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Letter-Sound Correspondence Intervention with Students with ASD

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Abstract

Background: The purpose of this study is to evaluate an intervention procedure to teach letter-sound correspondence for students diagnosed with autism spectrum disorder (ASD). Similar studies have been conducted; however, further research is needed. Purpose: Evaluation of this intervention to see improvement of letter-sound correspondence over five rounds of exposure to the intervention. Methodology: The research design was a single case study using a multiple baseline across participants. Baseline data were collected before intervention. The target population included three students aged 3-5 diagnosed with ASD who were previously enrolled in the Autism Clinic on campus. Materials included a laminated picture page for the letter, five response pages with the target letter highlighted, five response pages with no highlighting, and characters for identifying the correct letter. The dependent variable for this study was independently and correctly identifying letters with their corresponding sound out of five sets. This reflects the goal to evaluate the comprehension of letter-sound correspondence. Percent correct on probes data were collected out of two trials each session on correct and incorrect responses when asked to identify a sound with a corresponding letter. If correct for one trail and wrong for the second, the data reflected 50/100, if correct for both trails the data reflected 100/100, and if incorrect for both trails the data reflected 0/100. General procedures included researchers teaching the students the information (1st active practice, 2nd guided practice, 3rd independent practice) three times and then evaluating. Results: We discovered that this intervention process worked better with some students compared to others. Two of the three students showed growth in their knowledge of letter-sound correspondence. Discussion: While results show an improvement in letter-sound correspondence for two out of three students, we need to consider student behaviors and stimulations that cause distractions from the teaching and intervention. Other literature has shown the importance of letter-sound correspondence intervention for students with ASD for later reading comprehension. This information shows that we can use this intervention practice in therapy sessions and school to teach students letter-sound correspondence. We can continue research by evaluating another intervention process and comparing the two to see what process works best.

Keywords: Sound-letter correspondence (LSC), autism, communication

Introduction

Letter-sound correspondence (LSC) is imperative to learning to read and write. Studies show that teaching this skill to preschool students improves their reading and writing abilities in the future. Students with ASD may find that "literacy not only provides the traditional benefits but may also serve as a powerful method of communication with others" (Benedek-Wood et al., 2016). Teaching this skill early to students with ASD can help them in the future to use reading and writing as a method of communicating.

Benedek et al. (2016) evaluated modeling the LSC and guided practice with the LSC in three children diagnosed with autism who are also non-verbal. They used multiple probes across participants and the study took place in preschool classrooms. Six LSCs were targeted (o, t, r, l, u, and p). The researchers measured letter-sound correspondence based on performance during a probe session and tested acquisition on the six LSCs. A percentage out of 12 was computed. The results indicated that all three participants demonstrated acquisition and maintenance of the skill across all multiple letters in the set and the procedures were socially valid when teachers were asked to evaluate them. Limitations include that there were only 3 participants, so replications are needed.

Wright et al. (2022) evaluated explicit instruction in LSC, modeling, and guided practice with four children; two were diagnosed with autism and limited speech, and two were diagnosed with developmental delays and short phrase production. They used multiple probes across participants and the study took place in a preschool classroom. Six LSC's targeted (m, n, o, a, s, and t). The researchers measured letter-sound correspondence based on the correct identification of grapheme with associated sound with picture probes. The results indicated all participants showed acquisition and maintenance of LSC across all letters in the set. The procedures were

socially valid when interventionalists were asked to evaluate them and researchers followed up with phone calls or virtually due to covid. Limitations include that there were only 4 participants, so replications are needed, COVID sent school to home, so maintenance was not completed in the school setting, and the study was limited to only one element of reading.

Schlesinger & Gray (2017) evaluated literacy (letter name, letter sound, word reading, word spelling) treatment approaches- multisensory versus structured language (following Orton Gillingham) effects on students with dyslexia vs normal development. Eleven-second graders participated in the study: six typical development (four girls), five with dyslexia (two girls), all seven years eight months to eight years eight months old. They used multiple baselines and multiple probe single case design, and the study took place at the university lab, local library, or the participant's home. Treatment alternated from structured language to multisensory. Researchers measured correct letter names, letter sounds, word reading, and word spelling in all 3 stages of the study. Scores were a percentage out of nine for letter names and letter sounds, scores were out of twelve for word reading and spelling. Results show that there is a need for students with dyslexia to be provided with differentiated instruction that's diagnostic, prescriptive, and empirically based. The study included a social validity measure. Limitations include the short duration of treatment sessions may explain the poor response of participants with dyslexia, interventionalist, and participants introduced to reading and spelling practices not commonly used in the classroom and results only show English-speaking dominant students.

