2015

Effects of Encoding Practice on Alphabet, Phonemic Awareness, and Spelling Skills of Students with Developmental Delays

Laura Nicole Delrose

Louisiana State University and Agricultural and Mechanical College

EFFECTS OF ENCODING PRACTICE ON ALPHABET, PHONEMIC AWARENESS, AND SPELLING SKILLS OF STUDENTS WITH DEVELOPMENTAL DELAYS

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Communication Sciences and Disorders

by
Laura Nicole Delrose
B.A., University of California - Santa Barbara, 2009
M.A., Louisiana State University, 2011
August 2015

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ABSTRACT

Reading instruction has historically been deemphasized for students in special education, and the limited research on this topic reveals that sight word vocabulary is most commonly taught in special education classrooms (Browder, Wakeman, Spooner, Ahlgrim-Delzell, Algozzine, 2006). However, successful reading instruction must target the five essential components: vocabulary, fluency, comprehension, phonics, and phonemic awareness (National Reading Panel, 2000). The extremely small body of research attempting to teach phonics and phonemic awareness to students with mild to severe disabilities approaches instruction from a decoding framework with mixed success (Browder et al., 2006). Alternatively, this study aims to teach from an encoding framework.

Encoding is the process of converting speech sounds to print by applying the alphabetic code (Herron, 2008). Students are actively engaged in the process relying on their current level of knowledge to construct words. Any attempt is viewed as a success that can be gradually improved by feedback and increased phonological and phonemic awareness. This study investigated whether encoding practice embedded in a narrative context would improve participants' developmental spelling patterns across intervention sessions, and whether scores on measures of phonological awareness, alphabetic knowledge, print knowledge, language abilities, and spelling would improve following the 18 intervention sessions.

Prior to any intervention, participants completed multiple baseline probes attempting to spell three lists of target words that were randomly selected from the words that would be targeted during intervention. Immediately before intervention sessions, participants attempted to spell five target words independently. During intervention sessions, the same five words were practiced in a narrative context with scaffolding and feedback (i.e., examiner and Phonic Faces).

Participants again attempted to spell the same five target words independently immediately following the intervention session.

On average, participants' spelling attempts improved following intervention sessions. One participant made expected positive changes in encoding abilities from baseline to intervention, while the other participants made inconsistent progress. From pretest to posttest, participants made clinically significant gains on standardized measures of phonological awareness, vocabulary, and language measures. Findings of the study suggest that students with developmental disabilities have the potential to learn early reading skills when given direct instruction and practice.

INTRODUCTION AND LITERATURE REVIEW

A review conducted by the National Reading Panel suggested that there are five crucial components of reading instruction for *all* students: vocabulary, fluency, comprehension, phonemic awareness, and phonics (National Institute of Child Health and Human Development (NICHD), 2000). Although reading instruction occurs daily for students in general education, historically, reading instruction has not been a high priority in most special education classrooms. Several reviews of research on reading instruction for students with mild to severe disabilities revealed a dearth of studies since the 1970s (Browder, Wakeman, Spooner, Ahlgrim-Delzell, Algozzine, 2006). A majority of existing studies focus solely on sight word vocabulary learning, and only a few have attempted to teach the alphabet and some rudimentary phonemic awareness or phonics skills to students with disabilities. Some studies taught isolated skills such as letter-sound correspondence or blending in a "drill" context with mixed success. More recent studies suggest that long-term, multi-skill reading programs can facilitate positive improvements in reading and language abilities and IQ scores of students with disabilities.

Other researchers suggest that an encoding approach to phonemic awareness and phonics instruction may be more efficacious than the traditional decoding approach. Encoding is the process of converting speech sounds into print by applying the alphabetic principle (Herron, 2008). Encoding is an active process that relies on students' current phonemic awareness and phonics skills to construct written words. The reciprocal process of decoding (i.e., converting letters to sounds) demands conventional correctness for success, and only one correct response is acceptable. During encoding any approximation of the target is viewed as a success, and attempts are gradually shaped through feedback (Allen, 1964; Herron, 2008). The purpose of this study is to determine whether encoding practice embedded in a narrative context would improve participants' developmental spelling patterns across intervention sessions, and whether scores on measures of phonological awareness, alphabetic knowledge, print knowledge, language abilities, and spelling would improve following 18 intervention sessions.

Federal Legislation for Students with Disabilities

For most of the twentieth century, an overwhelming number of children with disabilities were not allowed to attend public schools, instead being isolated in state institutions. Beginning in the 1970s, there was a nationwide push for students with disabilities to attend public schools and to receive an appropriate education. The federal government passed the Education of the Handicapped Act (EHA) in 1970 that offered grants to universities that developed programs to train teachers for students with disabilities (Katsiyannis, Yell, & Bradley, 2001). In response to the EHA, some states passed legislation specifically excluding the participation of students with disabilities in public education. In fact, according to congressional report in 1974, 1.75 million students with disabilities were still excluded from the public school system. In addition, the few students with disabilities who were enrolled in public school were not receiving quality instruction that met their educational needs (Katsiyannis et al., 2001).

The Education of the Handicapped Act of 1970 was amended in 1974 and 1975 (Katsiyannis et al., 2001). The 1974 amendment changed the act's name to the Education of All Handicapped Children Act (EAHCA) and was the first federal mandate to require that students with disabilities receive a free, appropriate public education (Katsiyannis et al., 2001). The 1975 amendment to EAHCA offered grants to states that provided free and appropriate education to disabled students, established laws, and showed that they were following the laws (Katsiyannis et al., 2001). In addition, the EAHCA of 1975 requires that special education and related services be provided to students with disabilities for free, in accordance with state standards, at all levels of schooling, and under the guidelines of the Individualized Education Program (IEP) (Katsiyannis et al., 2001).

Under the 1990 amendment, the EAHCA's name was again changed to the Individuals with Disabilities Education Act (IDEA), and its mission was to provide states with federal funding for efforts toward meeting the educational needs of students with disabilities (Katsiyannis et al., 2001). The Individuals with Disabilities Education Act was amended in 1997 to have four parts: a) congressional justification of IDEA, b) funding mechanisms and principles for educating disabled students, c) mandate for early intervention programs, and d) support programs ensuring forward progress in research and education of students with disabilities (Katsiyannis et al., 2001).

Because of the changes enacted by the evolution of EHA in 1970 to IDEA in 1997, students with disabilities were now guaranteed access to public education. As reported in the article by Katsiyannis and colleagues, more than 6 million students aged 3-21 received special education services from IDEA in the 1998-1999 school year. The effectiveness of special education was to be measured by improvements in educational achievements of students with disabilities, as mandated by the 1997 amendment to IDEA (Katsiyannis et al., 2001).

The No Child Left Behind Act of 2001 mandated that students with disabilities access, receive instruction in, and be evaluated against the general education curriculum (Hitchcock, Meyer, Rose, & Jackson, 2002). Ways to achieve access and measure progress for students with disabilities were explained clearly, while details regarding participation in the general curriculum did not outline effective, evidence-based instructional methods. For students to access the general curriculum, Individual Education Programs (IEPs) were developed for each student. The IEP details how the student will access the general education curriculum by including: 1) a statement of academic achievement, functional performance, and how the child's disability affects participation in the general education curriculum, 2) measurable, annual goals designed to increase performance/participation in general curriculum and meet individual student's needs, 3) a statement of special education and related services, supplementary aides and related services, and/or program modifications.

In terms of measuring progress, the NCLB Act outlined more specific criteria for measurement of learning and academic progress in students with disabilities, expecting that students with disabilities achieve the same standards as students without disabilities. The act required states to conduct annual testing aligned with state standards; however, states also had to meet adequate yearly progress demonstrated by improvement in test scores for the entire school as well as specific subgroup populations, including students with disabilities (Karger, 2005). Students with disabilities must be included in yearly assessments, and scores must be reported and counted toward adequate yearly progress. To accomplish this, several options for students with disabilities are available (American-Speech-Language-Hearing Association (ASHA), 2014). Some students with disabilities are required to take the same assessments as general education peers with no accommodations, and performance is scored on the general education state standards. Others take the same test and are scored on the same standards, but they receive accommodations such as extra time or use of technology (ASHA, 2014). Populations including severely disabled students may take alternate assessments based on alternate achievement standards (ASHA, 2014).

Despite the changes in testing participation and progress monitoring, there was little change in instructional methods for students with disabilities. The act developed the *Reading First* program for children who are at-risk for being referred to special education services or have a learning disability related to reading. The program aimed to implement effective reading strategies that would help children master reading by third grade (Karger, 2005). Supplemental educational services were to be provided outside of the regular school day for students at-risk and with disabilities attain proficiency on state standards (Karger, 2005). But one question remained, *how*?

Sight Word Approach to Literacy Instruction for Students with Developmental Disabilities

A recent review of reading instruction for students with developmental disabilities examined 128 studies conducted from 1975 to 2003 (Browder et al., 2006). Results revealed that majority of the 128 studies targeted sight word vocabulary acquisition using time delay, fading, or error correction procedures. After applying quality indicators for group design (Gersten, Fuchs, Compton, Coyne, Greenwood, & Innocenti, 2005) and single-subject design (Horner, Carr, Halle, McGee, Odom, & Wolery, 2005), the review suggested that such instructional methods are effective for sight word vocabulary acquisition for students with mild, moderate, and severe developmental disabilities.

Sight word vocabulary is an important part of learning how to read; however, solely teaching sight words will build a functional sight word vocabulary, but not true reading abilities. As reported by the National Reading Panel's study (2000), there are four other essential skills (i.e., fluency, comprehension, phonics, and phonemic awareness) that must be taught and mastered for reading.

Phonics-based Approaches to Literacy Instruction

The literature examining phonics and phonemic awareness instruction for students with developmental disabilities is extremely limited. Some studies have targeted a specific skill in isolation, while other studies developed a reading program to target multiple skills simultaneously. Studies reviewed included approximately 180 participants with mild, moderate, or severe cognitive disabilities.

Letter-sound correspondence. Hoogeveen, Smeets, and van der Houven (1987) conducted a study to determine the efficacy of the action mnemonic procedure with prompt-fading for teaching letter-sound correspondence to students with disabilities. In the action mnemonic procedure, graphemes were drawn into common objects whose sound is identical to the target phoneme (e.g., grapheme “s” was drawn into a snake since both make the /s/ sound). Other examples include the letter “r” drawn into an electric drill, “h” drawn into a dog breathing heavily, and “f” drawn into a bicycle pump. Features of the common object were gradually faded while the features of the grapheme were not so that association of the sound would transfer from the picture to the grapheme.

Participants were seven Dutch students ranging in chronological age from 10;2 to 19;8 years with mental ages ranging from 2;8 to 5;8 years. IQ scores ranged from 27 to 43 with an average of 37. Participants were able to discriminate highly-confusable lowercase letters and imitate words and phonemes, but unable to produce phonemes the associated phoneme for five lowercase letters. Twelve training items were chosen specifically for each participant based on letter-sound knowledge at pretest. Training items varied across participants with the exception that each grapheme must be targeted for more than one subject. The graphemes were divided into four sets of three, and participants were trained on one set at a time. The first phase of the study trained participants to associate the correct action sound (also the sound made by the target phoneme) with each pictured object and embedded grapheme. The second phase aimed to transfer the association to the grapheme only by gradually fading out the picture cues while leaving the grapheme unaltered.

A modified multiple baseline probe was used to assess participants' letter-sound correspondence (i.e., ability to provide the correct phoneme for each grapheme). All participants completed the training program in 5.45 to 14.35 hours with an average of 8.96 hours. There were 23,686 total trials. The average percentage of correct responses were displayed graphically, and individual scores are not reported. Analysis revealed zero level performance on pretraining probes and high performance for the final baseline probes (99.8%) and the follow-up probe collected after 14 days (99.8%). Scores decreased slightly on the follow-up probe collected after 100 days with an average score of 84.6%.

Although the action mnemonic procedure resulted in letter-sound correspondence learning, this procedure does not require phonemic awareness skills. The target phoneme is identical to the sound associated with the pictured object (i.e., panting dog makes the /h/ sound). This association is made without phoneme isolation. This strategy is effective for teaching letter-sound correspondence but it is unknown if this learning resulted in positive changes in phonemic awareness skills like isolation or blending.

Hoogeveen, Smeets, and Lancioni (1989) explored the efficacy of the first-sound mnemonic procedure in teaching letter-sound correspondence to students with disabilities and whether mastery of 23 Dutch letter-sounds would result in participants' ability to read syllables or words. In the first-sound mnemonic procedure, graphemes are the salient features for drawings of common objects whose name begins with the target sound (i.e., Dutch grapheme "Y" is drawn into an ice cream cone since the associated phoneme is the /ai/ sound). The features of the drawing are gradually faded, while the visual features of the grapheme remain. The first-sound mnemonic procedure requires phonemic awareness skills since students must first label the pictured object (i.e., ice water), and then isolate the initial sound to produce the target phoneme (i.e., /ai/ sound) associated with the grapheme (i.e., Dutch “Y”).

Four participants ranged in age from 8;4 to 13;4 and had IQ scores ranging from 47 to 68 with a mean score of 58. Exclusion criteria included having letter-sound correspondence for more than four letters or being able read words or sentences. During the last five months of the school year, training sessions occurred once or twice daily for 15 to 30 minutes. Participants received 33 to 39 hours of instruction with an average of 35 hours. The structured training program had six phases progressing from training on letter-sound correspondence to reading two syllable words. Training targeted nine vowels and 14 consonants with each letter corresponding to only one phoneme. The first-sound mnemonic procedure was only used in the first three training phases for letter-sound correspondence and reading syllables. Syllables and words for training were composed only of vowel sounds that had been mastered in Phase 1.

A modified multiple probe was used to measure participants’ progress throughout the study and three generalization probes were administered to measure reading ability of untrained words. At the conclusion of the study, one participant had reached the sixth phase (reading two syllable words), while the others ended in the fourth phase (reading CVC words) or fifth phase (reading one syllable CCVC or CVCC words). Rather than reporting individual scores, the mean percentages of correct responses on the pretraining, posttraining, and generalization probes were displayed graphically. The same words were tested on pre- and posttraining probes, and analysis revealed higher average performance on posttraining probes (96.6%). Generalization tests revealed that participants retained some ability to read untrained single words (85.4%), read sentences with trained and untrained words (90.2%) read whole sentences correctly (67.8%), and comprehend sentences with trained and untrained words (48.3%). Based on these results, the first-sound mnemonic procedure resulted in positive gains in participants' alphabet, blending, and decoding skills. Although there were some limitations, the authors posit that this method of instruction developed more advanced reading skills than the typical sight word instruction provided to students with intellectual disability.

Blending. Hoogeveen, Kouwenhoven, and Smeets (1989) developed an instructional program for students with moderate intellectual disability targeting blending skills. The effectiveness of the program was investigated in two separate experiments with the same participants. Training in the first experiment focused on word to word blending and establishing the meaning of the instruction "say together." Probes measured whether training in word blending generalized to blending smaller units. The second experiment determined whether using picture prompts during training resulted in greater abilities to blend a single consonant phoneme (C) to a VC syllable to form a CVC word, compared to training without picture prompts.

Eleven male and 11 female students with moderate intellectual disability participated in the study. Participants ranged in age from 7;0 to 16;9 years old. Their mental ages ranged from 4;2 to 9;0 years with an average of 6;3 years. All participants were nonreaders, and had IQ scores ranging from 40 to 67. Inclusion criteria included inability to blend two meaningful words into a compound word and inability to blend a single consonant sound (C) to a vowel-consonant syllable (VC) into a CVC word. Each of the 22 participants in this study was assigned to pairs based on mental age and preintervention probe scores.

There were two conditions in the first phase of the study, Instruction Training (IT) and Picture Naming (PN). All participants were trained in both conditions twice, and group membership only dictated the order of the four training conditions. During the IT condition, participants practiced blending two words into a compound word after being prompted to "put the words together" by the examiner. In the PN condition, participants labeled drawings of CVC words, and they did not practice blending in this condition. Probes were collected immediately before and immediately following each training condition. Items on each probe were identical and measured participants' ability to blend a single consonant phoneme (C) to a VC syllable.

Analysis of average scores revealed significant increases from pre-intervention to post-intervention during the IT condition, and average scores did not improve or decreased during the PN condition. Closer inspection of individual participants' gain scores from pre-intervention to post-intervention probes for both conditions revealed exceptionally high gain scores (i.e., gains of 13, 14, 15, 16, 23, or 25 points) for four subjects. Gains scores for all other subjects ranged from zero to six points. This parallels the implications from a similar study (Hoogeeven & Smeets, 1988) that revealed that for students with intellectual or other disabilities, explicit training in blending is necessary at the word, syllables, and phoneme level since training using larger units (word to word blending) did not transfer to the more difficult task of blending smaller units (blending C to VC units).

Two participants did not complete the first experiment, so they were not eligible for participation in the second experiment that the use of pictorial prompts as support for blending single consonant phonemes (C) to vowel-consonant syllables (VC) to form CVC words. Participants were separated into pairs based on the final postintervention probe administered in Experiment 1. Each member of the pair was randomly assigned to one of two conditions, Picture Prompting (PP) or No Prompting (NP). The picture prompts were the same drawings used in the Picture Naming condition in Experiment 1.

In the first step of the PP condition, the examiner modeled the target CVC word, and the participant imitated the word while pointing to the picture. In the second and third step, participants practiced blending units into the target word with 0.8 and 1.1 second pauses between units (i.e., In step two, examiner says, "Say together, c…at," with a 0.8 second pause between the consonant and VC syllable) with picture prompts to support blending. Picture prompts were removed, and there was a 1.1 second pause between units during the fourth and final step. In the NP condition, all four steps were the same except that pictures were never used. Training on steps continued until criterion was reached for the last step, or training was discontinued if a participant reached a cumulative total of 820 trials before completion of the last step.

The same 30-item probe for blending C to VC units used in the first experiment was used to measure progress in the second experiment. Four participants did not complete the program—one participant in the PP condition and three participants in the NP condition. For the Picture Prompt group, average blending accuracy was relatively high while picture prompts were used to support the verbal prompt (i.e., "say together") on the second (71.9%) and third (87.7%) steps, but average performance decreased to 58.5% once the picture prompts were removed on the final step. In contrast, for the No Picture group, blending accuracy increased across steps, earning the highest average performance (89.4%) on the final step. Results indicate that blending without picture prompts is more difficult at first since participants are trying to understand the task; however, this type of training produced significantly greater gains on post-intervention and generalization probes.

Hoogeveen and Smeets (1988) created an eight-phase training program to teach blending and single word reading to students with moderate to severe intellectual disability. Participants were seven Dutch students with IQ scores ranging from 30 to 51 with a mean of 43. There were four boys and three girls ranging in age from 8;8 to 17;9 years with an average age of 12;6 years. Eligibility criteria included the ability to produce correct phonemes for 12 or more lowercase letters 1.5 seconds after presentation and to identify names of common objects to be used during training. In addition, participants must be unable to blend phonemes into meaningful words or read meaningful words.

Training sessions occurred three to four days per week for 20 minutes. Phases 1-6 developed blending skills with units of increasing complexity including two words, two syllables, one syllable and one phoneme, and two phonemes using the prompt “Participant, say fast rain…drop”. The pause between units was increased from 0.8 seconds to 1.1 seconds to 1.5 seconds on specific substeps of Phases 1-6. Phases 1, 2, 3, and 5 used picture supports since targets were meaningful words; Phases 2 and 6 did not use picture supports since targets were meaningless words. Phases 7-8 targeted one syllable word reading including CV, VC, and CVC words. Phases 7-8 did not have any substeps or picture supports, but training on word reading continued until participants read 95% of the training words correctly. The words in Phases 7 and 8 were composed of letters the participants could read and had 41 and 38 words, respectively. Materials included white cards with either pictures of common objects or two- to three- letter printed words.

A multiple probe technique was used to evaluate participants’ progress during the program. All seven participants completed the program. Analysis of pre- and posttraining probes support the program’s sequence of skill building since blending two words was completed in the lowest average number of trials, or with the least difficulty. Blending two syllables had double the average number of trials for words, and two phonemes had double the average for syllables. All participants had the most difficulty with blending two phonemes to create both meaningful and meaningless CV and VC words (Phases 5 and 6); consonant to vowel blending is more difficult than vowel to consonant blending. Although participants had acquired letter-sound correspondence and blending skills, they had difficulty reading words in the last two phases, specifically CV words. Participants were able to produce individual phonemes the individual phonemes, but struggled to blend the phonemes into the target word.

Results reveal an expected developmental pattern of blending skills with smaller units being more difficult than larger units (i.e., blending words was easier for participants than blending syllables or phonemes). This study supports teaching blending skills to students with disabilities in a progressive sequence and providing visual cues as additional support for blending units correctly. Additionally, although participants learned letter-sound correspondence and blending skills, they struggled to apply this knowledge to successfully read two-letter words. This suggests that students with disabilities need explicit instruction and extended practice in phoneme blending before they are able to successfully decode CV, VC, or CVC words.

Segmentation. A series of two studies investigated the efficacy of a training program focusing on teaching final phoneme segmentation to students with moderate intellectual disability (Hoogeveen, Birkhoff, Smeets, Lancioni, & Boelens, 1989). The first experiment in the study aimed to establish the meaning of the prompt (i.e., "What is the final sound in…?), and the second experiment investigated time-based stimulus manipulation by systematically decreasing the pause between stimulus items. The same 16 participants were included in both studies, nine males and seven females. Chronological ages ranged from 6;3 to 19;5 years with an average of 13;0, and mental ages ranged from 4;5 to 9;0 with an average of 6;5 years. Participants were diagnosed with mild, moderate, or severe impairments since IQ scores ranged from 35 to 72. All participants were nonreaders, and the only specified inclusion criterion was the inability to isolate final consonants in CVC words.

The first study investigated attempted to train participants to repeat the last of two sequentially presented phonemes. There were two conditions, Direction Training (DT) and Picture Pointing (PP). All participants were trained in both conditions. Participants were assigned to pairs based on preintervention probes, and each member of the pair was randomly assigned to Group 1 or Group 2. The only difference between groups was the order in which training conditions were presented. Eight target phonemes (/f/, /g/, /k/, /m/, /p/, /r/, /s/, and /t/) and eight CVC words ending with one of the target consonant phonemes (roof, rug, book, gum, lip, car, bus, and rat) were chosen. The Picture Pointing (PP) condition used 90 stimulus cards depicting CVC words, each ending with one of the eight target phonemes. The examiner presented sets of nine pictures and instructed the participant to point to a specific object (e.g., "Point to….roof"). The Direction Training (DT) condition had two steps, imitate models of the target phonemes and respond to the "final sound" prompt (i.e., Examiner says, "What is the final sound in /k…t/?" with a 1.5 second pause between phonemes). Training continued until participants reached 18 out of 20 correct on two consecutive trials.

Probes were administered immediately before and immediately after training and consisted of 30 meaningful CVC words and 30 meaningless CVC words. Participants repeated the entire CVC word instead of segmenting the final sound for 97% of words on preintervention probes and 96.6% on postintervention. This is not surprising since phoneme segmentation was not explicitly taught during training, and participants did not have any practice segmenting the final sound from a CVC word during training—training items for teaching the "final sound" command included two phonemes separated by a pause.

The second study determined whether there would be any differences in final phoneme segmentation abilities if training used real words or nonsense words. The same pairs from Experiment 1 were used, and each member of the pair was randomly assigned to the real word or nonsense word condition. Each participant only received training in one condition. Participants practiced identifying the final sound from prompts consisting of CV and C units separated by a pause. The length of the pause gradually decreased from 1.5 seconds to 0 seconds in five steps.

All subjects successfully completed the training program. Scores on the preintervention probes were essentially zero, while average scores on postintervention probes for both real words and nonsense words were approximately 90%. Participants in both conditions scored higher on the probe correlating with training condition word type (i.e, participants trained with real words score higher on real word probes than nonsense word probes). Since generalization probes consisted of only meaningful words, not surprisingly, participants trained using real words performed significantly better than those trained with nonsense words on the generalization probes.

