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# Individualized Instruction in Letter Name Identification for a Student with Cortical Visual Impairment

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INDIVIDUALIZED INSTRUCTION IN LETTER NAME  
IDENTIFICATION FOR A STUDENT WITH CORTICAL VISUAL IMPAIRMENT

by

Holli Luff

A THESIS

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INDIVIDUALIZED INSTRUCTION IN LETTER NAME  
IDENTIFICATION FOR A STUDENT WITH CORTICAL VISUAL IMPAIRMENT

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University of Nebraska, 2019

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Students with cortical visual impairment (CVI) have difficulties participating in literacy activities and the reading process. An evidenced-based curriculum was adapted and modified to teach letter naming to a student with CVI. A multiple probe design was used to determine whether the instruction was effective with a student with CVI and if instruction in letter identification support identification of letter sounds for a student with cortical visual impairment. There was a functional relationship between the explicit instruction and the students immediately recorded correct responses, but the skill was not maintained.

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## CHAPTER 1: INTRODUCTION

Many people use the terms cerebral visual impairment and cortical visual impairment (CVI) synonymously. Cerebral visual impairment is a broad term used to describe all forms of visual processing disorders (Roman, 2010; Roman-Lantzy, 2018). CVI is a more specific visual impairment and defined as a, “visual impairment caused by brain damage or conditions that affect the part of the brain known as the posterior visual system” (Roman-Lantzy, 2018). This visual impairment occurs within the neurological pathways between the optic nerves at the back of the eye and the processing areas in the brain; meaning there is no physical damage to the structure of a student’s eye or brain.

The American Printing House for the Blind (APH) developed a registry to collect data on infants born with visual impairment. Colloquially, this register is referred to as Babies Count. Hatton, Ivy, and Boyer (2013) analyzed data collected from 2005 to 2011, which included data on 5,931 children with severe visual impairments from birth to three years old. The average visual diagnosis was 4.9 months of age, although services or referrals for services did not start until 10.5 months of age. The three most prevalent visual conditions were CVI with 24.9% of children, followed by retinopathy of prematurity (ROP) with 11.8% and optic nerve hypoplasia (ONH) with 11.4% (Hatton et al., 2013). This study shows that CVI is the most common visual impairment in children from birth to three.

Comparing the most recent Babies Count data (Hatton et al., 2013) with the previous data (Hatton, Schwietz, Boyer, & Rychwski, 2007) children were diagnosed at slightly earlier ages. Specifically, CVI was diagnosed at an average age of 6.8 months compared to 7.6 months old previously. However, CVI was still the most prevalent



condition in infants with visual impairments (23.6% of the 2007 sample). As these students grow up, they enter our school systems and professionals need to know how to teach these students and what it means to have CVI. There has not been a more recent Babies Count publication, although from the statistics of the previous articles, CVI is still the most prevalent visual condition.

### **Characteristics of CVI**

Children with CVI have some common visual characteristics. According to Roman-Lantzy (2018), it is important to become familiar with these characteristics when you are assessing and planning an intervention for a student with CVI. The CVI characteristics are the center of understanding how a student with CVI perceives materials, the environment and people around them. These characteristics include 1) color preference, 2) need for movement, 3) visual latency, 4) visual field preference, 5) difficulties with visual complexity, 6) need for light, 7) difficulty with distance viewing, 8) atypical visual reflexes, 9) difficulty with visual novelty, and 10) absence of visual guided reach.

Color preference is when an individual will pay attention to or is attracted to a specific color, typically a primary color. Vibrant color may keep the student alert and help them maintain their visual attention to an object or a task (Cohen-Maitre & Haerich, 2005). Red and yellow were reported by parents as the most commonly preferred colors by children with CVI (Roman-Lantzy, 2018).

When students need movement, this is to start or keep visual attention. To do this, the object or the viewer needs to be moving to increase the viewer's ability to see the object. Some students will move their head or their body if the objects or activities they

are participating in are not able to be moved. It is speculated that this is to provide themselves with visual stimulation (Roman-Lantzy, 2018).

Visual latency is the delayed response between being presented with an object and when the individual starts looking at the object. When an object is placed within viewing distance of students, it may take longer than average for them to focus or fixate on the object. If the individual is presented with enough wait time (which varies for each student), the individual may finally turn towards, fixate, or focus on the object presented to them.

Visual field preference is when the individual will only acknowledge visual stimuli if it is located in one or more specific areas of their visual field. The visual field is typically represented by four quadrants: top left, top right, bottom left and bottom right, with central vision overlapping in the middle. If students have peripheral field preferences, they may use eccentric viewing, which is when they turn their head to view objects using a particular portion of their visual field (e.g., turning head to the left in order to use right peripheral vision).

Difficulties with visual complexity occur when an individual has difficulty with discriminating details, finding objects at a distance and identifying human faces. Individuals with CVI visually respond better to objects if they are simple, solid in color, and the environment in which they are presented is simple and in their field preference. Often individuals with CVI have a difficult time viewing items at a distance because they are unable to see where one object starts and another ends, viewing objects in simple environments or backgrounds and within their viewing distance increases their ability to see and discriminate between objects.

Need for light is when the individual is attracted to the primary source of light and needs the light to be associated with the target object to view the object. Often this involves the use of light boxes for instruction to increase attention.

Difficulty with distance viewing is when the individual cannot pick an object from a certain distance. This is related to the difficulty with visual complexity. Children with CVI also can have difficulties with depth perception. This is in relation to the difficulty they have when distance viewing and their ability to visually understand how far away an object is from themselves or from the ground (Swift, et, al., 2008).

There is a natural reflex to blink when something approaches your eyes or the bridge of your nose, this is done to protect your eyes if the object were to reach your eyes. Children with CVI often have atypical visual reflexes where there is no reflex or a delay in this blink.

Typically, when you present a new object or toy to a child, they will reach for the new toy out of curiosity. Students with CVI have difficulty with visual novelty. This is a visual preference and attention for objects that are familiar to the individual. This can often cause problems when introducing new materials or objects that the student is not familiar with or curious about.

Visually guided reach is when you see an object and reach towards it while maintaining focus or fixation on the object. Children with CVI have difficulty with this and will often see an object, then turn their head away from the object before reaching towards the object. The individual can also touch and explore an object before visually focusing on it. Nevertheless, the two actions often happen at different times for these students.

When working with students who have CVI, it is important to know what these characteristics mean for the educational setting. Understanding how these characteristics effect an individual student guides instruction and materials development. Professionals can present materials and instruction that best serve the student in the environment they will best perform in.