Westerveld et al. (2018) evaluated if preliteracy skills can predict reading ability in students with ASD. There were forty-one participants (35 male, 6 female) who were all diagnosed with ASD, verbal (short sentences), and able to participate in preschool activities. The study took place in early childhood centers, children's homes, or university clinics. Two

assessments were given 6-12 months apart that lasted approximately 2 hours each. Assessment one included SCQ, PPVT 4, MSEL, PALS-PreK, RAN, and NEPSY-2. Assessment two included CELF-2, TARC, Castles, and Colheart test 2. Results came from a comparison of the scores from the two assessments. Findings show that almost all of the students in the study with ASD showed early signs of passage reading difficulties suggesting early assessment and intervention of the early reading skills, nonverbal cognition was strongly linked to single-word reading, and children who showed passage reading ability in their first year of schooling performed better on all preschool precursor literacy variables (vocab, name writing, group membership). Limitations include no control on the order of tasks in each assessment, a percentage of children were not able to complete some of the measures due to behaviors, and the study focused on verbal preschoolers with ASD, leaving out students who are nonverbal and minimally verbal ASD students.

Davidson & Weismer (2014) evaluated the characteristics and prediction of early reading abilities in children with ASD across four consecutive years. There were 101 participants with ASD who finished all 4 visits (one visit per year). Ninety-four finished the TERA-3 (82 males, 12 females) and the rest did not complete it due to behaviors. At each visit, the participants were seen for 2 sessions, each lasting 3-4 hours. One session assessed language and communication, the other assessed ASD symptoms, and cognition. These assessments were given ADI-R, ADOS, or ADOS-T given at the first and fourth visits. The TERA-3, PLS-4, and Mullen Early Scales of Learning were given at each visit and Vineland Adaptive Behavior Scales-2 was reported by the parent at each visit. Performance on assessments was compared to the TERA-3 normative sample and evaluation of change from the first visit to the next based on the standardized tests. Results show that reading proficiency at an average age of 5 ½ was "associated with higher

nonverbal cognition and better expressive language and social ability was inversely related to alphabet knowledge" and could be predicted at an average age of 2 1/2. Limitations of the study are not directly accounting for literacy exposure or in-home and early childhood education approaches to learning that could have affected early reading ability. All participants were living in Wisconsin at the time of the initial visit and had a retention rate of 88% across 4 years.

Dynia et al. (2017) evaluated emergent literacy skills in preschool children with ASD. Participants included 35 children from 3-5 years with ASD and 73 typical development children. The study included a secondary analysis of a larger study of book reading practices in special education classrooms. Then measures were taken in the second semester of their preschool year, decoding following the next year. These tests were given for the evaluation of emergent literacy skills: PALS, PWPA, TOPEL, CTOPP, and Woodcock-Johnson 3 test of achievement. Alphabet knowledge percent out of 52, print knowledge percent out of 18, phonological awareness percent out of 27, and decoding out of 32. The study included a conflict-of-interest statement. Results indicate phonological awareness was a large predictor of later decoding in children with ASD, but ASD does not moderate emergent literacy skills and decoding. Limitations include a small sample size, so the study needs to be replicated, and the study does not evaluate fluency and comprehension.

Justice et al. (2015) evaluated print-focused read-alouds taught by early special education teachers and caregivers for 291 children diagnosed with language impairment. They used a randomized controlled trial, and the study took place in preschool classrooms and the homes of the children, and there was fidelity and monitoring of the intervention. The study followed steps of random assignment of classrooms to a) teach teachers and caregivers how to implement teachings, b) monitor implements by teachers/caregivers, and c) measure the effects of treatment.

Teachers reading storybooks read 4 times a week for 30 weeks, and caregivers read a storybook 2 times a week for 30 weeks. The study included three sets of conditions of intervention given by the teacher/caregiver: regular reading/regular reading, print-focused/regular reading, and print-focused/print focused. Assessments were given to evaluate upper-lowercase knowledge and name writing (PWPA, PALS subtests) in the fall and spring semesters following the 30-week-book programs. Participants were assessed on print concept knowledge, upper-lowercase alphabet knowledge, and name writing. Results showed the children's print knowledge improved over the school year using this method. Limitations include that the teachers self-selected into the study, caregivers may not have implemented the interventions as described, and the study does not support long-term reading outcomes.

