This is an Accepted Manuscript of an article published by Taylor & Francis in *Disability and Rehabilitation Assistive Technology*, available online: http://www.tandfonline.com/10.1080/17483107.2025.2528858

Is One Enough? Screen Reader Use Among Employed People Who Are Blind or Have Low Vision in the U.S.

Michele C. McDonnall[1], Jamie Boydstun[1], and Anne Steverson[1]

[1]National Research & Training Center on Blindness & Low Vision, Mississippi State University

Michele C. McDonnall https://orcid.org/0000-0002-0942-1210

Jamie Boydstun https://orcid.org/0000-0003-1855-2965

Anne Steverson https://orcid.org/0000-0003-0067-4438

Correspondence concerning this article should be addressed to Michele C. McDonnall, P.O. Box 6189, Mississippi State, MS 39762. Email: m.mcdonnall@msstate.edu

Abstract

Screen reader software is a vital assistive technology (AT) that enables computer access for people who are blind or have low vision, but we know little about its use in the workplace. The purpose of this study was to learn about computer screen reader use among a group of legally blind workers, including type and number of screen readers used, factors associated with multiple screen reader use, and how multiple screen reader users select one for different tasks. Participants were 274 employed people in the U.S. who completed online or phone surveys and used screen readers on the job. Descriptive statistics, chi-square test, and logistic regression were used to analyze quantitative data, and content analysis was utilized with qualitative data. We found that JAWS was the predominant screen reader used, and most people utilized multiple screen readers. People who used multiple screen readers were less likely to report a challenge with working efficiently compared to sighted peers. Experiencing a problem while using a screen reader was the most common reason for deciding to use a different screen reader, followed by deciding based on knowledge that one screen reader works better than others for specific tasks. Several factors, in addition to having an AT or accessibility-related job, were associated with multiple screen reader use. Our findings suggest that using multiple screen readers can benefit workers in terms of efficiency and ability to troubleshoot problems experienced when using a screen reader, such as the inaccessibility or poor usability of digital content.

Keywords: blind, legally blind, low vision, assistive technology, screen reader software, employment

Is One Enough? Screen Reader Use Among Employed People Who Are Blind or Have Low Vision in the U.S.

Computer screen readers are a commonly used assistive technology (AT) by people who are blind or have low vision (B/LV). By converting text and visual elements into speech or braille through keyboard commands, screen readers provide access to digital information for school, work, and leisure. As schools and workplaces transition to digital environments that heavily rely on computer access, screen readers have become essential tools for education and employment.

Screen reader research has primarily focused on the accessibility, or inaccessibility, of digital content while using a screen reader (e.g., Lazar et al., 2004, 2007, 2012; Oh et al., 2021; Zong et al., 2022). Research specifically examining screen reader use is less common, with the exception of the long-standing WebAIM study, which has been conducted since 2008 (*WebAIM: Survey of Preferences of Screen Readers Users*, n.d.). Their 10th and most recent survey found that JAWS, NVDA, VoiceOver, and Narrator are the most commonly used computer screen readers, with JAWS and NVDA most frequently selected as the primary screen reader by users with disabilities (WebAIM, 2024). This same study also found that more than 70% of study participants use more than one computer screen reader (WebAIM, 2024). While this research provides a broad and descriptive overview of screen reader use, it does not explore the nuances of user experiences across different contexts and environments, and its sample includes more than 10% of screen reader users without disabilities. Given these limitations, recent AT research has included information about screen reader use among adults with B/LV, particularly in employment settings. One study found that almost all blind or legally blind workers use a screen reader on the job, making it the most frequently used AT in the work setting (McDonnall, Steverson, Sessler Trinkowsky, et al., 2024). Similarly, a recent report found that screen readers

were the most commonly selected workplace accommodation for persons with B/LV (Silverman et al., 2022). While these studies highlighted the widespread adoption of screen readers by employed persons with B/LV they did not explore other factors associated with screen reader use.

Screen readers are often used by students with B/LV to access their educational materials. According to teachers of students with visual impairments (TVIs), the use of screen readers and other AT provide many benefits to students beyond access, such as enhanced communication skills, increased independence, and improved overall well-being (Tuttle & Carter, 2022). However, the same study revealed that more than 80% of TVIs perceived students' inability to troubleshoot problems on their devices as a barrier to effective AT use (Tuttle & Carter, 2022), providing support for the incorporation of problem-solving skills with AT into instruction.

Two publications addressed the need for inclusion of such skills in AT training for students with B/LV. One study sought to establish a set of digital competencies based on input from TVIs, AT instructors, and related professionals. This research proposed that AT instruction include critical thinking skills to enable students to troubleshoot technology challenges (Kamei-Hannan et al., 2023). Such skills equip students to find alternative ways to complete tasks and prepare them to effectively navigate the continually changing digital landscape. Another publication identified the AT skills necessary for high school students who are blind to succeed in college, including the ability to troubleshoot their AT and the importance of mastering a secondary screen reader as a critical competency for effectively navigating diverse digital environments (Kelly & Kapperman, 2018). This second skill addresses the variations among operating systems, web browsers, and devices (e.g., desktops, laptops, tablets, and smartphones), offering a solution to seamlessly adapt to different technology environments. Collectively, these

publications underscore the importance of a comprehensive AT skill set that fosters independence and adaptability, preparing B/LV students for lifelong learning and digital competence.

