Title
Telerehabilitation Training to Facilitate Improved Reading Ability with New Magnification Devices for Low Vision

Journal
Optometry and Vision Science, 99(10)

ISSN
1040-5488

Authors
Bittner, Ava Katherine
Kaminski, John E
Ross, Nicole C
et al.

Publication Date
2022-10-01

DOI
10.1097/opx.0000000000001944

HHS Public Access
Author manuscript
Optom Vis Sci. Author manuscript; available in PMC 2023 October 01.

Published in final edited form as:
Optom Vis Sci. 2022 October 01; 99(10): 743–749. doi:10.1097/OPX.0000000000001944.

Telerehabilitation Training to Facilitate Improved Reading Ability with New Magnification Devices for Low Vision

Ava K. Bittner, OD, PhD, FAAO,
University of California, Los Angeles, Department of Ophthalmology, Stein Eye Institute, Los Angeles, California

John E. Kaminski, OD, FAAO,
Mid-Michigan Eye Care, Midland, Michigan

Nicole C. Ross, OD, MSc, FAAO,
New England College of Optometry, Boston, Massachusetts

John D. Shepherd, MD,
University of Nebraska Medical Center, Department of Ophthalmology, Truhlsen Eye Institute, Weigel Williamson Center for Visual Rehabilitation, Omaha, Nebraska

Stacy J. Thoene, OTD/R,
University of Nebraska Medical Center, Department of Ophthalmology, Truhlsen Eye Institute, Weigel Williamson Center for Visual Rehabilitation, Omaha, Nebraska

Nebraska Medicine, Omaha, Nebraska

Sarah Z. Bui,
University of California, Los Angeles, Department of Ophthalmology, Stein Eye Institute, Los Angeles, California

Patrick D. Yoshinaga, OD, MPH, FAAO,
Marshall B. Ketchum University, Southern California College of Optometry, Fullerton, California

BeST-AID Study Team

Abstract

Significance: This pilot study provides some insight about the potential benefits of telerehabilitation training to improve reading ability of adults with low vision with magnifiers, in order to spur future work with larger groups. Telerehabilitation services can be implemented clinically to facilitate access to follow-up care for low vision.

Purpose: A recent Cochrane systematic review revealed there are no published visual function outcomes for telerehabilitation with hand-held magnification devices for low vision; thus, this study aimed to provide evidence for its preliminary efficacy.

Methods: One to four months after receiving a new magnification device (i.e., hand-held or stand optical magnifier, or portable electronic magnifier), fourteen adult low vision patients (with any

Corresponding author: Ava Bittner, abittner@mednet.ucla.edu.

visual acuity level or ocular diagnosis) received two training sessions at home via telerehabilitation with their vision rehabilitation provider located remotely in-office. Telerehabilitation included a loaner smartphone for Zoom videoconferencing with remote control access software. The MNread test to assess near reading (acuity and speed) with the new magnifier was administered during each of the telerehabilitation sessions.

Results: Mean reading acuity with the magnifier was 0.17 logMAR across subjects prior to training at telerehabilitation session-1, which significantly improved to 0.09 on average a few weeks later at telerehabilitation session-2 (95%CI: −0.001,−0.16; *P*=.047). Logarithm reading speed with the magnifier for the reading acuity level at session-1 improved significantly by 0.18 log words per minute on average for the same text size at session-2 (95% CI: 0.06,0.29; *P*=.002). With the magnifier at session-2, 71% of participants gained at least 0.1 log unit in reading acuity and half improved by >0.01 in log reading speed; all participants with increased reading speed also improved in reading acuity (*P*=.02).

Conclusions: These preliminary data support that telerehabilitation can enhance reading ability and efficiency with newly prescribed magnifiers as an alternative option to in-office vision rehabilitation.

There are a variety of visual aids to assist people with low vision with near reading. The most commonly prescribed are magnification devices, such as hand-held or stand optical illuminated magnifiers, or portable electronic magnifiers.[1] Optical low vision aids can significantly improve reading accessibility;[2] however, after the dispense and initial in-office training for a new magnification device, patients may not retain the instructions on how to correctly utilize magnifiers at home or be able to successfully implement the recommendations for lighting and ergonomics without further guidance. Vision rehabilitation can improve reading ability and quality of life,[3,4,5] but effectiveness depends on and increases when rehabilitation techniques are applied over repeated training sessions to reinforce patient motivation, compliance, and skills in the optimal use of magnifiers.[6,7] There are many important considerations during vision rehabilitation training for magnifiers, such as the working distance, proper viewing angle, application to appropriate types of near tasks, stability while utilizing the device, eccentric viewing strategies and/or use of spectacle correction if indicated.

