Balancing typeface legibility and economy
Practical techniques for the type designer

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Enemies or friends?

Typeface legibility and economy — are they adversaries or can they work together? Their relationship is filled with tension. Common wisdom says that efforts to increase legibility can reduce the amount of text on a page, whereas techniques used for efficient use of space can jeopardize legibility. Is this the real situation?

This essay looks at some of the variables that affect legibility, particularly those under the control of the type designer. From this foundation, it continues with a summary of techniques used in the design of economical typefaces throughout type history and evaluates their impact on legibility. The focus is primarily on Roman text types, even though others (sans-serif, blackletter) can be quite compact and legible in their own right. Extreme experiments in legibility or economy are also not covered as they have little practical value.

What makes a typeface legible?

Communication through the printed page requires the reader to translate symbols into meaning. Legibility refers to how easily this critical process is performed. Ovink defines it as 'the ease and accuracy with which a reader is able to perceive the printed word'.[1] Although a case can be made for using two separate terms — legibility (visual perception) and readability (comprehension)[2] — this essay will not make such a distinction.

Legibility has been studied using tests of reading speed, comprehension, ocular movement and many other criteria. The sheer number of studies on legibility highlights its importance. It has also been problematic, as each

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[1] Lynne Watts and John Nisbet, *Legibility in children's books: a review of research* (Windsor: NFER Publishing Company, Ltd., 1974), p. 10.

[2] Walter Tracy, *Letters of credit* (London: Gordon Fraser Gallery Ltd., 1986), p. 31.

investigation redefines legibility according to a new standard. The result is broad disagreement as to what makes text legible. In reality, there are too many varia-bles that contribute to legibility to determine a set of hard and fast rules for maximizing it.[3] It is possible, however, to determine some general guidelines that can help to create legible text.

One area of agreement among many researchers and writers is that typeface legibility is strongly, if not primarily, influenced by choices made in typographic layout and not by typeface characteristics.[4] It is quite easy to design a page using a generally legible typeface (such as Times Roman) and yet create quite illegible text, or text that is poorly suited to its intended pur-pose. Further discussion of layout and use techniques falls out of the scope of this essay but cannot be discounted.

There are some typeface characteristics, though, that lend themselves to more legible text than others. These are the areas that can be controlled by the type designer — color, weight, size, distinctive features and others. Through careful attention to these considerations, the type designer can make it easier for the typographer to create legible text.

Ascenders, descenders and x-height

It has been suggested that x-height may be the most important factor in typeface legibility, particularly in small sizes.[5] Letters with ascenders or descen-ders are critical for word shape and letter recognition.[6] Long ascenders and descenders help to distinguish characters from one another, such as **h** and **n**.[7] Smaller x-height also increases the white space between lines and 'emphasizes the line-image of the typeface'.[8] Types with very large x-heights can be slower to read, probably due to weaker word shapes.[9]

Nevertheless, research has concluded that typefaces with larger but moderate x-heights are generally more legible at small sizes and under some reproduction methods. It seems that the increased x-height gives increased legibility like that of a larger type size. Types that differ somewhat in style, such as Times and Perpetua, can even have similar legibility if their x-heights are equalised.[10]

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[3]   Watts and Nisbet, p. 13.

[4]   Merald E. Wrolstad, 'Methods of research into legibility and intelligibility', in *Typographic Opportunities in the Computer Age*, ed. by John Dreyfus and René Murat (Prague: Typografia, 1970), pp. 36–41 (p. 37).

[5]   E. C. Poulton, 'Size, style, and vertical spacing in the legibility of small typefaces', *Journal of Applied Psychology*, 56 (1972), 156–61 (p. 158).

[6]   Herbert Spencer, *The visible word* (London: Lund Humphries, 1969), pp. 14–15.

[7]   Watts and Nisbet, p. 31.

[8]   André Gürtler and Christian Mengelt, 'Fundamental research methods and form innovations in type design compared to technological developments in type production', *Visible Language*, 19.1 (1985), 122–47 (p. 143).

[9]   Betty Binns, *Better Type* (New York: Watson-Guptill Publications, 1989), p. 17.

