About Visual Acuity and Type Design: A Protocol

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It is well known that the fund of knowledge of what is called visual design (graphic design, information design, etc.) has been assembled from many other disciplines. On the one hand, it is possible to talk about subjects that have remained fairly stable over time—subjects such as semiotics or visual rhetoric that have given a theoretical foundation to a predominantly praxis-oriented and intuition-driven discipline and have established bridges between design and other fields of study.[1] On the other hand, graphic design curricula have responded to fast-paced changes, particularly in technology, by incorporating emerging perspectives.[2] Aside from the efforts of keeping graphic design relevant in its current state, there have been calls to practitioners and educators over the past few decades to transform the field into a more rigorous and structured discipline,[3] embrace methods that would lead designers to justify their decisions by "quantifiable means," and embrace empirical and participatory research as a common practice.[4] This is not to say there has been no research on design-related topics. One subject of interest for graphic designers that has produced an extensive corpus of empirical research is the influence of typography and editorial layout on reading activity. Early research was conducted mostly in the field of psychology by Tinker and Paterson between the mid-1920s and the late 1960s;[5] since then, work has been consistently revised and updated in design and other disciplines.[6] The extent of research available on this subject might be exceptional when compared with other design-related topics. Some subjects remain somehow obscure for the average design practitioner—subjects that despite the urge to provide rigor, quantifiable means, and participatory research in graphic design and design in general, have escaped these demands. One of these subjects is type design, a topic that despite its closeness to typography remains seen more as a craft-like practice, presumably due to a lack of didactic resources and protocols. According to Karen Cheng:

> Despite the growing interest and need for new typefaces, there are nevertheless surprisingly few books that explain either the general issues involved in type design (formal and optical balance in letterforms). . . . There is no single "correct" process for creating a typeface. The methodologies

1 See Hanno H. J. Ehses, *Semiotic Foundation of Typography*, edited by Nova Scotia College of Art and Design. Design Papers 1. Halifax: Design Division, Nova Scotia College of Art and Design, 1976; Renira Rampazzo Gambarato, "Peircean Semiotics in the Context of Design Praxis: Abduction and Perception in Dialogue," *Sign Systems Studies* 41, no. 4 (December 17, 2013): 424–32, https://doi.org/10.12697/SSS.2013.41.4.03; Steven Heller, ed., *The Education of a Graphic Designer*, 2nd ed (New York, NY: Skyhorse Publishing Inc., 2005), and Thomas Ockerse and Hans van Dijk, "Semiotics and Graphic Design Education," *Visible Language* 13, no. 4 (1979): 358–78; Gui Bonsiepe, "Visual / Verbal Rhetoric," *Zeitschrift Der Hochschule Für Gestaltung 14/15/16* [Magazine of the University of Design 14/15/16](1965), 23–40; and Audrey Bennett, ed., *Design Studies: Theory and Research in Graphic Design* (New York: Princeton Architectural Press, 2006).

2 See Anne Beekman, "Good Work! Incorporating Service Learning into Graphic Design Curriculum," *Mid-America College Art Association Conference* (October 5, 2012), http://digitalcommons.wayne.edu/macaa2012/2012/oct05/18.

3 Gui Bonsiepe, "A Step Towards the Reinvention of Graphic Design," *Design Issues* 10, no. 1 (Spring 1994): 47–52, https://doi.org/10.2307/1511655.

4 Bennett (2006), 12; and Wendy Gunn and Louise B. Løgstrup, "Participant Observation, Anthropology Methodology and Design Anthropology Research Inquiry," *Arts and Humanities in Higher Education* 13, no. 4 (October 1, 2014): 428–42, https://doi.org/10.1177/1474022214543874.

of individual designers are as unique and varied as the designs themselves.[7]

For instance, it is reasonable to argue that legibility is one of the most important goals (if not the most important) for designers of typefaces intended for continuous reading. Traditionally, type design relied heavily on optical approximation to induce legibility to typefaces, a fact denounced by Herbert Bayer in 1967 as equivalent to "lack of principle and structure, precision and efficiency."[8] With the turn of the century, the scientific rigor with which legibility has been studied has changed dramatically, opening the door to novel methods to measure it.[9] Most studies conducted so far tend to focus on assessing legibility from the self-reported experience of the reader on already existing typefaces. This is perfectly reasonable, because, as Legge explains, "although the physical rendering of text influences the quality of text images on the retina, the ultimate assessment of legibility depends upon the properties of a participant's perceptual representation,"[10] a point that Beier has discussed at great length concerning familiarity.[11] From a practical standpoint, this approach suffices when the task is to identify existing typefaces or formal features that are more and less legible and why, which addresses the effective use of typography, rather than its design. In the words of Gerard Unger: "Although type designers have so far received very few clues for enhancing legibility, some studies have yielded information on which improvements can be based."[12]