Although several studies mention screen reader use, no study has thoroughly evaluated screen reader use among employed people who are B/LV. For TVIs and other professionals who work with students, the ultimate goal is for the student to be prepared to succeed in their education and ultimately the workforce. A greater understanding of how screen readers are used by successfully employed B/LV people can inform professionals who work with this population in terms of the necessary training and preparation. Research on how people with B/LV select which screen reader to use is lacking, as is research on the factors associated with the use of multiple screen readers in the workplace. To address these gaps and extend the research, the purpose of this study was to provide insights into screen reader usage patterns among employed individuals with B/LV by addressing the following research questions:

RQ1: What screen readers are most commonly used by employed people in the United States?

RQ2: How many different computer screen readers do employed people in the United States use?

RQ3: Is use of a single versus multiple computer screen readers associated with the perceived challenge of working less efficiently than sighted peers?

RQ4: For people who use multiple screen readers, how do they select which screen reader to use for their work tasks?

RQ5: What factors are associated with multiple computer screen reader use at work?

Method

This study is part of a larger longitudinal survey research project investigating AT use in the workplace. The primary goals of the research project are to identify gaps in and challenges

with AT use at work and changes in workplace AT use over time. To be eligible for the project, participants had to (1) be B/LV, (2) be age 21 or older, (3) live in the United States or Canada, (4) use AT on the job, and (5) intend to work four or more years. Participants completed annual surveys between 2021 and 2024. The authors' university Institutional Review Board for the Protection of Human Subjects determined this study to be exempt.

Survey Design and Data Collection

Data from the research project's first two surveys were used for this study. All surveys collected data about the participant's current job, AT used on the job, challenges with AT, and the adoption of new AT, while each survey also covered additional specific topics. Surveys included multiple-choice and open-ended items created to assess each topic. Survey 1 collected demographic information and included skill level with AT and need for AT training as specific topics. Survey 2 included preferred and actual methods for learning AT and follow-up questions about screen reader use (e.g., brands of screen reader used, awareness of screen reader features) as additional topics. Data for the present study primarily came from Survey 2.

Before survey distribution, we consulted stakeholders from blindness organizations and technology companies. They reviewed the surveys and made recommendations for changes, such as identifying items that required clarification or additional multiple-choice options, and additional questions. After making edits based on this feedback, seven people who are B/LV pilot tested the surveys, and minor edits (e.g., adding screen reader navigation instructions and "choose only one" wording to the end of single-selection questions) were made based on their feedback.

Data collection for Survey 1 occurred between May and September 2021, and for Survey 2 between May and September 2022. Most participants completed the survey online via

Qualtrics; 29 scheduled an appointment with a researcher to complete the survey via phone. Participants received a small electronic gift card for completing each survey.

Participants

For this study, we restricted the sample to include those who completed Survey 2, lived in the United States, and were totally blind or legally blind (N = 305). This study's sample was further limited to participants who used either a third-party screen reader or built-in screen reader at work (N = 274). Participants' demographic characteristics are presented in the Results section.

Variables

Descriptive Analyses (RQ1-4)

To address RQ1, participants were asked to identify their *primary screen reader* based on the question, "Which computer screen reader do you use most frequently?" and were asked to select one option from the following eight options: (a) JAWS, (b) NVDA, (c) Narrator, (d) VoiceOver on Mac, (e) Fusion (ZoomText/JAWS combo), (f) Dolphin Screen Reader or SuperNova Magnifier and Screen Reader, (g) ZoomText speech (not Fusion), and (h) Other (please specify). Afterward, participants identified all *secondary screen readers* used based on the question, "Which other computer screen readers do you use?" Participants had the same eight options as the primary screen reader question with the addition of a "None" option. To answer RQ2, we summed the number of screen readers each participant reported using to determine the *number of screen readers used*. Participants who indicated they used more than one screen reader received the open-ended question: "Given that you use more than one computer screen reader, how do you decide which screen reader to use for different tasks?" which was used to address RQ4.

Participants selected all of the AT challenges they personally experienced on the job in

the past year from 15 options. RQ3 focused on one of those challenges: *working efficiently (compared to sighted peers)*, which was coded "Yes" if the person selected that challenge and "No" if they did not. This was one of the last items in the survey, and 11 of the 274 participants did not answer the question, resulting in a sample of 263 for the RQ3 analysis.

