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Hearing is reading: Using musical notes to enhance and encourage recall of the braille alphabet and improve braille literacy

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Abstract

For many blind or visually impaired people, learning to read braille is a long and frustrating experience. The purpose of this research is to determine if the process of associating musical notes to braille letters enhances and encourages memory recall and retention. Working for one hour a week, over a four-week period, participants learned to recognize eight different braille letters, and the musical notes associated with them. They were able to recognize different words created using the same letters, as well as, read sentence fragments, and sentences in braille. After a four-week break, the participants were tested on their ability to remember and recall the letters using the notes as triggers to stimulate memory. This research shows that when information is attached to a specific cue that involves one of the five senses it is easier for the brain to recall said information.

Keywords: Visually impaired, braille, blind, memory recall, memory association

Introduction

It has long been believed that when a person loses one of their five senses, the other four become heightened. Whether this is true or not, losing one's sight, hearing, or smell means relearning things one has already mastered. For many people who have lost their sight, this means relearning how to walk without tripping to how to cook and clean. It means having to adjust to a new definition of independence. It also means learning how to read using the braille system. In fact, learning to read braille takes a lot of practice and time. For this reason, many people choose not to learn it at all.

This study aims to determine if there is a faster and more efficient way to teach braille-specifically regarding to what extent memory is affected by the association of musical notes with the letters of the alphabet. The hope is to create a pedagogical anchor by combining the senses of touch and sound, thereby allowing the brain to link the feel of the braille letter to the associated sound in long-term memory enhancing memory recall and retention.

The Braille System

The braille system is a code of raised dots representing letters, numbers, punctuation, and words when arranged in different patterns. These can then be read by touch for those who are visually impaired. Braille was initially designed to work with the French alphabet and grammar system. There are now 137 different braille codes representing 133 languages in 142 countries worldwide ^[1].

The History of Braille "The Night Writer"

Charles Barbier de La Serre (1767-1841) was an artillery officer in the army of Napoléon Bonaparte. Barbier designed a writing system for the French military that could be read in the dark. It eliminated the need for light sources that called the unwanted attention of enemy snipers. He called his system sonography ^[2]. The sonography system consisted of a six-by-six grid of cells consisting of twelve dots each. These dots were combined in different patterns

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¹ Judith M. Dixon, ed., World Braille Usage. 3rd ed. (Perkins School for the Blind, 2013) xvi

² Stephen Bertman, "Louis Braille and the Night Writer," History Today (2016). 2

to represent the French language's letters and letter combinations.

Barbier's system worked, but the soldiers rejected it because it was too difficult to learn ^[3]. In 1821, he took his system to the Royal Institute for Blind Youths in Paris and presented it to the staff, faculty, and students, but they, too, rejected it because it was missing letters and punctuation ^[4].

Louis Braille was born on January 4, 1809. He was the youngest son of a French cobbler, and as a child, he would follow his father everywhere he went. When Louis was only three years old, he was playing with a sharp tool in his father's shop and badly injured his right eye. Within two years, he had lost sight in both eyes.

At ten, Louis was enrolled at the Royal Institute for Blind Youths in Paris. While in school, he heard Barbier present his sonography system. It was twelve-year-old Louis who came up with the system of braille that we use today. The students at the Institute loved Braille's writing system, but the teachers hated it. They claimed that it was too hard to learn.

Braille became a teacher at the Institute for Blind Youths in Paris. Sadly, when he was still young, he developed tuberculous and died at the age of forty-three. The French government finally approved his writing code two years after his death. Six years after his demise, the World Congress for the Blind made braille the standard system of reading and writing for the blind ^[5].

Why Braille Literacy is Important

Braille literacy is essential as it is the only reading and writing system that allows people who are blind to communicate and take in information independently ^[6]. According to the Perkins School for the Blind, "Braille, as the world's pre-eminent system of touch reading and writing used by people who are blind, continues to be a vital tool of literacy. Allowing immediate and direct access to written communication, braille has broadened from a method for reading embossed books to a multimodal tool encompassing a myriad of uses, from braille signage and product labeling to refreshable braille displays. As a tool or writing, it also allows a person who is blind to easily record accurate information and access that information quickly for later use." ^[7].

Another reason that braille literacy is critical is that (according to The World Health Organization WHO report, as of 2018) there are 285 million visually impaired people worldwide ^[8]. About 90 percent of these people live in developing countries ^[9]. Learning braille can open doors to many opportunities, such as learning (specifically regarding mathematics, science, and music), professional careers, personal improvement, and so on.

The Trouble with Braille

³ Bertman, "Louis Braille and the Night Writer." 2

⁴ Bertman, "Louis Braille and the Night Writer." 3

⁵ Sen Mrittika, and Santosh G Honavar, "Louis Braille: Dancing in the Dark," *Indian Journal of Ophthalmology* 70, no. 1 (2022): 5

⁶ R. M. Sheffield, F. M. D'Andrea, V. Morash, & Chatfield, (2022). "How Many Braille Readers? Policy, Politics, and Perception," *Journal of Visual Impairment & Blindness*, 116 no.1 (2022): 22

⁷ Dixon, "World Braille Usage, Third Edition (V2)," viii

⁸ Fahad Ghayyor *et al.*, "Difficulties Faced by Visually Impaired Students Blind Schools of Khyber Pakhtunkhwa (KPK)," *Ophthalmology Update* 16 no.1 (2018): 494

⁹ Ibid. 494

The trouble with braille is that becoming fluent takes a long time. One's mind must translate what the fingers feel into letters, words, and sentences. Then, it must decipher the meaning of what one has just read. Adding to the struggle is that many braille codes have a contracted form. The contracted form is when single cells can represent an entire word instead of a single letter. For example, "a" in English braille could represent the letter or the word, "and," the meaning of the cell depends on the context in which it is used. This can be very confusing for beginner readers.