[10]   Herbert Spencer, Linda Reynolds and Brian Coe, *The effects of image degredation and background noise on the legibility of text and numerals in four different typefaces* (London: Readability of Print Research Unit, Royal College of Art, 1977), p. 1; Poulton, p. 158.

Contrast

There has been little research into contrast and its relationship to legibility. Tinker found that increased contrast did not enhance legibility. On the contrary, thin lines can actually diminish it.[11]

Though not directly supported by research, designers have distinct opinions on contrast. Weidemann wrote that 'Strong contrasts […] result in a choppy typographic appearance and reduce reader recognition of distinctive letter characteristics.'[12] Tschichold and others, though, were of the opinion that abandoning contrast would harm legibility.[13]

Color and stroke weight

A summary of various studies showed that there is no clear difference in legibility between regular and bold weights, although readers preferred bolder faces.[14] It has been suggested that extremes of color should be avoided and that 'The optimal stroke width for individual letters should be about 18% of the total width or height of the letter.'[15]

Serif design

Why have serifs at all? Common wisdom, oft repeated, is that serif faces are inherently more legible than sans-serif ones. Many studies support this view, although their validity is sometimes questioned.[16] The bulk of research, however, shows a mixed result when viewed as a whole.

The shape of serifs can influence legibility. Tinker found that long, heavy serifs (such as in slab-serif types) can decrease legibility.[17] In certain production environments, particularly phototypesetting, bracketed serifs retain their shape best, increasing letter distinction and legibility.[18]

Distinctive character features

Legibility is higher in typefaces with strong distinctive character shapes. Foster recommended emphasizing features that 'promote rapid and accurate letter discrimination'.[19] Because the top half and right side of letters seem to be most important for letter recognition, they are good places to highlight distinctive characteristics. One criticism of Modern style typefaces is that the design created too much uniformity of letter shape.[20]

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[11] Spencer, *The visible word*, p. 25.

[12] Kurt Weidemann, 'Biblica — designing a new typeface for the Bible', *Baseline*, 6 (1985), 7–11 (p. 7).

[13] Jan Tschichold, 'Of what value is tradition in type design?' in *Typographic Opportunities in the Computer Age*, ed. by John Dreyfus and René Murat (Prague: Typografia, 1970), pp. 52–55 (p. 52); Watts and Nisbet, p. 30.

[14] Spencer, p. 31.

[15] Rolf F. Rehe, *Typography: how to make it most legible* (Carmel, Indiana: Design Research International, 1974), p. 31; p. 24.

[16] Ole Lund, 'Why serifs are (still) important', *Typography Papers*, 2 (1997), 91–104.

[17] Spencer, p. 25.

[18] Weidemann, p.7.

[19] Jeremy J. Foster, *Legibility research 1972–1978: a summary* (London: Graphic Information Research Unit, Royal College of Art, 1980), p. 14.

[20] Watts and Nisbet, p. 37; p. 33.

Counter shape

Counters — the white spaces inside letters — are very important. Watts and Nisbet found compelling agreement among various studies that 'the greater the relative area of the enclosed space within a letter, the greater its legibility'. For example, **e** can be made more legible by increasing the internal white space. They also point out that other techniques to increase legibility (bold print, higher contrast) can actually decrease legibility if they reduce internal space.[21]

Shape is also important. Because counters give the eye important clues in letter recognition, varying their shapes can also help increase distinctivity and legibility.[22]

Familiar forms

The most terse comment on legibility is attributed to Eric Gill: 'Legibility, in practice, amounts simply to what one is accustomed to.'[23] Although humorous, it has been confirmed by research. Familiar forms are more legible than unfamiliar ones.[24] So it seems best to remain close to basic, familiar shapes when trying to maximize legibility.

The need for economy

The desire — and need — for typeface economy is not new. From the very beginnings of writing symbols on media, there has been pressure on the scribe to fit as much text on a page as possible. The cost of material has always been a concern, but is joined by the desire to publish compact, portable editions. These concerns live on today as web designers seek to fit as much content as possible within one window size to minimize scrolling.