Logistic Regression Model (RQ5)

Dependent variable. We specifically wanted to evaluate factors associated with multiple screen reader use at work in the logistic regression model. Therefore, we reclassified five participants who reported using only one screen reader at work (in their response to the open-ended item) from the dichotomous *multiple screen reader* variable to create the *multiple screen reader at work* variable (1 = used multiple computer screen readers at work, 0 = used one screen reader at work), which was the outcome variable for the logistic regression model.

Independent variables. For this exploratory analysis, we included nine variables in the initial logistic regression model thought to potentially be relevant to the use of multiple screen readers at work. Six demographic variables were included: continuous variables *age* and *number of years worked*, the categorical variable *age at vision loss* (age 0-4, age 5-18, and age 19+), and dichotomous variables *sex* (male = reference), *vision level* (1 = totally blind, 0 = legally blind), and *non-visual disability* (1 = yes, 0 = no), which included disabilities or chronic conditions. Some of the most common non-visual disabilities or conditions mentioned were diabetes (n = 28, 10.2%), depression (n = 26, 9.5%), anxiety (n = 24, 8.8%), and being hard of hearing or having a hearing impairment (n = 23, 8.4%). Conditions such as asthma, chronic headaches, and heart conditions were also mentioned, although less frequently.

The three other variables were type of job, the primary way the person learned to use a screen reader, and average AT skill. We expected that holding a job related to AT or accessibility

(such as AT instructor or accessibility tester) would be strongly associated with use of multiple screen readers at work. *AT or accessibility-related job* was a dichotomous (1 = yes, 0 = no) variable created based on participant write-in responses to their job title and job description. Participants selected all the methods they used to learn how to use a screen reader from the following seven options: (a) In school, (b) Self-taught, (c) Training provided through vocational rehabilitation (VR) or another agency for the blind, (d) Vendor, (e) Tutorials, (f) Another person with B/LV, and (g) Other (please specify). The participants then identified the primary way they learned to use a screen reader from their previously selected options. In addition to the seven options initially provided to the participants, we created "Other training" based on write-in responses that mentioned training that did not fit into an existing category. We created the dichotomous variable *screen reader training primary*, which differentiated between people who considered training (i.e., in school, training provided through VR or agency for the blind, vendor, another person with B/LV, or other training) the primary way they learned to use a screen reader (yes = 1) versus those who considered another method the primary way they learned (no = 0). The final variable, *average AT skill*, came from Survey 1. Participants rated their skill level with AT used at work, selected from a list provided in the survey, on a scale of *1 (beginner)* to *10 (advanced)*. We created *average AT skill* based on the mean of participants' self-perceived skill ratings across all workplace AT, which was about 7 AT but ranged from 1 to 22 (see McDonnall, Steverson, Sessler Trinkowsky, et al., 2024 for more information).

Data Analysis

We used SAS 9.4 for quantitative analyses. For demographic variables (see Table 1) and RQ1 (Common Screen Readers) and RQ2 (Number of Screen Readers Used), we used descriptive statistics (i.e., frequencies and means). For RQ3 (Association with Working

Efficiently Challenge), we used a Chi-squared test of independence. We used logistic regression to analyze RQ5 (Factors Associated with Multiple Screen Reader Use), including the nine variables described above in our initial model:

$$\ln(P_{\text{multiple SR use at work}}/1\text{-}P_{\text{multiple SR use at work}}) = \beta_0 + \beta_1 X_{\text{Age}} + \beta_2 X_{\text{Sex}} + \beta_3 X_{\text{Age at vision loss}} + \beta_4 X_{\text{Vision level}} + \beta_5 X_{\text{Non-visual disability}} + \beta_6 X_{\text{Years worked}} + \beta_7 X_{\text{AT/Acc-related job}} + \beta_8 X_{\text{Training primary}} + \beta_9 X_{\text{Average AT skill}}$$

Non-visual disability was a significant variable in the model, despite not being related to multiple screen reader use in bivariate analysis, suggesting a confounding effect once other factors were controlled. Therefore, we tested the interaction between non-visual disability and other variables in the model and retained the one interaction effect that was significant. In the interest of parsimony, we utilized backward stepwise selection based on decrease in Akaike information criterion (AIC) values to identify our final model (Hosmer et al., 2013; Zabor et al., 2022). We manually removed nonsignificant variables from the model sequentially until we identified the best-fitting model according to AIC values; only *age at vision loss* was removed from the final model.

$$\ln(P_{\text{multiple SR use at work}}/1\text{-}P_{\text{multiple SR use at work}}) = \beta_0 + \beta_1 X_{\text{Age}} + \beta_2 X_{\text{Sex}} + \beta_3 X_{\text{Vision level}} + \beta_4 X_{\text{Non-visual disability}} + \beta_5 X_{\text{Years worked}} + \beta_6 X_{\text{AT/Acc-related job}} + \beta_7 X_{\text{Training primary}} + \beta_8 X_{\text{Average AT skill}} + \beta_9 X_{\text{Average AT skill}} \times \text{Non-visual disability}$$

For RQ4 (Selection of Screen Reader), the researchers used content analysis to identify themes in participants' open-ended responses about how they decided which screen reader to use for specific tasks. First, the lead researcher inductively created 10 codes from the provided responses. The other two researchers reviewed the responses and the codes for acceptability, discussing some codes to clarify their meaning. Next, all three researchers independently coded responses using the agreed-upon coding scheme. The researchers then compared codes and

discussed any discrepancies. When discrepancies emerged, researchers provided a rationale for their coding. Either all researchers came to agreement based on the discussion, or, less frequently, codes were further clarified to reach agreement. The final code frequencies were tabulated using SAS 9.4.

