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ALPHABET KNOWLEDGE INTERVENTIONS AND AUTISM SPECTRUM DISORDER: A NEED FOR MNEMONICS OR MOTIVATION?

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Abstract

Reading is one of the most essential skills, for not only academic success but lifetime success. Moreover, alphabetic principle, including the ability to name letters, is crucial to developing reading skills. This study examined the effectiveness of two alphabet knowledge interventions designed to improve the letter naming fluency of a child with Autism Spectrum Disorder. An alternating-treatments design was employed to compare the effects of each intervention. Intervention A focused on providing ample opportunities for learning, error correction, and used pictures as mnemonics. Intervention B also provided ample opportunities to respond and error correction but also included positive contingencies for accurate performance. Specifically, performance was paired with a token economy, providing the opportunity for the participant to earn a reinforcer of his/her choice. Both interventions improved the participant's letter naming fluency skills, but Intervention B was more effective. Discussion emphasizes the pivotal role motivation plays in improving knowledge and performance on academic tasks among students with Autism Spectrum Disorder.

Keywords: Autism Spectrum Disorder, alphabetic principle, letter naming fluency

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Alphabet Knowledge Interventions and Autism Spectrum Disorder: A Need for Mnemonics or Motivation?

Reading is the single most essential skill for academic success (Cihon, 2008). Moreover, poor reading skills have broad consequences that impact more than solely academic success. They can impact the rest of your life. There is evidence that a lack of reading skills is correlated with many negative outcomes for both children and adults. Poor reading skills have been associated with higher rates of crime, early mortality rates, and other social problems (National Early Literacy Panel [NELP], 2008; Lozy & Donaldson, 2019). The National Early Literacy Panel argues that poor reading skills impact adult's abilities to fully participate in society (2008). People with low literacy are less informed about civic affairs and are less likely to vote. These people are also more likely to be in a lower socioeconomic class due to being paid less and being out of work more often. Adults with poor reading abilities typically face difficulties in meeting healthcare needs of themselves and their families, and are at increased risk of partaking in socially harmful activities (NELP, 2008). These factors impact almost every aspect of adult life, making it easy to see how crucial it is to become a proficient reader.

Throughout childhood the detrimental effects of poor literacy skills are most evident. Wagner found that a lack of foundational reading skills correlates with reading disabilities and/or students falling behind their peers (2010). Once a student falls behind it is very difficult to catch up. An individual's reading skill development begins with the development of emergent literacy skills at a young age. Emergent literacy is defined as any knowledge or ability that is acquired prior to reading or writing (Westerveld, Trembath, Shellshear, & Paynter, 2016). Since children's alphabet knowledge is the best predictor of later reading and spelling abilities, developing these skills is a common goal in preschool and kindergarten classrooms (Piasta &

Wagner, 2010). Alphabetic principle is the comprehensive understanding that letters and the combinations of letters represent language (Texas Education Agency, 2002). This includes knowing letter names, understanding letter sounds, and recognizing words. It can be measured through any activity in which a child identifies, types, or writes letters, and is crucial to master alphabetic principle in order to become a successful reader (Piasta & Wagner, 2010). The Preschool Reading, Writing, and Communication Academic Standards in High Quality Early Childhood Care and Education Settings refer to early alphabet knowledge and phonemic awareness as the "building blocks of understanding language" (Colorado Preschool Program Staff, 2012, p. 7). Perhaps even more importantly, these standards recognize that letter recognition is a fundamental skill that children need to perform accurately and quickly (Colorado Preschool Program Staff, 2012). In preschool, students are expected to recognize at least 10 letters, typically including the letters in their name, by the end of the school year. By the conclusion of Kindergarten students are expected to recognize every letter of the alphabet in both upper- and lowercase forms (Common Core State Standards Initiative, 2020a). In this same school year, students are expected to begin sounding out words and blending letter sounds together before moving to first grade. Additionally, students learn the basics of rhyming as Kindergarteners (Common Core State Standards Initiative, 2020a). By first grade there are no common core standards regarding alphabet knowledge, insinuating that it is presumed students have mastered these skills by the end of Kindergarten. For students, this means there is merely a one- or two-year window to develop alphabet knowledge before being classified as a student needing additional supports. There are many different things to take into consideration when developing interventions to teach these skills.

Using the Instructional Hierarchy for Intervention Development

Consideration of a student's skill level is of key importance when developing instructional interventions, because the amount of assistance a student needs is dependent upon their level of mastery. The instructional hierarchy is a model that encompasses a sequence of five stages through which skills are learned to proficiency. The acquisition stage is at the base of the hierarchy. Students in the acquisition stage have limited knowledge of the subject or task (Codding, Volpe, & Poncy, 2017). Because tasks are too difficult to be completed independently, instruction should facilitate accurate performance of the skill. Modeling the skill and providing explicit feedback about performance are critical components of effective instruction for learners in the acquisition stage (Parker & Burns, 2013). In the context of alphabet knowledge teachers would be directly telling the student the names of letters of the alphabet to a child throughout the acquisition stage. For example, the teacher would name letters in front of a child and tell him or her how to improve their accuracy when attempting to name letters.

The next stage in the instructional hierarchy is the fluency stage. After students become accurate, the focus of learning shifts to becoming fluent in the use of the skill. Students in the fluency stage need sufficient practice to build correct automatic responses, because practice improves skill fluency (Codding et al., 2017). Effective instructional techniques to establish fluency include providing diverse practice opportunities, giving performance feedback, setting goals, and implementing positive contingencies for accuracy (Codding et al., 2017). For alphabet knowledge this would mean having a variety of activities for children to practice letter names and receive feedback on their performance. Learning in this stage can also be achieved through error monitoring strategies. For example, a student might watch videos of another child incorrectly identifying letters and be given the opportunity to identify and correct mistakes. This strategy is most effective when immediate feedback is utilized.