### **CVI and Additional Disabilities**

Many children who have CVI are born prematurely, this can lead to additional problems that impact the student physically, cognitively and neurologically. Individuals with CVI require a lot of individualized interventions and a team of knowledgeable professionals. This individualization increases when a student has additional disabilities. In the second Babies Count survey, Hatton et al. (2013) collected information on additional disabilities from 98.9% (5,865 students) of the total participants and found that 34.7% of the sample were identified as having only a visual impairment, while 28.3% also had a developmental delay, and 37% also had additional disabilities other than developmental delays (such as cerebral palsy, deafness or a hearing loss). From the sample of 1,480 infants with CVI, 15% of the sample had a visual impairment only, 29% had CVI and a developmental delay, and 56% had CVI and additional disabilities. The proportion of infants with CVI and additional disabilities is higher than for other visual conditions, these percentages are, potentially, an improvement from previous data, where 73% of a sample of 509 infants with CVI also had additional disabilities (Hatton et al., 2007). Comparing the data from the two Babies Count articles, there is an increase in students with CVI because of the relationship in medical advances and the number of children surviving premature births with a neurological impairment (Roman-Lantzy,

2018). These medical advancements are saving children who would have originally not come to full term through the assistance of medical interventions, increasing the number of babies born with CVI. Roman-Lantzy (2018) supports Hatton et al. (2013) findings, by stating that approximately 60% of children with CVI have or are at risk for additional disabilities.

### **Phases of CVI**

There are three phases of CVI, used to describe the severity and level of visual functioning of a student. The combination and severity of characteristics help professionals determine which phase a student is in (Holbrook, et, al. 2017). The main assessment used to identify CVI phases was created by Roman (2007) and is referred to as the CVI Range. In this assessment, the professional is able to observe the student's functional vision and score if behaviors occur or do not occur. The lower the score, the more severe the CVI. Students can begin in any phase; it is not necessarily a developmental progression from Phase I through Phase III, though the purpose of instruction is to increase visual functioning as much as possible with the goal of entering Phase III. Another thing to considering regarding the phases and the range scores for a student is possible outlier scores. Some students may mostly display characteristics associated with one phase, but also show characteristics associated with other phases (Roman-Lantzy, 2018).

In Phase I, the major focus of the professionals is around building visual behaviors, this is the most severe phase. All interventions and materials are designed for students who do not use their vision consistently or intentionally. The objective to this stage of intervention is to simply get a child to look at an object or glance in its general

direction, then the professionals have established they are capable of phase I activities and objectives. These students only look at objects. They are often described as looking through objects, and this is usually limited to objects they have been exposed to very often and in very controlled environments. These students will react to light, movement, and possibly familiar objects, but are not fixating with intention and are not able to identify objects.

In Phase II, the major focus for professionals is integrating vision with function. Students in phase II will use visual behaviors intentionally by looking at a target and or reaching towards an object or person, these tasks will take additional time and be dependent on a second party identifying the want or the need. These students are not completely independent in using their visual behaviors. These students may actively look for an object or attempt to manipulate it using their vision, reach or the assistance of others. These students also have better visual attention for details and often are able to differentiate between objects. In Phase II, students start to build anticipation, linked with physical manipulation of objects, and rewards for their manipulation of objects. These students may perceive or start to perceive their own ability to affect the world through their active participation and this can become motivating for increasing visual attention.

In Phase III, the goal of the professionals and student has evolved to the refinement of the CVI characteristics. Students in this phase are often described as “resolving” their CVI (Roman-Lantzy, 2018). While this term is a little misleading, it is widely used to describe students with CVI at this higher level of functioning. But it is important to clarify that CVI does not ever resolve. In phase three, professionals identify the specific CVI characteristics of students and provide instructional strategies to increase

visual efficiency and decrease negative visual behaviors, such as light gazing, they also focus on important visual details and targets that are arranged in complex arrays.

Working on these skills can assist the student with CVI to continue developing their ability to better discriminate details within or associated with an image, symbols, and using their distance viewing. Additionally, this is the phase where students with CVI may be working on literacy skills. Although these students can achieve the most with their functional vision, they often will need the most adaptations to materials and specialized instruction throughout the day in comparison to the other two phases. This is because students in Phase I and Phase II require less variety and the span of adaptations are more focused (Roman-Lantzy, 2019).

### **Review of Relevant Literature**

Prior to the study, I conducted a database search of Academic Search Premier, ERIC, and PsycInfo using the terms “cortical visual impairment” AND “reading”. In this search, 11 articles matched these criteria with only two articles relating to students with CVI and reading strategies. Both articles were written by the same authors and were observational studies of the same children over the years.

Fellenius, Ek, and Jacobson (2001) looked at the reading abilities of 7-10 year old children with CVI and Periventricular Leukomalacia (PVL) in Sweden. There was no intervention and no control group, the researchers were mostly interested in self-accommodations the children had developed for dealing with the visual difficulties associated with having CVI and PVL. They followed four students for two years using a case study design. One of the children had cerebral palsy and a severe motor disability. The other three children did not have additional disabilities. All participants had average

verbal intelligence as an inclusion criterion for the study. The students were visited and observed 11 times throughout two years. At the end of the two years the authors explained that the growth in these students was affected by their educational placements and teachers. A major limitation of this study was the lack of description related to the strategies used by each student that were deemed successful. There seemed to be an assumption on the part of the authors that strategies the students used on their own were the reason they were having success as readers. There was no evaluation or critique of strategies being used, and strategies were self-reported by the participants.

The other study found in this search (Ek, Fellenius, & Jacobson, 2003) was a follow-up of the same children one year later. This study had similar limitations but did include a pre-post assessment of decoding skills. However, the purpose of administering the assessment at two time points was to see if the participants changed the strategy, they used to accomplish the task. Researchers were not specifically interested in the student's scores or changes in scores from time one to time two. As previously, no intervention was provided so it is unclear why a change would occur or how the researchers planned to explain a change if one did occur.

Although these articles were related to the topic of CVI and reading, there was little information that was useful for the planning of this study. Overall these articles described a small number of a specific subset of the population and results were very vague regarding what strategies worked for these students and how anything was related to CVI. Visual crowding was the only characteristic mentioned by these authors in relation to the characteristics of CVI and while I assume these students were in phase



three because of the tasks they were completing, this was never stated and there was no mention of an assessment to determine phase at all.

### **Reading Processes and CVI**

Before a child starts to read, they must visually locate and fixate on letters and words. For typically developing students, fixating on a letter takes less than half of a second (Gough, 1972). For students with CVI, this process does not begin until Phase III and then may still involve a long visual latency. Next, there is a connection that occurs within the visual system to the brain to recognize or retrieve what the letter or icon is and its corresponding sound or meaning. For students with CVI, the complexity of the page may affect their ability to see and identify a familiar word and icon. It is common for teachers to adapt books by removing background images in order to reduce the complexity of visual stimuli. It takes a typical student 600msec to read and speak a three-letter word, all while these processes are occurring. There is not data available for how long this process may take a student with CVI.

