Adjusting Typography for Low Vision Readers

A Case Study on Distance Reading Performance

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Abstract. This research delves into a case study of applied research on typographic design, regarding the redesign of the wayfinding of France's ophthalmology hospital's. An experimental design was developed and run on a sample of patients from the hospital with diverse visual conditions. These fell into three groups: blurry vision ($N = 15$), central vision loss ($N = 11$), and peripheral vision loss ($N = 15$), as well as a control group ($N = 14$). The experiment tested six typeface variations, optimised for legibility with a pilot group. These varied in width and weight. The results demonstrate that larger letter widths have varying effects across different groups. These findings align with existing literature, which underscores the effects of typographic variables on readability.

1. Context

This experimental research explores typographic adjustments, specifically letter width, and their impact in patients with low vision. A psychophysics experiment was designed and run on 55 participants to explore these effects. Participants of the experiment were patients with various underlying visual conditions representing three groups of interests: severe blurry vision ($N = 15$), central vision loss ($N = 11$) and peripheral vision loss ($N = 15$), along with a control group of normal vision participants ($N = 14$). The experiment was conducted at Quinze-Vingts Hospital, France's national public ophthalmology hospital, between September and October of 2023.

2. Methods

In the experiment, which measured reading acuity, six variations of a new bespoke typeface were tested. Participants were asked to fixate on

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Y. Haralambous (Ed.), *Grapholinguistics in the 21st Century 2024. Proceedings*
Grapholinguistics and Its Applications (ISSN: 2681-8566, e-ISSN: 2534-5192), Vol. 12.
Fluxus Editions, Brest, 2026, pp. 709–712. https://doi.org/10.36824/2024-graf-mang
ISBN: 978-2-487055-12-4, e-ISBN: 978-2-487055-13-1

the center of the display. Starting with a point size of 0, a string of letters would grow at a constant rate from that central point of the screen, reaching a maximum size of 250pt after 15 seconds. The task consisted in pressing one of the buttons of the keypad as soon as reading the string of letters was possible. Two alternating noise masks would then appear for 0.5 seconds each, before the participant had to correctly choose the string they had just read among three different but similar-looking options, using the remaining buttons of the keypad. The model served as a threshold acuity experiment, based on Waller (2007).

Each participant completed 120 trials of this task. The string of letters was shown in one of six typeface variations for each trial, making 20 times for each typeface variations. The order of display of these was randomised for each participant. For the text stimuli, a list of 120 non-sense 4-letter strings was prepared. Three similar looking alternatives were written for each item (e.g., for “bzix”; “bztx,” “bqix” and “bzxi” were the three similar looking alternatives). These were created manually including and permuting one or two easily mistakable letterforms per string.

Reaction times were used as a comparative measurement of reading acuity. The answers to the similar-looking alternative questions were collected and stored, but the real intention of these was to maintain attention throughout the experiment. The list of strings was shown at random, with no participant having the same stimuli order as another.

The typographic variables of each variation were broken down as continuums of letter width, boldness and inter-letter spacing. Each participant produced six average reaction times for each of the versions of the typeface studied. Every average was produced after clearing the data of outliers. Because of the repeated measures design of the experiment—where six measurements were relative to each participant—and the non-normal distribution of reaction times, a generalised linear mixed model study was chosen for the analysis of regression. Model terms were tested using the Satterthwaite method.

3. Results

When looking at all reaction times, regardless of eye disease, the regression study showed a strong effect caused by width. This did not happen with boldness and inter-letter spacing. If participants are broken down by eye disease, we see this effect repeating for all patient groups at different levels. This effect is specially significant with healthy participants, followed by participants with blurry vision. When it comes to boldness, a positive effect can be observed for patients with blurry vision.

The findings of the present study show an advantage exerted by letter width on reading acuity of lowercase latin text. This advantage was studied with a bespoke unpublished typeface, which show largest advantages at very extended letter widths of between 140-160. This advantage was tested in four groups underlying visual conditions, each of which showed a different effect of letter width on performance. A performance plateau emerged after Version C (width 140) for central and peripheral vision loss groups and after Version D (width 160) for patients with blurry vision and healthy readers. On letter boldness, we observed a positive effect on reading acuity for patient groups with blurred vision, with bolder weight reducing reaction times. Conversely, regarding the typographical variable of inter-letter spacing, we found no significant effects on reading acuity.

To the best of our knowledge, this is the first study to investigate the effects of multiple typographical variables with the same typefaces family on low vision readers with various visual deficits. The findings demonstrate that wider letter shapes can benefit all reader groups to varying degrees, and align with recent literature, which highlights that typographic variables affect each reader differently.

This research fed the design process of Zed, which was developed alongside data collection. Additionally, Zed Text is now the typeface for Quinze-Vingts Hospital, where the experiment took place. It is currently being implemented by Integral Designers as the wayfinding and identity typeface. The font is expected to expand its language support beyond Latin, with research prepared for Thai, Arabic and Armenian.

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