Another effective strategy for students in the fluency stage is incremental rehearsal (Parker & Burns, 2013). Incremental rehearsal involves making a task more difficult as a student proceeds. For example, when developing alphabet knowledge, a student would begin with a small group of known letters. As the student learns the items in the group he/she is given, unknown letters would be added. For example, an interventionist would start with the first six letters of the alphabet and would add three each time the student learns the present six letters.

After students become accurate and fluent in a skill, the student reaches the generalization stage. Through this stage each student is striving to gain the ability to apply these skills in different settings or situations with varying materials and/or people (Codding et al., 2017). Learning could be accomplished in this stage by presenting the opportunity to perform alphabet knowledge in multiple different ways, with different people or materials.

Another factor throughout the instructional hierarchy is motivation of the student. Two different techniques can help motivate a child to complete an academic task: incremental rehearsal and positive reinforcement. As discussed previously, incremental rehearsal includes easier problems in drill practices and therefore increases the student's enjoyment of the activity which increases completion rates (Parker & Burns, 2013). One example of positive reinforcement in the context of an instructional hierarchy is the mystery motivator, in which the student is told they will receive a mystery prize for completing the activity. Reinforcement for doing the activity comes from the mystery prize he/she receives at the end. In the context of alphabet knowledge interventions, one could implement incremental rehearsal as discussed above and inform the student they will receive a mystery prize after completing the alphabet knowledge activity.

Instructional Approaches to Teaching the Alphabetic Principle

As mentioned previously, it is crucial to master alphabetic principle in order to become a successful reader (Piasta & Wagner, 2010). Letter identification is the first skill children must develop to enhance their early literacy skills. Phonemic awareness, another important early literacy skill, is almost never developed in the absence of letter name knowledge. Letter identification and phonemic awareness are the two strongest variables that influence understanding alphabetic principle (Griffith & Klesius, 1992). A meta-analysis of 63 studies found that higher fluency of letter names was associated with significantly improved letter sound knowledge. Moreover, a positive impact was observed in studies that utilized letter name instruction (Piasta & Wagner, 2010). Due to the importance of alphabetic principle, and letter identification as a foundational skill, there are several studies that explore how to teach these skills effectively.

The most widely accepted strategy for teaching alphabetic principle is the use of pictures as a mnemonic strategy. One study involved participants who were students ages 10 to 15 with "mild mental retardation". This study was a between-subjects design with two groups. The groups were matched for age, sex, and years with the current classroom teacher. The only difference between the conditions was whether or not pictures were used to assist in letter identification during a letter fluency task. Hetzroni and Shavit (2002) found that the group using mnemonic pictures named significantly more consonants (*M=11.75)* than the control group (*M*= 5.00) on a letter naming fluency post-test. This study supports the idea that using pictures to assist letter identification is effective.

Not all strategies are so widely accepted. According to Piasta and Wagner (2010), there has been "disagreement about the appropriateness of early literacy instruction and about what constitutes effective instruction" (p. 2). The most widely discussed conflict within the literature

is teaching alphabetic principle within the context of a broad, meaning-focused activity or a specific, code-focused activity. Evans, Bell, Shaw, Moretti, and Page gave the example of a meaning-focused activity as a lesson within the context of a larger language arts class rather than through direct, isolated alphabetic principle teaching (2009). Evans et al. assessed 149 kindergarten students for letter name knowledge, phonological awareness, and cognitive abilities (2009). These students attended public schools in which teachers intended to teach all uppercase and lowercase letter names throughout the entire school year, rather than focusing on letters for a portion of the school year. As mentioned above, these teachers taught letters in broader activities rather than isolated teaching instances. By the end of the year students, on average, mastered 89.1% of uppercase letters and 74.9% of lowercase letters (Evans et al., 2009). This suggests that learning letters in the context of a different activity is effective. However, Connor, Morrison, and Slominski found that code-focused activities improved preschooler's alphabet recognition growth more than meaning-focused activities (2006). Code-focused activities are isolated activities focused on individual letters and based on the understanding that reading comprehension relies on automatic recognition of letters and words. Meaning-focused activities focus on the English language as a whole and emphasize letters and words as communication rather than isolated letters with names. The present study will further explore differential impacts of using a code-focused activity (Intervention A) and a meaning-focused activity (Intervention B). Although there is some controversy regarding which technique is best, there are several general principles which guide the instructional techniques that educators choose to employ.

Certain strategies are known to increase the effectiveness of all interventions, despite the subject matter. For example, individualized instruction increases student engagement and improves outcomes. Providing a student with frequent opportunities to respond, allowing

him/her to set their own goals, focusing on foundational skills, explicit instruction, student verbalization, incremental rehearsal, motivation and reinforcement are all crucial aspects of effective interventions (Codding et al., 2017). Focusing on foundational skills leads to improved development of later skills. Explicit instruction, where students are shown what to do, is one of the most strongly supported instructional practices to help struggling students learn. As discussed above, incremental rehearsal is beginning with a small group of known items and adding few unknown items as the student learns the items in the group he/she is given. Reinforcement should be provided for effort, persistence, task completion and/or skill improvement. This can be specific praise, tokens exchanged for prizes, or reinforcement achieved through goal setting (Codding et al., 2017). All of these strategies are implemented in broad areas of education, even outside of alphabetic principle, but are still beneficial to implement in the context of learning letter names.

Reading Skill Development for Individuals with Autism Spectrum Disorder

Despite the tremendous lack of research regarding the emergent literacy development in people with neurodevelopmental disorders like ASD, it is known that people with Autism Spectrum Disorder (ASD) have a higher risk of reading difficulties. ASD is a disorder characterized by social-communication skill impairments as well as repetitive and restricted behaviors and interests. The severity and symptoms of ASD vary greatly and can present many challenges, including challenges regarding emergent literacy skills (Westerveld et al., 2016). People with ASD experience lower rates of incidental learning and need more systematic exposure for learning to occur (Culatta, Kovarsky, Theadore, Franklin, & Timler, 2003). Children in this population who are at risk for reading difficulties may not acquire adequate alphabet knowledge from incidental and informal teaching, therefore requiring targeted, one-on-

one instruction. Additionally, people with ASD have been found to have poor phonological awareness (Piasta & Wagner, 2010). Since we know phonological awareness is almost never developed in the absence of letter name knowledge, this is a crucial place to begin instruction.