Optics, the branch of physics that deals with the behavior of light in relationship with sight, has fairly rigorous protocols and procedures that can be used to inform design research practice and pedagogy. A potentially useful tool for type design is the principle of visual acuity. Visual acuity, the "ability of the visual system to resolve detail,"[13] is a measurement used to prescribe vision-correcting glasses based on a relation between the distance from and size of specially designed graphic props. Tinker first noted the explicit connection between legibility and visual acuity in 1963, however, it is only recently that visual acuity has been taken over to explain optical size in type design. Ahrens's book *Size-Specific Adjustments to Type Designs*,[14] one of the few texts dealing with optical size around the time of its publication, devotes a chapter to this topic.[15] Of course, the relationship between visual acuity and legibility does not make these two concepts interchangeable. Legibility, as defined by Legge, Beier, and others, is mostly a top-down perceptual process, whereas visual acuity is bottom-up.[16] The difference between these processes is rarely acknowledged because in practice, visual acuity is perceived as conceptually embedded in legibility. However, acknowledging the difference between them allows for the application of the principle of visual acuity—and potentially other bottom-up processes—as preceding

5 Although this is not an extensive list, it is worth highlighting D. G. Paterson and M. A. Tinker, "Studies of Typographical Factors Influencing Speed of Reading. II. Size of Type," *Journal of Applied Psychology* 13, no. 2 (1929):120–30, https://doi.org/10.1037/h0074167 and "Influence of Line Width on Eye Movements," *Journal of Experimental Psychology* 27, no. 5 (1940): 572–77, https://doi.org/10.1037/h0054498; M. A. Tinker and D. G. Paterson "Studies of Typographical Factors Influencing Speed of Reading. III. Length of Line," *Journal of Applied Psychology* 13, no. 3 (1929): 205–19, https://doi.org/10.1037/h0073597 and "Studies of Typographical Factors Influencing Speed of Reading. V. Simultaneous Variation of Type Size and Line Length," *Journal of Applied Psychology* 15, no. 1 (1931): 72–78, https://doi.org/10.1037/h0073704; Miles A. Tinker, "The Relative Legibility of the Letters, the Digits, and of Certain Mathematical Signs," *The Journal of General Psychology* 1, no. 3–4 (1928): 472–96, https://doi.org/10.1080/00221309.1928.9918022 and *Legibility of Print* (Ames: Iowa State University Press, 1963).

6 See Mary C. Dyson, "How Physical Text Layout Affects Reading from Screen," *Behaviour & Information Technology* 23, no. 6 (2004): 377–93, https://doi.org/10.1080/01449290410001715714; Mary C. Dyson and Gary J. Kipping, "Exploring the Effect of Layout on Reading from Screen," in *Electronic Publishing, Artistic Imaging, and Digital Typography*, edited by Roger D. Hersch, Jacques André, and Heather Brown, Lecture Notes in Computer Science 1375 (Springer Berlin Heidelberg, 1998), 294–304, http://link.springer.com/chapter/10.1007/BFb0053278; Sofie Beier and Chiron A. T. Oderkerk, "Closed Letter Counters Impair Recognition," *Applied Ergonomics* 101 (May 1, 2022): 103709, https://doi.org/10.1016/j.apergo.2022.103709; Sofie Beier, Chiron A. T. Oderkerk, Birte Bay, and Michael Larsen, "Increased Letter Spacing and Greater Letter Width Improve Reading Acuity in Low Vision Readers," *Information Design Journal* 26, no. 1 (July 19, 2021): 73–88, https://doi.org/10.1075/idj.19033.bei; Katsumi Minakata, Christina Eckmann-Hansen, Michael Larsen, Toke Bek, and Sofie Beier, "The Effect

Figure 1
An E optotype created from a 5×5 grid, intended to assess visual acuity. Source: Author.