There are electronic devices that can assist with learning braille, but for 90 percent of the visually impaired population, electronics are not an option. Electronic screen readers and touch screens are expensive and may not be available in their country. This dramatically limits the independence of those who are blind or visually impaired. In many developing countries, braille is unavailable on public signs, and there is very little structure to support blind people.

Another issue is that the exact number of braille readers worldwide is unknown, as the definition of "braille literacy" changes depending on with whom you are talking ^[10]. Until there are clear and consistent definitions of what braille literacy looks like, an exhaustive answer will never be known. Additionally, many countries do not offer braille instruction in their schools for various reasons. The main one is that there are not enough certified braille teachers. It is easy to understand this when most schools are understaffed and overcrowded.

This research aims to determine if there is a faster and more efficient way to teach braille. This is important as many people who are blind or visually impaired have never had the opportunity to learn. Many of them also find braille too difficult and time consuming to learn and quit before discovering the freedom that it offers. It is the hypothesis of this paper that attaching a musical note to each letter of the braille alphabet will increase recall speed and accuracy in literacy.

Summary

Louis Braille designed the braille system of reading and writing in the early 1800s. It has undergone many revisions and is now used worldwide in 133 languages. Sadly, braille is difficult and time-consuming to learn, making it expensive to teach. Since most of the visually impaired population lives in developing countries, many do not have access to braille education, and there is a scarcity of people trained to teach it. The hope is that this research will aid in relieving some of these issues by providing a faster and more efficient way of teaching braille, allowing the blind and visually impaired to be more independent and study God's word on their own.

Literature Review

While there is a lot of research on braille and different ways to teach it, much of the research is about the standard ways of teaching that have been used for the last several years. Understanding what has been studied and how braille has been taught is essential to see where a different approach may fit. Because braille requires so much memory work, it

¹⁰ R. M. Sheffield, F. M. D'Andrea, V. Morash, and S. Chatfield, "How Many Braille Readers? Policy, Politics, and Perception," *Journal of Visual Impairment & Blindness*, 116 no.1 (2022): 21

is also important to understand the role that long-term memory and memory recall play. This literature review examines the present research on the methods and theories of how the braille system is taught, the two writing methods, the role of technology in teaching braille, how long-term memory and memory recall work, and some problems with learning braille.

"The United Nations Convention on the Rights of Persons with Disabilities (CRPD) affirms the right to education for disabled persons and aims to ensure Braille instruction for blind individuals."^[11] However, providing an education can take many forms. While the Western world views literacy as part of education for everyone, in many developing countries, literacy is not guaranteed for those who are blind or visually impaired. Many believe teaching visually impaired people to read braille wastes time and resources. It is thought that they can receive a good education through simply listening. Braille books take up a lot of room.

According to Bibles for the Blind and Visually Handicapped International, a braille Bible, for example, consists of seventeen volumes. Each volume is the thickness of one standard print Bible and is eleven inches tall by eleven and a half inches wide^[12]. This makes audiobooks an ideal choice for many things, but studying from one is difficult.

Every person has the right to an education. People who are blind or visually impaired should have the right to read and study scripture on their own. For many visually impaired people worldwide, this means they must first be taught to read braille.

Current Teaching Methods

For many, learning to read braille is a daunting task. As with sighted readers, gaining proficiency in braille takes practice and determination. Many visually impaired adults do not believe learning to read in braille is worth the time and effort. Learning braille is essentially the same as learning a new language. The brain must translate what the fingers are feeling into letters, words, and sentences that can be understood. Then, the meaning of the sentences must be interoperated to grasp the entire meaning of what is written. Farrow remarks, "According to the American Foundation for the Blind, learning braille could take a year or more of weekly lessons."^[13]

It is important to note that one way of teaching people to read is no better than another^[14]. Three models of reading instruction are used with any reader- sighted or blind. The Meaning-centered model focuses on the reader's ability to determine the meaning of what is written. The skills-centered approach model focuses on being able to decode print into words. The interactive model uses a mix of the other two.

There are also several approaches to teaching reading. The Basal Reader Approach is teacher-driven and has a complete program for the teacher to follow. The Language

Experience Approach uses the learner's personal experience and way of speaking. The story the learner shares is transcribed in their unique way of telling it, and then they are assisted in reading what was transcribed. Literature-Based takes the view that if the student chooses a topic that interests them to read about, they will enjoy it more and learn on their own. A Whole-Language Approach is a "child-centered, literature-based approach to language teaching that immerses students in real communication situations."^[15] These approaches are effective but must be modified when teaching braille to a blind person.

Two Ways to Write Braille

Louis Braille devised a six-dot system consisting of a two-dot wide by three-dot high cell. The combination of dots raised within the cell tells you what letter, number, or character you are reading. Many countries have adapted this system to fit their unique alphabet and grammar structures.

Over the years, the English braille has developed into two different writing systems. The first way, called Grade 1, or Alphabetical, is where every letter, number, and punctuation mark is represented by its cell. According to Mobaraki *et al.*, this results in large volumes that take up a lot of space on bookshelves^[16]. Grade 2, or "contracted braille," uses 189 contractions, many representing whole words with one cell^[17]. This results in shortened volumes that take up a lot less space. The problem is that contractions can be confusing, as the dot combinations used could represent a single letter or an entire word, depending on context.