It has been shown that students with disabilities struggle to generalize learning to other skills, and this was confirmed by the first experiment when participants were simply trained to repeat a phoneme not to segment phonemes. This study highlights the important point that students with disabilities must receive explicit instruction in a skill if they are to improve that skill (i.e., the study must explicitly teach final phoneme segmentation for participants' segmentation skills to improve). Participants showed more improvements in final phoneme segmentation in the second experiment since training items were similar in presentation to the probe items. Gradually decreasing pauses between units for segmentation may be an effective strategy for teaching phoneme segmentation to students with intellectual disability.

A study investigated the ability of students with moderate intellectual disability to segment sentences into words and words into syllables and phonemes (Gottardo & Rubin, 1991). Seventeen students attending special education classes in three different public schools ranging in age from 10 to 15 years participated. Participants were grouped according to the type of reading instruction they were receiving at school. Four participants received code-emphasis (i.e., phonics-based) reading instruction targeting letter-sound correspondence, phonemic awareness, and orthographic rule training with controlled vocabulary. The remaining 13 participants received whole-word reading instruction with some attention to initial sounds. Tasks were administered in three 30-minute sessions, and colored blocks were used as a visual aid. For all students, average performance on word counting tasks (83%) was higher than counting syllables (78%), and performance on phoneme counting tasks was the lowest (51%). Although segmentation skills at the word and syllable level were similar for both groups, participants receiving code-emphasis instruction in the classroom performed significantly better on phoneme manipulation tasks.

Results suggest that manipulation at the word and syllable level were easier than phoneme manipulation tasks. These findings parallel findings from studies investigating blending abilities of students with disabilities (Hoogeeven & Smeets, 1988). Participants receiving code-emphasis reading instruction performed better on phoneme tasks suggesting that this type of reading instruction is more effective than whole-word instruction when teaching phonemic awareness to students with disabilities at the phoneme level.

Direct instruction programs. The Direct Instruction System for Teaching Arithmetic and Reading (DISTAR) is a phonics-based reading program that was created in the 1960s for preschool and kindergarten students (Bereiter & Engelmann, 1966). It was originally developed for students from low socioeconomic status who typically have low language abilities upon entering school, but the program has been used with a variety of populations. The DISTAR Reading Program uses explicit strategies to teach early reading skills like letter-sound correspondence, blending, and rhyming, while the DISTAR Language Program focuses on semantic, syntactic, and pragmatic skills (U.S. Department of Education, Institute of Education Sciences, What Works Clearinghouse, 2007).

One study implemented the DISTAR Reading Level I program with students with moderate intellectual disability (Bracey, Maggs, & Morath, 1975). Participants were six children ranging in age from 7;0 to 14;0 with IQ scores between 30 and 40. All participants had been institutionalized for a minimum of five years and were unable to sound out single words. Students received group instruction from the classroom teacher for 15 to 30 minutes daily. Throughout the day, participants completed workbook activities and worksheets individually. Token reinforcements were used in conjunction with the reading program. Researchers administered 19 pre- and posttests accompanying the DISTAR program, although pretests were not administered until the intervention had been implemented for several weeks. No testing was administered before intervention began. Tests measured participants' ability to identify sounds, blend sounds, and read words. Participants made significant gains from pre- to posttest on 14 of 19 tests suggesting that students with intellectual disabilities can learn early reading skills if skills are practiced daily. If more than 15 to 30 minutes of instructional time was devoted to early reading skills, students with disabilities could make even greater gains on literacy skills.

A two-year, longitudinal study investigated the efficacy of the DISTAR Language program by implementing a true experimental design with random assignment of participants to an experimental or control group (Maggs & Morath, 1976). Participants were 28 children with moderate to severe intellectual disability living in an institution in Australia. Participants ranged in age from 6;0 to 14;0 years, and IQ scores ranged from 20 to 45. The experimental group received instruction from the DISTAR Language Program for one hour daily, while the control group received one hour of instruction from the Peabody Language Kit or teacher-created language programs. The pre- and posttest assessment battery measured basic concepts, verbal comprehension, and IQ scores. Results revealed significantly greater gains for the experimental group, specifically increasing mental age by an average 22.5 months, while the control group only increased mental age by an average of 7.5 months. This finding suggests that one hour of language instruction from the DISTAR program can result in improved overall intellectual abilities as measured by mental age.

Gersten and Maggs (1982) conducted a five-year, longitudinal study examining the long-term effects of the three levels of the DISTAR Reading and Language Programs on students with moderate to severe intellectual disability. The reading program targets decoding by teaching phonics skills and comprehension, while the language program targets receptive and expressive language. Participants were 12 students enrolled in special education in a public school in Australia ranging in age from 6;0 to 12;6. Seven students were male, and five female. Four students had Down syndrome. All participants had limited previous language instruction and no prior reading instruction. Language instruction was implemented for 30 minutes daily for six months. After six months, the teacher believed that participants' language skills were "sufficient enough" to begin reading instruction. DISTAR Reading and Language instruction were implemented daily for the remainder of the five year study. Pre- and posttest measures included the Stanford-Binet IQ test with the Peabody Picture Vocabulary Test (PPVT) as a concurrent validity measure, the objective-referenced Baldie Language Ability Test, and the norm-referenced Neale Analysis of Reading. At posttest, results revealed a significant gain of 5.8 points (adjusted for the regression phenomenon) in IQ scores, and average reading performance equivalent to an early third grade level. Results from this study suggest that long-term, daily instruction in reading and language results in improvements in IQ scores and reading abilities for students with intellectual disabilities.

Other reading programs. MacAulay (1968) designed a study combining traditional operant conditioning techniques with a special program for teaching speech and early reading skills to students with intellectual disability. Participants were all nonverbal or severely limited in verbal abilities ranging in age from nine to 15 with IQ scores between 28 and 80 at pretest. Some participants had concomitant disorders such as hearing loss and autism. Prior to intervention, all 11 participants' verbal behavior was observed. The program was developed based on observations and was tailored to address the specific needs of the participants. Session length varied from 20 to 60 minutes. The first two steps focused on teaching 31 individual sounds (i.e., consonants, short vowels, long vowels, and digraphs except for /wh/, /ð/, and /ʒ/) in isolation. While the examiner pointed to a printed letter, participants were asked to imitate the examiner's models, then to identify sounds independently. As additional cues for correct production, consonants were black and each vowel had a corresponding color. The sounds were reviewed in isolation during the third step, and blending instruction began on the fourth step. The fourth step taught phoneme blending using flashcards and hand cues with the 31 previously trained phonemes. The examiner used models and hand cues to teach blending phonemes into words using the 31 previously trained phonemes. The fifth focused on learning new words. The sixth step tested retention and comprehension of these words, and word productions on tests were assigned an intelligibility rating of good, fair, or poor.

Progress was reported individually in a case study format, and the same information was not provided for each participant. There is virtually no information reported on participants' blending performance during the program. Six participants remained in the first three steps for the entire study. All six were able to produce some intelligible sounds in isolation, improving from few to no sounds at pretest. The remaining participants learned three, seven, nine, except on participant who learned 47 words with good pronunciation. The same participant, who had the highest IQ score at pretest, also learned four understandable phrases. Participants who learned new vocabulary words were able to point to the corresponding picture for some words that they were not able to pronounce, suggesting that they had learned the concept of the word and pronunciation may follow with repeated practice. An implication from this study is that instruction is effective when tailored to the needs participants in the study. Importantly, this study suggests that even nonverbal students can learn letter-sound correspondence, vocabulary concepts, and good pronunciation of vocabulary words when given explicit instruction in these skills.

A similar phonics-based instructional program was designed for students with intellectual disability who had some reading abilities from prior instruction (Nietupski, Williams, & York, 1979). This investigation of the reading abilities of students with disabilities is unique since it is one of the few that embedded phonics instruction in a reading context, rather than teaching phonics skills in isolated, drill activities. Six students aged 11 to 15 years with IQ scores ranging from 42 to 54 participated in the study. Participants were able to imitate vowels and consonants in isolation, discriminate between sounds, label all alphabet letters, list two words beginning with each alphabet letter, label printed consonants, sort pictures based on initial letter, and recognize sight words at the preprimer level. The program had three major goals: 1) facilitate more accurate word blending by using the “say it fast” prompt, 2) use “fun activities” such a board games and word wheels during instruction, and 3) incorporate phonics into reading and reading related activities. Instruction was delivered in individual and group settings. Four of the five participants had completed the program, and the other student was in the final stage of instruction by the end of the school year.

One weakness of this study is a lack of formal testing before beginning the program that can be compared to testing after completing the program. Another weakness is the task selected for the bi-weekly probe measuring progress across the program. Probes consisted of 10 rows of 10 letters. Lowercase letters *a, e, i, o, u* representing short vowel sounds were randomly ordered, and participants had to provide the appropriate short vowel phoneme for each letter. A rate of sounds per minute was calculated based on the number of correct responses in 30 seconds. The probe did not measure letter-sound correspondence for long vowels and consonants or reading VC and CVC words (i.e., skills that were practiced in games and instruction). Although the study has some limitations, it emphasizes the importance of incorporating phonics instruction for students with disabilities into reading activities. Other studies from the 1980s did not recognize the importance teaching phonics while reading, and only a few more recent studies have taught phonics skills to students with disabilities in a reading context.

The Four Blocks Literacy Program (Cunninham, 1999) consists of a basal block, literature block, word block, and writing block. The program was designed for students in general education, and Hedrick and colleagues were the first researchers to investigate the efficacy of this program for students with intellectual impairment (Hedrick, Katims, & Carr, 1999). Nine students with an average age of 9;8 participated in the year long study. Seven participants were classified with mild intellectual impairment; three of these students had Down syndrome, and one had Fragile X syndrome. The other two students were diagnosed with severe learning and language disorders with concomitant low-normal IQ scores, severe ADD or ADHD, and seizure disorders. IQ scores that were reported ranged from 40 to 76.

The teacher delivering the instruction had a master's degree in special education, and instruction in each block occurred for 45 minutes. In addition to the four literacy four blocks, there was a daily math block and on alternating days, a social studies or science block. Participants read the same texts in the basal block and engaged in choral reading, reading in pairs, playing roles, or individual reading. Participants were free to choose their own reading material during the self-selected reading block, and shared what they read with others. The working with words block focused on sight words, sorting words by initial sounds or spelling patterns, and building target words with cut-out letter tiles. High frequency words and words with irregular spelling patterns were displayed on the word wall. The writing block aimed to use the writing process to reinforce oral and written literacy skills and to provide opportunities for students to write and share with others. This block was the most difficult for the participants since they had little to no opportunities for writing prior to participating in this program, and the teacher often had to provide models for copying at the beginning of the school year. Toward the end, students began to use invented spelling for difficult words in more writing activities. The teacher also engaged students in editing by writing sentences on the board, modeling self-thinking aloud, and interacting with students to correct the sentence.

Reading abilities were assessed using the Brigance Diagnostic Inventory of Basic Skills (Brigance, 1983), Test of Early Reading Ability-2 (TERA-2; Reid, Hresko, & Hammill, 1989), Analytic Reading Inventory, and informal measures. Narrative retell skills and writing skills were also assessed. Writing samples were collected throughout the year and evaluated against

Sulzby's (1989) continuum of writing behaviors include drawing, scribbles, letter strings, invented spelling, and conventional spelling. On the Analytic Reading Inventory at pretest, all participant but one read below a 50% level on preprimer word lists. At posttest, seven participants had made gains on the preprimer list, while one reached a first-grade level and another reached a third-grade level. Gains were not made on comprehension, and some participants most participants doubled their scores on story retelling measures. Analysis of writing behaviors over the year revealed strong positive improvements in invented spelling and progress toward conventional writing abilities.

The authors suggest that with some adaptations to the original program, the Four Blocks Literacy Program can facilitate the literacy skills of students with intellectual disability. This study shows that students with disabilities can not only engage in reading, writing, and spelling activities, but also that long-term, daily practice in reading, writing, and spelling will result in improvements in these skills.

Comprehensive Literacy Programs for Students with Developmental Disabilities

Recent studies have suggested that students with mild to severe disabilities have the potential to develop meaningful literacy skills given intense, comprehensive, phonics-based instruction (Allor, Mathes, Roberts, Cheatham, & Champlin, 2010; Browder, Ahlgrim-Delzell, Flowers, & Baker, 2008). The Early Literacy Skills Builder curriculum was developed specifically for students with severe disabilities and implemented a control group design (Browder et al., 2008). The experimental group was explicitly taught phonemic awareness skills such as phoneme blending and segmentation to facilitate decoding skills. The control group received literacy instruction as outlined by their Individualized Education Program (IEP), often focusing on sight word or picture identification. Pre- and post-test literacy assessments included two standardized tests and two tests developed by the research team (Browder et al., 2008). Results revealed that students who received instruction following the Early Literacy Skills Builder curriculum made significantly greater gains than students in the control group (Browder et al., 2008).

Allor and colleagues investigated the efficacy of reading program using direct, comprehensive, phonics-based instruction to teach early literacy skills to students with intellectual disabilities (Allor, Mathes, Roberts, Cheatham, & Champlin, 2010). The longitudinal study was conducted over four years, and resulted reported are from the end of the first three years. Fifty-nine students participated in the study, 34 in the experimental group and 25 in the control group, and IQ scores ranged from 40 to 69. Participants were in first through fourth grade at the start of the study and were randomly assigned to groups. Participants in the control group received typical special education instruction as outlined by their schools. Fourteen of these students' typical instruction followed a structured curriculum, while the other 11 students typically engaged in writing their name, naming letters, or listening activities. Participants in the experimental group received daily instruction in small groups for 40 to 50 minutes by trained "intervention teachers." Instruction focused on integrating and applying concepts of print, phonological and phonemic awareness, oral language, letter knowledge, word recognition, vocabulary, fluency, and comprehension (Allor et al., 2010).

An assessment battery measuring phonological awareness, expressive and receptive vocabulary, word reading, and language abilities was administered before the start of the longitudinal study (pretest), at the end of each school year, and after four years of the study (posttest). In addition, *Dynamic Indicators of Basic Early Literacy Skills* (DIBELS; Good & Kaminski, 2002) was used to monitor monthly progress on Phoneme Segmentation Fluency, Nonsense Word Fluency, and First-Grade Oral Reading Fluency. At the end of the first three years of instruction, the experimental group demonstrated significantly greater gains on the standardized assessment battery when compared to the control group (Allor et al., 2010). Gains in DIBELS scores significantly favored the experimental group for all three subtests.

Results longitudinal studies of direct, comprehensive reading programs consistently reveal that this type of instruction is more effective than the typical reading instruction for students with disabilities. Although there is still more research needed to determine effective methods for teaching reading to students enrolled in special education, current research confirms that reading instruction must target prerequisite reading skills such as letter-sound correspondence, phoneme segmentation, and phoneme blending for reading abilities to develop. In addition, long-term programs provide the opportunity for significant improvements in phonics skills, phonemic awareness, and decoding abilities of students with disabilities.

The Process of Encoding

Encoding is the process of building words by applying the alphabetic code to convert speech sounds to print. This process highlights the relationship between spoken and written language (Herron, 2008; Weiser, 2012; Weiser & Mathes, 2011). When encoding, the first step is to pronounce the target word, immediately activating meaning and pronunciation in the left hemisphere (Herron, 2008). Next, the word is segmented into phonemes, starting with the initial sound. Once the target phoneme has been isolated, alphabetic code knowledge is activated to determine which letter makes that particular sound. The process of segmenting each sound and matching it to the appropriate letter is repeated until the entire word is constructed (Herron, 2008). Decoding is the reciprocal of encoding. It is the process of reading words by converting print to speech. When decoding words, visual processing is activated to identify each letter, and then, alphabetic code knowledge is activated to identify the corresponding phoneme (Herron, 2008; Weiser, 2012; Weiser & Mathes, 2011). Once all letter-sound matches have been made, the phonemes are blended into the target word. Meaning is activated last, and only if the phonemes have been blended successfully.

While most believe learning to read is a decoding process, Herron (2008) argues that encoding is a more effective approach to teaching phonics and phonemic awareness. For students who are just learning the alphabetic principle, decoding words that do not follow conventional rules is very difficult. When teaching from an encoding framework, students start by building simple, predictable words that follow the alphabetic principle. Encoding does not demand conventional correctness for success. Instead, students use their current knowledge to produce a spelling attempt that is gradually shaped through feedback, practice, and increased phonological knowledge. Invented spelling attempts are encouraged and thought to provide vital information about the child's phonological system. Encoding activities are rooted in meaningful interaction with text, such as reading or writing a story. Words can be handwritten or constructed by manipulating letter tiles, letter cards, or plastic letters (Herron, 2008; Weiser, 2012). Encoded words or sentences provide a platform for students to practice segmenting phonemes, blending phonemes, substituting phonemes, or even decoding their own writing.

Spelling Development

Spelling development does not happen in a sudden burst of insight once children reach kindergarten; rather, the process begins in infancy through daily interactions with language and print in the environment. Scribbling can begin as early as 18 months (Cattel, 1960), and toddlers enjoy it for both the motor movement and the visible traces that their actions produce (Gibson & Yonas, 1968). By age 3 or 4, children identify writing as different from drawing (Lavine, 1977), and their scribbling begins to resemble adult writing (Gentry & Gillet, 1993). Although three-year olds have some concepts about print, evidenced by early "writing" and recognizing familiar words in the environment, they do not understand that alphabetic writing represents each sound in a spoken word (Lavine, 1977). Instead, preschool-age children believe that written words correspond with word meaning, hypothesizing that larger objects or people should be spelled with more letters than smaller objects or people (Ferreiro & Teberosky, 1982; Levin & Korat, 1993; Levin & Tolchinsky Landsmann, 1989). More experiences with print guide children to realize that spoken and written language are related at the level of individual sounds or phonemes. In other words, more experiences with print will facilitate phonics and phonemic awareness skills. When children have this realization, they will naturally attempt to spell words using existing knowledge of both spoken and written language.

Invented spelling. Children's unconventional attempts at spelling words are known as invented spelling. Children use invented spelling prior to and during early reading and writing instruction (Niessen, Strattman, & Scudder, 2011), and invented spelling relies on current knowledge of print, letter names, and letter sounds (Ahmed & Lombardino, 2000). Charles Read was one of the prominent researchers to investigate children's spelling patterns. While examining the spellings of young untutored children for insights into speech perception, Read (1975) noticed repeating patterns of spelling attempts for the same words. Upon further analysis of these errors, Read determined that the errors had a phonetic basis and confirmed this consistent pattern across preschool children (Read, 1975). Results determined that patterns of sound categorization are a crucial influence on early spelling development (Read, 1975) and can provide much information about a child's phonetic relationships between spoken and written language. These errors suggest that spelling is not a passive process that simply relies on rote memorization, but that spelling is an active process that involves coordinating and applying current phonological and phonemic awareness.

Stages of developmental spelling. Gentry (1982, 1984) further explored patterns in children's spelling and identified five major stages of spelling development with specific orthographic characteristics distinguishing one stage from the other (1987). His work confirmed Read's (1975) find that spelling is an active process of testing, reconstructing, and reorganizing orthographic knowledge (Gentry, 1988). Although spelling development has been organized into stages, children do not travel through the stages in a linear progression; in fact, children may use spelling patterns characteristic of several stages in the same composition. If children attempt to spell words that are more complex than their current knowledge level, patterns of invented spelling will be seen. Older students and adults will also use early patterns of invented spellings when they are asked to spell unfamiliar words. Spelling attempts are classified, not the speller (i.e., Johnny produces spelling attempts from the Precommunicative stage, not Johnny is a Precommuicative speller).

Children begin to "spell" by using a combination of capital letters, lowercase letters, and numbers to represent their message. This first stage of spelling development is known as the Precommunicative Stage (Gentry, 1984). As shown in Table 1.1, children use three different strategies during this stage (Norris, 1989; "Stages of Writing," n.d.). When using the Prephonemic strategy, children create long strings of random letters and/or numbers that do not follow the alphabetic principle. When children use the Early Phonemic Strategy, the alphabetic principle is applied to the initial letter(s), but random letters form the rest of the word. When using the Letter-name Strategy, children represent one or more syllables with letter names rather than letter sounds.

The second stage of spelling is called the Semiphonetic Stage since partial phoneme and syllable representations are seen in this stage. Application of the alphabetic principle is demonstrated for some but not all of the word. The same phonological processes seen in speech development such as final consonant deletion or cluster reduction are also seen in spelling development.

Table 1.1
Gentry's Stages of Developmental Spelling

Stage of Spelling	Example	Description
1. Precommunicative Stage	A 7 u b t 0 ooo D F	Combination of capital lowercase letters and/or numbers, incorrect spacing
1a. Prephonemic Strategy	L o 3 p u u y H 7 i d *dinosaur*	Random letters/numbers that do not follow alphabetic principle
1b. Early Phonemic Strategy	D t r p s / *dinosaur* B U p R a / *bottle*	Apply alphabetic principle knowledge to initial letter with random letters following
1c. Letter-name Strategy	AT / *eighty* LFNT / *elephant*	Represent syllable/sound with letter-name
2. Semiphonetic Stage	Mtr / *monster* E / *eagle*	Partial phonemic/syllable representations Phonological processes seen
3. Phonetic Stage	Mostr / *monster* Egl / *eagle*	All phonemes are represented, but spelling is unconventional
4. Transitional Stage	Monstur / *monster* Eegel / *eagle*	Begin to use orthographic principles and patterns unconventionally
5. Conventional Stage	Monster Eagle	Complete and correct orthographic representation

Sources: Gentry, 1988; Norris, 1989

The third stage is the Phonetic Stage when children realize that several discrete sounds are sequenced together to form a word. Each sound in the word is represented based on salient phonetic features, but all phonemes are not represented conventionally. Although visual aspects of the word are not considered in this stage (Gentry, 1984), an unfamiliar reader would likely be able to determine the target word from the incorrect but phonetic spelling. In the fourth stage, the Transitional Stage, spelling attempts use orthographic principles unconventionally (i.e., lazie for lazy). Conventional spellings are formed when the alphabetic principle and orthographic rules have been applied correctly. According to Mellon (1975), most typically developing children become conventional spellers around nine years old. Changes and errors in invented spellings reveal the child's current level of letter-sound correspondence, spoken and written phonology skills, and mastery of orthographic principles.

Underlying Skills in Speech and Spelling

Although they are different modalities, spoken and written language share many of the same linguistic features including phonological, pragmatic, semantic, syntactic, and morphological skills (Blood, Mamett, Gordon, & Blood, 2010). Specifically, spelling depends on understanding the relationships between phonemes and graphemes (Ehri, 2000; Treiman & Bourassa, 2000). Children must not only segment the spoken word into individual phonemes, but also select the appropriate grapheme to represent that phoneme (Ball & Blachman, 1988). If children cannot master these basic phonemic awareness skills in speech, they will not be able to apply them while spelling. Similarly, children display phonological processes in speech—whether developmentally appropriate or not—that are seen in Semiphonetic Stage spelling attempts. Such processes include, but are not limited to fronting, devoicing, final consonant deletion, cluster reduction, or devoicing (Hoffman & Norris, 1989). When spelling a word, the child is segmenting a word into phonemes and then matching each phoneme with the appropriate grapheme.