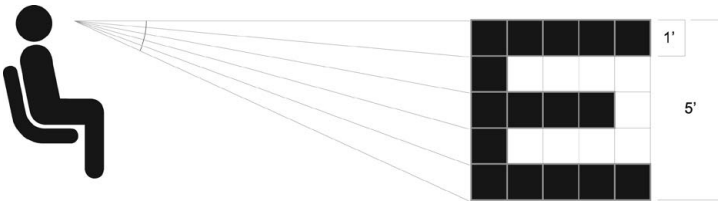
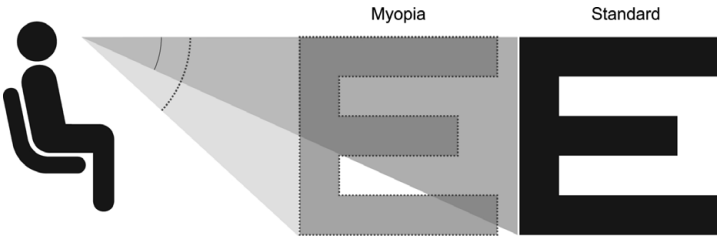


Figure 2
Concerning visual acuity, the difference between myopia and standard vision is the wider angle of vision that a myopic eye needs to perceive the same thing as a standard eye. Source: Author.



of Serifs and Stroke Contrast on Low Vision Reading," *Acta Psychologica* 232 (February 1, 2023): 103810, https://doi.org/10.1016/j.actpsy.2022.103810.

7 Karen Cheng, *Designing Type*, 1 edition (New Haven, CT: Yale University Press, 2006), 10–11.

8 Helen Armstrong, *Graphic Design Theories: Readings from the Field*, 1st ed, Design Briefs (New York: Princeton Architectural Press, 2009), 44.

9 See Charles Bigelow, "Typeface Features and Legibility Research," *Vision Research* 165 (December 1, 2019): 162–72, https://doi.org/10.1016/j.visres.2019.05.003; See Xavier Molinero, Montserrat Tàpias, Andreu Balius, and Francesc Salvadó, "Typeface Recognition and Legibility Metrics," *Cognitive Systems Research* 88 (December 1, 2024): 101263, https://doi.org/10.1016/j.cogsys.2024.101263.

10 Gordon E. Legge, "Displaying Text," in *Psychophysics of Reading in Normal and Low Vision* (Boca Raton, FL: CRC Press, 2007), 108.

11 Sofie Beier, "Typeface Legibility: Towards Defining Familiarity," Thesis (Royal College of Art, 2009), https://researchonline.rca.ac.uk/957/.

12 Gerard Unger, *Theory of Type Design* (Rotterdam: Nai010, 2018), 172.

13 Consilium Ophthalmologicum Universale, "Visual Acuity Measurement Standard," *Italian Journal* (1984): 8.

14 Tim Ahrens, *Size-Specific Adjustments to Type Designs* (Mark Batty, 2008), http://justanotherfoundry.com/size-specific-adjustments-to-type-designs.

the consideration of legibility factors. To integrate protocols for the assessment of visual acuity into typography, it is necessary to identify which legibility factors rely on visual acuity (described in the following pages). Identifying such factors resulted in a protocol for calculating a numeric value that could support the estimation of the minimal size and distance necessary to perceive formal features in signs, typographic or otherwise. It also provides an approach to introduce numerically calculated optical sizes in typefaces. The protocol attempts to be one more entry into the call to provide research rigor to design methods to ease its pedagogy.

Visual Acuity

The principles for the calculation of visual acuity were developed by Herman Snellen in 1862 and are still applicable today.[17] Snellen established a unit of 1′ (1 arc minute, 1/60 degrees) as a standard of minimum visibility and set a procedure that involves positively identifying individual signs with identical properties. Using a grid of 5 × 5, Snellen created a series of alphanumerical signs of 5′ each called optotypes (see Figure 1). These optotypes are arranged by size in a chart starting with a single large optotype at the top and progressively diminishing to the row with the smaller optotypes at the bottom. The chart is set at a fixed standard distance from the subject (six meters) and the visual acuity is evaluated by assessing the recognition of the optotypes. Using the height of the smallest recognizable row of optotypes and the distance, the variation between the angle that a person with "standard" vision would require to identify the optotypes and the actual angle required by the subject is determined. For instance, an individual with near-sightedness or myopia would require a wider angle of vision than a person with standard vision (see Figure 2). The method for the calculation of the angle is the Pythagorean theorem, expressed as $tan\ \alpha = b: a$, where α is the angle, b is the distance between the

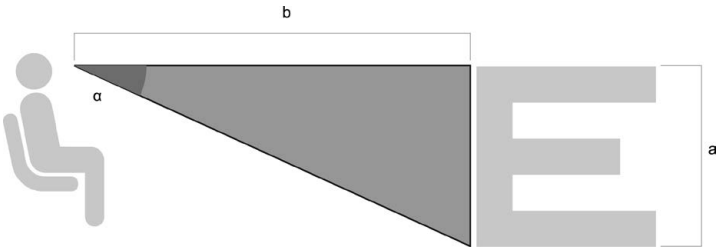


Figure 3
How a right-triangle formula is used to calculate visual acuity based on the size of the recognized optotypes at a fixed distance. Source: Author.

subject and the optotype, and *a* is the height of the optotype. Based on this formula, a person with a standard vision (5′ or 0.08333°) would be able to recognize an optotype of 8.7266 mm at a distance of six meters. Having any two values of either angle of vision, distance, or size of the optotype enables the calculation of the third (see Figure 3).