Results

Table 1 presents the sample characteristics and the descriptive statistics for all study variables, by overall sample and by use of multiple screen readers at work. Most participants identified as white, female, totally blind, and had at least a bachelor's degree. More than half of the sample (57.3%) used only third-party computer screen readers, while 37.2% reported using a combination of both third-party and built-in computer screen readers, and 5.5% used only built-in computer screen readers. Most participants were multiple computer screen reader users, accounting for 62.4% of the sample.

RQ1: Most Commonly Used Screen Readers

Table 2 displays the percentage of participants who reported using each computer screen reader. JAWS was the most commonly used, with 71.2% of participants selecting it as their primary screen reader, followed by NVDA, VoiceOver, and Fusion. Less frequently reported were ZoomText and Narrator. Additionally, a small percentage of participants indicated using some other screen reader, including ChromeVox and Orca.

For participants who reported using more than one computer screen reader, Narrator was most frequently selected as a secondary computer screen reader, followed closely by NVDA, VoiceOver, and JAWS. It is notable that users were less likely to select these screen readers (with the exception of JAWS) as their primary choice but were more inclined to use them as secondary options. This finding suggests that users rely on free or built-in options to complement

their primary screen reader.

RQ2: Number of Screen Readers Used

Participants reported using an average of 2.17 (*SD* = 1.21) computer screen readers. However, this average varied by job type, with participants in an AT or accessibility-related job using an average of 3.26 (*SD* = 1.23) computer screen readers and those in any other type of job reporting an average of 1.98 (*SD* = 1.11) screen readers.

RQ3: Association with Working Efficiently Challenge

Users of multiple computer screen readers (*n* = 171, 62.4%) were less likely than single screen reader users (*n* = 103, 37.6%) to report experiencing the challenge of working efficiently compared to sighted peers. The chi-square test of independence indicated a significant association between multiple screen reader use and the challenge of working efficiently, $\chi^2(1, N = 263) = 4.74$, $p = .03$. Specifically, 39.3% of multiple screen reader users considered working efficiently as a challenge, in contrast to 53.0% of single screen reader users.

RQ4: Selection of Screen Reader

The 10 themes that emerged from users' open-ended responses regarding their decision-making process when choosing between multiple computer screen readers are presented in Table 3. More than half of users (56.8%) indicated that their approach was to try another screen reader when the one they are using does not work, suggesting the use of a secondary screen reader is based on experiencing a problem with the primary. For example, one user commented:

> *My default screen reader is JAWS. I will only try another screen reader if JAWS poorly performs a given task. Generally, if a task performed poorly by JAWS is in the Chrome browser or an application which is not part of Windows or the Office suite, I will fall back to NVDA, then Narrator as a last resort. If the task*

performed poorly by JAWS is part of Windows or Office, I will try Narrator as the fallback and NVDA as the last resort.

Of note is that more than half of these respondents (63.0%, or 35.8% of the total number of respondents) only reported using a secondary screen reader when their primary does not work or in a specific situation, such as when their computer "crashes." In other words, they did not provide any other information about how they select which screen reader to use. However, many other responses reflected a decision-making process, as users considered software or task compatibility to achieve maximum efficiency. For example, one participant shared:

I can perform most tasks using NVDA, however JAWS does better on some websites or does a better job with a touch cursor. Narrator is often used if for whatever reason the computer is frozen or the screen reader is not responding. Also, some apps for my job are more accessible with VoiceOver on the Mac. My main criteria are efficiency and ease of use.

Similarly, another participant said:

It all depends. I find that NVDA supports the web much better, so that's what I usually use when visiting web pages. I use JAWS for Word and Outlook. I use Narrator when all else fails. Oddly enough, Narrator will read things that both JAWS and NVDA won't.

Another comment highlights the complexity in screen reader selection, as users may not only rely on personal experience:

I primarily rely on JAWS, but if a site/program isn't working well with JAWS, I will try another one. I also read articles and other information that may tell me that another screen reader is better at something, so I will use it for that same

purpose. I also have to train others to use other screen readers on occasion.

For those whose work involves training others, staying informed on updates and advantages of different screen readers may be necessary to recommend or teach the most suitable tools for various tasks. Overall, these comments emphasize that screen reader choice is often a balancing act tailored to meet specific needs and situations. Ultimately, many participants' screen reader choices reflect a strategic approach aimed at maximizing efficiency.

