Research Reports

Age-Related Macular Degeneration and Reading Performance: Does Font Style Make a Difference?

Christina Hedlich, Elizabeth Barstow, and Laura K. Vogtle

The National Eye Institute (2015) reports that by the year 2050, the number of individuals with age-related macular degeneration (AMD) will rise from 2.07 million to 5.44 million. AMD causes central vision loss, which can affect independence in activities such as medication management, meal preparation, and personal finances (Smallfield, Clem & Myers, 2013). Most of these activities require reading, making an inability to read a concern for those with AMD (Hassell, Lamoureaux, & Keeffe, 2006).

Font size and style of text may improve reading performance for individuals with low vision. Most recommendations addressing font styles are not evidence based. One font characteristic with conflicting outcomes is the use of serifs, decorative extensions placed on ends of characters. Many persons with low vision report reading serif fonts as easiest, a text style frequently used in reading materials (Strizver, 2015). A sans-serif font is void of any serifs and is commonly used in charts and captions (Strizver, 2015).

Studies have investigated attributes of fonts for typical vision readers and low vision readers, but few have focused on individuals with AMD. Mansfield, Legge, and Bane (1996) compared font styles on reading performance in those with and without low vision. Results indicated that participants with central visual field loss were more sensitive to differences in font style, and the Courier font produced the fastest reading speed. Tarita-Nistor, Lam, Brent, Steinbach, and González (2013) focused on the reading performance of those with AMD using four different font styles. Reading performance was best with the Courier font, while the Arial font produced the poorest performance. In contrast, a systematic review of 18 studies found no conclusive evidence to support a relationship between print legibility and serif choice for reading with low vision (Russell-Minda et al., 2007). The studies included in that review focused on the different typeface characteristics, which limited the investigators' ability to provide definitive recommendations.

Advocacy groups such as the American Foundation for the Blind (n.d.), the Canadian National Institute for the Blind (n.d.), and the Council of Citizens with Low Vision International (n.d.) that publish guidelines of text composition for readers with vision loss recommend the use of mono-spaced, san-serif font styles. These guidelines are not evidence based but represent the preferences of readers with low vision (Tarita-Nistor et al., 2013).

The aim of this mixed-methods study was to determine the preferred font style of individuals with AMD, and whether a sans-serif, proportionally-spaced font (Arial) or a serif, mono-spaced font (Courier New) improved reading performance for individuals with AMD. *Reading performance* was defined as reading acuity, critical print size, and maximum reading speed.

Methods

A mixed-methods design was used in which the researchers collect and analyze qualitative and quantitative data in a single study (Driscoll, Appiah-Yeboah, Salib, & Rupert, 2007). The advantage of this design was the ability to compare and contrast data types to better understand font preferences for those with AMD. This study was approved by the University of Alabama at Birmingham institutional review board, and written consent was provided by each participant.

Participants

We recruited participants using a convenience sample from an outpatient low vision clinic and support group. Inclusion criteria were: visual acuity between 20/30 and 20/400, contrast sensitivity of at least 10%, intact cognition, and AMD. Conditions other than cataract or cataract removal were excluded; participants had to be 55 years of age or older, able to speak English, and had to demonstrate at least a third-grade literacy level.

Those who had had cataract surgery in one or both eyes were not excluded from this study. Fifty percent (eight) of the participants had bilateral cataract removal in their eye health history; 18% (three) had documented cataract removal in one eye. Thirty-two percent (five) of the participants had not undergone cataract removal in either eye and did not have more than a moderate grade of cataract at the time of the study.

The sample (N = 16) consisted of eight men and eight women with a mean age of 81.9 years (SD = 7.8 years). Six participants (38%) had near-normal vision, five (31%) had moderately low vision, and five (31%) had severely low vision (see Table 1). Assignment to one of these three groups was determined by visual acuity corresponding to the World Health Organization Levels of Visual Impairment groups (Dandona & Dandona, 2006).