Using an angle for the calculation of size allows for a fixed value regardless of variations in distance, which makes it convenient for guidelines and norms, mostly related to the display of text on digital screens. For instance, the International Organization for Standardization recommends 20 to 22 arc minutes as a preferred value,[18] the Kodak Ergonomic Handbook 14 to 22 arc minutes,[19] and Sanders and McCormick 16 to 22 arc minutes.[20] For the International Organization for Standardization, the norms are given as "independent of technology, task or environment."[21] Understandably, the existence of these norms and many others does not guarantee their compliance.

Factors of Legibility

The factors influencing legibility in typefaces have been well-documented over the years.[22] Gaultney's list of these factors includes ascenders, descenders, x-height, contrast, color, stroke weight, serif design, distinctive character features, counter shape, and familiar forms.[23] These factors align with Bigelow's.[24] Although these characteristics affect the legibility of typographic signs, not all of them can be accounted for through visual acuity. For the protocol presented here, the factors related to visual acuity are classified into two categories. Vertical measures, which refer to optical limits, correlated to the size of the optotype in Snellen's method, and strokes, which refer to formal features of the typographic sign that need to be identified to perceive the sign as intended, correlated to the standard unit of minimum visibility. The first category includes x-height, ascenders, and descenders; the second category examines contrast, weight, and counter shape.

Vertical Measures

Research suggests that the x-height—the measure from the baseline to the height of the lowercase letters—might be more important for the recognizability of the typographic sign than any other factor (see Figure 4).[25] However, ascenders and descenders have a positive

15 Paul Shaw, "For Them, Size Really Is Everything," *Eye (0960779X)* 18, no. 72 (Summer 2009): 91. It is important to note that Ahrens' book was re-edited after this article. The new edition is Ahrens and Mugikura, *Size-Specific Adjustments to Type Designs: An Investigation of the Principles Guiding the Design of Optical Sizes* (Reading: Just Another Foundry, 2014).

16 Nadine Dijkstra, Peter Zeidman, Sasha Ondobaka, Marcel van Gerven, and Karl Friston, "Distinct Top-down and Bottom-up Brain Connectivity During Visual Perception and Imagery," *Scientific Reports* 7, no. 1 (July 18, 2017): 5677, https://doi.org/10.1038/s41598-017-05888-8.

17 Herman Snellen, *Probebuchstaben zur Bestimmung der Sehschärfe* [Test Letters to Determine Visual Acuity] (Utrecht: Van de Weijer, 1862), https://archive.org/details/probebuchstaben00snelgoog.

18 International Organization for Standardization, "ISO 9241-303:2011 Ergonomics of Human-System Interaction—Part 303: Requirements for Electronic Visual Displays," Store: *ISO Standards Catalogue*, 2015, http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=57992. It is important to note that the text of the standard was revised and upheld in 2022.

19 The Eastman Kodak Company, *Kodak's Ergonomic Design for People at Work*, 2nd ed. (Rochester, NY: John Wiley & Sons, Inc, 2003), http://ca.wiley.com/WileyCDA/WileyTitle/productCd-0471418633.html.

20 Mark S. Sanders and Ernest J. McCormick, *Human Factors in Engineering and Design*, 7th ed. (New York: McGraw-Hill, 1993).

21 International Organization for Standardization, 2015.

22 See Dyson 2004, Dyson & Kipping 1998, Legge & Bigelow 2011, Spencer 1969, Tinker 1928 and 1963; also, TovaRabinowitz, *Exploring Typography* (Boston: Cengage Learning, 2015).

Figure 4
The x-height of Arial, relative to the rest of the vertical measures: body height, ascenders, and descenders (kp index). Source: Author.

