Accommodative Response to Desktop & Handheld Video Displays

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Description
Purpose: To determine the difference, if any, in text legibility and the accommodative response between hard copy, LCD desktop, and handheld video displays, and how it affects users’ accommodative responses.

Introduction: Many users report greater comfort reading on a handheld device than on a desktop monitor. We postulated that this was because handheld resolution is often higher than desktop monitors, despite their smaller display size. Text legibility and accommodative responses were measured to test this hypothesis.

Disciplines
Optometry

Comments
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Introduction
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Methods
Subjects. 37 subjects, all pre-presbyopic (younger than age 40) participated in the study. All wore the proper spectacle or contact lens prescriptions, if applicable.

Tasks. Subjects were asked to perform two tasks: Text legibility and Accommodation in reading.

In Text legibility, they were asked to read aloud a row of five high frequency words of 5 or 6 letters from a designated distance. The words were displayed on hard copy, desktop monitor or handheld display at various font sizes. After each attempt, the subject was asked to back up to a distance that would increase acuity demand by logarithmic steps and repeat the process until now words can be correctly recognized.

For Reading, subjects were asked to read text presented on hard copy, desktop monitor or handheld display while their pupil size and accommodation were monitored with Grand-Seiko auto-refractor.

Equipment: Text were displayed on a 15” desktop LCD monitor (120 dpi), a 2.5” HP iPAQ smartphone (left) (140 dpi), or hard copy (right) (printed form a 1200 dpi laser printer). Both video displays were capable of displaying ClearType rendered text. Tahoma font was used for presentation as constrained by iPAQ.

Results
For text legibility, smaller logMAR indicates better legibility. With tested font and chosen handheld, handheld conditions were equal in legibility to each other, and significantly poorer than non-handheld conditions (F = 9.9, p<.001). The handheld 12-point ClearType was more legible than handheld 12-point non-ClearType. There were no differences between the LCD monitor and hard copy. Also, pupil size was significantly smaller when looking at the desktop monitor than either the handheld or hard copy (F=53.37 < .001), likely due to monitor luminance. While not tested, smaller pupil size generally increases depth-of-focus.

Conclusions:
1. Word legibility was better on the 15” LCD desktop monitor than it was for the 2.5” handheld display tested.
2. This may be explained by pupil size, which is smaller due to the increased luminance of desktop monitors compared to handheld devices.
3. Therefore, video display users that prefer handheld displays must do so for other factors, possibly including proprioceptive feedback to convergence of the eyes.

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