The question arises, "When do you teach contractions to the visually impaired?" Is this something that one should teach children in elementary school, or should the person wait until high school? According to Mobaraki *et al.*, it is best to teach contracted braille and alphabetic braille simultaneously or only contracted braille. If a person only uses alphabetic braille for too long, contracted braille is more challenging to learn^[18].

Some believe teaching only Grade 1 braille is the best way to learn to read. According to Troughton (1992), as cited by MacCuspie, many braille users increased their literacy level when they were allowed to read uncontracted (Grade 1) braille^[19].

A five-year study was conducted by Emerson *et al.* to determine which way of teaching was best. According to Swenson, the study followed students from Pre-K through Fourth Grade. The results showed that while teaching contracted braille at early stages created stronger readers, the vocabulary and comprehension levels of the students were below grade level. This means that the students could read the words well but did not understand what they were reading about. It is speculated that the teachers focused solely on teaching the braille code and not on proper reading techniques^[20].

¹¹ Lindsay N. Harris *et al.*, "Braille Literacy as a Human Right: A Challenge to the 'inefficiency' Argument against Braille Instruction," *International Journal of Psychology* 58 no.1 (2023): 52

¹² Keith Reedy, "About Bibles for the Blind and Visually Handicapped," *Bibles for the Blind and Visually Handicapped International*. Accessed April 14, 2024

¹³ Kendra R. Farrow, "Using a Group Approach to Motivate Adults to Learn Braille," *Journal of Visual Impairment & Blindness* 109, no.4 (2015): 318

¹⁴ Evelyn J. Rex *et al.*, *Foundations of Braille Literacy*, (New York: AFB Press, 2008), 81

¹⁵ Rex *et al.*, *Foundations of Braille Literacy*, 70

¹⁶ Mohsen Mobaraki *et al.*, "A Comparative Analysis of Contracted versus Alphabetical English Braille and Attitudes of English as a Foreign Language Learners: A Case Study of a Farsi-Speaking Visually Impaired Student," *Journal of Visual Impairment & Blindness* 111, no. 5 (2017): 471

¹⁷ Ibid. 471

¹⁸ Ibid. 474

¹⁹ P. Ann MacCuspie, "Access to Literacy Instruction for Students Who Are Blind or Visually Impaired A Discussion Paper," *Paths to Literacy*, 2002. 13

²⁰ Anna M. Swenson, "The ABC Braille Study: Results and Implications for Teachers," *Paths to Literacy* 1-4

Variables of Teaching Braille

According to Hall and Newman, as cited by Barlow-Brown, many studies have been performed to determine braille acquisition variables. Their study of seven known variables showed that there were three that made learning braille easier and faster. One was if the students were allowed to look at the cell, not just feel the symbol. The second was if the braille symbols were easy to distinguish from each other. The third was if the students could look at the symbols as they were tested ^[21]. If the student is entirely blind instead of visually impaired, the first and third variables do not help. However, another variable that should be considered is the size of the braille symbol when first learning the alphabet.

Many people believe a student should learn on standard-size braille cells when first learning to read braille, but Barlow-Brown *et al.* believe differently. Their study teaching braille to nursery school children found that using a larger braille cell helped. Children who learned on the enlarged braille cells could easily read the standard size cells. Making the cells bigger makes it easier to read the letter, just as making the font bigger helps us to read printed material easier ^[22].

Another variable is that there is an entirely different braille code for mathematics and science classes. This means that those who are blind or visually impaired must learn another new set of braille symbols. This affects their education overall and is difficult for them because these subjects rely heavily on seeing and understanding graphics, charts, pictures, and more. It takes longer for blind and visually impaired students to feel and understand the graphics than for others to look at and comprehend them ^[23].

Technology

Technology plays a vital role in teaching braille to those who are blind or visually impaired. Over the years, many different devices have been created to assist blind people in learning braille and communicating. McCarthy *et al.* found that using a software-based braille tutoring program and regular instruction allowed students to learn Grade 2 braille in a fun and efficient way ^[24]. By developing technological tools that assist in learning braille at an early age, educators can guarantee the inclusion of the visually impaired in society ^[25]. The problem with technology is that it is expensive. With 90 percent of the visually impaired population living in developing countries, this may not be an answer.

How Does Memory Work?

²¹ Fiona Barlow-Brown, Christopher Barker, and Margaret Harris. "Size and Modality Effects in Braille Learning: Implications for the Blind Child from Pre-reading Sighted Children," *British Journal of Educational Psychology* 89 no. 1 (2019): 172

²² Fiona Barlow-Brown, Christopher Barker, and Margaret Harris. "Size and Modality Effects in Braille Learning: Implications for the Blind Child from Pre-reading Sighted Children," *British Journal of Educational Psychology* 89 no. 1 (2019): 172

²³ L. Penny Rosenblum and Tina S. Herzberg, "Braille and Tactile Graphics: Youths with Visual Impairments Share Their Experiences," *Journal of Visual Impairment & Blindness* 109 no. 3 (2015): 174

²⁴ Tessa L. McCarthy *et al.*, "An Artificial Intelligence Tutor: A Supplementary Tool for Teaching and Practicing Braille," *Journal of Visual Impairment & Blindness* 110 no. 5 (2016): 320

²⁵ Katherin Duarte-Barón *et al.*, "Design and Construction of a Device for Facilitating the Learning of Braille Literacy System," *Ingeniería y Competitividad* 18 no.1 (2016.): 80

Working Memory and Long-Term Memory

Working memory is a type of short-term memory that people use when they learn things. When people learn something new, that information is stored in their working memory. However, working memory can only hold around seven pieces of information. The oldest information is expelled from the working memory if an eighth piece of information is received. If the brain decides that information is essential, it is put into long-term memory. That information will sit in long-term memory indefinitely, but if it is not recalled, its neuropathways are "broken," and the information becomes more challenging to remember. According to Bartsch and Shepherdson, the key to successful memory retrieval lies in the ability to use temporal contextual cues to guide the brain's search in long-term memory ^[26].

