Adjusting Typographic Metrics to Improve Reading for People with Low Vision and Other Print Disabilities

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Abstract

A new software technique called typometrics is presented. This enables users to choose a wide range of typographic metrics to assist reading. A software implementation called TRx (Typometric Prescription) is described. TRx is a style authoring tool for web languages. Designed for use by assistive technology (AT) specialists and users with print disabilities, this software enables users to create personal reading environments with all the range of style available to authors of documents. The article concludes with a description of a three part study planned to collect baseline data for implementing typometric interventions to improve reading.

Keywords

Low Vision, CSS, Text Customization, User Centered, Reading, Assistive Technology

Introduction

People with print disabilities have limited employment opportunities because they cannot read professional literature in standard print effectively. When text is only available on paper, there is no way to alter the appearance of a printed document. By contrast, Web languages like Hypertext Markup Language (HTML) with Cascading Style Sheets (CSS) have created near total flexibility for digitally-rendered text (Shea). This means that the historical ecology that created standard print (Legge and Bigelow 14-18) can now be extended via digitally-rendered text to include non-normal readers. This can be achieved by giving this neglected group user-centered access to typographic metrics ("Text Customization"). This access should support user preferences and remain semantically faithful (Dick). Prior to this project, no comprehensive instrument existed to collect and record the preferred typographic metrics for people with low vision and other print disabilities. With the style authoring tool TRx, users and researchers can explore the value of adjusting typographic metrics to improve reading.

Discussion

Review of Literature

Typometric software techniques: 1) adjust the typographic metrics of text to create customized text for individuals with print disabilities, and 2) preserve the semantic cues provided by the typography of the original document format. Typographic metric adjustment provides access to text in formats that remove barriers that exclude people with print disabilities ("Text Customization"). Semantic preservation provides equal access to all information conveyed in the presentation of the document (Dick).

By definition, ophthalmology cannot treat, and optometry cannot correct low vision ("Low Vision"). While low vision optometrists can provide lens systems to improve how well a client sees print, these corrective devices are seldom robust enough to support the reading needs of working professionals who suffer from low vision. For effective intervention, one must change the text being read, not just how well one sees it.

Printed text on paper cannot be changed. While people with normal vision are served well by this medium, people with print disabilities are excluded entirely or at least effectively. Legge and Bigelow (14-18) show that the size of running text in publications converged to a value just above the critical print size (CPS) of normal readers. CPS is the smallest size one can read at maximum speed. Their study examined print size in publications since Gutenberg. Font size was driven by what the authors define as an ecology involving technology, reader preference and printing cost. When print was new, the text size was as close to the critical print size as technology permitted. As technology improved, the size of running text decreased, but it only dipped below the critical print size of normal readers when the nature of the content required smaller print (e.g. stock exchange reports).

One unspoken fact emerges from the Legge-Bigelow study. People with print disabilities were excluded. The present authors assert that other typographic metrics like font families and spacing were shaped by the same ecology. The inflexibility of print on paper forced rigid conformance to the reading preferences of normal readers in order to sell paper publications.

Document semantics are based on two dimensions, content and presentation ("Info and Relationships"). Content is the actual text and images created by the author. The presentation is the appearance of the document structures that contain content. Document structures include paragraphs, headings, lists, citations and many more. The visual rendering of these structures conveys their usage. The presentation of content reveals the author's organizational model to the reader. The content within document structures and the way structures are presented convey meaning. If one is looking for a particular citation in a document, one only needs to scan for text presented in citation format instead of reading the entire document. Without these presentational cues, professional articles are difficult to read. A typometric transcription of a document may change the typographic metrics, but it will create a visual presentation that is semantically equivalent to the original (Dick). The document will not look like the original, but visual differences between elements are preserved. This enables a reader who needs typographic transcription to customize a document to fit their reading needs, yet perceive the same organizational model the author intended (Dick).

Customizing typographic metrics would be impractical without the World Wide Web and its content markup language HTML, and presentation style language CSS. Since the style of a document is housed by one component, the CSS code, and content is housed by another, the HTML code, the view of a document can be customized to meet any individual's needs just by changing the CSS style and leaving the HTML content constant (Shea). This separation of content and presentation makes customization on a mass scale practical.

Using CSS, spatial metrics like spacing and border size can be customized to an accuracy of less than 1/3 millimeter. Colors can be chosen from a palette of 16 million, and virtually all major font families can be rendered ("Cascading"). The readers excluded from the ecology that produced standard print can now be included with web technology.

Enlargement of text has long been provided in numerous forms: lens magnification, closed circuit TV and screen magnification (Zimmerman, Zebehazy, and Moon 192-238). The first typometric tool was WebAdapt2Me by IBM ("IBM"). This was a comprehensive system, based on user testing, that identified font-size, font-family, line-spacing, letter-spacing, column format and color as typographic metrics that users could choose to adjust to improve reading (Hanson 4-6). WebAdapt2Me did not address semantic preservation, but it did provide the first significant user access to typographic metrics. Hanson's user testing showed a strong preference for control over font size, spacing, margins size and font-family.

