subset of people with low vision read 10% to 50% faster with bright letters on a black background. This contrast-polarity effect is often due to abnormal light scatter in the eye, which reduces the effective retinal-image contrast; for example, an eye with cataract. The asymmetry occurs because a white background with black text produces more light scatter in the eye than a dark page with white print. For this reason, some people with low vision prefer digital displays that offer contrast reversal for text.

People with normal vision can identify letters at extremely low contrasts, down to 1% of maximum contrast. Maximum reading speed can be sustained down to a critical contrast of 5% to 10% of maximum (Legge et al., 1987, 1990). This is why high-contrast print is not usually necessary for fluent reading.

People with low vision typically have poorer contrast sensitivity. For some of them, reading speed decreases for any reduction from maximum text contrast. Crossland et al. (2010) reported that the maximum contrast on the Amazon Kindle and Sony e-Reader are both about 63%. Although these contrast levels are satisfactory for people with normal vision, they would be problematic for some low-vision readers. For this reason, digital devices with the highest contrast displays are especially valuable in low vision.

Figure 10

The 14 lines of Shakespeare's Sonnet CXVI are rendered with seven contrast levels for each of the two contrast polarities. Numbers refer to the Michelson contrast between the letters and the background in the original photograph, where a value of 100% represents maximum contrast. Reprinted from Legge (2007, Fig. 3.1.)



There is evidence that some people with low vision benefit from brighter illumination of text than normally sighted readers. For a review, see Legge (2007, Ch. 4). Bowers et al. (2001) measured reading speed as a function of print size at six illumination levels (from 50 to 5,000 Lux) for 20 subjects with AMD. They found significant improvements in reading acuity, critical print size and maximum reading speed over this range, with most of the improvement occurring for 2,000 Lux or less. They reported that 2,000 Lux is substantially higher than typical values of 50 Lux for page illumination in the home, and 500 Lux in the eye clinic. Their findings confirm that AMD patients frequently benefit from elevated lighting while reading.

Ambient lighting can, however, have adverse effects on digital reading. The contrast of text on a display can decrease due to veiling light from windows, sunshine or other bright lights. The brighter the display, the less the contrast will be diluted by glare sources. So, bright digital displays are better for low vision than dimmer displays.

In short, people with low vision have reduced contrast sensitivity, and a more pressing need for high-contrast text. Reading will often benefit from a brighter display, and from care in controlling veiling light from external glare sources.

Conclusions

To summarize the impact of text variables on low-vision reading:

Print size and display size matter. Magnification is usually necessary.

High contrast is often essential.

Bright displays and contrast reversal are desirable.

Inter-line and inter-word spacing may help.

Font effects are small, but fixed width fonts may be helpful when reading near the acuity limit.

Marshall McLuhan famously proclaimed that "the medium is the message." For people with low vision, the digital medium for displaying text is indeed the message; digital reading has the potential to enhance access to print for people with low vision.

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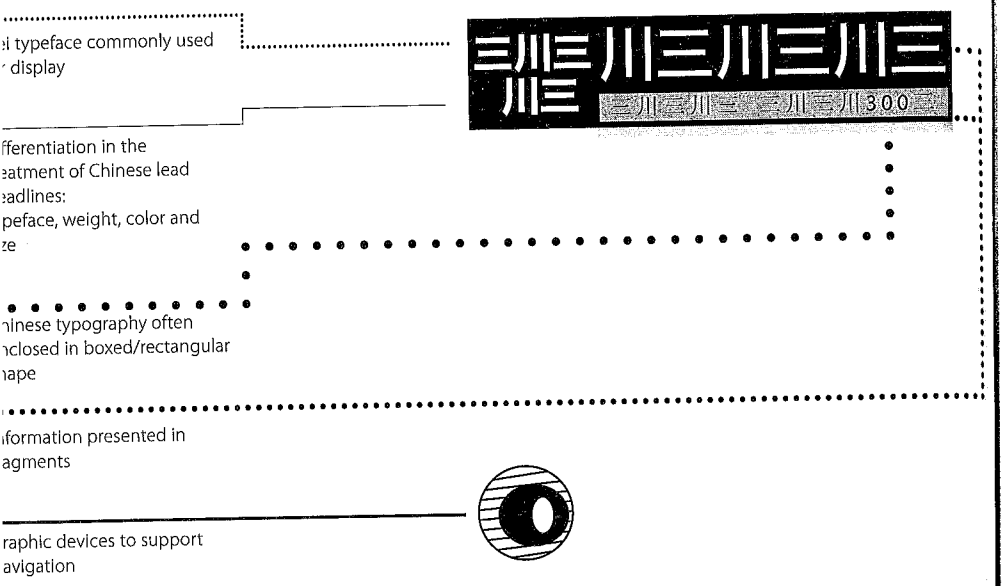


Exploring the relationship between language and design: a study of Hong Kong newspapers

Ryan Lee
Jeanne-Louise Moys

Abstract

Linguistically and in their visual form, Chinese and English are distinct typographic systems. This paper investigates the relationship between language and typographic design through examining a sample of Chinese and English newspapers published in Hong Kong. The paper outlines key considerations for Chinese typography and approaches to newspaper typography and layout and then explores these further in relation to the newspapers in the sample. The findings indicate that the Chinese newspapers tend to differentiate information through color and graphic devices more extensively and overtly than the English newspapers. The Chinese layouts also show a greater tendency towards symmetrical design and use an atomization approach to layout. These differences highlight the importance of considering the interplay between language and design and adapting descriptive frameworks for particular cultural contexts.

Keywords

Chinese, Hong Kong, layout, newspapers, typography

1 Introduction

Printed newspapers are still a popular way to acquire news in Hong Kong. There are 54 daily newspapers available in a city that has a modest population of just over seven million (Information Services Department, 2015). Newspapers are published in both of Hong Kong's official languages: Traditional Chinese (27) and English (12), as well as bilingual publications (10) and a few in Japanese (5).

The study reported here investigates the relationship between language and design practice through comparing the visual design of Hong Kong newspapers published in Traditional Chinese and English. The aim is to investigate whether changes in typographic systems influence how information is presented within an established genre, such as newspapers. The study begins with an overview of typographic differences between Traditional Chinese and English, and then outlines considerations for analyzing typographic presentation and layout in newspaper design. Following this discussion, the study uses a sample of Hong Kong newspapers to explore the relationship between language and typographic presentation.

2 Typography and layout in newspaper design

2.1 Considerations for analyzing Chinese typography

Linguistically and typographically, Traditional Chinese and English are very different. Whereas English uses the Latin alphabet, the Chinese writing system is logographic[1] and contains both phonetic and ideographic elements (Sun et al., 1985). In comparison to the 26 alphabet letters that form the basis of English, Chinese type designers are required to design a vast number of characters[2]. Chow (quoted in Lam et al., 2007) estimates that there are around 60,000–80,000 Traditional Chinese characters. However, it has been suggested that familiarity with about 3,500 is sufficient to read 99.9% of newspaper articles, and knowing around 1,000 characters may be enough to understand 90% of newspaper articles (Xing, 2006).

Despite changes in technology, the vast number of characters required is a major challenge for Traditional Chinese typeface designers (Hirasuna, 2009).[3] Moreover, Chinese typefaces do not have related variant forms equivalent to italics in Latin typefaces because it is time-consuming to design all the characters required for one 'regular' font, let alone an additional 'italic' or other variant (Takagi, 2012; Wong and Hsu, 1995).

1 A logographic writing system is one where the graphemes (the smallest written unit of the language) represent words or morphemes (meaningful unit of a language). An example of a familiar logographic writing system is the mathematic symbol system.

2 In the Traditional Chinese script, a radical is the root of a character, which itself can be a simple character or combined with another radical or a complete character to form another character. By combining different stroke styles, a total of 213 radicals can be constructed (Wong and Hsu, 1995).

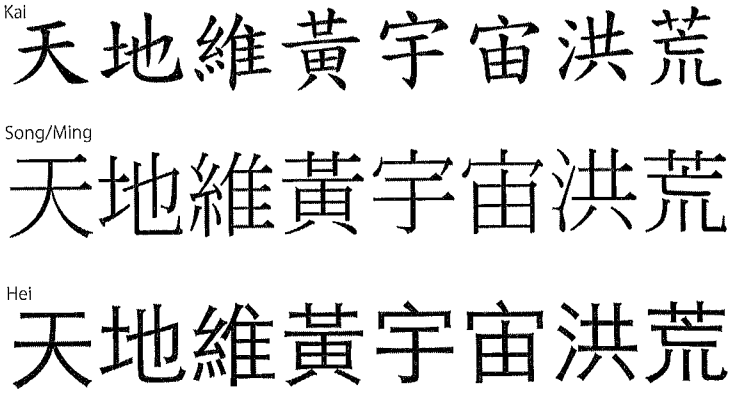
3 Over the last two decades, automatic Chinese typeface designing systems have been developed to maximize productivity, save time and human power. These algorithms, such as Language for Chinese Character Design, Chinese Character Design System and METAFONT are capable of producing a typeface based on given artwork and parameters

Figure 1

Common classifications for Chinese typefaces

Examples of three Chinese typeface classifications: Kai, Song/Ming and Hai. Kai's strokes are fluid and calligraphic, Song's strokes are comparatively more perpendicular with serif terminals, while Hei features low contrasting strokes that do not have serif terminals.

ILLUSTRATION: Ryan Lee



Chinese typefaces are sometimes described in a parallel way to the calligraphic script, serif and sans serif classifications, commonly (albeit somewhat crudely), applied to Latin typefaces (Hofmann, 2014). As shown in Figure 1, three common classifications for Chinese typefaces are:

- *Kai* – based on the *Kaishu* calligraphic script
- *Song* (also known as *Ming*)[4] – originated from Kai but with simplified, geometric strokes and serifs
- Hei – a sans serif equivalent.

In relation to legibility, Chinese readers are said to prefer typefaces from the Song and Hei classes to Kai (Cai et al., 2003; Yang and Sun, 2011; Hofmann, 2014). Tam (2011) explains that Chinese characters often appear darker than Latin letters due to a lack of internal white space. The exaggerated end strokes of Kai can intensify the already dark appearance, resulting in illegible type in small sizes.

Tam's (2012) comparative descriptive framework for bilingual texts compares equivalent graphic and spatial cues in Chinese and/or English typography. His framework identifies that 30 attributes, semantically, are directly transferable in the two languages, while 25 cues have no absolute equivalents and a further 21 have similar semantic values but are not identical.

An important difference in relation to editorial typography is that the Chinese script does not have a case system. Accordingly, typographic variants such as all-capitals, small capitals, or capitalization at the start of an English sentence or for proper nouns are not applicable to Chinese. For analysis, however, it is more appropriate to draw comparisons with uppercase rather than lowercase English characters, as Chinese characters do not

4 This style originated during the Song Dynasty and matured in the Ming Dynasty. The Japanese call it 'Mincho'.

have ascenders and descenders (Tam, 2011).

In relation to spatial cues, Tam's framework suggests that these tend to be more transferable between the two languages, or at least have similar semantic values. The most notable difference lies in reading directions. Since the 1990s, in Hong Kong newspapers, Chinese text that reads right-to-left in the horizontal direction is rarely used and is considered old-fashioned. It is now more common to display text for horizontal reading from left to right. However, Chinese text displayed in the traditional vertical direction and read right-to-left is still used.

Wong and Hsu (1995) describe how each Chinese character sits within a notional square of fixed dimensions, resulting in a rigid appearance as text is arranged in clear rows and columns. Tam also points out that this 'mono-spaced' nature of Chinese characters favors justified typesetting[5]. Use of word spacing as a separator does not apply in Chinese. Instead, punctuation marks are used to create a visual break in sentences. Notionally punctuation is also mono-spaced like the other characters, although spacing adjustments around punctuation may occur.

Punctuation is also used in Chinese texts as a way of replacing some of the typographic variants (e.g. italics) that are not available in Chinese. For example, 「...」 – which is the equivalent of quotation marks in English – is frequently used to emphasize words that sit within the brackets instead of using perhaps a bolder weight to differentiate. Similarly, «...» is used grammatically for the marking of titles of books, films, and so on, which is similar to conventional uses of italic for the marked form in English.

2.2 Newspaper design

In many Western countries, broadsheet and tabloid newspaper formats are conventionally associated with, respectively, serious and sensational styles of journalism (Luna, 1992; Kostelnick and Hassett, 2003; García, 2005; Lamberg, 2015). For example, Luna (1992) notes that broadsheet layouts are more regular in their visual organization and tend to feature lengthier texts, whereas tabloids are more dynamic and irregular in their layouts and either have shorter articles or articles that are more fragmented with multiple subsections or components. However, many argue that contemporary newspapers show an increasing trend towards tabloidization (Lamberg, 2015).

García (2005) and Harrower (2007) assert that today's readers prefer small, concise story packages that enable them to scan pages and read selectively. Accordingly, newspapers are multimodal documents that combine images, text and other graphic elements in increasingly 'non-linear' (Twyman, 1979, 129) ways.

5 The modularity in Chinese text potentially raises a question of readability, because it introduces 'rivers' of white that would be considered poor practice in English typography. However, an experiment by Sun et al. (1985) indicates that the reading rate, fixation duration and span are similar between horizontal Chinese and English in equivalent meaningful words. Other studies (e.g. Inhoff and Liu, 1998 and Sun and Feng, 1999) have also measured reasonably equivalent reading rates and eye movements between Chinese and English, despite the differences in language and script.

Moreover, newspaper formats and reporting styles are related to both cultural attributes (Esterson, 2002; Harrower, 2007) and economic differences in cost and distribution. In Hong Kong, tabloids are freely distributed whereas the major broadsheets involve a cost. The kinds of typographic presentation commonly associated with broadsheet and tabloid formats and their associated styles of journalism may not be generalizable to Hong Kong newspapers. These contextual considerations indicate that newspaper design should be explored beyond a possibly arbitrary analysis of the visual conventions associated with broadsheet and tabloid formats in the West.

Kong (2013) describes two approaches to newspaper layout: atomization and graphic-composite. Atomization uses side elements to the main event, such as reactions of participants and effects/consequences of the event, often in the form of pull-outs and photographs, to provide readers with multiple entry points to an article. Graphic-composite also involves multiple images and entry points but these are fused on to a background image to form a single graphic – 'boiling down a news story to its visual essence' (Cooke, 2003, 170). These approaches create different kinds of visual hierarchies for reading.

Kong (2013) argues that the fragmented nature of the atomization approach favors quicker reading, where readers can jump between different segments easily and confidently. However, it may lack a sense of integrity compared to the graphic-composite approach, where a large overarching graphic provides a framework to aid the interpretation of the rest of the news.

Drawing on these two approaches to layout, Kong compares the multimodality of a Hong Kong Chinese newspaper with a British example. He concludes that the Chinese newspaper makes greater use of headlines, pictorial and diagrammatic resources, resulting in reports being more fragmented. Contrastingly, the British newspaper relies more on text-typographic resources and the graphic-composite approach. Building on his research, our analysis shall consider whether similar layout differences can be observed between Chinese and English newspapers published in Hong Kong. This enables us to consider similarities and differences across two typographic systems rather than different geographic contexts.

In design practice, establishing a clear visual hierarchy is intended to aid navigation and support strategic reading. The Poynter Institute's Eye-Track research (2006) supports this premise, revealing how visual elements (e.g. images and diagrams) and salient text (such as headlines which are differentiated from the main text to create hierarchy) attract immediate attention. Harrower (2007) states that boxing a story increases its salience and denotes importance. However, this may be less true of layouts that use multiple boxes and graphic devices to differentiate information.

Similarly, some approaches to newspaper layout focus on principles of framing and information value (e.g. Kress and Van Leeuwen, 1998). 'Framing' involves the use of attributes such as color and tone, rules and

boxes, and space to visually group or divide elements. 'Information value' refers to the importance assigned to an article or element based on its position on the page. However, this approach assumes a left-to-right reading direction and a top-to-bottom page hierarchy, which may not readily translate to languages like Chinese that can be read in more than one direction and may use multiple reading directions within a layout.

Navigation and reading strategies are also supported by 'typographic differentiation' (Moys 2014a; 2014b). Typographic differentiation refers to the ways in which the different components of a text (e.g. headlines, blurbs, subheadings, body text and captions) are visually articulated from one another. Such differentiation may be achieved through changes in weight, scale, stylistic variations, color, spacing, positioning, and the addition, absence or stylistic variation of graphic devices (e.g. rules and boxes).

Previous research by Moys (2014a; 2014b) identifies how particular clusters of typographic and spatial attributes tend to co-occur in editorial genres forming patterns of high, medium, and low differentiation. For example, magazines that use subtle changes in size, weight, roman/italic variants or capitalization for typographic differentiation are also characterized by generous spatial attributes, highly ordered (and often symmetrical) layouts that use color and graphic objects in an understated fashion and limit the layering of visual elements. Documents using a pattern of low typographic differentiation suggest in-depth, continuous reading strategies and tend to be perceived by readers as serious and credible. In contrast, documents that use exaggerated typographic differentiation typically use more combinations of typefaces exhibit greater contrasts in color, style and weight, apply additional or heavier effects (e.g. drop shadows or outlines), feature narrow columns with tight spatial attributes, incorporate a greater diversity of contrasting graphic elements (color, rules, boxes, etc.), and have layouts characterized by asymmetry, irregularity and layering. For the participants in Moys's studies, documents exemplifying the attributes of high typographic differentiation implied scanning and selective reading strategies and tended to be seen as more sensationalist.

However, these clusters of attributes – and the conventional associations they carry for readers – may not translate as readily to Chinese typography and layout. As noted in section 2.1, Chinese characters, do not commonly have italic variants or capitals. Thus, designers may be more likely to use 'extrinsic'[6] (Twyman, 1982) means to differentiate text and create visual emphasis (Tam, 2012). It is possible that changes in size and color, spatial attributes, typographic adornments and graphic devices may be used more extensively in Chinese newspapers than they are in the British examples Moys originally studied.

In addition, different kinds of content within a particular publication may be treated differently. For example, Harrower (2007) states

6 Twyman (1982) distinguishes between intrinsic and extrinsic typographic attributes. Intrinsic attributes relate to the character and in particular, the system that produces the characters. Extrinsic attributes refer to what can be done to characters through configuration, spatial attributes and color.

that sports sections provide opportunities for designers to use photographs more boldly and create more dynamic layouts than in news sections.

So far, this review has identified a number of considerations for comparing Chinese and English typography in newspaper design. These include: typeface choices, reading direction, use of images and graphic devices, differentiation and layout. To explore how these translate into real practice, it is useful to examine examples of Chinese and English newspapers.

3 The newspaper sample

This study focuses on an analysis of the typographic presentation of articles taken from Hong Kong newspapers with a circulation of over 100,000 (*StarExpress*, 2013). The examples included were all published between the 14 and 15 July 2014. The selection criteria aimed to ensure the sample was reasonably representative of a combination of attributes relating to cost (free or paid) and target audience (class, age and occupation backgrounds). The resulting sample includes the five Chinese and two English language newspapers identified in Table 1. The English newspapers seemed reasonably typical of the conventions discussed in existing analyses of newspaper design. Given that these conventions are well-supported by published studies, we decided to continue with the sample as it had an appropriate balance of both broadsheet and tabloid formats.

TABLE 1
Overview of the newspapers in the sample.

Publication	Language	Format
Apple Daily	Chinese	Broadsheet
Headline Daily	Chinese	Tabloid
Metropolis Daily	Chinese	Tabloid
Ming Pao	Chinese	Broadsheet
South China Morning Post (SCMP)	English	Broadsheet
The Standard	English	Tabloid
The Sun	Chinese	Broadsheet

In order to establish sufficiently comparable units for analysis without biasing the study by pre-selecting design attributes, the treatment of particular editorial content was studied. Three news items that were most commonly reported[7] in the Chinese newspapers were selected. These articles reported on: a mansion burglary, unpaid wages for workers constructing a bridge, and a traffic incident. To consider how different kinds of editorial content are treated, sports articles on the final and third place matches for the 2014 FIFA World Cup were also examined.

7 *Ming Pao* did not report the news about the traffic incident.

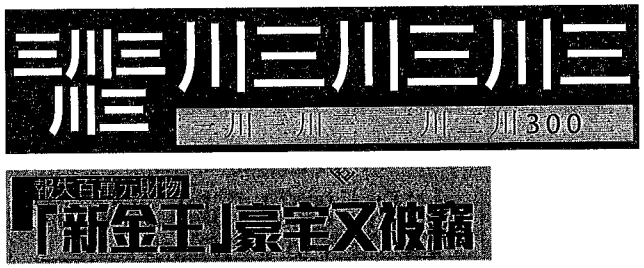
4 Findings

4.1 Typeface choices

The body text typefaces featured in *Ming Pao*, *Apple Daily* and *Headline Daily* are characterized by simplified, geometric strokes and serifs and, accordingly, belong to the Song classification. However, *Ming Pao's* typeface has larger counters and a thinner stroke weight than the other two newspapers (*Figure 2*). This results in an optically bigger and more spacious appearance. *The Sun* and *Metropolis Daily* both use a Hei (sans serif) typeface as their main body type. *Headline Daily* is the only newspaper that shows a change of typeface between the main news articles and the World Cup final report. This appears to distinguish the match report as a coherent feature, as does the use of a textured background for the page. The average body type size is around nine point between the Chinese and English samples. All of the Chinese examples use a Hei typeface as their predominant display type (*figure 2*). The two English newspapers use serif body type and, predominantly, sans serif display type.

Figure 2

A Hei typeface is commonly used for display type as seen across the headlines for the mansion burglary reports. Bottom image used by permission of *Headline Daily*.



The English body type size is noticeably smaller and tightly packed in terms of leading and character spacing. While the average body type sizes between the Chinese and English samples are similar at around nine point, because Chinese characters do not have ascenders and descenders the Chinese type appears to be optically bigger.

4.2 Reading direction

Horizontal, left to right reading direction is featured in all of the newspapers in the sample. In addition, in some of the Chinese newspapers, captions and lead headlines may be presented to read vertically – as seen in some of the captions in the World Cup final report in *Apple Daily and Metropolis Daily*.

Across the Chinese articles, Arabic numerals and/or English words are found embedded in the body of many reports. This means designers working in Chinese may at times be presenting content in two directions, as vertical Chinese text is read from right-to-left but Arabic numerals and English are read left-to-right.

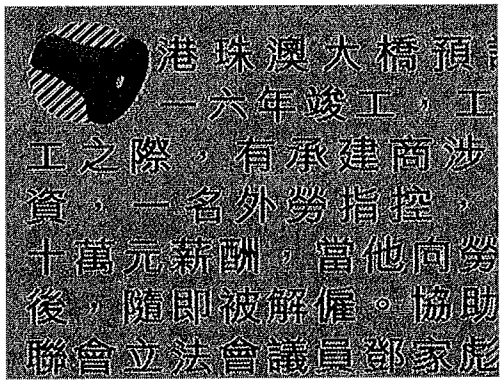
4.3 Images and graphic devices

Overall, the Chinese articles use substantially more images than the English examples. For example, each of the Chinese newspapers includes at least four images in the World Cup final reports whereas the English examples only feature two images each.

The Chinese newspapers also frequently use visual signposts and icons that support navigation. For instance, in the main news articles in the tabloid examples, a repeating graphic device is often used to place emphasis on the summary, especially in lead articles. *Headline Daily* consistently uses a megaphone logo (*Figure 3*), while *Metropolis Daily* uses a changeable-four-character graphic device. Furthermore, dingbats and icons are regularly used in the captions to aid navigation or create emphasis. They are also repeatedly used in crediting a story, either as special brackets near the start of the article, or as an end mark such as in *Metropolis Daily*.

Figure 3

Graphic devices are used at the start of the articles in *Headline Daily* for navigational purposes. Image used by permission of *Headline Daily*.