Table 1
Characteristics of the participants.

Age	Gender	Visual acuity	Morgan (grade)	Contrast
74	M	20/50	13.8	10%
82	F	20/60	16.5	5%
82	F	20/100	7.6	5%
88	F	20/125	15.2	10%
91	M	20/200	5.1	10%
86	F	20/125	7.5	10%
76	M	20/200	13.9	5%
94	F	20/100	7.6	5%
75	M	20/40	13.9	1.25%
93	F	20/80	10.0	5%
78	M	20/60	16.5	5%
85	F	20/80	11.4	1.25%
74	M	20/200	13.9	5%
66	M	20/80	16.5	5%
86	F	20/200	15.2	5%
81	M	20/200	16.5	1.25%

Note: Visual acuity = visual acuity according to LEA Numbers Chart for Vision Rehabilitation; Morgan = Morgan Reading Comprehension Assessment; Contrast = contrast sensitivity according to LEA Numbers Low Contrast Test, 10M.

Measures

The MNREAD Acuity Chart and qualitative interview transcripts were the primary outcome measures used. In the following section, screening and data collection tools are described.

Screening measures. Participants were screened for the inclusion criteria. The LEA Numbers Chart for Vision Rehabilitation, manufactured by Elgin, Illinois–based Good-Lite, designed to measure visual acuity from the normal to profound range, was used to screen for visual acuity (Colenbrander, 2018). Contrast sensitivity was assessed using the LEA Numbers Low-Contrast Test, 10M, which measures contrast sensitivity function from 1.25% to 25% (Good-Lite Company, 2018). Cognitive status had to assessed with a tool that did not require vision to be a prerequisite. The Short Portable Mental Status questionnaire (Pfeiffer, 1975), a reliable and valid measure of cognition in older adults, was used. Reading comprehension was measured using the Morgan Reading Comprehension Test, which was designed to determine reading comprehension levels of individuals with AMD (Watson, Wright, & Long, 1996).

Data collection measures. The MNREAD Acuity Chart (Regents of the University of Minnesota, 1994) was modified with Courier New (serif) and Arial (sans-serif) fonts to assess the dependent variables of reading acuity, critical print size, and maximum reading speed. Written permission was obtained from those authors to create and utilize a modified version of the test for this study.

Arial	The quick brown fox ran fast.
Courier New	`The quick brown fox ran fast.`

Figure 1. Examples of Arial and Courier New fonts used.

Modified charts included print size of 0.0 logMAR to 1.3 logMAR printed on 92 bright 67-pound paper using a Xerox D95 LaserJet printer. The print size of each logMAR level sentence was determined by the height of a lower-case letter *x* (*x*-height) on the original MNREAD Acuity Chart to equate the two fonts when creating the testing boards without having to alter the fonts. The sentences used on the testing charts were taken from the original chart to ensure length and lexical difficulty similar to the original test. See Figure 1 for samples of both fonts used.

To learn participant perspectives for font preference, semi-structured interview scripts were developed using open-ended questions to guide the interview process. The interview script utilized input from four low vision experts, followed by pilot testing on five clients with low vision, and was modified for clarity.

Data collection and analysis

The location of data collection was chosen by the participants, and it occurred in a private location at either the participant's home or a low vision center.

Quantitative elements. Each adapted MNREAD Acuity Chart was presented in the same order (Arial first and Courier New second) with the same lighting, to ensure uniformity of testing conditions. The light source, a Hanavex LDT2 LED table lamp set on 5500k color temperature and 4000k brightness, was positioned 12 inches above the test charts. Testing procedure and scoring followed those outlined in the MNREAD Acuity Chart manual.

Data was analyzed using IBM SPSS Version 23. Means and standard deviations for age were calculated across all participants and within low vision group categories. Means and standard deviations for data from the MNREAD Acuity Chart (reading acuity, critical print size, and maximum reading speed) were calculated for both fonts tested. The nonparametric Wilcoxon signed-ranks test was used to determine if there was a significant difference of font on the dependent variables.