RQ5: Factors Associated with Multiple Screen Reader Use

Logistic regression results indicated that several factors were significantly associated with the use of multiple computer screen readers at work. One independent variable, age at vision loss, was initially included in the model but was removed due to lack of significance. The final, best-fitting model, presented in Table 4, provides the most meaningful factors associated with multiple computer screen reader use at work, despite some variables not reaching statistical significance. The model demonstrated good fit between the observed and predicted values, as indicated by a nonsignificant Hosmer-Lemeshow test, $\chi^2(8) = 2.22$, $p = .97$. The likelihood ratio Chi-square test also showed that the overall model was significant, $\chi^2(9) = 79.78$, $p < .001$, with a Nagelkerke $R^2 = .34$.

As expected, being employed in an AT or accessibility-related job had a strong positive association with using multiple computer screen readers at work, with participants in these jobs over 20 times (OR = 20.58; 95% CI: 3.88, 109.25) more likely to use multiple computer screen readers. Conversely, people who considered training their primary learning method for screen readers were significantly less likely to use multiple computer screen readers at work (OR = 0.44; 95% CI: 0.25, 0.78). Average AT skill had a significant and positive association with multiple screen reader use, although its effect differed based on non-visual disability, as

evidenced by the significant interaction between AT skill and non-visual disability. For users without a non-visual disability, the odds ratio for AT skill was 2.09 (95% CI: 1.49, 2.92), indicating that each one-point increase in AT skill was associated with two times higher odds of using multiple screen readers at work. This association was not present for participants with a non-visual disability (OR = 1.09; 95% CI: 0.80, 1.49). Having a non-visual disability was associated with being a multiple screen reader user, but this relationship did not increase based on the person's AT skill level. Males, compared to females, had more than twice the odds of using multiple computer screen readers at work (OR = 2.36; 95% CI: 1.24, 4.49). Age, vision level, and number of years worked were not associated with multiple screen reader use.

Discussion

The purpose of this study was to investigate computer screen reader use, particularly the use of multiple screen readers, among a sample of employed, legally blind people in the United States. It has been recommended that postsecondary students who are blind have skills with more than one screen reader (Kelly & Kapperman, 2018), yet research had not confirmed the importance of using multiple screen readers. This study is the first to gather information about which and how many computer screen readers are being used by employed people who are legally blind. We also investigated how people who utilize multiple screen readers select between their options and factors associated with multiple screen reader use at work.

We found that most employed people utilize more than one screen reader. The average number of computer screen readers used was two, but almost one-third of participants used three or more computer screen readers. Although few used built-in screen readers exclusively, more than 42% of participants utilized a built-in screen reader. This is perhaps a testament to the progress of built-in accessibility features in mainstream technology. Overwhelmingly, the most

commonly used screen reader was JAWS (including JAWS within Fusion) with 77.7% of participants identifying it as the computer screen reader they used most frequently and another 12.8% identifying it as a secondary screen reader. Although the most recent WebAIM screen reader survey also found JAWS to be the dominant primary screen reader in North America, the proportion was considerably lower at 55.5% of respondents (WebAIM, 2024). Overall, almost 91% of our sample utilized this software. JAWS appears to have a dominance in the market of employed U.S. screen reader users, despite the availability of free (e.g., NVDA) and built-in alternatives.

Websites and software do not always function the same way with different screen readers (Reuschel et al., 2023), and study participants indicated they use alternate screen readers for occasions when their primary screen reader does not work with digital content. Given that inaccessible digital content was a challenge experienced by almost all participants (McDonnall, 2023), the ability to utilize more than one screen reader is an important method to deal with this challenge. In fact, experiencing difficulty or problems accomplishing a task with one screen reader was the most common rationale for deciding to utilize another screen reader. Many multiple screen reader users said they select their screen reader based on the task they need to perform. For example, some people indicated that NVDA works better with web apps or with the web in general, so they typically use NVDA for those tasks. Respondent comments make it clear that people who use multiple screen readers utilize problem-solving skills to deal with inaccessible digital content.

Multiple screen reader users whose selection processes were in the categories “works best with particular program or task” or “fastest option” are people who had enough experience or knowledge to pre-select a screen reader based on the task. However, more than one-third of

participants indicated that one screen reader is their primary, and another or other screen readers were only used as a backup if their primary is not working or in specific situations (e.g., when their primary screen reader "crashes"). While the ability to switch to a different screen reader when problems occur is valuable, the option of pre-selecting the most appropriate screen reader for certain tasks or situations likely allows for greater work efficiency. People who use multiple screen readers were significantly less likely to report experiencing the challenge of working efficiently compared to sighted peers, yet more than 39% of multiple screen reader users still experienced this challenge. While there are likely multiple reasons for this, one factor may be the inability to pre-select the most appropriate screen reader based on the task to be performed, and instead needing to troubleshoot accessibility and usability problems as they occur.