There are several theories on how to teach information to make it easier to recall later. One of the newer theories in teaching is that of Embodied Cognition. This theory "...emphasizes the inseparable link between brain, body, and the world." ^[27]. The idea behind this theory is that combining the physical senses and experience will enhance a student's ability to learn, understand, and remember what is being taught. This is why song lyrics are easier to remember when you put actions to them.

The use of music in teaching is very effective in recalling information from long-term memory. "Music simplifies learning since it creates a link between music and taught information." ^[28] Music makes learning easier because it improves the encoding, storage, and recall of new information. Not only does music make learning enjoyable, but it can motivate people to learn new things ^[29].

In their study on the use of retrieval cues, Liu *et al.* found that using retrieval cues and other retrieval practices enhances the durability of memory over time ^[30]. In their study, one group was given retrieval cues when memorizing information. The other group was taught the information and then given a chance to restudy the info. Both groups were tested on the information forty-eight hours later and again in one week. The group that used the retrieval cues could remember more than those who restudied the information.

Problems with Learning Braille

Many things make learning braille difficult. Some of these issues are with the system itself, and some are the mental hurdles people construct themselves. There is also the misperception that braille is "a less efficient medium for learning." ^[31]. This perception has led to a shift to auditory media for instruction for blind students early in their

²⁶ Lea M. Bartsch, and Peter Shepherdson. "Freeing Capacity in Working Memory (WM) through the Use of Long-Term Memory (LTM) Representations," *Journal of Experimental Psychology: Learning, Memory, and Cognition* 48, no. 4 (2022): 466

²⁷ Panagiotis Kosmas *et al.*, "Moving Bodies to Moving Minds: A Study of the Use of Motion-Based Games in Special Education," *TechTrends: Linking Research & Practice to Improve Learning* 62, no. 6 (2018): 594

²⁸ Zahra Nikkhal Bahrami *et al.*, "The Impact of Musical Mnemonic on Vocabulary Recalling of Iranian Young Learners," *International Journal of Instruction* 12, no. 1 (2019): 992

²⁹ Ibid. 992

³⁰ Shaohang Liu *et al.*, "Progressive Retrieval Practice Leads to Greater Memory for Image-Word Pairs than Standard Retrieval Practice," *Memory* 30, no.7 (2022): 798

³¹ Mackenzie E. Savaiano *et al.*, "Vocabulary Word Instruction for Students Who Read Braille," *Exceptional Children* 82, no. 3 (2016): 339

education^[32]. Because of this shift and the time it takes to learn to read braille, many countries feel that braille literacy is unnecessary^[33]. The perception that braille is a less efficient learning medium is inaccurate. In their study, Harris *et al.* showed that for a visually impaired person, reading braille is no less efficient than reading print for a sighted person^[34].

The lack of quality teachers is another issue that has affected braille literacy. There is speculation that many teachers trained to teach braille are not competent in the braille code. This makes it difficult for them to teach their visually impaired and blind students effectively^[35].

For many people who have lost their vision later in life, learning braille carries a stigma and reminds them of what they have lost. This requires them to accept that they are blind and learn to think about their situation differently, more positively. This, in turn, can help build their self-esteem and allow them to become more independent. Yet it is a decision that they must be willing to make^[36].

Finally, the minimal use of braille in society makes practicing braille daily tricky. "A child who uses print is immersed in a printed world from birth."^[37] A person who is blind does not have the luxury of access to braille wherever they go. Yes, there are signs here and there, but not many restaurants offer braille menus, and stores do not label their items in braille. This world is made for those who are sighted.

How this Research Can Make a Difference

This research aims to make a difference in the lives of those who are blind or visually impaired. Improving the braille teaching process, making it faster and easier to learn, will remove some of the obstacles experienced by many. Becoming literate in braille will enhance the lives of the blind and visually impaired by allowing them to find meaningful employment and giving them independence. Additionally, it will also enable them to study God's word in a more profound and life-changing way than ever before.

Methods

This chapter presents the methodologies used in this research. It also covers who the participants are, the setting in which the experiment was conducted, the ethical considerations, the specific method of data collection, and the limitations of the research.

Methodology

Research Design

This was a five-week, design-based research (DBR) action

study. According to Leedy *et al.* (2019), "The primary goal of DBR studies is to produce new theories and articulate practices that can have a bearing on learning and teaching in actual educational settings."^[38] The aim of this research was to examine how braille is taught and determine if there is a better way to teach it building from the Our Daily Bread Ministries Literacy Program (ODBMLP), which aligns to the methodology taught in the Barclay College Master of Arts Literacy Program. If braille can be taught to the blind and visually impaired in a way that allows them to gain literacy faster and more efficiently, it would benefit both students and teachers. The students would achieve independence in many areas of their lives, and the teachers would be able to take on the teaching of other students. This would, in turn, spread braille teaching to more blind and visually impaired people in a shorter period.