A previous randomized controlled trial used the MNRead test, a validated outcome measure for reading ability, to evaluate the efficacy of additional training with low vision devices compared to dispensing a device without ongoing support or therapy.[7] This clinical trial, the Veterans Affairs (VA) Low Vision Intervention Trial II (LOVIT II), found that additional therapy training improved reading acuity by 0.10 logMAR on average at the four month follow-up as compared to essentially no change (0.01 logMAR) in the group randomized to no additional therapy.[7] Significant increases in reading speed also occurred following additional vision rehabilitation in the LOVIT II trial, which did not change in the group without additional therapy.[7] This trial provided vision rehabilitation services in-office, but there are several barriers that can limit low vision patients' ability to attend in-office training sessions as part of clinical practice, such as lack of transportation and poor physical health.[8–11]

A much larger proportion of Medicare beneficiaries reported using a low vision device (26.1%) than those who had received vision rehabilitation services (3.5%), indicating that there is a gap in the delivery of care for these individuals.[12] Telerehabilitation has the potential to overcome the barriers encountered for vision rehabilitation services that are traditionally rendered in-office. However, a recent Cochrane systematic review revealed there are no publications with outcomes on visual function changes following telerehabilitation for hand-held magnification devices for low vision.[13] Clinical providers and insurance payors may be unlikely to embrace a new service delivery modality if there is no evidence for its efficacy. Therefore, we conducted a pilot study in which we measured changes in reading ability with a new magnifier at two telerehabilitation sessions to determine the proportion of people with low vision who improved in their ability to read a smaller print size and/or whether they read more efficiently. We hypothesized that it would be feasible for vision rehabilitation providers to give remote training via telerehabilitation to reinforce the skills needed for the optimal use of new magnifiers, which would be beneficial to improve reading outcomes in most participants with low vision after practicing with the magnifier between sessions.

METHODS

The multicenter study protocol was approved by the institutional review board at the University of California, Los Angeles (UCLA) and followed the tenets of the Declaration of Helsinki. All participants provided oral informed consent by phone. The study protocol was listed on clinicaltrials.gov with the identifier NCT04066075 prior to enrolling the first participant.

Participants were recruited at clinical practices that provided the vision rehabilitation services, which included the following four academic institutions and a private practice: (1) University of Nebraska Medical Center (UNMC) in Omaha, NE, (2) Mid-Michigan Eye Care, a private practice in Midland, MI, (3) New England College of Optometry (NECO) in Boston, MA, (4) Southern California College of Optometry (SCCO) in Fullerton, CA, and (5) UCLA Stein Eye Institute. The providers for the telerehabilitation training included optometrists at four sites and an occupational therapist at UNMC. At an in-office visit prior to study enrollment, participants received a new magnifier that was prescribed by the vision rehabilitation provider who measured best-corrected visual acuities at distance with either an Early Treatment of Diabetic Retinopathy Study chart or Snellen chart, and at near with a continuous text reading card or the MNRead test.[14] The vision rehabilitation provider also measured the participants' contrast sensitivity at the in-office visit using either the Peli-Robson or MARS charts (Precision Vision; Woodstock, IL).

Study participants were adults aged 18+ years who had newly received portable electronic video magnifiers, hand-held or stand optical magnifiers; only one magnifier per subject was included in the MNRead evaluations and analyses presented here. There were no specific inclusion or exclusion criteria for visual acuity or ocular diseases. Exclusion criteria were: medical or self-reported history of cognitive impairment, non-English speaking, no access to a home telephone, and moderate to severe cognitive impairment as scores less than 20 on the Telephone Interview for Cognitive Impairment (TICS).[15] TICS scores of 21–25 indicate mild cognitive impairment, scores of 26–32 are considered ambiguous, while scores of 33 and above indicate normal cognition. The TICS, SF-36 general health questionnaire,[16] and Hospital Anxiety and Depression Scale (HADS)[17] were administered by phone at the time of study enrollment and study completion 4-months later. Data are from a randomized controlled trial conducted from 2020–2022 and we excluded participants who had only one telerehabilitation session or received in-office training for the control group.

In advance of the scheduled telerehabilitation sessions, we shipped a kit of loaner equipment to participants' homes. Participants used a loaner smartphone for the telerehabilitation session, which was a Verizon cellular data enabled Samsung Galaxy S6 smartphone, rather than their own Internet-enabled device. Participants were instructed to place the loaner smartphone in a loaner stand that was adjusted to allow the vision rehabilitation provider to view the participants' magnifier relative to the reading material during the session. The Lighthouse continuous text near reading card and MNRead test were provided in sealed envelopes with instruction for participants to open it only during the session. We used videoconference services from Zoom.us and provided support in the connection to videoconferencing through the use of remote control access software (RescueAssist by LogMeIn, Inc.) on our loaner smartphones. This enabled the study principal investigator (AKB) to remotely initiate and end the Zoom videoconferencing sessions for participants after confirming by phone that they were ready to begin.

A standard protocol for the interaction between the vision rehabilitation provider and the participant during the telerehabilitation encounter was utilized consistently across all training sessions for portable electronic video magnifiers, hand-held or stand optical magnifiers. The sessions took place in participants' homes while the provider was in-office and usually lasted approximately one hour. Participants were asked to set-up the videoconferencing where they typically did most of their reading with the magnifier in their home. Our vision rehabilitation providers assessed participants' technique with their magnifier and reading fluency with the Lighthouse continuous text card and MNRead test, followed by their own reading materials of interest.