Figure 5
Differences between vertical measures of various fonts. The body height of the font is marked with a dotted line, and the baseline with a thick black line. From left to right: Adobe Caslon, Gandhi serif, and Fedra Serif A. Source: Author.

influence on the recognition of words and therefore legibility. Legge and Bigelow explain that the x-height has more influence on the perceived size than the actual metric size of the typographic sign.[26] This is because the metric size or body height of the font is a relatively arbitrary measurement that in some cases will account for the distance between the upper limit of the highest ascender and the bottom limit of the lowest descender, usually *k* and *p*, respectively; De Buen calls this measure the kp index.[27] In most cases, the kp index ignores the extra space, either between the top limits of ascender and body height, between the bottom limits of descender and body height, or both. In some cases, particularly in swash or calligraphic fonts, the height could be even smaller than the kp index. The size of the font, commonly given in postscript points, is merely a fixed space in which these different measurements and scenarios are negotiated by the type designer based on the purpose of the font (See Figure 5).[28]

Strokes

For this article, the term "strokes" refers to the factors of legibility that deal with formal relations in the typographic sign. The first of these factors is contrast, which is the ratio between the widths of thicker and thinner strokes on a character, usually vertical and horizontal, respectively. A high contrast means an extreme variation, and a low contrast implies a modest one. Recent studies have shown that low contrast tends to favor visibility in fonts with high typographic weights.[29] In general, it is common to resort to low contrast when the font has to be used in difficult reading conditions, such as small sizes, long distance, or high-speed reading, and high in display fonts or print on coated paper.[30] "Weight" refers to the overall area of the sign, expressed in values like light, book, or bold, among many others. Empirical research reports no major legibility differences between regular and bold weights of the same typeface, but it has been recommended to avoid extreme weights to maintain legibility.[31] Researchers like Rubinstein have even suggested the use of quantitative ranges based on specific metrics

23 Victor Gaultney, "Balancing Typeface Legibility and Economy," (2001), http://www-01.sil.org/~gaultney/BalanLegEcon.pdf.
24 Bigelow, (2019).
25 Bigelow, (2019); Gaultney, (2001); Robin Nicholas and Patricia Saunders, "Arial," (The Monotype Corporation, 1982).
26 Gordon E. Legge and Charles A Bigelow, "Does Print Size Matter for Reading? A Review of Findings from Vision Science and Typography," *Journal of Vision* 11, no. 5 (2011): https://doi.org/10.1167/11.5.8.
27 Jorge De Buen, *Manual de diseño editorial*[Editorial Design Manual], 5th (Gijón, España: Ediciones Trea, S.L., 2020).
28 Carol Twombly and Willian Caslon, "Adobe Caslon Pro," (Adobe Systems Incorporated, 2001); Cristobal Henestrosa and Raúl Plancarte, "Gandhi Serif," (Librerias Gandhi S.A. de C.V., 2012); Peter Bilak, "Fedra Serif A," (Typotheque type foundry, 2006).
29 Sofie Beier and Chiron A. T. Oderkerk, "High Letter Stroke Contrast Impairs Letter Recognition of Bold Fonts," *Applied Ergonomics* 97 (November 2001):103499,_https://doi.org/10.1016/j.apergo.2021.103499.
30 Maarten Gelderman, "A Short Introduction to Font Characteristics," *TUGboat* 20, no. 2 (June 1999): 96–104.
31 See Gaultney (2001) and Gelderman (1999).

Figure 6
The smallest necessary measure to identify regular and black weights of Fago. In the former, this measurement comes from the typographic form, the bar of the lowercase *e* specifically. For the latter, this measurement would come from the counter form. Source: Author.

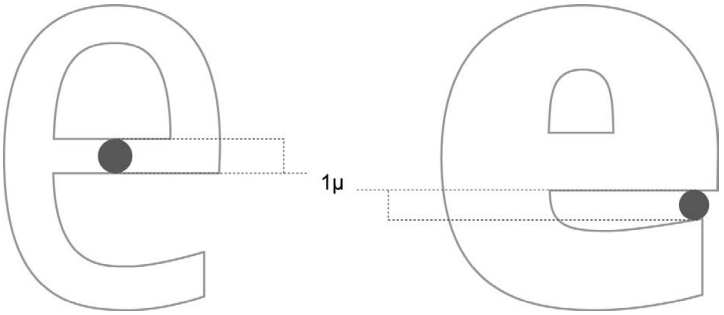
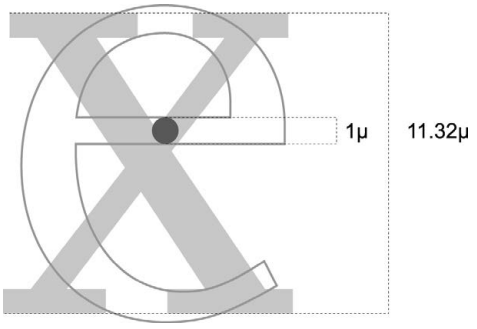


Figure 7
The procedure used to measure the x-height of Scala in relative acuity units. The result of this operation is 11.32*µ*. Source: Author.



of the typographic sign.[32] Finally, counter shape (or counter form) refers to the inner white space enclosed by a letterform.[33] Overall, research demonstrates a positive influence of ample counter shapes on legibility,[34] although this factor does not stand alone; it has to be balanced with the rest of the formal aspects of the letterform and with the vertical measures.