Reading is a complex process, and the simplest description is provided by the Simple View of Reading (Gough & Tunmer, 1986), which describes reading as the product of decoding processes and language comprehension processes. Strengths in one area can mildly compensate for the other, but deficits in either can affect overall reading ability. For students with CVI, there may be deficits in both areas, but decoding is an especially difficult task for children with CVI, even those in Phase III. Depending where the student scores in Phase III can determine how difficult the task of decoding in combination with language comprehension can be. In addition, asking these students to pair a visual stimulus with an auditory stimulus is a complex process. Having them

identify a letter is one thing but putting that letter with other letters adds complexity and changes the task.

The Simple View of Reading (Gough & Tunmer, 1986) makes a lot of sense, and describes complex processes in an easy to understand way. But when exploring reading curricula, many programs describe reading skills as a developmental process. One of the first skill domains to develop for typically developing readers is phonological awareness. This is the ability to identify, manipulate, and use the sounds heard in words, including discriminating between different sounds and words. The next skill mentioned is phonics. This is when the child can link sounds to letter-symbols. These are foundational skills for decoding and are necessary for readers to recognize the majority of the English language (Gough & Tunmer, 1986). The last skill described in this developmental process is comprehension, which is the culmination of all the preceding skills in understanding what the reader is reading. In many reading curricula the term comprehension can mean the understanding of what is being read or the message of the passage. In the Simple View of Reading, comprehension refers to the student's ability to understand the language behind the message they are reading. Without understanding the language, the student isn't truly reading. This developmental description maps onto the Simple View of Reading nicely, in that the higher order skill of comprehension is a combination (product) of lower level skills that develop earlier.

For many students with visual impairment, learning to read starts in a formal educational setting. Fellenius et al. (2001) argue that there is no difference between sighted readers and readers with visual impairments regarding the linguistic and cognitive process in meaningful reading. However, they go on to say the identification of letters

and words or the decoding process can be influenced by CVI. This is because students with CVI often have trouble with visual complexity, making it difficult to identify small details in letters or symbols that help differentiate them from other letters or symbols (e.g., b and h). Because of this, it is increasingly difficult for students with CVI to become fluent readers. This difficulty is increased by the fact that typical print is 8-12-point font, single spaced, with many lines on a page. Students with CVI have difficulties distinguishing between word and letter boundaries when their materials are crowded, or the print is too small.

### **Adaptations for CVI**

Curriculum and educational materials are not created with CVI in mind. For some students, depending on their phase, materials either need simple modifications or need to be completely modified. Some simple modifications for a student with CVI would be printing their materials on their preferred color paper with a highly contrasting color for the print. For this modification, it is important to not just pick a light shade of their preferred color, the richer the color the better (Roman-Lantzy, 2019). The student will keep visual attention better and be naturally guided to the materials if they are easier to see. Students with CVI have difficulty picking out details from pictures if the background is busy or visually crowding from a near or far. Removing visual distractors and isolating the object or item you want the student to retain visual attention to is a simple modification if this is what the student needs. Students with CVI also can have difficulty with crowding, small print size, space between letters, close together lines of words, and materials being placed out of their preferred visual fields. These difficulties can affect

their skills in finding and maintaining their place when reading or writing (Barclay, 2015).

The way CVI characteristics affect the reading process makes traditional reading interventions too complex for many students with CVI. This causes them to struggle academically unless they receive the appropriate amount of support and modifications for their materials and instruction. Often teachers will use multiple strategies to keep attention and enthusiasm within their class. If a student has difficulty with visual latency, participating in the alphabet chant in the morning could be too quick for them to focus and identify each letter and the corresponding visual. Difficulties with visual novelty can be a challenge if you are introducing a new topic or item during instruction. Children with CVI prefer items that they have viewed over and over again in comparison to items they are unfamiliar with (Roman-Lantzy, 2018).

### **The Current Study**

The purpose of the current study was to teach letter-name correspondence to a student with CVI using modified materials and instruction from the Kindergarten Peer-Assisted Learning Strategies Curriculum (K-PALS). From previous work with the student (Luff, 2017), I knew her alphabetic knowledge and phonological awareness skills had decreased. This indicated that whatever we had done previously didn't stick. For this study, I wanted to design instruction that had more evidence and structure. The idea of adapting an existing evidence-based curriculum made the most sense because it could be something her teachers would potentially use, giving better and more consistent access to instruction for this student. I chose K-PALS because it is a widely used and widely

known evidence-based strategy that focuses on the early and lower level decoding skills and is highly effective for those students who are at the same reading level as Lilly.

### **Research Questions**

1. Is an adapted evidence-based procedure for teaching letter identification effective for a student with cortical visual impairment?
2. Does instruction in letter identification support identification of letter sounds for a student with cortical visual impairment?

## **CHAPTER 2: METHOD**

### **Participant**

Lilly is a social and spunky 10-year-old girl who was diagnosed with CVI at 17 months of age. Lilly loves to be social with her classmates and help her teacher with tasks or ‘jobs’ throughout the day. She also loves recess because this gives her time to play with her friends and classmates. She has severe cognitive, motor (fine and gross), and speech delays in addition to her visual condition. Lilly has continued to make slow but steady progress since her rehabilitation started in 2009. She learned how to walk around the age of 27 months old but uses Ankle-Foot Orthosis (AFO) to help her walk and keep balance. Lilly is reportedly in CVI Phase 3. She receives full paraeducator support at school but does participate in modified academic curriculum, along with a life skills program. Lilly also takes medication for focus and attention.

### **Setting**

The study took place in a quiet conference room in the Barkley Memorial Center. The room was well lit with minimal visual distractions. The desk faced a blank wall and I sat next to Lilly. We recorded the lessons using a laptop placed directly in front of us

with a blacked-out screen. We used the same room every day. In the beginning of the intervention her mother and I set up a schedule to meet three times a week, this ensured consistency and worked best with the timeline.

### **Developing Materials**

K-PALS instruction focuses on phonemic awareness, letter-sound recognition, sight-word reading, and decoding. K-PALS is suggested to be used 3 to 4 times a week and should take about 20-30 minutes (Fuchs, et, al. 2016). When adapting K-PALS, I started with the first training lesson in decoding because the lessons before use pictures as the main educational tool to explain the word or the letter sounds. Although these pictures look simple on the page, to ensure Lilly understood what the lesson objective was, I would have had to teach her what each picture was, generalize those concepts, and then start instruction. I used the first decoding lesson that did not use only pictures for instruction.