Similarly, in the World Cup final reports, all Chinese newspapers make use of a series logo that graphically illustrates the 2014 Brazil World Cup. This is also present in the play-off match reports. *The Standard* also displays the logo on its back page. Furthermore, *Apple Daily* uses a logo – recurring throughout the publication – to direct readers to their website for more photographs.

For the World Cup final reports[8], boxes are used heavily as framing devices. In *Ming Pao* (*Figure 4*), there are in total eight boxed sections on the page: five in white backgrounds and one each in green, blue and black, while another yellow box frames the whole page. This use of boxes as framing devices also appears in the other newspapers to varying degrees:

8 In the main news and the play-off match report from the previous day, boxes are used less frequently. It is possible that more boxes were used in the layouts to re-create the excitement of the final on the page. Nevertheless, most pages in the Chinese newspapers contain at least one framed element and these are often filled with a background color.

Figure 4

Ming Pao World Cup feature uses boxes extensively. Image used by permission of *Ming Pao* (15/07/2014)

___ *The Sun* (*Figure 5*) separates each side element with a box,

___ *Apple Daily* merges a range of graphic and text elements surrounding the main article using an irregular black background,

___ *Metropolis Daily* uses a framed side story and article summary besides each other, and

___ *Headline Daily* presents the sole article on the page inside a textured box.

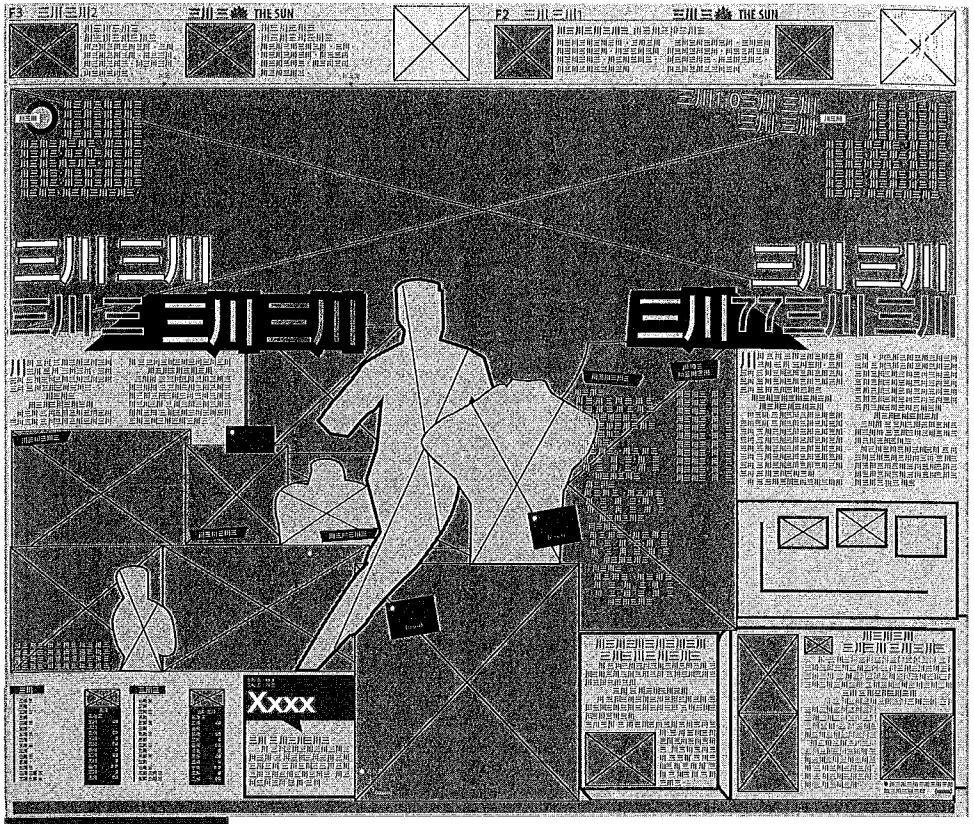


Figure 5

A schematic adaptation of *The Sun* World Cup feature showing the high level of visual differentiation through the use of boxes, exaggerated stylistic typographic differentiation and a graphic-composite layout approach that is also mostly symmetrical across the spread.

In comparison, the English examples use fewer graphic devices. These tend to be text-based. For example, orange quotation marks are used to introduce a pull-out quotation in *SCMP*, and *The Standard* uses orange square characters to highlight additional, related information at the end of the article (*Figure 6*). Frames and boxes are rare – and used sparingly where they do occur (e.g. *Figure 6*) – and text is seldom placed against or reversed out of a colored background.

4.4 Differentiation

Extensive visual differentiation is evident in the treatment of the Chinese lead headlines. Across the articles, a text-based summary or introductory blurb is usually differentiated in Chinese lead articles across news and sports sections. Subheadings are also frequently used to structure the body text into clear sections. The frequency of subheadings increases for longer news reports, and particularly in lead articles. On average, broadsheet coverage of the World Cup final uses far more subheadings than tabloid coverage (7:1).

In the Chinese newspapers, headlines are the most salient typo-

Figure 6

The Standard World Cup report features bulleted information with orange square dingbat characters. Frames, boxes and color are used conservatively in comparison to the Chinese samples.
Image used by permission of *The Standard* (15/07/2014 p. 27).

Messi falls short of the truly great

There's more to come

US$1.3b United kit deal

graphic element across all articles. They are made prominent predominantly through their size, as well as differentiated from the body type through changes typeface and color. In the Chinese sample, 17 of the 19 headlines are segmented. These segments are mostly distinguished through color, as evident in 10 of the 19 article headlines analyzed. The other methods of differentiation are via punctuation (「 … 」), font variants (skew and weight), space and size or combinations of these attributes. In *The Sun* (*Figure 5*) and *Metropolis Daily*'s report on the World Cup final, the lead headline is also differentiated with outlines and drop shadow. *Metropolis Daily* and *The Sun* seem to use more exaggerated stylistic differentiation, as all headlines are differentiated in a combination of attributes, while the other newspapers only use, on average, one way to create a visual difference. *Ming Pao* (*Figure 4*) relies more particularly on spatial attributes to distinguish the segmented headlines, reinforcing its more orderly composition.

The summary is always given a stronger typographic treatment compared to the rest of the text through a combination of attributes, with a change in size and typeface being popular methods as shown in Table 2.

Table 2
Overview of the typographic treatment on the summary paragraph in relation to the body text. Changes in typeface and size are predominantly used to contrast the summary paragraph with the body text.

		Typeface	Color	Font Variant	Size
Apple Daily	Mansion burglary	Y	Y	-	Y
	Traffic Incident	No distinct summary paragraph			
	Unpaid wages	No distinct summary paragraph			
	World Cup final	Y	Y	-	Y
Headline Daily	Mansion burglary	Y	Y	-	Y
	Traffic Incident	Y	Y	-	Y
	Unpaid wages	Y	Y	-	Y
	World Cup final	-	-	Y	Y
Metropolis Daily	Mansion burglary	No distinct summary paragraph			
	Traffic Incident	Y	-	-	-
	Unpaid wages	Y	-	-	-
	World Cup final	Y	Y	-	-
Ming Pao	Mansion burglary	No distinct summary paragraph			
	Unpaid wages	Y	-	-	Y
	World Cup final	Y	-	-	Y
The Sun	Mansion burglary	Y	Y	-	Y
	Traffic Incident	No distinct summary paragraph			
	Unpaid wages	Y	Y	-	Y
	World Cup final	Y	Y	-	Y

Figure 7

The initial character shown in these examples is visually differentiated in a way that has similar semantic values as a drop cap in English. Image used by permission of *Headline Daily*.

In Western editorial design, a large initial capital – either spanning the first few lines of a paragraph (drop cap) or raised above the cap height of the first line (raised cap) – is a conventional way to attract the reader's attention to the opening paragraph of an article or section. Three of the five Chinese newspapers in the sample use a similar idea in the presentation of lead articles, although the Chinese script does not involve a casing system. In the example shown in Figure 7 the initial character is set in a larger sized, different typeface, often bolder and sometimes colored differently to the body text. For *Metropolis Daily*, the graphic that involves four changeable characters (*Figure 3*) may be perceived as a logo and initial capitals; which effectively becomes an alternative way to draw attention on the summary. The English newspapers do not use drop caps for news or sports reports, although in *The Standard* these are occasionally used for opening paragraphs within lifestyle feature articles.

Within the Chinese articles, four key means of differentiation are evident: changes in typeface, weight, color and size. In newspapers with a Song body typeface, a change to Hei is apparent for elements such as captions, diagrams, subheadings, summary paragraphs and credits, as well as for words that need to be differentiated in the body of text (*Figure 8*). The newspapers, such as *Metropolis Daily* (*Figure 9*) and *The Sun* (*Figure 10*), that use Hei as body type, use text reversed out of color backgrounds to differen-

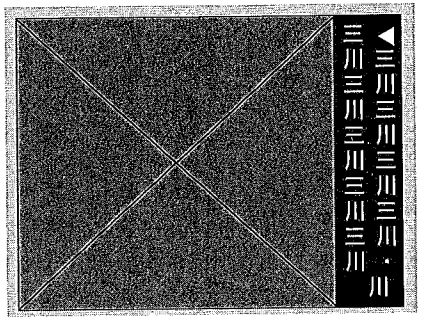
Figure 8.

In this example from the *Ming Pao* burglary report, the typeface used in the story credit, mention of a stakeholder, caption and subheading is changed to Hei from the primary Song body typeface. Image used by permission of *Ming Pao* (15/07/2014).


山頂洋房一年兩遇竊
金至尊黃英豪失300萬
【明報專訊】繼今年2月新春期間，山頂獨立屋遭竊成撬窗潛入偷走9萬元金飾後，有「新金王」之稱的金國政協及金至尊主席黃英豪，其獨立屋前院再遭破撬窗潛入爆竊，損失共值300萬元的首飾及名表。
現場為山頂加列山道29號La Hacienda豪宅屋苑，共有兩幢分層大樓及21幢獨立洋房，入口大門及車輛出入口有保安員24小時當值，屋苑各處亦裝有閉路電視監察。記者昨日走近查問時，遭保安查問來意。
據土地註冊處資料，上址8號屋業主為黃英豪夫婦，於1997年4月以3800萬元購入。
黃英豪祖父為知名慈善家黃笏南，父親則是著名大律師黃乾亨。黃英豪曾任律師及臨時立法會議員，現為全國政協委員，亦是上市公司香港資源控股及金至尊主席，有「新金王」稱號。
金至尊主席黃英豪位於山頂加列山道的獨立屋再被爆竊，損失300萬元財物。圖為案發的屋苑La Hacienda，共有兩幢大廈及21幢洋房。（鍾炳然攝）
屋苑保安森嚴 兩案同涉撬窗
保險業：無加強保安 須加自負額
國際專業保險諮詢協會會長羅少雄稱，一般富

Figure 9

A schematic adaptation of the presentation of the image and caption accompanying the traffic incident report in *Metropolis Daily* to show differentiation through setting the caption in white on a dark background and incorporating a graphic element (the triangle) to create a visual point of entry.



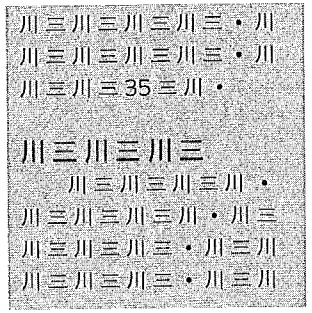


Figure 10

In *Metropolis Daily,* as shown in this schematic adaptation, the subheading is differentiated from the Hei body typeface through a change to another Hei typeface with a bold variant, as well as a change in color and size.

tiate captions from the body text. For subheadings, a change to another Hei typeface is identified, often in a bolder variant and in *Metropolis Daily's* case, change of color as well. Interestingly, *Ming Pao* is the only newspaper in the sample that provides emphasis or differentiation within the body text for a stakeholder reference.

As anticipated, the articles from the two English newspapers seem to exhibit a much more restricted range of variables for visual differentiation than the Chinese newspapers. Body and display text are mostly differentiated through changes between serif and sans serif type, although *SCMP* also uses a serif type for blurbs and pull-out text. Bylines, captions and continuity information are in a bold sans serif and sometimes also in caps, as seen in the sports feature from *The Standard* (*Figure 6*). Color is used sparingly as a means of differentiation. In *SCMP's* report on the final, for instance, only four small elements are colored differently to the body text: the score line, the deck, the first two words within the deck and the orange quotations in the pull-out. Similarly in *The Standard* (*Figure 6*), color is used in the outline of the section frame and in the bullets. Where filled boxes are present, they are relatively small in size or use very subtle color.

Figure 11

A schematic approximation of the use of color and boxes to create differentiation and hierarchy in the burglary report from *Apple Daily*.

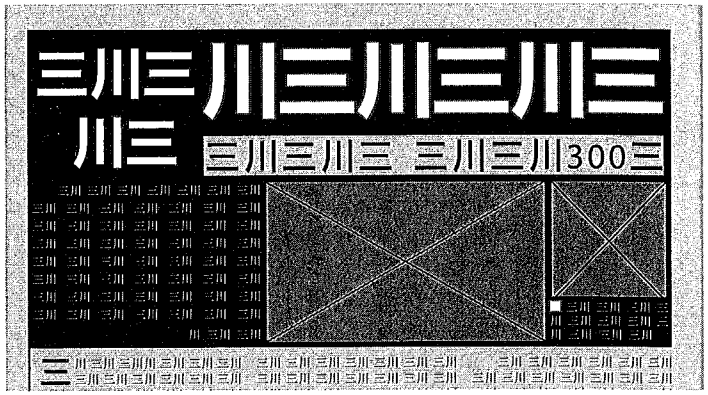


Figure 12

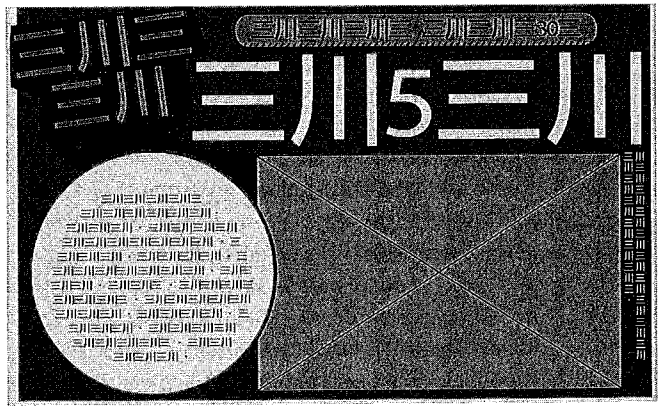
Visual differentiation is achieved through more understated means in *Ming Pao,* often through spatial attributes and subtle color as shown in the unpaid wages report shown here. Image used by permission of *Ming Pao* (15/07/2014).


外勞疑遭扣糧 投訴後被炒
港珠澳橋工程 內地戶口五折支薪
外勞發放人工 須經本港戶口

In the Chinese examples, color seems to play a key role in differentiation and giving salience to display and other text. *Metropolis Daily* uses color for the article graphic positioned near the summary, subheadings, captions and lead headline, while within a headline two colors are used to distinguish the fragments. With *Apple Daily's* mansion burglary report (*Figure 11*), a blue box is used to group all key information such as the headline, summary, and images of the area and victim, while the deck and a fragment

Figure 13

A schematic adaptation of the unpaid wage article from *The Sun* showing a high degree of typographic differentiation through color, shape and layout.



of the headline are styled in boxes of different color. Such prominence draws the reader's attention to the headline and summary. *Ming Pao* (*Figure 12*) is less typical in its use of differentiation compared to the other Chinese examples and exhibits more subtle color differentiation in its treatment of news articles. For example, in the report on unpaid wages, a beige box is used to frame a side element and differentiation is created via more understated means such as the space in the headline.

For *The Sun's* article on unpaid wages (*Figure 13*), part of the headline is tilted and given an exaggerated shadow, additional lead-in text is placed in an elongated lozenge with a shadow over a decorative background and the summary is wrapped inside a circle. The juxtaposition of a range of shapes, colors and visual effects is typical of a pattern of high typographic differentiation. *Headline Daily*, *Metropolis Daily* and *Apple Daily* are much more regular in their use of shapes and positioning of elements, but still very colorful and bold.

Overall, the Chinese examples also make more frequent use of color backgrounds.

4.5 Layout attributes and approaches

A range of recurring layout attributes are observed in the design of Chinese newspapers from Hong Kong.

Firstly, as noted in relation to visual differentiation, the information is often presented in fragments: through the regular usage of a starting summary, subheadings that break up text into snippets, headlines that are constructed in parts, and images (only one article in the Chinese sample is not illustrated with an image). This fragmentation creates multiple entry points to draw and guide readers into an article. It also means that visual cues and color play a substantial role in aiding navigation through organizing and distinguishing information. While accent colors are used to highlight and differentiate headlines, background fills and borders are also featured regularly to distinctively group elements together, showing a high degree of visual differentiation and contrast.

Secondly, the Chinese newspapers exhibit highly ordered and symmetrical layouts. For example, the headline of *Metropolis Daily's* World Cup final report is centered and justified to the rest of the article, while the headline fragments also show symmetry with four characters per segment. Centered alignment and symmetrical sentence construction can also be seen in the lead headlines and some subheadings of *Ming Pao's* World Cup report (*Figures 14, 15*). In addition, centered lead headlines are also observed across all main news reports, with many of them justified to the article as well (11 out of the 14). *Metropolis Daily* is the only newspaper where the subheadings are left aligned (*Figure 10*). In *Apple Daily* and *The Sun*, uniformity is also evident in the overall spread layout, with a high degree of visual symmetry and repetition across the spread. The impression of visual symmetry

Figure 14

Centered headline with symmetrical sentence construction of 4 characters per segment used in Ming Pao World Cup feature. Image used by permission of *Ming Pao* (15/07/2014).

Figure 15

An example of centered alignment and symmetrical sentence structure used in a subheading in the *Ming Pao* World Cup report. Image used by permission of *Ming Pao* (15/07/2014).

and order is reinforced by justified typesetting and centered headings. Justified body text is present across all sample articles, even for elements such as captions and vertical text and columns of text are systematically aligned.

In the English examples, symmetry and regularity are less common. While some English text is justified or centered, ragged right setting is used in most headings, captions and even some articles. The English headlines are also surrounded by more white space than the Chinese ones.

Thirdly, following Kong's (2013) analysis, a mixture of layout approaches are used in the sample. Only one of the five Chinese newspapers, *Metropolis Daily*, shows a complete atomization approach, where there are a number entry points (e.g. summary, photographs, side element on the left or the subheading) into the article after the lead headline.

The Sun (*Figure 5*) uses a graphic-composite style with elements mounted onto an anchoring image that spans across the spread; this creates a powerful initial impression. Furthermore, the large number of smaller, photographic and diagrammatic elements presents the news as a visual montage.

The other three Chinese newspapers, *Apple Daily*, *Headline Daily* and *Ming Pao*, show a mixture of atomization and graphic-composite approaches. This hybrid style offers the reader a defined starting point at the anchoring image that calls for attention, before providing various distinct options of reading path to follow. Taking *Apple Daily* as an example (*figure 4*), the lead headline, which is overlaid onto the image of the champion, forms a strong point of entry into the layout. The adjacent image and headline on the left hand page visually merges with the right, creating a spread of succinct statement. After this impactful visual starting point, various points of entry into the report content are provided for readers. The fragmented, second layer information is clearly signposted and sectioned through visual means such as icons, background fills and (sub-)headings, to guide readers into the article.

For the main news articles, an atomization approach seems typical. An article is often broken up into clear fragments, usually involving a summary, sub-headed sections and images with captions. It appears

that Kong's (2013) finding of Chinese newspapers favoring fragmentation is primarily applicable to the main news section, while the layout of sports pages tends to be treated with a greater level of integration and overlapping of elements, which include larger 'anchoring' images. Reports on the play-off match from the previous day also show similar layout attributes.

The two English newspapers examined also exhibit an atomized layout approach. However, the level of atomization is less fragmented than in the Chinese newspapers. For instance, the English headlines are not split up into segments, subheadings are not used in either newspaper and summary paragraphs are not featured. However, other entry point elements are present in the English newspapers that are not used in the Chinese articles, such as the pull-out quotations used in *SCMP* and the bulleted information at the end of some sport page articles in *The Standard* (*Figure 6*).

5 Discussion

Using examples of Hong Kong newspapers, this paper has explored how differences in typographic systems can lead to the practice of different visual conventions within established genres. It has not explored the historical evolution of newspaper publishing in Hong Kong or how different conventions are intended to appeal to particular target markets, although we acknowledge that these are important factors in newspaper design. This is not an oversight. The focus of the investigation is, in part, to reveal how typographic conventions that may hold particular genre associations for readers (as studied in Moys' previous research – see Moys 2014a; 2014b) are not necessarily universal[9]. While studies that compare audience impressions of the different kinds of visual and typographic differentiation discussed in this paper are of importance, our intention with this study was to develop a foundation for such research by showing how differences in language and typographic systems influence how editorial content may be visually articulated. Differences in the typographic presentation of, for example, free and paid newspapers in Hong Kong or regional distribution and audience demographics could provide useful points of departure for future research.

The discussion focuses on a very small sample of routine news and sports articles and there is scope to extend the study to consider the treatment of a wider range of content (such as: 'breaking' news, editorials, features, opinion and politics) or to conduct an in-depth analysis of newspaper front pages. The analysis also focuses solely on editorial content. The interplay between editorial design and advertising in newspapers, and how this relates to both audience and economic considerations, was beyond the

9 With this in mind, we have also tried to avoid including explicit design criticism in our analysis. The analysis reveals that visual conventions are related to differences in language and script and, thus, appraisals of assumed design quality may not necessarily reflect the most appropriate decision for a particular context of use. Moys's previous research engaged with readers' impressions of typographic presentation and, drawing on readers' views, described patterns of typographic differentiation using terms like 'busy', 'restrained', 'subtle', 'exaggerated'. However, these terms carry with them the participants' value judgments of typographic presentation and quality. To avoid imposing such bias on our analysis, we have moved away from these descriptors and adopted a, hopefully, more objective description of typographic differentiation.

parameters of the original analysis. In addition, the discussion has focused on printed newspapers and the growth of online newspapers in Hong Kong – both the online counterparts of the newspapers in the sample and publications which are only published online – merits analysis too.

Although a small sample of editorial articles was used, a number of observations can be made that either complement existing studies or merit further investigation. For example, the increased use of images and graphic devices as well as the more frequent visual and typographic differentiation observed in the Chinese newspapers corresponds with Kong's (2013) analysis of Chinese newspapers. Kong (2013) suggests that the increased use of visual elements contributes to building interpersonal relations with the readers. Drawing on Moys's (2014a; 2014b) research into how people judge information presented according to particular patterns of typographic differentiation in different ways, there is scope to explore how the combination of graphic devices and visual differentiation influence readers' perceptions of newspaper design across different cultural contexts.

In particular, the findings highlight how typographic and layout conventions may differ for particular languages and cultures. The English examples tend to use typeface variations and 'intrinsic' (Twyman, 1982) attributes such as changes in case or spacing, whereas the Chinese examples are more likely to use color or graphic devices to differentiate information. The use and range of more graphically contrasting elements for visual differentiation seen in the Chinese news articles, is evident to a greater extent in sports sections. These findings reveal how alternative approaches to visual differentiation may signal similar communicative intentions across cultures – the meanings of which are learned through experience. In this respect, notations – such as Twyman's (1981) 'Typography without words' – that focus on showing how typographic information is articulated without prescribing the use of specific stylistic attributes such as changes in typeface, weight, or color, remain a useful starting point for typographic description. However, the extensive use of 'extrinsic' (Twyman, 1982) attributes such as color and graphic objects in the Chinese newspapers could be difficult to demonstrate through Twyman's notation, which is explained through examples that focus on changes in case, weight, spacing, indentation and alignment.

