Positive Display Polarity Is Particularly Advantageous for Small Character Sizes: Implications for Display Design

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Objective: To test the display luminance hypothesis of the positive polarity advantage and gain insights for display design, the joint effects of display polarity and character size were assessed with a proofreading task.

Background: Studies have shown that dark characters on light background (positive polarity) lead to better legibility than do light characters on dark background (negative polarity), presumably due to the typically higher display luminance of positive polarity presentations.

Method: Participants performed a proofreading task with black text on white background or white text on black background. Texts were presented in four character sizes (8, 10, 12, and 14 pt; corresponding to 0.22°, 0.25°, 0.31°, and 0.34° of vertical visual angle).

Results: A positive polarity advantage was observed in proofreading performance. Importantly, the positive polarity advantage linearly increased with decreasing character size.

Conclusion: The findings are in line with the assumption that the typically higher luminance of positive polarity displays leads to an improved perception of detail.

Application: The implications seem important for the design of text on such displays as those of computers, automotive control and entertainment systems, and smartphones that are increasingly used for the consumption of text-based media and communication. The sizes of these displays are limited, and it is tempting to use small font sizes to convey as much information as possible. Especially with small font sizes, negative polarity displays should be avoided.

Keywords: display polarity, contrast polarity, positive polarity advantage, character size, font size, mobile devices, smartphones, text-based communication, detail perception, display design

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INTRODUCTION

Ergonomic display design depends on various factors, such as whether text is displayed with dark characters on light background (positive polarity) or light characters on dark background (negative polarity). Several authors reported better legibility of a positive display polarity as compared with a negative one. For instance, a positive polarity advantage was demonstrated in terms of lower error rates and response times in letter identification (Bauer & Cavonius, 1980), faster transcription of displayed letters (Radl, 1980), faster reading performance (Chan & Lee, 2005), better proofreading performance (Buchner & Baumgartner, 2007; Piepenbrock, Mayr, Mund, & Buchner, 2013), better word–nonword discrimination (Mayr & Buchner, 2010), increased visual acuity (Piepenbrock et al., 2013), and higher visual comfort (Taptagaporn & Saito, 1990, 1993). Findings of no positive polarity advantage have also been reported. For instance, no differences between positive and negative polarity displays have been reported for reading speed and comprehension (Cushman, 1986), proofreading rate and accuracy (Creed, Dennis, & Newstead, 1988; Gould et al., 1987), reading rate (Legge, Pelli, Rubin, & Schleske, 1985; Legge, Rubin, & Luebker, 1987), reading time, search time, and subjective preference (Pastoor, 1990), as well as visual acuity and perceived display quality (A. H. Wang & Chen, 2000). However, these findings may have been the result of low statistical power (e.g., Legge et al., 1985, with $n = 6$; Legge et al., 1987, with $n = 2$) and the use of flicker-prone cathode ray tube monitors (e.g., Creed et al., 1988; Cushman, 1986; Gould et al., 1987; Pastoor, 1990; A. H. Wang & Chen, 2000; for details, see Mayr & Buchner, 2010). A negative polarity advantage does not seem to have been reported to date for observers with normal vision such that the