The magnifier training was individualized for each participant, based on their needs with the magnification device. Generally, the training strategy involved verbal instructions from the provider to make any necessary adjustments to the placement of the magnifier and/or reading material, including feedback on the working distance, viewing angle, movement of the magnifier, and/or device adjustments to obtain the best magnification level and field of view while reading. In each session, the vision rehabilitation provider was able to verify whether the participant had been utilizing and appreciated any recently prescribed updates to the spectacle prescription, the recently dispensed magnification device(s), and any supporting items, such as a gooseneck lamp or reading stand. While the provider administered the MNRead test and participants read their own materials of interest, valuable insights on each participant's unique reading techniques (i.e., working distance, lighting) and reading fluency (i.e., speed, accuracy, print size) with their magnification device were obtained. Corrections, modifications and reinforcement for optimal use of the magnification device and placement of materials were often needed to maximize near visual function. This was accomplished through verbal instructions from the provider to make necessary adjustment to the placement of the magnifier and/or reading material, including feedback on the working distance, viewing angle, movement of the magnifier, and/or device adjustments to obtain the best magnification level and field of view while reading.[18] The two participants with a portable electronic video magnifier were instructed to manually self-adjust the magnification level that would allow them to read most efficiently and/or access smaller print sizes. Gains in fluency, confidence and motivation to continue reading were noticeable by the vision rehabilitation providers from the initial to the subsequent telerehabilitation session.

The MNRead measurements for timing and errors across all print sizes read by participants were obtained by a single investigator (AKB) across all telerehabilitation sessions and participants. At the first telerehabilitation session, the MNRead was administered for assessment purposes prior to magnifier training. For the second telerehabilitation session, the MNRead was used to evaluate if the participant had improved in their reading ability since the first session before offering any additional training if needed. The mean amount of time between sessions was 39 days (range 21–79 days; SD 16). Participants read the MNRead test sentences aloud as quickly as possible while trying to avoid errors, starting with largest print size without their magnifier (with spectacle correction if appropriate for near) and then were instructed to start using their magnifier whenever their reading ability slowed and became more difficult with smaller text sizes. They were allowed to either hold the MNRead test material or place it on the table, whichever was most appropriate for their reading needs, magnifier use, and/or level of vision.

Data Analyses

Descriptive statistics were used to summarize the study data and findings. Our study design allowed participants to read the larger text sizes without their magnifier, as they would during daily activities; therefore, since they only read a few smaller sized sentences with the magnifier, we were unable to calculate the traditional MNRead metrics for maximum reading speed across several sentences and critical print size. Forcing them to read all of the MNRead text sizes, including the larger sized sentences, with their magnifier would have been a difficult, impractical task. Reading acuity was defined as the smallest text size in the MNRead test for which the participant was able to read the entire sentence accurately with their magnifier. We compared the reading speed calculated as words per minute (600/time recorded in seconds) for the reading acuity level with the magnifier at session 1 to the same text size at session 2, which we defined as reading speed at the reading acuity level at session 1. We also calculated the logarithm_{10} reading speed change between sessions 1 and 2, in order to determine whether it exceeded the previously reported 95% coefficient of repeatability of 0.1 log words per minute or 25% for the MNRead in visually impaired subjects.[19] We used random-effects generalized least squares linear regression to account for within-subject correlation to evaluate for differences in logMAR reading acuity or reading speed between sessions 1 and 2. Logistic regressions were used to evaluate whether there were any significant factors related to the odds of improved reading acuity (≥0.1 logMAR) or reading speed (≥0.1 log words per minute or 25%) with the magnifier at the second session. Mean scores were used for the questionnaires (TICS, SF-36, HADS) completed at baseline and study completion. Data were analyzed using Stata/IC version 15.1 (Stata Corp., College Station, Texas, USA).

RESULTS

Table 1 shows the participants' demographics, ocular diagnoses, visual function data, magnifier information, and MNRead results, including the smallest text size (i.e., reading acuity) that was read with the magnifier at each session. Mean reading acuity with the magnifier was 0.17 logMAR across subjects prior to training at the first telerehabilitation session, which significantly improved to 0.09 logMAR on average at the second telerehabilitation session a few weeks later (95% CI: −0.001,−0.16; P=.047). The majority (71%; n=10 of 14) of participants gained at least 0.1 log unit in near reading acuity with their magnifier at the second telerehabilitation session. Most of the participants gained 0.1 logMAR in reading acuity (57%; n=8 of 14) since only 14% (n=2 of 14) of all participants gained more than 0.1 logMAR.

Table 2 displays the data for logistic regression analyses in which we explored whether any patient-related, vision-related or magnifier-related factors were significantly associated with whether the participant improved in their reading acuity or speed with the magnifier between-sessions. Mean SF-36 general health was the only variable that was significantly predictive of which participants improved in reading acuity with their magnifier. Participants with better general health had significantly greater odds of improved reading acuity at telerehabilitation session 2, as shown in figure 1. All the participants who did not improve in near reading acuity (29%; n=4 of 14) had a hand-held optical magnifier, but half of those who improved in reading acuity had a hand-held magnifier.