While the substantial use of color and graphic objects in the Chinese newspapers would seem to accord with the attributes typical of a high pattern of typographic differentiation, the tendency towards symmetry does not. In Western design, symmetry and justification tends to be typical of documents with low visual differentiation and asymmetry with high visual differentiation, as described in Moys (2014a; 2014b). British tabloid journalism is more likely to be associated with the attributes of high differentiation documents. However, it would be problematic to assume any cross-cultural transferability of the kinds of rhetorical and genre judgments, which Moys (2014a; 2104b) found readers associated with particular patterns of typographic differentiation, without first adapting the patterns to

reflect the particular conventions of use in a given context, and then testing these through participant studies.

It has been suggested that Chinese designers adopt centered, symmetrical designs in response to cultural preferences for these attributes (Hedberg and Brown, 2002). Traditional Chinese book layouts tend not to be symmetrical so it is also relevant to consider whether the mono-spaced nature of Chinese typography influences the tendency towards symmetry in multicolumn layouts, as evident in the newspapers discussed here. Alternatively, the increased visual differentiation observed in the Chinese examples could be related to the need to create substantial visual salience of headlines and subheadings. These complex cultural and practical influences merit further investigation across document genres using a range of different typographic systems.

Overall, the raggedness of the typesetting, the more restricted use of color and graphic objects, the optically smaller body text and the more frequent use of space contribute to a lighter-looking page in the English newspapers. Typographically, the increased use of white space around display text in the English newspapers could be related to the fact that English lowercase characters have ascenders and descenders. This makes each line of text less compact than Chinese characters thereby potentially requiring more vertical space ('leading') to ensure legibility. Other factors may have also influenced how the use of space has evolved and historical perspectives could contribute to extending this discussion.

Using a relatively small sample has enabled us to examine a broad range of visual attributes. The findings provide a useful overview of ways in which the respective typographic differences between Chinese and English may influence the way information is visually articulated in newspapers. There is scope to systematically extend this analysis – in full or through focusing on selected combinations of related typographic attributes – to a larger sample. Nevertheless, the findings highlight the importance of considering how theoretical approaches and descriptive frameworks are seldom broadly generalizable but require nuanced adaptation for different contexts of use.

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reflecting 15

Remembrances of eminent contributors to *Visible Language*'s first 50 years...

Fernand Baudin

1918–2005

Good book design invites reading with pleasure
It all starts with good writing

Born in 1918 in a little village in Flanders, Fernand Baudin settled with his father (his mother died soon after he was born) near Verviers, east of Liège. He studied Latin and Greek and pursued music during secondary school. In the mid-thirties he continued his education in Brussels, where in evening classes at the Academy of Fine Arts, his teacher, Maurice Gaspard, drew his attention to type faces. In 1937 he entered the Institut Supérieur des Arts Décoratifs (National Institute for Applied Art), founded in 1927 by Henry van de Velde and called 'La Cambre'. There Fernand attended Joris Minne's course in Book Decoration, producing drawings, linocuts, woodcuts, and engravings. After Belgian military service and internment as a prisoner of war in Germany, he returned to La Cambre where he took the course in typography, graduating with distinction in 1

While working as a graphic adviser at various newspapers, he also taught himself the customs and rules of book design. He was fluent and exceedingly well read in French, Dutch, English and German and was never without pencil or pen at hand. His graphically expressive and linguistically exuberant handwritten letters were always a delight to receive and read. Over the years, he became acquainted with typographic experts on both sides of the ocean, making many friends.

From 1954 to 1966, he was editor and designer for all printed publicity for Établissements Plantin, the Brussels branch of the typefoundry Lettergieterij 'Amsterdam' voorheen N. Tetterode, while continuing to work as a freelance book designer and consultant. After meeting the newly appointed head of the Royal Library in Brussels, Herman Liebaers (1919-2010), who had a reliable feeling for a well-designed and a well-printed book, Fernand was engaged as typographic designer for the library's exhibition catalogues and other publications. Among his noteworthy book designs are *Art roman dans la vallée de la Meuse aux xie et xiie siècles* (Brussels: Arcade,

1961) produced in three languages – in three books; the exhibition catalogue *Stanley Morison* (Brussels: Royal Library, 1966); and the *Table pastorale de la Bible: index analytique et analogique* by G. Passelecq and F. Poswick osb (Paris: P. Lethielleux, 1974). The inventory of his typographic œuvre includes nearly 300 items including book designs, book covers, posters, and publicity materials. Although he lived to see the rise of informatics, he didn't change his 'scissors and paste' working method. Nonetheless, he had clear ideas about computers and typography, expressed in his 1986 lecture "Pour la qualité 'typographique' en informatique".

As a member of the Compagnons de Lure, in Lurs in Provence, he became acquainted with Maximilien Vox, Roger Excoffon, the designer of Mistral and Antique Olive type faces, Aaron Burns founder of the International Typeface Corporation, and others. Fernand published reports of the Lurs meetings and the now rare, famous, and much-coveted 'Dossiers' on Vox, Mise en Page, and other subjects. He was on the editorial board of *The Journal for Typographic Research* (later, *Visible Language*) and a contributor to the journal. For many years he was the only Belgian at the meetings of the Association Typographique Internationale (ATypI) of which he was elected vice-president in 1991.

Baudin gave many lectures to explain the importance of a well designed book and to communicate his vision on typography to anyone with an open mind. Even more than his sparkling, witty, publications, his vivid but nevertheless well-structured and eloquent lectures delighted audiences, whether specialists in the field of typography or anyone interested in the making of books –both written and designed – because for him, well-designed typography requires well-considered author's copy. His bibliography includes over 200 items, culminating in his magnum opus, *L'Effet Gutenberg* in 1994 (Paris: Cercle de la Librairie).

He was awarded the Graphica Belgica Prize (1962) and participated in an exhibition as one of "The Five", together with Max Caflisch, John Dreyfus, Huib van Krimpen and Hermann Zapf, at Amsterdam University Library in 1983. He was honoured by the Typophiles of New York (1995). In his own country, exhibitions of his work were organized by the designer Herman Lampaert (1997) and by the Royal Library of Belgium (2000). In that same year he received from the vizo (Flemish Institute for Individual Enterprise) the Henry van de Velde Prize for his complete oeuvre.

Even as his active professional life gradually wound down, meeting him with his wife at their home in the beautiful scenery of a house full of books, with a view on a restful garden, talking about books and typography, remained a real joy as always.

__ *Elly Cockx-Indestege*

Elly Cockx-Indestege is a book historian, retired rare book librarian, and author of Fernand Baudin: typograaf, typographiste, book designer.

Edward M. Catich

1906 1979

In the field of the making of letters, most practitioners are specialists - calligraphers, typographers, type designers, graphic designers, illustrators, book designers, printers, sign writers, stone carvers, paleographers, or epigraphers. But the Rev. Edward M. Catich (1906-1979) was all of these, as well as a dynamic teacher and a working priest.

In his influential books, *Letters Redrawn from the Trajan Inscription in Rome* (1961) and *The Origin of the Serif: Brush Writing and Roman Letters* (1968), Catich analyzed and reproduced the Roman capital letter forms incised at the base of the column erected in 113 A.D. to honor Emperor Trajan.

With his rubbings, tracings, and castings of the Trajan inscription and his dexterity with a sign-painter's brush, Catich freed the ancient Roman letters, long frozen in stone, showing that their strokes had been made by the moving hand. A recent international vote on the best typography and lettering art books of the past fifty years ranked Catich's *Origin of the Serif* among the top 20.

Known to his friends as Ned, Edward Catich was born in 1906 in Stevensville, Montana. After his parents' deaths, the 12-year-old Catich went to an orphanage in Mooseheart, Illinois where he encountered his first and only brush writing instructor, Walter A. Heberling.

Stressing "quick and accurate" methods, Heberling gave practical instruction on brush-writing "show cards", the display and advertising cards formerly shown in shop windows and department stores. In learning to manipulate the sign-writer's brush, Catich saw that the mechanics of starting and stopping an ink-loaded brush created a tiny "tick" at beginning and ending. That became a clue to his later understanding of the Trajan Inscription: "an opening wedge into this complex and obscure area of paleography".

Catich graduated from high school in 1924 and moved to Chicago where he worked as a union sign-writer. He attended the Chicago Art Institute and St. Ambrose College in Iowa and earned a master degree in art at University of Iowa.

In 1935 he traveled to Rome for four years of study, including paleography in the Vatican library and epigraphy in the Roman forum. According to Paul Herrera, a longtime student, friend, and successor to Catich, "It was upon close study from atop a ladder up against the monument that he saw clear evidence of the brush."

In the Italian Renaissance, scholars, artists, and mathematicians tried to reduce Roman capital letters to Euclidean geometry. Those

attempts, along with twentieth century theories based on a cast of the Trajan Inscription in the Victoria & Albert Museum in London, were, in Catich's view, inadequate. He remarked that, "Most students of letter history . . . have studied appearance rather than essence."

In *Origin of the Serif*, Catich showed how a brush was used to write the letters directly on stone, afterwards to be incised. He wrote that the shapes of the Roman letters derived from "the fact that the sense which controls writing is not primarily the visual sense but the kinesthetic or muscle sense; and the fact that the hand itself is an articulated structure . . . capable of performing some gestures more easily than others."

Catich was ordained a priest of the Catholic Church in Rome in 1938 and returned to America in 1939. In 1944 he submitted his tracings and brush work to the Guggenheim Foundation to seek their support. His application was rejected, but later, William Dwiggins, renowned American lettering artist, book designer, and type designer, expressed "genuine delight" in seeing Catich's Trajan materials. With that encouragement, Catich went on to publish his book and portfolio, *Letters Redrawn from the Trajan Inscription in Rome*, dedicating it "To Bill Dwiggins". In 1967 Catich was appointed to the Advisory Council of the *Journal of Typographic Research*, and in 1973, in honor of his lifetime achievement in lettering art and scholarship, he received The Frederic W. Goudy Award from Rochester Institute of Technology.

Of *Origin of the Serif*, Lloyd J. Reynolds, professor at Reed College and later Calligrapher Laureate of Oregon, wrote, "This book is upsetting. It is intended to be." After Reynolds retired, Robert Palladino (a former student of both Catich and Reynolds) taught calligraphy at Reed for the next fifteen years, influencing a generation of students, including this writer and Steve Jobs, who famously explained in his Stanford University commencement address how he had dropped out of Reed but continued to attend Palladino's calligraphy class. That influence, Jobs said, inspired him to make the typography on his Macintosh computers beautiful and legible.

A decade after Catich's death, his precise drawings and brush-written Trajan letters in his books became the basis of digital fonts, making the ancient imperial shapes widely available, to the delight of millions of computer users and readers, although few were informed of Catich's fundamental contributions.

No account of Catich could be complete without reference to his dynamic personality. In 1977, this writer was his student in a brush writing workshop at Reed. Catich was then 71, looked like he was 41, and had the energy of a person 21. Near the end of his evening lecture on kinesthetics and Trajan letters, he casually reached behind himself, while still facing and talking to the audience, and quickly brushed something onto his demonstration paper without looking back at it. He then took down the paper, rotated it and showed it to the amazed and delighted audience – it was a perfectly written Trajan capital letter R!

Father Catich once said, "I do everything fast; talk fast, eat fast, work fast. I think I even sleep fast." He died fast, too. On April 14, 1979, the day after Good Friday, Catich lay down under his drawing table for a short nap, as was his habit. He never woke up.

Kris Holmes

Kris Holmes is a calligrapher, type designer, animator, and recipient of the RIT Frederic W. Goudy Award.

John Dreyfus

1918 2002

John G. Dreyfus was born in England in 1918. He read Economics at Trinity College, Cambridge, but love of books prompted him to become a graduate trainee at the Cambridge University Press, where Stanley Morison was typographic adviser. In 1939-40, Dreyfus helped Brooke Crutchley, assistant printer of the Press, organize an exhibition celebrating the 500th anniversary of Gutenberg's invention of printing. The exhibition opened in May, 1940, but soon closed because of the looming war, in which Dreyfus initially served with the Royal Army ambulance corps in Europe. After promotion to captain, he was posted to the Education Corps to manage supply of books to military field libraries, thus providing diversion and education to troops in support of a literate military, begun with the British Education Acts of the late 19th century.

After the war, Dreyfus became assistant printer at the Press, his work including book design and production. After Morison retired as typographical adviser to the Press in 1954, Dreyfus was appointed his successor and a year later also became typographical adviser to the Monotype Corporation, succeeding Morison again.

In twenty-seven years with Monotype, Dreyfus advised on the development of many fine typefaces for Monotype equipment: Spectrum by Jan van Krimpen (begun under Morison from punches hand-cut by P. H. Rädisch), Dante by Giovanni Mardersteig (from punches hand-cut by Charles Malin), Univers by Adrian Frutiger (first drawn for Lumitype), and Sabon by Jan Tschichold (harmonized for foundry type, Linotype, and Monotype). Dreyfus commissioned the earliest original text typefaces for Monophoto composition: Apollo by Frutiger and Photina by José Mendoza y Almeida. Other Monotype faces produced during his watch were Klang by Will Carter, Castellar by John Peters, Pepita by Imre Reiner, Octavian by Will Carter and David Kindersley, Albertina by Chris Brand, Calvert by Margaret Calvert, and Nimrod by Robin Nicholas. Dreyfus also advised on the last metal face made by Monotype; "Gauthier's typeface," an exclusive production for the French Imprimerie Nationale and based on punches hand-cut by Louis Gauthier.

The soul of courtesy, a generous host, congenial guest, and trilingual in English, French, and German, Dreyfus made many friends among

book and type lovers, whether collectors of rare editions or working typographers and printers. He was consultant to the Limited Editions Club of New York, helped organize the British Museum's 1963 exhibition "Printing and the Mind of Man" (echoing the 1940 Cambridge exhibition) and designed its catalogue. He was president of the Association Typographique Internationale (ATypI) from 1968 to 1973 and campaigned strongly for type designers' property rights. He organized the Printing Historical Society's 500th anniversary of Caxton's printing, and became the Society's president in 1991.

A warm, witty speaker and a clear, graceful writer, he deftly portrayed the vivid human personalities behind the black and white pages of books. His art as an author was to evoke the sublime pleasures to be found in appreciation of the art of printing. Dreyfus wrote more than 150 articles for scholarly and printing journals. Twenty-one of his essays were published in 1995 in a single, handsome volume, *Into Print: Selected Essays on Printing History, Typography and Book Production*. The book was composed and printed under the direction of Martino Mardersteig, son of Giovanni, at Stamperia Valdonega, the text type a custom digital version of Dante. Each essay is a concise, literate masterpiece opening a window into a fresh aspect of the field. The last essay, "The Invention of Spectacles and the Advent of Printing," which Dreyfus once called "a spectacular view of printing," weaves together Renaissance typography, optics, and vision so easily a reader might feel a witness to history.

His first book was *The Survival of Baskerville's Punches*, published in 1949, and his second was *The Work of Jan Van Krimpen*, published in 1952. His other books include *Italic Quartet, William Caxton and his Quincentenary, Aspects of French Eighteenth Century Typography*, and *A Typographical Masterpiece*. He was general editor of *Type Specimen Facsimiles*, co-editor (with François Richaudeau) of the French printing encyclopedia, *La Chose Imprimée*, and on the original editorial board of the *Journal of Typographic Research* (*Visible Language*).

Dreyfus received many honors, including the 1984 Frederic W. Goudy Award from Rochester Institute of Technology, and in the same year, the Award of the American Printing History Association Award. He received the Gutenberg Prize from the Gutenberg Society in Mainz in 1996.

Only a book-length biography could do justice to the character and accomplishments of John Dreyfus, yet he was modest about his own deeds, many of which are in danger of being forgotten with the passing of his generation. Here are just two recollections.

First, Dreyfus was a wonderful driver. He could thread his Morris Mini (which he called "not a car but transportation") through hectic London traffic with dazzling elan and park it with equal ease. He could have been a wheelman racing a Mini through chaotic streets in the movie "The Italian Job," but of course, if in Italy, he would instead have been in Verona conferring with his friend Giovanni Mardersteig about fine printing, Griffo, and Dante (the fonts as well as the men) - all more important than an audacious gold heist in Turin.

Second, his impeccable taste in tailoring not only made him best-dressed man in ATypI (his French friend Roger Excoffon the closest contender), but also led to his saving the life of a young American type designer. Two decades ago, Dreyfus invited Steve Matteson and others to dinner in London, and noticing that jet-lagged Steve had forgotten to wear a jacket, loaned him a handsome cardigan to satisfy the dress code of the restaurant. As they walked along, Steve, while listening raptly to Dreyfus discuss Van Krimpen's Lutetia type, incautiously stepped into a street without looking right, to the direction of oncoming traffic in Britain. Just before Steve was run-over, Dreyfus grabbed the cardigan and yanked him back to safety. When Steve apologized for damage to the cardigan, Dreyfus just laughed and said he was glad he had the sense that someone might not be looking for cars. John Dreyfus passed away in December, 2002, mourned and remembered by his many friends and colleagues.

Charles Bigelow

Charles Bigelow is a MacArthur Foundation Prize fellow, former professor of digital typography at Stanford University and retired Melbert B. Cary, Jr. Professor of Graphic Arts at RIT.

Adrian Frutiger

1928 2015

Adrian Johann Frutiger was born on May 24, 1928 in Unterseen near Interlaken, where his father operated the Oberländer Webstube (a weaving shop in the same house where the family lived). His mother managed the household and raised one girl and three boys. Their house was near the railway station where Adrian studied mechanical operations. With his father's Jacquard loom, he studied the punched cards (forerunners of IBM computer cards) that controlled the weaving pattern of the loom. His youthful curiosity about mechanical and automated systems later helped him design typefaces for technological innovations like phototypesetting, optical character recognition, strike-on composers, and digital computer typesetting.

Of his roots in design, Adrian wrote, "In the Bernese Oberland a pictorial manner of expression became popular in the 19th century: the making of paper cutouts of silhouettes, cutting out scenes from their daily lives in black paper. I have always felt a reluctance to use black ink as a medium, preferring whenever possible to scratch, cut or engrave material."

Adrian wanted to become an artist, but his father said, "Learn a profession first and do what ever you wish afterwards." Adrian learned hand type composition at the local printer. As his final apprentice work, he wrote about the churches of the Lake of Thun, composed the text in type, illustrated it with his own woodcuts, and printed it as a booklet.

During 1949/1950 Adrian studied typography at the Kunstgewerbeschule Zürich (School of Arts and Crafts). He studied type history with Alfred Willimann and type and lettering design with Walter Käch, gaining deep feeling and expertise in the forms and proportions of letters. His final school project was a Leporello (accordion-fold) book entitled "Schrift/Lettering," which presented the development of European writing. He engraved it in nine wood blocks, a masterpiece that took nearly a year to complete and print. This book so impressed Charles Peignot that in 1952 Frutiger was hired by the Deberny & Peignot Type foundry in Paris.

Peignot employed Frutiger as artistic manager with the goal of producing high quality type designs (fonts) for the Lumitype-Photon, the first successful electro-optical photocomposition system. Adrian's first text type design was a French Latine-style seriffed face named Méridien. He followed it in 1957 with his famous sans-serif family, Univers, its proportions and spacing based on letter proportion of the Renaissance. Frutiger's unique concept of a complete spectrum of rationalized weights and widths, denoted by a universal numbering system instead of traditional, idiosyncratic style names, became world-famous and brought Adrian wide recognition by the age of 30. Later he founded his own studio with André Gürtler and Bruno Pfäffli near Paris 1961 and designed many more typefaces in various historical and modern styles. For several of them, he used the numerical style and weight designations and rationalized proportion system first devised for Univers.

Frutiger was Lecturer at the Ecole Estienne and at Ecole Nationale Supérieurs des Arts Décoratifs in Paris. He also found time to write *Der Mensch und seine Zeichen* (Signs and Symbols) a book about the history, design, and meaning of written symbols, originally published by Horst Heiderhoff. It has since been translated into nine languages. Frutiger also wrote some of the earliest articles for the Journal of Typographic Research.

He designed a sans-serif alphabet for the signage of the Charles de-Gaulle airport at Roissy near Paris and later developed it as a typeface for Linotype. Named "Frutiger," it soon became a type family of world-wide popularity. Admired for its legibility and subtle elegance, it is widely used in graphic design as well as in airport signage and way-finding graphics around the world.

Adrian was the acknowledged modern master of the sans-serif typeface genre, with his grotesque sans Univers, humanistic sans Frutiger, and geometric sans Avenir, all widely popular.

During his decades of work designing some 40 printing types, as well as logotypes, symbols, and signage systems, Adrian also worked on 'free form' engraving, sculpture, and drawing expressing universal themes of life, creation, and nature executed in wood, stone, or on paper.

Adrian Frutiger received many awards and honors, including the Gold Medal of the Type Directors Club of New York, the Frederic W. Goudy Award of RIT, The European Design Award, the Order of Arts and Letters of France, and the Gutenberg Prize of the City of Mainz. He is recognized as one of the greatest type designers of the 20th and early 21st centuries.

__ *Erich Alb*

Erich Alb is an intrepid world traveler, typographer, and editor who has published books by Adrian Frutiger, Hans Ed. Meier and René Groebli.

Jean Larcher

~~1947~~ 2015

Most typographers and calligraphers who know the work of Jean Larcher (1947–2015) will remember the masterful, intricate curves that he drew in a flourished Spencerian style. Probably the best 20th century French calligrapher in this hand, Larcher primarily focused on the expansion of calligraphy awareness across the world during his last years, through his demonstrations, workshops and talks.

In 2014 he expressed his lifetime of practice and achievement in a voluminous book that gathered together the sum of his calligraphic experience. *Traits de Caractère* ("Character traits", "Linien mit Charakter") is a 500-pages compilation of a varied multitude of calligraphic styles, mostly expressing short maxims and mottos as an excuse for calligraphic entertainment. If the shape of the exercise is far from being a novelty, one can gladly welcome it as a partial archive of his hand.

Larcher's calligraphy, like that seen in his magnum opus, is what most people will remember him for. A few will recall, however, his previous career that displayed the less settled, more energetic style he practiced during the 70s and 80s. The young and fierce Larcher was then a practitioner of optical art, fantastic alphabets, and geometrical patterns, which he published in several compendia through Dover Books. Also among his books of that era was a manifesto in the shape of a book, *Propositions pour une typographie nouvelle* ("About typography, for a new one", "Proposiciones para una tipografia nueva") (1976), in which he expressed his critical views about why the teaching of calligraphy and typography in France had declined in the 20th century.

Larcher's type designs in his early career were released by the now defunct phototypesetting firm Hollenstein. His constructed and fanciful alphabets bore odd names such as Crayon, Menhir and Guapo, and were miles away from his later classical calligraphic style. They show that as young man he was fascinated by the emerging graphic styles of North America that we dreamed of importing to France. His lettering work of the time was no different: colorful, cheeky, geometric.

His mature calligraphic styles, although radically different in manner and execution, were no less exuberant, and were executed with

dazzling skill. Let's remember their author as he was throughout his career: bright and witty, full of energy and passionate about his art, traits that shall now endure forever in his work.

__ *Jean-Baptiste Levée*

Jean-Baptiste Levée is a type designer, ATypI board member, and teacher at the Amiens school of Arts & Design and at the University of Corte.

Alexander S. Lawson

1912 2002

Alexander S. Lawson began his distinguished career as a teacher of the printing arts and a scholar of its history in the most humble manner possible. At the age of 16, he took a job as a copy-boy in New York City at the Hearst-owned *New York American* newspaper. His interest in printing technology led him to enter a printing apprenticeship program, where he was able to supplement his on-the-job training with evening classes in typography and design. He eventually earned a journeyman's license and employment as a compositor for the Guide Printing Company in Brooklyn. From 1941 to 1945, Lawson did a tour in the Navy, fully expecting to return to his old job at the end of the war. However, like so many other veterans, he decided instead to take advantage of the GI Bill and enrolled in the Printing and Publishing program at Rochester Institute of Technology in Rochester, NY. Within a few years, he had been appointed to the faculty and spent the rest of his career at RIT teaching typography, composition, and the history of type design.