Purpose of the Study

This study focused on the development of foundational skill fluency, specifically letter identification skills. Letter naming fluency is defined as "a measure of alphabetic awareness that assesses a child's ability to name letters" (Al Otaiba et al., 2008, p. 288). Letter naming fluency is a foundational skill of alphabet knowledge that is an important skill for all children to develop. The importance is only enhanced when students with ASD are considered. However, there is a lack of research regarding effective letter naming interventions for people with ASD. The present study sought to compare the effectiveness of two different interventions designed to teach a child with Autism Spectrum Disorder how to identify letters of the English alphabet. Both interventions incorporated ample opportunities to respond and error correction. However, each intervention contained unique components in order to determine the specific strategies that are most effective at improving letter naming fluency. Researchers used an alternating treatments design in which the student received intervention three times a week for five weeks.

Method

This study was exempted from Institutional Review Board (IRB) review in accordance with Federal regulations. The project #20-0072 was approved by the Appalachian State IRB on 10-11-2019.

Participant and Setting

The setting for this study was an Applied Behavioral Analysis clinic located in the southeastern region of the United States of America. The participant in the study was a

kindergarten student that was diagnosed with Autism Spectrum Disorder. The participant was referred by his kindergarten teacher and parents for additional help in letter identification ability. All intervention sessions were conducted in therapy rooms at the clinic. Each intervention was delivered individually to the student.

Dependent Variable

The Dynamic Indicators of Basic Early Literacy Skills (DIBELS) 6th Edition Letter Naming Fluency (LNF) probes were used to measure alphabet knowledge (Good & Kaminski, 2002). The student was presented with a page containing randomly ordered upper and lowercase letters. Prior to taking this probe, the researcher used the following standardized instructions and started a timer for 1 minute.

> "Here are some letters (point). Tell me the names of as many letters as you can. When I say "begin", start here (point to first letter), and go across the page (point). Point to each letter and tell me the name of that letter. If you come to a letter you don't know I'll tell it to you. Put your finger on the first letter. Ready, begin (Good & Kaminski, 2002, p. 7)."

Each accurately identified letter was scored as correct. Letters read incorrectly and letters skipped were counted as errors. The DIBELS LNF score was reported as the number of letters correct (LC) in 1 minute. Appendix A contains a sample LNF probe.

Procedures

An alternating treatments design was used to compare the effects of the two letter identification interventions. Baseline data were collected across 11 sessions. As baseline data were collected, researchers determined a schedule for counterbalancing the presentation of the interventions to control for potential order effects. The order in which they were delivered was chosen randomly, by flipping a coin. Interventions were delivered in 25-minute sessions, three times per week, for five weeks. The order in which they were delivered was chosen randomly, by flipping a coin. LNF probes were administered after each intervention session.

Intervention A

The instructional, repetitive practice intervention was designed to address gaps in the student's knowledge of letter names. In this intervention, the student matched individual cards with upper- and lowercase letters and a picture of an item that started with that letter to an identical card. As the student progressed through the activity, he was asked the name of each letter. Immediate feedback was given through verbal praise if the student answered correctly. Verbal or physical correction was provided for incorrect responses and matches. If the student required verbal correction, the researcher provided the correct answer and asked the student to respond to the question correctly. If he required physical correction, the researcher provided hand-over-hand guidance to assist the student in making the correct match.

Intervention B

The second intervention was designed to target the student's motivation to name letters correctly by incorporating positive contingencies for accurate performance. This intervention consisted of an alphabet memory game paired with a token board economy. Cards with one letter were placed face down on the table. The researcher and student took turns flipping over two cards of their choice with the goal of making a match. When either player made a match, the student was asked what letter match was made. Asking the student each time gives him practice identifying every letter rather than approximately half. Immediate feedback was given through verbal praise when the student answered correctly or verbal correction when the student answered incorrectly. If the student required verbal correction, the researcher provided the correct answer and asked the student to respond to the question correctly. Throughout the entire game, the student earned tokens that could be exchanged for a reinforcer of his choice. Reinforcers were delivered when the student earned eight tokens. Each token was earned after

every third or fourth letter was matched and identified correctly by the student. It was the researcher's discretion to determine if a token would be awarded on the third or fourth letter match, but the student always received all eight tokens by the end of the game.

Interobserver Agreement

A second researcher observed and simultaneously scored the letter naming fluency probe during three of 11 administrations (27.27% of baseline data points). The intention when beginning this study was to have the same percentage of LNF administrations observed by a second researcher during the intervention phase of the study. However, due to the Covid-19 pandemic, only one of the 18 intervention sessions was observed (5.56% of intervention points). Scores from both raters were compared for interobserver agreement. Agreement was calculated by the number of letters agreed upon by the researcher divided by the number of letters observed by each researcher. Mean agreement was 94.3% during the baseline phase. Agreement was 93.33% for the intervention administration that was observed.

Intervention Fidelity

To ensure that each intervention was implemented as intended, the researcher developed an implementation checklist for each intervention (Appendix B and C). Another checklist was made for intervention A and intervention B using the descriptions in the methods section above. Each step of the intervention was rated as satisfactory, not satisfactory, or non-applicable. Interobserver agreement on fidelity was 100%. Another researcher completed the checklist simultaneously for three of 11 administrations (27.27%) of the baseline data points and one of 18 (5.56%) intervention sessions. The main observer completed a checklist for each intervention session. Integrity was calculated for all intervention sessions by dividing the number of completed intervention steps by the total number of intervention steps and report the average for

each intervention. Interventions A and B were also implemented with 100% fidelity and 100% interobserver agreement on fidelity.