Banajee (2007) used Phonic Faces contextualized in an illustrated story to teach early reading skills to three children (5;0, 6;1, and 8;9 years) with severe speech and physical limitations, including one child with Down syndrome and two with cerebral palsy. Phonological awareness skills were generally in the poor to very poor range for all subjects, and all scored below the preprimer level on reading measures. Students learned two target letters and letter-sounds during each session, one using plain print and one using Phonic Faces. Phonic Faces (Norris, 2001) are picture cards that provide cues for the placement (i.e., lip, tongue, or teeth) involved in producing the corresponding sound, as well as voicing features associated with the phoneme. For example, the letter "p" is drawn in the mouth of a character with the vertical line representing stopping the air within the mouth and the curve representing the top lip popping the air from the mouth using the lips (see Figure 1.1 below). The Phonic Faces were contextualized within storybooks featuring that target sound. Results showed greater improvements for all three subjects during the Phonic Faces Storybook phases for letter names, letter sounds, and sound in word positions. Improvement was also seen in the pre and posttest scores on seven measures of phonological awareness (i.e., rhyming, deletion, substitution, isolation, segmentation, blending and graphemes) and on word recognition, and silent and oral reading.

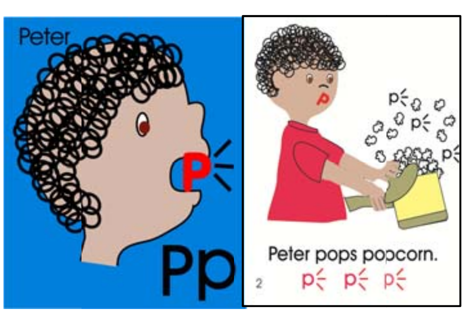


Figure 1.1 Example of a Phonic Face card and contextualized story for letter "p."

Delrose (2014) conducted a pilot study investigating the guided and spontaneous spelling abilities of three students with developmental delays. An encoding procedure was used to build five target words, and words for encoding were embedded in a written narrative. A cloze procedure and Phonic Faces were used to facilitate encoding during guided spelling. Participants completed encoding probes independently for the same five target words prior to and following intervention. Spelling attempts on probes were classified according to Gentry's stages of spelling development, and changes in spontaneous spelling and writing were tracked. According to pretest measures, all participants appeared to have strong letter-sound correspondence; however, during intervention, all did not demonstrate the ability to apply the alphabetic principle learned rotely to the process of encoding. One participant consistently created spelling attempts that were characteristic of the Precommunicative Stage of spelling using recognizable upper- and lower-case letters that did not represent alphabetic principle knowledge. Two participants were able to increase conventional spelling of target words from pre- to postintervention probes and demonstrated a major shift toward applying the alphabetic principle during encoding. Results suggest that students with developmental delays have the potential to acquire the ability to apply the alphabetic principle when given explicit instruction and practice. Qualitative analysis of spontaneous writing revealed that Subject 3 was able to write sight words that she had learned, but was not able to correctly decode sight words when translating her written message into a spoken message.

These findings suggest that learning about reading, phonemic awareness, and the alphabetic principle occurs effectively in a contextualized language condition. They also suggest the speech production cues depicted by Phonic Faces provide concrete cues that assist developmentally delayed children to discover the alphabetic principle and to use the alphabet for encoding and decoding. This study will expand on the findings of Delrose (2014) to address the following questions:

1. Will improvements in targeted letter-name and letter-sound associations be produced during the weeks when contextualized encoding is implemented?
2. Will improvements in developmental spelling be produced during the weeks when contextualized encoding is implemented?
3. Will improvements in standardized measures of phonemic awareness, spelling, alphabet knowledge and articulation be found following intervention?

METHODS

This study investigated whether encoding practice embedded in a narrative context would improve participants' developmental spelling patterns across intervention sessions, and whether scores on measures of phonological awareness, alphabetic knowledge, print knowledge, language abilities, and spelling would improve following 18 intervention sessions.

Setting

School. This study was conducted at a Title I, inner city public elementary school in Louisiana. There were 516 students enrolled during the 2013-2014 school year with approximately 95% of students eligible for free or reduced lunch (U.S. Department of Education, Institute of Education Sciences, & National Center for Education Statistics [USDOE, IES, & NCES], 2013-2014). The school population is not racially diverse and is composed predominately of African-American students (85%). Other races represented include Hispanic (11%), Caucasian (1%), Asian/Pacific Islander (1%), and multiracial (1%) (USDOE, IES, & NCES, 2013-2014). Eleven percent of students are enrolled in special education (Louisiana Department of Education, 2015). According to available data on statewide standardized testing administered during the 2013-2014 school year, 73% of the entire school population performed at grade level or above grade level. Only 36% of students with disabilities performed at or above grade level.

Classroom. All participants from this study were enrolled in special education and had the same special education teacher. Participants spend most of the day in the special education classroom, but a portion is spent in general education classroom with mainstream peers. The special education teacher has a bachelor's degree and has been teaching special education for 16 years. She has been teaching at this school for the past two years. Although the teacher has an aide, the aide does not remain in the special education classroom for the entire day. The aide accompanies older students while they attend general education classes, and she does not often assist with the younger students.

Participants. Five students, ranging in age from 6;6 to 9;10 and in grade from kindergarten to third, participated in the study. There were four males and one female. All participants were African-American. Three students had a diagnosis of developmental delay, and two of those students had a comorbid diagnosis of ADHD. One student had a diagnosis of specific learning disability, and one student was on the autism spectrum. Most participants had repeated one grade. All of the participants used oral language as a primary communication mode, were able to handwrite independently, did not have vision or hearing problems, and spoke English as a first language. All participants' parents signed and returned consent forms for participation in the study.

Language skills were measured by the TOLD:P4 Oral Picture Vocabulary subtest and the DELV Syntax subtest. Vocabulary skills were poor with the exception of Subjects 2 and 3 who scored in the low average range. Syntax scores were very poor or poor for all subjects except Subject 3 as measured by the DELV. The decoding scores were also very poor for all subjects, although the normative data did not go below 85 for the two children who were 6;6 years. Both scored 0 on all decoding tasks. The older students knew enough sight words to read simple sentences but guessed completely wrong on unfamiliar words.

Participants' articulation errors were documented and taken into consideration when analyzing spelling errors. In addition, students' degree of dialectal variation was documented and taken into consideration when analyzing spelling errors. All participants' dialect varied from Standard American English (SAE) to some degree. Most participants' dialect has strong variation while one participant showed some variation from SAE. Table 2.1 presents a profile of the participants including age, gender, grade, repeated grades, language levels, degree of dialectal variation, and disability.

Table 2.1
Demographic Characteristics and Profile of Participating Subjects

Sub	**CA**	**Sex**	**Gr**	**Grade Repeat**	**TOLDP Vocab SS=Rate**	**Dialect Var**	**DELV Syntax SS=Rate**	**Decoding**	**Diagnosis**
1	6;6	M	K	Y/K	5=Poor	Strong	4=Poor	<85=Bel Avg*	Dev Delay
2	6;6	M	1	N	8=Low Avg	Some	3=Very Poor	<85=Bel Avg*	Dev Delay & ADHD
3	8;5	F	1	Y/K	8=Low Avg	Strong	6= Bel Avg	63=Very Poor	Dev Delay & ADHD
4	9;0	M	2	Y/1	4=Poor	Strong	3=Very Poor	<50=Very Poor	Specific Learning
5	9;10	M	3	Y/K	5=Poor	Strong	1=Very Poor	52=Very Poor	Autism

*scored 0 on all decoding tasks but ranked "Below Average" for age 6;6. "Low Avg" = low end of the average range. "Bel Avg" = below average.

Assessment Battery

A battery of assessments was administered at pretest and posttest to measure gains in phonological awareness, developmental spelling, print knowledge, alphabet knowledge, syntax, semantics, and pragmatics. Because of their influence on spelling, measures of articulation and dialect variation were included in the pretest battery, but these measures were not administered at posttest.

The Phonological Awareness Test 2 (TPAT 2). The TPAT 2 assesses the phonological awareness skills of children between 5;0 and 9;11 (Robertson & Salter, 2007). The authors report that the normative population mirrored the school demographics reported in the 2004 National Census including students from special education, all socioeconomic levels, and diverse racial groups. The seven subtests that were administered are described in Table 2.2.

Table 2.2
Subtests from The Phonological Awareness Test-2

Subtest	Task
a. Isolation: Initial, Final, Medial	a. identify phonemes in each position in words
b. Blending: Syllables and Phonemes	b. blend syllables or phonemes to form words
c. Segmentation: Sentences, Syllables, and Phonemes	c. dividing words, syllables, and phonemes
d. Deletion: Compound Words and Syllables, Phonemes	d. manipulate root words, syllables, and phonemes by deleting target unit
e. Substitution with Manipulatives	e. change target word into another word by substituting a sound in the initial, medial, or final position using colored blocks
f. Rhyming: Discrimination and Production	f. identifying rhyming pairs and providing a rhyming word
g. Decoding	g. ability to blend sounds into nonsense words

Primary Spelling Inventory (PSI). The PSI (Bear, Invernizzi, Templeton, & Johnston, 2012) is a test of spelling with 26 items ordered in increasing complexity. The test was designed for emergent readers in the early elementary grades. Words are first said in isolation, then within a sentence, and then repeated in isolation. The test is discontinued after five errors. For this study, the first ten words were administered to assess spelling attempts for short vowel words (fan, pet, dig, rob, gum), blends (sled, stick), long vowel silent e pattern (hope, shine), and long vowel double vowel pattern (wait).

Concepts About Print (CAP). Concepts About Print (Clay, 2006) assesses emergent knowledge about the function and conventions of print. The test booklet entitled “Sand” was used during the assessment. The CAP measures five components of emergent reading including basic principles (i.e., knowledge of book parts, function of print), reading directionality (where to start, left-to-right, top-to-bottom), word structure (changes in letter and word order), and conventions of print (punctuation, upper and lower case), and graphemes (letters within words). The CAP was normalized with 320 children in 1968 and 282 children in 1978. Stanine scores are provided for children up to age 7;3. For older students in this study, the stanine scores for available norms will be reported as a comparison for their developmental level.

Letter Identification Observation Task. The Letter Identification observation task (Clay, 2006) measures letter-name and letter-sound knowledge for upper- and lower-case letters and the ability to provide words that begin with each letter-sound. Raw scores will be compared from pretest to posttest.

Diagnostic Evaluation of Language Variation—Norm Referenced (DELV-NR). The DELV-NR (Seymour, Roeper, deVilliers, & deVilliers, 2005) is an assessment that is sensitive to differences in the language of an individual who speaks a nonstandard dialect of English such as AAE. It is the first standardized assessment that is specifically designed to detect a language disorder in children with nonmainstream dialects. The syntax, pragmatics, and semantics subtests were administered.

Diagnostic Evaluation of Language Variation—Screening Test (DELV-ST). The Language Variation Status subtest was administered to determine whether participants speak Standard American English (SAE) or a nonstandard variation of English such as African-American English (AAE) (Seymour et al., 2005). If the child's dialect deviates from SAE, the test score will indicate the degree of variation as "Strong Variation" or "Some Variation."

Goldman-Fristoe Test of Articulation—Second Edition (GFTA-2). The GFTA-2 (Goldman & Fristoe, 2000) assesses the articulation of consonant sounds for children and adults aged 2;0 to 21;11. The Sounds-in-Words subtest measures spontaneous productions, and Sounds-in-Sentences subtest measures imitative productions through story retell.

Test of Language Development-Primary—Fourth Edition (TOLD-P:4). The TOLD-P:4 (Newcomer & Hammill, 2008) assesses children's oral language. Only the Oral Vocabulary subtest was administered. This measure is not expected to change from pretest to posttest.

Pretest Performance Profiles

Table 2.3 presents participants' pretest performance on the Concepts About Print including the letter identification subtest that measures of letter names, letter sounds, and ability to provide a word that begins with each letter-sound (Clay, 2006).

Table 2.3
Participants' Pretest Performance on Concepts About Print and Letter Identification

Subject	**PRINT CONCEPTS**		**LETTER NAME**		**Letter**	**Letter**
	Raw	**%**	**Capital**	**Lowercase**	**Sound**	**Word**
1	10	42%	17	20	14	8
2	7	29%	24	24	20	7
3	15	63%	26	22	26	20
4	11	46%	23	20	20	15
5	13	54%	25	26	23	26

Most participants demonstrated a moderate level of knowledge about early print concepts with scores ranging from 42-63%; however, Subject 2 demonstrated the lowest level of print knowledge, only earning 29% of the total points. Subject 1's general alphabetic knowledge is the lowest. While Subject 3 appears to have relatively strong letter identification skills, he struggles to provide words beginning with each letter-sound. Subject 2's pretest measures reveal the same pattern with even lower scores on the "Letter Word" subtest. Based on pretest measures, Subjects 4 and 5 appear to have strong letter-name and letter-sound skills and are able to easily provide a word beginning with each letter-sound.

Participants' phonological awareness was also assessed using The Test of Phonological Awareness 2 (TPAT-2) (Robertson & Salter, 2007). Table 2.4 provides a profile of participants' performance on all subtests administered. The TPAT-2 has a mean of 100 and a standard deviation of 15, and almost all pretest scores are at least -1.0 standard deviation below the mean. Some participants' raw scores were below the lowest score reported in the normative data and such standard scores will be noted with an *.

Table 2.4
Participants' Pretest Performance on Phonological Awareness Measures

Sub	Rhyme Total		Segment Total		Isolate Total		Delete Total		Substitute Total		Blend Total		Decode Total	
	SS	%	SS	%	SS	%	SS	%	SS	%	SS	%	SS	%
1	84	14	60	1	74	8	79	9	<85*	<18	85	19	<85*	<21
2	57	2	63	2	74	8	<56	<1	<85*	<18	67	4	<85*	<21
3	78	10	54	1	48	2	51	1	<66*	<5	59	4	63	4
4	<35*	<1	<52*	1	<48*	<1	<52	<1	<40*	<1	<51	<1	<50*	<1
5	<40*	<1	<55*	<1	<53*	<1	<52	<1	<51*	<2	<51	<1	52	1

Participants attempted to spell the first ten words on the Primary Spelling Inventory (PSI; Bear et al., 2012) and scores are profiled in Table 2.5. The raw score represents the number of words spelled conventionally. In addition, the Spelling Stage Composite score (based on the weighted scoring system explained later in the document on Table 2.9) and the most common stage of spelling are reported for each subject.

Table 2.5
Spelling Performance at Pretest

Subj	Raw Score	Spelling Stage Composite	Most Frequently Occurring Stage of Spelling
1	0	0.30	Prephonemic
2	0	0.45	Prephonemic
3	0	0.50	Prephonemic & Semiphonetic
4	0	0.45	Prephonemic
5	2	1.65	Phonetic

Four of the subjects were not able to spell any words on the PSI conventionally at pretest, and their spelling attempts were typically characteristic of the Pre-phonemic strategy used in the first stage of spelling. Pre-phonemic spelling attempts do not follow the alphabetic principle or syllable shape. Subject 5 was able to spell two words (*fan* and *gum*) conventionally, and he most commonly produced Phonetic spelling attempts.

Table 2.6
Language Performance at Pretest

	DELV-NR			TOLD VOCAB		
Subject	**Total Lang**	**%tile**	**Rating**	**SS**	**%tile**	**Rating**
1	74	4	Poor	5	5	Poor
2	77	6	Poor	8	25	Low Avg
3	71	3	Poor	8	25	Low Avg
4	76	5	Poor	4	2	Poor
5	45	<0.1	Very Poor	5	5	Poor

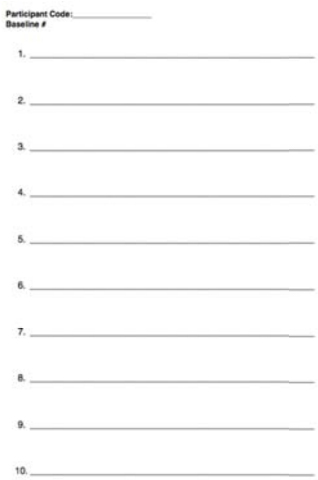
Language skills including semantics, pragmatics, syntax, and vocabulary were also assessed. Table 2.6 presents a profile of participants' Total Language Composition Scores (mean of 100 and a standard deviation of 15). All scores were in poor or very poor range. On the TOLD Oral Picture Vocabulary (mean of 10 and a standard deviation of two), all participants' vocabulary skills were rated in the low average or poor range. Table 2.7 provides a profile of participants' articulation errors based on the assessment administered prior to intervention, and errors will be taken into consideration when analyzing spelling attempts.

Table 2.7
List of Articulation Errors and Standard Score at Pretest

Subj	Standard Score	Standard Deviation	% Rank	Phonemes Produced in Error
1	83	-1.1	13	/ð/, /θ/, /tʃ/, "s" blends
2	55	-3.0	3	/ð/, /θ/, /tʃ/, /ʃ/, /l/, /z/, gliding "l" and "r" blends
3	87	-0.9	6	/ð/, /θ/, /tʃ/, /v/ only final, /ʃ/ only final,
4	58	-2.8	2	/ð/, /θ/ medial and final, /v/ only initial, and "s" blends
5	79	-1.4	5	/ð/, /θ/, /tʃ/, gliding of initial blends containing "r"

Materials

Baseline probes. Prior to beginning each narrative story, participants completed four (Group A) or seven (Group B) baseline probes comprised of the same 10 words. All 10 words started with the target phoneme for the story (i.e., "Sam Goes Swimming" targeted the /s/ phoneme, so all words on baseline and intervention probes began with "s"). Baseline probes were labeled with participants' identification code, target letter, and baseline session number for data tracking. Probes were printed on a standard size sheet of paper, but a smaller version is reproduced in Figure 2.1.



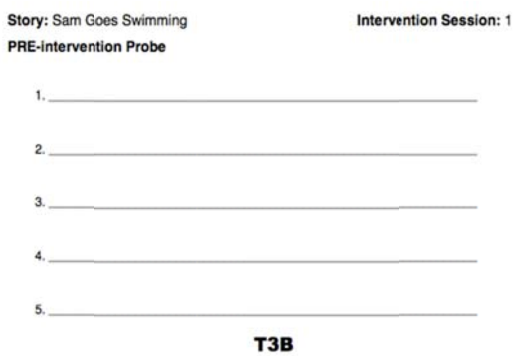
Participant Code:____________
Baseline #

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________
7. ______________________________
8. ______________________________
9. ______________________________
10. ______________________________

Figure 2.1. Reproduction of the baseline encoding probe sheet.

Thirty words beginning with each target letter (S, L, and F) were selected as words for intervention (i.e., 30 "S" words, 30 "L" words, 30 "F" words). From the 30 words, 10 were randomly selected for testing during the baseline period, prior to the start of any intervention (i.e., 10 "S" baseline words, 10 "L" baseline words, and 10 "F" baseline words). The same 10 "S," "L," and "F" words were spelled each baseline session.

Pre-intervention and post-intervention encoding probes. At the start of and immediately following each intervention session, participants attempted to spell the lesson's five target words independently. Participants' identification code, story title, and session number were recorded on the probe sheet for data tracking. Pre-intervention and post-intervention probes were identical with the exception of the “pre” or “post” label. An example of an intervention encoding probe sheet is shown in Figure 2.2.


Story: Sam Goes Swimming **Intervention Session:** 1
PRE-intervention Probe

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________

T3B

Figure 2.2. Example of an intervention encoding probe sheet.

Lesson Plan. Lesson plans were created by extracting photographs from previously videotaped events. Six sequenced photographs were used to create a unified narrative that met six criteria (see Table 2.4). Consent forms were signed by all individuals appearing in the videos/pictured sequences granting ownership to the researcher for use in this project and all future uses. Three different narratives were created for this study. Each narrative followed typical story grammar structure, targeted a different phoneme, and was centered around a different event: 1) “Sam Goes Swimming” targeted the /s/ phoneme and is about a boy going swimming with his dad, 2) “Leon in the Library” targeted the /l/ phoneme and is about a boy going to the library with his dog, and 3) “Frankie at the Zoo” targeted the /f/ phoneme and is about a boy at to the zoo with his family. Narratives were comprised of six lesson plans, yielding 18 total lesson plans. The text contained only simple sentences and common words containing target phoneme. Encoding opportunities included the single target phoneme in any position in the word or five whole words beginning with the target phoneme. Spaces corresponding to the length of the target unit were used to represent the missing letters, (i.e., “scared” appears as __cared and “Sam” appears as __ __ __). Table 2.8 lists more specific sentence-level requirements for syntax, phonology, and encoding.

Table 2.8
Competencies for Photo Story Lesson Plans

Criteria	**Description**
1 – Overall Discourse Structure	Unified story must create a complete narrative structure
2 – Overall Phonological Structure	Story must target a specified phonological pattern by using many words with the target sound (i.e., /s/ sound)
3 – Story Grammar Discourse	Each picture/lesson plan fits a story grammar element (i.e., setting, beginning action, problem, plan, attempt, and ending)
4 – Sentence-level Syntax	All sentences are simple following the NP + VP + (NP) or (PP) pattern and some narrator statements ending with “said Sam” or beginning with “Sam said”
5 – Sentence-level Phonology	Each sentence must have multiple words containing the target phoneme in initial, medial, and final positions
6 – Sentence-level Encoding	Each sentence must have opportunities for encoding the single target phoneme in any position or short, predictable words that begin with the target phoneme

Phonic Faces. Phonic Faces (Norris, 2001) were presented on 3” x 4” picture cards. The alphabetical letter is drawn into the face of the character to depict the placement of the lips, tongue, or teeth used to produce the corresponding sound. Figure 2.3 shows the letter “b” depicting the bottom lip that bounces when the /b/ phoneme is produced. The corresponding grapheme is also written in upper- and lower-case on the card. All 42 letters and digraphs are represented in unique faces.

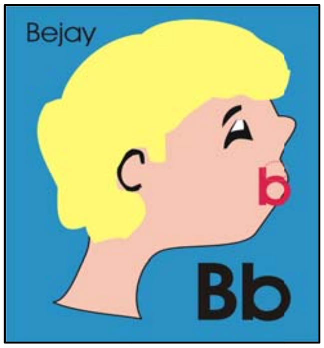


Figure 2.3. Example of a Phonic Face card for the /b/ phoneme.

Procedures

This study implemented a single-subject, multiple baseline design to investigate the efficacy of the intervention. The five participants were assigned to two groups, Group A and Group B, based on different baseline phases and pretest data. Because of time limitations, the intervention was administered in groups of two-to-three students. Based on pretest profiles, Group A was comprised of the lower performing subjects (i.e., Subjects 1, 2, and 4) on encoding and prerequisite skills, while the higher performing subjects (i.e., Subjects 3 and 5) comprised Group B.

This design controls for threats to internal validity, such as maturation and test-retest, by giving multiple baseline probes before beginning the intervention. A stable baseline phase, where scores are not increasing, minimizes this threat. If changes do not begin to occur until the point corresponding to the start of intervention, then it is probable that the treatment caused the changes. In addition, if multiple individuals are tested with variable baseline phases before intervention begins, then there is further support for a probable causal treatment effect.

Baseline phase. After pretesting, but prior to any intervention, all participants completed baseline probes for both "s" and "l" words. Participants in Group A continued in the baseline phase for four probes and then began the intervention phase. Participants in Group B continued in the baseline phase for three additional sessions (completing seven total baselines) before entering the intervention phase. Additionally, participants completed baseline probes for "f" words before beginning the third story, but after intervention sessions had begun. Grouping of participants did not change. Group A completed four baseline probes, and Group B completed seven.

Intervention phase. Both groups completed the intervention phase over eight weeks. Although each group entered the intervention phase at different times, each group continued in the intervention phase until the three stories (or 18 lessons) were completed.

Intervention session procedures. Intervention sessions were 45 minutes and occurred three to four times per week, depending on the classroom or school schedule. At the start of each session, participants independently completed the pre-intervention encoding probe, attempting to spell that lesson's five target words. The examiner read the script detailing the instructions and encouraging students to attempt to spell words that may be hard for them. Each probe word was presented orally three times with a 20 second pause between repetitions. During the pre-intervention probe, laminated folders were used to form a privacy enclosure around each participant's record form. Folders minimized distractions and prevented participants from seeing others' spelling attempts. The examiner collected probe sheets immediately after completion and presented a lesson plan to each participant.

