Customizing the Reading Experience for the Low Vision Reader

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Disclosure Statement:
• Nothing to disclose

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Objectives
1. Understand clinical measures of visual performance as they pertain to reading, including acuity reserve, critical print size, visual field, and contrast sensitivity
2. Discuss use and limitations of optical magnification for reading
3. Describe use of electronic media to adapt reading material to suit the individual reader
4. Review non-optical means to enhance reading such as absorptive filters and illumination

Reading with Low Vision

• Reading is the most common complaint and primary goal (Coco-Martin et al., 2012; Elliot et al., 1997)

• Adults with low vision that cannot read, lose a primary connection to the world (Warren & Barstow, 2011)

Low Vision Rehabilitation

• There is strong evidence that low vision care for reading is effective (Lovie-Kitchen, 2011)

• Reading rehabilitation programs can increase reading performance and quality of life (Coco-Martin et al., 2012)

Reading with Low Vision

• Impediments to reading with low vision (Whittaker & Lovie-Kitchin, 1993)
  – Inadequate acuity reserve
  – Inadequate contrast reserve
  – Presence and size of a central scotoma
  – Inadequate field of view

PSYCHOPHYSICS OF READING WITH LOW VISION
Visual Acuity

- Snellen acuity is a poor predictor of reading performance (Legge, 1985)

Reading Rate

- Wide variation in peak reading rate among low vision readers
- 64% of the variance can be accounted for by just two clinical variables (Legge, 1985)
  - Status of the central fields
  - Status of the ocular media

Acuity Reserve

- Ratio of the print size that the patient intends to read and acuity threshold
  \[ R_A = \frac{S_P}{S_T} \]

<table>
<thead>
<tr>
<th>Reading Rate (wpm)</th>
<th>Minimum Acuity Reserve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spot (~40 wpm)</td>
<td>1:3:1 (0.1 log unit or 1 line)</td>
</tr>
<tr>
<td>Fluent (≥ 100 wpm)</td>
<td>2:1 (0.3 log units or 3 lines)</td>
</tr>
<tr>
<td>Maximum</td>
<td>3:1 to 8:1 (0.5 to 0.9 log units or 5-9 lines)</td>
</tr>
</tbody>
</table>

Critical Print Size

- Smallest print size at which patient can read with their maximum reading speed
- Indicates the minimum magnification required for effortless reading

Contrast Sensitivity

- Contrast sensitivity has a strong linear relationship with reading speed (Cacho, 2010)
- Contrast sensitivity by itself accounts for no more than 38% of the variance in reading rate (Lovie-Kitchin, 2011)
- Contrast sensitivity only seems to be a limiting factor when it is very low (Cacho, 2010)
Central Scotoma

- Single most important factor in low vision reading is whether or not the central field is intact (Legge, 1985)
- Reading speed decreases as the scotoma size increases (Cacho, 2010)

Comprehension

- Comprehension scores for low vision readers are only slightly less than mean scores for normal subjects (Legge, 1989)
- Reading comprehension is not correlated with reading rate (Watson, 1992)

Prescribing for the Low Vision Reader

1. Specify the reading goal in terms of print size and reading rate
2. Define the required acuity reserve and threshold print size
3. Measure reading rate for print sizes above threshold
4. Select a magnification system that provides equivalent viewing distance
5. Calculate the viewing distance required to achieve the required threshold size
6. Assess performance with varying illuminations

Interventions for Reading

- Non-optical intervention
  - Font characteristics
  - Large print materials
  - Illumination
  - Filters/Contrast
  - Line guides
  - Ergonomics and positioning
- Optical
  - High-powered readers
  - Hand magnifiers
  - Stand magnifiers
- Electronic magnification
  - Video magnification
  - Electronic books
  - E-readers/tablets
- Typeface
  - Even spacing between letters
  - Wider letters
  - Higher crossbars
  - Heavier letters
  - Letters more open
  - San serifs
  - Larger punctuation
  - San serifs
  - Larger punctuation
Font Examples

<table>
<thead>
<tr>
<th>Grandmother</th>
<th>Arial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grandmother</td>
<td>Verdana</td>
</tr>
<tr>
<td>Grandmother</td>
<td>Helvetica</td>
</tr>
<tr>
<td>Grandmother</td>
<td>APHont</td>
</tr>
</tbody>
</table>

Arial vs. Helvetica

What’s the Point?