The user preferences observed by Hanson are supported by psychophysical data that show positive improvements in reading resulting from adjustments to typographic metrics (Legge). Moreover, Russell-Minda et al. (405-12), in their survey of research on legibility of text, confirm the strong relationship between typographic metric adjustments, reading performance and user preference. McLeish (35-40) demonstrated that small increases in letter spacing (+0.1 to +0.5 above normal spacing) improved reading speed.

The Typometric Prescription (Style Authoring Tool) —TRx

When optometrists use the phoropter to perform refraction testing, they make small changes in how the client sees a fixed sample of text by repeatedly switching lenses. They use client reports of how well the client sees the sample text to direct the refraction process until a lens prescription is reached. When assistive technology (AT) specialists use TRx to select a reading environment, they follow a similar process. This test begins with a client whose vision is corrected as much as possible. How well the client sees is the fixed point. Only the typography varies. Through a sequence of changing formats the AT specialist uses client reports to converge on a textual reading environment the client prefers. We call the result the client's *reading profile*. For both optometrist and AT specialist the client's declaration of satisfaction is the end point of the process.

The TRx instrument presents each user's style choice visually on the computer screen. The user adjusts the style parameter like font or border size by clicking on buttons labeled *more* and *less.* Each change appears immediately on the screen in a sample area. The user is never asked to supply a numeric value for a typographic metric. Instead, users only respond to what looks right to them. A sequence of choices (*more* or *less*) gradually converges to a profile. The process is like the choices an optometrist relies on for refraction testing.

The TRx instrument allows full access to all of the styling parameters available to a document author: font (family, size and boldness), spacing (letter, line and word), color (background and foreground) and box model (margins, padding and borders). One can continue changing parameters until maximum readability is reached. Since TRx is accessible to users with print disabilities, the user can change the reading profile or make new profiles with TRx after the initial session with an AT specialist.

TRx includes a collection of document formats to help users start the process. Additionally, TRx provides a full book sample, so that users can test their reading profile in a realistic reading environment. TRx reading profiles can be produced in a variety of electronic formats depending on need. A CSS coded version of the reading profile can be applied to HTML content code in order to create a presentation in the user's preferred format.

An Initial Study

Our initial study of the TRx software will gather baseline data on how to use typometric modifications to aid reading. It will consist of three parts: 1) collection of demographic data, 2) evaluation of individual adaptations to reading, and 3) observation and support for using typographic metric adjustment to improve reading.

We will initially study college students with low vision (visual acuity: 20/60 to 20/400). Enrollment in college implies that reading is an essential life function. Only students registered with the Disabled Students Services Office (DSS) at California State University, Long Beach (CSULB) will be selected. Enrollment in DSS indicates willingness to seek help.

The demographics that interest us are medical and academic. We will collect the following data: medical diagnosis, visual acuity, visual field, color perception, and whether low vision is congenital or acquired. We will also collect academic data: major, scores on standardized exam, entering GPA, university GPA, matriculation institution, and the services the student requests from DSS. An initial contact with CSULB DSS office provided an estimate of twenty-five students that fit the target population.

In the second study, we will collect quantitative visual reading functionality data using measurement instruments like the MNREAD (Legge 167-85). We also will collect qualitative data obtained from interviews. Our qualitative data will focus on the accommodation strategies that allowed these students to succeed in their academic studies.

The data from the second study will help us implement the third study, the typometric intervention, in a way that disrupts the students' lives as little as possible. All of these students have developed personal strategies to survive with a disability in a difficult academic environment. We will be asking them to modify their survival strategy, and that can be disruptive even if it provides improvement. Based on individual information we have gathered, we will customize an intervention strategy that minimizes disruption. We will provide students with weekly support sessions. While these are primarily for support, we will collect qualitative data based on our interactions.

The goal of our three part study is to assess who is helped, how typometric intervention fits into a general student success strategy, and how the negative side effects of changing reading strategy can be minimized.

Conclusion

Our study will not address the ultimate question: does typographic metric adjustment improve professional reading for people with low vision and other print disabilities? This question has many facets, but one central question is this: does typometric adjustment improve reading stamina? Stamina is a critical barrier to most readers with print disabilities. Comfort level while reading has a significant impact on reading stamina. Can typometric adjustment reduce headaches, nausea and posture difficulties associated with reading with print disabilities? Our baseline studies should give us guidelines so that we can identify some of the essential variables.

A complete answer to the ultimate question may take years. Our team invites researchers to use TRx to improve reading for people with print disabilities. At present, assistive technology for low vision appears to be stalled at screen magnification. Hopefully this research will expand the choices of assistive technologies for many people with low vision and others with print disabilities.

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