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Use of Braille in the Workplace by People Who are Blind

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Abstract

Interest in the benefits of braille for people who are blind is high among professionals in the blindness field, but we know little about how braille is used in the workplace. The broad purpose of this study was to learn how employed people who are blind use braille on the job. Specific topics investigated included: work tasks refreshable braille technology (RBT) is used for, personal and job characteristics of RBT users compared to non-users, and factors associated with RBT use among workers with at least moderate braille skills. This study utilized data from 304 participants in a longitudinal research project investigating assistive technology use in the workplace by people who are blind. Two-thirds of our participants used braille on the job, and more than half utilized RBT. Workers who used RBT did not necessarily use it for all computer-related tasks they performed. RBT use was generally not significantly related to job characteristics, except for working for a blindness organization. RBT use was not significantly related to general personal characteristics but it was significantly different based on disability-related characteristics. Only older age and higher braille skills were significantly associated with RBT use on the job in a multivariate logistic regression model.

Keywords

Blind, legally blind, braille use, assistive technology, employment.

Introduction

Interest in the benefits of braille use by people who are blind is high among professionals in the blindness field. There are many potential benefits to using braille as opposed to only using audio output for people who are blind. Braille is an important "literacy medium" (Wormsley) in a world that has continued to expand the availability of information through technology. Benefits to using braille include tactile access to spelling and text structure, as well as a method to quickly scan text (Rempel). Braille technology has made braille access even more readily available. A qualitative study by Martiniello et al. identified misconceptions about braille, including braille is only for those who are totally blind, braille is too difficult to learn, and braille is only useful for lengthy readings. Many people have asserted that braille use has decreased substantially over the past several decades, but recent research determined that this assertion is not based on fact, as the data to determine this is simply not available (Sheffield et al.).

Research related to braille has primarily focused on teaching and learning braille (Hall and Newman; Hoskin et al.; Martiniello et al.; Emerson et al.; Bickford and Falco). Correlates of braille use have also been a focus area of a small body of research. A few studies investigated the relationship between regular braille use and employment and found a positive association (Bell and Mino; Bell and Silverman; Ryles). Another study investigated the relationship between braille reading status and several outcomes. This study found that braille readers since childhood had higher life satisfaction, self-esteem, and employment rates compared to all others, and that people who learned to read braille at a later point in life had higher outcomes in the areas compared to people who never learned to read braille (Silverman and Bell).

Very little research has investigated how people actually use braille in their daily lives. Only two research studies that addressed braille use were found, and no studies investigated how

braille is used at work. A 1998 study focused on braille communication modes taught by teachers of students with visual impairments (TVI) and used in practice by 71 adults (Allman). The other study, published in 2012, was a qualitative study of 12 braille users aged 16 to 20 who were high school or college students (D'Andrea). This study provided information about devices and tools the students used for reading and writing, as well as preferences for using braille. Both studies are dated and used relatively small samples.

Other sources have provided personal accounts of how people use braille in their daily lives. The National Federation of the Blind's publication *The Braille Monitor* has published many such stories. A journal article provided a description of four people's use of braille from a panel session at a conference in 1989 (Huebner). This article provided many examples of the ways in which braille was being used by the four panelists in everyday life. While existing information provides support for the usefulness of braille to people on a personal level, it does not inform us about braille use at work.

Given the importance that professionals in the field place on braille, we thought it would be valuable to explore how braille is being used by employed people who are blind. The broad purposes of this study were to learn how many employed people use braille and how braille is being used on the job. Five research questions (RQ) were addressed.

1. What percentage of employed people who are legally blind utilize braille on the job and what percentage utilize refreshable braille technology (RBT) on the job?
2. How did braille technology users obtain the RBT they utilize on the job?
3. What percentage of braille technology users utilize RBT for specific work tasks?
4. How do the personal and job characteristics of RBT users compare to those of people who do not use RBT at work?

5. What personal factors are associated with RBT use on the job among people who report at least moderate braille skills?