Professor Lawson's appreciation for the printer's art was based as much on historical knowledge as it was on his intimate familiarity with the mechanics of type, composition, and the workings of a pressroom. He was proud to be considered a scholar of typeface history, but his real passion was teaching students who were preparing for careers in the graphic arts. In addition to the rote fundamentals of design and composition, Lawson encouraged his classes to do research on great typographers and early practitioners of printing. He established publication opportunities via a private press he named The Press of the Good Mountain, many of whose titles found their way into library collections throughout the country. He also founded *The Typographer*, a well-regarded student journal that provided his students with real-life experience in editing and production. In 1960, Lawson acquired an important collection of Frederic W. Goudy material from the widow of Howard Coggeshall, a printer in Utica, NY, and close friend of Goudy. The collection included archival material as well as the only surviving castings of the so-called "Lost Goudy Types" and helped inspire Lawson to study the history of type design even more deeply.

In looking back on his career, Alex Lawson considered his role in helping to acquire the rare book collection of New York City businessman

and printer Melbert B. Cary, Jr., for RIT in 1969 as his most important accomplishment. The collection numbered some 2,300 volumes and was rich in type specimens, printers' manuals, and the works of famous printers. With additional financial support provided by the Mary Flagler Cary Charitable Trust, Lawson was appointed that same year as the first Melbert B. Cary, Jr. Professor of Graphic Arts, a position he held until his retirement in 1977. He was now able to teach with actual examples of historic typography, and he relished the ability to share the landmarks of printing in the small reading room of the Cary Collection, located in the very center of RIT's School of Printing, surrounded by the machinery and technology of the modern day printing industry. Also with support of the Cary Trust, he established the Frederic W. Goudy Award, which brought distinguished typographers including Hermann Zapf, Adrian Frutiger, John Dreyfus, and others, to meet and speak to RIT students.

"After the opening of Cary," he once wrote, "I taught my class with the students sitting on the floor and passing around the books under discussion, even, Heaven help me, the [1499] Poliphilus! I once told Rollo Silver, who taught at Simmons for so many years, about that, and he was so delighted that he told every librarian he knew, adding that I let the book circulate."

If rare book curators winced when he told this story, Lawson was unapologetic. His students had been taught the value of the books they were examining and handled them accordingly. Years later, many of them, now commercial printers themselves, remembered those classes with reverence, appreciating the links they shared with craftsmen who had toiled five centuries earlier to produce works of enduring typography.

As an author, Lawson wrote widely read columns for trade journals, including an influential and long-running series for Printing Impressions on the history and development of typefaces. Later, he edited and expanded the best of these articles for the book *Anatomy of a Typeface*, published by David Godine in 1990. Other publications by Lawson include the much-reprinted *Printing Types: An Introduction* (1977), *100 Type Histories* (with Archie Provan, 1983), *The School of Printing, RIT; The First Half Century* (1987), and *The Compositor as Artist, Craftsman, and Tradesman* (1990). He also served on the original advisory board of the *Journal of Typographic Research* (*Visible Language*).

Lawson's reputation as a typeface scholar also brought him into contact with many type designers, most notably Hermann Zapf, whom he first met at a Typophiles luncheon in New York in the 1950s. Zapf welcomed his comments on the recently released Palatino type and credited Lawson with helping him to persuade the Stempel foundry to deviate from its awkward German baseline standard in the design of Optima. The two became close friends, and Zapf received the first annual Frederic W. Goudy Award from RIT in 1969. Lawson received the same award in 1979. After Lawson retired as Cary Professor in 1977, he recommended that Zapf succeed him,

leading to Zapf's own long-running relationship with the university. Years later, Hermann Zapf wrote a moving tribute to Lawson in which he said:

"You worked hard to prepare students for a changing industry and an era of computers just then appearing on the horizon . . . . You had a gentle way of teaching, guiding each student from his own imperfect solutions to the correct answers. You belonged to the most outstanding teachers and typographic personalities of the 20th century."

In Lawson's honor, RIT established the Alexander S. Lawson Publishing Center of the RIT Cary Graphic Arts Press in 2007.

David Pankow

David Pankow is Curator Emeritus, Cary Graphic Arts Collection of RIT.

Robert Hunter Middleton

1898 1985

Robert Hunter Middleton (1898–1985) was a modest company man who produced a prodigious range of typefaces in the mid-twentieth century for the Ludlow Typograph Company of Chicago. Since 2012, a few authoritative historical monographs and documentaries have celebrated the two dominant hot metal typecasting machines of his era: the Linotype and the Monotype. However, the story of their smaller but more enduring competitor, the Ludlow, remains to be told in detail. Any Ludlow history would be centered on the influence of Middleton, its type director for 40 years.

Bob Middleton immigrated to America from Scotland as a child with his family. In the early 1920s he studied printing and typographic arts with Ernst F. Detterer at the School of the Art Institute of Chicago. It was a curriculum that embraced the fine press ideals of William Morris and the attention to lettering arts pioneered by Edward Johnston, all in lively Chicago: the center of the American printing industry and home to venerable firms like R. R. Donnelly and The Inland Printer. Middleton assisted Detterer in completing drawings for the Ludlow typeface Eusebius, based on Nicholas Jenson's fifteenth century types. His work earned him a recommendation for a permanent post at Ludlow in 1923.

The Ludlow Typograph combined Linotype casting technology with the ease of setting typographic matrices by hand, instead of via a complex mechanical keyboard and matrix magazine schema. It was a relatively low-cost system that supplied constant quantities of fresh type and eliminated the need to redistribute. Ludlow became the favorite method for casting advertising and news headlines in large sizes, and as such, they made profits on selling matrices of new typefaces exclusive to the machine.

Middleton deftly catered to the advertising market by designing display types such as Delphian Open Title (1928), Karnak (1931), Umbra (1932), and Stencil (1937). He also created the popular script faces Mayfair Cursive (1932), Coronet (1937), and Flair (1941). His genius was most apparent in designing robust sans serifs in multiple weights, widths, and italics including the Record Gothic (1927/56), Tempo (1930), and Radiant (1938) families. Middleton's Stellar typeface in 1929 was an early humanist sans serif with classical proportions and subtly tapering stems—predating Hermann Zapf's Optima by 29 years. Not to be pigeonholed into any one style, Middleton's virtuosity also transferred to the design of a careful Ludlow revival in 1929 of Claude Garamond's original types. By 1971 when he retired, Bob Middleton had produced 98 successful typefaces of his own for Ludlow, while cultivating a diverse catalog of fonts from other designers for his firm.

Middleton's work as type director extended beyond Chicago as he was active in the typographic milieu of the era through AIGA, The Society of Typographic Arts, The Chicago Caxton Club, and the International Association of Printing House Craftsmen. He worked beside Herbert Bayer in his quiet fashion to launch the International Design Conference in Aspen in 1951 and with Charles Peignot as a founding member of ATypI in 1957. He earned accolades and awards internationally, including the 1968 Type Directors Club Medal and the 1971 RIT Goudy Award for Typographic Excellence.

After retirement Middleton concentrated on private press pursuits at his Cherryburn Press. There he labored on printing a collection of historic wood engravings made by Thomas Bewick (1753–1828). Middleton had acquired the blocks inexpensively when heirs unloaded them during the war-torn 1940s. He devised a method of meticulous packing on his Washington handpress that brought forth the tiniest details in the prints from the vintage engravings—hitherto unseen in previous publications. This culminated in 1970 with his publication of an impressive portfolio of 100 Bewick prints and subsequent of donation of his Bewick artifacts to the Newberry Library of Chicago that also now holds his personal archive.

"His work, like the man himself, is never flamboyant, and always good," wrote James Wells, Curator Emeritus of the John M. Wing Foundation of the History of Printing at the Newberry Library. Perhaps Robert Hunter Middleton was the quintessential personification of that crystal goblet in the classic typography parable.

Amelia Hugill-Fontanel

Amelia Hugill-Fontanel is Associate Curator of the Cary Graphic Arts Collection , RIT.

Willem Ovink

1912 1984

Gerrit Willem Ovink was born on October 22 in 1912 in the city of Leiden. His father was a teacher of classic languages who later became professor of philosophy at the University of Utrecht. Ovink attended grammar school in Utrecht and studied art history and philosophy at the same university.

In 1938 he received his doctorate in psychology with his thesis entitled *Legibility, atmosphere-value and forms of printing types.* This was the first scientific publication in the Netherlands on the subject of legibility. He reviewed theories of legibility and methods of defining and measuring it and experimentally studied the recognizability of sans-serif single letters, the effects of typeface weight, stroke-thickness, and letter shape on visibility of display typefaces, and the legibility of words and lines.

A second and important part of his thesis was on "atmosphere-value" of typefaces, a major contribution to the study of semantics, emotional effects, and congeniality of type designs. Most subsequent papers and theses on these topics cite Ovink's thesis. [cf. Dirk Wendt, *Journal of Typographic Research*, 1968].

For his research, Ovink visited Sjoerd de Roos, an internationally recognized Dutch book and type designer who was curator of Typefoundry Tetterode's "Typografische Bibliotheek" (typographic library), which contained some 5,000 technical books on typography and printing and 1,800 books on design and typeface catalogues, along with 17,000 objects related to graphic arts, including a large collection of type and matrices.

In June 1945, Ovink was appointed as aesthetic adviser for Typefoundry Tetterode in Amsterdam, but as he was also needed by the Dutch government, he worked part-time for the company and part time for the Ministry of Defence in The Hague, creating a personnel ranking and profiling system based on physical and mental condition.

In 1948 Ovink became curator of the Tetterode typography library and increased the collection by 300 to 400 books annually. In 1971 he arranged the transfer of the library to the University of Amsterdam's library "Bijzondere Collecties" or "Special Collections".

Ovink himself did not design fonts, but he assisted designers with development of typefaces of interest to Dutch and international customers. Among the typefaces (and designers) he assisted were Columbia, Flambard (Dolf Overbeek), Hadassah (Henri Friedlaender), Lectura (Dick Dooijes), Mercator (Dick Dooijes), Orator (Leonard H.D. Smit), Pascal (José Mendoza y Almeida), Promotor (Leonard H.D. Smit), and Raffia (Henk Krijger).

Ovink wrote hundreds of articles on type and typography and was a columnist and editor for the magazine Intergrafia as well as a founder

and managing editor of the English-language typography journal Quærendo, to which he contributed reviews and articles, including in 1979 "From Fournier to metric, and from lead to film", a masterful study of typographic measurement and standardization. He also wrote articles for Tetterode's in-house magazine and for several graphic arts periodicals. His tantalizing 1958 essay on "Dutch Chocolate Letters" is a perennial favourite, and his 1966 essay, "Some notes on the history of perfume types" continued his thesis study of atmosphere-value into the realm of olfaction and luxury. He was a member of the original editorial board of *The Journal of Typographic Research* to which he also contributed articles. He wrote several books on type and the history of publishing houses and printers. In 1951, the year Tetterode celebrated its centennial anniversary, he wrote a monograph "A Hundred Years of Type Foundries in Amsterdam".

In 1952 he visited the USA to give presentations on European typography and the Tetterode typefaces. The trip was arranged by Continental Type in New York, a subsidiary of Tetterode.

In 1956 Ovink was appointed to a Personal Professorship on "The History of Printing Aesthetics" at the University of Amsterdam UvA. A few years later his professorship was turned into an Extraordinary Chair.

Ovink was an early member of ATypI (Association Typographique Internationale) and joined their committee on legibility research in 1967. He was not only a talented writer but also a gifted public speaker and gave numerous lectures in the nineteen fifties, sixties and seventies on typography, book design and type in Belgium, France, Germany, the UK and the Scandinavian countries.

Ovink retired from Tetterode in 1977 and from the university in 1982. In 1983 he was awarded the prestigious Gutenberg Prize in Mainz. Sadly on February 8 1984, just a few months later, he died.

Footnotes: Tetterode, with subsidiaries in both Europe and Asia, was a typefoundry and a dealer organization distributing hot metal typesetters, printing presses, bindery equipment, and supplies for letterpress, gravure and offset printers.The design and engraving of type was discontinued in the nineteen seventies followed by the discontinuation of type casting in 1988. The legal rights for Tetterode typefaces were acquired by Linotype/Monotype.

Although Tetterode no longer exists, the Tetterode Collection library survives as part of the "Special Collections" at the UVA University of Amsterdam library, one of the largest known specialized institutes on type design history. The majority of the books and articles Ovink wrote together with all of Tetterode's typeface designs are in this library.

www.bijzonderecollecties.uva.nl/en

__ *Henk Gianotten*

Henk Gianotten, a former student of G. W. Ovink, worked at Typefoundry Amsterdam Tetterode for four decades, and continues to consult and write on topics in typography and type.

John W. Seybold

1916 2004

John W. Seybold has been called the father of computer typesetting, but he could more properly be called it's godfather, in the traditional sense of the word, a person who helps in a child's upbringing and development. He helped computer typesetting grow from tentative commercial acceptance to industry dominance. He began as an economist but became a publisher, author, and consultant. His own early research into the new technologies led to his lasting influence in the industry.

Perhaps more than anyone else of his era, he was cognizant not only of the technical and commercial aspects of computer technology in printing, but also of its ramifications in publishing, labor relations, society, and literacy. In the early days of desktop publishing, he remarked that it would cause more people to learn about fonts, serifs points, picas, and typography than at any previous time in literate history.

The son of school teachers, Seybold was born in Indiana in 1916 and raised in Ohio. He attended Swarthmore college in Pennsylvania, majoring in economics and graduating in 1936. He worked as an economist for the New Deal WPA and taught economics at Olivet and Swarthmore colleges, while pursuing graduate studies at the University of Pennsylvania. During WWII he served as an economist on the National War Labor Board. After the war, he became Director of Industrial Relation for the Printing Industries of Philadelphia. As a negotiator between printing firms and unions, he was regarded as an "honest broker" by both sides and was often appointed as an impartial arbitrator in union/management disputes.

As offset lithography replaced letterpress printing, and photo-typesetting replaced hot-metal typesetting, Seybold saw that vast increases in typesetting efficiency could be gained from computerized text processing coupled with computer-driven photo-electronic composition. Predicting that these technologies would become the future of publishing, in 1963 he founded a firm called Rocappi (Research on Computer Applications in the Printing and Publishing Industries), the first company to embrace the whole process of computing in the editing, manipulating and formatting of text to produce "commercial quality" published materials.

Seybold's 1968 article in *Visible Language* (then called the *Journal of Typographic Research*), "Esthetic Values in Computerized Photo-composition," analyzed the complex decision-making of skilled typesetters, compared the artisan to automation, and predicted that computers would ultimately master high quality text composition. He was right — today it can be done on smart phones. The following article in that same issue was by Hermann Zapf on "The Changes in Letterforms Due to Technical Developments." Two prescient views of the future.

In 1971, Seybold founded The Seybold Report, which became a widely respected and influential newsletter for the publishing industry, then transitioning from analog to digital technology. As a consultant, he advised companies ranging from typesetting equipment manufacturers to printers to magazine publishers. In 1972, he persuaded U.S. News & World Report to be the first customer for a computerized editorial and production system invented by Atex, a recent garage start-up by M.I.T. graduates. Atex became a dominant maker of computer composition systems for magazines and newspapers. Seybold, an enthusiast as well as a critical journalist, continued to influence the adoption of publishing technology through the 1970s and into the 1980s. His books surveying the field were written for editors, writers, and publishers as well as printing professionals. In his last book, The World of Digital Typesetting (1984), he pays attention to "the preparation of information which possibly will never be produced on a printing press, although it will indeed be published by means of some kind of imaging engine." In the same book, he uses a term he coined, "What You See Is What You Get" (WYSIWYG) to describe on-screen text that matches the layout and style of what will be printed.

Those who worked with John Seybold understood that his achievements and influence derived from more than his vast knowledge and hard work. He was a perceptive critic, an articulate speaker, a persuasive negotiator, a fair judge, a wise counselor, and congenial company. In short, people trusted him, and they were not disappointed.

— *Charles Bigelow*

Charles Bigelow is a MacArthur Foundation Prize fellow, former professor of digital typography at Stanford University and retired Melbert B. Cary, Jr. Professor of Graphic Arts at RIT.

Miles A. Tinker

1893 1977

Miles A. Tinker was the foremost American legibility researcher in the first half of the 20th century and probably the most prolific of the entire century. After military service in World War I, he received his B.A. in 1921 and his M.A. in 1922 from Clark University in Massachusetts. At Stanford University, his 1927 psychology dissertation was "An Experimental study of legibility, perception, and eye movement in the reading of formulae".

As a professor of psychology at the University of Minnesota from 1927 to 1959, Tinker continued to research legibility while teaching a broad range of

psychology courses including experimental methods, history of psychology, and the psychology of sensation and perception. He served as the major or joint advisor for 24 Ph.D.'s and 24 M.A.'s, while, over a forty year period, publishing more than 100 papers and books on psychology, reading, and legibility, often in collaboration with his Minnesota colleague, Donald G. Paterson.

Tinker's work was uniformly experimental and quantitative. In dozens of studies of reading involving more than thirty thousand readers, Tinker and Paterson measured the effects of physical variations in type size, type style, line width, line spacing, and combinations of these factors, including the spatial arrangement of text on the page: paragraphing, page margins, single versus double column text, and column separations. They studied the effects on legibility of color of ink and paper and also of paper texture and surface gloss. Newspaper legibility and the readability of mathematical formulas and tables were further areas of investigation, as was reading under ambient conditions, such as illumination and light sources, angle of page to the reader's eye, and page vibration.

Tinker compared and evaluated several different methods of measuring legibility, including eye movements, visibility through filters, recognition at a distance, degrees of focus and blur, short exposures, eye blink rates, visual fatigue, reader opinions, and speed of reading. This last, speed of reading, was Tinker's preferred measure and influenced subsequent studies of reading and legibility. A later reading researcher, Gordon E. Legge, in *Psychophysics of Reading in Normal and Low Vision* (2007), cited a series of thirteen classic and influential papers by Tinker and Paterson on factors influencing speed of reading.

With Patterson, Tinker wrote *How to Make Type Readable: A Manual for Typographers, Printers and Advertisers* (Harper & Bros, 1940), based on the authors' twelve years of research and reading tests given to 33,000 persons. Tinker's best known and most influential book is *Legibility of Print* (Iowa State University Press, 1963), which summarizes his and Paterson's scientific research over more than three decades. That book was followed by his *Bases for Effective Reading* (University of Minnesota Press, 1965), written for educators, publishers, parents, and the general public interested in reading about reading. From his decades of scientific research, Tinker describes the general process of reading and methods for improving reading ease and efficiency.

Professor Tinker was a Fellow of the American Psychological Association, a Fellow in Distinguished Service Foundation of Optometry, and he received a Citation of Merit from the International Reading Association. He was a member of the original editorial board of the *Journal of Typographic Research* (later *Visible Language*) beginning in 1967.

__ *Charles Bigelow*

Charles Bigelow is a MacArthur Foundation Prize fellow, former professor of digital typography at Stanford University and retired Melbert B. Cary, Jr. Professor of Graphic Arts at RIT.

Merald Wrolstad

1923 1987

The ties between the alphabet, literacy, and typography were essential for Merald Wrolstad, the founder, first editor and publisher of *The Journal of Typographic Research* (later *Visible Language*). In 1967, he was armed with a Ph.D. in Typography from the University of Wyoming and recognized the need for more substantial investigation of letterform design, research into reading and writing, and creative use of visible language. He was frustrated by linguists' exclusive focus on the auditory nature of language. His mission was to provide the visible nature of language as a counterbalance.

Merald designed communications for the Cleveland Museum of Art and had the opportunity to travel for them. In this context he was able to easily develop international connections. I suspect his role at the Museum didn't exhaust his intellectual curiosity or skills. This and a devoted wife gave him the mental space with which to undertake the daunting task of launching a new journal.

It took optimism to begin a scholarly journal in a largely apprentice-based skill in which learning is predicated on doing, and doing again, and again to refine letterform. This seemed to miss the scholarly point, because it was about visual acuity, a system of forms, attention to negative spaces, and tacit knowledge. Further, Merald never intended the journal to be a how-to manual, he went beyond this to open the journal to scientific study, encouraging objective investigation of legibility and readability, learning to read and write, and more.

His approach to the journal was holistic with regard to content, open to controversial ideas yet careful about the peer review process. The journal size (6 by 9 inches) was a homage to Aldus Manutius, a late fifteenth century scholar and publisher who wanted to popularize print. This historic format proved to be practical and economical even today. Many issues were typographic experiments; he resisted the staid and predictable visual presentation of typical journals. He wanted to explore the visible language of the journal practically as itself. Merald knew his typographic history and he understood the processes of science. He reveled in esoteric information and was a valued resource for authors before google. Always willing to think with you, he could often point the way.

Editing an interdisciplinary journal requires the editor to have broad scholarly connections. In this Merald was no exception. His warm, gregarious character drew people to him. He knew linguists, typographic designers, poets, educators, perceptual psychologists, historians—the list could go on. If his immediate contact was not the right reviewer, he or she could often suggest someone else until an appropriate reviewer appeared.

The interdisciplinary nature of some articles posed a real challenge for Merald who relished the search for reviewers and its resolution because it was essential to maintain the quality of the journal. A calligrapher and friend, Gunnlaugur SE Briem (1987, 4) stated, "His private network spanned the globe. He knew statisticians and visionaries, scientists and typographers, flat-earthers, scholars, alchemists and conspiracy theorists, and was kinder to most of them than they deserved. Everybody who mattered in his field knew him and any lunatic with an idea got a hearing."

Visible Language was Merald's obsession, it was a kind of open-ended uncertainty he hungered to develop. Colin Banks, a British communication designer and Merald's friend, appreciated that he united science and the humanities in the journal. Colin quoted Merald in 1971 when the journal was changing its name (1987, 10): "Typographic research has become a label that has to be stretched; visible language is a concept that remains to be fulfilled."

And fulfill it he did. Merald was a risk-taker in starting and privately funding the journal. He pursued his own curiosity and learning about visible language and in the process enriched many lives. He didn't write very much but promoted the scholarship of others as he sought to round out an understanding of the many aspects of visible language. Apart from the journal, he co-edited (with Paul Kolers and Herman Bouma) the two-volumes of *Processing of Visible Language*, which brought together influential papers on the psychology, design, and engineering of literacy. A generous spirit, he led a multidimensional life—from his experience as an airman flying P-51 Mustangs over Italy in WWII to his devotion to scholarship, from his aesthetic delight in letterforms to his insistence on statistical goodness, to say nothing of the many friendships he sustained. He was a man for all seasons.

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— *Sharon Poggenpohl*
Sharon Poggenpohl is the successor to Merald Wrolstad and Editor Emeritus of Visible Language.

Hermann Zapf

1918 2015

Hermann Zapf was born in 1918 in Nuremberg, Germany. As a teenager, he aspired to study electrical engineering but was prevented by the Nazi regime. Instead, he apprenticed as a photo-retoucher, and after seeing an exhibition of the work of Rudolf Koch, renowned German calligrapher and type designer, he taught himself calligraphy from Koch's manual *Das Schreiben als Kunstfertigkeit* and Edward Johnston's manual, *Writing, Lettering, and Illuminating.*

After his apprenticeship, Zapf worked at typography and calligraphy in the Frankfort studio of Paul Koch, Rudolf's son. Conscripted into the German army, he served as a mapmaker. After the war, he worked for the D. Stempel foundry in Frankfort. He also designed books for several notable publishing companies and designed typefaces. Today, he is most widely known for his many typeface designs, including Palatino, Melior, Optima and other faces for Stempel and Linotype, and for Zapf Chancery and Zapf Dingbats (among others) for the International Typeface Corporation.