The examiner first prompted participants to identify and attempt to decode the title (i.e, "Sam Goes Swimming"). The group named and practiced the target phoneme with Phonic Faces as support (i.e., "We are working on the snake sound today. Practice with me, *sssssssss*. What letter tells our mouth to make the snake sound? That's right, letter S."). The group discussed the events depicted in the photograph for that lesson plan as well as the narrative events from the prior lesson plan(s), if applicable, to remind participants of the entire narrative.

The examiner read the text while participants attempted to track the text with their fingers, moving each time the examiner read a word. The examiner provided models for the target unit to be encoded—either the single target phoneme or a whole word beginning with that phoneme. The examiner prompted and modeled the target phoneme in an exaggerated and elongated manner with cueing (i.e., "We need to make this word say *sssit*, but I only see 'it.' Which sound are we missing?") and provided appropriate feedback for incorrect responses (i.e., "The /t/ sound is already there. Listen again. We need it to say *ssssit*, but it only says 'it'."). Once participants said the appropriate phoneme, the examiner prompted participants to match that sound to the appropriate letter (i.e., "Which letter tells our mouth to say /s/?), and the examiner provided verbal and visual feedback when participants did not match the letter-sound appropriately.

Similar prompts and models were used for each individual phoneme when encoding entire words (i.e., "We need to write "sun" here. *Ssssun.* What is the first sound in *sssss*un? That's right, /s/. What letter tells our mouth the make the /s/ or the snake sound? That's right, letter S.). Once participants matched the letter-sound, the examiner set down the corresponding Phonic Face as a visual cue to support phoneme-grapheme correspondence while building words. Participants wrote the letter in the corresponding blank. This process was repeated until the entire word was constructed (i.e., "What is the middle sound in *suuuuun*?"). After the entire word was encoded, each participant took a turn to independently build the target word using the Phonic Faces. The participant laid down the Phonic Faces in order, said each phoneme independently, and blended the sounds into the target word (i.e., After laying down the pictures cards for the word sun, the examiner would say, "Tell me all the sounds in that word."

Participant would say," /s/, /ʌ/, /n/." Examiner would say, "What word did you make?" Participant would say "sun."). Immediate feedback on any errors would be provided, and the participant would attempt the word again.

Following the encoding activity, the post-intervention encoding probe was administered. The five target words were the same words attempted during the pre-intervention probe and encoded during the lesson plan. The post-intervention probe was conducted under the same conditions as the pre-intervention probe.

Data Analysis

Each of the encoded words was analyzed for the pattern of errors and stage of spelling. Changes in encoding abilities including patterns of errors and stages of spelling were tracked for each participant within and across probes.

Graphic Analysis. The patterns of change in spelling attempts from baseline to intervention will be judged using graphic analysis. The predicted outcome is a stable or falling slope during the baseline phase, followed by a rising slope at the point where intervention was initiated. Participants in Group B should maintain the stable baseline longer and only show changes when their intervention phase begins.

Spelling Stage Composite Score. Each spelling attempt obtained from baseline, pre-intervention, post-intervention, and PSI was analyzed and assigned a stage of spelling. The stages included Precommunicative (i.e., Prephonemic and Early Phonemic), Semiphonetic, Phonetic, Transitional, and Conventional. The definitions provided by Gentry (see Table 1.1) were used to make these assignments. The words from the probe were then given a Spelling Stage Composite Score. To determine the Spelling Stage Composite scores, each stage of spelling was assigned a weighted number from 0 to 0.30 as shown in Table 2.9.

Table 2.9
Weighted Scoring System for the Spelling Stage Composite Score

Stage of Spelling	Weighted Score
1a. Prephonemic	0
1b. Early Phonemic	0.05
2. Semiphonetic	0.10
3. Phonetic	0.15
4. Transitional	0.20
5. Conventional	0.30

To calculate the Spelling Stage Composite score, sum the weighted scores associated with each spelling attempt. For example, each baseline probe consists of 10 total words. On a hypothetical baseline probe consisting of 10 total words, one word was Pre-phonemic, one Early Phonemic, two Semiphonetic, two Phonetic, two Transitional, and two Conventional. The equation to calculate to Spelling Stage Composite score for the hypothetical baseline probe is as follows: 0 +0.05 +0.1 +0.1 +0.15 +0.15 +0.20 +0.20 +0.30 +0.30, yielding a score of 1.55. The total number of test words varied on spelling measures—ten words on PSI and baseline probes, but five words on intervention probes. Since ten words generated a higher maximum score than five, the Spelling Stage Composite score was converted to a percentage of the maximum score, termed the Percent Spelling Stage Composite score.

The Percent Spelling Stage Composite score allows for comparisons among probes that have differed maximum point values. For probes with ten spelling attempts (i.e., PSI and baseline probes), the maximum point value was 3, and the Spelling Stage Composite score (weighted average) was divided by 3, yielding a percent. For probes with five spelling attempts (i.e., pre-intervention and post-intervention probes), the maximum point value was 1.5 and the Spelling Stage Composite score (weighted average) was divided by 1.5, yielding a percent. To calculate the Percent Spelling Stage Composite score, the Spelling Stage Composite score (generated by the weighted scoring system in Table 3.9) was divided by the maximum point value for that probe. So, for a Spelling Stage Composite score of 1.55 on a baseline probe, the Percent Spelling Stage Composite score would be 1.55 ÷ 3, or 51.6%.

Standardized Test Measures. Standard scores, percentile ranks, and ratings will be reported for the subtests and total scores of the TPAT, CAP, TOLDP and DELV. Gains will be determined by clinical significance, defined as: a) a gain score above what would be expected by the standard error of measurement (SEM) alone, or b) a movement from a low or dysfunctional range to a normal or functional range (Bothe & Richardson, 2011). The SEM is different for each subtest and normative age group, but in all cases is less than one standard deviation. Therefore, for this study, clinical significance was considered to be any improvement equal or greater than +1.0 standard deviation of change.

Reliability

The scores for all test measures and for the Composite Spelling Score were checked for accuracy using inter-rater agreement. The researcher initially scored and analyzed assessment data and encoding probe data. Lab assistants who had been working as volunteers in a research lab for at least one year scored the assessment data for reliability. Lab assistants were trained by the examiner and had prior experience scoring these assessments. All participants' assessments were checked for accuracy, and inter-rater agreement for the assessment battery was 98%. Twenty percent of participants' encoding probes were checked by one of the lab volunteers. The volunteer was trained by the examiner but scored the probes independently. There was 90.8% agreement on baseline probes and 89.6% agreement on intervention probes.

RESULTS

The purpose of this study was to determine whether encoding practice embedded in a narrative context would improve participants' developmental spelling patterns across intervention sessions, and whether scores on measures of phonological awareness, alphabetic knowledge, print knowledge, language abilities, and spelling would improve following intervention. Each subject's spelling attempts on baseline and post-intervention probes were classified according to Gentry's stages of developmental spelling (Table 1.1). Subjects' Percent Spelling Stage Composite scores were calculated, and subjects' scores on baseline and post-intervention probes were compared to determine if scores were higher during weeks when intervention was implemented. Subjects' average Spelling Stage Composite scores on pre-intervention and post-intervention probes were compared to determine if the intervention resulted in immediate changes in spelling. Finally, on standardized assessment measures, positive gains of +1.0 standard deviation or greater were considered clinically significant changes. Progress on non-standardized assessments were determined by gains in raw scores or ratings.

Question 1

The first question of this study asked whether contextualized encoding practice would result in improvements in patterns of developmental spelling (i.e., comparing baseline spelling attempts from weeks before any intervention occurred to spelling attempts from weeks when intervention was implemented). Thirty words beginning with each target letter (S, L, and F) were selected as words for intervention (i.e., 30 "S" words, 30 "L" words, 30 "F" words). From the 30 words, 10 were randomly selected for testing during the baseline period, prior to the start of any intervention (i.e., 10 "S" baseline words, 10 "L" baseline words, and 10 "F" baseline words). The same 10 “S,” “L,” and “F” words were spelled each baseline session. For Group A, the baseline period was four sessions. For Group B, the baseline period was seven sessions. The words from baseline each occurred once during intervention sessions, but unlike baseline, the other intervention words were unique each session. Profiles for each subject were examined for stability of baseline performance and changes from baseline to intervention spelling attempts. Differences were determined by comparing the Percent Spelling Stage Composite scores, as explained in the methods chapter, on baseline probes versus post-intervention probes. Higher Percent Spelling Stage Composite scores (i.e., closer to 100%) indicate more advanced stages of developmental spelling.

Profile of Subject 1

Subject 1 (age 6;6) was the second lowest performing subject during both baseline and intervention. Subject 1 was a member of Group A, completing four baseline probes for each target letter (S, L, F). Subject 1 was present for 14 out of 18 intervention sessions. Table 3.1 compares examples of Subject 1’s spelling attempts for the same words on baseline and post-intervention probes for “S,” “L,” and “F” words. Any missing post-intervention spelling attempts on Table 3.1 are due to his absences.

Analysis of “S” word spelling attempts reveals that Subject 1 shifted from using of soft “c” to represent the initial /s/ sound on baseline probes to mostly conventional representation of the /s/ sound on post-intervention probes. The profile for “L” words shows that most spellings transitioned from mostly Pre-phonemic attempts composed of random consonants at baseline to conventional representation of the initial consonant on post-intervention probes. Representations of final consonant sounds were beginning to emerge (i.e., lgt for “sits”; soz for “sees”).

Table 3.1
Examples of Subject 1's Spelling Attempts on Baseline and Intervention Probes for "S," "L," and "F" Words

Target "S" Words	BASELINE		POST-INTERVENTION	
	Spelling Attempt	**Stage of Spelling**	**Spelling Attempt**	**Stage of Spelling**
sits	cat	Phonetic	lgt	Pre-phonemic
Sam	cam	Phonetic	Sam	Conventional
sees	Oeb	Pre-phonemic	soz	Semiphonetic
side	cib	Semiphonetic	salb	Early Phonemic
summer	cPBck	Pre-phonemic	soml	Semiphonetic
six	ctc	Pre-phonemic	laF	Pre-phonemic
sun	cabB	Pre-phonemic	sas	Semiphonetic
sad	5ap	Pre-phonemic	cay	Semiphonetic
soon	cbB	Pre-phonemic	son	Phonetic
so	con	Semiphonetic	cam	Prephonemic
Target "L" Words	**BASELINE**		**POST-INTERVENTION**	
	Spelling Attempt	**Stage of Spelling**	**Spelling Attempt**	**Stage of Spelling**
look	syr	Pre-phonemic	--	--
lost	rop	Pre-phonemic	--	--
lunch	lpr	Early Phonemic	--	--
low	lop	Semiphonetic	lon	Semiphonetic
let	nyr	Pre-phonemic	--	--
leg	ron*	Pre-phonemic	lokk	Early Phonemic
lift	lpa	Early Phonemic	lot	Semiphonetic
long	otp	Pre-phonemic	--	--
lazy	plp	Pre-phonemic	lo5	Pre-phonemic
lit	lpT	Phonetic	lom	Semiphonetic
Target "F" Words	**BASELINE**		**POST-INTERVENTION**	
	Spelling Attempt	**Stage of Spelling**	**Spelling Attempt**	**Stage of Spelling**
fun	kron*	Pre-phonemic	fyrko	Early Phonemic
five	rorron*	Pre-phonemic	fyroo	Early Phonemic
fuzzy	prQ	Pre-phonemic	--	--
frog	ron*	Pre-phonemic	monoy	Pre-phonemic
fish	fono	Early Phonemic	fit	Semiphonetic
fox	axl	Semiphonetic	--	--
fence	ron*	Pre-phonemic	--	--
finger	florr	Early Phonemic	--	--
feet	ron*	Pre-phonemic	fot	Semiphonetic
first	ffyo	Early Phonemic	royoky	Prephonemic

*Letters sequences from his name. Red letters = letters written backwards or upside down.

The profile for “F” words demonstrates that Subject 1 frequently used letter sequences from his name on baseline probes, resulting in Precommunicative (Stage 1) spelling attempts. Only three of ten words began with the letter “f” and only one final consonant was recorded correctly. In contrast, four of six attempts on post-intervention probes captured the initial sound for “F” probes. No medial letters were correct except the spelling of “fit” for “fish.” While changes were seen, Precommunicative spelling attempts remained the most prevalent pattern.

Table 3.2 displays the number of Subject 1’s spelling attempts from each stage of spelling on baseline and intervention probes for letter words “S,” “L,” and “F.” Subject 1 predominately produced spelling attempts from the first two stages of spelling, the Precommunicative Stage (i.e., Pre-phonemic and Early Phonemic) and Semiphonetic Stage. Across baseline and intervention probes for all letters, there was a low percentage (13%) of spellings from the third stage or higher (i.e., Phonetic, Transitional, and Conventional Stages).

Semiphonetic spellings were most common on baseline and post-intervention probes for “S” words, representing 40% of spelling attempts on both probes. Subject 1’s spelling attempts did not improve from baseline since the percentage of Pre-phonemic spelling attempts increased (from 22.5% to 40%), while the percentage of higher levels spellings from Phonetic, Transitional, and Conventional stages decreased. Pre-phonemic attempts increased (from 17.5% to 35%) and Semiphonetic attempts decreased (from 47.5% to 32.5%) from baseline to post-intervention on “L” words. Conventional spellings increased from 0% to 2.5% of “L” words. “F” words show a similar pattern of increasing Pre-phonemic attempts and decreasing Semiphonetic attempts from baseline to post-intervention. Subject 1’s conventional attempts on “F” words increased from 0% to 5%. At baseline, only 5% of “S” words were spelled conventionally, while during intervention a small percentage of words from each letter group showed conventional patterns.

Table 3.2
Subject 1's Spelling Attempts Profiled by Stages of Spelling

Stage of Spelling	"S" WORDS			
	Baseline		Intervention	
	Raw	%	Raw	%
1a. Prephonemic	9	22.5%	24	40%
1b. Early Phonemic	6	15%	6	10%
2. Semiphonetic	16	40%	24	40%
3. Phonetic	6	15%	4	6.67%
4. Transitional	1	2.5%	0	0%
5. Conventional	2	5%	2	3.33%
Total Possible "S" Words	40	100%	60	100%
Stage of Spelling	**"L" WORDS**			
	Baseline		**Intervention**	
	Raw	**%**	**Raw**	**%**
1a. Prephonemic	7	17.5%	14	35%
1b. Early Phonemic	9	22.5%	6	15%
2. Semiphonetic	19	47.5%	13	32.5%
3. Phonetic	5	12.5%	6	15%
4. Transitional	0	0%	0	0%
5. Conventional	0	0%	1	2.5%
Total Possible "L" Words	40	100%	40	100%
Stage of Spelling	**"F" WORDS**			
	Baseline		**Intervention**	
	Raw	**%**	**Raw**	**%**
1a. Prephonemic	11	27.5%	13	32.5%
1b. Early Phonemic	6	15%	8	20%
2. Semiphonetic	20	50%	15	37.5%
3. Phonetic	3	7.5%	2	5%
4. Transitional	0	0%	0	0%
5. Conventional	0	0%	2	5%
Total Possible "F" Words	40	100%	40	100%

Percent Spelling Stage Composite score. To quantify changes in spelling patterns, a Percent Spelling Stage Composite score was derived based on the total number of spelling attempts in each stage for each baseline and each intervention probe. Four baseline probes occurred prior to intervention followed by six intervention sessions for each letter. Since baseline probes consisted of 10 words and post-intervention probes consisted of only five words, a Percent Spelling Stage Composite score was calculated to allow for comparison of probes. The Percent Spelling Stage Composite score was calculated by dividing the Spelling Stage Composite score by the maximum point value for each type of probe (i.e., baseline probe scores were divided by 3, yielding a percent, and intervention scores were divided by 1.5 also yielding a percent). Percent Spelling Stage Composite scores for baseline and post-intervention probes are presented for each letter separately, "S" words in Figure 3.1, "L" words in Figure 3.2, and "F" words in Figure 3.3.

S Words. During baseline probes for "S" words, Subject 1's Percent Spelling Stage Composite Scores were stable except for an approximately 30% increase in performance on the third baseline session, yielding an average baseline score of 28.5%. Recall that during baseline, the same 10 words selected randomly from intervention words were spelled.

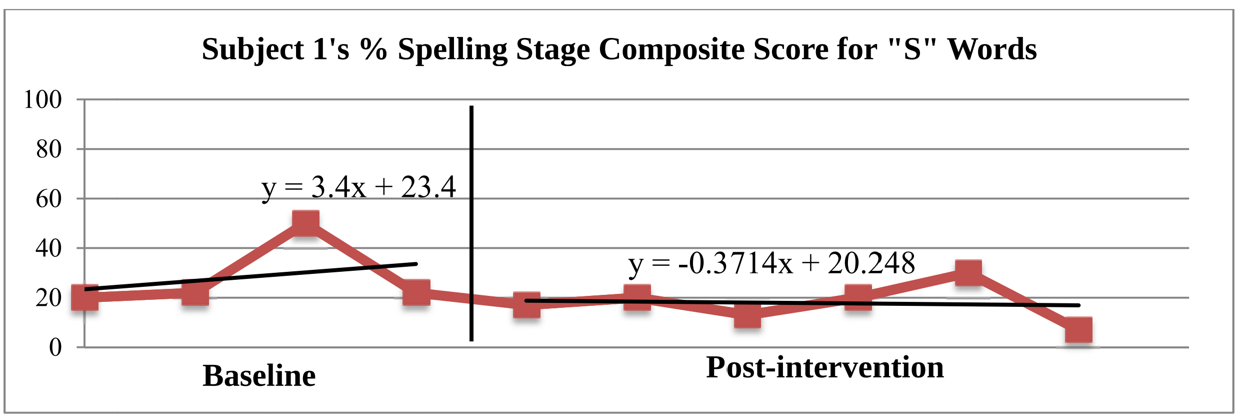


Figure 3.1 Subject 1's Percent Spelling Stage Composite scores on "S" word baseline and post-intervention probes.

Subject 1's performance remained at or below the baseline levels across six intervention sessions for "S" words, with the exception of an increase on session five. Intervention probes included five words that were encoded during intervention, and may or may not have included any of the baseline words. The words changed each session. His average score on post-intervention probes was 17.8%, reflecting a decrease in spelling complexity from baseline words instead of the expected increase.

L Words. As displayed in Figure 3.2, Subject 1's Percent Spelling Stage Composite Scores increased on baseline probe two and then declined across the remaining baseline attempts for "L" words. Subject 1's scores did not improve as expected for "L" word post-intervention probes. Only his score on intervention probe five was higher than baseline scores. Subject 1's average performance was exactly equal for baseline and post-intervention probes (25.75%).

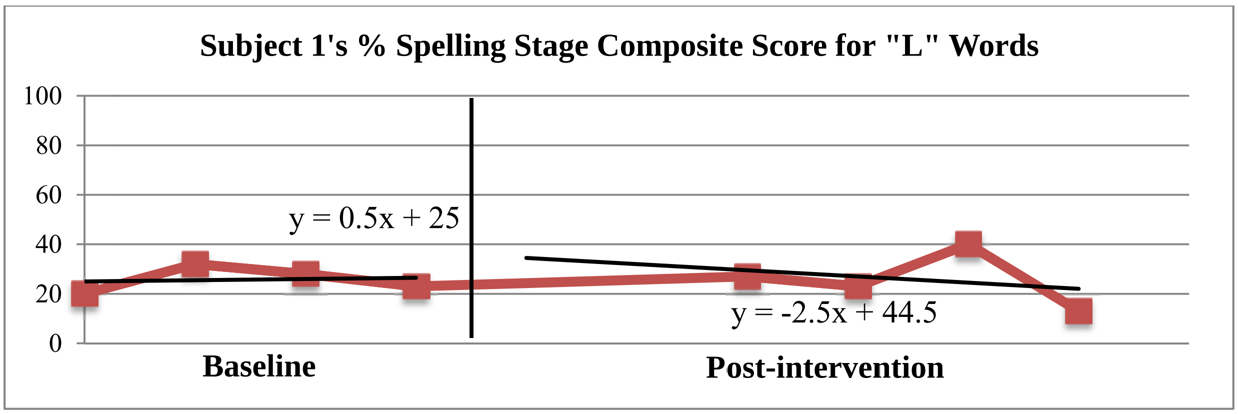


Figure 3.2 Subject 1's Percent Spelling Stage Composite scores on "L" word baseline and post-intervention probes.

F Words. Figure 3.3 reveals that a stable baseline on "F" word probes was not achieved since scores ended in an upward trend. Scores on post-intervention probes were inconsistent. Two scores were within baseline, two scores were above baseline, and two intervention sessions were not completed due to absences. A stable baseline followed by increases during intervention was not seen on Subject 1's spelling attempts for "F" words.

Summary. Analysis of the Percent Spelling Stage Composite scores revealed that Subject 1 did not show the expected pattern of stable baseline followed by consistent positive change during intervention for any target letter. His scores on post-intervention probes were similar to baseline scores. Only two intervention probe scores were higher than baseline scores on the third intervention series, the “F” words.

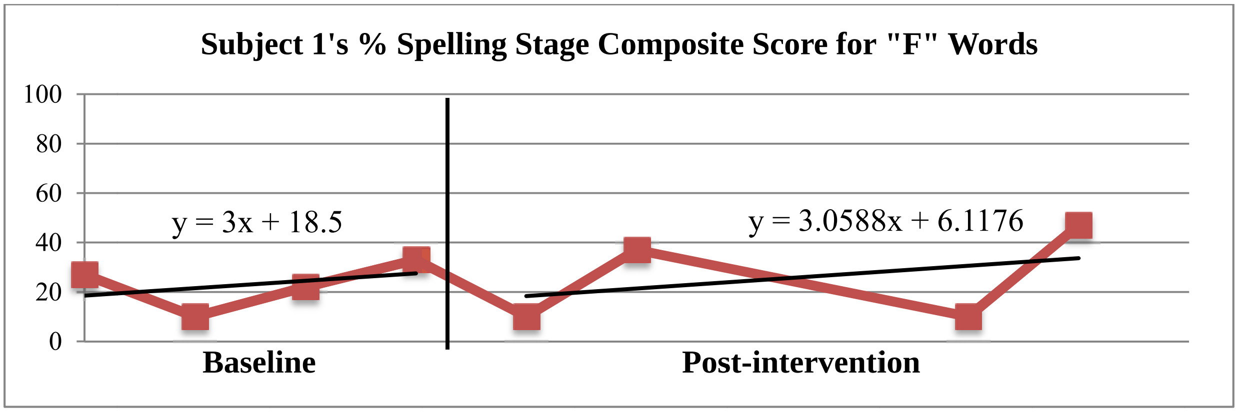


Figure 3.3 Subject 1’s Percent Spelling Stage Composite scores on “F” word baseline and post-intervention probes.

Profile of Subject 2

Subject 2 (age 6;6) was consistently the lowest performing subject during both baseline and intervention. Subject 2 was a member of Group A, thus he completed four baseline probes for each target letter (S, L, F). Subject 2 was present for 16 out of 18 intervention sessions. Table 3.3 compares examples of Subject 2’s spelling attempts for the same words on baseline and post-intervention probes for “S,” “L,” and “F” words. Any missing post-intervention spelling attempts on Table 3.3 are due to his absences.

The profile for “S” words shows that baseline spelling attempts were primarily Early Phonemic attempts where initial /s/ sounds were represented by initial letter “s” (five words) and “c” (two words). Other spelling attempts were composed of random consonants and vowels. Subject 1 produced two letter sequences from his name. Post-intervention spelling attempts were predominantly Early Phonemic and Semiphonetic attempts. Only one initial /s/ sound was represented with “c,” and the rest were represented conventionally. Attempts also frequently captured the features of the final sounds.