Holding an AT or accessibility-related job was strongly associated with using multiple screen readers at work, as expected. Despite this robust relationship, several other factors were also associated with using a single versus multiple screen readers. One was the primary way the person learned how to use a screen reader – those who considered training to be the primary way they learned (42.3% of the sample) were less likely to use multiple screen readers. Hands-on training is the preferred way to learn new AT (McDonnall, Steverson, & Boydstun, 2024), and certainly training in how to use a complex AT such as a screen reader will be desired, if not required, for most people. However, screen reader users must continue to learn after their training ends. Screen reader manufacturers regularly add new features, and this has been occurring at a rapid pace recently with the lightning speed of technological advancements. Mainstream productivity software, such as Microsoft Office products, are also evolving quickly, forcing screen reader manufacturers to keep pace. Screen reader users must be flexible and open to continuous learning to keep up with these changes. Inability to self-direct learning for existing

AT will likely be a barrier to advance AT skills, confidence, and efficiency.

Perhaps relatedly, another factor associated with using multiple screen readers was self-perceived average AT skill level, with higher skill level associated with greater odds of using multiple screen readers, but only for people who did *not* report a non-visual disability or chronic condition. Having a high AT skill level may be associated with many years of experience and the ability to self-teach as AT advances. However, it is not clear why this relationship existed only for people without a non-visual disability. Finally, gender was significantly associated with multiple computer screen reader use, even after controlling for the preceding factors. It is also not clear why men were more than twice as likely as women to use multiple screen readers. An important question to consider is: Are women less likely to be encouraged to learn to use multiple screen readers?

Limitations

A limitation of this study is that it relies on self-report data, which brings with it several potential problems, such as sampling bias, response bias, and measurement error. For example, although we emphasized "computer" screen reader in the survey questions, some people may have reported the screen reader used on their phone (i.e., VoiceOver). Although our overall survey focused on AT used at work, the questions about computer screen reader use were not explicitly limited to the workplace. Many participants appear to have answered the questions related to their use of screen readers at work, based on their open-ended responses. Thus, we focused our final research question on multiple screen reader use at work and reclassified people who made it clear that they were using only one computer screen reader at work. However, it is possible that participants who used a single screen reader at work but did not state that in their response were misclassified for the logistic regression analysis. Another important limitation of

the study is that the sample was drawn from the U.S. only; thus findings are not generalizable to other countries where different brands of screen readers may be used more prevalently.

Implications

This study's findings are relevant for education and rehabilitation professionals who work with people who are legally blind as they provide evidence to support the importance of learning to use more than one screen reader. Skill with at least two screen readers has been a recommendation in the field for many years, specifically for youth who are blind and planning to attend postsecondary school (Kelly & Kapperman, 2018). This study documents that most employed people utilize more than one screen reader and that multiple screen reader users are less likely to identify working less efficiently as sighted peers as a challenge. Our findings suggest that personnel preparation programs for TVIs should require their students to become adept at multiple screen readers so they are prepared to teach each blind student to utilize at least two screen readers. Naturally, AT instructors should also be capable of teaching students to utilize multiple screen readers, including any screen reader the student prefers to learn or would benefit from learning. While JAWS was very commonly used among the employed people in our study, students should be given a choice of which screen readers to learn.

Given the overwhelming use of screen readers in the workplace among people who are legally blind, we can deduce that screen reader skills are important for employment. Although not causal evidence, we found that unemployed people were more likely than the employed participants in this study to report a need for training in using a screen reader (McDonnall et al., 2023). At a bare minimum, learners who use Windows and want to pursue employment need to be able to access and utilize an alternative screen reader for situations when their computer crashes or their primary screen reader is not working. Many people indicated Narrator was their

backup screen reader for these situations. To improve efficiency, which is vital in the workplace, learners should be encouraged to become familiar and comfortable with at least one secondary screen reader in addition to Narrator.

People prefer training as a learning method for new AT (McDonnall, Steverson, & Boydstun, 2024), and almost all participants reported receiving training on the use of screen readers. However, most participants considered other learning methods, likely used after their initial training, as their primary way of learning to use a screen reader. It is vital that AT users understand the importance of ongoing learning after training ends. AT trainers must encourage their students to embrace a continuous learning mindset related to AT and provide them with the skills and resources for self-directed learning. Relatedly, good problem-solving skills are essential for the screen reader user, both to learn to use a screen reader initially and for ongoing learning and troubleshooting. Our findings align with and support previous recommendations for professionals who work with people who are B/LV to foster problem-solving skills as part of the teaching process for AT and other skills (Candela, n.d.; Kamei-Hannan et al., 2023; Mino, 2011), enabling them to thrive in educational settings and beyond. In addition, our findings support the importance of organizations and companies that employ people who are B/LV allowing and providing for the use of more than one screen reader. Using more than one screen reader can help address the inaccessibility of the digital environment, enabling B/LV employees to succeed in the workplace.