During this study, the researcher met with participants weekly for approximately one hour. During that hour, the participants were blindfolded and asked to perform specific tasks using the braille alphabet. These tasks included:

Week 1: Identifying individual braille letters and matching the letters with their associated musical notes on a small piano keyboard.

Weeks 2 and 3: Spelling words by identifying the braille letters and their associated notes and reading braille words on a page.

Week 4: Reading braille sentence fragments on a page.

Week 5: Consisted of a test of the participant's memory retention and recall. Week 5 tests covered everything learned in weeks 1-4. This will take place one month after the Week 4 session. The details of the process are outlined in the next section.

Data Collection

The data for this research was collected using the following five-week experiment. Weeks one through four were instruction in the braille alphabet and practice reading words, sentence fragments, and sentences. Four weeks after the final instructional session, a test was administered to determine the level of braille retention and recall of each participant.

Step-by-step Instructions for Experiment

(See Appendix II for a list of needed supplies)

Week 1:

Before You Start:

- Create stickers with the braille cells representing these letters A, E, F, N, R, S, T, and U. Adhere stickers to random keys on the keyboard.
- Create braille letter card for the same letters. It is best to create several lines of letters for participants to read on one card, leaving a cell width between letters. This saves time, space, and paper.

Step 1: Blindfold Participant

³² Mackenzie E. Savaiano *et al.*, "Vocabulary Word Instruction for Students Who Read Braille," *Exceptional Children* 82, no. 3 (2016): 339

³³ Lindsay N. Harris *et al.*, "Braille Literacy as a Human Right: A Challenge to the 'inefficiency' Argument against Braille Instruction," *International Journal of Psychology* 58, no.1 (2023): 54

³⁴ Ibid. 56

³⁵ Vassilios Argyropoulos *et al.*, "Undergraduate Student Education Programs Regarding Braille Literacy: A Transnational Comparative Study," *Higher Education Studies* 9, no. 4 (September 20, 2019): 44

³⁶ Kendra R. Farrow, "Using a Group Approach to Motivate Adults to Learn Braille," *Journal of Visual Impairment & Blindness* 109, no. 4 (2015): 318

³⁷ MacCuspie, P. Ann. "Access to Literacy Instruction for Students Who Are Blind or Visually Impaired A Discussion Paper," *Paths to Literacy*, 2002, 13

³⁸ Paul D. Leedy, Jeanne Ellis Ormrod, and Laura Ruth Johnson, *Practical research: Planning and design*, (NY: Pearson, 2019) 285

Step 2: Position the keyboard in front of the participant.

Step 3: (Ask for permission to touch!) Guide the participant's fingers to the keyboard and let them feel the first letter. Tell them the letter and have them say the letter out loud.

Step 4: Have them “play” the note and simultaneously sing the letter name aloud.
(Repeat Steps 3-4 for all eight letters, three times)

Step 4: Tell participants that you will now play one of the notes, and they need to tell you the letter corresponding to that note. (If this is too difficult, stop and allow them to feel and play the letters on the keyboard three more times, then resume Step 4.)

Step 5: Now tell the participant, “I will remove the keyboard and put a piece of paper in front of you. You need to feel the paper and tell me what letters are on it; they will be in random order. If you need help finding the paper, I will guide you.” Remove the keyboard and put down a letter card. Ask the participant to feel and name the letters. If they do not name the letter correctly, play the note that corresponds to the correct letter, tell them the name of the correct letter and allow them to feel it again. Continue in this way for all eight letters.

Week 2:

Before you start:

- Prepare a list of 3- and 4-letter words for the participant to practice spelling on the keyboard. (See Appendix II)
- Prepare one page each of the exact 3-letter and 4-letter words, in braille and in a different order, for the participant to read on paper.

Step 1: Blindfold the participant and inform them you will place the keyboard before them. Tell them you will ask them to spell 3- and 4-letter words. As they find each letter on the keyboard, they need to sing the letter's name and play the key simultaneously. Read the first 3-letter word and ask the participant to find the letters that spelled the word. Track how many mistakes the participant makes in spelling the word. If the participant spells the word correctly, Move on to the next word. If the participant has problems spelling the word, pause and review the letters. Repeat this step for all the words.

Step 2: Inform the participant that you will remove the keyboard and replace it with paper. This paper contains a list of 3-letter words in Braille. Ask the student to read each word out loud. If the participant gets the word correct, have them move to the next word. If the participant does not read the word correctly, have them try again. Remind that participant that if they get stuck, they may ask for the corresponding note to be played for the letter they are stuck on. If they still do not correct it, return to the keyboard and have them review the letters. Once they have read all the words correctly, move to Step 3.

Step 3: Repeat Step 1 using the list of 4-letter words.

Step 4: Repeat Step 2 using the list of 4-letter words.

Week 3

Before you start

- Prepare a list of 5- and 6-letter words for the participant to practice spelling on the keyboard. (See Appendix II)
- Prepare one page of the exact 5-letter and 6-letter words, in braille and in a different order, for the participant to read on paper. And one page of sentence fragments using the words from last week and this week.

Step 1: Blindfold the participant and inform them you will place the keyboard before them. Tell them you will ask them to spell 5- and 6-letter words. As they find each letter on the keyboard, they need to sing the letter's name and play the key simultaneously. Read the first 5-letter word and ask the participant to find the letters that spelled the word. Track how many mistakes the participant makes in spelling the word. If the participant spells the word correctly, move on to the next word. If the participant has problems spelling the word, pause and review the letters.