Table 3.3
Examples of Subject 2's Spelling Attempts on Baseline and Intervention Probes for "S," "L," and "F" Words

Target "S" Words	BASELINE		POST-INTERVENTION	
	Spelling Attempt	Stage of Spelling	Spelling Attempt	Stage of Spelling
sits	see	Early Phonemic	cncss	Pre-phonemic
Sam	cdn	Pre-phonemic	saw	Semiphonetic
sees	bag	Pre-phonemic	scn	Early Phonemic
side	rhc	Pre-phonemic	sasnc	Pre-phonemic
summer	sLa*	Early Phonemic	sam	Semiphonetic
six	scn	Early Phonemic	sae	Early Phonemic
sun	sat	Early Phonemic	sat	Semiphonetic
sad	nce*	Prephonemic	sot	Semiphonetic
soon	cnc	Prephonemic	sen	Semiphonetic
so	san	Early Phonemic	san	Early Phonemic
Target "L" Words	**BASELINE**		**POST-INTERVENTION**	
	Spelling Attempt	**Stage of Spelling**	**Spelling Attempt**	**Stage of Spelling**
look	cnc	Pre-phonemic	sen	Pre-phonemic
lost	sen	Pre-phonemic	nct	Pre-phonemic
lunch	nce*	Pre-phonemic	lan	Semiphonetic
low	Bop	Pre-phonemic	lln	Early Phonemic
let	ncn	Pre-phonemic	sen	Pre-phonemic
leg	Law*	Pre-phonemic	lac	Semiphonetic
lift	wre*	Pre-phonemic	lpc	Early Phonemic
long	nce*	Pre-phonemic	san	Pre-phonemic
lazy	ncn	Pre-phonemic	cnc	Pre-phonemic
lit	cnc	Pre-phonemic	tcn	Pre-phonemic
Target "F" Words	**BASELINE**		**POST-INTERVENTION**	
	Spelling Attempt	**Stage of Spelling**	**Spelling Attempt**	**Stage of Spelling**
fun	sen	Pre-phonemic	sen	Pre-phonemic
five	sen	Pre-phonemic	scm	Pre-phonemic
fuzzy	scn	Pre-phonemic	sen	Pre-phonemic
frog	scnc	Pre-phonemic	rncc	Pre-phonemic
fish	ren*	Pre-phonemic	sen	Pre-phonemic
fox	ncn	Pre-phonemic	--	--
fence	sen	Pre-phonemic	sen	Pre-phonemic
finger	ncn	Pre-phonemic	--	--
feet	cnc	Pre-phonemic	fen	Semiphonetic
first	fnc	Early Phonemic	cnc	Pre-phonemic

*Letters sequences from his name.

All spelling attempts were Pre-phonemic on baseline probes for “L” words. Subject 2 did not apply the alphabetic principle when spelling and often used letter sequences from his name. By post-intervention, four spelling attempts had transitioned to Early Phonemic or Semiphonetic, capturing the initial sound and partial syllable shape. He continued to spell words with letter “s” in the initial position, but four spelling attempts began with the target letter “l.” For “F” words, Subject 2 produced mostly Pre-phonemic spelling attempts on baseline and post-intervention probes. Only one word transitioned to a higher stage on post-intervention probes (i.e., “feet” from Early Phonemic to Semiphonetic). Although he did not use letter sequences from his name, he repeatedly spelled “F” words as “sen” on both baseline and post-intervention attempts.

Table 3.4 displays the number of Subject 2’s spelling attempts from each stage of spelling on baseline and intervention probes for letter words “S,” “L,” and “F.” Subject 2’s spelling attempts were characteristic of the first two stages of spelling, the Precommunicative Stage (i.e., Pre-phonemic and Early Phonemic) and Semiphonetic Stage. Across baseline and intervention probes for all letters, there was a very low percentage (2.5%) of spellings from the third stage or higher (i.e., Phonetic, Transitional, and Conventional Stages).

On baseline probes for “S” words, the majority of Subject 2’s spelling attempts were characteristic of the Precommunicative Stage, and he predominately used two strategies from this stage, the Early Phonemic Strategy (42.5%) and the Pre-phonemic Strategy (35%). He initially spelled one word phonetically and two conventionally on the baseline probes, but Subject 2 did not produce any spelling attempts higher than the second stage on post-intervention probes. His spelling attempts transitioned to mostly Semiphonetic (62%) spelling attempts on post- intervention probes.

Table 3.4
Subject 2's Spelling Attempts Profiled by Stages of Spelling

Stage of Spelling	"S" WORDS			
	Baseline		Intervention	
	Raw	%	Raw	%
1a. Pre-phonemic	14	35%	8	16%
1b. Early Phonemic	17	42.5%	11	22%
2. Semiphonetic	6	15%	31	62%
3. Phonetic	1	2.5%	0	0%
4. Transitional	0	0%	0	0%
5. Conventional	2	5%	0	0%
Total Possible "S" Words	40	100%	50	100%
Stage of Spelling	**"L" WORDS**			
	Baseline		**Intervention**	
	Raw	**%**	**Raw**	**%**
1a. Pre-phonemic	20	50%	43	71.67%
1b. Early Phonemic	10	25%	13	21.67%
2. Semiphonetic	6	15%	4	6.67%
3. Phonetic	1	2.5%	0	0%
4. Transitional	0	0%	0	0%
5. Conventional	3	7.5%	0	0%
Total Possible "L" Words	40	100%	60	100%
Stage of Spelling	**"F" WORDS**			
	Baseline		**Intervention**	
	Raw	**%**	**Raw**	**%**
1a. Pre-phonemic	33	82.5%	42	84%
1b. Early Phonemic	5	12.5%	3	6%
2. Semiphonetic	1	2.5%	5	10%
3. Phonetic	1	2.5%	0	0%
4. Transitional	0	0%	0	0%
5. Conventional	0	0%	0	0%
Total Possible "F" Words	40	100%	50	100%

On baseline probes for "L" words, Subject 2 produced mostly Precommunicative Stage spellings, again using the Pre-phonemic Strategy (50%) and Early Phonemic Strategy (25%) most frequently. He spelled one "L" word phonetically and three words conventionally on baseline probes, but he did not spell any words phonetically or conventionally on intervention probes. On “L” post-intervention probes, most of Subject 2’s spelling attempts were characteristic of the first stage, the Precommunicative Stage. He used the Pre-phonemic Strategy (71.67%) most frequently followed by the Early Phonemic Strategy (21.67%). Subject 2’s performance was similar on baseline and intervention probes for “F” words. He produced Pre-phonemic spellings on baseline (82.5%) and post-intervention (84%) probes. Subject 2 initially spelled one word phonetically on baseline probes, but no phonetic spellings were produced during intervention. Semiphonetic spelling attempts increased slightly on intervention probes (i.e., from 2.5% to 10%). There were no conventional spellings of “F” words.

Percent Spelling Stage Composite Score. Percent Spelling Stage Composite scores for baseline and post-intervention probes are presented for each letter separately, “S” words in Figure 3.4, “L” words in Figure 3.5, and “F” words in Figure 3.6.

S Words. Subject 2’s baseline scores decreased across the first three sessions as shown in Figure 3.4. His Percent Spelling Stage Composite score remained at or above baseline level across the intervention sessions. His average score was 18.5% during baseline, while his average score was 26.6% on post-intervention probes.

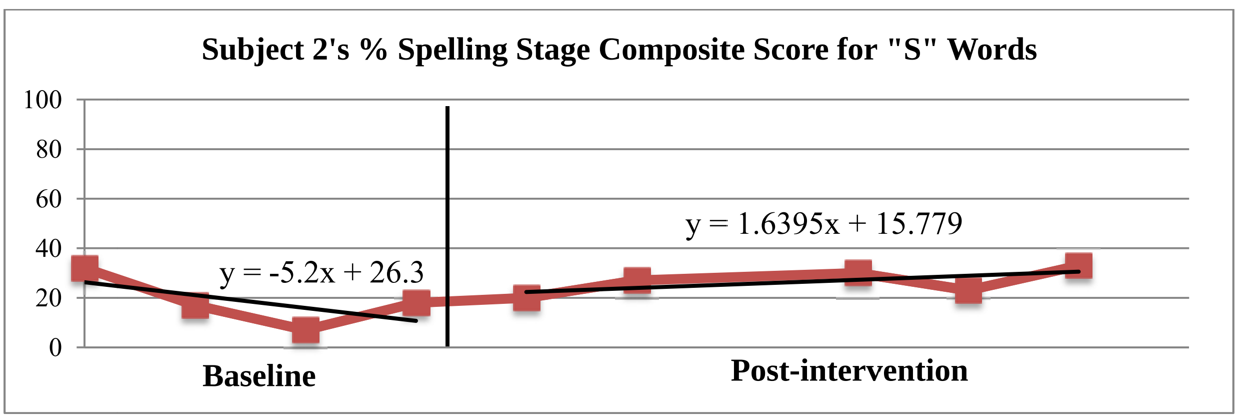


Figure 3.4 Subject 2’s Percent Spelling Stage Composite scores on “S” word baseline and post-intervention probes.

L Words. Figure 3.5 reveals a sharp decline in performance after the first baseline session for "L" words, but scores on the last three baseline probes were stable. Percent Spelling Stage Composite scores did not improve on post-intervention probes since scores were within or below baseline performance. In addition, Subject 2's average score decreased 11.5% from baseline (18%) to intervention (6.5%).

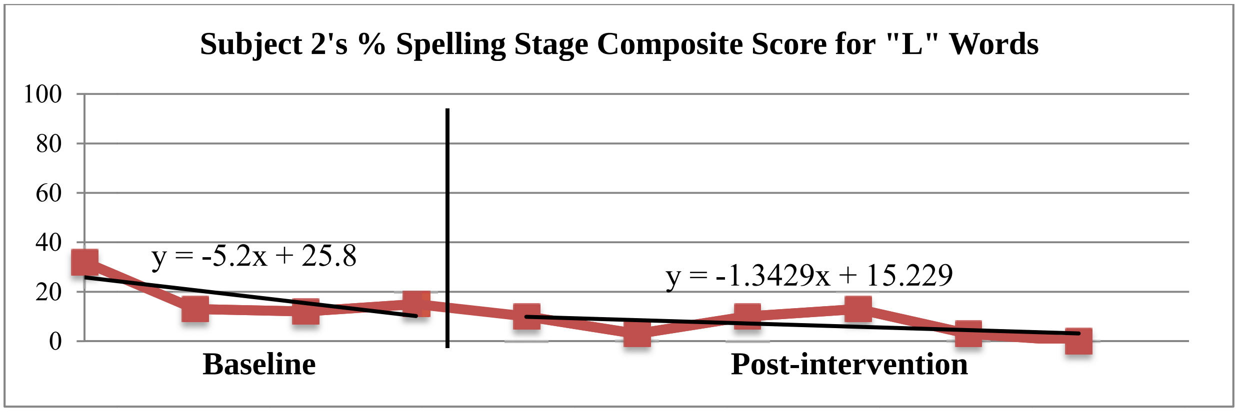


Figure 3.5 Subject 2's Percent Spelling Stage Composite scores on "L" word baseline and post-intervention probes.

F Words. Subject 2's performance was lowest for "F" words. He earned a score of 0 on some probes, indicating all spelling attempts were Pre-phonemic. As shown in Figure 3.6, Subject 2's second baseline score was the highest (20%), while the other baseline scores were below 10%. A similar trend was seen on post-intervention probes. Subject 2's average Percent Spelling Stage Composite score decreased 3.35% from baseline (8.75%) to post-intervention probes (5.4%).

Summary. Analysis of the Percent Spelling Stage Composite scores for all letters reveal that Subject 2's baseline performance was consistently low and relatively stable. Subject 2's scores on post-intervention probes were not consistently higher than scores on baseline probes. Percent Spelling Stage Composite scores increased slightly on post-intervention probes for "S" words, but decreased on post-intervention probes "L" and "F" words.

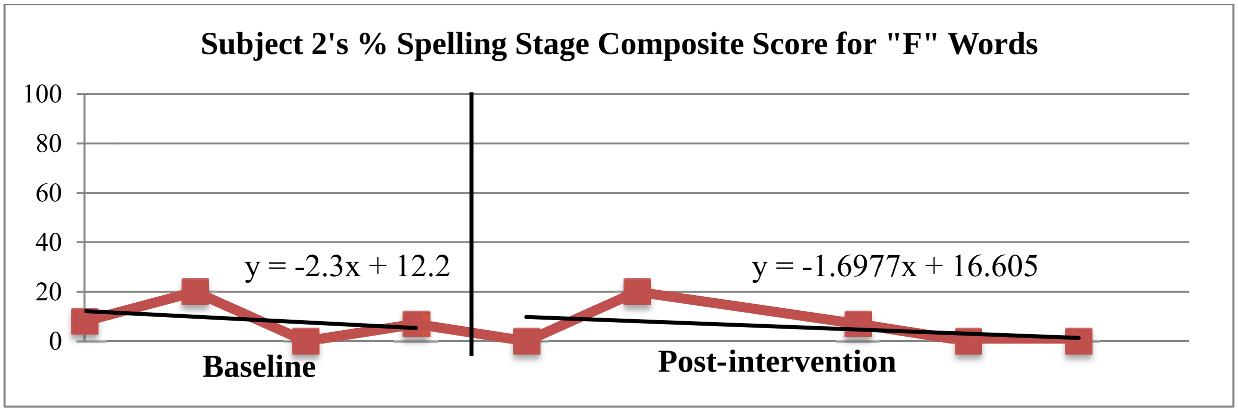


Figure 3.6 Subject 2’s Percent Spelling Stage Composite scores on “F” word baseline and post-intervention probes.

Profile of Subject 3

Subject 3 (age 8;5) made the most improvement during the intervention. Subject 3 was a member of Group B, thus she completed seven baseline probes for each target letter (S, L, F). Subject 3 was present for all 18 intervention sessions. Table 3.5 compares examples of Subject 3’s spelling attempts for the same words on baseline and post-intervention probes for “S,” “L,” and “F” words. She produced mostly Semiphonetic spelling attempts on baseline probes for “S” words. Error patterns show that Subject 3 added letter-sounds to words, sequenced sounds incorrectly, substituted close phonemes, and represented short vowels accurately but had difficulty with long vowels. On post-intervention probes, seven “S” words were spelled conventionally, and similar error patterns to baseline were seen on Semiphonetic spellings on post-intervention probes.

The profile for “L” words indicates improvement in spelling attempts during intervention sessions. Baseline attempts were characteristic of the first and second stages, the Precommunicative and Semiphonetic Stages. No spelling attempts were from the third stage or higher. On post-intervention probes, Subject 3 was able to capture phonemes and syllable shape more accurately as evidenced by emerging Phonetic and Conventional spellings.

Table 3.5
Examples of Subject 3's Spelling Attempts on Baseline and Intervention Probes for "S," "L," and "F" Words

Target "S" Words	BASELINE		POST-INTERVENTION	
	Spelling Attempt	**Stage of Spelling**	**Spelling Attempt**	**Stage of Spelling**
sits	tis	Semiphonetic	sit	Conventional
Sam	san	Semiphonetic	Sam	Conventional
sees	seDL	Semiphonetic	sees	Conventional
side	sail	Early Phonemic	siDi	Semiphonetic
summer	smLa	Semiphonetic	srmm	Semiphonetic
six	xsi	Semiphonetic	six	Conventional
sun	snu	Semiphonetic	sun	Conventional
sad	satnf	Semiphonetic	sadt	Semiphonetic
soon	snnn	Semiphonetic	soon	Conventional
so	solw	Semiphonetic	so	Conventional
Target "L" Words	**BASELINE**		**POST-INTERVENTION**	
	Spelling Attempt	**Stage of Spelling**	**Spelling Attempt**	**Stage of Spelling**
look	lkoo	Semiphonetic	look	Conventional
lost	lttua	Early Phonemic	Lto	Semiphonetic
lunch	lhtn	Semiphonetic	lahll	Early Phonemic
low	lwot	Semiphonetic	low	Conventional
let	ltaB	Early Phonemic	let	Conventional
leg	Lggtt	Semiphonetic	Lag	Phonetic
lift	LFie	Semiphonetic	left	Phonetic
long	Letu	Early Phonemic	gnol	Semiphonetic
lazy	sae	Pre-phonemic	Lze	Phonetic
lit	ltum	Early Phonemic	tal	Pre-phonemic
Target "F" Words	**BASELINE**		**POST-INTERVENTION**	
	Spelling Attempt	**Stage of Spelling**	**Spelling Attempt**	**Stage of Spelling**
fun	fnLut	Semiphonetic	fun	Conventional
five	vFi	Semiphonetic	five	Conventional
fuzzy	fzn	Semiphonetic	fzee	Phonetic
frog	Fgl	Semiphonetic	FgL	Semiphonetic
fish	fih	Semiphonetic	fih	Semiphonetic
fox	fox	Conventional	fox	Conventional
fence	vofs	Prephonemic	FisL	Semiphonetic
finger	Fgl	Semiphonetic	Fgl	Semiphonetic
feet	flLuut	Early Phonemic	Frs	Semiphonetic
first	fnLut	Semiphonetic	fun	Conventional

*bold letters indicate the correct grapheme in the correct position

Subject 3 produced mostly Semiphonetic spelling attempts on "F" word baseline probes and only one Conventional spelling. On post-intervention probes, she produced four Conventional spellings and one Phonetic attempt. Interestingly, two attempts that remained Semiphonetic were spelled the same way on baseline and post-intervention probes.

Table 3.6 displays the number of Subject 3's spelling attempts from each stage of spelling on baseline and intervention probes for letter words "S," "L," and "F." Subject 3 produced Semiphonetic spelling attempts most frequently on baseline and intervention probes for all target letters. She was able to produce some Conventional spellings at baseline, but for each letter the percent of words spelled conventionally increased from baseline to intervention. The same pattern was seen for Phonetic spellings with the percent of phonetic spellings increasing, sometimes dramatically, during intervention.

On baseline probes for "S" words, Semiphonetic spelling attempts occurred most frequently (62.86%). Higher level Phonetic (7%) and Conventional (14% attempts also occurred, as well as approximately 16% Precommunicative attempts. During intervention, Semiphonetic spellings were also the most frequent (60%). In addition, the percentage of spelling attempts from Stage 1 (i.e., Pre-phonemic and Early Phonemic) decreased to 11%, while the percentage of Phonetic and Conventional spellings increased to 29%. Although Semiphonetic spellings were most frequent on "L" word baseline and intervention probes, the frequency decreased from 52.86% on baseline to 41.67% during intervention. Phonetic spellings increased dramatically to 28.33% during intervention, and Conventional spellings approximately doubled (16.67%). The profile for "F" words shows a similar trend with the frequency of Semiphonetic spellings decreasing from baseline (64.29%) to intervention probes (46.67%). Phonetic spellings increased from 7.14% to 30%, and Conventional spellings increased from 10% to 18.33%.

Table 3.6
Subject 3's Spelling Attempts Profiled by Stages of Spelling

Stage of Spelling	"S" WORDS			
	Baseline		Intervention	
	Raw	**%**	**Raw**	**%**
1a. Prephonemic	1	1.42%	3	5%
1b. Early Phonemic	10	14.29%	4	6.67%
2. Semiphonetic	44	62.86%	36	60%
3. Phonetic	5	7.14%	7	11.67%
4. Transitional	0	0%	0	0%
5. Conventional	10	14.29%	10	16.67%
Total Possible "S" Words	70	100%	60	100%

Stage of Spelling	"L" WORDS			
	Baseline		Intervention	
	Raw	**%**	**Raw**	**%**
1a. Prephonemic	14	20%	1	1.67%
1b. Early Phonemic	11	15.71%	6	10%
2. Semiphonetic	37	52.86%	25	41.67%
3. Phonetic	2	2.86%	17	28.33%
4. Transitional	1	1.42%	1	1.67%
5. Conventional	5	7.14%	10	16.67%
Total Possible "L" Words	70	100%	60	100%

Stage of Spelling	"F" WORDS			
	Baseline		Intervention	
	Raw	**%**	**Raw**	**%**
1a. Prephonemic	2	2.86%	0	0%
1b. Early Phonemic	10	14.29%	3	5%
2. Semiphonetic	45	64.29%	28	46.67%
3. Phonetic	5	7.14%	18	30%
4. Transitional	1	1.42%	0	0%
5. Conventional	7	10%	11	18.33%
Total Possible "F" Words	70	100%	60	100%

Percent Spelling Stage Composite Score. To quantify changes in spelling patterns, Percent Spelling Stage Composite scores for baseline and post-intervention probes are presented for each letter separately, "S" words in Figure 3.7, "L" words in Figure 3.8, and "F" words in Figure 3.9.

S Words. Subject 3's Percent Spelling Stage Composite scores on baseline probes for "S" words show a slight upward trend with a spike in performance on the third baseline probe. During intervention, Percent Spelling Stage Composite scores were variable as shown in Figure 3.7. Scores on three post-intervention probes were higher than baseline scores, while the other three were at or below baseline performance. However, Subject 3's average Percent Spelling Stage Composite score for "S" words increased 11.19% from baseline (41.14%) to post-intervention probes (52.33%).

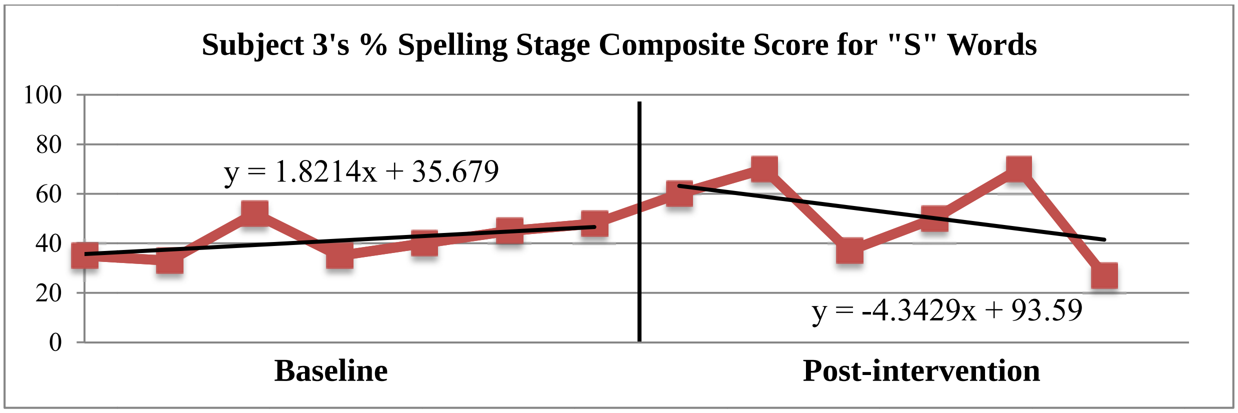


Figure 3.7 Subject 3's Percent Spelling Stage Composite scores on "S" word baseline and post-intervention probes.

L Words. A stable baseline was not achieved across the seven baseline sessions for "L" words indicated by the upward slope shown in Figure 3.8. During intervention, Subject 3's Percent Spelling Stage Composite score increased sharply on the fourth post-intervention probe. Although the intervention sessions ended in a slight downward trend, the last score remained higher than baseline and the first three intervention sessions. As shown by the increasing slope, Subject 3's spelling attempts generally improved across the "L" intervention sessions. In addition, Subject 3's average score on post-intervention probes increased by 21.14% (from 28.86% to 50%).