Millions of items have been set in Zapf typefaces over the 60 years. The vast majority of magazines using Latin alphabets most likely will contain at least one or two ads in a Zapf typeface. The Viet Nam War Memorial in Washington, D.C., visited by over 4 million people a year, has the 58,282 names etched in Zapf's Optima capitals. Today, most popular personal computers offer some Hermann Zapf typefaces, from Aldus to Zapfino.

Zapf made many friends in the US, including calligrapher Paul Standard, an early supporter, and typographer Jack Stauffacher, who in 1960 brought Zapf as a visiting teacher to the Carnegie Institute (now Carnegie Mellon University) in Pittsburgh. There, Stauffacher arranged for Zapf to design a special "private press" typeface, Hunt Roman, cast by the Stempel foundry, to be the exclusive face of the Hunt Botanical Library at Carnegie.

In the 1970s, Zapf devoted more time to teaching, both in Darmstadt (1972–81) and at the Rochester Institute of Technology (RIT) in New York, where he was appointed Melbert B. Cary, Jr., Professor of Graphic Arts in 1977. After one year, however, Zapf found the Rochester winter uncongenial but arranged to teach summer courses in calligraphy and computer typography. The classes filled quickly. I was number 12 on the waiting list, but then Zapf decided to let in everyone who applied, and so 48 people attended his first summer courses. In that first class were Kris Holmes, John Neal, Julian Waters, and Charles Bigelow. Kris summed up the way we all felt about Zapf: "He was not only a brilliant designer, he was one of the most generous and kindest people I have ever known." Zapf was kind enough to serve on the *Visible Language* Advisory Board.

It was an amazing time for many of us. The classes continued until 1987. Over those years, Georgia Deaver, John Stevens, Larry & Marsha Brady, and many other American calligraphers and type designers studied with Zapf.

Many books have been written on Hermann Zapf the artist (I've written a few of them myself), but I wish to add a few words about Hermann Zapf the man. He did so much for so many of us so often that it is impossible to summarize this generosity. On innumerable occasions I watched him stop everything he was doing to devote his entire efforts to helping anyone who asked for help, from great practitioners to total beginners. When you spoke with him, he gave you his complete attention and all the time in the world, as if he had nothing more important than to attend to your questions, when in fact he had a busier schedule than just about anybody.

Zapf received numerous awards and honors during his lifetime, including the Frederic W. Goudy Award from RIT; the Gold Medal from AIGA (American Institute of graphic Artists); the Gutenberg Award of the City of Mainz; an Honorary Doctorate from the University of Illinois / Urbana-Champaign; and the Order of Merit of the Federal Republic of Germany.

It is difficult to sum up such an enormously important figure in the history of the letter arts in a few paragraphs. Whenever I had to explain it to someone unfamiliar with calligraphy and type design, I would simply say that what Beethoven was to music or Michelangelo to sculpture, that is what Hermann Zapf was to the letter arts: few will equal him, and none will ever exceed his achievement in his chosen art.

I am hardly alone in praising Zapf. Here is what some others have written about him:

Andreas Weber (German communication expert):
"[H]e himself never became self-absorbed or condescending. Well into his old age, Hermann Zapf actively sought contact with others, particularly young and struggling individuals, who he would listen to, speak with, help, assist and encourage."

Sebastian Lester (British lettering artist):
"He leaves a monumental legacy. He was a giant in the fields of both type design and calligraphy. It takes extraordinary talent to work at the highest level in either area of letterform design but to be a true master and innovator in both is unheard of. It is Zapf's versatility with letterforms, and his profound virtuosity as a calligrapher, that establish him as one of the greatest ever."

Robert Bringhurst (author of *The Elements of Typographic Style*):
"The greatest type designer of our time, and very possibly the greatest type designer of all time...."

— *Jerry Kelly*
Jerry Kelly is a book designer, calligrapher, printer and type designer in New York City. He studied with, and has written books on, Hermann Zapf.

Top 50 typography books of the last 50 years

A broad group of type experts and aficionados voted in May of 2016 on the best typography books written since the start of *Visible Language* in 1967.

1 Bringhurst, R. (1992). *The elements of typographic style*. Vancouver: Hartley & Marks.

2 Smeijers, F. (1996). *Counterpunch: making type in the sixteenth century, designing typefaces now*. London: Hyphen Press.

3 Kinross, R. (1992). *Modern typography: an essay in critical history*. London: Hyphen Press.

4 Frutiger, A. (1978). *Der Mensch und seine Zeichen*. Echzell: Horst Heiderhoff Verlag.

Frutiger, A. (1989). *Signs and symbols: their design and meaning* (A. Bluhm, trans.). New York: Van Nostrand Reinhold.

5 Tracy, W. (1985). *Letters of credit: a view of type design*. London: Gordon Fraser.

6 Hochuli, J. (2008). *Detail in typography: letters, letterspacing, words, wordspacing, lines, linespacing, columns*. London: Hyphen Press.

7 Tschichold, J. (1975). *Ausgewählte Aufsätze über Fragen der Gestalt des Buches und der Typographie*. Basel: Birkhäuser.

Tschichold, J. (1991). *The form of the book: essays on the morality of good design* (H. Hadeler, trans.). Vancouver: Hartley & Marks.

8 Noordzij, G. (1985). *De streek: theorie van het schrift*. Zaltbommel: Van de Garde.

Noordzij, G. (2005). *The Stroke: theory of writing* (P. Enneson, trans.). London: Hyphen Press.

9 Ruder, E. (1967). *Typographie: ein Gestaltungslehrbuch (Typography; a manual of design*, D.Q. Stephenson trans.; *Typographie: un manuel de creation*, Madeleine Wolf, trans.). Teufen: Verlag Arthur Niggli.

10 Zapf, H. (1987). *Hermann Zapf & his design philosophy: selected articles and lectures on calligraphy and contemporary developments in type design, with illustrations and bibliographical notes, and a complete list of his typefaces*. Chicago: Society of Typographic Arts.

11 Spiekermann, E., & Ginger, E. M. (1993). *Stop stealing sheep and find out how type works*. Mountain View, CA: Adobe Press.

12 Unger, G. (1997). *Terwijl je leest*. Amsterdam: De Buitenkant.

Unger, G. (2007). *While you're reading*. New York: Mark Batty Publisher.

13 Knuth, D. E. (1986). *Computers & typesetting*, 5 vols. Reading, MA: Addison-Wesley.

14 Cheng, K. (2005). *Designing type*. London: Laurence King Publishing.

15 Lupton, E. (2004). *Thinking with type*. London: Laurence King Publishers.

16 Müller-Brockmann, J. (1981). *Rastersysteme für die visuelle Gestaltung: Ein Handbuch für Grafiker, Typografen und Ausstellungsgestalter*. Niederteufen: Verlag Arthur Niggli.

Müller-Brockmann, J. (1981). *Grid systems in graphic design: a visual communication manual for graphic designers, typographers and three dimensional designers*. New York: Hastings House.

17 Catich, E. M. (1968). *The origin of the serif*. St. Ambrose College, Iowa: Catfish Press..

18 Knuth, D. E. (1979). *TEX and METAFONT: New directions in typesetting*. Bedford, MA: American Mathematical Society.

19 Carter, H. G. (1969). *A view of early typography up to about 1600*. Oxford: Clarendon Press. (Reprinted in 2002 with introduction by James Mosley, London: Hyphen Press).

20 Willberg, H. P., & Forssman, F. (1997). *Lesetypografie* [Read typography]. Mainz: Hermann Schmidt.

21 Martín, J. L. (2008). *Ricard Giralt Miracle: el diálogo entre la tipografía y el diseño gráfico* [Ricardo Giralt Miracle: dialog between typography and graphic design]. València: Campgràfic.

22 Berry, J. D. (Ed.) (2002). *Language culture type: international type design in the age of unicode*. New York: Association Typographique Internationale.

23 Martín, J., & Mas, M. (2001). *Manual de tipografía: del plomo a la era digital* [Manual of typography: lead to the digital age]. València: Campgràfic.

24 Haralambous, Y. (2004). *Fontes & codages*. Paris: O'Reilly.

Haralambous, Y. (2007). *Fonts & encodings* (P.S. Horne, trans.). Sebastapol, CA: O'Reilly.

25 Henestrosa, C., Meseguer, L., & Scaglione, J. (2012). *Cómo crear tipografías: del boceto a la pantalla* [How to create fonts: from sketch to screen]. Madrid: Tipo E.

26 Mosley, J. (1999). *The nymph and the grot: the revival of the sanserif letter*. London: Friends of the St Bride Printing Library.

27 Ahrens, T., & Magikura, S. (2014). *Size-specific adjustments to type designs*. Munich: Just Another Foundry.

28 Hochuli, J., & Kinross, R. (1996). *Designing books: practice and theory*. London: Hyphen Press.

29 Bigelow, C., Duensing, P. H., & Gentry, L. (1988). *Fine Print on type: the best of Fine Print magazine on type and typography*. San Francisco: Fine Print/Bedford Arts.

30 Osterer, H., & Stamm, P. (2008). *Adrian Frutiger–Typefaces: the complete works*. Basel: Birkhäuser.

31 Legge, G. E. (2007). *Psychophysics of reading in normal and low vision*. Mahwah, NJ: Lawrence Erlbaum Associates.

32 Highsmith, C. (2012). *Inside Paragraphs: typographic fundamentals*. Boston: The Font Bureau.

33 De Buen Unna, J. (2000). *Manual de diseño editorial* [Publishing design manual]. México: Santillana.

34 Middendorp, J. (2004). *Dutch type*. Rotterdam: 010 Publishers.

35 Burke, C. (1998). *Paul Renner: the art of typography*. London: Hyphen Press.

36 Jaspert, W. P., Berry, W. T., & Johnson, A. F. (2008). *Encyclopaedia of type faces: 5th Edition*. London: Cassell.

37 Twyman, M. (1970). *Printing 1770-1970: an illustrated history of its development and uses in England*. London: Eyre & Spottiswoode.

38 Young, D. (1999). *Fonts & logos: font analysis, logotype design, typography, type comparison, and history*. Sherman Oaks, CA: Delphi Press.

39 Blackwell, L. (1992). *Twentieth-century type*. London: Laurence King Publishing.

40 Kinross, R. (2002). *Unjustified texts: perspectives on typography*. London: Hyphen Press.

41 Rayner, K., Pollatsek, A., Ashby, J., & Clifton Jr, C. (2012). *Psychology of reading*. New York: Psychology Press.

42 Daniels, P. T., & Bright, W. (1996). *The world's writing systems*. Oxford: Oxford University Press.

43 McLean, R. (1980). *The Thames & Hudson manual of typography*. London: Thames and Hudson.

44 Southall, R. (2005). *Printer's type in the twentieth century: manufacturing and design methods*. London: British Library.

45 Noordzij, G. (2000). *Letterletter: an inconsistent collection of tentative theories that do not claim any other authority than that of common sense*. Vancouver: Hartley & Marks.

46 Baines, P., & Haslam, A. (2002). *Type and typography*. London: Laurence King Publishing.

47 Corbeto, A. (2011). *Tipos de imprenta en España* [Types of printing in Spain]. València: Campgràfic.

48 Aicher, O. (1988). *Typografie* [Typography]. Berlin: Ernst.

49 Caflisch, M. (2003). *Schriftanalysen: Untersuchungen zur Geschichte typografischer Schriften* [Font analysis: studies on the history of typographic fonts]. St. Gallen: Typotron.

50 Eisenstein, E. L. (1979). *The printing press as an agent of change: communications and cultural transformations in early-modern Europe*, 2 vols. Cambridge: Cambridge University Press.

the following articles are not special issue topics but are general interest articles previously submitted to *Visible Language*.

Ed.

Book history scholarship: creation, transmission of knowledge and archives

Danné Ojeda and Mathieu Lommen

Abstract

This text takes the form of a conversation between Danné Ojeda and Mathieu Lommen with a preliminary introduction by Danné referring to book history and the history of reading. The talk took place on 14 May 2014, in the Special Collections (Bijzondere Collecties), that house medieval manuscripts, books, prints, among other heritage materials in the University of Amsterdam, The Netherlands.

Through the introduction and the following conversation, we will examine books' materiality and form as they define both the history of the book from its infancy and that of reading. The former will help us to understand how books have influenced not only thinking but also human ergonomic behavior towards these artifacts. The text also highlights the development of book forms by examining why certain transformations or deviations to the traditional book form took place and their impact on the history of book development and reading. This is in order to ascertain the consequences of the book's physical transformation on the reader's use and appreciation of it as a ***b**asic **o**bject **o**f **k**nowledge*. In this regard, first the introductory text offers a succinct overview of the changes and transformations of the book's physical forms. Second, the conversation focuses on the Special Collection of the University of Amsterdam in order to expose the criteria, guidelines, and parameters which classify a book as a "collectable object", to be archived for the preservation of a record of the history of books and their forms.

Key words:

Book definition; knowledge creation; knowledge transmission; book archives; designer as author; History of book and history of reading.

When writers die they become books, which is, after all,

not too bad an incarnation.

Jorge Luis Borges

Introduction by Danné Ojeda

Books are artifacts that communicate and preserve a specific kind of human knowledge; they are time capsules that survive in myriad formats, materials, and platforms. David Pearson calls them *emblems of our culture* while regarding them "as one of the defining characteristics of developed civilizations" (Pearson, 2012, 7). History provides compelling examples of the significance of books as empowering artifacts that transmit knowledge whereby the burning of books flares angrily as an exercise of power to erase political, cultural, or religious dissent. We might recall the Qin Shi Huang Dynasty who in 213 BC ruled the burning of any book that excluded subjects such as agriculture and medicine; the annihilation of Maya codices deemed heretical by Fray Diego de Landa in the sixteenth century; and the destruction of Jewish texts in 1933, as they were considered disobedient to the Nazi idea of Nation. The complete destruction of libraries during the last century remains scorched into our memory: the Jaffna Public Library in Sri Lanka, the National and University Library of Bosnia and Herzegovina, the Iraq National Library and Archive, Al-Awqaf Library in Baghdad, and the Saeh Library in Tripoli, Libya, are *emblems of culture* that have recently been reduced to ashes.

These events occurred as a book's content is generally perceived as the carrier of unorthodox thinking. Leslie Howsam notes, however, that the book is not only a *text* — a point of interpretation between authors and readers — but also *a material object*. He also remarks how this latter quality is frequently overlooked as a result of the power of the former and signals its importance as follows:

> '...the book-as-object holds the evidence of its own making; it carries not only the obvious text on pages but a further "text" in its formats, materials, design and impression... Such design elements are sometimes called the 'paratext', a useful concept introduced by the literary theorist Gérard Genette. Paratextual elements (bindings, blurbs, design, and so forth) supplied by editors and publishers can affect the meaning of the text... It is the combination of textuality and materiality, perhaps unique among human-made artefacts, that gives the book its power to convey a sense of its past.'
> (Howsam, 2015, 4)

In this text we will examine books' materiality and form with its paratextual elements, as they define both the history of the book from its infancy and that of reading. The former will help us to understand how books have influenced not only thinking but also human ergonomic behavior towards these artifacts. Danné Ojeda will look into the development of book forms by examining why certain transformations or deviations to the traditional form took place and their impact on the history of book development and reading. This is in order to ascertain the consequences of the book's physical transformation on the reader's use and appreciation of it as a ***b**asic **o**bject **of** **k**nowledge*. Following this line of thought, Danné will first offer a succinct overview of the changes and transformations of the book's physical forms. Second, she will focus on the Special Collection of the University of Amsterdam — which hosts an extensive archive of historical printed books — and converse with the design historian and curator Mathieu Lommen, in order to define the criteria, guidelines, and parameters which classify a book as a "'collectable object'", to be sheltered and archived in order to preserve a record of the history of books and their forms.

Pearson states that the book form as we know it "emerged in the Near East in the first centuries AD" with the appearance of the first codex (Pearson, 2012, 34). Codices were usually made of papyrus, and they almost immediately began to substitute the scroll, which was the common written format of the time. It was the codex's ease of reading that established its spread; the scroll had to be rolled upwards and downwards with both hands, in a fashion similar to that of a computer screen's scroll function today. The reader had access to a fragment of the scroll's information, but was unable to visualize it in its totality. The codex amply overcame this impediment by allowing the reader to have a better sense of the content as a whole. It also made browsing easier and allowed the possibility of cross reference. Codices grew in number of leaves and size, enabling a vast amount of information to be stored, while parchment or vellum progressively replaced papyrus.

When looking at the book as object from the viewpoint of the history of reading, Robert Escarpit defines it as a "reading machine" (Escarpit, 1968, 15). Alejandro E. Parada adds that the book is indeed a machine, a maker of different readers based on a textual script (Parada, 2010, 95). Alternatively, in the same decade, Alberto Manguel referred to the book as the result of the evolution of formats that have been adapted to their intended use: reading (Manguel, 1996, 125). This reminds us of the maxim "*Form follows function*", a Modernist principle and almost a manifesto that defined "good design"[1].

1 Form follows function is a well-known principle associated with Modernist design and architecture in the twentieth century. Many designers have adopted this way of doing as a mantra. For example, Dieter Rams revealed in his Ten Principles of Good Design: "Good Design Makes A Product Understandable: It clarifies the product's structure. Better still, it can make the product clearly express its function by making use of the user's intuition. At best, it is self-explanatory." See Rosenfield, Karissa. 2012. Dieter Rams Ten Principles of "Good Design". http://www.archdally.com/198583/dieter-rams-10-principles-of-%25e2%2580%259cgood-design%25e2%2580%259d (Accessed December 31, 2015).

The incunable: the infancy of book forms

The increasing use of paper for writing between the tenth and twelve centuries, together with the advent of printing around 1440–50, gave the final impulse to the production of current book forms. The invention of the printing press by Johannes Gutenberg — born in Mainz, Germany — triggered the mass production of books in a magnitude never before seen. These first printed books, produced before 1501, were called incunables[2] as Nicole Howard explains in her timeline drawn in *The Book. The Life Story of a Technology*. Transitional forms produced in this period of the infancy of the book were intermediate versions between the manuscript and the book format as we know it today. Their pages served as an experimental platform on which to examine different printing and letterpress techniques and to test new materials and sizes that would define the physical form of books in the years to come. Although printed with movable metal type, one of the most visible characteristics of the incunables was their fondness of handwritten letterforms, and they may therefore be regarded as manifestations of a longing for the continuation of what I call "the canon of handwritten culture" inherited to date in books that passed on the trace of physical human presence or, indeed, its absence: ink strokes, amended errors in rubrications, columns, and marginal notes. Hence, I consider the *incunabula* to be perhaps one of the last unconscious and sustained tributes to centuries of handwriting practice.

"The age of the printed word"

The sixteenth century became "the age of the printed word". However, the physical form of the book inspired by the historical codex form, has remained largely intact thanks to its functionality until today.

Post-incunable transformations of the book form were mainly manifested in diverse typographical applications to improve legibility, as well as in the page layout and subsequent changes in technology.[3] David J. Shaw notes how there was an increased specialization visible though book making and book page content hierarchy and markup, although printing starting from the incunable period remained essentially unchanged. With regards to the page, text layout was clearly improved by the introduction

2 From the Latin incunabula, meaning related to the "cradle" or "birthplace". In the Encyclopedia of Library and Information Science, incunabula are defined as "any book printed with movable metal type prior to January 1, 1501. This definition includes only the first 50 years of typographic printing. Block books or xylographic books of the same time period are normally not considered to be incunabula as they would not have been printed typographically—that is to say with movable meta type." See Allen Kent, Harold Lancour and Jay E. Daily, Eds. 1974. Encyclopedia of Library and Information Science. New York, Basel: Marcel Dekker Inc. 265.

3 New technologies were all employed to the benefit of content layout. If we focus on the nineteenth century, for example, several new options emerged for printing images: lithography, wood engraving and photography.

of the book title, a title page, the name and location of its producer, page numbers introduced in the early sixteenth century, and the development of indexes (Shaw, 2011, 222). Moreover, when examining technological and industrial advances, punch-cutting, type-founding, bookbinding, and papermaking were broadened and developed into separated activities.

Several factors contributed to the reaffirmation of the age of the printed word. When referring to the period of Gutenberg's printing revolution, Lotte Hellinga observes a change in the readership of books by the middle of the fifteenth century, when both the readership and the ownership of books were no longer solely for the privileged few (Hellinga, 2011, 207). This was partly due to some more technological aspects of printing discussed extensively by Adriaan van der Weel in his book *Changing our textual minds*: the *increased speed of copying* which allowed information to be disseminated faster than with manuscript production; the consequent *increase in copies* so that readership could be multiplied, to which I would like to add the resulting lower cost of the book due to ease of reproduction; and lastly, *legibility*, thanks to the printing press facilities which made identical reproductions of typographic applications possible, allowing texts to be read more easily than those that were handwritten (van der Weel, 2011, 82)[4]. Other socio-historical conditions that contributed to the significant expansion of the printed book include, on the one hand, the progressive increase in literacy rates in Europe and the growing interest shown by the academia in published books for scholarship and, on the other, the industrialization process developed throughout the Enlightenment, which intensified the specialization and division of the printing sector and expanded the systems for the commercialization and distribution of books.

New book formats emerged as a result of changing reading habits. During the seventeenth and eighteenth century books were mainly being read in libraries. However, taking advantage of Guttenberg's invention, the humanist Aldus Manutius (c. 1451–1515) became one of the first publishers renowned for his high quality printed work that established a printing house in Venice. Although small-sized books had been produced before, Manutius published a series of pocket-sized books that even today are considered beautifully edited and published. They were also very well received in his time, creating a hallmark that was soon imitated throughout Europe in editions such as those produced by Elzevir in Leiden. This was also an indication that the mass production of books was slowly taking into account the interests of a different reader: one who was more interested in owning a book that could be carried beyond enclosed walls and taken to different places. Manguel reminds us at this point that of "all of the shapes that books have acquired through the ages, the most popular have been

4 The importance of typeface development or *homo typographicus* as van der Weel likes to put it, definitively increased the legibility of books. In the nineteenth century, an example was the invention of the bold typeface that added to the rest of the Roman and the italic cuts a variety of textual emphasis or tones or voices within a text (van der Weel, 2011, 95).

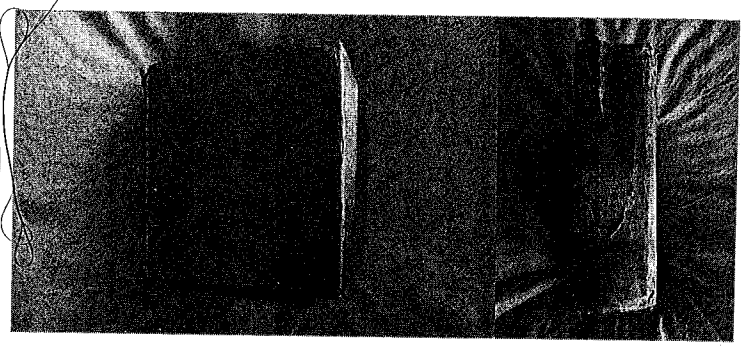
those that allowed the book to be held comfortably in the reader's hand."[5]

As previously observed, "canonical" book forms have evolved from the codex to the incunable. During this process, the same physical characteristics prevailed: the book had numerous leaves or pages and was bound with a cover. However, there are relevant examples of books that appear to be early departures from this standardized book form.

Reviewing the Special Collection at the University of Leiden, I came across the *Vossiani Latini in Octavo*, a rather atypical book and an exceptional discovery in the Dutch manuscript collection. The third part of this book, which dates from the eleventh century, is made of scraps of animal skin (possibly from a cow) prepared as parchment, which have been recycled and bound together. This is why book historian Erik Kwakkel speaks about the object as an example of "Medieval garbage".[6] Kwakkel presupposes that in order to make book production less costly, the leftovers of some parchments were cut out and used to finish this book. The result of using these irregularly sized parchments is an asymmetrical pagination that affects the *join or gutter*, as well as the *edges of text block*, and the complexity of the book's *text block* in general.