Reading speed with the magnifier for the reading acuity level at session 1 improved significantly by 15 words per minute on average for the same text size at session 2 (95% CI: 2,29; P=.026). For the logarithm of the reading speed with the magnifier for the reading acuity level at session 1, there was a significant improvement by 0.18 log words per minute on average for the same text size at session 2 (95% CI: 0.06,0.29; P=.002). Half of the participants (50%; n=7 of 14) had an improvement in log reading speed by >0.1 log words per minute or >25% between sessions 1 and 2 for the reading acuity level at session 1. The odds of developing a meaningful increase in reading speed with the magnifier (i.e., >0.1 log words per minute or >25%; outside previously reported test-retest variability) was not significantly associated with any of the variables in table 2. However, subjects with the slowest log reading speeds at session 1, had the greatest improvement in log reading speed (−0.49; 95% CI: −0.85,−0.14; P=.01) or percent change in log reading speed (−204%; 95% CI: −345%,−61%; P=.009) with the magnifier at session 2, as shown in figure 2. The two participants with the greatest improvement in log reading speed had portable electronic magnifiers. All of the participants who had a meaningful increase in reading speed with the magnifier (i.e., >0.1 log words per minute at session 2), also improved in their reading acuity with the magnifier at session 2 (Pearson chi^2=5.6; P=.02), as shown in figure 2.

DISCUSSION

This prospective cohort pilot study provides evidence for the potential to gain improvements in near reading acuity and/or speed for most participants who received telerehabilitation for a new magnifier. We documented that the majority of participants were able to access a smaller text size in the range of fine print with their magnifier and/or read small text more quickly a few weeks after receiving instruction from their vision rehabilitation provider remotely via videoconferencing. Based on the previously reported precision of the coefficient of repeatability of 0.08–0.12 logMAR for reading acuity and 0.08–0.13 log words per minute for reading speed with the MNRead in visually impaired subjects,[19] it remains possible that our statistically significant mean changes of 0.08 and 0.18 log units for reading acuity and log reading speed could be considered meaningful, but larger studies of telerehabilitation training are needed to further evaluate these estimates of effect size. This preliminary work provides support for the feasibility and potential benefits of telerehabilitation to provide magnifier training, in order to help support the design and conduct of future, larger scale studies on this topic.

Our participants who did not improve in reading acuity with the magnifier had worse general health; we hypothesize that they may require more than two training sessions due to other comorbidities that might limit rehabilitation. Reduced general health may be associated with reduced dexterity; Dickinson et al. found that impaired dexterity can significantly impact outcomes and limit the successful use of near optical aids.[20] The vision- or magnifier-related factors that we measured were not associated with the odds of improved reading acuity or speed, indicating that the potential for improvement with telerehabilitation may not restricted according to type or level of visual impairment or magnification device. Similarly, a previous scoping review identified that age, ocular diagnosis and visual acuity did not influence usage of optical visual aids, whereas consistent training was a contributing factor to magnifier usage, which highlights the importance of ongoing training as in our study.[21] Our multicenter study's findings may be generalizable to a diverse group of adults who receive magnifiers for low vision since we included participants who had a wide range of visual impairment and evaluated several types of magnifiers.

The LOVIT II[7] trial reported a mean increase in maximum reading speed of 19.5 words per minute following additional vision rehabilitation, which was similar to our mean increase of 15 words per minute, although we only assessed reading speed for a single sentence at the reading acuity level, so the definitions for reading speed differed between studies. The LOVIT II trial[7] found slightly greater improvement in reading acuity on average following vision rehabilitation services than our study. This could be explained by the fact that LOVIT II participants were U.S. veterans who received all low vision devices deemed appropriate for them, whereas our participants were recruited from clinical practices in which they were required to self-pay or obtain devices from state commissions or other agencies. This factor may have impacted which devices were dispensed and provided, with potentially fewer or less expensive devices in our study. Our participants had better baseline mean reading acuity (0.54 log units) than LOVIT II participants (0.89 log units), and we included participants with mild cognitive impairment who were excluded from LOVIT II; either of those factors could potentially influence outcomes, but have not yet been evaluated in a large cohort.

Additionally, the LOVIT II trial participants received longer duration of training (mean 234 minutes) than in our study (~120 minutes), with more intensive instruction in eccentric viewing, word and letter recognition skills, scanning techniques, and homework to practice skills. Our study did not specifically give homework other than to practice using their magnifier for typical reading tasks as part of daily activities. Future studies could explore dose effects for the amount of device training and/or inclusion of homework, as well as whether a specific type of magnifier tends to yield the greatest improvement in reading acuity. This data was not reported from the LOVIT II trial, presumably because multiple devices were used per participant.

In subjects with age-related macular degeneration who had adapted to the use of magnifiers, reading speed improved following at-home training through a computer program for reading sequentially presented text (RSVP) compared to those who were randomized to receive no training.[22] Similar to our study, they found the largest improvements among those with the slowest baseline reading speed. Home-based computer reading training programs also improved reading speed for individuals with juvenile macular dystrophies who were already using magnifiers.[23] Collectively, the research on additional home-based training, either computerized or via a vision rehabilitation provider as in our study, indicates an increased potential for improvements in reading beyond the initial gains provided solely by the device when first dispensed, particularly for the slowest readers.