In K-PALS, new target sounds and letters are accompanied by small pictures as reminders for students. These pictures were eliminated for Lilly for reasons described above. On a page, K-PALS materials have three lines of letters, each line has four letters and a reinforcement star. Stars would be too visually distracting for Lilly, so they were eliminated. During the pilot testing, I tested what color worked best for the materials, what size of font would be most beneficial for instruction, how many letters per line, and how many lines per page Lilly could visually process given sufficient spacing and time allotted for visual latency.

According to Lilly's CVI phase score, she is Phase III. Meaning from her CVI range score, and Individualized Educational Plan (IEP), she should be able to retain and

use education information through the use of her functional vision with accommodations and consistent instruction. In order to decide the appropriate accommodations to make, I used her educational records and my personal experience of working with Lilly in the past and tested various adaptations of materials. In the pilot session and development of materials I used the letters c, b, and m because in a previous study done with Lilly (Luff, 2017), we worked on these letters and her IEP stated she had retained mastery in identifying the name and sounds of these letters.

I tested materials printed in black on white paper with a yellow highlight around each letter in her recommended 14-point font or larger, found on her IEP. With these materials, Lilly was unable to see the letters and frustrated easily and stop the activity. In her IEP it recommends the use of yellow overlays, I did not have access to these, so I tested a high contrast yellow background which was easier for her to attend to and she became less frustrated with the task immediately. The use of yellow paper with 36-point font worked best for her, she did not seem to fatigue or strain her eyes as easily and using Lilly's preferred color served as a visual 'anchor' or a way to attract and hold her visual attention during instruction (Roman-Lantzy, 2018).

Then, I tested materials with five letters per line and with six letters per line. With six letters per line, there was not sufficient space between letters for Lilly to fixate on one letter at a time. I separated out the lines to five letters equally spaced out per line to decrease visual clutter, one line centered on each page in landscape format. Five letter per line was the final decision for intervention materials. This also made the development of the probe easier, since there was nine different letters and they appeared five times during a probe and five being a divisor of 45 allowed for equal number of letters per page.

Once I knew there would be five letters, I tested the materials with one line of letters per page and two lines of letters per page. Lilly had difficulties tracking and would get distracted by the other line of letters. Because of this difficulty I chose to use one line per page that was equally spaced and in the center of the page. I also addressed other characteristics of CVI (Roman-Lantzy, 2018) and made additional modifications to this instruction that were based on Lilly's needs (Table 1).

Table 1

*Modifications to Instructional Materials Based on Characteristics of CVI for Lilly*

<b>CVI Characteristics</b>	<b>Modifications made for Lilly</b>
Color preference	Materials printed on high contrast yellow cardstock with black lettering
Need for movement	The instructor used her finger as movement The use hand-under-hand for movement
Visual Latency	Student allowed 10-15 seconds per letter and more than one verbal cue (3)
Visual Field Preferences	Materials presented close to the reader
Difficulty with visual complexity	well-spaced out letters and cover sheet available
Need for light	Instruction was in a well-lit room
Difficulty with distance viewing	Materials were viewed close to the student
Atypical visual reflexes	Not addressed
Difficulty with visual novelty	She has exposure and instruction in letters
Absence of visually guided reach	Not addressed or needed



The final study materials were printed on high contrast yellow cardstock paper with five letters per line, one line centered per page in black 36-point font and presented in the landscape orientation. These modifications were observed to work best for Lilly in keeping her attention and decreasing distractions on the paper. Appendix B shows an example lesson developed as a result of this pilot testing.

### **Developing Letter Sets**

After the pilot testing of materials, I started the preassessment process using the same paper and font size determined in the pilot testing. In this assessment she was presented with a single letter in the center of a yellow index card. I showed her each card two times a day for four days, asking her, “What letter?”. During preassessment, I also gathered data on identifying letter sounds. I started by simply asking, “What sound?” then if she did not answer I would prompt, “This letter says....”(wait for her response). If she still did not answer I would move to the most assisted prompt and say, “This is the letter a, a says....” (wait for her response). When given the last of the three prompts, she would answer correctly 78% of the time. The interesting part of this situation was I had to phrase it in a very specific way for her to understand and answer the prompt correctly. Seeing this during preassessment showed me that if she was given the letter name, she knew the letter sound. The preassessment was done for four days to test the reliability of Lilly’s answers, CVI is known to be a very inconsistent condition, and this data helped to gather information for the start of baseline. After the four days of pre-assessment it was clear that Lilly knew the sounds of letters better than she knew the name of each letter when given their name (see Table 2). The presentation of the letters was randomized because Lilly has a great auditory memory and presenting letters in alphabetical order

would have made it less clear whether she identified the letter or remembered the order of the alphabet. She only knew one letter sound every time (4 out of 4 times), and this was the first letter in her real name (Lilly is a pseudonym).

Table 2

*Preassessment data by letter*

Letter	Correct letter sound identification	Correct letter name identification
a	1/4	0/4
b	3/4	0/4
c	3/4	0/4
d	3/4	0/4
e	0/4	0/4
f	1/4	1/4
g	2/4	0/4
h	2/4	0/4
i	3/4	1/4
j	0/4	1/4
k	3/4	1/4
l	1/4	1/4
m	2/4	1/4
n	0/4	0/4
o	4/4	2/4
p	3/4	1/4
q	0/4	0/4

r	0/4	0/4
s	2/4	0/4
t	1/4	0/4
u	2/4	0/4
v	0/4	0/4
w	3/4	0/4
x	0/4	0/4
y	1/4	0/4
z	1/4	0/4

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After looking at Lilly's pre-assessment scores I was able to choose letter sets for the intervention. Because Lilly did not know the names of all 26 letters consistently, I had almost the whole alphabet to choose from for the initial skill. As a generalization skill, we also wanted to see if Lilly could remember the sounds of the specific letters we worked on. I chose letters that could show growth in the target skill (letter identification) and the generalizable skill (letter sound correspondence), meaning the scores on both skills had to be inconsistent or unable to perform the task. These criteria narrowed down to following letters; a, g, t, e, h, y, u, r, and s. Once I had identified what letters we would be working on, I placed letters with similar features in different sets; making sure that g and y were not in the same set and t and h were not in the same set since they have visual similarities that could be confusing if the student is not focusing on the salient features of each letter (g and y dipping below and t and h have a tall feature). I also took into

consideration what sound each of these letters made and attempted to put at least one vowel in each set. The final sets were: Set 1 (a, g, t), Set 2 (e, h, y) and Set 3 (u, r, s).

### **Procedures**

**Baseline probes.** Baseline took place over four days after preassessment. In these four days, Lilly was given a 45-letter probe and asked to name the letter, “What letter?” If Lilly answered incorrectly; I would move on to the next letter. If Lilly did not answer I would wait seven to ten seconds for a response. If she still did not answer, I would repeat the prompt, “What letter?” and wait another ten seconds. If she still did not answer, I moved on to the next letter. No corrective feedback was provided during baseline probes. Letters were randomized when creating materials, so each letter appeared five times in each baseline and probe session. Pages were randomly ordered in each session.