Qualitative elements. Interviews immediately following MNREAD administration required participants to reflect upon preferred font style and reasons for this preference. Each interview was audio recorded and transcribed verbatim. Member checking was used to assure interpretation accuracy.

The qualitative data was organized using thematic analysis. The primary investigator sorted information into themes that describe font choice and reason for preference. Qualitative themes were compared to the quantitative data to provide additional insight into font style preference.

Results

Quantitative data

Data analysis was completed on combined levels of vision impairment. Based on the analysis from the Wilcoxon signed-ranks test, no significant differences were observed between the median scores on reading acuity ($Z = -.979$, $p = .328$), critical print size ($Z = -1.153$, $p = .279$), and maximum reading speed ($Z = -1.153$, $p = .249$) between the Arial and Courier New fonts, across all participants (see Table 2).

Qualitative data

Four main themes emerged: hobbies, reading adaptations, frustrations, and font preference. Only the themes relevant to the topic of this paper will be discussed here.

Table 2
Descriptive statistics of outcome variables.

Variable	Mean (n = 16) Arial/Courier New	*SD* Arial/Courier New
Reading acuity	.69/.65	.35/.36
Critical print size	.99/.99	.25/.19
Maximum reading speed	110.87/119.56	55.18/59.93

Note: Reading acuity and critical print size = logMAR; Maximum reading speed = words per minute (WPM).

Font preference. Font preference and reason for that preference were reported at the end of each interview. Fifty percent of participants preferred the Arial font, providing four main reasons: "the letters were closer together" (two participants), "the print appears bolder" (one participant), "the print appears darker" (three participants), and "the print appears clearer/stands out more" (two participants). Twenty-five percent of participants preferred the Courier New font, providing two reasons: "It has wider spacing, which makes the font look larger" (three participants) and "I worked in the printing industry, and I am used to reading serif fonts" (one participant). Four participants saw no difference between fonts. Those with visual acuity in the near-normal group had less font preference than the groups with more severe visual impairments (see Table 3).

Discussion

The results of the quantitative data did not show a significant difference between the two fonts for the variables of reading acuity, critical print size, and maximum reading speed. The qualitative data revealed no difference in font preference across all acuity levels; however, eight out of 16 preferred the Arial font compared to the four participants who preferred the Courier New font or stated no preference of font (four participants). The measures of critical print size and maximum reading speed match the results in the Tarita-Nistor et al. (2013) study. However, their conclusion about the value of the Courier font was based on the percentage of patients who could read an entire line of text at 0.3 logMAR (33%) at the reading speed of 11.2 words per minute. This is far from the 80 words per minute that is considered fluent reading. It is difficult to discern the difference in the samples of these two studies, since the Tarita-Nistor et al. study (2013) only stated the logMAR or Snellen (20/59); in comparison, the current study provides more detailed information concerning the subjects studied. Study results do not support outcomes found by Tarita-Nistor et al. (2013) that the Courier font enhanced reading performance in individuals with AMD.

Table 3
Font preference by levels of visual impairment.

Group	Arial	Courier New	No preference
Near-normal	3 (42.9%)	0	3 (60%)
Moderate	3 (42.9%)	2 (50%)	0
Severe	2 (14.2%)	2 (50%)	1 (40%)

The qualitative data demonstrated that 50% of participants preferred the Arial font. Although this is a small sample, the data provides support for the importance of client input when providing recommendations for print material font. The results provide some support for the recommendations made by low vision advocacy groups that encourage sans-serif fonts. This study highlights the need for more research in the area of font preference and for the inclusion of a wider range of vision loss conditions to provide more evidence-based recommendations.

Limitations

A small homogeneous sample size (N = 16) creates difficulties with generalization and transferability. The adapted MNREAD Acuity Charts were not presented in a random order, which may have contributed to testing bias.