Results

Baseline and intervention data were graphed. Visual analysis of the graphs was used to determine intervention effects. Specifically, researchers interpreted the level, trend, and variability of each phase and intervention. Effect sizes were calculated to determine the magnitude of change between baseline and each intervention phase.

Level

Table 1 contains the mean LNF score, median LNF score, and range of LNF scores for each phase of the study. The median score for the baseline data points (*Mdn*= 9) was lower than the median score of both interventions. With the scores on intervention B *(Mdn* = 18) being higher than intervention A scores (*Mdn*= 16) overall. The change in means between baseline data points and intervention A was 7. While the change in means for intervention B was 9. As you can see in Figure 1, both interventions had scores that showed improvement when compared to baseline data points. Moreover, the median scores for intervention B doubled compared to baseline scores. These differences in medians show significant improvement during both interventions, with intervention B showing additional improvement than intervention A.

Trend

Trend lines from each phase were examined to identify systematic increases of decreases over time. Figure 2 shows the trend lines of baseline and both interventions. The trend line for baseline data points had a downward trend with a small rate of improvement (*ROI*= .05). Intervention A improved slightly, had an upward trend, and a higher rate of improvement than the baseline trend (*ROI*= .20). Again, Intervention B showed the most upward trend with the

highest rate of improvement (*ROI*= .66) when compared to baseline data points and intervention A.

Variability

Variability of data within baseline and each intervention phase was determined using the 80-20% stability rule, which recommends that data be considered stable if 80% of data points fall within 20% of the median line (Hunley & McNamara, 2010). After calculating 20% of the median value, a data envelope was created by inserting a line 20% above the median line and another line 20% below the median line. After creating the data envelopes, depicted in Figures 3, 4, and 5, the percentage of data points falling within each envelope was calculated. Stability is achieved if 80% or more of the data points are encompassed within the data envelope (Hixson, Christ, & Bruni, 2014). Data in the baseline phase did not meet the criterion, with 64% of points falling within the data envelope. Intervention A data were also variable, with 50% of data points falling within the data envelope. Data for Intervention B did not meet the criterion but approached stability, with 75% of points falling within the envelope.

Effect size

Effect sizes were calculated in order to obtain an estimate of the magnitude of the change that each intervention produced. Researchers used the g-index, which relies on the baseline trend line to determine the proportion of scores within each intervention phase that fall above the baseline trend line (Hunley & McNamara, 2010). The g-index of Intervention A was .36, while the g-index of Intervention B was .27. Both interventions resulted in a positive g-index, indicating that improvement in letter naming fluency occurred.

Discussion

Both interventions were effective in improving the client's performance on the DIBELS letter naming fluency probe. Each intervention was designed to include critical features of evidence-based academic intervention. Specifically, both interventions provided ample opportunities to respond and immediate feedback including error correction. The improvement produced by each intervention is consistent with previous research on effective instructional techniques (Piasta & Wagner, 2010). Although the difference in median scores for each intervention phase was minimal (Intervention A *Mdn*= 16; Intervention B *Mdn*= 18), both scores were higher than the baseline median of 9. The same applies for rate of improvement (Intervention A *ROI*= .20; Intervention B *ROI*= .66) when compared to the baseline rate of improvement of .05. However, given the rate of improvement, the intervention that incorporated reinforcement (Intervention B) was more effective than the one that did not (Intervention A). This finding supports the claim that motivation and reinforcement are crucial aspects of effective interventions for all subjects as well.

Intervention A combined ample opportunities to respond and error correction with mnemonics in a code-based activity. There exists a large body of research that indicates frequent opportunities to respond and immediate feedback with error correction are effective intervention strategies (Piasta & Wagner, 2010; Codding et al., 2017) Moreover, the Intervention A results support Hetzroni and Shavit's (2002) findings that using pictures as mnemonics is an effective strategy for teaching letters. Each card that the student matched had a picture of an item that started with the letter depicted on the card. The picture helped the student encode the letter by adding additional context for the task. Lastly, this matching intervention was more of a code-based activity than the Intervention B memory game. The only task in Intervention A was to match the letters and recite the names. This finding that Intervention B (meaning-focused) was

more effective than Intervention A (code-based) supports previous research that has found the use of meaning-focused activities to be a more effective strategy for teaching letter names (Evans et al., 2009).

Similar to Intervention A, Intervention B included ample opportunities to respond and error correction. In addition to these components, the student received reinforcement for correct responses. When the student received all eight tokens at the end of the intervention, he was able to select a reinforcer of his choice. This component motivated the student to do well and remember the letter names which is consistent with literature on the effectiveness including positive contingencies for reinforcement in academic interventions (Parker & Burns, 2013; Codding et al., 2017). Intervention B was also designed to be a more meaning-focused activity than the matching game. The student had two goals: provide correct letter names correct and find more matching cards than the researcher. The evidence that Intervention B was more effective than Intervention A supports the ideas from Evans and his colleagues that meaning-focused activities are more effective than code-focused activities (2009).

Both providing ample opportunities to practice a skill and supplying error correction were shown to improve the participant's letter naming fluency through both interventions. Moreover, the differences between each intervention revealed that picture mnemonics and reinforcement can be effective. However, providing reinforcement, and therefore motivation, is an effective teaching strategy for the ASD population.

Limitations

There are several possible limitations to this study. Researchers employed a single case design with only one participant. Although small n studies allow researchers to control for threats to internal validity, external validity is low. It is difficult to generalize the findings in this

study to other populations. Additionally, it is difficult to conclude that the interventions alone produced the results. Children have opportunities to learn about letters outside of structured intervention, especially from parents and teachers (Piasta & Wagner, 2010). The participant was enrolled in Kindergarten at the time of this study. However, it should be noted that the participant received school-based instruction for the entirety of the study. This continuous enrollment would not explain the differences in between baseline data points and intervention data points. A final limitation of this study is the lack of interrater agreement on the dependent variable and fidelity during the intervention phases, which was unavoidable due to Covid-19 pandemic.