This concern resulted in interesting experiments in writing economic-ally, first on the manuscript page and later in type itself. Blackletter scripts, for example, are a direct result of attempts to take an existing script (in this case, later Carolingian hands) and find creative ways to fit more text on a line, and more lines on a page.[25]

Designers of Roman type throughout history have applied these and new techniques to their realm. Their concern for space conservation initially focused on vertical character alterations that allowed more lines of text on a page, but soon affected the most basic parameters of letter shape. New techniques were developed not only to make letters more compact, but to make smaller letters more legible.

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[21] Watts and Nisbet, p. 25–31.

[22] Stuart Gluth, 'Roxane, a study in visual factors effecting legibility', *Visible Language*, 33.3 (1999), 236–53 (p. 246).

[23] Spencer, p. 11.

[24] Watts and Nisbet, p. 33; p. 38.

[25] Donald M. Anderson, *Calligraphy: the art of written forms* (New York: Dover Publications, Inc., 1969), p. 84.

Shortened ascenders and descenders; increased x-height

Initial attempts at economical type began with casting type of one size on the body of the next smaller size. The resulting economy was gained because lines of text were closer together and not a result of any actual changes in letter design.[26]

Soon, the character shapes themselves became malleable. Pierre Haultin, sometime between 1557 and 1559, was the first punchcutter to experiment with enlarging the x-height of letters.[27] His *Philosophie Romaine* had an x-height only slightly larger than the common Garamont of similar size, but large enough to make a difference in perception. The increased x-height improved legibility, allowing text to be set at a smaller size, yet be as readable as larger sizes of other faces.

Figure 1. Garamont's *Cicero Romaine* (11 pt.) and Haultin's *Philosophie Romaine* (10 pt.) compared with equalized ascender heights.[28]

Increasing x-height has the resulting effect of shortening ascenders, but type designers have also explicitly adjusted descenders to increase economy. Shorter descenders allow lines of text to be set more closely — with greater economy.

This technique was used heavily in the newspaper types of the twentieth century. Descenders were sometimes changed to such an extent that letters took on different forms. Ionic, The first of Linotype's Legibility Group, illustrates some of these transformations. The lower stem of **p** is shortened considerably. The ascender of **b** is quite short. The link of **g** is raised above the baseline, giving it a cramped and twisted look. The counter of **y** is shrunk both horizontally and vertically to allow enough room for the tail. Although these features aid economy, the departure from traditional shapes can actually threaten legibility when taken to such an extreme.

Figure 2. Linotype Ionic at 9 pt. size.[29]

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[26] Stanley Morison, 'On the classification of typographical variations', in *Letterforms: typographic and scriptorial* (Point Roberts, WA: Hartley & Marks, 1997), pp. 3–94 (p. 16).

[27] Ibid.

[28] Types 29 and 26 of Christopher Plantin's Index Characterum 1567, in Hendrik D. L. Vervliet and Harry Carter, *Type specimen facsimilies II: reproductions of Christopher Plantin's Index Sive Specimen Characterum 1567 & Folio Specimen of c. 1585, together with the Le Bé–Moretus Specimen c. 1599* (London: The Bodley Head, 1972).

[29] *Linotype news faces* (type specimen) (London: Linotype & Machinery Ltd), p. 2.

Shortened descenders, however, do not need to harm legibility. Skilled designers such as Dwiggins and Unger agree.[30] Descenders can be designed in ways that are not quite so radical. Unger's own Gulliver is a good example of this, and will be discussed later in greater detail.

There is a limit to the economic effect of these transformations. Unger comments that 'too often a large x-height requires extra leading, thus nullifying most of the saved space'.[31] Harry Carter agrees: 'Several contemporary 12 point types fail because their ascending and descending strokes have been shortened until there is not enough white between the lines, and leading only accentuates their deformities.'[32] This was written in 1937, during the great popularity of the Legibility Group.