A limitation of our small sample size was that there were only two or three participants with portable electronic or stand optical magnifiers, respectively. Therefore, we were unable to assess whether there were significant changes in reading according to magnifier type, and we recommend that larger future studies should address this question. We did not include desktop closed circuit televisions (CCTVs) in our study, but a previous randomized controlled trial indicated that additional training did not improve reading with desktop CCTVs.[24] This deserves further investigation, although training is often given by a company representative upon delivery of the CCTV rather than a vision rehabilitation provider. Affordability of care is also an important consideration when comparing telerehabilitation to in-office care, and while there was no formal cost evaluation performed in our study, this should be a focus of future investigations. The loaner phone and stand that were provided in our study are important elements of the protocol to enable accessibility for patients with low vision, which we would recommend for future studies or clinical care; otherwise many who cannot access videoconferencing on their own would be excluded, as in a previous report.[25] We did not encounter any issues with the phones and stands that were shipped to participants since none were broken, lost or stolen; therefore, it should be a sustainable approach if the shipping costs are covered.

The known impact of vision loss on reduced quality of life, increased depression, anxiety, and/or emotional distress is likely to persist after an initial vision rehabilitation encounter if follow-up training is not given to maximize new device acceptance and minimize abandonment. Customized vision rehabilitation treatment plans to address the unique needs of visually impaired patients with follow-up by the vision rehabilitation provider can be similarly effective towards the ultimate goal to best utilize patients' remaining vision by learning to correctly and optimally use magnification devices. As in our study, vision rehabilitation providers promote gains in reading fluency, automaticity, confidence and motivation to build upon those gains. Through verbal instructions and suggestions, visual confirmation, and patient responses, we were able to provide effective device training, which resulted in improved reading ability. Standardized near reading cards used during a telerehabilitation session allow providers to assess if a significant visual decline has occurred due to possible ocular disease progression since the last office visit, which would prompt an in-person evaluation to provide timely treatment as needed. Telerehabilitation should enable more efficient system-wide resource allocation to deliver care safely and conveniently, including individuals in remote locations, which we anticipate will lead to improved vision-related outcomes.

In conclusion, our preliminary data support that telerehabilitation can enhance reading ability and efficiency with newly prescribed magnifiers as an alternative to in-office care for vision rehabilitation. Future work as a randomized controlled trial with a larger sample size should compare the effects of training for new magnifiers that is provided in-office versus telerehabilitation for improvements in reading acuity and/or speed, as well as reading ability assessed with a patient reported outcome measure. Establishing an evidence-basis for the efficacy of telerehabilitation training for magnifiers used by individuals with low vision should help support its implementation into clinical practice and insurance reimbursement rates for services.

ACKNOWLEDGMENTS

NEI R21 EY029883 to AKB; 2019 Clinical Research Award from the American Academy of Optometry Foundation. Contributions to the study from other members of the BeST-AID study team included: Dr. Alicia Donahue at NECO in Boston, MA, the UCLA study coordinators, Kelly Hofschneider and Max Estabrook, and the UCLA student research assistants (Tameen Ahmed, Jewel Chu, Samantha Ito, Xuan Kuang, Joyce Kuo, Leanne Lee, Hannah Liu, and Megan Yu)

REFERENCES

1. Virgili G, Acosta R, Bentley SA, et al. Reading Aids for Adults with Low Vision. Cochrane Database Syst Rev 2018;4:CD003303. [PubMed: 29664159]
2. Latham K Benefits of Low Vision Aids to Reading Accessibility. Vision Res 2018;153:47–52. [PubMed: 30292724]
3. Binns AM, Bunce C, Dickinson C, et al. How Effective Is Low Vision Service Provision? A Systematic Review. Surv Ophthalmol 2012;57:34–65. [PubMed: 22018676]
4. van Nispen RM, Virgili G, Hoeben M, et al. Low Vision Rehabilitation for Better Quality of Life in Visually Impaired Adults. Cochrane Database Syst Rev 2020;1:CD006543. [PubMed: 31985055]
5. Pearce E, Crossland MD, Rubin GS. The Efficacy of Low Vision Training in a Hospital-based Low Vision Clinic. Br J Ophthalmol 2011;95:105–8. [PubMed: 20837788]
6. Stelmack JA, Tang XC, Reda DJ, et al. Outcomes of the Veterans Affairs Low Vision Intervention Trial (LOVIT). Arch Ophthalmol 2008;126:608–17. [PubMed: 18474769]
7. Stelmack JA, Tang XC, Wei Y, et al. ; LOVIT II Study Group. Outcomes of the Veterans Affairs Low Vision Intervention Trial II (LOVIT II): A Randomized Clinical Trial. JAMA Ophthalmol 2017;135:96–104. [PubMed: 27978569]
8. Pollard TL, Simpson JA, Lamoureux EL, Keeffe JE. Barriers to Accessing Low Vision Services. Ophthalmic Physiol Opt 2003;23:321–7. [PubMed: 12828622]
9. Lam N, Leat SJ. Barriers to Accessing Low-Vision Care: The Patient's Perspective. Can J Ophthalmol 2013;48:458–62. [PubMed: 24314403]