Despite these limitations, it is clear the intervention that included positive contingencies for accurate performance resulted in higher scores on DIBELS letter naming fluency probes. Motivating students to learn is one of the most crucial aspects of teaching any skill and this study shows it is no different for people with Autism Spectrum Disorder.

Directions for Future Research

Future research to isolate the most effective aspects of intervention is crucial for the improvement of alphabetic principle teaching. It would benefit students and teachers to understand not only which strategies are effective, but how these strategies interact. Future researchers could conduct component analyses to further investigate which combination of strategies is the most effective.

Another area with scarce research is the education of people with Autism Spectrum Disorder as a whole. As mentioned previously, researchers have investigated the emergent literacy development of people with ASD. This study focused on one-on-one interventions because people with ASD require more systematic exposure to educational activities (Culatta et

al., 2003). Due to this finding and the ASD population's lower rates of incidental learning there is a dire need for future researchers to study group instruction of people who have ASD. This research combined with present findings will help people with ASD acquire alphabetic principle and therefore become more successful readers. This line of research will reduce the likelihood of experiencing the negative consequences of poor literacy skills and therefore improve the quality of life thousands of people.

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Table 1. Mean, Median, and Range of Letter Naming Fluency Scores for Each Condition

Phase	Mean LNF Score	Median LNF Score	Range
Baseline	9.45	9	5-15
Intervention A	14.9	16	7-22
Intervention B	16.5	18	12-19