- Printer’s designation for print size
- Each point is 1/72 of an inch
- Point size indicates the height of the metal slug on which the type is set

Maxular

- A novel font designed to increase legibility and readability for persons with AMD
- Characteristics of Maxular
  - Regular spacing between strokes
  - Proportional spacing between letters
  - Soft terminations
  - Exaggerated distinguishing features

Maxular

Bach Beethoven Dufay
Bartok Elgar Handel
Palestrina Telemann

Large Print Designations
American Printing House for the Blind

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular Print</td>
<td>12 Pt</td>
</tr>
<tr>
<td>Enlarged Print</td>
<td>14-16 Pt</td>
</tr>
<tr>
<td>Large Print</td>
<td>&gt; 18 Pt</td>
</tr>
<tr>
<td>Enhanced Print</td>
<td>&gt; 18 Pt  with other formatting changes</td>
</tr>
</tbody>
</table>
Availability of Large Print

• Local Public Library
• Book Sellers
• Doubleday Large Print Home Library
• Readers Digest Partners for Sight Foundation
• Readhowyouwant.com

Is Bigger Really Better?

• Potential harmful effects to consider in the classroom
  – Decreased access to full instructional opportunities
  – Diminished access to the full range of the curriculum
  – Lack of opportunities for social interaction
  – Decreased self-esteem
  – Stigmatization
  – Isolation from peers in the educational setting
  – Lack of availability outside the classroom

Illumination

• No difference found between types of light bulbs for any reading outcome (Esperjesi, 2007)
• Intensity, color and direction are most important (Haymes & Lee, 2006)

Illumination

• Recommended lighting levels for reading ~2000 lux (Bowers, Meek & Stewart, 2001)

Filters

Contrast

• Electronic display (Siegenthaler et al., 2012)
• Illumination contrast versus color contrast (Legge et al., 1990)
• Bold versus normal typeface
Ergonomics and Positioning

- Comorbidity
- Working distance
- Joint protection/pain
- Endurance

(Li, Lin, & Lee, 2002; Markowitz, 2006)

Ergonomics for Tablets/eReaders

Optical Aids

- High plus readers
- Hand magnifiers
- Stand magnifiers

Electronic Magnification Systems

- CCTV
- Portable Video Magnifiers
- Computer Magnification
- Spec-Mounted Displays

Electronic Books

- Categories of Digital Text
  - Supported Reading Software (SRS)
  - Digital Talking Books (DTBs)
  - Commercial Digital Text (e-books)

The Digital Revolution

- Students with disabilities must have access to the latest technology available to improve their access to text materials and permit them to compete equally on the academic playing field.

AHEAD's Perspective on the Issue of Textbook Access, 2006
Digital Reading Speeds

- Improvement over book reading
  - 42 more wpm on average with the iPad 2 (18-point font)
  - 12 more wpm on average with the Kindle (18 point font)
- Preference correlated to degree of vision loss
- iPad’s back illuminated screen credited as key to improvement

Availability of e-Books

- Public Libraries
- Bookshare.org
- Accessible Book Collection
- Internet Archive’s Open Library

Electronic Books

**Pros**
- Lightweight and portable
- No overdue fees
- Convenient
- Decreased library overhead costs

**Cons**
- Limited availability
- Library hosting fees
- Use statistics not easily tracked
- Reader privacy concerns

There’s an App (or Device) For That

- E-Readers
- Tablets
- Smartphones
- Apps
  - Kindle
  - Nook
  - iBooks
  - Google Play
  - Aldiko
  - Zinio
  - Blio

Summary

- Reading is a multifactorial process
- Interventions can, and should, be customized to meet a patient’s goals
- Electronic devices and electronic media are powerful resources for the low vision reader

References

References


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