Method

Data Source & Sample

Data were obtained from a longitudinal survey study about the use of assistive technology (AT) in the workplace by people who are blind or have low vision. The purpose of the longitudinal study is to increase knowledge about what AT is used at work, how AT use changes over time, satisfaction with AT, and challenges people experience using AT at work. The overall study consists of collecting data from the same group of participants in four annual surveys conducted between 2021 and 2024. Criteria for participation in the study included: (1) being blind or having low vision, (2) age 21 or older, (3) currently working, either for an organization or self-employed, (4) using AT on the job, (5) planning to work for the next four years, and (6) residing in the United States or Canada. For the present study, we restricted the sample to only include people who reported being totally blind or legally blind, used a computer at work, and used a screen reader to access the computer, resulting in a sample of 304 people. Data from Survey 1 and Survey 2 were used for this study.

Data Collection

Data were collected via Qualtrics in an online survey. Participants were provided the option of completing the survey by phone; 24 people were asked the questions verbally by phone and a research assistant entered their responses in Qualtrics. Data collection occurred in May through September 2021 (Survey 1) and May through September 2022 (Survey 2). Some participants joined the study in 2022; those 48 people completed Survey 1 and Survey 2 questions at the same time, although a few of the Survey 1 questions were changed slightly, as

discussed in the Variables section. Most data used for this study came from items in Survey 1.

Variables

Participants were asked to select all AT that they used at work from a list of 28 AT. We identified *braille users* as anyone who reported using a braille device at work, including refreshable braille displays, braille notetaking devices, braillewriters, or braille labeling systems. We identified people as *refreshable braille technology* (RBT) *users* if they reported using a refreshable braille display, a braille notetaker, or both.

Participants were asked how they obtained each AT they use at work in Survey 2. They were provided with a list of five options (see Table 1 for the list) and an "other" option in which they could write in a response. We reported their responses to this item for the two RBTs.

Participants were asked whether they perform 14 specific tasks at work ("Do you perform the following tasks on your job?", e.g., "use a computer to access the Internet, use email or create text documents"). We then asked them to identify which AT they use for the work tasks they perform. In the first implementation of Survey 1, people were able to provide the primary AT and secondary AT they use for the tasks. To streamline the implementation of the combined Survey 1 and Survey 2, we did not ask participants to identify secondary AT used for work tasks. Because people could have selected screen reader or RBT as their primary AT (and the other as a secondary AT), we only used data from the original Survey 1 respondents for these variables. We included 7 of the 14 work tasks for which RBT was utilized for this study, as identified in Table 2. Sample sizes for the work task items vary because people reported performing only some of the tasks for their jobs.

We included nine personal characteristics as independent variables to address RQ 4. *Sex* was a dichotomous variable (Male, Female). *Age* was continuous but was classified into five

categories (21-30, 31-40, 41-50, 51-60, 61 or older). *Race* was dichotomized to white race or minority. *Hispanic ethnicity* (yes to "Are you of Hispanic, Latino, or Spanish origin?) and *non-visual disability* (yes if participant reported having one or more other disabilities or chronic health conditions) were also dichotomous variables. *Education level* was grouped into three categories: less than bachelor's degree, bachelor's degree, and graduate or professional degree. *Level of vision loss* included three self-identified categories: totally blind, legally blind with minimal functional vision, legally blind with some functional vision. To determine *age of blindness onset*, participants were asked how old they were when they started having serious difficulty seeing, even with glasses or magnification. Their responses were grouped into three categories: pre-school (age 0-4), K-12 (age 5-18), post-school (age 19 or older). *Braille skill* was based on participants' self-report of their skill level from four possible responses: (1) no braille skills, (2) minimal braille skills, such as using uncontracted Grade One braille, (3) moderate braille skills, such as some use of contracted Grade Two braille, and (4) proficient braille skills, fluent in contracted Grade Two braille.

We included five job characteristics as independent variables to address RQ 4. The first was the *Bureau of Labor Statistics* (BLS) *occupational group* for the person's job. Participants reported their job titles and employers, which was used to identify corresponding BLS job titles and codes. Participants' jobs were in 14 BLS groups, listed in Table 4. Only the 10 groups with 5 or more observations were used in the data analyses. We also categorized the participants' jobs based on whether they were *disability-related* (e.g., including jobs such as TVI, AT instructor, and rehabilitation counselor; National Industries for the Blind jobs; jobs related to accessibility), *employed by a blindness organization* (regardless of type of job), or *government job* (federal, state, or local jobs, including public school teachers). All three variables were dichotomous.

Annual earnings (from all jobs) was a 6-category variable in the survey and was further grouped into three categories, as listed in Table 6.