Figure 1. Letter Naming Fluency Score vs. Intervention

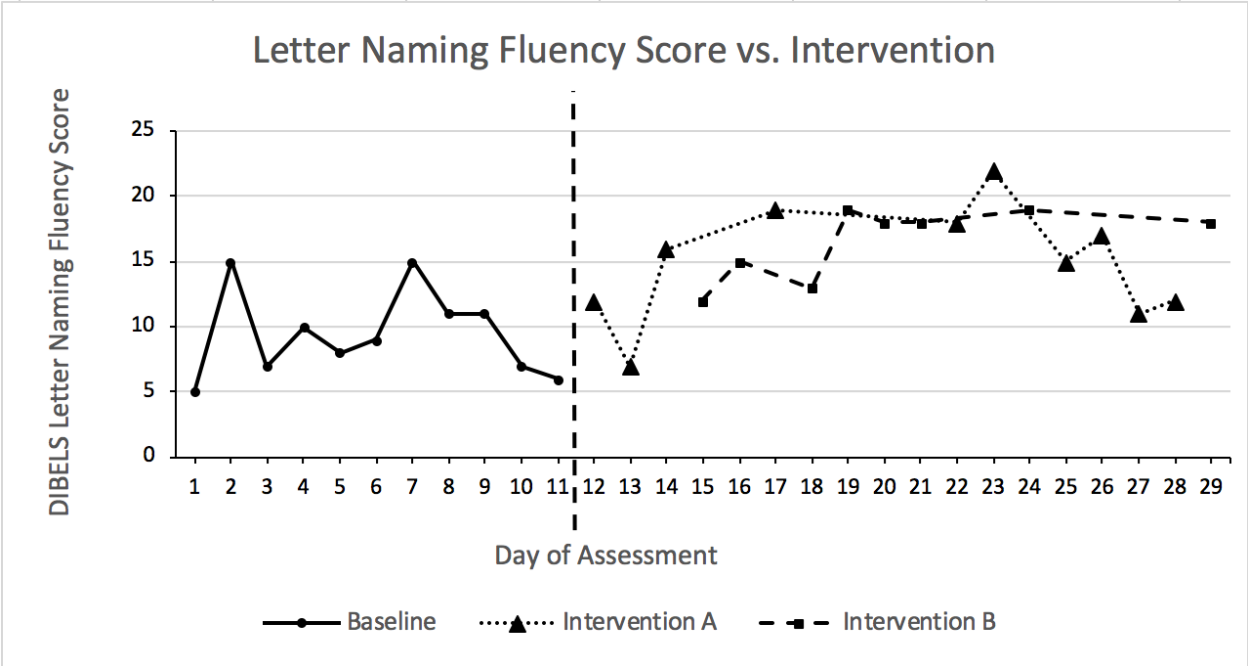


Figure 2. Letter Naming Fluency Score vs. Intervention with Trend Lines

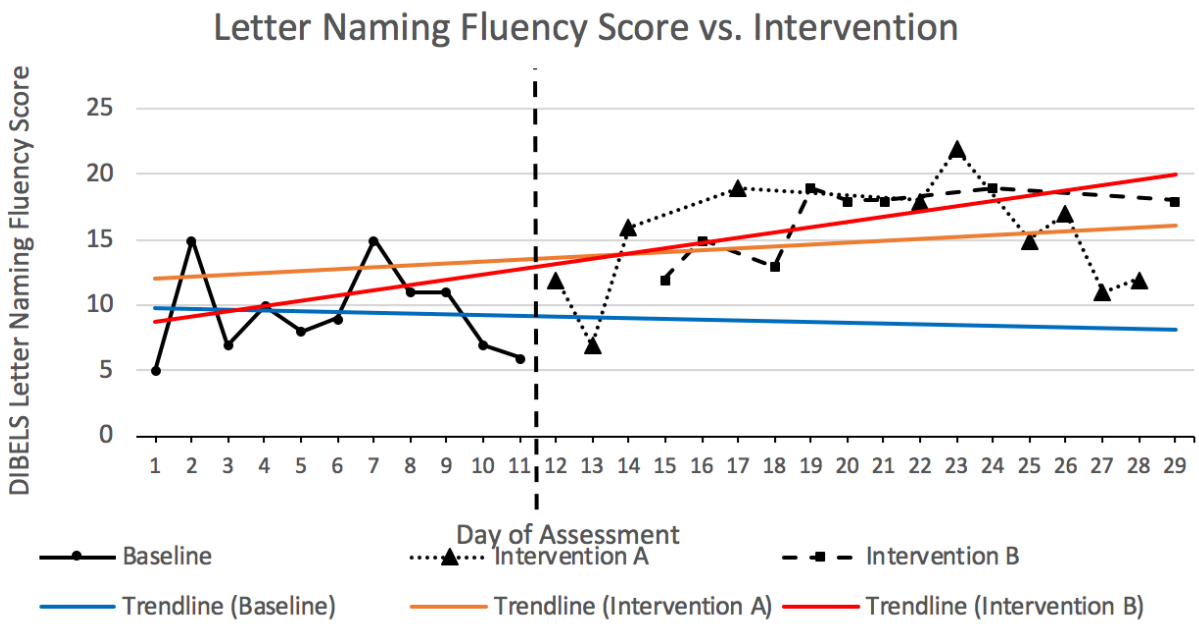