10. Khimani KS, Battle CR, Malaya L, et al. Barriers to Low-Vision Rehabilitation Services for Visually Impaired Patients in a Multidisciplinary Ophthalmology Outpatient Practice. J Ophthalmol 2021;2021:6122246. [PubMed: 34881054]
11. Malkin AG, Ross NC, Chan TL, et al. U.S. Optometrists' Reported Practices and Perceived Barriers for Low Vision Care for Mild Visual Loss. Optom Vis Sci 2020;97:45–51. [PubMed: 31895277]
12. Choi S, Stagg BC, Ehrlich JR. Disparities in Low-Vision Device Use among Older US Medicare Recipients. JAMA Ophthalmol 2018;136:1399–1403. [PubMed: 30193379]
13. Bittner AK, Yoshinaga PD, Wykstra SL, Li T. Telerehabilitation for People With Low Vision. Cochrane Database Syst Rev 2020;2:CD011019. [PubMed: 32102114]
14. Legge GE, Ross JA, Luebker A, LaMay JM. Psychophysics of Reading. VIII. The Minnesota Low-Vision Reading Test. Optom Vis Sci 1989;66:843–53. [PubMed: 2626251]
15. Mangione CM, Seddon JM, Cook EF, et al. Correlates of Cognitive Function Scores in Elderly Outpatients. J Am Geriatr Soc 1993;41:491–7. [PubMed: 8486880]
16. Ware JE Jr, Sherbourne CD. The MOS 36-Item Short-Form Health Survey (SF-36). I. Conceptual Framework and Item Selection. Med Care 1992;30:473–83. [PubMed: 1593914]
17. Zigmond AS, Snaith RP. The Hospital Anxiety and Depression Scale. Acta Psychiatr Scand 1983;67:361–70. [PubMed: 6880820]
18. Baldasare J, Watson GR, Whittaker SG, Miller-Shaffer H. The Development and Evaluation of a Reading Test for Low Vision Individuals with Macular Loss. J Vis Imp Blind 1986;80:785–9.
19. Subramanian A, Pardhan S. Repeatability of Reading Ability Indices in Subjects with Impaired Vision. Invest Ophth Vis Sci 2009;50:3643–47.
20. Dickinson C, Shim M. The Influence of Manual Dexterity on Reading Speed with a Hand-Held Magnifier. Invest Ophth Vis Sci 2007;48:4368–74.
21. Lorenzini MC, Wittich W. Factors Related to the Use of Magnifying Low Vision Aids: A Scoping Review. Disabil Rehabil 2020;42:3525–37. [PubMed: 31120308]
22. Kaltenegger K, Kuester S, Altpeter-Ott E, et al. Effects of Home Reading Training on Reading and Quality of Life in AMD—A Randomized and Controlled Study. Graefes Arch Clin Exp Ophthalmol 2019;257:1499–512. [PubMed: 31111250]
23. Nguyen NX, Stockum A, Hahn GA, Trauzettel-Klosinski S. Training to Improve Reading Speed in Patients With Juvenile Macular Dystrophy: A Randomized Study Comparing Two Training Methods. Acta Ophthalmol 2011;89:e82–8. [PubMed: 21272283]
24. Burggraaff MC, van Nispen RM, Hoeben FP, et al. Randomized Controlled Trial on the Effects of Training in the Use of Closed-Circuit Television on Reading Performance. Invest Ophthalmol Vis Sci 2012;53:2142–50. [PubMed: 22427558]
25. Ihrig C Home Low Vision Ocular Rehabilitation Telehealth Expansion Due to COVID-19 Pandemic. Telemed J E Health 2022;28:873–7. [PubMed: 34559013]