Data Analyses

We utilized descriptive statistics (frequencies) to address RQs 1, 2, and 3. Chi-square was used to answer RQ 4, and logistic regression was used to address RQ 5. We utilized a subset of the personal characteristic variables, including basic demographic factors and blindness-related factors, for the logistic regression model and included only participants who reported moderate or proficient braille skills (n=244). We sequentially removed non-significant variables from the initial model and used change in Akaike information criterion (AIC) values to determine variables to retain in the final model. Odds ratios provided a measure of effect size.

Results

Demographic information about participants is provided in Table 3. Two-thirds of study participants (66.1%, n = 201) used braille on the job, while just over half (52.6%, n = 160) used RBT on the job. Refreshable braille display use was more common, with 73 people who used only that RBT, 51 people who used both RBTs, and 36 people who only used a braille notetaker. Participants who used braille notetakers on the job mainly purchased the device themselves, whereas participants who used braille displays mainly reported their employers paid or purchased it for them. See Table 1 for full results about how participants obtained their RBT. The percentage of participants who utilized RBT for specific work tasks is presented in Table 2.

Table 1. How refreshable braille technology used on the job was obtained

Method	**Braille Notetaker (N = 73)**	**Braille Display (N = 121)**
I purchased it	39.7	23.1
Someone gave it to me	5.5	4.1
Agency or governmental program paid for it	31.5	25.6

Method	Braille Notetaker (*N* = 73)	Braille Display (*N* = 121)
Employer paid/purchased	20.6	44.6
It was free	0.0	0.8
Other	2.7	1.7

Note. All numbers are percentages.

Table 2. Percentage of refreshable braille technology (RBT) users who utilize RBT technology for specific work tasks

Work Task	*N**	Use RBT
Take notes in a meeting	105	82.9
Make formal presentations	73	64.4
Use a computer to access the Internet, use email, or create text documents	112	55.4
Use a computer to access the organization's database or software system	77	42.9
Use a computer to create spreadsheets	81	42.0
Use a computer to create presentations	48	41.7
Use a computer to participate in a meeting	112	35.7

**N* represents the number of RBT users who reported performing the work task.

Tables 3 through 6 present the percentages of RBT and non-RBT users by various personal and job characteristics. RBT use differed significantly for 4 of the 9 personal characteristics, all of which were related to vision loss or other disability (see Table 3). Participants who used RBT were more likely to experience vision loss early in life, have no or limited functional vision, and have higher braille skills. They were less likely to report a non-visual disability. RBT use differed significantly on only 1 of the 5 job characteristics, with people who work for blindness organizations less likely to use RBT. There were some large differences for job occupational group, but these differences did not reach statistical significance.

Table 3. Refreshable braille technology (RBT) use by personal characteristics

Personal Characteristic	***N***	**Sample (%)**	**RBT User (%)**	**Non-RBT User (%)**	χ^2	***df***
Sex					0.03	1
Female	181	59.5	53.0	47.0		
Male	123	40.5	52.0	48.0		
Education level					2.04	2
Less than bachelor's degree	62	20.4	50.0	50.0		
Bachelor's degree	114	37.5	57.9	42.1		
Graduate or professional degree	128	42.1	49.2	50.8		
Age category					5.52	4
Age 21 to 30	37	12.2	55.6	44.4		
Age 31 to 40	84	27.6	51.2	48.8		
Age 41 to 50	78	25.7	48.7	51.3		
Age 51 to 60	69	22.7	47.8	52.2		
Age 61 or older	36	11.8	70.3	29.7		
Race					1.39	1
White	251	82.6	54.2	45.8		
Other	53	17.4	45.3	54.7		
Hispanic ethnicity					0.65	1
Yes (Hispanic)	32	10.5	59.4	40.6		
No (Hispanic)	272	89.5	51.8	48.2		
Age of blindness onset					38.32**	2
Pre-school (Age of onset)	202	66.5	64.4	35.6		
K-12 (Age of onset)	52	17.1	40.4	59.6		
Post school (Age of onset)	50	16.5	18.0	82.0		
Level of vision loss					28.90**	2
Totally blind	206	67.8	62.1	37.9		
Legally blind with min. functional vision	73	24.0	39.7	60.3		
Legally blind with some functional vision	25	8.2	12.0	88.0		
Non-visual disability					4.52*	1
Yes (nonvisual disability)	110	36.2	44.6	55.5		
No (nonvisual disability)	194	63.8	57.2	42.8		