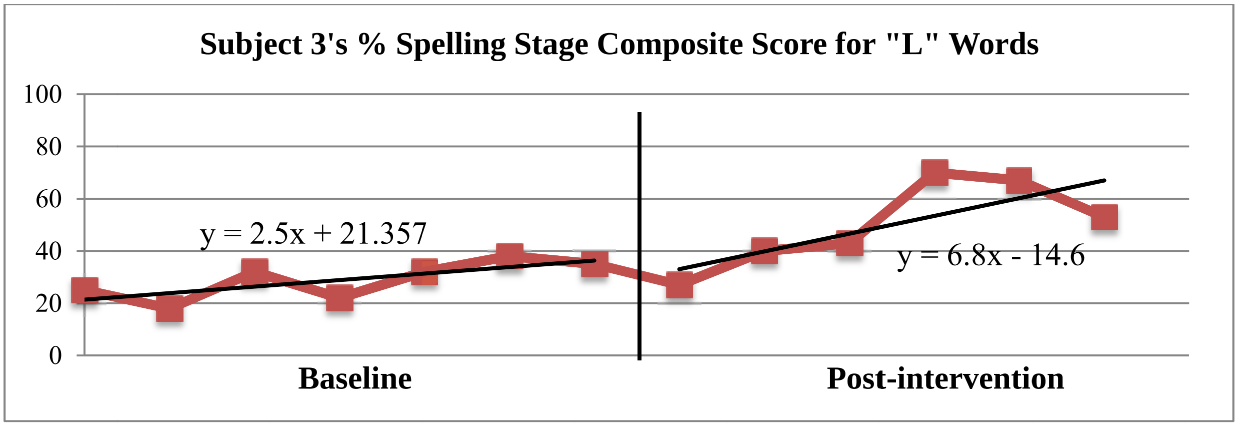


Figure 3.8 Subject 3's Percent Spelling Stage Composite scores on "L" word baseline and post-intervention probes.

F Words. Although the slope of the line indicates a slight increase in Spelling Stage Composite scores on "F" baseline probes, Subject 3's scores were similar (within 12%) on all seven probes. Subject 3 earned the highest score on the first intervention probe as seen in Figure 3.9. Scores across the other five sessions remained relatively stable and were lower than the first intervention session, but higher than baseline. For "F" words, Subject 3's average Percent Spelling Stage Composite score increased 18.88% from baseline to post-intervention.

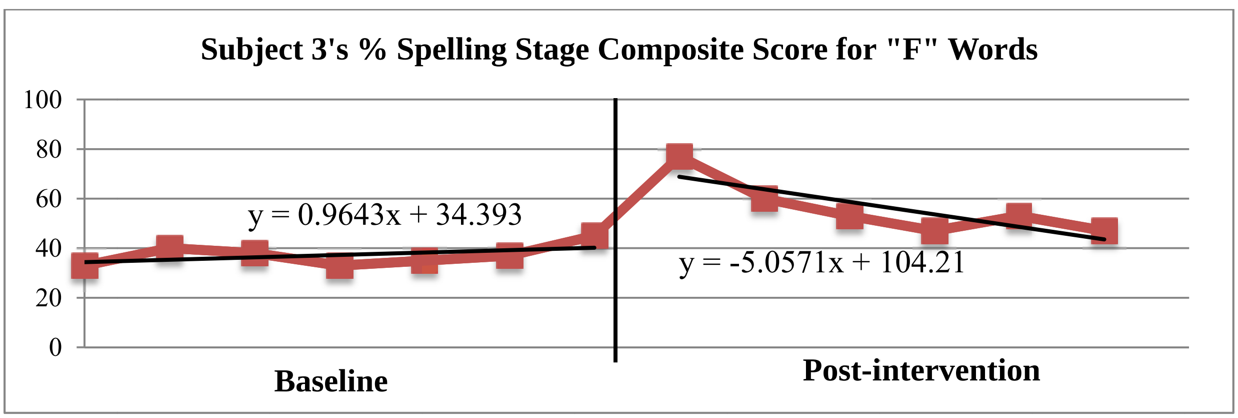


Figure 3.9 Subject 3's Percent Spelling Stage Composite scores on "F" word baseline and post-intervention probes.

Summary. Analysis of the Percent Spelling Stage Composite scores reveals that although Subject 3's baseline performance showed a slight upward trend, most of her baseline scores fluctuated within 32% and 45%. All scores on post-intervention probes were at or above baseline for "S," "L," and "F" words. Only scores on "L" words showed a consistent upward trend across the six intervention sessions. Scores on post-intervention probes for "S" words were variable. Post-intervention scores for "F" words showed an initial increase on the first intervention session but an overall downward trend.

Profile of Subject 4

Subject 4 (age 9;0) was the highest performing member of Group A on pretest measures and on encoding probes during intervention. Subject 4 completed four baseline probes for each target letter (S, L, F). Subject 4 was present for 17 out of 18 intervention sessions. Table 3.7 compares examples of Subject 4's spelling attempts for the same words on baseline and post-intervention probes for "S," "L," and "F" words. Three "S" baseline words were practiced during his only missed session, and this data is missing from Table 3.7. The profile for "S" words show that spelling attempts were shifting from mostly Early Phonemic attempts to Semiphonetic and Phonetic attempts with conventional initial consonants and more accurate syllable shape (i.e, sam for summer and sat for sits).

Table 3.7
Examples of Subject 4's Spelling Attempts on Baseline and Intervention Probes for "S," "L," and "F" Words

Target "S" Words	**BASELINE**		**POST-INTERVENTION**	
	Spelling Attempt	**Stage of Spelling**	**Spelling Attempt**	**Stage of Spelling**
sits	sme	Early Phonemic	sat	Phonetic
Sam	sa	Semiphonetic	--	--
sees	se	Semiphonetic	seis	Transitional
side	ste	Early Phonemic	set	Semiphonetic
summer	spa	Early Phonemic	sam	Semiphonetic
six	sn	Early Phonemic	--	--
sun	st	Early Phonemic	san	Phonetic
sad	sta	Semiphonetic	sact	Semiphonetic
soon	snc	Early Phonemic	snm	Semiphonetic
so	cta	Pre-phonemic	--	--

Table 3.7 continued

Target "L" Words	BASELINE		POST-INTERVENTION	
	Spelling Attempt	**Stage of Spelling**	**Spelling Attempt**	**Stage of Spelling**
look	lop	Semiphonetic	luc	Phonetic
lost	los	Semiphonetic	los	Semiphonetic
lunch	lon	Semiphonetic	lasch	Semiphonetic
low	loc	Semiphonetic	lop	Semiphonetic
let	loll	Early Phonemic	lat	Phonetic
leg	lao	Early Phonemic	ltcg	Early Phonemic
lift	fof	Semiphonetic	luit	Semiphonetic
long	lum	Semiphonetic	loc	Semiphonetic
lazy	llo	Early Phonemic	lat	Semiphonetic
lit	lat	Phonetic	lit	Conventional
Target "F" Words	**BASELINE**		**POST-INTERVENTION**	
	Spelling Attempt	**Stage of Spelling**	**Spelling Attempt**	**Stage of Spelling**
fun	fui	Semiphonetic	fun	Conventional
five	fof	Semiphonetic	fivef	Semiphonetic
fuzzy	fus	Semiphonetic	fioor	Early Phonemic
frog	freg	Phonetic	frog	Conventional
fish	fah	Semiphonetic	fi	Semiphonetic
fox	fox	Conventional	fox	Conventional
fence	fus	Semiphonetic	funt	Semiphonetic
finger	fRu	Early Phonemic	feel	Early Phonemic
feet	feg	Semiphonetic	feet	Conventional
first	fus	Semiphonetic	fikonf	Early Phonemic

*bold letters indicate the correct grapheme in the correct position

Some spelling attempts for "L" words transitioned to higher stages of spelling following intervention. At baseline, most spelling attempts were Semiphonetic with unconventional final consonants except for one (i.e., lat for lit). On post-intervention probes, Subject 4 produced Semiphonetic attempts most frequently. He spelled one word conventionally and two words phonetically. On baseline probes for "F" words, he spelled one word conventionally, consistently represented the initial /f/ sound with letter "f", and final consonant sounds were emerging (i.e., fof for five). By post-intervention, three more words were spelled conventionally: one CVC word (fun), one initial consonant cluster (frog), and one vowel digraph (feet). He added an extra letter to a conventional spelling (i.e., fivef for five) but was able to remember that the word had the "silent e" spelling pattern.

Table 3.8 displays the number of Subject 4's spelling attempts from each stage of spelling on baseline and intervention probes for letter words "S," "L," and "F."

Table 3.8
Subject 4's Spelling Attempts Profiled by Stages of Spelling

Stage of Spelling	"S" WORDS			
	Baseline		Intervention	
	Raw	%	Raw	%
1a. Prephonemic	2	5%	0	0%
1b. Early Phonemic	15	37.5%	3	6%
2. Semiphonetic	19	47.5%	40	80%
3. Phonetic	0	0%	4	8%
4. Transitional	1	2.5%	2	4%
5. Conventional	3	7.5%	1	2%
Total Possible "S" Words	40	100%	50	100%
Stage of Spelling	**"L" WORDS**			
	Baseline		**Intervention**	
	Raw	**%**	**Raw**	**%**
1a. Prephonemic	0	0%	0	0%
1b. Early Phonemic	7	17.5%	2	3.33%
2. Semiphonetic	26	65%	34	56.67%
3. Phonetic	7	17.5%	19	31.67%
4. Transitional	0	0%	0	0%
5. Conventional	0	0%	5	8.33%
Total Possible "L" Words	40	100%	60	100%
Stage of Spelling	**"F" WORDS**			
	Baseline		**Intervention**	
	Raw	**%**	**Raw**	**%**
1a. Prephonemic	0	0%	0	0%
1b. Early Phonemic	1	2.5%	9	15%
2. Semiphonetic	28	70%	35	58.33%
3. Phonetic	7	17.5%	7	11.67%
4. Transitional	0	0%	0	0%
5. Conventional	4	10%	9	15%
Total Possible "F" Words	40	100%	60	100%

Percent Spelling Stage Composite score. To quantify changes in spelling patterns, Percent Spelling Stage Composite scores were calculated. The baseline and post-intervention probes are presented for each letter separately, “S” words in Figure 3.10, “L” words in Figure 3.11, and “F” words in Figure 3.12.

S Words. Although there is an increase in Percent Spelling Stage Composite score after the first baseline session for “S” words, the last three baseline scores are stable. The third and fifth intervention sessions show a slight increase in performance, but scores from the other three intervention sessions are similar to baseline scores. Subject 4’s average Spelling Stage Composite scores increased by 8.15% from baseline (31.25%) to post-intervention probes (39.4%). The expected change from baseline to intervention was not shown.

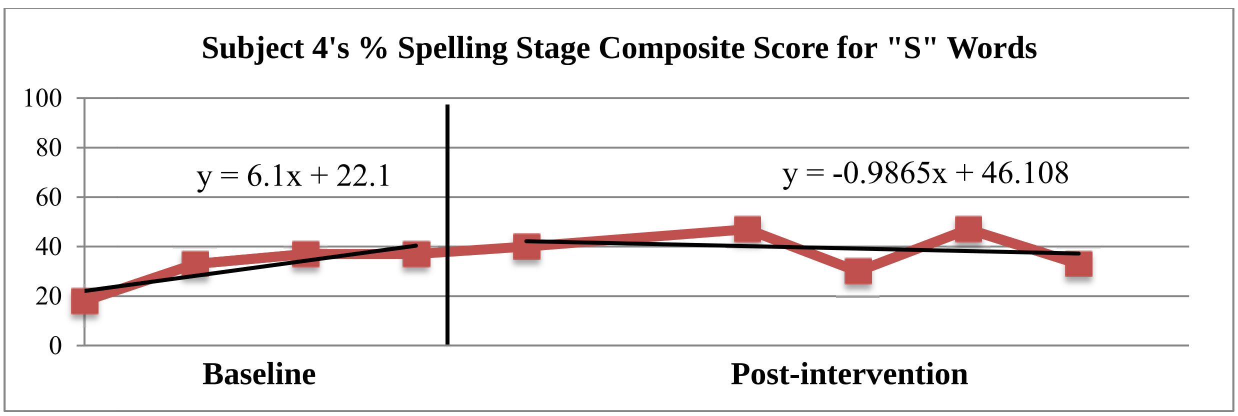


Figure 3.10 Subject 4’s Percent Spelling Stage Composite scores on “S” word baseline and post-intervention probes.

L Words. As shown in Figure 3.11, a stable baseline was achieved for “L” words since Subject 4’s scores only varied within 5%. His average Percent Spelling Stage Composite score was 33.25% at baseline. Scores on post-intervention probes were consistent across the first four sessions and remained at baseline. Subject 4’s score increased 27% on the fifth post-intervention probe, and his score was higher than baseline on the final “L” probe. Subject 4’s average score increased to 43.83% on post-intervention probes.

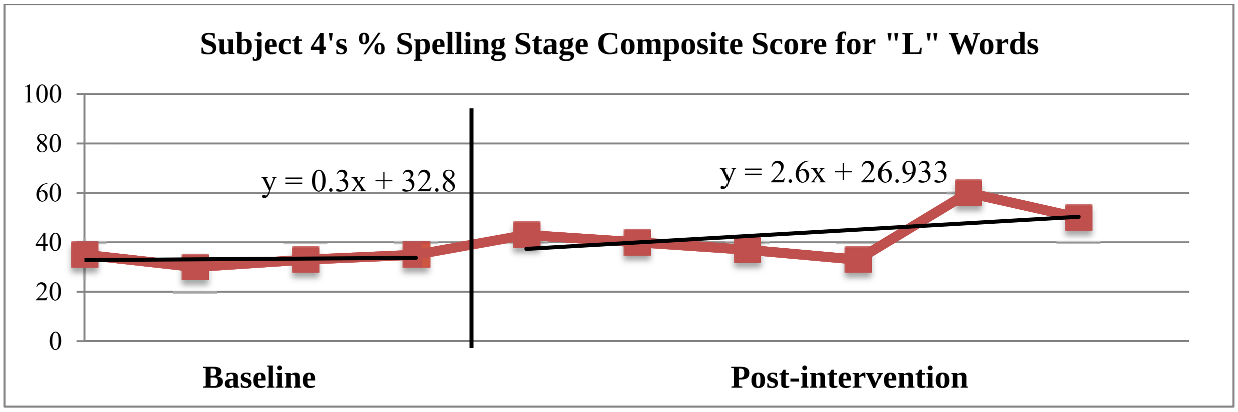


Figure 3.11 Subject 4's Percent Spelling Stage Composite scores on "L" word baseline and post-intervention probes.

F Words. As shown in Figure 3.12, a stable baseline was achieved for Percent Spelling Stage Composite scores for "F" words. Subject 4's average score on baseline probes was 42.75%. The first and last post-intervention probe scores are similar to baseline scores, but intervention sessions two through five show a slight increase from baseline. Subject 4's average Percent Spelling Stage Composite score increased by 4.58% on post-intervention probes. However, the expected increases in scores across post-intervention probes were not shown for Subject 4's spelling attempts on "F" words.

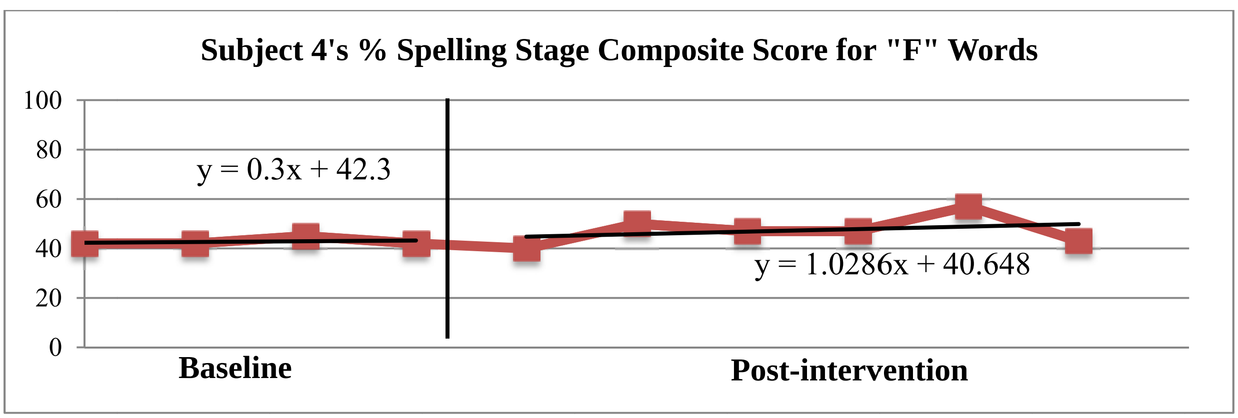


Figure 3.12 Subject 4's Percent Spelling Stage Composite scores on "F" word baseline and post-intervention probes.

Summary. Analysis of Subject 4's Percent Spelling Stage Composite scores reveals that he was able to attain stable scores for all letters at baseline. His average performance increased from baseline to post-intervention for all three target letters, but the greatest changes were seen in “S” and “L” words. However, the reliable change from baseline to intervention was not shown for any letter.

Profile of Subject 5

Subject 5’s (age 9;10) progress and attendance were inconsistent during the intervention. Subject 5 was a member of Group B, thus he completed seven baseline probes for each target letter (S, L, F). Subject 5 was present for 8 of the 18 intervention sessions. Table 3.9 compares Subject 5’s spelling attempts for the same words on baseline and post-intervention probes for “S,” “L,” and “F” words. Any missing data from Table 3.9 is due to Subject 5’s absences. Subject 5 never produced spelling attempts from the first stage of spelling (i.e., the Pre-phonemic or Early Phonemic strategies from the Precommunicative stage) for any target letter. He was able to spell more “S” words conventionally than “L” or “F” words.

The profile for “S” words reveals that Subject 5 was able to spell half of the baseline “S” words conventionally before intervention. Of the remaining five words that were not spelled conventionally at baseline, Subject 5 was able to spell three conventionally on post-intervention probes. Analysis of “L” words reveals mostly Semiphonetic spelling attempts at baseline with two Phonetic and one Conventional spelling attempt. Some “L” words transitioned into higher stages on post- intervention probes, but four examples are missing due to absences during intervention. Although there are not many examples from “F” word post-intervention probes, baseline spelling attempts were still included to contribute to the profile of Subject 5’s spelling abilities. Subject 5’s spelling attempts were mostly Semiphonetic on baseline probes for “F” words. Two baseline words were practiced during the first “F” intervention session: *fun* and *five*. These two words were spelled conventionally on post-intervention probes.

Table 3.9
Examples of Subject 5's Spelling Attempts on Baseline and Intervention Probes for "S," "L," and "F" Words

Target "S" Words	BASELINE		POST-INTERVENTION	
	Spelling Attempt	**Stage of Spelling**	**Spelling Attempt**	**Stage of Spelling**
sits	six	Semiphonetic	sits	Conventional
Sam	Sam	Conventional	Sam	Conventional
sees	sids	Semiphonetic	--	--
side	sad	Phonetic	side	Conventional
summer	sunmmr	Semiphonetic	sunmmber	Semiphonetic
six	six	Conventional	six	Conventional
sun	sun	Conventional	sun	Conventional
sad	sad	Conventional	--	--
soon	soon	Conventional	--	--
so	saw	Semiphonetic	sow	Phonetic
Target "L" Words	**BASELINE**		**POST-INTERVENTION**	
	Spelling Attempt	**Stage of Spelling**	**Spelling Attempt**	**Stage of Spelling**
look	like	Semiphonetic	--	--
lost	Lot	Semiphonetic	--	--
lunch	Lush	Semiphonetic	Luch	Semiphonetic
low	Luw	Phonetic	Low	Conventional
let	Lat	Phonetic	Lat	Phonetic
leg	Las	Semiphonetic	Lags	Phonetic
lift	Lut	Semiphonetic	Let	Semiphonetic
long	log	Semiphonetic	--	--
lazy	Lasy	Semiphonetic	lazy	Conventional
lit	lit	Conventional	--	--
Target "F" Words	**BASELINE**		**POST-INTERVENTION**	
	Spelling Attempt	**Stage of Spelling**	**Spelling Attempt**	**Stage of Spelling**
fun	fun	Conventional	fun	Conventional
five	fave	Transitional	five	Conventional
fuzzy	fusy	Semiphonetic	--	--
frog	fog	Semiphonetic	--	--
fish	feh	Semiphonetic	--	--
fox	fox	Conventional	--	--
fence	fex/fix	Semiphonetic	--	--
finger	fegr	Semiphonetic	--	--
feet	fid	Phonetic	--	--
first	fost	Semiphonetic	--	--

Table 3.10 displays the number of Subject 5's spelling attempts from each stage of spelling on baseline and intervention probes for letter words "S," "L," and "F." Subject 5 never produced spelling attempts from the first stage of spelling, and he rarely produced Transitional spelling attempts.

Table 3.10
Subject 5's Spelling Attempts Profiled by Stages of Spelling

Stage of Spelling	"S" WORDS			
	Baseline		Intervention	
	Raw	%	Raw	%
1a. Prephonemic	0	0%	0	0%
1b. Early Phonemic	0	0%	0	0%
2. Semiphonetic	19	27.14%	13	43.33%
3. Phonetic	16	22.86%	6	20%
4. Transitional	0	0%	0	0%
5. Conventional	35	50%	11	36.67%
Total Possible "S" Words	70	100%	30	100%
Stage of Spelling	**"L" WORDS**			
	Baseline		**Intervention**	
	Raw	**%**	**Raw**	**%**
1a. Prephonemic	0	0%	0	0%
1b. Early Phonemic	0	0%	0	0%
2. Semiphonetic	50	71.43%	12	30%
3. Phonetic	9	12.86%	16	40%
4. Transitional	0	0%	2	5%
5. Conventional	11	15.71%	10	25%
Total Possible "L" Words	70	100%	40	100%
Stage of Spelling	**"F" WORDS**			
	Baseline		**Intervention**	
	Raw	**%**	**Raw**	**%**
1a. Prephonemic	0	0%	--	--
1b. Early Phonemic	0	0%	--	--
2. Semiphonetic	30	42.86%	--	--
3. Phonetic	17	24.29%	--	--
4. Transitional	1	1.42%	--	--
5. Conventional	22	31.43%	2	100%
Total Possible "F" Words	70	100%	2	100%

The profile for "S" words reveals a 13.33% decrease in Conventional spellings from baseline to post-intervention probes. Semiphonetic attempts increased from 27.14% at baseline to 43.33% by post-intervention. Subject 5 made improvements on "L" words shifting from predominately Semiphonetic attempts at baseline to predominately Phonetic attempts on post-intervention probes. His Phonetic spelling attempts increased approximately 27% from baseline. Subject 5 produced 10% more conventionally spelled words on post-intervention probes for "L" words. Subject 5 produced Semiphonetic (42.86%), Phonetic (24.29%), and Conventional (31.41%) attempts on baseline probes for "F" words. Since Subject 5 only attended one "F" word intervention session, there are only two spelling attempts for comparison. Although Subject 5 spelled those two words conventionally on post-intervention probes, changes in spelling patterns for "F" words cannot be determined.

Spelling Stage Composite Score. To quantify changes in spelling patterns, Spelling Stage Composite scores for baseline and post-intervention probes were calculated and presented for each letter separately, "S" words in Figure 3.13, "L" words in Figure 3.14, and "F" words in Figure 3.15.

S Words. Subject 5 achieved a stable baseline on Percent Spelling Stage Composite scores for "S" probes, earning a score of 70% on four probes. As shown in Figure 3.13, scores on the first two intervention sessions are higher than baseline probes, but the third session marks a decline in performance. Subject 5 did not attend the remaining intervention sessions for "S" words. His average score did increase by 4.10% from baseline to post-intervention probes.

L Words. Subject 5's baseline scores for "L" words increased for the first three sessions as shown in Figure 3.14. There was a decrease on the fourth session followed by slight increases across the remaining baseline sessions. Scores increased across the first three post-intervention probes but ended in a downward trend. His average Percent Spelling Stage Composite score increased by 18.25% from baseline (46%) to post-intervention probes (64.25%).