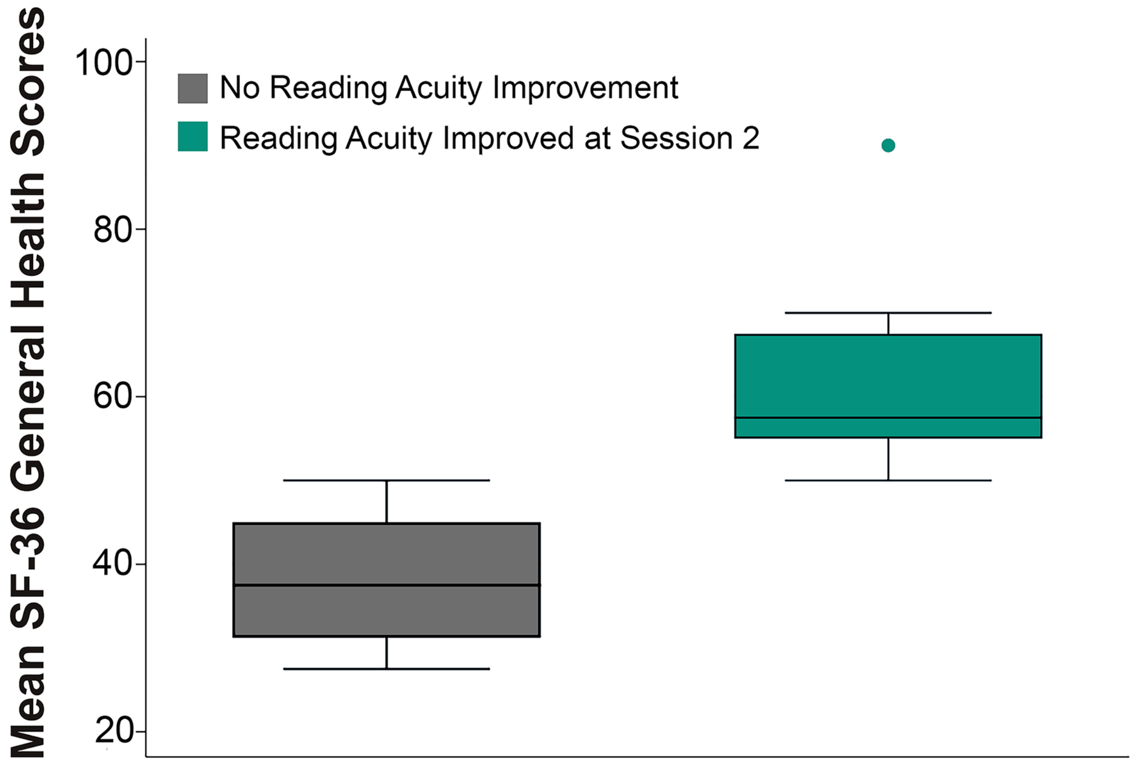

Figure 1.

Box plot of the mean SF-36 scores for general health in relation to whether participants improved in their reading acuity (≥0.1 logMAR) with the magnifier from telerehabilitation session 1 to session 2. In the box plot, the bottom and top of the box are the 25th and 75th percentile (i.e. the upper and lower quartiles, respectively) and the band near the middle of the box is the 50th percentile (i.e. the median). The ends of the whiskers represent the lowest datum within 1.5 times the interquartile range of the lower quartile, and the highest datum still within 1.5 times the interquartile range of the upper quartile. Outliers are represented as dots located outside of the whiskers.

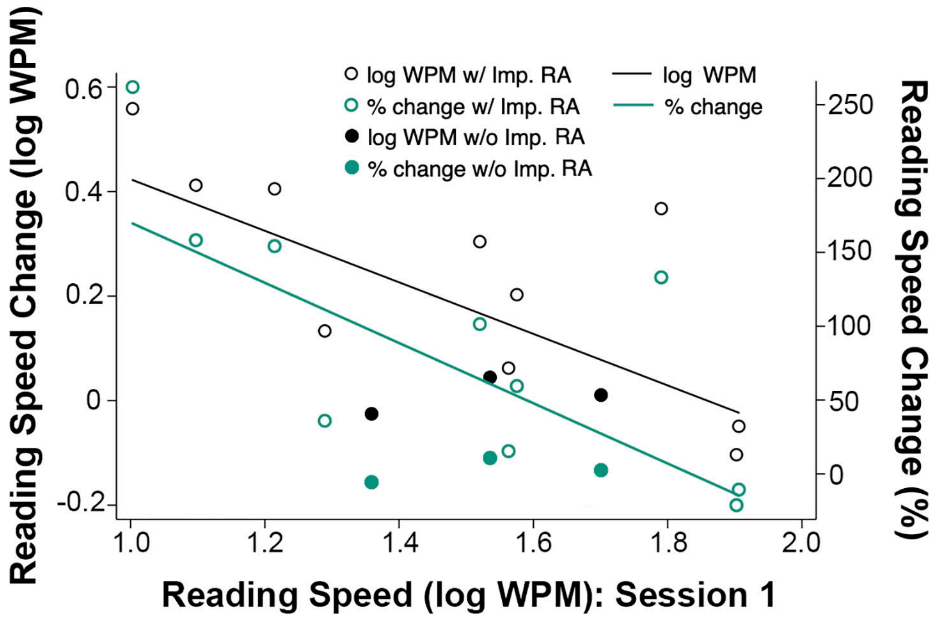

Figure 2.

Scatterplot of the between-session change (second – first telerehabilitation session) in log reading speed in words per minute (WPM) (black markers; y-axis on left side) and percent (%) change in the log reading speed (green markers; y-axis on right side) versus the baseline log reading speed with the magnifier at the first session, for participants with (w/) (open circles) or without (w/o)(filled circles) improved (Imp.) reading acuity (RA) with the magnifier at the second session. The regression lines are fit through all data points for log WPM (black) or percent change (green).

Table 1.

Participants' demographics, spectacle-corrected logMAR visual acuities (VA) at distance and near, magnifier information, MNread reading acuities with the magnifier at the two sessions, and change in reading speed as log words per minute (session 2 - session 1), with group means and standard deviation (SD) for the cohort.

