

# UNIVERSITY OF MINNESOTA

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To: Members of the Access Board

From: Gordon E. Legge, Ph.D.  
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To briefly introduce myself: I am a person with low vision. I have directed a research program for more than 30 years on visual factors affecting reading performance for people with both normal and low vision. Much of my research, and the research of others, is summarized in my 2007 book *Psychophysics of Reading in Normal and Low Vision*. Essential points include (1) Low vision affects Millions of Americans encompassing a wide range of visual conditions and acuities; (2) Most people with low vision have difficulty reading conventional print; (3) But with suitable text design, most people with low vision have functionally useful reading; and (4) People with low vision are adopters of digital reading (including mobile devices, iPads, etc) because of the potential for customization of text properties.

Looking back historically, Marshal McLuhan (1962) in his famous essay *The Gutenberg Galaxy* referred to the invention of movable type as bringing about the “tyranny of the visual.” With the growing cultural importance of printing and reading since the 15<sup>th</sup> century, people with impaired vision have often fallen outside the literate mainstream. Until recently, not much could be done to make print accessible, and low-vision reading received little consideration. The modern electronic era has softened the “tyranny of the visual,” by moving text from hard copy where it is difficult or impossible to read with low vision into digital representations which can be customized visually or converted to auditory or tactile formats. Digital documents on computers and mobile devices permit easy manipulation of print size, contrast, font, color, layout, etc. In short, we have an unprecedented opportunity to adapt text format to meet the needs of visually impaired readers.

To make this opportunity a reality, I urge the Access Board to consider the following points:

## 1. The Page-Navigation Problem

While people with the mildest forms of low vision may be accommodated with print magnification by a factor of 2, most require much higher magnification.

Third-party screen-magnifying software applications for computers, such as ZoomText exist, and are extremely useful. In most cases, this type of software requires visually-impaired users to manually scroll their magnified view along lines of text. We refer to this requirement as the "page-navigation" problem of low-vision reading. This is a challenging and sometimes daunting visual-motor task. It dissuades many people from reading altogether, slows down others, and can result in physical fatigue. One way to minimize this problem is to allow user-configurable magnification and structure of text so that horizontal page navigation is not necessary.

For any given person with low vision, fluent reading will depend on several factors including acuity, reading distance, print size, and font and display size. A reasonable standard that would accommodate reading by many people with low vision would be single-column text with configurable line lengths as short as 15 characters.

As an illustrative example, consider a reader with 20/200 acuity who requires 10X magnification to achieve fluent reading. Suppose this person uses an iPad 3 to read online. For the Times Roman font, the critical print size for a normally sighted person using a reading distance of 16 inches (fairly typical for reading) would be 9-pt. ("Critical print size" is the smallest print that can be read at a comfortable speed.) The low-vision reader would require characters that are 10 times larger, that is, 90-pt letters at the same viewing distance. 15 letters of this size would fit on a line of text (in landscape orientation) on the iPad 3 display.

This example illustrates that if the line length of texts are made adjustable to accommodate low-vision readers, the page-navigation problem can be mitigated for many individuals. Of course, for people with even lower acuity, still larger letters would be needed and at some point, page navigation would be necessary for visual reading.

I note also that there is recent evidence that dyslexic readers benefit from text with short lines of 20 characters or less.

## **2. Text Contrast**

It is well known that text contrast can be a limiting factor for many people with low vision. While normal vision is remarkably tolerant to reduced contrast (e.g., dark gray letters on a light gray background), some people with low vision suffer from any reduction from maximum text contrast.

It is also well known that some people with low vision, especially those with light scatter in the ocular media from cataracts or other opacities, benefit from contrast reversal i.e., use of white letters on a black background rather than black letters on a white background.

More generally, allowing for configurable selection of the color of both text characters and background is highly desirable.

### **3. Font and Spacing**

Finally, selection of font and spacing characteristics of text may be helpful, although the choices would interact with the number of displayable characters on a line of text.

In short, on behalf of the millions of Americans with low vision, I urge the Board to insist that the great promise for reading accessibility afforded by flexible design of digital text be incorporated into guidelines for web-based text.