Conclusion

This study demonstrates the need for research investigating the influence of fonts on reading performance in people with vision loss. Study findings demonstrate no consistent font preference by those with AMD. Low vision practitioners should tailor their recommendations for reading adaptations based on client preference.

References

American Foundation for the Blind. (n.d.). *Tips for making print more readable*. Retrieved from http://www.afb.org/info/living-with-vision-loss/reading-and-writing/making-print-more-readable/235

Canadian National Institute for the Blind. (n.d.). *Clear print accessibility guidelines*. Retrieved from http://www.cnib.ca/en/services/resources/Clearprint/Documents/CNIB%20Clear%20Print%20Guide.pdf

Colenbrander, A. (2018). LEA Numbers chart for vision rehabilitation [Vision assessment chart]. Retrieved from https://www.good-lite.com/Details.cfm?ProdID=58&category=8&Secondary=0

Council of Citizens with Low Vision International. (n.d.). *Best practices and guidelines for large print documents used by the low vision community*. Retrieved from http://acb.org/node/750

Dandona, L., & Dandona, R. (2006). Revision of visual impairment definitions in the International Statistical Classification of Diseases. *BMC Medicine, 4*(7). doi:10.1186/1741-7015-4-7

Driscoll, D. L., Appiah-Yeboah, A., Salib, P., & Rupert, D. (2007). Merging qualitative and quantitative data in mixed-methods research: How to and why not. *Ecological and Environmental Anthropology*, *3*(1), 19–28.

Good-Lite Company. (2018). *LEA Numbers low-contrast test, 10M* [Vision assessment chart]. Retrieved from https://www.good-lite.com/Details.cfm?ProdID=58&category=8&Secondary=0

Hassell, J. B., Lamoureaux, E. L., & Keeffe, J. E. (2006). Impact of age-related macular degeneration on quality of life. *British Journal of Ophthalmology*, *90*(5), 593–596. doi:10.1136/bjo.2005.086595

Kitchel, J. E. (n.d.). *APH [American Printing House for the Blind] guidelines for print document design*. Retrieved from http://www.aph.org/accessible-media-guidelines

Mansfield, J. S., Legge, G. E., & Bane, M. C. (1996). Psychophysics of reading XV: Font effects in normal and low vision. *Investigative Ophthalmology and Visual Science, 37*(8), 1492–1501.

National Eye Institute. (2015). *Age-related macular degeneration*. Retrieved from https://nei.nih.gov/eyedata/amd#5

Pfeiffer, E. (1975). A short portable mental status questionnaire for the assessment of organic brain deficit in elderly patients. *Journal of the American Geriatric Society, 23*(10), 433–41.

Regents of the University of Minnesota. (1994). *MNREAD Acuity Charts*. Minneapolis, MN: Author.

Russell-Minda, E., Jutai, J. W., Strong, G., Campbell, K. A., Gold, D., Pretty, L., & Wilmot, L. (2007). The legibility of typefaces for readers with low vision: A research review. *Journal of Visual Impairment & Blindness, 10*(7), 402–415.

Smallfield, S., Clem, K., & Myers, A. (2013). Occupational therapy interventions to improve the reading ability of older adults With low vision: A systematic review. *American Journal of Occupational Therapy, 6*(3), 288–295.

Strizver, I. (2015). *Serif vs. sans for text in print*. Retrieved from http://www.fonts.com/content/learning/fontology/level-1/type-anatomy/serif-vs-sans-for-text-in-print

Tarita-Nistor, L., Lam, D., Brent, M., Steinbach, M., & González, E. (2013). Courier: A better font for reading with age-related macular degeneration. *Canadian Journal of Ophthalmology, 48*, 56–62. doi:10.1016/j.jcjo.2012.09.017

Watson, G., Wright, V., & Long, S. (1996). *Morgan low vision reading comprehension assessment.* Trooper, PA: Homer Printing Company.