Subject ID #	Gender	Age (yrs.)	TICS score	Ocular Dx	Distance VA logMAR*	Near VA*	logCS	Mag. Type	Magnifier Power (D)	MNRead Acuity 1*	MNRead Acuity 2*	log WPM change (session 2–1)
1	F	71	26	AMD	0.45	0.7	1.2	HHM	10	0.1	0.1	0.04
2	F	78	42	AMD	0.30	0.4	1.05	SM	8	−0.2	−0.3	0.30
3	M	73	35	AMD	0.40	0.4	1.44	HHM	6	0.2	0.1	0.38
4	M	36	30	POAG	1.5		0.45	PEVM		0.1	0.0	0.41
5	F	69	38	AMD	0	0.7	1.65	SM	8	0.2	0.0	0.20
6	F	66	41	myopic degen.	0.45	0.7	1.35	HHM	10	0.3	0.2	−0.10
7	M	83	27	AMD	0.40	0.6	1.35	HHM	6	0.1	0.1	−0.03
8	M	59	39	ret. neovasc.	0.50	0.5	1.5	SM	11	0.1	0.0	0.13
9	F	93	27	AMD	0.48	0.3	1.05	HHM	6	0.1	0.0	−0.05
10	F	75	33	ION	1.0		0.4	PEVM		0.3	0.2	0.56
11	F	79	39	AMD	0.70	0.5	1.05	HHM	16	0.2	0.1	0.06
12	F	73	33	AMD	0.64	0.6	1.2	HHM	10	0.0	0.3	--
13	F	70	40	PDR	0.40	0.3	1.25	HHM	12	0.0	0.0	0.01
14	F	20	21	optic atrophy	0.70	0.9	1.4	HHM	20	0.9	0.5	0.41
Mean (SD)		68 (19)	34 (7)		0.57 (0.35)	0.55 (0.18)	1.17 (0.36)		10 (4)	0.17 (0.25)	0.09 (0.18)	0.18 (0.21)

F = female, M = male, yrs. = years, TICS = Telephone Interview for Cognitive Status, Dx = diagnosis, AMD = age-related macular degeneration, POAG = primary open angle glaucoma, degen. = degeneration, ret. = retinal, neovasc. = neovascularization, ION = ischemic optic neuropathy, PDR = proliferative diabetic retinopathy, VA = visual acuity, logCS = log contrast sensitivity, mag. = magnifier, HHM = hand-held optical magnifier, PEVM = portable electronic video magnifier, SM = stand magnifier, D = diopter, WPM = words per minute for reading speed

* = logMAR unit

Table 2.

Results from simple logistic regression models (odds ratios: OR) used to explore whether any patient-related or magnifier-related factors were significantly related to whether the participant improved in their reading acuity or speed with the magnifier between-sessions.

Variable	Improved Reading Acuity	Improved Reading Speed
Age	OR: 0.96; 95% CI: 0.88 to 1.06; *P* = .41	OR: 0.90; 95% CI: 0.77, 1.05; P = .18
Male gender	OR: 1.29; 95% CI: 0.09 to 18; *P* = .85	OR: 4.5; 95% CI: 0.37, 60; P = .26
mean TICS cognitive status score	OR: 1.08; 95% CI: 0.90 to 1.30; *P* = .43	OR: 0.99; 95% CI: 0.83 to 1.18; *P* = .91
mean HADS depression	OR: 0.96; 95% CI: 0.58 to 1.60; *P* = .88	OR: 1.01; 95% CI: 0.64 to 1.61; *P* = .95
mean HADS anxiety	OR: 1.07; 95% CI: 0.68 to 1.67; *P* = .78	OR: 1.30; 95% CI: 0.84 to 2.01; *P* = .24
mean SF-36 general health	OR: 1.03; 95% CI: 1.006 to 1.05; *P* = .01*	OR: 1.32; 95% CI: 0.92 to 1.88; *P* = .13
spectacle-corrected distance VA	OR: 3.8; 95% CI: 0.06 to 245; *P* = .53	OR: 3.18; 95% CI: 0.11 to 93; *P* = .50
spectacle-corrected near VA	OR: 1.00; 95% CI: 0.001 to 930; *P* = 1.0	OR: 5.40; 95% CI: 0.007 to 4202; *P* = .62
contrast sensitivity	OR: 0.34; 95% CI: 0.008 to 15.4; *P* = .58	OR: 0.51; 95% CI: 0.02 to 11.1; *P* = .67
optical magnifier power	OR: 1.08; 95% CI: 0.78 to 1.49; *P* = .65	OR: 1.04; 95% CI: 0.78, 1.38; P = .80
AMD vs. other ocular diagnosis	OR: 0.33; 95% CI: 0.03 to 4.4; *P* = .40	OR: 0.30; 95% CI: 0.03, 2.76; P = .29
Number of days between sessions	OR: 1.05; 95% CI: 0.94 to 1.17;| *P* = .37	OR: 1.03; 95% CI: 0.96, 1.11; P = .44

* = statistically significant: *P* = .01

TICS = Telephone Interview for Cognitive Status, AMD = age-related macular degeneration, VA = visual acuity.