There is clearly a need for balance when adjusting x-height, ascenders and descenders to both maximize economy while retaining legibility. Watts and Nisbet suggest that this balance can be attained by shortening descenders and lengthening ascenders.[33] This is, in fact, exactly what Linotype did with Ionic's very popular successor, Excelsior.

narrow-column matter. Other factors are (i) reproduction: the type must print clearly even when stereotyped and rotary-machined, which means that it has to have a clean and open cut; (ii) colour: the drawing of the letter should be strong enough to avoid greyness, even with thin inks at high speeds, while retaining sufficient contrast between the thick and thin strokes to beat monotony; (iii) proportion: the height/width relationship should be oblong, not square, and the body of the type (x-height) must not seriously encroach on the ascen-

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Figure 3. 9 pt. Ionic and Excelsior compared.[34]

Along with the x-height, most of Excelsior's lower-case letters (those without ascenders or descenders) were reduced, resulting in greater overall economy. Alphabet length was reduced from Ionic's 139 points to 132 for the 9 point size. Excelsior also seems more legible and pleasant to read.

Condensed forms

Excelsior was not the final word in economical, legible typefaces. Early criticism of the first Legibility Group faces was that the large, wide, lower-case forms worked against economy, especially in narrow column widths, driving newspapers to desire more condensed forms.[35] This desire was nothing new. The use of condensed forms as an economic design element began in the eighteenth century and reached its peak with the Didots, where narrow forms

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[30] Gerard Unger, 'Experimental No. 223, a newspaper typeface, designed by W. A. Dwiggins', *Quaerendo*, 9.4 (1981), 302–24 (p. 319).

[31] Gerard Unger, 'The design of a typeface', *Visible Language*, 13.2 (1979), 134–49 (p. 141).

[32] Harry Carter, 'Optical scale in typefounding', *Printing Historical Society Bulletin*, 13 (1984), 144–48 (p. 148) (first publ. in *Typography*, 4 (1937), 2–8).

[33] p. 31.

[34] *Linotype news faces*, p. 2.

[35] Gürtler and Mengelt, p. 136.

became standard.[36] Since then, narrower forms have been used in faces from many typographic traditions, commonly for the sake of economy.

The effect of condensed forms on legibility has not been objectively studied, but Weidemann suggests that extreme compression can cause 'characteristics of individual letters [to] fade into sheer verticality'.[37] An example using Slimbach's Minion typeface makes this clear.

> Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diem nonummy nibh euis mod tincidunt ut lacreet dolore magna aliguam erat volutpat. Ut wisis enim ad minim veniam, quis nostrud exerci tution ullam corper suscipit lobortis nisi ut aliquip ex ea co modo consequat. Duis te feugi facilisi. Duis autem dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accum

Figure 4. Slimbach's Minion Multiple master typeface with 367 weight and 450 width.

Minion was designed specifically as digital type and produced with Adobe Multiple Master technology. Width is adjusted not by brutal mathematical compression, but according to parameters set by the designer. Here, the width axis of the font is set to the minimum allowed (about 87% of normal). Despite Slimbach's impressive efforts to give his old-style face a successful condensed version, it still begins to show some 'sheer verticality'.

So how does one design condensed forms successfully? In early 1942, during the time of conservation efforts due to World War II, W. A. Dwiggins began a series of experiments toward the design of a highly economical face. At the same time a request was made for a face with a Spanish flavor. The two projects became one, and the result was Eldorado.[38]

Figure 5. Dwiggins' Eldorado in experimental 24 pt. size.[39]

Dwiggins was not new to the idea of economical types, but here he focused more attention to economy through condensed forms, unlike the vertical adjustments common in newspaper types. Although never very popular, Eldorado illustrates some useful concepts in economic design.

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[36] Morison, pp. 25–38.

[37] p. 8.

[38] *Eldorado* (type specimen) (New York: Mergenthaler Linotype Company, 1953), pp. 4–5.

[39] p. 11.

The greatest danger in condensed design is to compress everything. Dwiggins, on the other hand, carefully chose which letters to compress. Those letters which naturally respond well to compression — **a f r s t** — are thinned to the extreme, without diminishing critical features. Note the strong form of **a** and the sharp shoulder on **f**. Letters with counters, however, such as **b d g o p q** are given generous space. The diagonal strokes on **v w x y** are steep, making them narrower. He is also careful not to let the internal space of **m** and **n** get too small. All of these features work together to create a pleasant, readable face with no strong sense of compression.

Although they can help, condensed forms are not absolutely necessary for economy. Corona, one of Linotype's most successful newspaper types, has a condensed appearance. A later face, Olympian, based more on an old-style model, feels open and relaxed. Yet it is just as economical as Corona, if not more so. Other economical techniques can substitute for condensed forms.