Step 2: Inform the participant that you will remove the keyboard and replace it with paper. This paper contains a list of 5-letter words in braille. Ask the student to read each word out loud. If the participant gets the word correct, have them move to the next word. If the participant does not read the word correctly, have them try again. Remind the participant that if they get stuck, they may ask for the note that corresponds to the correct letter to be played. If they still do not read the word correctly, return to the keyboard and have them review the letters. Once they have read all the words correctly, move to Step 3.

Step 3: Repeat Step 2 using the list of sentence fragments.

Week 4

Before You Start

Prepare a page of sentences using the exact braille words as in weeks 2 and 3. (See Appendix II)

Step 1- Blindfold participants and inform them that they will not use the keyboard today. Instead, they will read sentences on paper. They are to start at the top and read each sentence aloud. There is no need to rush; they may take as long as needed. Place the sentence page in front of them and ask them to read the first sentence. If they read it correctly, have them move to the following fragment. If they do not get it correct, have them try again. If they still do not get it correct, have them review the individual letters on the paper in week one. Remind the participant that they may ask for the note that corresponds to the correct letter played if they get stuck.

Week 5 (Four Weeks Later)

Braille Memory Recall Tests

Before you start

Prepare braille pages from Appendix II for Week 5 Memory Tests:

Step 1: Blindfold the participant. Remind the participant that they may ask to have the corresponding note played for any letter they get stuck on.

Step 2: Inform the participant that you will place a piece of paper with braille letters in front of them. Ask the participant to read the letters on the paper and simultaneously name the letter aloud. Track the number of mistakes. When they finish, move on to step three.

Step 3: Inform the participant that you will place a piece of paper with braille sentence fragments before them. Ask the participant to read the fragments on the paper aloud. Track the mistakes. When they finish move on to step four.

Step 4: Inform the participant that you will place a piece of paper with braille sentences before them. Ask the participant to read the sentences on the paper aloud. Track the mistakes.

Setting and Participants

This research was conducted in an office, on the campus of Barclay College, in Haviland, Kansas. The participants were 4 female college students who volunteered. These participants were recruited through an announcement made during a weekly chapel service. There were no stipulations on how many of each gender were needed.

Ethical Considerations

There is the possibility that being blindfolded will trigger fear and cause discomfort. There is also the frustration of learning something new and potentially the feeling of anxiety due to testing. Sometimes the participants need help orientating their hands on the keyboard or paper, the researcher should always ask permission before touching a blindfolded participant to assist them.

Limitations

One of the limitations of this research is that it was conducted with sighted people who were blindfolded. If this research were conducted with blind or visually impaired people, the outcomes might be different. Another limitation is the small sample size. If the sample were bigger, the average of the results would change.

Assumptions and Biases

One of the assumptions about this research is that the results will be favorable because they have been favorable in similar experiments. Another assumption is that the older

the person is, the harder it is for them to learn and retain braille. A third assumption is that the music will help the participants to remember and easily recall the letters. Hashemi and Nima discussed the effect of music on ESL students' ability to learn new words and their definitions. They found that "the use of music as a mode positively affected the learners' learning and retention of the meaning of difficult words"^[39].

Data Processing and Analysis

During the first four weeks, the researcher tracked the number of times the participant answers correctly when asked to identify the braille letters, words, or fragments. The researcher also tracked the number of times the participant answers incorrectly. These numbers were kept and compared to the numbers from the week five test. It was hypothesized that the number of correct answers in the week five tests would be equal to or exceed that in the previous four weeks. The data collected answered the following questions:

Week 1

- Does retention and recall of braille letters increase when associated with musical notes?
- Can participants accurately associate the sound with the corresponding braille letter?
- Does the recognition of braille letters transfer from the keyboard to paper effectively and accurately?

Weeks 2-4

- Can the participant accurately put the braille letters together to create words with the sound as reinforcement? To what level of accuracy?
- Can the participant transfer the spelling and reading of braille words from the keyboard to paper, and to what level of accuracy?
- Does the accuracy of braille word recognition increase over the four weeks?
- Can the participant accurately read and verbalize braille sentence fragments and sentences?

Week 5

- To what extent can the participant accurately associate the braille letters with their corresponding notes?
- To what extent have the participants improved their ability to recognize and read braille words?
- To what extent have the participants improved their ability to read braille words, fragments, and sentences?

³⁹ Mohammad R. Hashemi, and Nima Yousefi, "The Effect of Music Composed as an Input Mode on High Intermediate L2 Learners' Knowledge and Retention of the Meaning of Difficult English Words," *International TESOL Journal* 16, no.7 (2021): 86

[illegible]

Summary

Results, Analysis and Discussions

Results

Demographics

The Experiment

Participants were then asked to depress the key and match pitch as they sang the name of the letter. This helped them to create a link between the brain, the body, and the world

During week two blindfolded participants were permitted to review the letters using the keyboard before starting the lesson. During week two, participants were asked to spell 3- and 4-letter words using the keyboard. The participants accomplished this by finding the letters in the correct order and saying the name of the letter as they depressed the key associated with each. After all words had been spelled correctly, the participants were then given an index card containing the same words and were asked to read each word aloud. After this lesson, the researcher asked the participants if the notes helped them remember the letters. Three of the four said that the notes did help them remember. The fourth said that the notes just confused her. It was easier for her to picture the cells in her mind.