**Instruction.** In adapting K-PALS to work with a student one-on-one, I changed the coaching strategy to a gradual release of responsibility; an explicit instruction framework using K-PALS materials. This strategy uses modeled practice, guided practice and independent practice and this framework was used to ensure the most support, repetition of letters, and one-on-one instruction. See Appendix A for an example of instruction used with Lilly.

I modeled the task of identifying the first letter saying, “This is the letter a. A says /a/. What is this letter?” and she would respond with the letter name. If she did not repeat the letter name, we reviewed the letter and the name one more time. Once Lilly responded correctly, I continued modeling by pointing to each letter in the line of five letter a’s and saying the letter name only. After modeling, I asked her to name the line of letters as I pointed to them. We repeated this procedure with the second and third letters

in the set, including lines where the letters were mixed. For independent practice, Lilly was given three pages of letters (one page at a time) which included the letters from the set being taught. I pointed to each letter and asked, “What letter.” Her response was recorded and the total number of correctly named letters was graphed. No corrective feedback was provided while Lilly completed the independent practice, but we discussed how she did generally once all three pages were done.

While adapting the K-PALS materials, as mentioned above, I removed the visual reminders for reinforcements or praise to reduce visual complexity and decrease distractions for Lilly. I placed my own reinforcement and praise reminders in my instructional materials, where Lilly would not see them. For her reinforcement choices she could get high fives, a hug, or a sticker at the end of the lesson.

**Maintenance probes.** Maintenance was administered just as in baseline, using the randomized pages of the 45-letter probes. Prior to testing she was reminded of the letters we learned but not retaught or given visuals; just a verbal list of the letters we had covered. These probes were given after instruction in each set of letters was completed (5 sessions).

**Generalization.** The generalization of this skill was measured by letter-sound correspondence. I was interested to see if Lilly would make a connection between the letter name and the sound of the letter from instruction. This was one of the reasons why the letters I chose for the sets had to be inconsistently identified for the letter sounds as well. While creating the materials for the generalization and probe, I decided to use the least informative prompt for Lilly, simply just asking her “What sound” to see if the

information from instruction would carry over. Generalization took place immediately after instruction, focused on the letter set and during the 45-letter maintenance probes.

### **Experimental Design**

A multiple probe design was chosen for this skill because we were able to probe across the different sets of letters with one participant. A multiple baseline design could also accomplish this, however asking Lilly to participate in an instructional lesson and a full 45-letter probe every session would have saturated her ability to stay focused and accurately demonstrate the task. The lessons alone were 15-20 minutes depending on Lilly's focus and effort or need for breaks. Adding in additional probes would have overloaded Lilly and decreased the amount of information she learned or retained. Another reason was Lilly was already too inconsistent in the preassessment. It would have frustrated her even more if she was forced to participate for that long in such a repetitive task.

Multiple probe was a logical decision because the sets of letters are independent of each other. Teaching her one set of letters does not affect her learning of the other sets of letters. Multiple probe also was chosen because this skill is not a reversible skill. Once Lilly learns a letter, there is no way of taking back the information. Whether she retains it was part of the research question and design of the study, but the assumption is that once she was taught a letter we could not return to baseline. Lilly also needs constant exposure and repeated procedures for her to retain information and the appropriate modifications to her materials. Removing the modifications or the type of instruction would not be educationally sound or professional to measure the skill and the materials impact.

**Interrater Reliability.** Interrater reliability (IOA) was scored with another individual who was familiar with the procedures and trained on the scoring for the probes and independent sections of the instructional days. IOA was scored on 25% of the total sessions, 7 sessions in total, this including one session of baseline, one per set and one per probe. In total, IOA was 99.6% in agreement with one discrepancy throughout the whole intervention. This discrepancy happened because of the student's speech and motor difficulties but when the videos and audio were slowed down and repeated, the second observer agreed with the original score. Appendix D shows the scoring sheet.

**Implementation Fidelity.** Implementation fidelity was scored with a different individual who was trained on the procedures and scoring in the accuracy of the instruction and procedures. Implementation fidelity was scored on 25% of the total sessions, 7 sessions in total, this including one session of baseline, one per set and one per probe. In total, implementation fidelity was 99.4% with five discrepancies throughout the whole intervention. The five discrepancies were: one time I did not ask the student to repeat the name of letter, and four times I did not use the scripted think aloud to let her know I would be looking at a line of letters. Appendix C shows the fidelity checklist.

### **CHAPTER THREE: RESULTS**

Overall, the results show some evidence that this instruction worked in teaching the skill. However, as the results will show, there are some questions about the practicality and maintenance of this type of instruction with Lilly. Figure 1 shows Lilly's performance in baseline, instruction, maintenance, and generalization for all letter sets. There is a clear functional relation between the beginning of instruction and an increase in her correct responses. The relevance of this relation is explored more in the discussion.

**Baseline**

Baseline took place after school over four days. During baseline, Lilly identified 0 letters by names and sounds across all letter sets. During the probe, Lilly requested a plain yellow paper to use as a coversheet. She used this coversheet when she was having a hard time focusing on a letter. She used this cover sheet 100% of the time during baseline, probe and the independent practice.

**Instruction**

Since instruction followed a scripted lesson plan, Lilly started to anticipate the prompts, indicating she knew the language and expectations well. During instruction movement was added to assist in keeping her attention. The amount of movement depended on her mood. Some days she was able to keep attention with just the planned finger movements from letter to letter. Other days, she would place her hand on top of my hand or under my hand while I pointed to each letter while asking her to name the letter. Another movement that was added into our lessons was when we finished a page of letters, I allowed her to stack the papers. This movement allowed Lilly to move her gaze from one area to across the table where she placed the paper and then shifted back to our materials. We also needed to take breaks during instruction. Allowing three to five short breaks allowed Lilly to reboot and regroup during instruction before we continued onto the next task. Tables 3, 4, and 5 show results by letter for each set.