Personal Characteristic	***N***	**Sample (%)**	**RBT User (%)**	**Non-RBT User (%)**	χ^2	***df***
Braille skill					108.94**	3
No braille skills	21	6.9	0.0	100.0		
Minimal braille skills	39	12.8	5.1	94.9		
Moderate braille skills	47	15.5	25.5	74.5		
Proficient braille skills	197	64.8	74.1	25.9		

* $p < .05$, ** $p < .0001$

Table 4. Percentage of refreshable braille technology (RBT) users by Bureau of Labor Statistics (BLS) occupation groups.

BLS Occupation Group	***N****	**RBT User**	**Non-RBT User**
Management	58	50.0	50.0
Educational Instruction and Library	47	63.8	36.2
Office and Administrative Support	46	43.5	56.5
Community and Social Service	45	48.9	51.1
Computer and Mathematical	40	57.5	42.5
Business and Financial Operations	19	63.2	36.8
Healthcare Practitioners and Technical	16	37.5	62.5
Arts, Design, Entertainment, Sports, and Media	12	75.0	25.0
Sales and Related	6	16.7	83.3
Legal	5	60.0	40.0
Life, Physical, and Social Service	4	0.0	100.0
Architecture and Engineering	3	66.7	33.3
Protective Service	1	100.0	0.0
Healthcare Support	1	100.0	0.0

Note. Fisher's exact test with Monte Carlo estimation, including only groups with 5 or more observations: $p = .19$.

* *N* represents the number of people who work in each occupation group.

Table 5. Refreshable braille technology (RBT) use by job type

Job Type	***n****	**RBT User**	**Non-RBT User**	**$\chi^2(1)$**
Disability-related	169	51.5	48.5	0.06
Employed by a blindness organization	112	43.8	56.3	5.06*
Government	98	59.2	40.8	3.30

* $p < .05$

* *n* represents the number of people who work in each job type.

Note. Sample $N = 290$ for Disability-related job and Blindness organization job. Sample $N = 292$ for government job.

Table 6. Refreshable braille technology (RBT) use by annual earnings.

Annual earnings	**RBT User (*n*=149)**	**Non-RBT User (*n*=134)**	**χ^2 (2)**
Less than $40,000	35.6	42.5	1.86
$40,000 - $79,999	39.6	38.1	
$80,000 or more	24.8	19.4	

The initial logistic regression model to identify factors associated with RBT use at work included seven independent variables (age [continuous variable], sex, education level, age of onset, vision level, nonvisual disability, and braille skill). The model was statistically significant ($X^2(10, n = 244) = 59.84$, $p < .0001$, however, several variables in the model were not related to RBT use and were removed sequentially to establish the final model.

Table 7. Logistic regression model identifying factors associated with refreshable braille technology use at work

Variable	***b***	***SE***	***df***	**Wald X^2**	***p***	**OR**	**OR 95% CI**
Age	0.04	0.01	1	9.61	<.01	1.04	[1.02, 1.07]
Sex (Male)	0.29	0.34	1	0.74	.39	1.34	[0.69, 2.58]

Variable	*b*	*SE*	*df*	Wald X^2	*p*	OR	OR 95% CI
Vision loss level (ref. = totally blind)							
Legally blind with minimal functional vision	-0.33	0.37	1	0.82	.37	0.72	[0.35. 1.48]
Legally blind with some functional vision	-1.23	0.76	1	2.62	.11	0.29	[0.07, 1.30]
Nonvisual disability	-0.58	0.33	1	3.11	.08	0.56	[0.30, 1.07]
Braille skill (Proficient)	2.45	0.43	1	32.71	<.001	11.63	[5.02, 26.97]

Note. *N*=244. OR=odds ratio. CI=confidence interval.

The final model included five independent variables (see Table 7); the model was statistically significant based on the likelihood ratio test $X^2(6, n = 244) = 57.89$, $p < .0001$, and explained 29% of the total variance in RBT use at work. The Hosmer and Lemeshow goodness-of-fit test of the final model was not significant, $X^2(6, n = 244) = 3.65$, $p = 0.89$, indicating good model fit. Only *braille skill* and *age* were significant predictors of RBT use. Participants who had proficient braille skills were 11.63 times more likely than participants with moderate braille skills to use RBT at work. Odds of using RBT at work increased by 4.2% for each additional year of age. For example, compared to a 30-year-old, a 50-year-old had 2.28 times higher odds of using RBT at work while a 60-year-old had 3.44 times higher odds of using RBT at work.