During week three participants were allowed to review the letters one time. They were then asked to spell 3- and 4-letter words in the same manner as week two. Participants were then given an index card with sentence fragments on it, and were asked to read them aloud. The participant identified as #8 was distracted by family-related issues and only completed half of the lesson.

During week four participants were not permitted to review the letters. The participants were given a sheet of sentences in braille and were asked to read them aloud. All of the participants completed this assignment in less than the allotted hour. Most of the participants would name each letter, then say each individual word before saying the entire sentence aloud. Participant number four would read the entire sentence then state it aloud. The participant would check herself if the context did not make sense and would self-correct before stating the sentence. She did not ask for the notes to be played. The first four weeks happened consecutively, with the fifth week retention test happening one month later.

During the week five retention test, the participants were not permitted to review the letters. They were given a sheet with rows of individual letters, words, and full sentences and were asked to read them aloud. All of the participants asked

⁴⁰ Panagiotis Kosmas, Andri Ioannou, and Symeon Retalis. "Moving Bodies to Moving Minds: A Study of the Use of Motion-Based Games in Special Education," *TechTrends: Linking Research & Practice to Improve Learning* 62 no.6 (2018) 594

for the notes to be played at some point in the test. All of the participants said that the test was hard for them but believed they did better than anticipated.

After the first week the participants were able to easily recognize the braille letters on the keyboard, and on paper. Over the next three weeks, they were also able to read individual words, sentence fragments, and sentences on

paper with great accuracy. The overall number of attempts and mistakes per participant, per week, are shown in Figure 1. The same data is shown in graph form in Figure 2. A comparison of the data from weeks one and two versus week five is shown in Figure 3.

Data Tables

Student	WK1		WK2		WK3		WK4		WK5	
	Attempts	Mistakes	Attempts	Mistakes	Attempts	Mistakes	Attempts	Mistakes	Attempts	Mistakes
#2	75	31	22	2	30	9	12	2	87	4
#4	61	24	21	1	33	13	16	6	87	4
#7	76	28	28	8	41	21	25	15	112	29
#8	75	20	29	9	No Data	No Data	75	65	90	11
Totals	287	103	100	20	104	43	128	88	376	48

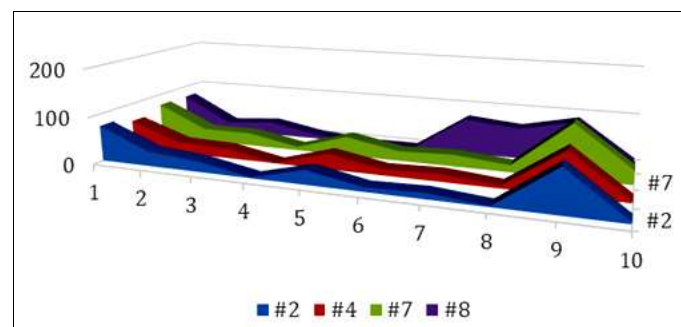


Fig 2: Comparison of attempts and mistakes by participant over the first 4 weeks

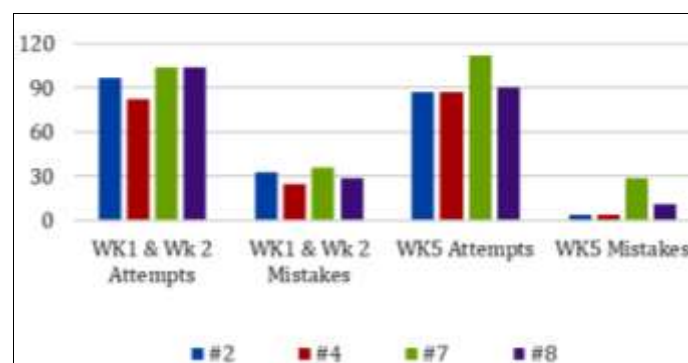


Fig 3: Weeks 1&2 Attempts and Mistakes vs. Week 5 by Participant

As shown in the graphs above, the number of mistakes decreased drastically over the four weeks and stayed low even after a four-week break. Asking for the notes to be played was a way for participants to check themselves. By week four, they seldom needed the notes. During the week five, retention test participants did revert to asking for the notes until they felt confident in their memory of the letters.

Discussion

The answer to the question of whether the retention and recall of braille letters increases when associated with musical notes seems to be yes. After four hours of instruction and practice, the number of mistakes made by the participants dropped drastically. What started as a 59 percent combined average of accuracy over the four weeks of instruction, dropped to an 87 percent combined accuracy in week five. The American Foundation for the Blind estimates that learning braille could take a year or more ^[41].

It is said that music creates a link between itself and information that is taught ^[42].

This leads one to wonder if the speed and accuracy with which the participants learned braille was the result of the notes, or because they were sighted and knew what the letters looked like? And if this is true then will the results be the same if the participants are visually impaired? In conversations with the participants after the lessons, many of them said that they pictured the braille cell in their mind and filled in the dots mentally to create a picture of what they were feeling. If a person were visually impaired, they should be able to do the same thing. However, if a person has been blind from birth, would they “see” the cells the way a sighted person does? More experimentation is needed to determine the answers to these questions.

There has long been a debate about best practices in teaching braille ^[43]. Do you teach contracted braille (Grade 2) first, or do you teach alphabetic braille (Grade 1) first?

⁴¹ Kendra R. Farrow, “Using a Group Approach to Motivate Adults to Learn Braille,” *Journal of Visual Impairment & Blindness* 109 no. 4: (2015): 318

⁴² Bahrami *et al.*, “The Impact of Musical Mnemonics on Vocabulary Recalling” 992

⁴³ Rex *et al.*, “Foundations of Braille Literacy,” New York: AFB, 2008, 81

According to Mobaraki *et al.*, it is best to teach both simultaneously ^[44]. While this experiment focused on alphabetic braille, contracted braille could be taught in the same way, with modifications.