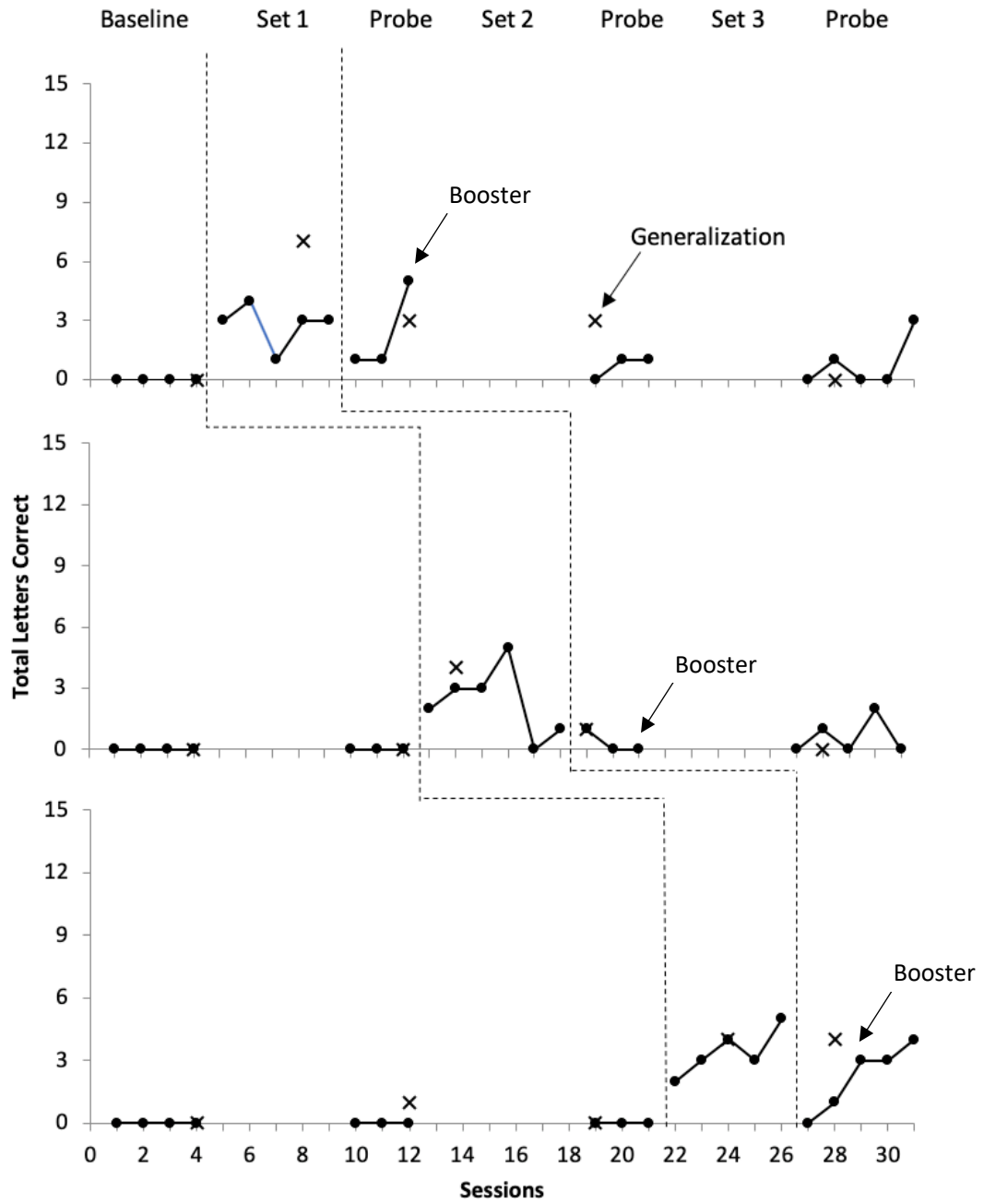


Figure 1. Lily's correct responses across letter sets.

Table 4

*Lilly's Results for Letter Set One*

	Preassessment	Baseline	Instruction sessions					Maintenance probes		
			5	6	7	8	9	10-12	19-21	27-31
a	0/4	0	3	0	1	1	1	3	2	1
g	0/4	0	0	2	0	0	2	4	0	1
t	0/4	0	0	2	0	2	0	0	0	2

*Note:* Each letter appears five times during baseline, instruction, and maintenance sessions.

Table 5

*Lilly's Results for Letter Set Two*

	Preassessment	Baseline		Instruction sessions						Maintenance probes	
		1	2	13	14	15	16	17	18	19-21	27-31
e	0/4	0	0	0	1	0	2	0	1	2	1
h	0/4	0	0	2	1	1	2	0	0	0	1
y	0/4	0	0	0	0	2	1	0	0	0	2

*Note:* Each letter appears five times during baseline, instruction, and maintenance sessions.

Table 6

*Lilly's Results for Letter Set Three*

	Preassessment	Baseline			Instruction sessions					Maintenance probes
		1	2	3	22	23	24	25	26	27-31
u	0/4	0	0	0	0	0	0	0	2	0
r	0/4	0	0	0	1	2	0	1	0	0
s	0/4	0	0	0	1	1	4	2	3	11

*Note:* Each letter appears five times during baseline, instruction, and maintenance sessions.

**Maintenance**

Across all letter sets, Lilly showed a decrease in correct responses during maintenance probes. Although the average was higher than baseline, her scores indicate that the instruction was not maintained.

Table 7

*Lilly's Individual Letter Results for Generalization*

		Preassessment	Session Number						
			4	8	12	14	19	24	28
Set 1	a	1/4	0	3	0		1		0
	g	2/4	0	2	2		2		0
	t	1/4	0	1	0		0		0
Set 2	e	0/4	0		0	0	1		0
	h	2/4	0		0	1	0		0
	y	1/4	0		0	2	0		0
Set 3	u	2/4	0		1		0	2	0
	r	0/4	0		0		0	0	0
	s	2/4	0		0		0	2	4

*Note:* Shaded cells indicate instruction in other letter sets. The black line in the table shows changes from instruction of a set to the maintenance.

**Generalization**

Generalization was scored once during an instructional session of each set and then once during each maintenance period. Overall, there did appear to be some generalization skills. See Table 6 for the generalization scores throughout the intervention.

## CHAPTER FOUR: DISCUSSION

As previously mentioned, there was a clear functional relation between the beginning of instruction and an increase in Lilly's correct letter naming. However, her responses never showed a direct pattern, one day she would identify one letter and the next she would not identify the letter. Although this was frustrating as the instructor, this was also interesting to see such inconsistent growth. Everyday seemed like she was relearning the skill, even when she had correct responses, and she seemed unable to take the information she had learned the previous days and carry it over.

I also found it interesting that skills would translate to the independent practice but not the maintenance probes. During instructional days, I would ask her to review the letters before we started the independent practice and she could do it with ease. She always listed the letters in the order she learned them in, and this was a consistent pattern. It is clear that the number of letters in a set was easier for her to recall, whereas, recalling and identifying all three sets was overwhelming.