A Protocol

Having a universal guideline for calculating perceptible font sizes is incompatible with the extent and variety of existing legibility factors besides size, which was briefly described already. Every font has its own requirements and design features. The idea of treating typographic signs as if they were optotypes seems to overlook the fact that the purpose of the optotypes in Snellen's method is just the formal contextualization of the actual unit of measurement. In other words, the optotypes are merely the vehicle of the minimum visible unit (1′). The possibility of using these principles in typographic signs requires the definition of a unit that, given the variety of factors, would only apply to a particular font and a particular weight. Arguably, following Snellen's procedure, such a unit would have to be defined based on the smallest necessary measurement to make an integral sign legible. For instance, in fonts with ink traps, the ink trap itself could be such a unit. Assuming the horizontal strokes are the thinnest based on the definition of typographic contrast and all the signs in the font face share the same metric criteria, the smallest necessary measure could be found in the height of the bars of any given sign. In the case of

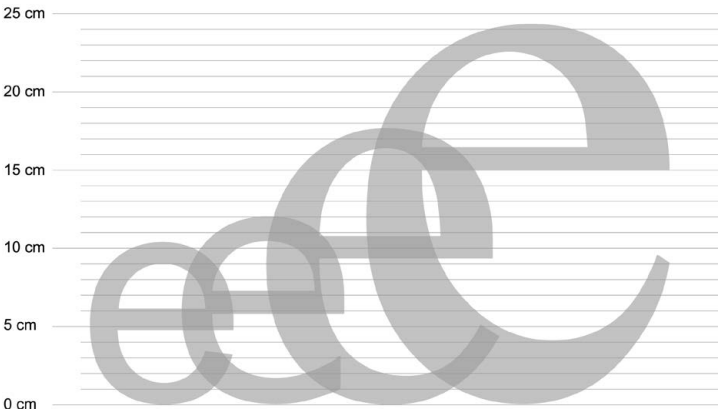
32 Richard Rubinstein, *Digital Typography: An Introduction to Type and Composition for Computer System Design* (Boston, MA: Addison-Wesley Longman Publishing Co., Inc., 1988).

33 See Spencer (1963) and R. Bringhurst, *The Elements of Typographic Style*, 4th ed. (Vancouver, B.C. Canada: Hartley & Marks, Publishers, 2013).

34 See Bringhurst (2013) and Lynne Watts, *Legibility in Children's Books: A Review of Research* (Windsor: NFER Publishing Company LTD., 1974).

Figure 8
Comparison of the minimum required size to perceive Arial, Verdana, Georgia, and Times New Roman at fifty-meters distance according to the protocol presented here. The closer the μ value is to zero, the higher its relative acuity. Source: Author.

Font	Arial	Verdana	Georgia	Times N.R.
μ/60	7.14/60=0.119	8.26/60=0.137	12.18/60=0.203	16.68/60=0.278
Size (x)	10.38 cm	11.95 cm	17.71 cm	24.26 cm



reverse contrast fonts, for instance, the minimal measure could be found on the width of the stems; in black and ultra weights it is common to find the smallest measure not in the shape of the letter face but in the counter form (see Figure 6). Here I use fonts with standard proportions and the bar of the lowercase *e* to demonstrate the calculations and ease direct comparison. The definition of this measurement is the first step of the protocol presented here. I refer to this unit as 1μ (Figure 6).[35] This unit would be used to measure the typographic sign in the same way arc minutes are used to measure the height of the optotypes (see Figure 7). However, based on its effect on legibility, it is not the body height of the font that should be measured but the x-height. I refer to the value resulting in dividing the x-height by the smallest necessary measurement as relative acuity (Figure 7).[36] The procedure of measuring the x-height of the font face is the second step of this protocol.