The key to literacy is not only being able to read the words, but also the comprehension of what has been read. No matter which form of braille is taught, if the student does not understand what they have read, then are they truly literate? The use of higher-level thinking questions is therefore suggested as a supplement to the method of teaching used in this experiment.

It has also been suggested that using a larger size of braille cell when teaching braille for the first time ^[45]. The experiment by Brown *et al.* was conducted using sighted children. The children were able to see the braille cells as well as feel them. This does seem to show that the visually impaired may benefit from a larger cell while first learning braille. However, if the student is completely blind, does the size of the cell still make a difference? The participants in this experiment learned on standard size braille cells. At first, they struggled to distinguish where one word stopped and another began, but that did not last long. The size of the cell did not seem to adversely affect their ability to read the words accurately.

For many blind and visually impaired people in the United States and Europe, access to technology and braille resources is not an issue. However, for much of the rest of the world this is a major hurdle ^[46]. The method used in this experiment does not require technology. Teachers could use a piano keyboard, a xylophone, anything that makes multiple unique sounds. While this method of teaching solves the problem of a lack of technology, it does not solve the issue of a lack of braille resources.

Chapter 5 Conclusion and Spiritual Integration

This research was conceived out of real-life experience. A friend of the researcher was working with the deaf blind in South Sudan, attempting to teach them to read using raised symbols instead of dots or words so they could have access to scripture. Some blind people came to the workshop asking if he could teach them also. They also wanted to be able to read scripture on their own. He discovered that some of them had been taught braille but had forgotten it. Others had never learned. It was from these conversations that this research came about.

Conclusion

The method outlined in my research works. The participants from my research improved drastically in their braille abilities. After meeting for an hour, a week for four weeks, just 4 hours total, they went from a 59 percent combined average of accuracy over the four weeks to an 87 percent combined accuracy in week five. Significantly, the week five test happened after a month of not practicing.

Does associating musical notes to each of the braille letters enhance and encourage memory recall? Yes, it does. When musical notes are associated with individual letters, it gives

the participant a way to anchor the letter in their mind. When that is combined with the physical activity of feeling the raised dots in the braille cell, it allows the brain to form attachments to each individual letter. This then allows the brain to form neuropathways that connect the entire experience to long-term memory. When the note is played, the brain is then able to follow those neuropathways and recall the correct letter. It is the same thing that happens when you walk into a house and can tell what is for dinner just by what you smell.

Limitations

There were limitations for this research. One, the sample size was small; only 4 participants. Two, all the participants were sighted. Three, the keyboard was too small. Four, only eight letters were taught. Five, all the participants were within the same age range.

Suggestions for Further Study

There are many suggestions for further study. However, future experiments should be conducted with both visually impaired and blind participants, in a range of ages.

- Does this method work for teaching contracted braille?
- How well does this method work for those who have been blind from birth?
- How well does this method work in longer studies with the entire alphabet?
- How long after the study is finished can participants recall the correct letter when the note is played?

Concluding Thoughts

There are thousands of people who face vision loss every day. Many of these people must relearn skills that they have had all their lives. This is a scary time for them as they face a future of darkness and uncertainty. Learning to read braille gives them back some of their independence and dignity. It allows them to study and interpret scripture on their own and not have to rely on the interpretations of others. The method described in this research could take away the fear and dread of having to learn to read again, allowing them to enjoy scripture on a deeper level once more.

Faith Integration

The inspiration for my research was born out of a real-life experience. I not only work for Barclay College, but also for Our Daily Bread Ministries, specifically for the Africa Strategic Initiatives Team. One of my team members was in South Sudan helping to teach deaf blind people to read scripture. A group of blind people came and asked if they could learn to read also. These people did not have access to braille Bibles, and many of them were braille illiterate. Through conversations with them, he discovered that what braille they had learned, they quickly forgot it due to lack of use. They wanted to read and study scripture for themselves, and that is very difficult to do using an audio Bible. So, the question was asked, "How can braille be taught quickly and in a way that it is easy to review and remember?"

My reason for coming to Barclay was to encourage students to become involved in missions- to show them how they could impact the world for God's Kingdom, even in Haviland, Kansas. I believe that God has great plans for Barclay. Furthermore, I believe that the research undertaken through this course has the potential to change the world.

Matthew 28:19-20 is very familiar to all of us. It is Jesus's

⁴⁴ Mohsen Mobaraki *et al.*, "A Comparative Analysis of Contracted versus Alphabetic English Braille and Attitudes of English as a Foreign Language Learners" 474

⁴⁵ Fiona Barlow-Brown *et al.*, "Size and Modality Effects in Braille Learning: Implications for the Blind Child from Pre-reading Sighted Children," *British Journal of Educational Psychology* 89 no. 1 (2019): 172

⁴⁶ Fahad Ghayyor *et al.*, "Difficulties Faced by Visually Impaired Students Blind Schools of Khyber Pakhtunkhwa (KPK)," *Ophthalmology Update* 16 no. 1 (2018): 495

command that we should go and make disciples. We are to spread his commands and teachings to everyone. To do this, we need to know what he taught. This requires time spent in his word and in constant communication with him. For those that are blind or visually impaired, the ability to study scripture is not always a reality. It is my hope that this research will help to change that.

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