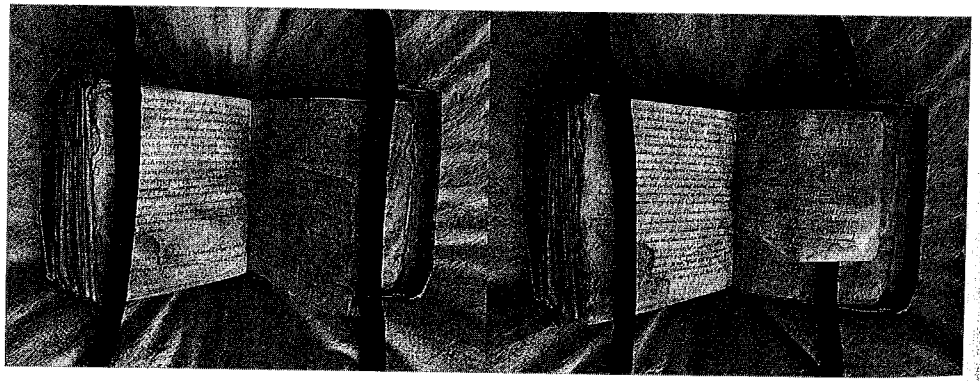
Figures 1-2

Vossiani Latini in Octavo.
Manuscript VLO 92, Part 3,
11th century
Leiden University Libraries,
Special Collection.
Photo: D. Ojeda



Figures 3-4

Vossiani Latini in Octavo
Manuscript VLO 92, Part 3
(Fragments)
11th century, Leiden
University Libraries, Special
Collection.
Photo: D. Ojeda

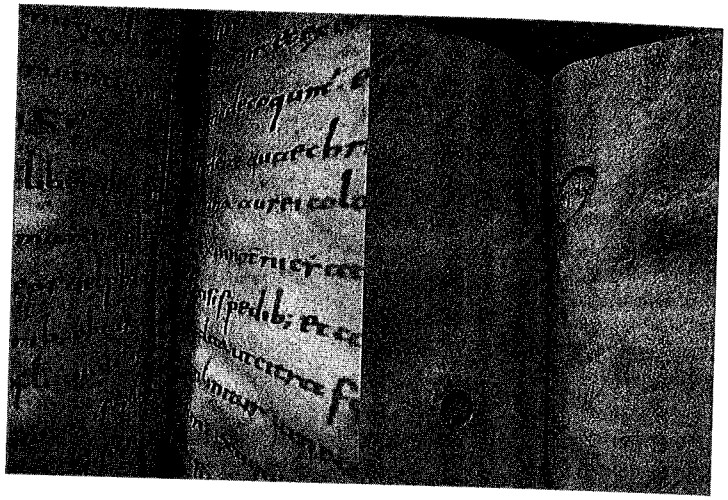


5 See Manguel, A. 1996. *A History of Reading*. New York: Penguin Books, 128.

6 Libraries, L. U. 2012. Medieval garbage in Leiden University Library.

figures 5 - 6

Vossiani Latini in Octavo
Manuscript VLO 92, Part 3
(Fragments)
11th century, Leiden
University Libraries,
Special Collection.
Photos: D. Ojeda



Half pages in the book (Figures 3 and 4) are the result of the "whatever found" material strategy used to assemble the text block. As a note in the margin that expresses an interesting parallel experience, book designers nowadays tend to use half pages as a design approach to highlight different kinds of information within a given book's content for the reader.

Other relevant examples of variances in book forms are the anatomical flap books developed between the sixteenth and nineteenth centuries, primarily for medical students. Layers of the human anatomy could be seen through a series of meticulously superimposed illustrations (later becoming printed images) on their pages — also known as *fugitive sheets* — in times when the study of the human body with cadavers was prohibited. Anatomical flap books were complex in terms of production: parts of the human anatomy were assembled by means of layers of paper that opened to reveal the interior of the human body's structure. The books performed a simulated autopsy that the reader followed by opening finely illustrated or printed pieces of papers corresponding to the human body. Fugitive sheets can also be considered early examples of pop-up books, and their "animated images" appealed to a great number of readers beyond the medical personnel for which they were initially intended.

To make a book is to "curate" information— A conversation between Danné Ojeda and Mathieu Lommen

Following Danné's interest in the book as object and how these artifacts characterize humankind's knowledge and behavior, she approached Mathieu Lommen — current curator of graphic design at the Special Collec-

tion Library, University of Amsterdam (UvA) — to speak about book history scholarship and the creation and transmission of knowledge, as well as his current criteria for safeguarding books in the digital era. Lommen studied Dutch Literature (Nederlandse letterkunde) at the University of Amsterdam. He has curated exhibitions based on treasures found in the Special Collection such as "Book seeks reader: advertising from the book world since the 17th century" (Special Collections, 2008). He was Managing Editor at *Quaerendo* (1997–2011) and member of the editorial board of *Codex: the journal of letterforms*. He also edited *The Book of Books. 500 Years of Graphic Innovation* (2012), published by UvA, Amsterdam, and Thames and Hudson Publishers, London.

•••••

Q:

Mathieu, when did you start working in the Special Collection and how do you describe your current role?

A:

I officially became the curator in 2001. Before that, I catalogued type specimen collections and prints for the university library. As a curator I collect, describe, and present collections.

•••••

Q:

Are there specific requirements you might need to comply with as a curator of the Special Collections, for instance, curating one exhibition per year?

A:

Exhibitions on graphic design are usually presented every two years. Although they may be presented more often, there is at least one exhibition on graphic design every two years.

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Q:

What sort of guidelines have you developed or have you followed to organize the Special Collections? For example, what kind of classification do you use, and what could be the special "features" you and your team of specialists look for when selecting a book for the Special Collections? I recently read in *The Book of Books: 500 Years of Graphic Innovation*[7], a book which you just published, that since its foundation in 1578, the Amsterdam University Library has collected books primarily "for their content". However, it also began to select books based on "*their production method or design*". Could you speak about the general criteria applied currently for selecting books for the Special Collections?

A:

Libraries like this one collect books because of their rarity or use of a special method of production. Books by Bodoni or William Morris were not collected for their content because the content had already been published several times before. Libraries always loved exquisite luxurious books. For hundreds of years, the Amsterdam University Library has collected *edition deluxe*, luxuriously-produced intellectual books.

If you look at books by Baskerville and at the list of inscribers for his books (which is attached to our copy), you will see the names of several libraries that acquired them. These copies were archived because of the quality of Baskerville's book design and production. Other collectors' items include books that are rare or valuable and first editions of famous authors' publications. There are also books by designers which are not valuable but which we acquire. For example, a Penguin designed by Jan Tschichold is rather cheap, but nevertheless it is something special we like to keep in a good condition.

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Q:

Is there any difference between the books you collect from the Netherlands and those that you select from abroad?

A:

We do not acquire that many books which we call "primary works". We collect secondary literature — books about books — and books designed by designers. What we prefer to do is find collectors, and we acquire their collection. For example, we recently acquired a collection of Dutch photo books by famous Dutch photographers from the 1940s to today.

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Q:

Hence, in terms of classification, the Special Collection focuses on classics book forms, exquisite, luxurious books, or rare books, among other exceptional objects. It is also a collection that focuses on research, which is why you collect secondary rather than primary sources. Is that an accurate description?

A:

Yes, indeed. Our library is different from a museum. For example, we do archive works by important figures, such as Irma Boom. We cherish them but also have a broader view. We do not only collect beautiful things. Since we are a scientific institution, we want to depict the broader field of the graphics trade, not only attractive 'big' names. We also collect artefacts on the process of design, mainly for research purposes.

Regarding exhibitions, we have to invest in relevant topics. For example, you cannot make an exhibition about the design of dictionaries because it will attract only very few people.

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Q:

In collecting historical items, what difficulties do you face?

A:

One of the difficulties I faced at the Special Collection was breaking the tradition of collecting *traditional bibliophile* editions, letterpress printed

7 Lommen, M., ed. (2012). *The Book of Books. 500 Years of Graphic Innovation*. London, Thames & Hudson Publishers.

books in small editions. I think that nowadays those editions do not have the same importance they had in the 1890s or 1900s. These bibliophile editions do not add to the history of the book, so I think that it is not money well spent. Something new I suggested was that we should collect Irma Boom's books, for example. She was in her 40s when we acquired her archive. I think that it might be difficult for institutions like this one to understand that internationally-acknowledged books by individuals such as Irma Boom that can presently be acquired for 30 or 40 euros, are, from the perspective of the history of design, more important than some luxurious editions that might cost hundreds of euros.

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Q:

I believe that when you acquire books for the Special Collections, you have to justify why you select them. Could you briefly describe this process?

A:

The process has changed over time. When I started acquiring living archives, the organization was different. I could acquire books and archives and put them in stacks. But nowadays, the organization is stricter, and I am not allowed to do this on my own. We first discuss this in an acquisition team. We have to discuss how much space an acquisition will require and how much it will cost to catalogue these books. As a rule, we do not pay for archives. So at present, we do not take complete archives or complete productions like we did with Irma Boom. I usually will talk to the designers if they are still alive and will make a selection of their books and archive. It is not only about beautiful things but also about how these objects contribute to research.

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Q:

Why have you acquired Irma Boom's archive? What elements set her books apart and make them interesting for research purposes?

A:

When I acquired her archive, she was already known as an important book designer both among her Dutch colleagues and internationally. I was quite sure that she was a good asset to our collection. I thought that if we waited, maybe some other institution would ask her for her archive.

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Q:

You recently collaborated with Irma Boom on two of her exhibitions: Biography in Books (2010, University of Amsterdam Library, The Netherlands), and The Architecture of the Book (2013, Institut Neerlandais, Paris, France). Through this experience, you gained an insight into how she works and how she thinks in terms of book production, among other issues. Is there something you would like to share on how she engages in the production of the books she designs?

A:

I think Irma Boom has the advantage of the Internet. The Internet makes it

clear that making a book has to be a meaningful endeavor. The book form as a documentation of something you have researched and the book as a sequence of images is not — in most cases — the best way to think of book production. In the Internet era, one needs a strong justification to make a book. Why do you choose to publish your content as a physical book and not as a website or a PDF? The printed form has its share of advantages and disadvantages. In Irma Boom's case, she profits from the Internet as the existence of Internet fuels the recognition that Irma's work is justified because of the personal choices she makes. And, I think this is the only way you can justify the existence of a book. One should not misuse the medium of a book any longer for things that a book is not good at. If one uses the medium of a book, it is important to know why a particular type of paper is chosen, why the pictures are arranged in a particular way, and why the book has been bound in this way. A book should be justified: Why is it is a book and not something else?

•••••

Q:

Hence, you think that nowadays, the book as a medium has gained specificity because it differentiates itself from the Internet, and because the book — amidst the digital era — is somehow a 'space' to propose alternatives to the digital environment.

A:

Yes. At present, the choice of a book as a medium should be a justified one. Please, do not misuse the medium of books because my house is full of books, and I do not have space for more.

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Q:

Through your words, I perceive the worldview of a researcher. Your main approach to books is to study their content, in particular the manner in which books have been designed and produced. You further seek to evaluate and select books to be preserved for future generations. A priority for you seems to be that there shall be a need for the book to exist or for the book to perform a purpose.

…But coming back to your earlier statement, from the point of view of a book designer and speaking from my own point of view, this is basically what designers do: they justify why a book should exist.

A:

This is especially so since the Internet came into existence. Before, you did not have to justify why you made a book, because wanting to publish information seemed to be reason enough. But now, you can publish information in many different ways.

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Q:

In that sense, one could say that your definition of a book is that of a specific physical object that can justify its existence outside of (as opposed to) the digital medium.

A:

Yes. It should be that way. There are many advantages and disadvantages when one compares a book to the Internet. The Internet includes everything: if you publish all artworks from a museum, what would we look at? Thousands of pictures and so much information would be available. In comparison, a book should be something that is more of a selection, maybe a performance.

Q:

A book then allows you to select very specific information, to curate information.

A:

Yes, to curate information. That is a nice way of formulating it. To make a book is to curate information. And this is what Irma Boom is good at: curating information. She rightfully takes that role.

Q:

Going back to the Special Collections, why are they entitled "special"?

A:

That is the international convention. All libraries like this one have "Special Collections".

Q:

So is it a generic term for this sort of collection?

A:

Yes. You have lending libraries, and you have the more special collections, those that host either very expensive or not very expensive but fragile or very rare books. For example, we have a large collection that is not expensive at all consisting of printed ephemera of the book trade. They are very rare and important for research.

Q:

Where does the "rarity" of the book reside? Is it in the way the book is made, or is it rare as a result of a transformation to the canon of the traditional book form?

A:

The less valuable a book is when it is published, the greater the chance that it becomes rare. There are forty or more Gutenberg bibles. That it is not a rare book. The Baskerville books are not rare either. Those books were expensive then, and they continue to be expensive now, so everyone who owns them will keep them safely. But if you were to look for well preserved children's books from the 50s, they would be very difficult to find. Similarly, it would be hard to find a book by Heartfield from the 20s with a photomontage.

Q:

You mentioned some keywords that describe the Special Collections. How do you classify the collection?

A:

Rare or expensive. These are the first criteria. Because the collection comprises of books that are worth thousands of euros, medieval manuscripts which are of course both unique and expensive, and original letters, these objects cannot be borrowed. There are also ephemeras that are interesting for research purposes. It may be because of their content, or their form, or because they have been specially printed. We are also interested in printing techniques, such as examples of very early offset printing, or early photographic techniques. So, keywords that define the collection could be expensive, rare, and vulnerable.

Q:

Examples of the early printing techniques will offer a look into the history of books as a technology. This highlights an interesting area for me, which is how the cannon of what a book is in terms of its format has been developed and how this canon has been challenged during the history of book design. This leads me to ask if there is any original or foundational book that you have in the collection that, when you look at it, you say, "This is the very first book that was printed without a cover," or "This is the very first book with its spine exposed?"

A:

We have the first Dutch book to have its illustrations printed in colour, early lithographed books, and a nice collection of the bindings of early 19th century publishers. Earlier books were not bound by the publisher but individually instead. If you were a wealthy person who loved books, you could have your books bound in expensive leather and stamped with gold lettering. But the difficulty with the history of the book is that, in my opinion, it is very much an Anglo-Saxon history. And one of my objectives as a curator of the collection is to try expanding the Anglo-Saxon view of the book's history by including, for example, modern books from France and Germany.

Q:

Could you name some authors whose books you think are foundational? I am thinking of books that challenged the traditional form of a book.

A:

I would think one could name Baskerville as a foundational author because in the 18th century, he was the one who thought to look at a book as a whole: at the paper, at the printing, and of course at the design of the typeface.

While I cannot recall precise examples, what I do know is that the industrialization of the book in the 19th century uniformed its production, often making it less interesting. The book became a cheaply produced object with a nice cover that had to be sold.

Q:

If you had to select one of the most valuable or the most beautiful books you have in the collection, or if you had to select the most interesting one because it is most ephemeral or fragile, or because it is the most luxurious or expensive, which book would that be? Perhaps to name just one might be difficult, but just as an example, what book would you select?

A:

I could not select one book… If there was a fire and I could only take one book, I would probably save a book by Arrighi. He was the most famous 16th-century Italian calligrapher and perhaps the most famous calligrapher of all times. The book was made on commission of the poet Vittoria Colonna and completed in 1517. It is a thick book entirely written by Arrighi himself. Yes, I will definitively go for this book. I love writing, so I will probably take that one because it is unique and so beautiful.

Q:

What is the content of this book?

A:

I always forget what the book is about because I am not interested at all in the content of it. People always ask about that, but I will have to look it up. I only look at the writing. There are also very nice illustrations.

Q:

During a conversation I had with Irma Boom, she mentioned that she had selected a book by Aldus Manutius to be shown as part of her retrospective exhibition organized together with the Special Collection. She added that her selection was motivated by the fact that Manutius's book was considered one of the most important and beautiful books of your collection. Is there a book by Aldus Manutius that deserves to be safeguarded from a fire?

A:

The *Hypnerotomachia Poliphili*? I am not sure if this was the one she used for the exhibition. It is an iconic book because of the content and the illustrations. But several libraries internationally possess copies.

Q:

Is Manutius's book a foundational book? Is it a book that might have started a tradition, for example in terms of printing techniques, or does it have any other pioneering feature?

A:

Not in printing techniques. But other books published by Manutius started the tradition of printed pocket books. These met the people's desire for portable books. One of these pocketbooks[8] is reproduced in *The Book of Books: 500 Years of Graphic Innovation.*

8 Mathieu Lommen refers to the book *Johannes Aurelius Augurellus, [Poemata]* (Venice: Aldus Manutius).

Q:

And within the Special Collection, do you also archive unfinished books? I am thinking, for example, of scale models or dummies. For instance, Irma Boom creates dummies to produce her final books. Do you have unfinished books such as dummies or scale models created by Irma Boom?

A:

We have some dummies from her archive. Yes.

Q:

And do you collect unfinished books, dummies, or unfinished letters from centuries past?

A:

Not especially. They are rare. If we have them, we will not discard them of course.

Q:

Is there a way for the public to access these rare, unfinished books?

A:

You could maybe find them in some of our modern archives. Because they are unfinished, they might not be catalogued on an item level, but they might instead be listed as part of the archive. And because they would not be published books, they would not be described in our catalogue on an item level. Generally, books are catalogued on an item level, but there is also an archival description of the whole collection. One can go to the online catalogue, and objects not archived on an item level would be described in an inventory.

Q:

There is a special place for miniature books in the history of books in general. How do you treat them?

A:

Miniature books have of course always been very collectable. They are in closed stacks because they can be easily stolen.

Q:

And in principle, the public has access to everything?

A:

Yes.

Q:

Even to non-catalogued items?

A:

Yes. Only a very few books are not easily available to the public because they are very vulnerable. For example, although we have the book *Dlia golosa*

by El Lissitzky in paperback, offering the original to the public will destroy it. In this case, we offer facsimiles. And if someone wants to see the original book, a curator needs to approve the request. But although some books are restricted, the public has access to 99.9% of the materials in our collection.

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Q:

Talking about book designers, Cees W. de Jong referred to a comment you once made: "Books made by designers often seem to be the resort of emptying a bookcase: too personal and lacking in explanation."[9] What did you mean by this statement?

A:

I meant that designers are not researchers. Not all designers are this way, but generally speaking, they are not capable of looking for materials in the way a researcher will. It is a skill you learn in university: how to find articles, or reliable information about a subject in libraries or archives. It is very time consuming. And this limits the way you can progress. Designers often also have difficulties with writing. Conversely, they can articulate a visual essay, and that is why they invented it.

In the future, there will be — I think — a sort of competition between authors and designers. If the designer wants to be an author, why couldn't the author be a designer too? The same is true of book publishers. I am sure many publishers have many good ideas and concepts for publishing books, and that designers often work from their concepts, but it is never mentioned. I think the author of the future should have more knowledge about book making if he chooses to publish in the printed form. If you want to make a documentary, you have to know something about filming and how to use the camera. If you choose the medium of a book, you should know something about designing books.

•••••

Q:

That is thought provoking. Your words defend your position as an author.

A:

Yes. As an author, I do not want just to provide the text and pictures for someone else to make a book. It should be a cooperation from the beginning.

•••••

Q:

As a design historian, you know your subject, and you want to control as many elements as possible of the book's production. You mentioned earlier that in the future, there could be a competition of skills and authorship. How much are you able to allow a designer to contribute to your book? In other words, how much do you allow a designer to be a co-author?

A:

As much as he or she allows me to be a co-designer. If designers would really be co-authors, they would design less books. Many designers note each

9 *The Book of Books: 500 Years of Graphic Innovation* edited by M. Lommen.

hour they have worked on a project. But as an author, you hardly ever get paid for all your hours. So, if a designer wants to be co-author, no problem, come with me to the archives, do the selection and the writing together with me. I use to write one book every two or three years, while designers make ten or more books each year. You cannot live from writing books. I work to write books. So, I don't think that there will be much competition in that area.

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Q:

On this point, it is good to go back to Irma Boom's books, since you have worked with her and we both agree that she is a designer-author. She edits content, does visual research, develops visual ideas, and creates concepts. She is both also because she is able to "translate" these elements into the physicality or the materiality of the book. Therefore, when one sees her books, one is able to grasp the content of it by the way the object is produced. She is experienced in speaking content through form. Right? From that point of view, a designer might not necessarily have to go with you to the archives, but he or she can interpret this research material using form to create content, as Irma Boom does. What are your thoughts on that?

A:

Yes, alright. Irma Boom is a league of her own. But then in general, a designer is called an author after the researcher/author has made the content selection. Designers work on many subjects, so to me it seems difficult for them to judge the quality of research done by someone else.

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Q:

Talking about your current occupations, what book or curatorial research project are you involved with at this moment?

A:

I am working on Letters from the beginning of the 15th century until now.

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Q:

Are you creating a sort of historical *continuum*?

A:

Yes. It will be an exhibition and a book about Letters. There has not been much historical research in this field. One can make real discoveries among Letters that have never been noticed in the last few decades and in this way contribute to the existing literature. And this is very exciting.

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Q:

When I look at those handwritten Letters or books, I always experience some sort of nostalgia for what has been lost with the advances of technology. There are certainly many advantages, but they come at the expense of something that could have been essential in that époque, like the development of calligraphy once was essential to its era. Do you think that with the current

technological developments, we are witnessing the end of the era of books?

A:

No. There is just a change. I do not think books have the impact they used to have. The printed book as a mainstream object of communication is disappearing. I offered a book to my daughter a few weeks ago. I had not finished my sentence when she said, "You know I am not interested in books." When she was young, she had a whole room filled with books. We bought meters of children books, but now she is not interested in books. Her generation is not interested in books. That is why I think that the book as a mainstream object is finished. Although I regret this, I think the book will become an elite medium.

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Q:

'The book as an elite medium'... that is how books first developed. First, books were an elite object, although for completely different reasons. Only wealthy people could acquire and customize them. Late however, they became a mass medium object. Do you think that in the future the book will go back to its roots and once again be just an elite object?

A:

Certainly more special. There will be no paperbacks anymore. I am no longer a curator of books as a mass medium. I love books because they used to be just that. But that is going to end. For quite some time, it made me sad. But I know it will be that way. I cannot change it.

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Authors

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Mathieu Lommen works since 1991 as a curator of graphic design and typography at the Special Collections of the University of Amsterdam (UvA), where he has also taught graphic design history. He has published multiple works on book and type design from the nineteenth century onwards and has curated several exhibitions on these subjects. His publications include: Limited Edition: Archive of the Foundation De Roos 1945–2005 (2006), the brochure 50 years Helvetica (2007), Het cahier Kees Nieuwenhuijzen (2009), Irma Boom: Biography in Books (2010); The Book of Books. 500 Years of Graphic Innovation (2012, Thames & Hudson) and Irma Boom: The Architecture of the Book (2013).

REFLECTION

Editor's Note

One means of advancing design is to encourage discourse, and one way to encourage discourse is to thoughtfully discuss what has been put forth as design knowledge in academic journals. With the following article, *Visible Language* launches a "Reflection" feature whereby scholars or practitioners engage with a recently published article in a considered, thoughtful, reflective way. In this inaugural Reflection article Professors Emily Verba Fischer and Reneé Seward, who both teach typography at the University of Cincinnati (UC), were invited to consider Maria dos Santos Lonsdale's article "Typographic Features of Text: Outcomes from Research and Practice" from *Visible Language* 48.3 and to reflect upon how it relates to their classroom activities. Emily and Renee's typography teaching often occurs in the early semesters in UC's Myron E. Ullman School of Design, just prior to students' first cooperative education, or "co-op" job, and thus their focus in this early courses is on using their personal research and the research of others like Maria to prepare students for immediate entry into practice.