Wodka et al. (2013) evaluated predictors of phrase and fluent speech in children with ASD and severe language delay. The study included 535 children at least 8 years old who did not acquire phrase speech before 4 years old. They included a parent interview (ADI-R), ADOS used to classify current speech abilities, Kaplan-Meier used for IQ, behavior checklists were implemented, and Cox Proportionate Hazards Regression analyses are given. Data was taken on the stated tests that assessed behaviors, nonverbal intelligence (social and cognitive), autism symptoms, and phrase production. Results showed nonverbal cognition was the biggest predictor of fluent phrase speech, and children without phrase speech before 4 years with average nonverbal intelligence have a relatively good prognosis for fluent speech after age 10. Limitations include the parent reports for behavior that could be biased.

Knight et al. (2019) evaluated predictors of reading in students diagnosed with ASD. Participants included 183 students ages 4-7 with an IQ above 50 and diagnosed ASD (167 completed all 3 assessments). This study was a longitudinal study across two assessments (1st

assessment in the summer or early fall of the first school year, and the 2nd assessment during comprehension assessments later that year). These assessments were given to evaluate pre-literacy skills: ADOS, WPPSI 3, CASL, AIMSweb, and WJ-3. Results showed that curriculum-based measures accurately predicted reading skills in students with ASD. Limitations include that recruitment for study was ongoing, so assessments were at different times due to this.

Allor et al. (2014) evaluated if scientifically based reading instruction is effective for students with below-average IQs. Participants are students who started at grades 1-4, all verbal, and IQ was between 40-80 (31 participants consistent over 4 years), 10 research teachers (9 female, 1 male, and southwestern schools (elementary for first 3 years) with a relatively large number of students whose IQ is between 40-80. A comprehensive battery assessment was given at the start of the study and the end of each academic year. There were two groups included (contrast and treatment group). In the contrast group, students were given typical general education or special education instruction depending on their school. The treatment group received the instruction daily for 40-50 minutes in small groups (1-4) by highly trained intervention teachers. Assessments given included CTOPP, EVT, PPVT, TOWRE, WLPB-R, and DIBELS for the pretest and WIAT-II for the posttest. The primary intervention for the treatment group was Early Interventions in Reading. The evaluation came from a comparison of test results and progress monitoring. Results showed students with ID and borderline range IQs should be provided with evidence-based reading instruction. Limitations include that students would move from school to school so the dosage was not tightly controlled, 11% participated for 1 year, variability of instruction in the contrast group, the study did not directly assess IQ, and the study couldn't analyze possible teacher effect. This was a 4-year longitudinal study that implemented fidelity checks and staff development.

After researching letter sound correspondence, similar limitations include a small set of participants, so replications were needed. We conducted a research study in letter-sound correspondence intervention. Given that letter-sound correspondence is a skill required to read and write, the purpose of this study was to evaluate an intervention process for letter-sound correspondence given to students diagnosed with ASD. This study evaluated the student's response when prompted to identify letters with their corresponding sounds.

Method

Participants

The participants included three students, two male, and one female. All were diagnosed with autism before attending the clinic, nonverbal, and all use AAC devices. All participants attend the university preschool clinic two-three times a week for three and a half-four hours weekly for the fall semester of 2021. Josh was three years old; Daniel was three years old; and Emily was four years old during the study.

Settings and materials

This study took place at the University of Arkansas Autism Clinic on campus. The clinic has two therapy rooms and a main classroom. The clinic included typical preschool procedures and materials: circle time, crafts, toys, and child-size tables and chairs. The clinic followed similar classroom activities and included research time in the schedule. Each session the student was taken to a therapy room or to the classroom table to complete intervention for each study going on in the clinic. Materials included a laminated picture page for the letter, 5 response pages with the target letter highlighted, 5 response pages with no highlighting, and characters for identifying the correct letter.

Dependent Variable and Measures

The dependent variable for this study was the percent of independently correctly identified letters with their corresponding sound out of 5 sets. Each set was scored as correct if identified correctly after the first attempt or incorrect if no response or if incorrectly chose the corresponding sound. There were 5 sets of measures each taken after three consecutive intervention sessions. During the measure, the student was provided with 5 opportunities to correctly identify the sound corresponding with the correct letter.

Research Design

The research design was a single case study across multiple participants with multiple probes. There were 5 rounds of intervention and evaluation; each round included 3 sets of intervention sessions followed by an evaluation. The criterion for mastery was an improvement of correct sound-letter correspondence identification from the baseline to the last round of intervention and evaluation.

Baseline

During the baseline session, students were provided with each letter in the alphabet to identify the correct sound correspondence to choose which letters we will use for the study. They were provided with letter pictures, given the name of each letter, and then asked to state the sound. Once completed with each student, 5 sounds were chosen for the study.