Discussion

This study provides new information about how many workers who are legally blind use braille and RBT, as well as how they are using RBT on the job. Most people who use braille on the job (in any form) also use RBT – only 13.5% reported only using a braillewriter or braille labeling system. Not surprisingly, a higher percentage of people with more significant visual impairments used braille and RBT on the job. However, as Martiniello et al. discussed, braille

could be beneficial to adults with various levels of low vision.

Participants reported a variety of methods for obtaining the RBT that they used on the job. Even though these devices were used on the job, far less than half of them were paid for or purchased by employers. Almost 40% of braille notetaker users reported that they purchased these devices themselves, as did almost a quarter of refreshable braille display users. Since many popular braille notetakers are built on Android operating systems, employers may consider them personal devices, similar to mobile phones or tablets. Braille notetakers are also generally more expensive compared to refreshable braille displays with a similar number of braille cells. Considering the relatively high percentage of participants who purchased RBT on their own, more employers and governmental programs should consider providing RBT for braille users who could utilize this expensive technology on the job.

Although more than half of the sample used RBT on the job, they did not necessarily use it for all work tasks. Only 55.4% to 35.7% of RBT users utilized their devices for specific computer-related tasks. These relatively low rates may be associated with a need for more training in how to effectively utilize RBT. About one-third of RBT users reported that they would benefit from more training on using these devices (McDonnall et al.). Alternatively, it may be that some tasks lend themselves to the need for RBT more than others.

It is surprising that people who work for blindness organizations were less likely to use RBT. This suggests that potentially fewer people who teach or can serve as role models for consumer receiving services use RBT, as compared to other employment settings. Although differences did not reach statistical significance, our results suggest that the use of RBT may be more common, and perhaps more important, in certain occupation groups. Three-quarters of people in the Arts, Design, Entertainment, Sports, and Media group were RBT users. There are a

wide variety of jobs in this group, including for example an editor, interpreter, and transcriber who used RBT in our sample. Other BLS occupation groups with higher than average RBT users were Educational Instruction and Library, which included AT instructors in our sample, Business and Financial Operations, and Architecture and Engineering. RBT would be of great value to those in highly technical fields, where it would be beneficial to have access to tactile information when making precise edits to text, such as those exploring programming code for accessibility or software development. Other groups had a much lower percentage of RBT users, such as Sales and Related occupations.

Only disability-related personal characteristics were significantly associated with RBT use in univariate analyses, including age of blindness onset, vision level, having a nonvisual disability, and self-rated braille skill. As expected, braille proficiency was a key factor associated with whether people use RBT on the job. Those with blindness onset prior to school age were much more likely to use RBT on the job, while fewer who experienced vision loss during their schooling and far fewer who experienced vision loss after high school used RBT on the job. This may speak to a need for more opportunity and encouragement for braille instruction for people who lose vision later in life, as research has supported positive outcomes for those who learn braille later (Silverman and Bell).

When utilizing multivariate analyses with people who had proficient or moderate braille skill, only having proficient braille skill and age were significant factors. As age increased, the odds of RBT use increased, but proficient braille skill was clearly the key factor associated with using RBT on the job. If we presume the value of RBT use, then it is important to understand how someone becomes proficient with braille and who is proficient with braille. When age was categorized, it was evident that members of the oldest age group (61 or older) were much more

likely to use RBT. Those 61 or older would have completed high school prior to the emergence and availability of personal computers in the 1980s, as well as the availability of the Internet in the 1990s. It is likely that their educational experiences would not have been impacted by the misconception that screen readers and other AT replace the need for braille, including the need for braille instruction and braille support in educational settings.

We should acknowledge limitations to this study, which include that all data is self-reported and our sample may not be representative of all employed people who are legally blind. In addition, we categorized participants into BLS occupation groups based on their job title and employer, but accuracy cannot be certain due to limited details about the jobs.