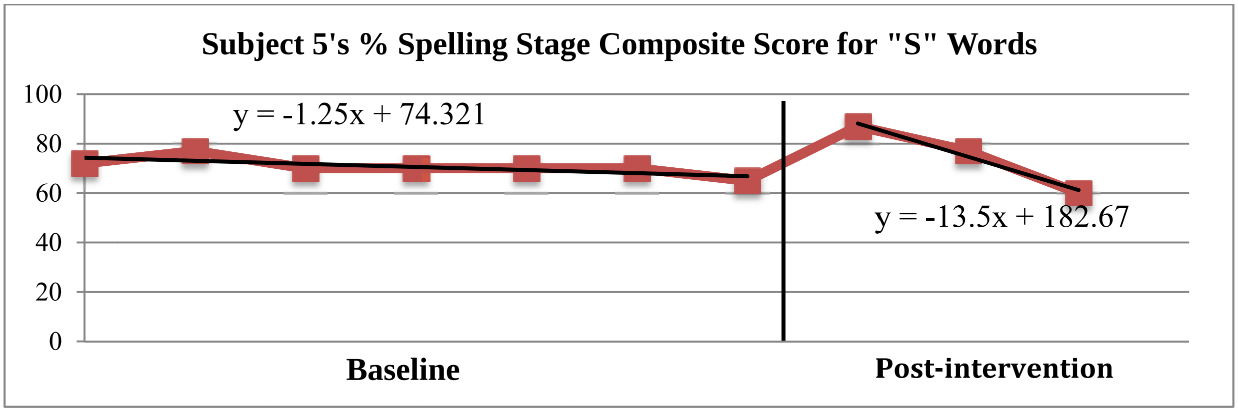


Figure 3.13 Subject 5's Percent Spelling Stage Composite scores on "S" word baseline and intervention probes.

F Words. It is hard to draw an accurate comparison from baseline to post-intervention probes for "F" words since Subject 5 only attended one intervention session. His baseline scores are increasing slightly across the seven probes. The single post-intervention probe score did not differ from baseline scores as shown in Figure 3.15.

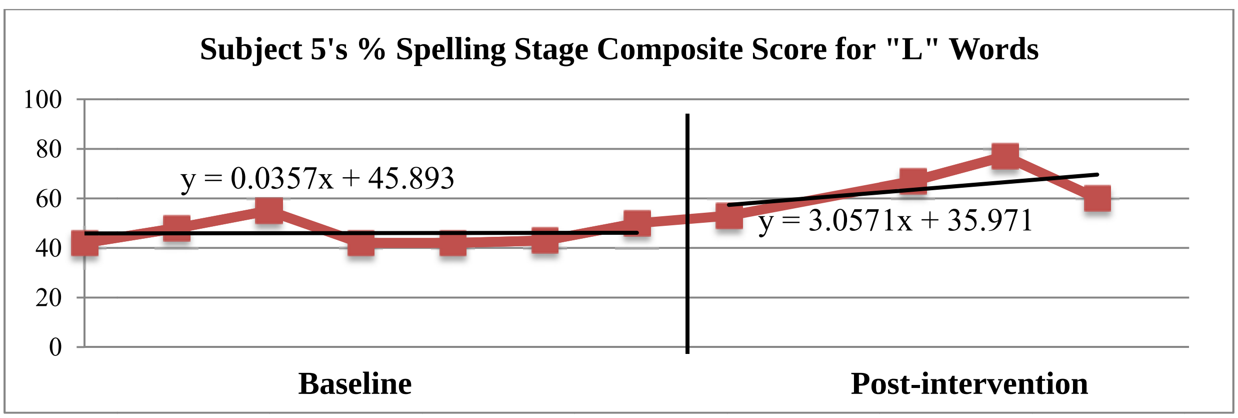


Figure 3.14 Subject 5's Percent Spelling Stage Composite scores on "L" word baseline and intervention probes.

Summary. Analysis of Subject 5's Spelling Stage Composite scores reveal relatively stable baseline for all letters. He increased his average score during intervention for "L" words and showed slight increase for “S” words. There were not enough intervention sessions for “F” words to determine if performance improved from baseline.

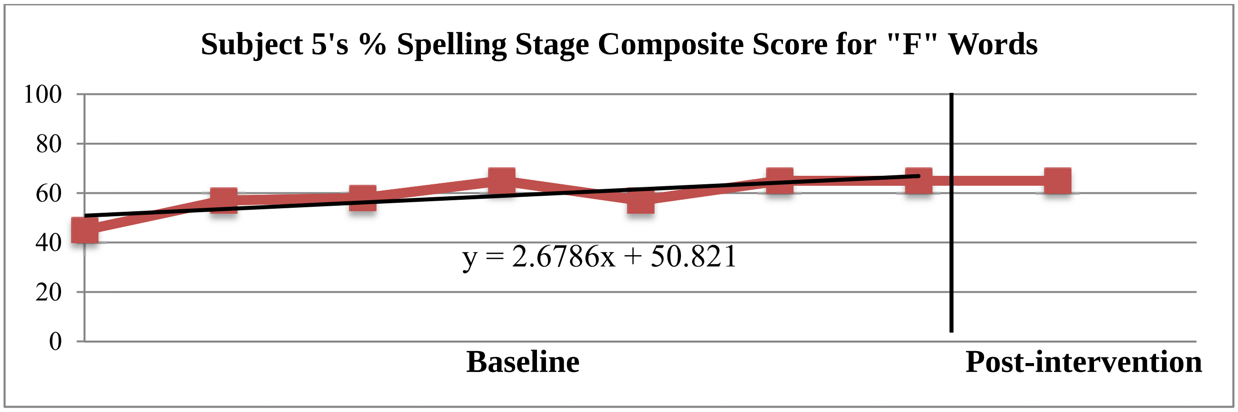


Figure 3.15 Subject 5’s Percent Spelling Stage Composite scores on “F” word baseline and intervention probes.

Question 1 Summary

Question one predicted that following encoding practice, improvements in patterns of developmental spelling would be seen. Comparisons of the same words spelled during baseline attempts and intervention attempts did show changing patterns of developmental spelling, with overall better patterns during intervention. The Spelling Stage Composite Score also showed changes from baseline to intervention, with generally more spelling attempts reflecting higher stages during intervention phases. However, the changes were not sufficiently large nor consistent enough to show the expected patterns of change from baseline to intervention phases of the study, with the possible exception of letters “S” and “L” for Subject 3.

Question 2

The second question of this study asked whether immediate changes would be seen in spelling attempts between pretest (i.e., five words spelled immediately before the session began) and posttest (i.e., same five words spelled immediately following the session). This measure examined learning resulting from the encoding practice. The five words were unique each session, with six sessions per letter. This resulted in 30 different words each for “S,” “L” and words. Each set of five words was practiced in story contexts. The profiles for each subject were examined for gains from the session pretest to the session posttest in the Spelling Stage Composite score, based on the total number of spelling attempts in each stage. On both pretest and posttest probes, the maximum Spelling Stage Composite score is 1.5 points.

Profile of Subject 1

Subject 1’s (age 6;6) average Spelling Stage Composite score did not improve from pre-intervention to post-intervention probes for “S” words. In fact, scores declined 0.11 points or by -7.3% as shown in Figure 3.16. Although improvements were small, average scores did improve for “L” and “F” words from pre- to post-intervention probes. Subject 1’s average Spelling Accuracy score increased 0.10 points (+6.67%) on “L” words and 0.08 points (+5.3%) on “F” words.

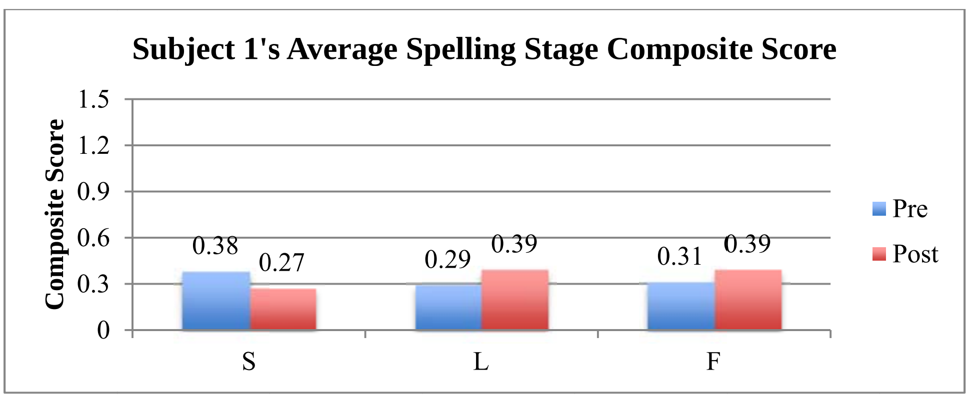


Figure 3.16 Comparison of Subject 1’s average Spelling Stage Composite scores on pre-intervention and post-intervention probes.

Profile of Subject 2

Subject 2’s (age 6;6) average Spelling Stage Composite score improved by an extremely small margin from pre-intervention to post-intervention spelling attempts as shown in Figure 3.17. His average performance increased the most for “S” words, improving by 0.07 points

(+4.6%), while average scores increased by only 0.02 points (+1.3%) for "L" words and 0.03 points (2%) for "F" words.

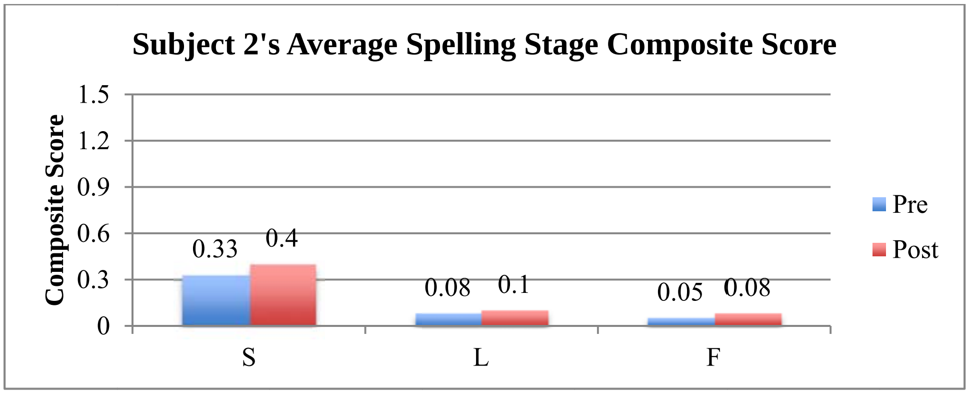


Figure 3.17 Comparison of Subject 2's average Spelling Stage Composite scores on pre-intervention and post-intervention probes.

Profile of Subject 3

As shown in Figure 3.18, Subject 3's (age 8;5) average Spelling Stage Composite scores increased the most on "S" words (+0.25 points or +16.67%) and "F" words (+0.19 point or +12.67%). Post-intervention scores increased by only 0.07 points (+4.67%) on "L" words.

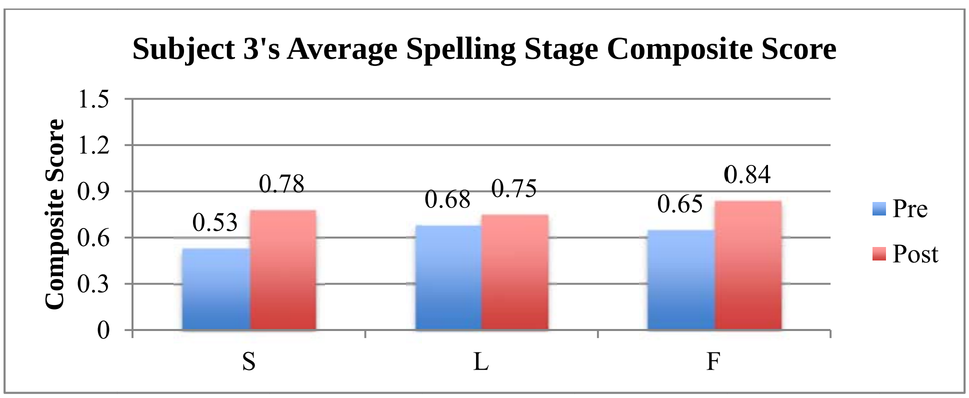


Figure 3.18 Comparison of Subject 3's average Spelling Stage Composite scores on pre-intervention and post-intervention probes.

Profile of Subject 4

Figure 3.19 displays that Subject 4's (9;0) average Spelling Stage Composite score did increase for "S" and "F," but improvement on "L" words was only 0.01 points. Subject 4's average score increased by 0.09 points (+6%) for "S" words and by 0.14 points (9.33%) for "F" words.

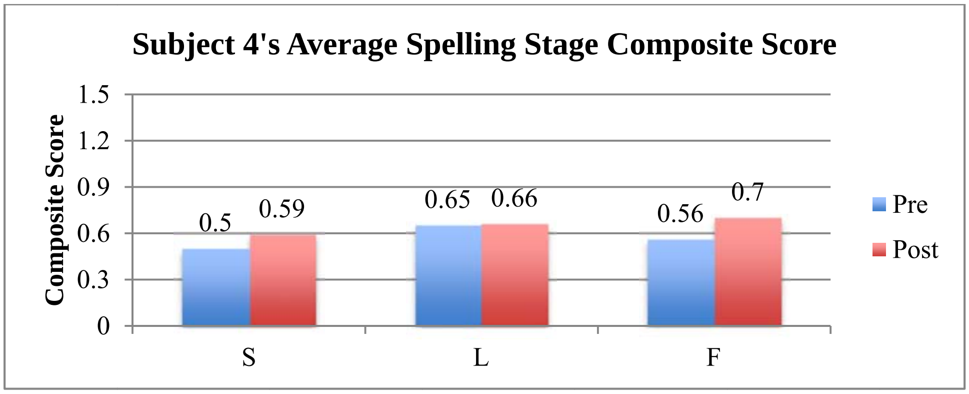


Figure 3.19 Comparison of Subject 4's average Spelling Stage Composite scores on pre-intervention and post-intervention probes.

Profile of Subject 5

Subject 5's (9;10) average Spelling Stage Composite score increased from pre-intervention to post-intervention probes for "S" and "L" words, but not for "F" words. "S" words increased the most by 0.40 points (26.67%), followed by "L" words with a 0.15 point (10%) increase (7.21%). Subject 5's average Spelling Stage Composite score remained the same on pre-intervention and post-intervention probes. As stated earlier, Subject 5 only attended one intervention session for "F" words, so an accurate comparison of the pre- and post-intervention spelling attempts cannot be made.

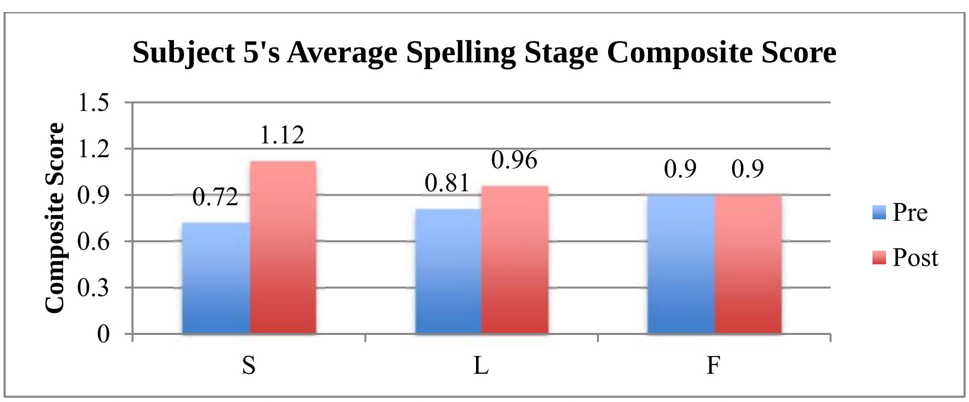


Figure 3.20 Comparison of Subject 5's average Spelling Stage Composite scores on pre-intervention and post-intervention probes.

Question 2 Summary

Although most changes were small, all five subjects' average Spelling Stage Composite score increased from pre-intervention for post-intervention for all target letters, except for Subject 1's scores on "S" words (which declined) and Subject 5's scores on "F" words (which remained the same). These findings suggest that on average, learning did occur during intervention sessions although some changes were small. Without a control group, the significance of these changes could not be measured.

Question 3

The third question of this study asked whether improvements on measures of phonemic and phonological awareness, developmental spelling, alphabet knowledge, and print knowledge would be seen following the intervention (i.e., whether gains were made from pre-test to post-test on language and literacy assessments). Standard scores, percentile ranks, and ratings will be reported. Gains will be determined by clinical significance, defined as a) a gain score above what would be expected by the standard error of measurement alone, or b) a movement from a low or dysfunctional range to a normal or functional range (Bothe & Richardson, 2011). For this study, clinically significant was considered to be any improvement equal or greater than +1.0 standard deviation of change (a more conservative measure). Since the letter identification test (Clay, 2006) does not include standard scores, gains will be determined by raw scores.

The Phonological Awareness Test (TPAT-2)

The TPAT-2 examined phonological awareness skills considered prerequisite to reading and spelling. Some skills, such as the ability to isolate phonemes heard in words, are more directly related to encoding, while others, such as rhyming are more indirectly related.

Phoneme Isolation. It was predicted that participants' phoneme isolation skills would improve as a result of the intervention since this skills was practiced in intervention. Phonemes were tested in the initial, final, and medial word positions. Subjects 1 and 2's scores on the *Initial Phoneme Isolation* task reached the ceiling on pretest. Both subjects' scores remained the same at posttest as shown in Table 3.11. The other three subjects made clinically significant improvements, particularly Subjects 4 and 5 who increased scores by +3.1 SD and +4.9 SD, respectively. At posttest, all five subjects' scores on the initial position task were in the average range. Changes for initial phoneme isolation improved as predicted.

On the *Final Phoneme Isolation* task, all subjects scored in the very poor range at pretest. Subject 5 made clinically significant improvements at posttest, improving his score +2.4 standard deviations to the below average range. Subject 2's final phoneme isolation score did not change, and this was consistent with his spelling patterns during encoding. The other three subjects' scores changed less than 0.5 standard deviations, so ratings remained very poor for isolating sounds in the final position. Changes for final phoneme isolation were emerging but did not reach predicted levels for all but one subject.

All subjects struggled with isolating sounds in the medial position. Subjects 1, 2, and 3 were unable to isolate any medial sounds on pretest or posttest, and their scores remained in the very poor range. A raw score of 0 is not reported in the TPAT-2 scoring manual, so the standard score associated with the lowest reported raw score has been assigned. A "less than" sign has been added to the standard score to indicate that the true standard score is lower than the scores reported in the scoring manual. Subject 4's gain score increased +3.53 SD to the average range. Although Subject 5's rating remained very poor, his score improved by +1.0 standard deviation. Predicted changes were seen for two of the five subjects.

Table 3.11
Changes in Isolation Skills for Initial, Final, and Medial Consonants

	INITIAL PHONEME ISOLATION						
	PRETEST			POSTTEST			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	108	70	Avg	108	70	Avg	0
2	108	70	Avg	108	70	Avg	0
3	80	8	Below Avg	97	27	Avg	1.1*
4	48	2	Very Poor	95	19	Avg	3.1*
5	<35	<1	Very Poor	108	67	Avg	4.9*

	FINAL PHONEME ISOLATION						
	PRETEST			POSTTEST			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	69	8	Very Poor	74	10	Poor	0.33
2	69	8	Very Poor	69	8	Very Poor	0
3	53	3	Very Poor	59	3	Very Poor	0.4
4	51	2	Very Poor	58	2	Very Poor	0.47
5	<50	<1	Very Poor	85	16	Below Avg	2.4*

	MEDIAL PHONEME ISOLATION						
	PRETEST			POSTTEST			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	<81	<17	Very Poor	<81	<17	Very Poor	0
2	<81	<17	Very Poor	<81	<17	Very Poor	0
3	<57	<3	Very Poor	<48	<1	Very Poor	-0.6
4	45	1	Very Poor	98	33	Avg	3.53*
5	<52	<2	Very Poor	66	4	Very Poor	1.0*

	ISOLATION TOTAL						
	PRETEST			POSTTEST			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	74	8	Poor	77	10	Poor	0.2
2	74	8	Poor	74	8	Poor	0
3	48	2	Very Poor	53	2	Very Poor	0.33
4	<48	<1	Very Poor	79	10	Poor	2.13*
5	<53	<1	Very Poor	79	11	Poor	1.8*

Total Phoneme Isolation scores (initial, final, and medial) improved less than 0.5 standard deviations for Subject 1 and Subject 3. Subject 2's score did not change. Subject 4 (SD = +2.13) and Subject 5 (SD = +1.8) made clinically significant improvements in isolation skills, and their ratings shifted from very poor to poor. Predicted changes were seen for two subjects, and were emerging for two subjects.

Blending. Blending involves synthesizing sounds to make a word, or the opposite skill of encoding which requires word analysis. This task was not directly practiced during intervention, and so gains in blending scores, particularly at the phoneme level, were not predicted. Table 3.12 displays scores on the syllable blending and phoneme blending tasks.

Table 3.12
Changes in Blending Skills at the Syllable and Phoneme Level

	BLENDING SYLLABLES						
	PRETEST			POSTTEST			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	78	11	Poor	43	1	Very Poor	-2.3
2	78	11	Poor	78	11	Poor	0
3	40	1	Very Poor	77	7	Poor	2.5*
4	<58	1	Very Poor	<58	1	Very Poor	0
5	<32	<2	Very Poor	32	2	Very Poor	0
	BLENDING PHONEMES						
	PRETEST			**POSTTEST**			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	90	23	Avg	100	43	Avg	0.7
2	68	4	Very Poor	74	9	Poor	0.4
3	67	5	Very Poor	<51	<1	Very Poor	-1.1
4	<48	1	Very Poor	<48	1	Very Poor	0
5	<50	1	Very Poor	86	17	Below Avg	2.5
	BLENDING TOTAL						
	PRETEST			**POSTTEST**			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	85	19	Below Avg	85	19	Below Avg	0.27
2	67	4	Very Poor	71	6	Poor	0.8
3	59	4	Very Poor	<48	<1	Very Poor	1.0*
4	<51	<1	Very Poor	<51	<1	Very Poor	1.1*
5	<51	<1	Very Poor	75	8	Poor	1.7*

Only Subject 3 made positive change on the *Blending Syllables* task, but this change was clinically significant (SD = +2.5). Subject 1's performance declined by -2.3 standard deviations, while all other subjects did not show any change. On the *Blending Phonemes* task, three subjects made positive gains, one of them clinically significant. Subject 5 showed a clinically significant gain of +2.5 standard deviations, improving in ranking from very poor to below average.

Subjects 1 and 2 gained +0.7 and +0.4 SD, respectively, while Subject 3's phoneme blending scores decreased at posttest. As predicted, reliable gains were not made by four subjects.

The *Blending Total* score considers changes at both the syllable and phoneme level. All subjects made positive improvement on overall blending skills, and three subjects showed clinically significant change. Subject 2 was approaching significant change with a standard deviation of +0.8.

Segmenting. It was predicted that participants' segmenting skills would improve as a result of the intervention, particularly at the phoneme level, since this skills was practiced in intervention. Segmenting progresses from larger units, including the ability to parse an oral sentence into words, to smaller unites including syllables and finally phonemes within words.

On the *Sentence Segmentation* task (i.e., segmenting sentences into words), all subjects made positive gains as shown in Table 3.13. Changes for four out of five subjects were clinically significant, and Subjects 1 and 4 improved over +3.0 standard deviations. On the *Words to Syllables Segmentation* task, Subjects 1 and 5 made clinically significant gains of +1.3 while Subject 3 made lesser gains. On the *Word to Phoneme Segmentation* task, three subjects showed clinically significant gains of +1.0 standard deviation or greater shifting from the poor to the average range. Subject 2 was approaching significant change at +0.8 standard deviation, but Subject 1 did not change.