This is not Olympian, a series from Mergenthaler, a true design departure, traditional only in its legibility under newspaper conditions.

This is Olympian, a new series from Mergenthaler, a true design departure, traditional only in its legibility under newspaper conditions.

Figure 6. Corona and Olympian 9 pt. compared.[40]

Horizontal stress

Old-style forms with angled stress do not easily handle compression. In his typeface Demos, Gerard Unger chose to give all characters a horizontal stress. One effect of this is that the forms can then respond more gracefully to both careful condensation and raw mathematical compression. In his article describing Demos, Unger listed other consequences of this design: 'Such an effect also results in wide open counters, giving the typeface a large look and allowing for a choice of type size one or even two sizes smaller than is possible with most current designs.'[41]

It is also possible to mix the two types of stress and benefit from both the openness of the horizontal and the distinctiveness of the angular. This was common in some Garamond designs and can even be seen in more recent types such as the Olympian example, above.

oorlog tegen Hannibal, werd de cultus van Kybele, de grote moe-dergodin uit Phrygië, naar Rome

Figure 7. Unger's Demos.[42]

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[40] *Olympian* (type specimen) (New York: Mergenthaler Linotype Company, 1970), pp. 3–4.

[41] 'The design of a typeface', p. 141.

[42] p. 143.

Smaller, lighter capitals

Demos is also illustrative of another technique for economy — smaller, lighter capitals. They are slightly shorter than the ascenders, are similar in weight to the lower-case letters (but not quite as light), and are narrower than most capital designs. The visual effect is smooth. Stuart Gluth described a similar effect in his typeface Roxane: 'The capital letters […] are narrow, the letter often being only as wide as is necessary to carry the profile, and light, barely stronger than the lower case, so as not to interrupt the reader's eye'.[43] While this is a pleasant touch with a minor effect on economy in English, it is particularly economical with German texts, or any that use capitals widely.

Techniques for smaller sizes

Until the days of phototypesetting, type could only be used at the sizes for which it was cut. Designers created type for a particular size. Economy was increased by using smaller and smaller type. To make this successful, designers found ways to make smaller type more legible. Harry Carter described these well in his article on 'Optical scale in typefounding'.

Some of these techniques can be seen in the design of *The Times* New Roman — a profoundly economical and legible face. By comparing the 6, 12 and 18 point sizes, the techniques used for the smaller sizes become clear. Note that the smaller sizes are actually less economical in width. Economy comes from the ability to set smaller type more tightly yet retain legibility. Plantin, the type used as the primary model for Times, is also shown for comparison.

Figure 8. *The Times* New Roman 6 pt., 12 pt. and 18 pt. faces shown enlarged to similar size.[44]

Wide forms in smaller sizes provide more space for the important characteristics of each letter, especially the counters so critical for legibility.

Increased letterspacing, as seen here in the 6 point Times, has been used since the days of Haultin to make smaller sizes more readable.[45]

Reduced contrast was a hallmark of most newspaper faces during the early twentieth century. Fine hairlines (as can be found in larger sizes of Times) did not reproduce well in most printing environments of the time.[46] The thickening of thin strokes gave the letters a stronger, more durable image. Although it has generally strong contrast, even Times illustrates this technique in its smaller sizes. Note the thicker shoulder and crossbar in the **a**, the bottom of **b** and the right diagonal of **y**.

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[43] Gluth, p. 147.

[44] *Times New Roman* (type specimen) (London: The Monotype Corporation Limited).

[45] Fred Smeijers, *Counterpunch* (London: Hyphen Press, 1996), p. 139.

[46] Alexander Lawson, *Anatomy of a typeface* (Boston: David R. Godine, 1990), p. 274.

  Stronger overall color is quite common for smaller types. This is quite evident in the 6 point Times Roman and is reminiscent of Plantin.