The measurement of the x-height expressed in μ could then be used to calculate the minimum size at which the signs of a particular font can be perceived and recognized at a given distance by using the formula $x = d * tan\ (\mu/60)$, where x is the minimum perceptible x-height of the specific font and d is the distance between the viewer and the typographic sign. The division of the unit μ by 60 ensures that the angle is expressed in arc minutes and not degrees. To demonstrate, four common typefaces are compared using this protocol: Arial, Verdana, Georgia, and Times New Roman.[37] For each one of these fonts, the smallest measure (1μ) was taken from the bar of the lowercase *e*, with a hypothetical distance (d) of fifty meters. The results are presented in Figure 8.

35 Ole Schaefer, "Fago" (FontShop International, 1999).

36 Martin Majoor, "Scala Regular" (FontShop International, 1995).

37 Robin Nicholas and Patricia Saunders, "Arial" (The Monotype Corporation, 1982); Matthew Carter, "Verdana," (Carter & Cone, 2008); Matthew Carter, "Georgia," (Carter & Cone, 2006); Stanley Morrison, Victor Lardent, and Monotype Type Drawing Office, "Times New Roman" (The Monotype Corporation, 2008).

Font	Arial	Verdana	Georgia	Times N.R.
μ/60	7.14/60=0.119	8.26/60=0.137	12.18/60=0.203	16.68/60=0.278
Size (x)	125 m	104.16 m	71.42 m	52.08 m

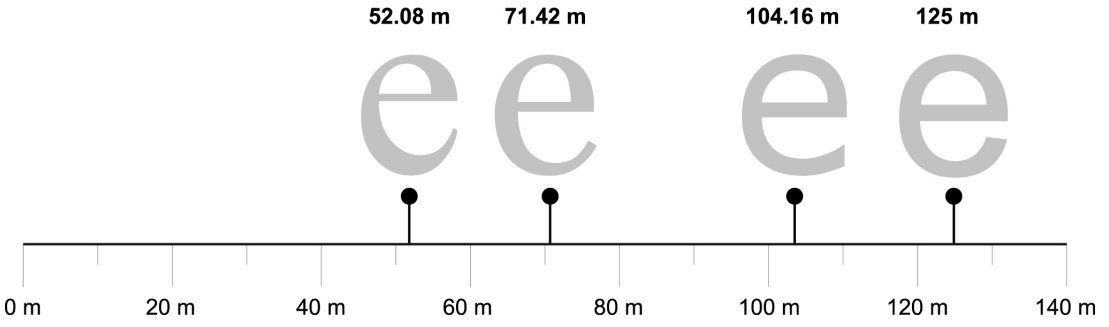


Figure 9
Comparison of the maximum possible distance to perceive Times New Roman, Georgia, Verdana, and Arial according to the protocol presented here. The closer the μ value is to zero, the more distance the sign can allow for, without becoming imperceptible. Source: Author.

The same formula could be used to calculate the maximum distance at which a particular font can be perceived at a given size by using the formula $d = x: tan\ (\mu/60)$, where d is the maximum distance between the subject and the font, and x is the x-height of the font (the height of the lowercase *x*). The protocol is demonstrated using Arial, Verdana, Georgia, and Times New Roman at a hypothetical x-height (x) of 25 cm. The results are presented in Figure 9.

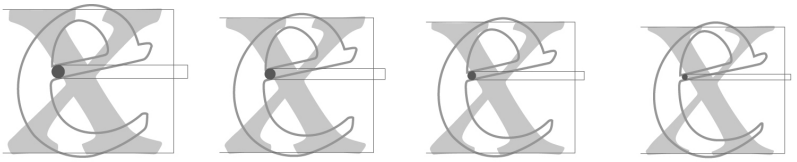
For each case, the operations would result in a minimum perceptible size and maximum distance, respectively, likely too small or too far to be read comfortably. Some adjustments might be recommended.

From the type design perspective, visual acuity principles seem to provide some theoretical background to practices that have emerged from experience and scientific proof for concepts derived mostly from trial and error. The most obvious application of this protocol in type design is the development of optical sizes, a practice that has been mastered over the years but has had little documentation. Even literature on the creation of optical sizes from a technical point of view gives rather vague instructions: "Determining the correct axis map for an optical size axis is more art than science, requiring testing and visual judgement. The procedure entails first making an educated guess at a suitable axis map."[38] The design of typefaces with variable axes saw a comeback in 2016 with the introduction and fast popularization of the Variable Font technology.[39] This technology has been a framework for enlightening discussions about the process of typographic design,[40] however, these discussions do not deal with protocols or specific methods behind the design of optical sizes. This is not to say that this protocol would account for all the circumstances involved in designing optical sizes, but it could help establish basic guidelines for some of the factors, such as weight, contrast, or x-height. To

38 Adobe Systems Incorporated, "Designing Multiple Master Typefaces," (Adobe Systems Incorporated, 1997), https://partners.adobe.com/public/developer/en/font/5091.Design_MM_Fonts.pdf.