General procedures

Throughout this research study, researchers taught the students the information (1st active practice, 2nd guided practice, 3rd independent practice) three times and then evaluated them. This was repeated for a total of 5 sets.

1st: Activate Meaning	2nd: Guided practice	3rd: Independent Practice with Feedback
Introduce: "Let's learn about [sound]. /a/ /s/ /p/ /k/	Say, "Let's show [character] (SpongeBob, Charlie and the chocolate factory guy, frog) to find [sound] (/a/ /s/ /p/ /k/)!", hand the character to the participant, and place a response plate in front of the participant.	Say, "It's your turn to show [character]," and place a response plate in front of the participant.
Relate to familiar words by stating the sound then stating each word on the word plate while pointing to it.	Say the sound while pointing to the letter, prompting the participant to place the character on the letter; use hand-over-hand if no response.	Say, "Show character [sound]." (/a/ /s/ /p/ /k/)
	Repeat four more times, changing through response pages with different target letter locations.	Wait, then provide praise, corrective feedback, or prompting as needed based on response.
	*Repeat four more times, changing through response pages with different target letter locations.	
Materials: picture page for the letter	Materials: 5 response pages with target letter highlighted; character	Materials: 5 response pages with no highlighting; character

Experimenter

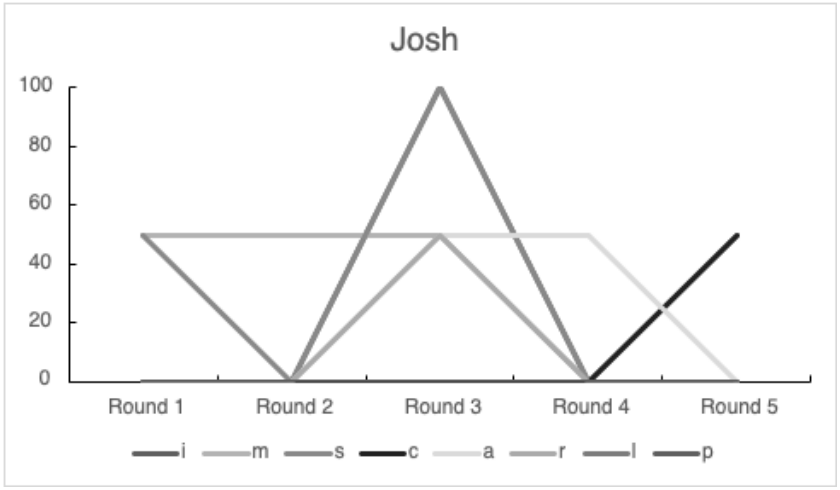
Two different interventionalists were involved in this study. The primary experimenter was an associate professor at the University of Arkansas who achieved her doctorate in Speech-Language Pathology. The secondary experimenter was an undergraduate honors student studying communication disorders and sciences at the University of Arkansas. The primary experimenter trained the secondary experimenter in all procedures of the study with 100% fidelity.

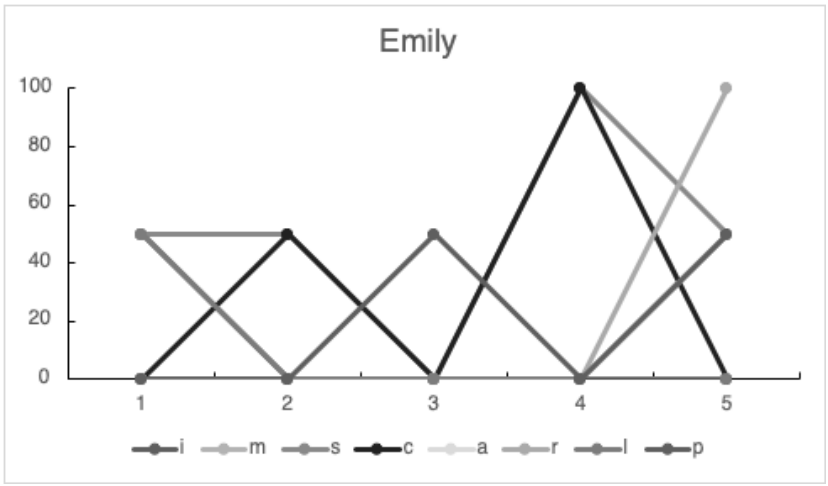
Compliance with Ethical Requirements

The Institutional Review Board (IRB) is a committee that reviews research proposals to make sure they are ethical and moral, and all the methods have protocols to keep the information confidential. The proposal to the IRB for this research is focused on making sure the children's information who participate is completely confidential. The age, gender, and medical history of the participants will strictly be kept between the investigators in this research team. The research team observed three students during the Fall 2021 semester and took data for two months to see if there is an improvement in the child's ability to understand letter-sound correspondence of /i/ /m/ /s/ /c/. The only people who will have access to these data are Sarah Hoemann, Dr. Holyfield, and Dr. Lorah.