  Solid, magnified serifs were also an element of Plantin, but one that did not carry over into Times, except only slightly in the 6 point size.

abcdefghijklmnopqrstuvwxyz
abcdefghijklmnopqrstuvwxyz

Figure 9. Monotype Plantin 110 and Times Roman 327 compared.[47]

Focus on distinctive features

  In Eldorado, Dwiggins highlighted distinctive features with great success. Carter calls attention to other specific examples of this emphasis and argues that 'The eye reads only the distinguishing features of the letters, and so the distinguishing features should be stressed in proportion to the difficulty of reading.'[48] This is essentially a legibility issue, but the type designer may need to make compromises when designing economic faces, and it is important that distinguishing features not be lost in the process.

  The 'M-formula' was a specific technique developed by Dwiggins that highlighted distinctive features. It fooled the eye into seeing curves that did not exist by accentuating features with strong, almost angular lines. When highly reduced these angles produced the effect of curvature. It was most effective in 7 point or smaller type, but at 10 point or larger the strong features became too jarring. Although a full implementation of the formula in a face was never completed, its influence lives on in faces such as Telegraph Modern and Charter.[49]

agotefhr nlnimupd
a b e n s   a y c h s

Figure 10. The 'M-formula' as used directly in Dwiggins' Experimental No. 223 and indirectly in later typefaces, Tracy's Telegraph Modern and Carter's Charter.[50]

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[47] Tracy, p. 198.

[48] Carter, p. 148.

[49] Unger, 'Experimental No. 223', pp. 313–323.

[50] Ibid.

The balanced typeface

Are legibility and economy adversaries? No, they do not need to be so. Techniques used to improve legibility, such as the use of wide forms, can actually encourage economy by allowing smaller sizes to be used. Economical techniques, such as condensation of certain forms, can make text easier to read when applied judiciously. The key to harmonizing the two is balance.

The type designer needs to understand the effects of every decision on both legibility and economy. Questions need to be asked: *How much can I shorten these descenders before the letters become misshapen and distracting? Will this really allow lines to be set more closely? Or will the color become too heavy and require extra leading?* The answers are heavily dependent on eventual usage. Techniques appropriate for 6 point type do not apply to a book face. The publishing environment, including paper quality and reproduction process, may make certain requirements on the typeface. There are no simple guidelines for legibility or economy that apply in every case.

Gerard Unger, in his Gulliver typeface, manages to deftly balance legibility and economy. He also does so in ways that are appropriate for the intended purpose — newspaper production.

Clark, an independent when it comes to politics, is not alone in his skepticism. As George W. Bush and Al Gore argue over who has the better plan for dealing with the huge surpluses that experts say are coming,

Figure 11. Gulliver as used by USA Today, reproduced at 180%.[51]

This example shows Gulliver in use, mathematically compressed and tracked tightly. The x-height is large but reasonable. Capitals are thin, short and blend smoothly with the lower-case. Descenders do not immediately seem short, but are actually in the same range as other newspaper faces. Ascenders allow enough white space and are balanced well with descenders, making the whole typeface appealing to read.

Color is even and strong, but without great contrasts. There is, however, enough contrast to give character and distinction to individual letters. Stress is primarily horizontal and survives compression quite well. Remnants of angled stress in letters such as **c d e p** make then more distinct.

The letterforms are somewhat condensed, but not obviously so (although this compressed version enhances that aspect). Counters are open, as are the forms of **a g c e**. The first two of these letters also retain familiar two-story forms.

Unger also highlights important characteristics of other letters. The design of **t** emphasizes the curve at bottom. There are strong terminals on the ends of **y r f.** He also uses a thin form for **s** that aids economy without sacrificing legibility. Serifs are wedge-shaped and hold up well in reproduction, but are not too long. All of these characteristics make Gulliver a successful face for newspaper production and one that attracts the reader.

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[51] *USA Today*, 25 October 2000, p. 1.

With Gulliver, Unger has proven that balance is possible and successful. Through careful experimentation and a thorough understanding of the issues and techniques, a type designer can create a typeface that is highly legible, yet economical. Kurt Weidemann, in his essay on Biblica, eloquently summarizes the experience of designing such faces:

> *When the opportunities of an enlarged x-height and a condensation of the letterforms have been carried beyond a safe point, ease of reading and recognisability of character forms decreases rather than increases. To reach that limit without transcending it is the art of the contemporary type designer.*[52]

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[52] p. 11.

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