39 Tim Brown, "Variable Fonts, a New Kind of Font for Flexible Design," The Typekit Blog (September 14, 2016), https://blog.typekit.com/2016/09/14/variable-fonts-a-new-kind-of-font-for-flexible-design/.

40 See Maíra Woloszyn and Berenice Santos Gonçalves, "The Design Process of Variable Fonts: A Prospective Survey-Based Investigation with Type Designers," in *Advances in Design and Digital Communication II*, edited by Nuno Martins and Daniel Brandão. Springer Series in Design and Innovation (Cham: Springer International Publishing, 2022), 54–65, https://doi.org/10.1007/978-3-030-89735-2_5, and "The Professional Practice of Type Designers in the Design of Variable Fonts," in *Perspectives on Design and Digital Communication III: Research, Innovations and Best Practices*, edited by Nuno Martins, Daniel Brandão, and Francisco Paiva, Springer



Weight	Caption	Regular	Subhead	Display
µ/60	10.87/60=0.181	12.45/60=0.207	15.33/60=0.255	22.34/60=0.370
x-height size	0.94 mm	1.08 mm	1.33 mm	1.93 mm
Body size	6.5 pt	8 pt	10 pt	15 pt

Figure 10 (Above)
Minimum visible height of Adobe Jenson Pro x-heights and corresponding body size of its optical sizes at a thirty-centimeters distance, according to the protocol presented here. Source: Author.

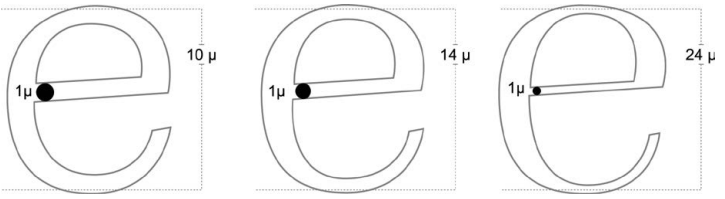


Figure 11 (Right)
Three lowercase e designed on relative acuity-induced values, according to the protocol presented in this article. From left to right: 10*µ*, 14*µ*, and 24*µ*. Source: Author.

demonstrate the possible application of this protocol in developing optical sizes, I analyzed Adobe Jenson Pro,[41] a font with four optical sizes (Caption, Regular, Subhead, and Display), at a fixed distance of thirty centimeters. The results are presented in Figure 10.

The introduction of what I refer to as relative acuity during the earlier stages of type design could positively inform the planning process of derived weights and optical sizes. In addition, it might be possible to generate ranges and recommendations based on these visual acuity principles and the intended use of the font. These recommendations could be part of a future research endeavor. To demonstrate how this protocol could inform the type design process, I induced relative acuity values to the lowercase *e* of a hypothetical font. These values are 10*µ*, 14*µ*, and 24*µ* (see Figure 11).

It is important to point out that these principles could also be applied to non-typographic glyphs in a font or any graphic sign. In these cases it would be necessary, just like with typographic signs, to identify the smallest element in the sign and use it as a unit to measure the rest of the sign for determining relative legibility. The consideration of other values such as speed (distance/time) could contribute to other applications, such as traffic signs.

Final Remarks

I introduced a protocol based on optometric methods for evaluating visual acuity as a tool to help designers make decisions related to typography, as a resource to justify those decisions, and to demystify a few of the design processes involved in type design, at least for novice practitioners. This protocol consists of (1) identifying a measure minimally sufficient in a typographic

Series in Design and Innovation (Cham: Springer International Publishing, 2023), 137–53, https://doi.org/10.1007/978-3-031-06809-6_9.

41 Robert Slimbach, "Adobe Jenson Pro," (Adobe Systems Incorporated, 2000).

sign for the integral identification thereof and (2) the measurement of the x-height based on this new unit. I demonstrated how the combination of the outcomes from applying this protocol to existing fonts, or its considerations for fonts in development (among other values like distance or intended size) could inform not only the practice and pedagogy of design but also the creation or amendment of current standards and norms that seem to overlook basic typography principles. The development of these recommendations could be a future endeavor. The intention behind this protocol is not to denounce or criticize craftspersonship in type design but to provide theoretical support to some of its aspects and present a case for the use of methods and practices from other disciplines. I attempt to respond to the silent yet permanent call for more rigorous design methods and pedagogical practices, particularly when other fields of study are looking outward and toward design as a discipline.