Figure 3. Baseline Variability Envelope

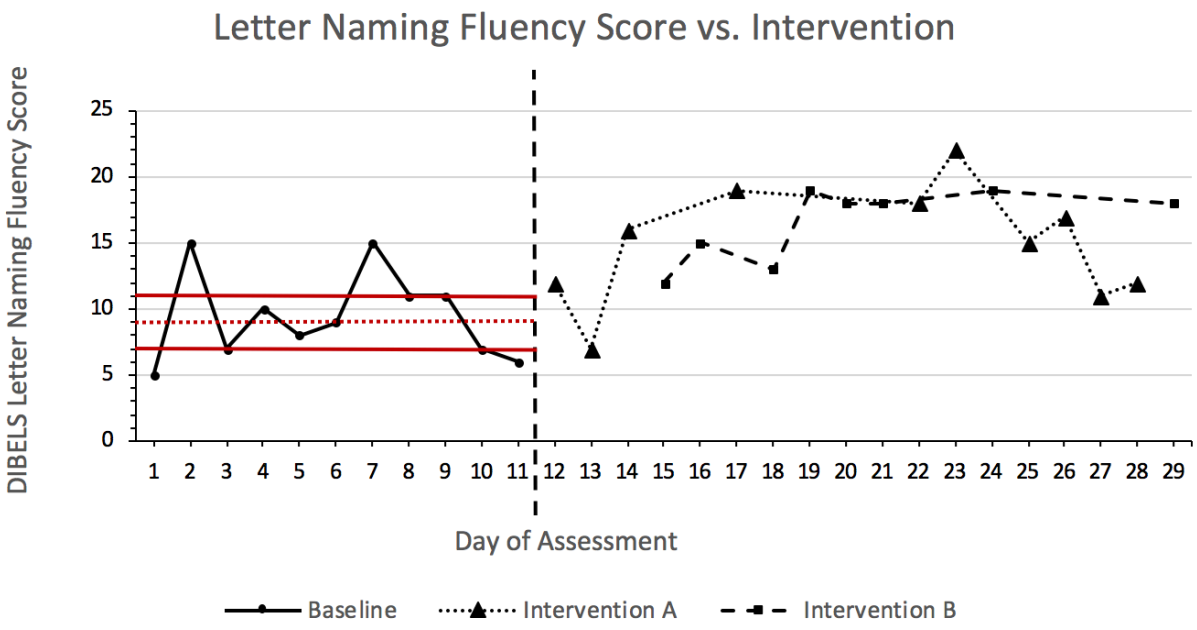


Figure 4. Intervention A Variability Envelope

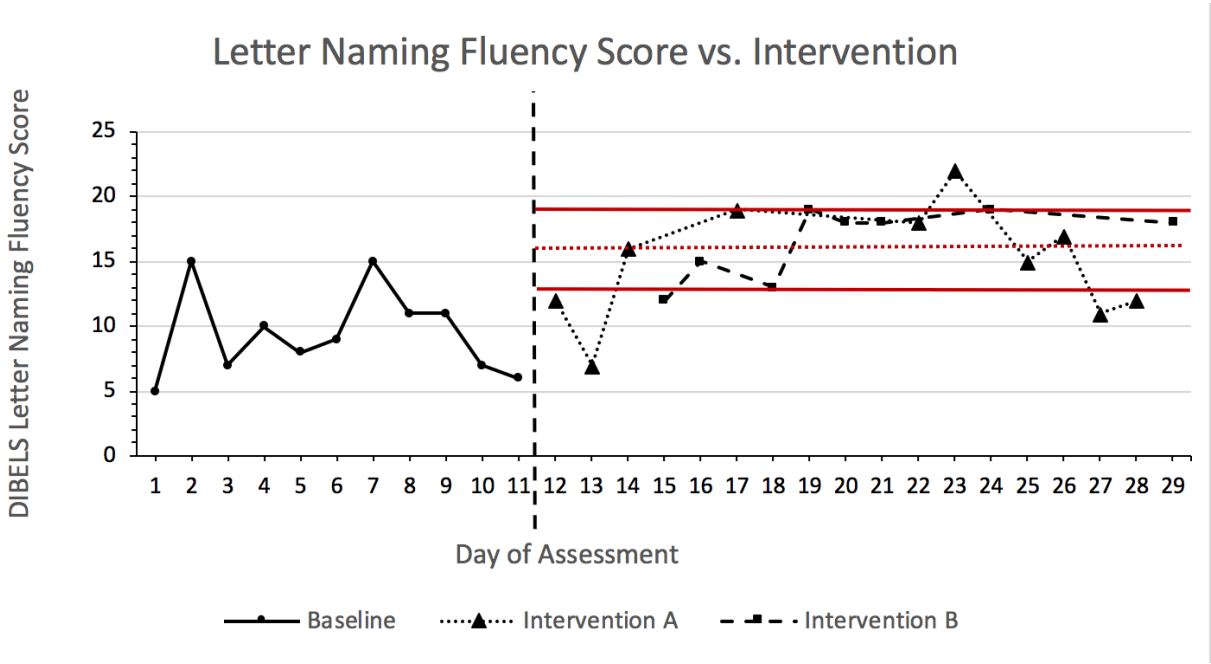
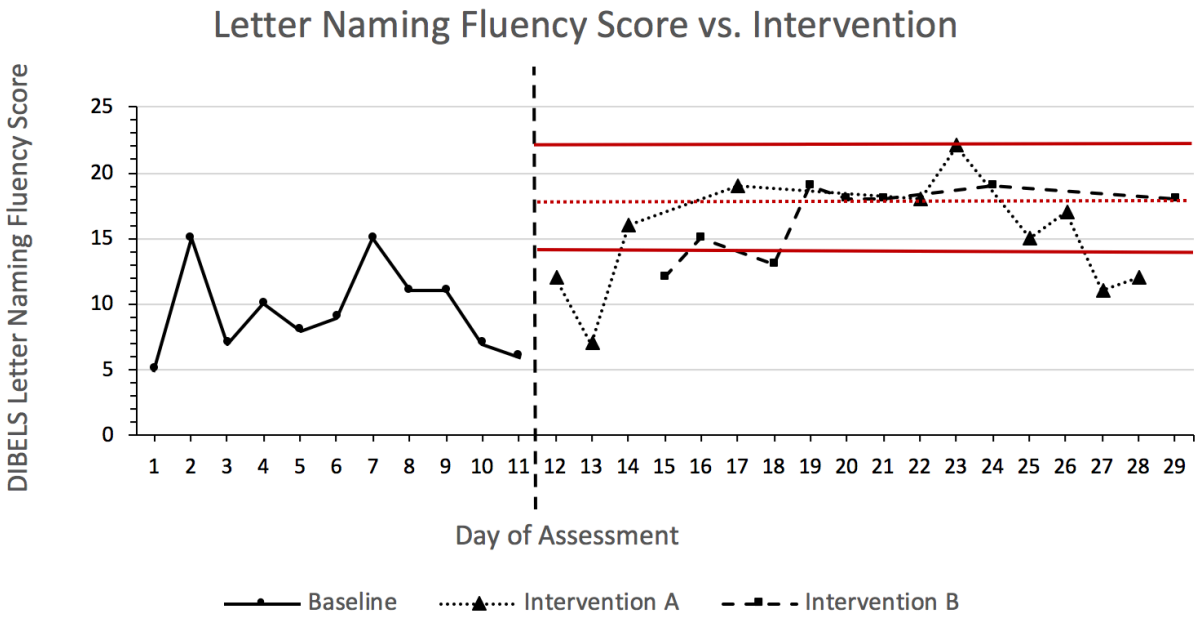
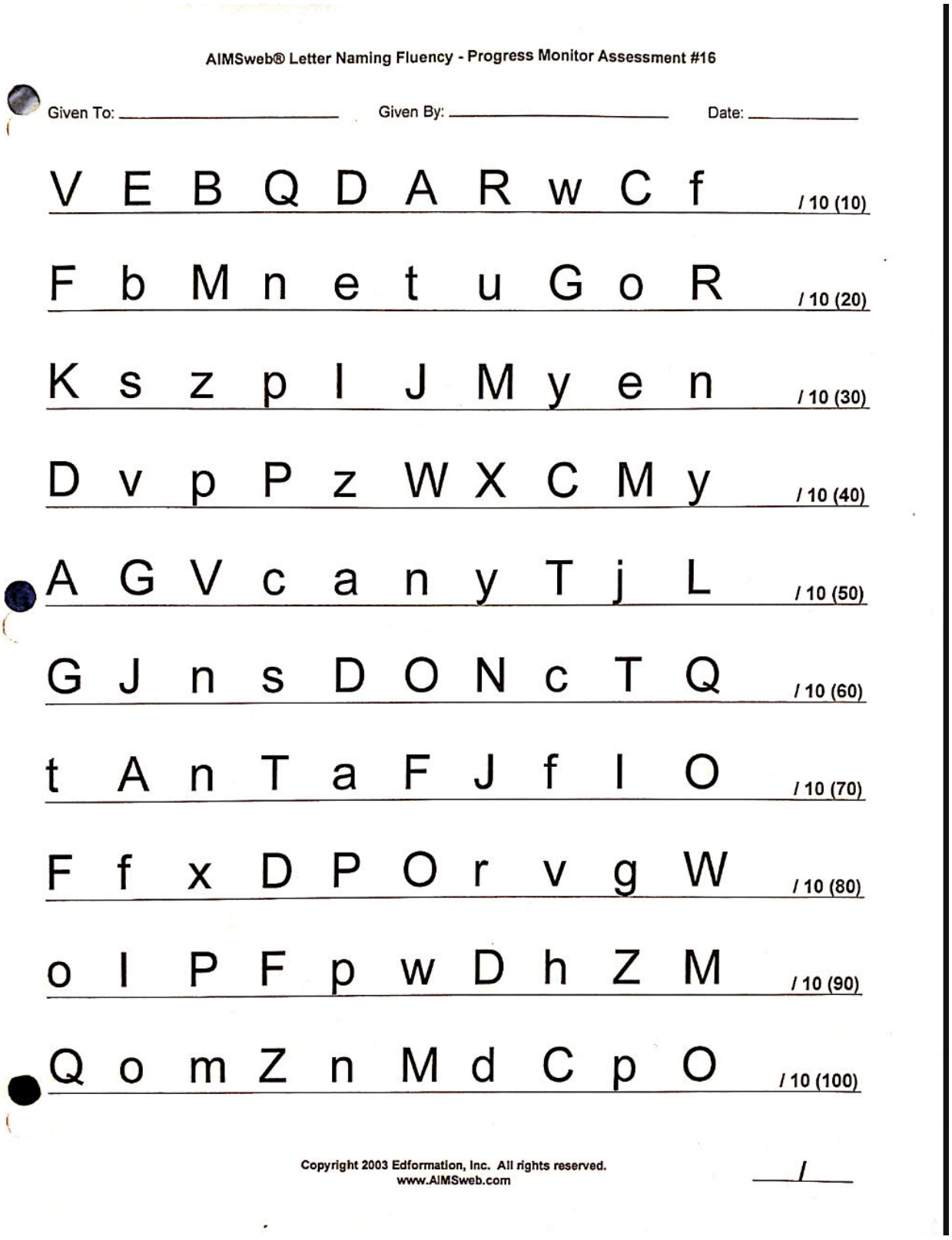