Maintenance was very frustrating for Lilly and this is when we used additional breaks and reinforcements. These sessions were also the longest, most sessions took anywhere from 45 minutes to an hour. During maintenance we would list the letters we had worked on and they were always listed in the order I had taught them, "a, g, t, e, h, y, u, r, s". If I tried to list them in any other way, Lilly would get confused and not be able to complete the list. I believe this was in relation to her auditory memory and the consistency of instruction. When we started the maintenance probes, she would miss identify or not even use the letters we had learned. I would ask her, "What letters are we looking for?" and she would tell me, "The letters we learned." then she would attempt list

them independently. She would use self-talk during the maintenance probes, reminding herself to think back to the letters we had learned. Typically, this helped with her focus on the probes, but she did not always name the letters correctly or use the letters we had learned.

For generalization, I asked Lilly to give me the sound of each letter as I pointed to them, sometimes she would get confused and give me the name of the letters. I would re-explain the task a maximum of two times a probe but provide no corrective feedback to her previous answers. After re-explaining the task, she would switch to identifying sounds, but randomly still say the name of a letter and switch back to the letter sounds.

During the first couple of attempts I was concerned that she did not know the difference between the tasks, so I asked her, “Is that the name of a letter or the sound?” and she would say, “That’s the name, not sound.” During generalization she would sometimes name the letter incorrectly and give me the correct letter sound. She also would say the correct letter name and then say the incorrect letter sound. Because corrective feedback was not provided, I praised her for her hard work, and we continued with the probes.

Although Lilly is cognitively and developmentally delayed, she is a very sensitive and observant student. She could tell when she wasn’t performing her best and she disliked the lack of corrective feedback. In the instructional sets, I would provide Lilly with corrective feedback as needed, but she struggled in confidence without this in the independent practice and maintenance probes.

In the beginning of this study I took great time and effort to create materials for Lilly that best suited her educational needs and CVI characteristics. Even with all of this

planning and troubleshooting, the materials were still overwhelming for Lilly. Part of me believes that this was in connection to the CVI characteristic of visual novelty. Although the letters were familiar to her, the use of new materials or learning a skill in a new way could have been difficult for Lilly. During the pilot session, I used letters that Lilly knew or mastered. This could have been a reason why she did not need the cover sheet and why it was not an original modification. The additional modification shows that no matter how individualized the materials were, she was still having difficulties with focusing and the visual complexity of the lesson.

Students with CVI can have memory recall difficulties (Barclay,2015) and because of this we added in booster sessions to the maintenance sessions. This was decided during the first set of letters when Lilly seemed to have grasped the skill when looking at her numbers from instructional days (scoring mostly 3's and 4's) and then during maintenance, her scores dropped to identifying just one letter. So, during session 12 I gave her a booster session on the letter in set one. Booster sessions were shortened lessons from the letter sets. We reviewed each letter, their sound and then one line of the letters mixed in with each other then move directly into the 45 letter probe procedures. In most instances of the booster session (session 12, session 21 and session 31), she either maintained her previous score or increased it by at least two more identified letters. In my opinion these were very successful for Lilly and reminder her what we were looking for and how to complete the task. There were instances when Lilly did not improve with a booster session (see Figure 1, session 21). I believe an outside circumstance affected her participation during the booster session and overall her score. I believe this because a relative had come to town that day and surprised her before our session. Because of this

event, I noted how Lilly wanted to finish quickly so she could see her relative. I believe this affected her score because the first booster improved her total score from one letter to five letters correctly named, and the third booster improved her total score (across all three sets) from five letters to seven letters correctly named.

When looking back at the data and discussing the differences between the scores in maintenance and independence practice it makes me question if the probes were too long or if the task was too complex for her. The instructional sessions took considerably less time than the maintenance probes. But the independent practice also focused on fewer letters and had fewer visual stimuli. The multiple factors in comparing these two tasks make it hard to know if the length of the probe was a limitation or if Lilly just needs repeated and continuous instruction to maintain a skill.

### **Limitations**

One limitation of the study is that there was only one participant. The results of this study are not generalizable to other children with CVI and, given the heterogeneity of the visual impairment, Lilly's results might be hard to replicate even with another student with CVI. However, there is so little research on teaching literacy skills to students with CVI that anything we can learn from this study may be valuable to the field of teaching students with visual impairments.

Another limitation was the amount of time available to complete the study and the time of year the study occurred. Because of other services Lilly received outside of school and completing the study by the end of the school year we had agreed on three times a week for instruction, but this was not always possible for the family. As a result, some weeks had two days of instruction and other had four to make up for those weeks

with two. On weeks with more instruction, Lilly seemed tired and bored with the procedures. The time of year did not help either. This study was conducted between February and May.

### **Implications for Teachers**

While there were small effects for Lilly, this type of instruction may not be practical. Although the instructional sessions were 15 to 20 minutes long, the materials and procedures were highly individualized and required one-on-one instruction, which is something most teachers do not have time to provide. In addition, the probe and maintenance process took close to an hour every time, this did not include the generalization procedures. So, to use this intervention in a classroom setting would be time constraining and difficult, but in a pull-out setting with just instruction and a short probe it could be feasible. This instruction was time intensive and required a lot of effort to create materials, procedures and then implement the intervention. This study shows that Lilly made small gains in the targeted skills, and because of this, the intensive instruction might not be worth the small improvement.

Lilly does not receive direct services from her teacher of the visually impaired. Instead, her teacher receives consultations on materials and learning strategies as part of indirect services. This is possibly the case for other students in CVI Phase III. I was able to create these materials and intervention because I am a trained TVI with knowledge on CVI and literacy. Although this study could be used in a classroom, it would be difficult to find more than one student to use it on at a time since students with CVI are so individualized.



For this study I adapted an evidence-based curriculum for a student with CVI and it did not show the expected results. The individuals who designed K-PALS did not design it with this specific population in mind, hence the need for multiple adaptations. Adapting this curriculum had an experimental effect but did not have what might be considered an educational effect for this student.

### **Future Research**

Roman-Lantzy (2019) mentions the teaching of salient features to students with CVI. This is done to improve a student's response to novelty items and teaching the salient feature of an object can improve their ability to discriminate objects and words. It is a whole-word approach to teaching reading, which is not in line with current trends in reading instruction and what is known to work best. A whole word approach for Lilly was not an option because of the visual complexity within a sight word and my professional alignment with the Simple View of Reading. If she memorized words based on shape and characteristics, she would not have a strategy for reading new words. Using salient features to identify and discriminate between letters would be a great step with this intervention. Although the materials were printed large enough for Lilly to see them, explicit instruction in what makes each letter visually different could assist in the identification of letters and their associated sounds.

Throughout the intervention I caught Lilly picking up her cover paper and looking at the whole line of letters. She would do this during the guided practice and independent part of the lesson the most. Lilly would look at the letters she had named and because she knew they were right she would scan the line of letters looking for similar or the same letters. When she would find them, she would point them out and tell me that the letters

were the same. Although this was not a skill we were working on directly, she was trying to see the similarities in the letters or the differences. Using this skill as a subskill could help a student build up to being taught the salient features of a letter and then to the identification of a letter by name.