Acknowledgments

The contents of this manuscript were developed under a grant from the U.S. Department of Health and Human Services, NIDILRR grant 90RTEM0007. However, these contents do not necessarily represent the policy of the Department of Health and Human Services and should not

indicate endorsement by the Federal Government.

The authors would like to thank the study participants for their time completing surveys and their insights into screen reader use and AT challenges experienced in the workplace.

Declaration of Interest

The authors report no competing interests to declare.

References

Candela, A. (n.d.). *Learning to fish: Problem-solving and other basic skills for future blind coders*. Perkins School for the Blind. Retrieved November 6, 2024, from https://www.perkins.org/resource/learning-fish-problem-solving-and-other-basic-skills-future-blind-coders/

Hosmer, D. W., Lemeshow, S., & Sturdivant, R. X. (2013). *Applied logistic regression* (3rd edition). Wiley.

Kamei-Hannan, C., Tuttle, M. J., & Songkhao, R. (2023). A conceptual framework for digital competence of students with low vision and blindness. *Journal of Visual Impairment & Blindness, 117*(1), 7–18. https://doi.org/10.1177/0145482X221149979

Kelly, S. M., & Kapperman, G. (2018). A second look at what high school students who are blind should know about technology. *Journal on Technology & Persons with Disabilities, 6*, 385–398.

Lazar, J., Allen, A., Kleinman, J., & Malarkey, C. (2007). What frustrates screen reader users on the Web: A study of 100 blind users. *International Journal of Human-Computer Interaction, 22*(3), 247–269. https://doi.org/10.1080/10447310709336964

Lazar, J., Dudley-Sponaugle, A., & Greenidge, K. D. (2004). Improving web accessibility: A study of webmaster perceptions. *Computers in Human Behavior, 20*(2), 269–288. https://doi.org/10.1016/j.chb.2003.10.018

Lazar, J., Olalere, A., & Wentz, B. (2012). Investigating the accessibility and usability of job application web sites for blind users. *Journal of Usability Studies, 7*(2), 68–87.

McDonnall, M. C. (2023). Challenges with AT in the workplace: Accessibility issues top the list. *AccessWorld, Summer 2023*. https://www.afb.org/aw/summer2023/challenges-with-AT-

in-workplace

McDonnall, M. C., Sergi, K., & Steverson, A. (2023). Comparison of assistive technology use and beliefs among employed and unemployed people who are blind. *The New Re:View*, *1*(2), 12–27. https://doi.org/10.56733/TNR.22.012

McDonnall, M. C., Steverson, A., & Boydstun, J. (2024). Actual and preferred methods for learning to use assistive technology. *Assistive Technology Outcomes and Benefits*, *18*, 20–35.

McDonnall, M. C., Steverson, A., Sessler Trinkowsky, R., & Sergi, K. (2024). Assistive technology use in the workplace by people with blindness and low vision: Perceived skill level, satisfaction, and challenges. *Assistive Technology*, *36*(6), 429–436. https://doi.org/10.1080/10400435.2023.2213762

Mino, N. M. (2011). Problem solving in structured discovery cane travel. *Journal of Blindness Innovation and Research*, *1*(3). https://nfb.org/images/nfb/publications/jbir/jbir11/jbir010302.html

Oh, U., Joh, H., & Lee, Y. (2021). Image accessibility for screen reader users: A systematic review and a road map. *Electronics*, *10*(8), Article 8. https://doi.org/10.3390/electronics10080953

Reuschel, W., McDonnall, M. C., & Burton, D. (2023). The accessibility and usability of online job applications for screen reader users. *Journal of Visual Impairment & Blindness*, *117*(6), 479–490. https://doi.org/10.1177/0145482X231216757

Silverman, A. M., Rosenblum, L. P., Bolandar, E. C., Rhoads, C. R., & Bleach, K. (2022). *Technology and accommodations: Employment experiences of U.S. Adults who are blind, have low vision, or are deafblind.* American Foundation for the Blind.

Tuttle, M., & Carter, E. W. (2022). Examining high-tech assistive technology use among students with visual impairments: *Journal of Visual Impairment & Blindness*, *116*(4), 473–484. https://doi.org/10.1177/0145482X221120265

WebAIM. (2024). *Screen reader user survey #10 results*. https://webaim.org/projects/screenreadersurvey10/

WebAIM: Survey of Preferences of Screen Readers Users. (n.d.). Retrieved November 6, 2024, from https://webaim.org/projects/screenreadersurvey/

Zabor, E. C., Reddy, C. A., Tendulkar, R. D., & Patil, S. (2022). Logistic Regression in Clinical Studies. *International Journal of Radiation Oncology*Biology*Physics*, *112*(2), 271–277. https://doi.org/10.1016/j.ijrobp.2021.08.007

Zong, J., Lee, C., Lundgard, A., Jang, J., Hajas, D., & Satyanarayan, A. (2022). Rich screen reader experiences for accessible data visualization. *Computer Graphics Forum*, *41*(3), 15–27. https://doi.org/10.1111/cgf.14519