We hope you enjoy Emily and Renee's reflections and that they stimulate others to write thoughtful Reflections on articles to be published in future issues of *Visible Language*.

Mike Zender, Editor

Typography Education: Eco-System and Excellence

Reneé Seward and Emily Verba Fischer

Abstract

The following two essays are responses to Maria Dos Santos Lonsdale's article entitled "Typographic Features Of Text: Outcomes from Research and Practice" (*Visible Language* 48.3, 2014). From the lens of two professors of typography from the Myron E. Ullman School of Design at the University of Cincinnati, these partner texts position Lonsdale's detailed information about typographic principles for legibility into a broader, typographic ecosystem. In Part 1, Reneé Seward defines this ecosystem as a complex relationship between two differing components of information processing: seeing and perceiving. In Part 2, Emily Verba Fischer explores the cultivation of aesthetic sophistication in design students through attention to detail within that ecosystem. Overall, these responses discuss the influence of the typographic ecosystem to education, research, and practice as a whole. They were written for the same audience as identified by Lonsdale in her paper, "typographic and graphic designers, teachers and students" (29).

Introduction

Maria dos Santos Lonsdale's article "Typographic Features of Text: Outcomes from Research and Practice" (*Visible Language* 48.3) aims to provide guidance for designers, teachers and students through the amalgamation of published resources on the legibility of text. The following two essays are responses to this article, and an attempt to relate selected ideas and principles from Lonsdale's text to the experience of type education at the University of Cincinnati's College of Design, Architecture, Art, and Planning.

Part 1: The Eco-System of Typography

Reneé Seward

1. Components of Typography

The main goal of typography is to organize text into structures that help people easily and enjoyably read and perceive written messages. Much of my personal research has been in the design and development of an innovative, interactive digital tool to help children learn to read (Seward, 2014). Just as reading is comprised of two main components, decoding and comprehending, so typography is comprised of two main components, seeing (the objective typographic mechanics) and perceiving (the subjective typographic messaging). The Seeing Component represents the objective typographic mechanics that allow viewers to easily and enjoyably process information whereas the Perceiving Component represents the subjective typographic messaging that allows viewers to convert what they see into meaningful content (gain knowledge). These components are not static— they are active principles that work interdependently with each other in order to comprise a whole. Typography can be described as an ecosystem that is a community of principles (typographic mechanics + typography messaging) living in conjunction with communication vehicles (environmental, mobile, print, desktop) that interact as a complete system. In Maria dos Santos Lonsdale's paper "Typographic Features Of Text: Outcomes from Research and Practice" in *Visible Language* 48.3 she summarizes principles that are good examples of the objective typographic mechanics, or the Seeing Component, that allows someone to recognize and process information. However, I believe that in many designed artifacts, there is another component working in tangent to these typographic mechanics which helps viewers comprehend and acquire knowledge— the Perceiving Component. I will describe the nature of a typographic ecosystem and a pedagogical approach to teaching this ecosystem in typography courses and then go on to discuss the influence of the ecosystem to education, research, and practice.

2. A Typographic Eco-System

"The width of a grid column influences the line length of a paragraph. A typeface's contrast influences how small you can set the typeface so it's still legible on your phone. The tools we use and the choices we make affect a design up and down the supply chain." (Jason Santa Maria, *On Web Typography*)

Typography can be described as a dynamic relationship within and between two components—Seeing and Perceiving. Maria dos Santos Lonsdale's paper provides a thorough literature review of what she defines as legibility principles of typography, what I describe as the Seeing Component of the typographic ecosystem. Willi Kunz in his book *Typography: Macro +Micro Aesthetics* defines the Seeing Component on two aesthetic scales: the Macro and the Micro.

> The Macro-aesthetics are noticeable at first glance. They consist of such things as overall format, type hierarchy, color, positive and negative space. The Micro-aesthetics requires a closer look in order to recognize them. They consist of such things as letterform anatomy, letter spacing, line spacing, line length, and kerning. (Kunz, 97)

The Seeing Component helps viewers mentally grasp or see the information being presented. According to Lonsdale the legibility component that establishes seeing allows viewers to read information quickly. I will go further to say that the Seeing Component allows viewers not only to gain speed in distinguishing letters (legibility) but also to ease and make desirable the decoding of information (readability) (Maria, 6; Lupton 2014).

> Legibility is a function of typeface design. It's an informal measure of how easy it is to distinguish one letter from another in a particular typeface. Readability, on the other hand, is dependent upon how the typeface is used. Readability is about typography. It is a gauge of how easily words, phrases and blocks of copy can be read. (Halley, 2015)

If the Seeing Component of type is done well, the design can make visible the content. In the design of books, the Seeing Component is the dominant aim in the design.

From reading Lonsdale's paper, the number of principles within the Seeing Component is considerable, and while many of these principles are points of contention between research and practice, we teach the most basic of them in introductory typography courses. Emily's essay below details three of them, yet I believe there is still another set of principles at work in many types of design that aid viewers in perceiving intended messages. I define these principles as the Perceiving Component. Just like the Seeing Component ,the Perceiving Component can be visualized on the two aes-

thetic levels (macro and micro). The macro-aesthetics consist of principles that synthesize type with imagery, sound, motion, physical materials, and/or interactive behaviors. The micro-aesthetics consist of the principles that allow for the strategic manipulation of principles within the "Seeing component" for the purpose of adding a distinctive voice to a design yet retain harmony among elements: for example, excessive letterspacing in a subtitle, alternative grids for an experimental book structure, and use of display typefaces in a title. After reading Londale's paper, I believe there is a need for a similar paper to be written that summarizes the principles that define the Perceiving Component of the typographic ecosystem.

The careful balance of these Seeing and Perceiving components pushes worthless data-driven messaging into knowledge. While in many books the Seeing Component is dominant, I still see instances within the table of contents, the cover, or the chapter introductions that utilize aspects of the Perceiving Component. The same is true of a movie title sequence; while it may be heavy on the Perceiving Component, there are still aspects of the Seeing Component seen in the typesetting of the actors' names on screen. In Richard Saul Wurman's book *Information Anxiety,* he explains a Continuum of Understanding theory which says that all messaging starts out as data, which is worthless and meaningless. Once data gets organized, it becomes information. Once information has stimulus added to it, the messaging turns to knowledge. Once readers understand that knowledge, they can turn the messaging to personal wisdom. The Seeing Component of typography turns the worthless amalgam of letters into information by giving them order and a visual system through the application of typographic mechanics. However, the Perceiving Component goes further to turn that information into knowledge through the addition of stimuli that make the information conversational, narrative-based, and experiential (see *Figure 1*).

Figure 1.

Layering the typographic ecosystem over Richard Saul Wurman "Continuum of Understanding", we see the progression of messaging from worthless data to information through the application of the seeing component of typography that gives structure, order, and a visual system to the perceiving component that adds stimuli to the messaging to make it conversational, narrative-based, and experiential knowledge.

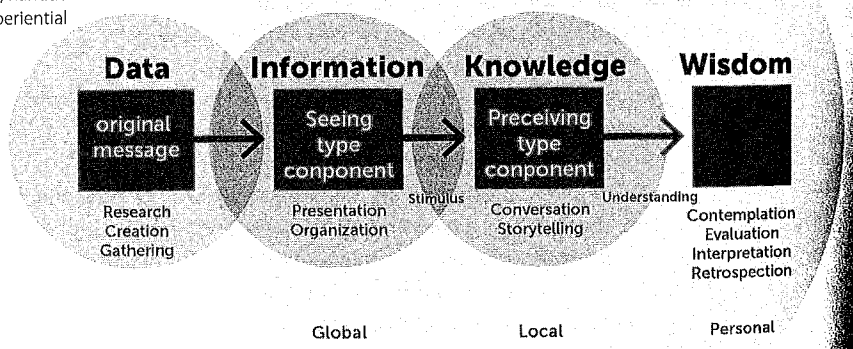
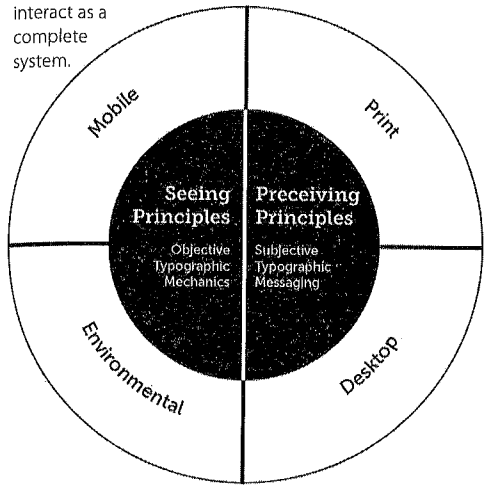


Figure 2.

The typographic ecosystem is a community of principles (typographic mechanics + typography messaging) living in conjunction with communication vehicles (environmental, mobile, print, desktop) within our environment that interact as a complete system.



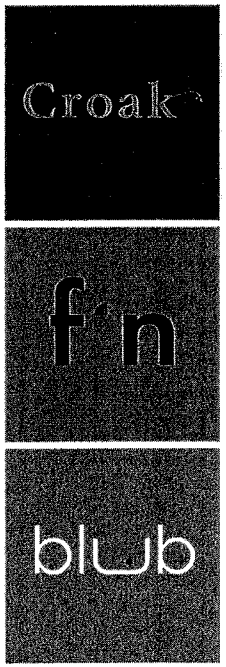
The dynamic relationship between these two components is the basis of the typographic ecosystem. Just as in an actual ecosystem where the living organisms function in conjunction with non-living components of their environment, these typographic components function in conjunction with differing communication vehicles of our environment. These communication vehicles consist of environmental, print, and digital based designed solutions (see *Figure 2*). The challenge of teaching this ecosystem is helping students gain sensitivities of the principles within each component and between each component. Furthermore, the challenge exists to help students gain sensitivities for how these components get applied differently to various communication vehicles. Some principles of type must be applied differently when being applied to environmental, mobile, print, and desktop solutions such as font size and font choice while other principles are more adaptive in application and apply more universally from one communication vehicle to another such as hierarchy and eye flow.

3. The Ecosystem in Pedagogical Application

In order for students to develop sensitivities for the components in the ecosystem and understand their inherent relationships, I teach these components in conjunction with each other. More specifically, I layer them together into typographic assignments. In a Typography 1 assignment, students develop observational drawing of typefaces that they believe represent an adjective that describes attributes of an animal. Then students are asked to letter space the adjective word with a chosen typeface. Subsequently, students manipulate aspects of the typeset word in order to personify the adjective of their chosen animal. Lastly, students develop an animated .gif that layers moving behaviors into their type system to further personify the adjective that describes the chosen animal. The Seeing principles of consideration in the assignment are the accuracy of drawing a typeface, typeface choice, and kerning. The Perceiving principles of consideration are the manipulations of the Seeing components of the typeset word to further personify the animal (see *Figure 3*). Additionally, the layering of moving behaviors adds stimuli to further personify the animal adjective.

Figure 3

Three examples of adjectives that personify an animal. Students select a typeface and manipulate the word to further personify a chosen animal. The student works from top to bottom are Sarah Frey, Corinne Clements, Mackenzie Overmyer.



In a Typography 2 assignment, students develop a series of three posters for an event. Students first address the Seeing component by developing the type standards (ie. typeface choice, type size, hierarchy, grid, etc.) for the series that will make the posters legible in an environment. Then students investigate the relationship of the Perceiving component to their type standards in order to make a memorable poster series. Students consider the relationship of type to image and how they can manipulate certain type mechanics to articulate an expressive message of the poster yet build an unpredictable harmony between elements.

> Sometimes that content has its own internal structure that a grid won't necessarily clarify; sometimes the content needs to ignore structure altogether to create specific kinds of emotional reactions in the intended audience; sometimes a designer simply envisions a more complex intellectual involvement on the part of the audience as part of their experience of the piece. (Samara, 120)

For example, in Figure 4 the paragraphs have been layered on top of each other and rotated in orientation to build harmony with the imagery and create a mood of an unsettled writing atmosphere. In Figure 5 the counterspace of the letter "O" in Oskar is filled in so that it builds harmony with the other circle elements in order to emphasis the geometric nature of Osker Fischinger's work. In Figure 6 the name Jacques Derrida has been broken and the body copy has been justified at an angle to create very distinctive shapes, but they all work together to help express Derrida's philosophy.

In a Typography 3 assignment, students develop a publication that will be read in print and on mobile devices. The Seeing principles include considerations of typeface choice for an identity of the publication and type standards for the content of the publication. These standards have to be developed for both print and mobile solutions. Designing for print and mobile helps students understand how the typography components differ from one communication vehicle to another. Some of the Perceiving principles include the integration of image with text, the breaking of the grid, and the use of display typefaces to help create an unpredictable harmony among elements, as well as establish an expressive voice to the messaging. For example, in Figure 7 notice the manipulation of the letters in the magazine name and the rotation of the first few words at the start of a story. In Figure 8 notice the relationship of the magazine name to the cover image, as well as the free nature of the handwritten typeface that does not conform to the grid.

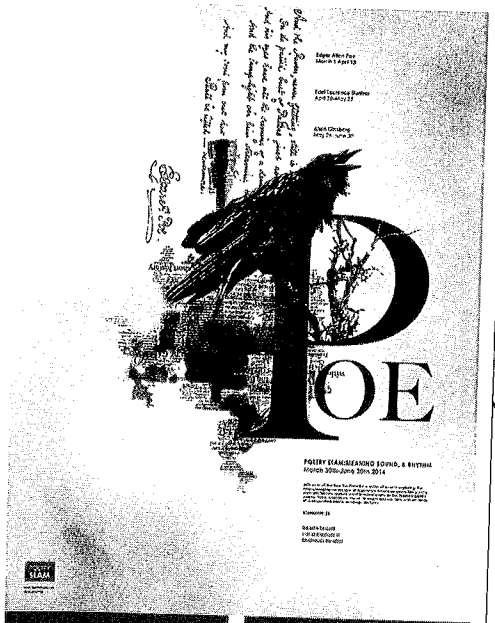


Figure 4

This poster shows the investigation of the relationship of the perceiving component to the student's type standards in order to make memorable poster series. The paragraphs that have been layered on top of each other and rotated in orientation build harmony with the imagery and create a mood of an unsetting writing atmosphere. This poster was designed by Sara Thompson.

Figure 5

This poster shows the investigation of the relationship of the perceiving component to the student's type standards in order to make memorable poster series. The counterspace of the letter "O" in Oskar is filled in so that it builds harmony with the other circle elements in order to emphasis the geometric nature of Osker Fischinger's work. This poster was designed by Andy Meyer.

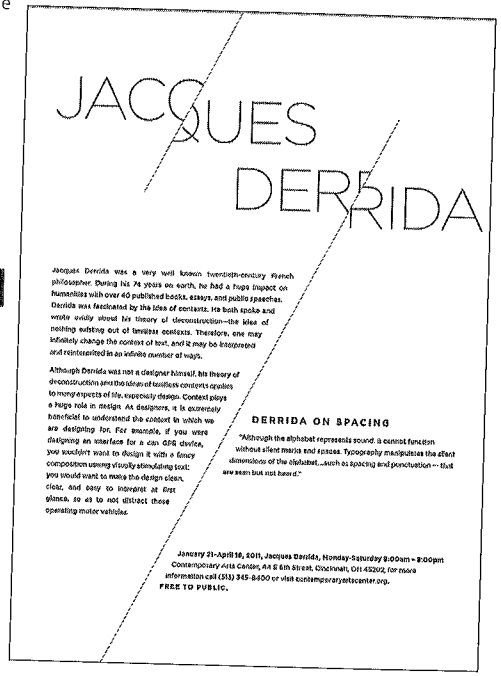


Figure 6

This poster shows the investigation of the relationship of the perceiving component to the student's type standards in order to make memorable poster series. The name Jacques Derrida has been broken and the body copy has been justified at an angle to create very distinctive shapes but they all work together to help express Derrida's philosophy.. This poster was designed by Brandon Kennedy

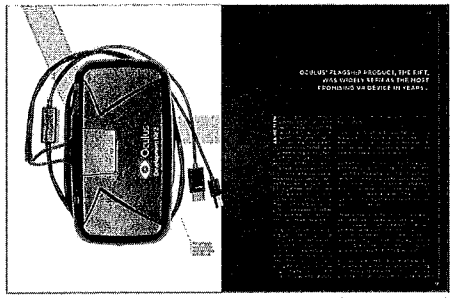


Figure 7

The spreads in this student project display the usage of both the Seeing and Perceiving components. Notice the manipulation of the letters in the magazine name and the rotation of the first few words at the start of a story. This project was designed by Josh Hill.

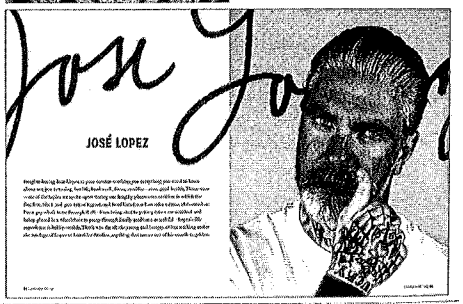


Figure 8

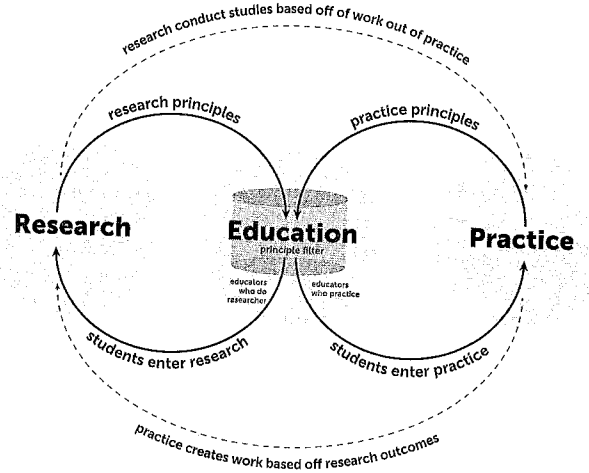
The spreads in this student project display the usage of both the Seeing and Perceiving components. Notice the relationship of the magazine name to the cover image, as well as the free nature of the handwritten typeface that does not conform to the grid. This project was designed by Elizabeth Cardone.

4. Education's Relationship to Research and Practice

In conclusion, the typographic ecosystem is as vast and complex as the world we live in, and it is important to understand its relationship to education, research, and practice. Londale's paper discusses the relationship of research and practice in establishing proven typographic mechanics. As the profession moves forward, we need to view research, practice, and education as three components working systematically together to execute, prove, and refine the entire typographic ecosystem integrating mechanical considerations of the Seeing Component with meaningful ones of the Perceiving Component. Figure 9 models the integration of research, practice, and education in which educators who serve a dual role as educator and researcher or practitioner integrate Seeing and Perceiving into a methodology that they teach to the next generation of designers. These designers will in turn enter into the profession and execute, prove, disprove, and refine, those same principles through their own work. The way that education filters the information from research and practice differs from one institution to another, which in turn produces designers with varied approaches to design.

Figure 9

The relationship of research, education, and practice is an ecosystem in which typography lives.



Our discipline, Communication Design, is in the process of growing up. We have been transitioning from what was originally a tradecraft where designers only practiced into a discipline where they have a discourse between practice and research (Poggenpohl 2009). With any growth process there are growing pains and Communication Design is no different. The pains of growth within our profession can be seen in (1) the disconnect between research and practice and (2) the lack of integration of Seeing and Perceiving. I do not believe research and practice currently interact enough with each other to provide integrated principles that can advance the profession as a whole. Once integration happens, it will no longer be necessary for education to function as the filter of research information but a deliverer of a complete typographic ecosystem.

Part 2: Beyond Legibility: Cultivating Excellence in Typographic Education

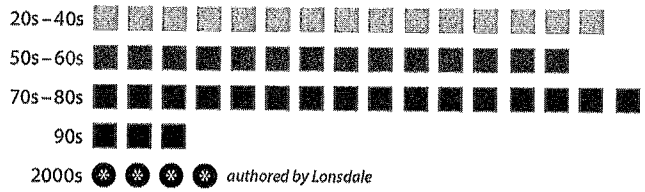
Emily Verba Fischer

1 — Functionality Versus Excellence

Legibility as studied from the 1920's until today (see *Figure 1*) is the focus of Maria dos Santos Lonsdale's article "Typographic Features of Text: Outcomes from Research and Practice." It is curious that the cited legibility studies seem to end just as the discipline of graphic design began "growing up" from a trade to a profession (and thus many developments of the digital age seem to be missing from the article). However, Lonsdale's article succeeds in laying out a body of knowledge on legibility to be critically examined with a fresh lens. A design educator like myself assumes the audience of her article (comprised of practitioners, teachers, and students) might be interested in something more than legibility. In order to communicate effectively in today's image flood, the design of text must be aesthetically sophisticated in addition to legible — that is of course if it wants to retain a viewer's attention.

Figure 1

Number of sources cited by decade



Students must certainly learn the principles Lonsdale has outlined, but through rigorous heuristic approaches in the classroom — reading alone will not do. Then, they must learn to combine these "ingredients" meaningfully so that the typographic cake they bake may be appropriately analytical and/or poetic, depending on the context and content. The cultivation of typographic sensitivity in design education is what elevates merely functional typography to excellent typography. Typographic sensitivity may be defined as a group of elements arranged together (made of letterforms, lines or bodies of text —potentially combined with imagery) that live in harmony with one another. I teach my students that every element within a format needs to have some kind of relationship (if not multiple relationships) to everything else. There is so much visual pollution in our virtual and physical worlds — merely knowing how to make type functional is not enough.

With functional typography, 1+1=2. The typographic result successfully accomplishes an intended communication task and is "legible." With excellent typography, 1+1=3. The typographic result is not only functional, but also aesthetically sophisticated. It is accessible and approachable. It succeeds in appropriately entertaining, informing, and/or persuading, depending on the intended audience. It may provide a visceral connection with the reader, if only for a short moment of delight or pause. It is well conceived and perfectly executed, promoting memorability and knowledge retention. If on the poetic side, it is imaginative. Beauty is a by-product of typography created correctly. In most cases though, excellent typography is invisible, bowing perfectly to its queen, Content.

The aptly titled chapter "Attractive Things Work Better" in Donald Norman's book *Emotional Design* illuminates how emotion is the bridge between harmonious aesthetics and the optimal functionality, or performance, of design. He states, "Emotions, we now know, change the way the human mind solves problems—the emotional system changes how the cognitive system operates" (page 18). Norman delves into how emotion touches upon the visceral, behavioral, and reflective parts of the brain (page 21); positive emotions can "broaden thought processes and facilitate better creative thinking, brainstorming, and the examination of multiple alternatives" (page 19). He cites a study performed in Japan where the perceived use of an ATM interface deemed "attractive" was easier to use than an unattractive interface. To prove the experiment wasn't culture-specific, the same experiment was performed in Israel, with success (page 17). Some conditions that tap into genetically programmed "positive emotions" include symmetry, brightness, saturated hues, and "sensuous" shapes (page 29). In a nutshell, harmonious design leads to positive emotions, which lead to increased knowledge and knowledge retention. This is the goal of typography.

2 — Typographic Features of Text: Going Deeper (Examples from the Classroom)

In her article, Lonsdale articulates published research on the following typographic principles: typeface choice, type variants, all caps versus lowercase, type size, color, micro spacing, macro spacing, configuration, and typographic structure. Of these principles, I will discuss only three in this article: typeface choice, micro spacing, and typographic structure. In my opinion, typeface choice and micro spacing are two of the most crucial for a student's early development of typographic sensitivity, and require rigorous focus on singular typographic principles. Typographic structure, on the other hand, illustrates ways students combine several principles in tandem to create harmonious compositions.