Results

Throughout this study, we discovered that this intervention approach worked for some students better than others. Two of the students showed growth in their knowledge of letter-sound correspondence. One student moved from 0 letters identified to 4 letters identified after 5 trials, another identified 4 consistently after 5 trials, and the other student made no progress. We can conclude that this form of intervention works for some students who have never been exposed to sound-letter correspondence before but does not work for all students. Attached are graphs that show the progression of sound-letter correspondence for students 1 and 3.





Discussion

Throughout this study, we need to consider student behaviors and stimulations that can cause distractions from the teachings and intervention approaches. The students became distracted and limited their ability to fully be able to learn the material. We could expand on this study by trying another type of intervention approach and comparing the two. This study has shown that this intervention worked for 2/3 of cases.

This study is like the multiple studies explained above. Benedek et al. (2016) evaluated modeling the LSC and guided practice with the LSC in three children diagnosed with autism and nonverbal. Wright et al. (2022) also evaluated the modeling and guided practice of LSC but with four children (two with autism, two with developmental disorders). This study evaluated an intervention process for LSC and guided practice with three children diagnosed with autism and nonverbal. Benedek et al. (2016) study showed that all students acquired LSC with the given letters. Wright et al. (2022) resulted in all students acquiring LSC with the given letters. This study showed two out of three students began to acquire LSC with the given letters. Both studies need further research because of the small number of participants.

Schlesinger & Gray (2017) evaluated literacy (letter name, letter sound, word reading, word spelling) treatment approaches across a larger scale. The goal of their study was similar to this study's goal- to evaluate an intervention for letter-sound correspondence with students. Also on a larger scale, Westerveld et al. (2018) found that almost all of the students in the study with ASD showed early signs of passage reading difficulties suggesting early assessment and intervention of the early reading skills. This shows that finding an early intervention process for LSC is important when teaching students with ASD to read, relating to this study's goal of evaluating a letter-sound correspondence intervention process.

Davidson & Weismer's (2014) results show that reading proficiency at an average age of 5 ½ was "associated with higher nonverbal cognition and better expressive language and social ability was inversely related to alphabet knowledge" and could be predicted at an average age of 2 ½. The findings relate to this study indicating that alphabet knowledge is important for reading proficiency. This study provides data on an intervention process of letter-sound correspondence (alphabet knowledge).

Dynia et al. (2017) evaluated emergent literacy skills in preschool children with ASD. Results indicate phonological awareness was a large predictor of later decoding in children with ASD, but ASD does not moderate emergent literacy skills and decoding. Justice et al. (2015) results showed the children's print knowledge improved over the school year using their method. These studies show that letter-sound correspondence intervention is needed, as shown in this study.

Wodka et al. (2013) results showed nonverbal cognition was the biggest predictor of fluent phrase speech and that children without phrase speech before 4 years with average nonverbal intelligence have a relatively good prognosis for fluent speech after age 10. This information shows that is important to consider nonverbal skills (like understanding letter-sound correspondence) to set goals for language development.

Knight et al. (2019) found that early literacy skills accurately predicted later reading comprehension. Since Early literacy skills include letter-sound correspondence, this shows the importance of this study.

Allor et al. (2014) results show that students should be provided with evidence-based reading instruction. As shown above, research shows that letter-sound correspondence is important for reading comprehension. This is backed by multiple research studies providing evidence that LSC is needed for reading instruction.

Summary of Experience

Throughout this study, I was able to learn how to teach and interact with students diagnosed with autism, work with challenging behaviors and distractions, and grow as a researcher. This study showed me how to properly take data, how to implement an intervention plan promptly, and how to draw conclusions from the data. I learned to implement this study

while other studies were going on in the clinic. This required time management and efficiency. I learned that to effectively teach the student, the environment had to have limited distractions and the sessions had to be short and effective. I observed that on some days the students struggled and on others, they thrived. Their performance would change based on their behaviors during the teaching and evaluation sessions. I recommend that each student continues to practice letter-sound correspondence as they begin to learn to read. This intervention process was effective with short sessions and when the setting had limited distractions. Continue this practice in the future to expand the student's knowledge of letter-sound correspondence.

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