Figure 5. Intervention B Variability Envelope



Appendix A. Sample Letter Naming Fluency Probe



AIMSweb® Letter Naming Fluency - Progress Monitor Assessment #16

Given To: _____ Given By: _____ Date: _____

V E B Q D A R w C f / 10 (10)

F b M n e t u G o R / 10 (20)

K s z p I J M y e n / 10 (30)

D v p P z W X C M y / 10 (40)

A G V c a n y T j L / 10 (50)

G J n s D O N c T Q / 10 (60)

t A n T a F J f I O / 10 (70)

F f x D P O r v g W / 10 (80)

o I P F p w D h Z M / 10 (90)

Q o m Z n M d C p O / 10 (100)

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___/___

Appendix B. Treatment Integrity Checklist for Intervention A

Matching Game- Intervention A

Characteristic of Measurement	Satisfactory	Not Satisfactory	N/A
Lay out one set of alphabet cards, face up.			
Instruct student as follows: "We're going to be matching capital letters to lowercase letters. When I hand you a letter, find the match and put it on top."			
Researcher hands the student one letter card at a time.			
As the student is matching, the researcher asks the child what the name of each letter is.			
If the student answers correctly verbal praise was given.			
If the student matches incorrectly, he is given one opportunity to correct it and then hand-over-hand physical correction was provided.			
If the student verbally responds incorrectly, verbal correction was provided in which the student was given the correct answer and asked to respond again.			

Appendix C. Treatment Integrity Checklist for Intervention B

Memory Game- Intervention B

Characteristic of Measurement	Satisfactory	Not Satisfactory	N/A
Lay all cards face down on a flat surface.			
Instruct student as follows: "We're going to be finding each letter's match. When I say begin, flip over two cards to see if they match. We'll take turns and you'll earn tokens as we play."			
Take turns finding letter matches. Asking the student what letter when a match is found.			
Reward student with a token on every third or fourth letter matched (it is up to the researchers discretion to reward 3rd or 4th)			
Reinforce the last match found with the final token.			

Appendix D. Consent form

Parental Permission for Child Participation in Research

Title: The Effectiveness of Different Letter Identification Interventions in Children with Autism Spectrum Disorder.

Introduction
The purpose of this form is to provide you (as the parent of a prospective research study participant) information that may affect your decision as to whether or not to let your child participate in this research study. The person performing the research will describe the study to you and answer all your questions. Read the information below and ask any questions you might have before deciding whether or not to give your permission for your child to take part. If you decide to let your child be involved in this study, this form will be used to record your permission.

Purpose of the Study
If you agree, your child will be asked to participate in a research study about the effectiveness of early literacy interventions. The purpose of this study is to compare two different letter identification interventions.

What is my child going to be asked to do?
If you allow your child to participate in this study, they will be asked to

- Complete academic interventions that are designed to increase letter identification skills.
- This study will take one hour per week. Interventions will be delivered during his Applied Behavior Analysis sessions.
- Your child's progress will be measured with brief, one minute, tests of letter identification. We will share his progress with you.

What are the risks involved in this study?
There are no foreseeable risks to participating in this study.

What are the possible benefits of this study?
The possible benefits of participation are an increase in your child's early literacy skills.

Does my child have to participate?
No, your child's participation in this study is voluntary. Your child may decline to participate or to withdraw from participation at any time. You can agree to allow your child to be in the study now and change your mind later without any penalty.

What if my child does not want to participate?
In addition to your permission, your child must agree to participate in the study. If you child does not want to participate they will not be included in the study and there will be no penalty. If your child initially agrees to be in the study they can change their mind later without any penalty.

How will your child's privacy and confidentiality be protected if s/he participates in this research study?

Your child's data will be kept confidential. Scores on letter identification tests will be maintained in a locked cabinet that only researchers have access to. Data will be destroyed when the study concludes.

The data resulting from your child's participation may be made available to other researchers in the future for research purposes not detailed within this consent form. In these cases, the data will contain no identifying information that could associate it with your child, or with your child's participation in any study.

Whom to contact with questions about the study?
Prior, during or after your participation you can contact the researcher Haley Poythress at 919-545-4969 or send an email to poythresshc@appstate.edu for any questions or if you feel that you have been harmed. You may also contact the faculty supervisor, Dr. Jamie Yarbrough, at 828-262-8966 or yarbroughjl@appstate.edu. Appalachian State University's Institutional Review Board has determined this study to be exempt from the IRB oversight.

Signature
You are making a decision about allowing your child to participate in this study. Your signature below indicates that you have read the information provided above and have decided to allow them to participate in the study. If you later decide that you wish to withdraw your permission for your child to participate in the study you may discontinue his or her participation at any time. You will be given a copy of this document.

_____I do give permission for my child to take part in this process.

_____I do not give permission for my child to take part in this process.

_____ Date_____
Parent Signature