2.1 — Letterform Design: In Response to Lonsdale's Principle "Typeface Choice"

Choosing and using bad (or even worse—mediocre) typefaces is like digging through the garbage for dinner, while ignoring a Grade-A steak sitting in front of you. I always ask students to identify which typeface they are using and where it came from. Who designed it? Was it a middle school student with access to technology or was it a student at the Werkplaats Typografie? Was it designed in the past 100 years, or the past 100 days? Is it just a yard sale Futura, or the poor man's Bembo?

A great chef's training begins with learning the subtle nuances of flavor, just as the type designer begins with the letterform. One pinch of spice or mixture of spices completely changes the tone of a meal, just as the effects of a serif, for example, completely change the tone of a text body. Good students come to understand that a letterform's anatomic details have domino effects in a text body. Understanding nuances (such as how counter spaces, x and y heights, or small cuts in a serif will make a letterform feel less heavy overall on a page) sets them apart as designers with heightened sensitivity. Once the student understands the subtleties of sans serif and serif letterforms, they are ready to begin making informed typeface choices for bodies of text. In order to understand these subtleties, they must draw.

The structure of the Communication Design program at the University of Cincinnati has always been sequential and methodical. Students toggle between semesters of school with full-time, paid internships or "co-op" experiences. Co-op employers have praised our students for understanding the consequences of typeface choice on the overall tone and appearance of text. Meanwhile, there is discussion among faculty about whether there is enough time in our curriculum to devote to drawing letterforms. I maintain that learning the architecture of the letterform is one of the critical building blocks of a solid design pedagogy; a necessary step in cultivating typographic sensitivity. Repetition and attention to detail through analogue drawing establishes an intimate relationship between student and letterform — not for the ultimate goal of designing typefaces for a living, but to develop discipline, patience, and craft. A solid foundation using the hand, brain and eye is in place before moving to the computer to trace final drawings.

Students may draw type more accurately in later years, having been taught correct proportions earlier in their education.

Figure 2A

Hand letterform design process (serif and sans serif). Freshman level: Jonathan Baird

Figure 2B

Letterform Design Process (serif and sans serif). Freshman level: Mykala Hayes

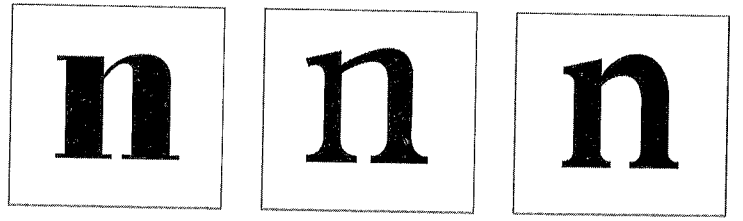


Figure 2C

Final "n"s. Freshman level: Michael Emerick, Kendra Gullno, Evan Hoffman

2.2 — Tracking Exercise: In Response to Lonsdale's Principle "Micro Spacing"

You have to have philosophy or else you are {David} Carson.
Wolfgang Weingart, 2004

As a disciple of the Basel School of Design, I am one who firmly believes in typographic boot camp. Any analogy works here: learning the ABCs before writing, learning basic notes before composing, etc. As students progress through their typographic education, they must quickly begin to meaningfully weave the principles outlined by Lonsdale together. Before this happens, however, no micro detail is too micro. Sensitivity is always achieved through limitation. For example, consider tracking. Type foundries do not communicate a fixed 0 tracking to our favorite text robot, InDesign. Therefore, when a student types a line of text with no tracking, it is not regulated. Students must learn to optically identify the proper tracking, and harness the computer as a tool. This is often confusing — I am not suggesting that students grossly track body copy. I am requiring that they sensitively find the proper 0 value through intense optical training.

Figure 3A

Enlarged snippet of Avenir, size 10/14, base tracking set to 10. Freshman level: Mailcole Mamo

is a world renowned Swiss typographer, responsible for designing internationally known typefaces such as Avenir and Univers. He died on September 10, 2015 at the age of 87, thus ending a career that spanned over 60 years. Frutiger stands as one of the most important typeface designers of 20th century. Everyday, in the media driven world, readers encounter his fonts. Graphic designers and font users alike equate the Frutiger name with beautiful, functional designs that withstand the test of time.

Figure 3B

Enlarged snippet of Baskerville, size 10/14, tracking set to 12. Freshman level: Cara Sortino

designs resulted in the creation of "Prairie School" architecture which lead him to be considered the most influential architect of his time. Wright worked not only as an architect but also applied his talents to graphic art and writing. When asked about his process, Wright remarked, "I never design a building before I've seen the site and met the people who will be using it." Wright's Prairie Style architecture exemplifies how design should

2.3 — Achieving Sensitivity: In Response to Lonsdale's Principle "Typographic Structure"

Most design educators are familiar with the basic type exercise focused on variation with limitations in place. For example, students are only allowed to design using 10/14 type with one type weight in the first round of the exercise. Freshman find it difficult to connect what they are learning about composition in other courses to text layout. After several thumbnails are drawn, students begin exploring digital compositions. In class, we talk about dynamic margins and unifying the space between all typographic elements. After discussing this at length, I ask the students to close their laptops and chop up their pages in order to improve their compositions. They may choose whether to make micro-adjustments or completely change the composition. A student named Li Mo stated, "Somehow I am much more creative when I'm using my hands." If emoji were acceptable to place in academic texts, I'd place the clapping hands right here.

Figure 4A

Students happily rethinking their digital variation by manual means — eyes, brains and hands only!

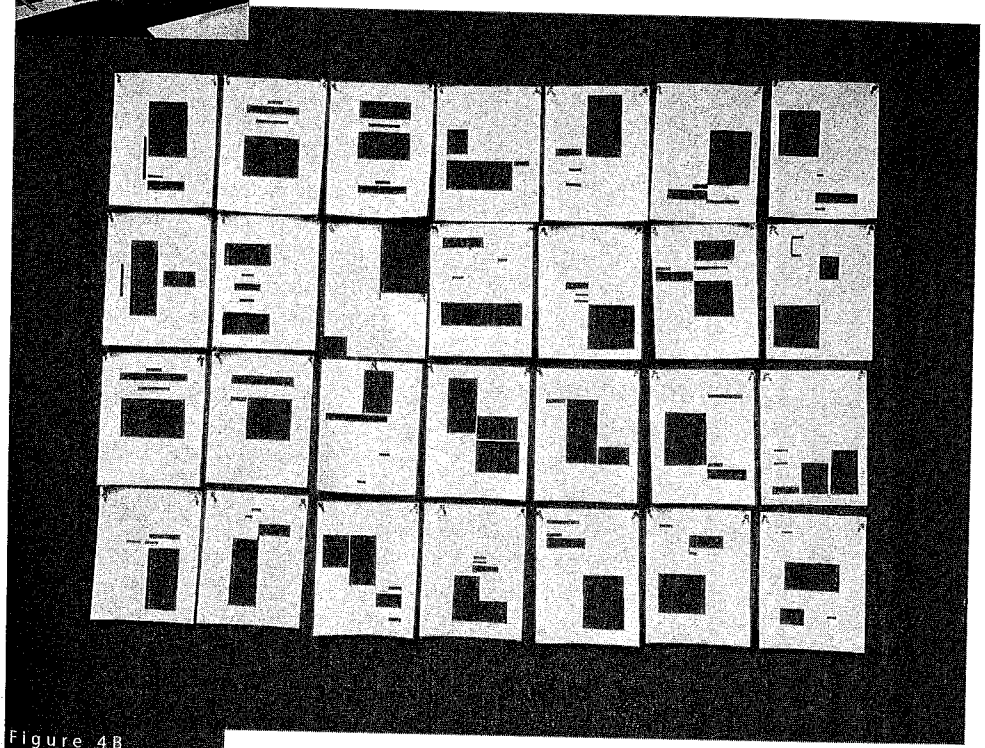


Figure 4B

Students analyzed the negative space from their manual refinement debris.

In his book *Visual Thinking for Design*, Colin Ware presents an opinion on the importance of structure from the neuroscience lens:

> Visual space is divided up into regions of common texture and color. Long chains of features become connected to form continuous contours. Understanding how this occurs is critical for design because this is the level at which space becomes organized and different elements become linked or segregated. Some of the design principles that emerge at this level have become understood through the work of Gestalt psychology (gestalt means form or configuration in German). But there is also much that we have learned in the intervening years through the advent of modern neuroscience that refines and deepens our understanding. (page 14)

The ultimate goal he presents for visual design is to create such that "visual queries are processed both rapidly and correctly for every important cognitive task the display is intended to support" (page 14). The responsibility of visual communication designers is profound — we must understand thoroughly what the intended communication is for a specific audience, no matter how small the design task. Pummeling this mentality into the freshman skull can be challenging, as most of them still think of design as "art."

Attention to all typographic principles yields the harmonic balance of the syntactic, semiotic, and pragmatic. The following student example in Figure 5 exemplifies many of Lonsdale's outlined principles in combination (typeface choice, type variants, all caps versus lowercase, type size, color, micro spacing, macro spacing, configuration, and typographic structure), and attain a balance between functionality and intuition. It has become increasingly important for students to analyze and design with complex content (information architecture), organizing effectively to reveal hierarchy and sequencing.

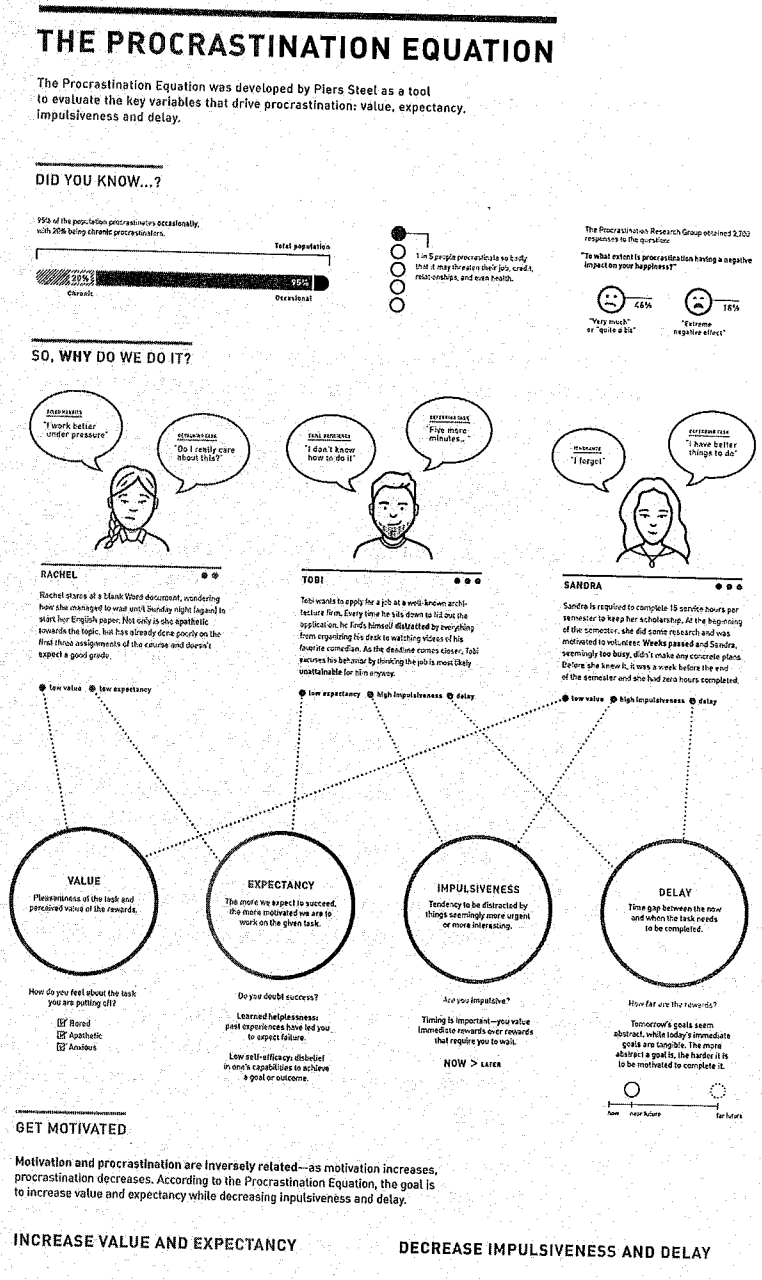
Figure 5

(opposite page)
The Procrastination Equation, Information Graphic, Pre-junior level: Rebekah Leiva

4. Conclusion:

Design is situated in the center of a delicate continuum between art and science. We have all heard the old adage about form and function; we must continue to respect it as our profession evolves. In order to achieve excellence, sensitivity must be cultivated in the classroom by first practicing the typographic principles outlined by Lonsdale (in isolation and in combination). Through repetition, the principles are internalized and become second nature for the student. Once these functional rules are habit, it is possible for them to use their intuition, taste, and voice in conjunction with this internalized knowledge to arrive in the center of the continuum.

There is no shortcut to typographic sensitivity, which is why it remains the ultimate indicator separating the "men from the boys" in terms of graphic design skill. It is the difference between a functional graphic



designer and an excellent designer. As the discipline of design continues growing up from its history as a trade to a profession, educators must cultivate the relationship between time and quality in teaching typographic principles — one by one, and then in combination. No detail is too micro. Once students understand the significance of these processes, they can achieve meaningful results faster when they are practicing professionally.

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Renee Seward is a tenured Associate Professor of Communication Design in the College of Design, Architecture, Art, and Planning. Ms. Seward teaches typography and design methodology courses within the program. Her research focuses on the development of multi-sensory learning tools for education. She is the creator of the See Word Reading tool, which teaches children sound/symbol correspondence. Ms. Seward brings to this project her expertise in Universal Design for Learning.

Book review:

Information Design as Principled Action

Jorge Frascara (ed.)

Explaining explanation design

The principles referred to in the title of *Information Design as Principled Action* are "the passion to help people attain their information-related goals," and "the passion to do things well" (p. 1).

Information Design as Principled Action (IDaPA from now on in this review) is a useful addition to the existing literature on information design. It gives a fresh overview of this discipline, ironically known by a slightly imprecise term. Readers will find a collection of most diverse contributions from a cohort of respected designers and researchers.

The book comprises 22 chapters written by 28 authors. The chapters are grouped in five parts: Introduction (1), Conceptual Frames (5), Historical Overviews (3), Case studies in design practice (8), and Case studies in design education (5). The contributors have not answered to a tight brief; rather, they have written about whatever they found interesting to share.

What is information design?

Information design is explanation design. Information design explains facts about the world and leads to knowledge and informed action. IDaPA's editor, Jorge Frascara does not offer this explanation in his 46-page introduction "What is information design?" He sticks to the definition offered by the International Institute for Information Design:

> Information design is the defining, planning, and shaping of the contents of a message and the environments in which it is presented, with the intention of satisfying the information needs of the intended recipients. (p. 8)

While being precise and comprehensive, IIID's definition is long enough to be difficult to remember. Also, it conflicts with Frascara's previous statement: "The messages that we broadcast are not received, but are interpreted by people" (p. 6). How can messages be interpreted without first having been received?

Jorge Frascara's introduction is also comprehensive:

> My introduction will deal with the conception of a design project and the importance of its final objective, the organization of the design process, the organization of content and its impact on visual structures, the importance of the user, the consideration of cultural differences, perception, legibility and readability, notions of color, the importance of the context of implementation and use, the role of images (representation and symbolism), diagrams, data design for decisions, and the need for research and evaluation. (p. 5)

Within this impressive agenda Frascara presents many details, sometimes strictly tangential, but also reaches bold conclusions, such as "Every design problem is interdisciplinary" (p. 16).

Most space (12 pages) is devoted to a highly detailed account of typography. Other main topics include Frascara's personal information design process and ISO's process protocol for the development of new pictograms. Ironically, the verbal descriptions of the pictograms, not the pictograms per se, constitute the standards. Diagramming also gets a fair share of the attention.

Wayshowing is given five lines under the heading "professional relevance." Readers are told that design studio Mijksenaar's four [three?]-color signage program for the New York airports "assume[s] a quality of paradigm" and "The approach is useful not only for any airport but also for other public facilities" (p. 49). Not totally true. Paul Mijksenaar is a great information designer, but color identification of sign types is not a new idea, nor is it necessarily the best idea available in all situations.

Tightly woven into the introduction are Frascara's respect for the difference between the user/s and the designer, the necessity of user-centered design, and research as being indispensable to good information design.

Conceptual frames

In "The use of worked examples and other forms of explicit guidance in ill-structured problem domains" authors Suna Kyun, Slava Kalyuga, and John Sweller take their point of departure in cognitive load theory, which says that studying worked examples is a great way to learn problem solving, especially for novice learners. However, the problems discussed have traditionally been well structured. The authors argue that this method applies to learning to solve ill-structured problems as well.

Patricia Wright in "Designing information for the workplace" provides useful information concerned with finding the information, understanding the information, and applying the information. Claude Shannon's three levels of communication come to mind.

In "Designing inclusive information space" Veronika Egger warns: "First and foremost inclusive thinking is not about disability" (p. 84). The chapter proves otherwise. Inclusive design is very much about caring for people with any kind of permanent or situational disability. "Solutions that work for people who face the greatest challenges are easy and comfortable for everyone else" (p. 85). This is broadly so, with notable exemptions. People with impaired vision will typically want speaking signs, signs on the floor, and signs at eye level in train stations and similar environments. These measures are not necessarily good for everyone else. Signs to be seen by everyone else from a distance should normally be placed above eye level.

Veronika Egger presents two illustrative cases where qualitative evaluation methods have strengthened inclusive design. In the first case, use of a virtual environment serves as a predictor for a real-world transportation building including its orientation system. The second case deals with testing the information quality of an intercom system placed outside police stations in rural areas.

In "Graphics with a cause: Otto Neurath and Hans Rosling" Yuri Engelhardt compares the intentions of two great information designers. Otto Neurath (1882–1945) was an Austrian political economist, social scientist, and philosopher; Hans Rosling is a Swedish medical doctor and scientist. According to Engelhardt there are four similarities in their intentions:

> [F]irst, both Neurath and Rosling believe that statistical data should be accessible to everyone. Second, both believe that making people aware of the relevant statistical data can raise awareness about global issues. Third, they are both convinced of the power of the visual. And fourth, they both employ the latest media technology of their times. (p. 97)

Next time Yuri Engelhardt deals with Neurath and Rosling, it would be nice to see a comparison between one of Neurath's great Isotype picture tables and Rosling's dynamic income–life expectancy bubble charts. What are the similarities/differences? What did Rosling bring to the table? Doesn't Rosling owe more to John Playfair than to Neurath? Would Neurath have approved of Rosling's bubbles? (The size of the bubbles represents the population size in countries/parts of countries.)

Historical overviews

In the first historical overview, "Even cavemen could do it better," Dietmar Winkler presents a pessimistic view on today's design profession:

> But most designers are not better educated or informed than the public on any subject matter. Like the public they only respond to the latest fads or social, political and technological rumors, delivered in media news bytes. They are as unprepared to critically interpret and separate fads from trends or framing cultural propositions. (p. 104)
>
> design has to direct observation, not just waiting to give shape to information, which has been assembled and authored by others. Universities should focus on specific knowledge areas and develop disciplinary concentrations for information design experts (i.e. medicine, law, hard and soft sciences, etc.). (p. 109)

In the second historical overview, "Pictopolitics: Icograda and the international development of pictogram standards: 1963–1986," Wibo Bakker delivers a thoroughly researched account of Icograda's not entirely successful efforts to influence the development of international pictogram standards. While Icograda's efforts met many obstacles, railways and Olympic games turned out to be great influencers on the development of pictograms. Bakker expresses some skepticism about ISO's peculiar dissemination of standards: "organizations have to buy ISO 7001 [concerning pictogram standards] to use it." (p. 134). "This carries not favorably on the design world's familiarity with it." (p. 134). Also, Bakker punctures the often-proposed Isotype influence on modern pictograms. It—Bakker calls it the "Isotype-Aicher construct" (p. 142)—has never been substantiated.

Case studies in design practice

In "The rhetoric of redesign in bureaucratic settings" Karen Schriver relates an information design project for the New York City Department of Transportation. Redesigning an application form for citizens who want permission to install temporary festival lighting on the streets for an event, Schriver and her team took as their point of departure the needs of external as well as internal stakeholders; the client as well as the audience. Schriver and her team then organized the information from the perspective of the external stakeholders.

The immediate supervisors and collaborators embraced the new design. However, the city's legal team, which had not been introduced to the team earlier in the process, rejected the new design. The lawyers found they could have produced a better plain English version; they found that the new version was longer, not shorter, than the old version; and they criticized as unnecessary some advice given about planning festival lighting.

In retrospect, Schriver suggests that her team should have insisted on at least one face-to-face meeting with all internal stakeholders. Designers must construct good design and connect with external stakeholders; they must also ensure that all internal stakeholders are onboard.

Karel van der Waarde and Carla G. Spinillo in "The development of visual information about medicine in Europe" and David Sless in "Regulating information for people" also relate the sometimes disappointing role played by supervising authorities.

Van der Waarde and Spinillo acknowledge that the design of information about medicine is included in European law: "The package leaflet must be written and designed to be clear and understandable, enabling the users to act appropriately, when necessary with the help of health professionals" (p. 185). However, the system does not encourage improvement. If designers deviate from already approved designs they have to deliver "empirical evidence that is comparable to the evidence that is required for the registration of medicines" (p. 188). The authors suggest a modified legislation that stimulates innovation and allows performance-based criteria.

In "Regulating information for people" Sless also deals with medicine information. He presents his longitudinal work using performance-based rather than the content-based information traditionally prescribed by authorities. Sless and his Communication Research Institute, CRI, have substantiated the proposed change by their systematic work with their robust

information design process.

Unsurprisingly, Sless takes his point of departure in what the consumer needs (from the labeling), which he calls "scoping." It includes consultation with all stakeholders as well as deciding the level of target performance. From there on the process continues with design, testing, and possible adjustment. Sless argues that the structure, the order of headings, are the most important factors in label design. Headings, instructions, and explanations, in that order, are key components of good medicine labeling.

At some point Sless and his team succeeded in convincing Australian authorities about the advantage of performance-based rather than content-based medicine labels. However, a draft of a new set of labeling guidelines suggests a return to the rules, pre-dating Sless's intervention.

"Transforming government letters: design and writing working together," by Rob Waller and Jenny Waller deals with graphic editing: adding visual structure to verbal documents. They work with enabling strategic reading, which is reading with a purpose. Proficient readers read strategically; they read certain texts carefully, skimming others, perceived as less important to them. Less proficient readers need help, which the authors suggest giving by layering letters logically in different clearly distinguishable parts, sometimes including panel pages and calculation pages.

Patterns, an idea adopted from Christopher Alexander's patterns in architecture, may be instrumental in document layering. In government letters patterns can be such items as news headlines, panels, summary tables, and narrative sums. By using patterns Waller and Waller layer texts in clear parts, which encourages strategic reading. Well-written letters are the result of both writing and design. Plain English is not enough. Graphic structure is essential.

"Design as a catalizer" [sic] by Roald Shakespear is a verbose stream of consciousness, stuffed with more or less relevant, sometimes funny, quotes and anecdotes. The account also includes three wayshowing projects in Buenos Aires: a visual plan for Buenos Aires, the Buenos Aires subway, and Biopark Temaiken.

To sum up

Readers of this review will understand that IDaPA is generous with essential information. It adds to our shared knowledge and understanding of good information design. However, some chapters—most of them not mentioned in this review—would have benefited from some editing, including truncation. Also several contributions would have gained from dropping their name-dropping: *Thanks to an invitation by xxx, yyy and I were offered a workshop at www*, etc.

As an example of information design IDaPA is not totally perfect. Important illustrations are shown in unreadable small formats, some captions are missing, a section heading is missing, typographic execution is poor. Books on information design should lead by example.

Information design as principled action
Jorge Frascara (Ed.)
318p, 17.5x25.5cm, US$ 35

Per Mollerup
Professor of Communication Design,
Swinburne University of Technology, Melbourne

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