Although the skill was not maintained, there was a functional relation during instruction. The results suggest that adapting an evidence-based practice curriculum was not enough for this student. The study shows that consistent and repeated instruction works for Lilly, although she may need more sessions to maintain the skill. Although her answers were not consistent there still was an improvement in Lilly's scores and her confidence in the task.

APPENDIX A  
EXAMPLE LESSON PROCEDURES

Session 1.1; Identifying letter sounds

**Goal:**

Today we are going to name the letters “a, g, and t”!

**Review:**

To learn how to read, we have to know what each letter is saying! When we put two or more letter sounds together, we get a word!

**Discuss:**

Today we are focusing on 3 letters!

a

g

t

**Instruction:**

This is the letter a. (Pointing to the letter)

a says /a/.

What is this letter? (pointing to the letter)?

Student responds

If incorrect, correct immediately.

*Praise*

**Think-aloud:**

Now looking at this row of letters, as I point to them, I am only going to say the letter’s name!

*Demonstrate*

a

a

a

a

a

**Instruct:**

Now it’s your turn!

a

a

a

a

a

**Instruction:**

This is the letter g. (Pointing to the letter)

g says /g/

What is this letter? (pointing to the letter)?

Student responds

If incorrect, correct immediately.

*Praise*

**Think-aloud:**

Now looking at this row of letters, as I point to them, I am only going to say the letter's name!

*Demonstrate*

g g g g g

**Instruct:**

Now it's your turn!

g g g g g

**Comb. Of a/g****Think-aloud:**

Now looking at this row of letters, as I point to them, I am going to say the letters g and a name when I see it!

*Demonstrate*

a g g a a

**Instruct:**

Now it's your turn!

g a g g a

**Instruction:**

This is the letter t. (Pointing to the letter)

t says /t/

What letter is this (pointing to the letter)?

Student responds

If incorrect, correct immediately.

*Praise*

**Think-aloud:**

Now looking at this row of letters, as I point to them, I am only going to say the letter t's name when I see it!

*Demonstrate*

t t t t t

**Instruct:**

Now it's your turn!

t t t t t

Comb. g/t

**Think-aloud:**

Now looking at this row of letters, as I point to them, I am only going to say the letter g or t's name when I see it!

*Demonstrate*

g t g t t

**Instruct:**

Now it's your turn!

g g t t t

Independent Practice

Now looking at these rows of letters, as you point to them, you'll say the name of the letter. Remember the names of the letters are a, g, and t!

With this list of letters, the teacher points to each letter (1<sup>st</sup> row). Then teacher point to each letter and prompts student for response (3 rows)

a	g	a	g	t
t	t	g	a	g
a	t	g	a	t
a	g	a	t	g

Say:

*What letter?*

*What letter?*

*What letter?*

*What letter?*

APPENDIX B  
EXAMPLE STUDENT MATERIALS

t

a

o

o

a

8

t

a

t

8



a

o

t

o

a

8

t

a

t

a

APPENDIX C  
IMPLEMENTATION FIDELITY CHECKLIST

Student ID: \_\_\_\_\_

Date: \_\_\_\_\_

Scorer: \_\_\_\_\_

Oral Presentation of Letter Names

(-) did not occur

(+) did occur

Procedural Step

(-) did not occur (+) did occur	Procedural Step
_____	Communicates goal
_____	Introduces letters
_____	Explains goal of teaching letters and names
_____	Reads target letters
_____	___ letter 1 ___ letter 2 ___ letter 3
_____	Exercise 1 modeling
	<input type="checkbox"/> Teacher names letter 1 while pointing
	<input type="checkbox"/> Teacher says letter sound
	<input type="checkbox"/> Teacher asks the student what letter 1 is
	<input type="checkbox"/> If student's response is incorrect, correct immediately
	<input type="checkbox"/> Read think aloud
_____	<input type="checkbox"/> Teacher demonstrates task (points to each letter says name)
	Exercise 1 guided practice
	<input type="checkbox"/> Prompt student to start task
	<input type="checkbox"/> Student demonstrates task by saying the letter 1 name
	<input type="checkbox"/> If student says wrong letter, correction
	<input type="checkbox"/> Praise student
_____	Exercise 2 modeling
	<input type="checkbox"/> Teacher names letter 2 while pointing
	<input type="checkbox"/> Teacher says letter 2 sound
	<input type="checkbox"/> Teacher asks the student what letter 2 is
	<input type="checkbox"/> If student's response is incorrect, correct immediately
	<input type="checkbox"/> Read think aloud
	<input type="checkbox"/> Teacher demonstrates task (points to each letter says name)
_____	Exercise 2 guided practice
	<input type="checkbox"/> Prompt student to start task
	<input type="checkbox"/> Student demonstrates task by saying the letter 2 name
	<input type="checkbox"/> If student says wrong letter, correction
	<input type="checkbox"/> Praise student

- \_\_\_\_\_ Combination of Letters 1 and 2 modeling
- Read think aloud
  - Teacher demonstrates task (points to each letter says name)

- \_\_\_\_\_ Combination of Letters 1 and 2 guided practice
- Prompt student to start task
  - Student demonstrates task by saying the letter 1 and letter 2 names
    - If student is incorrect, correct
  - Praise student

- \_\_\_\_\_ Exercise 3 modeling
- Teacher names letter 3 while pointing
  - Teacher says letter 3 sound
  - Teacher asks the student what letter 3 is
    - If student's response is incorrect, correct immediately
  - Read think aloud
  - Teacher demonstrates task (points to each letter says name)

- \_\_\_\_\_ Exercise 3 guided practice
- Prompt student to start task
  - Student demonstrates task by saying the letter 3 name
    - If student says wrong letter, correction
  - Praise student

- \_\_\_\_\_ Combination of letters 2 and 3 modeling
- Read think aloud
  - Teacher demonstrates task (points to each letter says name)

- \_\_\_\_\_ Combination of letters 2 and 3 guided practice
- Prompt student to start task
  - Student demonstrates task by saying the letter 2 and letter 3 names
    - If student is incorrect, correct
  - Praise student

### Probe

- \_\_\_\_\_ 1. Reads instructions for probe
- \_\_\_\_\_ 2. Reviews letters and their names
- \_\_\_\_\_ 3. Teacher demonstrates first page (points to each letter says name)
- \_\_\_\_\_ 4. Reminding student that every letter learned today will show up
- \_\_\_\_\_ 5. Asks student to demonstrate task



APPENDIX D  
INDEPENDENT PRACTICE SCORE SHEET

1.1 independent practice score sheet

If the student misses a letter, please highlight or fill in the box with the color blue.

g	a	g	t	t	0
a	t	a	a	g	2
g	t	a	a	g	1

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