Table 1

Sample Characteristics and Descriptive Statistics, Overall and by Multiple Screen Reader Use at Work

Variable	Overall Sample (*N*=274)	Multiple SR Use at Work (*N*=166)	Single SR Use at Work (*N*=108)
Age, *M* (*SD*)	45.82 (11.92)	45.00 (11.72)	47.08 (12.16)
Sex, *n* (%)			
Female	168 (61.3)	89 (53.6)	79 (73.2)
Male	106 (38.7)	77 (46.4)	29 (26.9)
Race, *n* (%)			
Asian	18 (6.6)	11 (6.6)	7 (6.5)
Black or African American	14 (5.1)	7 (4.2)	7 (6.5)
White	221 (80.7)	135 (81.3)	86 (79.6)
Some other racial identity	21 (7.7)	13 (7.8)	8 (7.4)
Hispanic/Latinx ethnicity, *n* (%)			
Yes	27 (9.9)	18 (10.8)	9 (8.3)
No	247 (90.2)	148 (89.2)	99 (91.7)
Vision level, *n* (%)			
Totally blind	188 (68.6)	121 (72.9)	67 (62.0)
Legally blind	86 (31.4)	45 (27.1)	41 (38.0)
Age of vision loss, *n* (%)			
Age 0-4	188 (68.6)	118 (71.1)	70 (64.8)
Age 5-18	41 (15.0)	23 (13.9)	18 (16.7)
Age 19+	45 (16.4)	25 (15.1)	20 (18.5)
Non-visual disability, *n* (%)			
Yes	93 (33.9)	61 (36.8)	32 (29.6)
No	181 (66.1)	105 (63.3)	76 (70.4)
Education			
Less than bachelor's degree	46 (16.8)	30 (18.1)	16 (14.8)
Bachelor's degree	103 (37.6)	62 (37.4)	41 (38.0)
Graduate degree	125 (45.6)	74 (44.6)	51 (47.2)
Years worked, *M* (*SD*)	19.22 (12.65)	18.97 (12.82)	19.59 (12.43)
Screen reader training primary, *n* (%)			
Yes	116 (42.3)	54 (32.5)	62 (57.4)
No	158 (57.7)	112 (67.5)	46 (42.6)
AT/Accessibility-related job, *n* (%)			
Yes	42 (15.3)	40 (24.1)	2 (1.9)
No	232 (84.7)	126 (75.9)	106 (98.2)
Average AT skill, *M* (*SD*)	7.98 (1.33)	8.28 (1.17)	7.51 (1.43)

Note. AT = assistive technology. SR = screen reader.

Table 2

Most Commonly Used Computer Screen Readers

Computer Screen Reader	Primary	Secondary
JAWS	71.2	13.9
NVDA	9.5	31.8
VoiceOver	7.3	21.2
Fusion	6.6	6.6
ZoomText	2.6	2.6
Narrator	1.5	37.2
Other	1.5	2.9
SuperNova	--	1.1
[None]		37.6

Note. All numbers are percentages.

Table 3

Themes for Deciding Which Screen Reader to Use

Theme	Percent
If one doesn't work, try the other/another	56.8%
One that works best with particular program or task	32.1%
Based on computer/OS being used	17.3%
To compare how they respond; for testing	9.9%
Use what student/trainee is using; for training	7.4%
Provides other reason for preferring one screen reader	5.6%
Required to use for work or available at work	4.3%
Greater comfort/familiarity with one screen reader	4.3%
Fastest option; one that can do the job the quickest	3.7%
Discusses use of phone vs. computer screen reader or only uses one screen reader at work	3.1%

Note. $N = 162$. OS = operating system.

Table 4

Logistic Regression: Factors Associated with Multiple Computer Screen Reader Use at Work

Variable	*B*	*SE*	Wald X^2	*p*	*OR* [95% CI]
Intercept	-4.79	1.67	8.27	.004	
Age	-0.03	0.02	2.52	.113	0.97 [0.93, 1.01]
Sex (Male=1)	0.86	0.33	6.79	.009	2.36 [1.24, 4.49]
Vision level (Totally blind=1)	0.25	0.30	0.70	.402	1.29 [0.71, 2.33]
Non-visual disability (Yes=1)	5.85	1.88	9.65	.002	
Years worked	0.02	0.02	0.96	.328	1.02 [0.98, 1.06]
AT/Acc-related job (Yes=1)	3.02	0.85	12.61	.000	20.58 [3.88, 109.25]
SR training primary (Yes=1)	-0.82	0.29	7.80	.005	0.44 [0.25, 0.78]
Average AT skill	0.74	0.17	18.62	<.001	
*Average AT skill * Non-visual disability*	-0.65	0.24	7.69	.006	

Note. $N = 274$. OR = odds ratio. CI = confidence interval. SR = screen reader.