Conclusion

There has been a complete lack of information about how braille is used at work, and this study helps to fill that gap in research and literature. Our findings indicate that slightly more than half of workers use RBT in some form, but not for all computer tasks. People who lose vision during school age or later in life were less likely to use RBT, likely associated with limited braille skill. Teenagers and adults who experience vision loss should have the opportunity for braille instruction, as well as training with RBT, and this should particularly be emphasized for those who are pursuing employment. People of all ages with less severe visual impairment should also have the option of learning braille. Future research should explore braille proficiency to evaluate who achieves it and how they achieve it, how RBT use benefits workers, and further investigate a potential relationship between RBT use and occupations.

Works Cited

Allman, C. B. “Braille Communication Skills: What teachers teach and visually impaired adults use.” *Journal of Visual Impairment & Blindness*, vol. 92, no. 5, 1998, pp. 331–37.

Bell, Edward C., and Natalia M. Mino. “Blind and visually impaired adult rehabilitation and employment survey: Final results.” *Journal of Blindness Innovation & Research*, vol. 3, no. 1, 2013, pp. 1–35, doi:10.5241/2f1-35.

Bell, Edward C., and Arielle M. Silverman. “Rehabilitation and employment outcomes for adults who are blind or visually impaired: An updated report.” *Journal of Blindness Innovation & Research*, vol. 8, no. 1, 2018, doi:10.5241/8-148.

Bickford, James O., and Ruth A. Falco. “Technology for early braille literacy: Comparison of traditional braille instruction and instruction with an electronic notetaker.” *Journal of Visual Impairment & Blindness*, vol. 106, no. 10, 2012, pp. 679–93, doi:10.1177/0145482x1210601012.

D’Andrea, Frances Mary. “Preferences and practices among students who read braille and use assistive technology.” *Journal of Visual Impairment & Blindness*, vol. 106, no. 10, 2012, pp. 585–96, doi:10.1177/0145482X1210601003.

Emerson, Robert Wall, et al. “Acquisition of literacy skills by young children who are blind: Results from the ABC Braille Study.” *Journal of Visual Impairment & Blindness*, vol. 103, no. 10, 2009, pp. 610–24, doi:10.1177/0145482X0910301005.

Hall, Anthony D., and Slater E. Newman. “Braille learning: Relative importance of seven variables.” *Applied Cognitive Psychology*, vol. 1, no. 2, 1987, pp. 133–41, doi:10.1002/ACP.2350010206.

Hoskin, Elizabeth R., et al. "Effectiveness of technology for braille literacy education for children: A systematic review." *Disability and Rehabilitation: Assistive Technology*, 2022, doi:10.1080/17483107.2022.2070676.

Huebner, K. M. "Daily uses of braille as told by four adult braille users." *Journal of Visual Impairment & Blindness*, vol. 83, no. 6, June 1989, pp. 308–09, doi:10.1177/0145482X8908300612.

Martiniello, Natalina, et al. "Enablers and barriers encountered by working-age and older adults with vision impairment who pursue braille training." *Disability and Rehabilitation*, vol. 44, no. 11, 2022, pp. 2347–62, doi:10.1080/09638288.2020.1833253.

McDonnall, Michele C., et al. "Assistive technology use in the workplace by people with blindness and low vision: Perceived skill level, satisfaction, and challenges." *Assistive Technology*, May 2023, pp. 1–8, doi:10.1080/10400435.2023.2213762.

Rempel, Johan. "Voices from the field: The importance of braille during a pandemic and beyond." *Assistive Technology Outcomes and Benefits*, vol. 16, 2022, www.atia.org/atob.

Ryles, Ruby. "The impact of braille reading skills on employment, income, education, and reading habits." *Journal of Visual Impairment & Blindness*, vol. 90, no. 3, 1996, pp. 219–26, doi:10.1177/0145482X9609000311.

Sheffield, Rebecca M., et al. "How many braille readers? Policy, politics, and perception." *Journal of Visual Impairment & Blindness*, vol. 116, no. 1, 2022, pp. 14–25, doi:10.1177/0145482X211071125.

Silverman, Arielle Michal, and Edward C. Bell. "The association between braille reading history and well-being for blind adults." *Journal of Blindness Innovation & Research*, vol. 8, no. 1, 2018, doi:10.5241/8-141.

Wormsley, D. P. “Braille as the primary literacy medium: General guidelines and strategies.” *Instructional Strategies for Braille Literacy*, edited by D. P. Wormsley and F. M. D’Andrea, AFB Press, 1997, pp. 1–16.