The *Segmentation Total* score considers combined changes from the sentence-level, syllable-level, and phoneme-level segmentation tasks. All five subjects made positive gains from pretest to posttest, and four of these changes were clinically significant. The ratings for all five subjects improved from very poor to poor or below average. Subject 2's positive changes were approaching clinical significance at +0.93 standard deviations. As predicted, improvements were seen for four out of the five subjects for this task.

Table 3.13
Changes in Segmentation Skills at the Sentence, Syllable, and Phoneme Level

	SENTENCE SEGMENTATION						
	PRETEST			POSTTEST			
SUBJ	SS	%	Rating	SS	%	Rating	SD
1	61	3	Very Poor	96	35	Avg	3.5*
2	70	5	Poor	79	8	Poor	0.6
3	64	2	Very Poor	88	18	Below Avg	1.6*
4	<47	1	Very Poor	98	36	Avg	3.4*
5	<53	<1	Very Poor	68	6	Very Poor	1.0*
	SYLLABLE SEGMENTATION						
	PRETEST			**POSTTEST**			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	68	3	Very Poor	87	19	Below Avg	1.3*
2	74	7	Poor	74	7	Poor	0
3	71	7	Poor	79	10	Poor	0.5
4	78	10	Poor	56	2	Very Poor	-1.5
5	54	2	Very Poor	73	7	Poor	1.3*
	PHONEME SEGMENTATION						
	PRETEST			**POSTTEST**			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	85	22	Below Avg	85	22	Below Avg	0
2	<85	<22	Poor	96	40	Avg	0.8
3	<77	<6	Poor	101	59	Avg	1.7*
4	73	3	Poor	91	28	Avg	1.2*
5	<75	<3	Poor	105	70	Avg	2.1*
	SEGMENTATION TOTAL						
	PRETEST			**POSTTEST**			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	60	1	Very Poor	83	12	Below Avg	1.5*
2	63	2	Very Poor	77	7	Poor	0.93
3	54	1	Very Poor	86	15	Below Avg	2.1*
4	<52	1	Very Poor	74	4	Poor	1.5*
5	<55	<1	Very Poor	81	11	Below Avg	1.8*

Deletion. It was predicted that participants' deletion skills would not show improvement as a result of the intervention, particularly at the phoneme level, since this skill was not practiced in intervention. Analysis of scores on the deletion subtest reveal that participants were able to manipulate syllables more easily than phonemes.

Table 3.14
Changes in Deletion Skills at the Word and Phoneme Level

	COMPOUND & SYLLABLE DELETION						
	PRETEST			POSTTEST			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	87	21	Below Avg	87	21	Below Avg	0
2	52	1	Very Poor	78	9	Poor	1.73*
3	60	1	Very Poor	86	16	Below Avg	1.73*
4	73	4	Poor	96	43	Avg	1.53*
5	<46	<1	Very Poor	116	85	Avg	4.67*
	PHONEME DELETION						
	PRETEST			**POSTTEST**			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	77	10	Poor	83	14	Below Avg	0.4
2	<72	<6	Very Poor	<72	<6	Very Poor	0
3	59	3	Very Poor	55	2	Very Poor	-0.27
4	<47	<1	Very Poor	47	1	Very Poor	0.07
5	<51	<1	Very Poor	51	2	Very Poor	0.07
	DELETION TOTAL						
	PRETEST			**POSTTEST**			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	79	9	Poor	83	14	Below Avg	0.27
2	<56	<1	Very Poor	67	3	Very Poor	0.8
3	51	1	Very Poor	66	3	Very Poor	1.0*
4	<52	<1	Very Poor	67	1	Very Poor	1.07*
5	<52	<1	Very Poor	77	8	Poor	1.73*

Four of the five participants made clinically significant gains on *Compounds and Syllables* task as profiled on Table 3.14. Subject 5 made the greatest improvements, improving from very poor to average skills (SD = +4.67). The ratings of Subjects 2, 3, and 4 also improved, but Subject 1's score remained the same. Positive gains were not seen on the *Phoneme Deletion* task. Subject 1 made the most change, increasing +0.4 standard deviations from poor to below average, while none of the other subjects' showed changes within one standard error of measurement. As predicted, phoneme deletion remained very difficult for all subjects.

The *Deletion Total* score represents performance on both subtests and indicates positive change for all participants, primarily due to changes at the syllable level. The last three subjects made clinically significant changes of +1.0 standard deviation or greater, although two remained in the very poor range. Subject 2's score was approaching significance at +0.8 standard deviations. Although Subject 1's standard deviation did not show clinically significant change, his rating improved to below average.

Substitution. The substitution task requires students to convert a target word into another word by making a substitution in a certain position (i.e, changing "mop" into "map" requires substitution of the /ae/ sound for the /aw/ in the medial position). Colored blocks are manipulated by the student to represent the substitution occurring in the word (i.e, substituting a different colored block for the middle block to represent the sound substitution occurring in the medial position). Table 3.15 profiles the changes in *Substitution* scores from pretest to posttest.

Table 3.15
Changes in Substitution Skills

	SUBSTITUTION						
	PRETEST			POSTTEST			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	<85	<18	Below Avg	--	--	--	--
2	<85	<18	Below Avg	100	56	Avg	1.1*
3	<66	<5	Very Poor	68	7	Very Poor	0.13
4	<40	<1	Very Poor	71	5	Poor	0.31
5	<51	<2	Very Poor	64	5	Very Poor	0.93

At pretest, all subjects had a raw score of 0. Zero is not reported in the TPAT2 scoring manual for any age, so the standard score associated with the lowest reported raw score have been assigned. A "less than" sign has been added to the standard score indicate that the true standard score is lower than the scores reported in the scoring manual. All subjects' scores improved on posttest, and Subject 2 made clinically significant improvement (SD = +1.1).

Subject 5's changes were approaching clinical significance (SD = +0.93). Changes were not expected on this subtest since this skill was not targeted during the intervention.

Rhyming. It was not expected that scores on the *Rhyming* subtest of the TPAT2 would change as a result of the intervention. The skill was not practiced, and there were no word families in the target words since words were grouped by initial consonants. The *Rhyming Discrimination* task is a receptive task that requires students to recognize rhymes by saying "yes" or "no" to each pair of words presented. Pairs include one syllable rhymes (i.e., book-look), two syllable rhymes (i.e., sweater-better), and foils (i.e., ring-rat, pudding-table). During the *Rhyme Production* task, participants are required to provide a word that rhymes with the stimulus word. Five of the words are single syllable (i.e., can, bark) and five are two syllable (i.e., brother, shower). As shown in Table 3.16, scores on the *Rhyme Discrimination* task decreased for the first three subjects and Subject 5's score did not change. Unreliable performance suggests that participants may have been guessing as is likely with a yes/no task.

On the *Rhyme Production* task, Subject 2 and Subject 5 were unable to provide any rhyming words at pretest. Only Subject 2 was still unable to provide rhyming words at posttest. Although Subject 5's standard deviation did not indicate change, Subject 5 was able to produce four rhyming words at posttest. Subjects 3 and 4 made clinically significant improvements, while Subject 1 and Subject 2's rhyme production remained poor or very poor on the *Rhyme Production* task.

The *Rhyming Total* score is a combination of scores on the *Rhyme Discrimination* and *Rhyme Production* subtests. Total scores declined from pretest to posttest for first three subjects as indicated by the negative standard deviation. Subject 4 made clinically significant improvement (SD = +1.73), but his rating remained "very poor." Subject 5's performance did not change.

Table 3.16
Changes in Rhyme Discrimination and Rhyme Production

	RHYME DISCRIMINATION						
	PRETEST			**POSTTEST**			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	107	66	Avg	55	1	Very Poor	-3.46
2	65	5	Very Poor	55	1	Very Poor	-0.67
3	91	11	Avg	<49	<2	Very Poor	-2.87
4	<35	<2	Very Poor	70	6	Below Avg	2.4
5	<43	2	Very Poor	<43	2	Very Poor	0
	RHYME PRODUCTION						
	PRETEST			**POSTTEST**			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	76	13	Poor	76	13	Poor	0
2	<66	<7	Very Poor	<66	<7	Very Poor	0
3	78	8	Poor	97	30	Avg	1.27*
4	52	3	Very Poor	67	5	Very Poor	1.0*
5	<51	<1	Very Poor	<51	1	Very Poor	0
	RHYMING TOTAL						
	PRETEST			**POSTTEST**			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	84	14	Below Avg	65	5	Very Poor	-1.27
2	57	2	Very Poor	53	1	Very Poor	-0.27
3	78	10	Poor	<54	2	Very Poor	-1.67
4	<35	<1	Very Poor	60	4	Very Poor	1.73*
5	<40	<1	Very Poor	<40	1	Very Poor	0

Decoding. The decoding subtest relies on participants' ability to identify graphemes, determine which sound is associated with each grapheme, and then blend those sounds. This is the opposite of the encoding process, but was not targeted during intervention. It was not expected that scores on the decoding subtest would increase since participants did not practice this skill directly. As shown in Table 3.17, Subject 4's scores did not change. Subject 5 made clinically significant improvements of +1.0 standard deviation. The first two subjects' scores increased but only by +0.13 standard deviation. Subject 3's scores decreased from pretest to posttest (SD = -1.2).

Table 3.17
Changes in Decoding Abilities

	DECODING						
	PRETEST			POSTTEST			
SUBJ	**SS**	**%**	**Rating**	**SS**	**%**	**Rating**	**SD**
1	<85	<21	Below Avg	86	24	Below Avg	0.13
2	<85	<21	Below Avg	86	24	Below Avg	0.13
3	63	4	Very Poor	45	1	Very Poor	-1.2
4	<50	<1	Very Poor	<50	<1	Very Poor	0
5	52	1	Very Poor	67	5	Very Poor	1.0*

Primary Spelling Inventory

The Primary Spelling Inventory (Bear et al., 2012) was administered at pretest and posttest. This test begins with CVC words and adds progressively more difficult patterns. Ten single syllable words, including short vowel (i.e., five CVC, one CCVC, and one CCVCC) and long vowel patterns (i.e., one double vowel and two silent e) were administered. Table 3.18 reports the raw score (i.e., number of conventionally spelled words), the Spelling Stage Composite scores (3 point maximum), and most frequently occurring stage of spelling on pre- and posttest. Four of the subjects produced Pre-phonemic (Stage 1) attempts most often and had Spelling Stage Composite scores that were less than 0.50. Subject 5 earned the highest score and produced mostly Phonetic spelling attempts.

At posttest, Spelling Stage Composite scores for Subjects 1, 3, and 4 more than doubled, indicating more spelling attempts in higher stages of spelling. Subjects 3 and 4 produced mostly Semiphonetic and Phonetic spellings, respectively, improving from Prep-phonemic attempts at pretest. Subject 2's score decreased to 0.05, and his spelling attempts were still mostly Pre-phonemic at posttest.

Table 3.18
Changes in Developmental Spelling Assessment

	PRETEST			**POSTTEST**		
Subj	**Raw Score**	**Spelling Stage Comp**	**Most Common Stage**	**Raw Score**	**Spelling Stage Comp**	**Most Common Stage**
1	0	0.30	Prephonemic	2	0.80	Prephonemic
2	0	0.45	Prephonemic	0	0.05	Prephonemic
3	0	0.50	Prephonemic	1	1.05	Semiphonetic
4	0	0.45	Prephonemic	1	1.20	Phonetic
5	2	1.65	Phonetic	1	1.50	Phonetic

Concepts About Print and Letter Identification

Concepts About Print (Clay, 2006). Concepts About Print is a 24-item test measuring emergent knowledge about the function and conventions of print. Table 3.19 shows reports raw scores, stanine scores, rating, and gains in raw scores made from pretest to posttest. Stanine scores are only reported for chronological ages 5;0 to 7;0. Subjects whose chronological age is outside of the range reported are marked with an *.

Table 3.19
Gain Scores on Concepts About Print

	PRE			**POST**			
Subj	Raw	Stanine	Rating	Raw	Stanine	Rating	Raw Gain
1	10	2	Poor	16	4	Low Avg	6
2	7	1	Very Poor	14	4	Low Avg	7
3	15	4*	Low Avg	12	3*	Below Avg	-3
4	11	2*	Poor	17	5*	Average	6
5	13	3*	Below Avg	15	4*	Low Avg	2

All subjects made gains except for Subject 3 whose score declined by three points. Subject 5's score only improved by two points. Subject 1 was able to correctly answer test more items associated with print directionality and knowledge of word structure at posttest. Subject 2 made the most improvements on items measuring basic principles of print such as where to start reading and left to right directionality. Subject 4 was able to correctly answer more items measuring basic principles of print and knowledge of word structure.

Letter Identification (Clay, 1972). Letter Identification measures letter-name and letter-sound knowledge for the 26 capital and lowercase letters as well as the ability to provide a word that begins with each letter-sound. At pretest, none of the subjects knew the *letter names* for all 26 letters in both capital and lower case form and at posttest only Subject 5 knew both. Gains ranged from -2 to +7 at posttest, with all knowing 24-26 capital letters and 21-26 lower case letters. At pretest, Subject 1 only knew 14 *letter-sounds* while the other subjects knew 20-26. Subject 1 gained 5 letter-sounds while others gained 1-3, with the exception of Subject 3 who missed one at posttest. Posttest scores ranged from 19-26. Further analysis of letter sounds that participants missed at pretest did not coincide with the initial sounds targeted during intervention (i.e., none of the participants made errors S, L, or F letter names or letter sounds). Subject 1's errors were based on confusion between similarities of visual features of letters such as lowercase "b" and "d," capital "W" and "M," lowercase "u" and "n," and lowercase "p" and "q." Other subjects made similar errors, but not on as many letters as Subject 1.

Table 3.20
Gains in Letter Identification

	Capital Letters			**Lowercase Letters**			**Letter Sound**			**Letter Word**		
Subj	Pre	Post	+/-	Pre	Post	+/-	Pre	Post	+/-	Pre	Post	+/-
1	17	24	**7**	20	21	**1**	14	19	**5**	8	18	**10**
2	24	25	**1**	24	24	**0**	20	21	**1**	7	12	**5**
3	26	24	**-2**	22	24	**2**	26	25	**-1**	20	22	**2**
4	23	25	**2**	20	23	**3**	20	22	**2**	15	18	**3**
5	25	26	**1**	26	26	**0**	23	26	**3**	26	26	**0**

Subject 5 could provide a *word beginning with each letter* at pre and posttest and Subject 3 neared mastery at 22. Subjects 1 and 2 provided few words at pretest (8 and7, respectively) but made large gains of +10 and +5, indicating improvement in associating letters and sounds with words. Subjects 1 and 4 could both produce 18 words at posttest.

The Diagnostic Evaluation of Language Variation (DELV-NR)

The DELV-NR assessed participant's syntactic, pragmatic, and sematic abilities. Scaled scores (SS) have a mean of 10 and a standard deviation of two points. Subject 4 made clinically significant changes on all three subtests, but he made the most gains on the syntax subtest (SD = 4.5). Subject 2 showed clinically significant changes on the syntax subtest, while Subject 1 improved by +2.5 standard deviations on the pragmatics subtest. All other changes were insignificant or negative.

Table 3.21
Gains on Language Subtests of the DELV

	Syntax					Pragmatics					Semantics				
	PRE		POST			PRE		POST			PRE		POST		
Sub	SS	%	SS	%	SD	SS	%	SS	%	SD	SS	%	SS	%	SD
1	4	2	5	5	0.5	3	1	8	25	2.5*	9	37	7	16	-1.0
2	3	1	5	5	1.0*	9	37	4	2	-2.5	6	9	4	2	-2.0
3	6	9	2	0.4	-2.0	3	1	1	0.1	-1.0	5	5	2	0.4	-1.5
4	3	1	12	75	4.5*	5	5	9	37	2.0*	6	9	9	37	1.5*
5	1	0.1	1	0.1	0	1	0.1	1	0.1	0	1	0.1	1	0.1	0

Oral Picture Vocabulary

Participants oral vocabulary was measured using the Picture Vocabulary subtest on the Test of Language Development-Primary (TOLDP:4). Participants' vocabulary skills were rated as poor or low average at pretest. Vocabulary scores were not expected to change since vocabulary was not targeted in the intervention; however, four out of five subjects showed clinically significant positive changes of +1.0, +2.0, and +2.5 standard deviations. These same four subjects' performances were rated as average by posttest. Subject 5's oral vocabulary scores decreased by +1.5 standard deviations.

Table 3.22
Gains on Oral Picture Vocabulary Subtest on the TOLDP:4

	TOLD VOCAB						
	PRETEST			POSTTEST			
Subj	SS	%	Rating	SS	%	Rating	SD
1	5	5	Poor	10	50	Avg	2.5*
2	8	25	Low Avg	12	75	High Avg	2.0*
3	8	25	Low Avg	10	50	Avg	1.0*
4	4	2	Poor	8	25	Avg	2.0*
5	5	5	Poor	2	<1	Very Poor	-1.5

Question 3 Summary

From the assessment battery, there were 18 subtests that measured improvement by clinically significant gains (i.e., +1.0 or greater standard deviation of change). Improvements on Concepts About Print and the letter identification task were measured by raw score gains, while improvements on the spelling task were measure by the Spelling Stage Composite score and number of conventionally spelled words. The number and percent of clinically significant improvements are reported for each subject. Gains made on the print concepts, letter identification, or spelling test are not included in this total but are reported for each subject.

Subject 4 made the highest number of positive gains on the assessment battery following intervention. Out of the 18 possible, he made 11 (61.1%) clinically significant gains. Subject 4 also doubled his score on the spelling test and was able to spell one word conventionally at posttest. He increased his print concepts score by six points, improving his skill rating from poor to average. He made two or three point gains on the letter identification task. Subject 5 made nine clinically significant gains (50%), moved from below average to average on print concepts, and had mastered the letter identification task at posttest. Subject 3 made seven clinically significant gains (38.9%) and doubled her score on the spelling test. Subjects 1 and 2 made the fewest positive gains on the assessment battery from pretest to posttest. Subject 1 made four clinically significant gains (22.2%). He also increased his print concepts score by six points, improving from a poor to low average skill rating. His score on the spelling test more than doubled, and he was able to spell one word conventionally at posttest. On the letter identification task, Subject 1 knew 10 more letter words, seven more capital letters, and five more letter sounds at posttest. Subject 2 also made four clinically significant gains (22.2%) on standardized subtests. He also increased his print concepts score by seven points, moving his skills rating from very poor to low average. He knew five more letter sounds by posttest.

All subjects except for Subject 5 made clinically significant improvements on the vocabulary measure. Four subjects made clinically significant improvements on the sentence-to-word segmentation and compound-and-syllable deletion subtests. Three subjects made clinically significant improvements on initial phoneme isolation. All subjects except for Subject 3 increased their scores on Concepts About Print. Subjects 2 and 5 did increase their scores on the spelling test.

DISCUSSION

Few studies have attempted to teach decoding skills to students with developmental disabilities, focusing instead on teaching sight words or functional words (Browder et al., 2006). However, recent studies have shown that students with mild to severe disabilities have the potential to develop meaningful literacy skills when provided intense, comprehensive, and long-term phonics-based instruction (Allor et al., 2010; Browder et al., 2008). Others have argued that encoding may be a more efficacious route to achieve higher decoding and overall literacy skills because the process begins with a meaningful word and enables existing knowledge of language to be used and refined as the student actively engages in word construction (Allen, 1964; Herron, 2008). This study explored this premise by engaging five students with learning and developmental disabilities in a story activity where they encoded five single syllable words within the story.

To test the question of whether encoding experiences would result in improvements in patterns of developmental spelling, a multiple baseline single subject design was used. Only one subject was able to encode words following the intervention sessions at a level higher than baseline. A second showed small changes while a third subject with autism showed inconsistent increases in performance across intervention sessions. The two youngest subjects with the least previous literacy knowledge showed no reliable changes or decreases in performance except for one who began to show improvements for the final story. Reflecting on these findings, it appeared that the trends in the data showed the encoding process was resulting in emerging changes. To better understand the results, the profiles of the students were compared to their results.

Subject 3 presented the most convincing profile of change related to the encoding practice. During the seven baseline probes, there was evidence of a test-retest effect with small increases in encoding from first to last probes. However, the encoding scores during the intervention phase in most cases were above the baseline levels for all three letters, especially for L words. Subject 3 was the most advanced student at pretest. She was 8;5 years, had a vocabulary in the low average range and had the highest syntactic abilities with a rating in the below average range. She had the highest score for concepts about print and knew all of her letter-sounds. Her phonemic awareness skills ranked very poor but her total composite was the highest in the group. Although her decoding skills were rated "very poor" her skills again were higher than the other subjects. Her encoding abilities were also the highest, with most attempts representing Semiphonetic spellings including correct initial sounds and also syllable shapes captured, although with incorrect letter-sounds. She had repeated kindergarten and was currently considered a first grader. Although she was diagnosed as developmentally delayed with comorbid ADHD, her attention to the encoding task was good and she enjoyed using the Phonic Faces to help her figure out the sound sequences within words she was attempting to encode. She consistently attended school and was the only subject present for all 18 intervention sessions.

Subject 4 also showed rising slopes for the letters "L" and "F", introduced during the last two six-week phases of intervention. The "L" words showed a fairly stable baseline scores that continued into the intervention sessions. However, during the last two sessions, scores were markedly higher. The "F" words also showed a stable baseline phase followed by a small increase that was maintained for four of the last five probes. Subject 4 did not present a profile of strong skills at pretest. He was 9;0 years, had a vocabulary in the poor range and very poor syntactic abilities. His concepts about print were in the very poor range, and he did not know six of his letter names or letter sounds. His rated very poor for all but one of the phonemic awareness measures. His decoding skills ranked very poor but he could read simple sentences by sight, guessing at unknown words. His encoding abilities were also lower than Subject 3, with most attempts representing Early Phonemic attempts comprised of initial sounds and a vowel. However, baseline attempts for the "F" words, completed after intervention for "S" and "L" had begun, were higher than those at the beginning of the study, suggesting generalization of learning. Subject 4 had repeated first grade and was considered a second grader. He was diagnosed with a specific learning disability and was a discouraged learner. However, as the intervention sessions progressed, he became increasingly engaged and excited about learning as he experienced success. He attended 17 of the 18 intervention sessions.

Subject 5 was diagnosed with autism and was 9;10 years old. He had repeated kindergarten and was currently considered a third grader. His attendance at school was inconsistent, so he had only been present for eight intervention sessions, three for letter "S," four for letter "L," and only one for letter "F." However, his scores for letters "S" and "L" did reflect generally rising slopes, especially for letter "F." It should be noted that his scores were near ceiling for letter "S" although his score on the final probe was his lowest. Subject 5 showed low oral language skills, with a vocabulary score in the poor range and syntactic abilities in the very poor range. Additional language subtest scores for pragmatics (i.e., social language) and semantics also were in the very poor range. Written language skills were a relative strength. While rating very low in concepts about print, his score was the second highest (below Subject 3) and he knew all of his letter names and all but three letter-sounds. His decoding skills were rated as very poor, but were the second highest in the group. Encoding was a relative strength and he scored the highest at pretest. For "S" words, 50% of his baseline words were spelled conventionally and other attempts were largely Semiphonetic or Phonetic. "L" and "F" words also showed higher level attempts, although with fewer conventional spellings (15% and 32%, respectively). He would engage during intervention sessions but appeared to be indifferent to the activity or learning, as is typically noted in children with autism.

Subject 1 was one of the youngest at age 6;6. He had a diagnosis of developmental delay and was currently in his second year of kindergarten. He attended 14 of the 18 intervention sessions. Although he was engaged and interested during sessions, he did not make expected progress in encoding. He made essentially no changes in encoding during the first 12 weeks of intervention ("S" and "L" words) but showed higher probes on 2 of 4 intervention sessions for "F" suggesting that encoding skills were emerging. This was shown by more correct initial sounds and emerging final sounds. Subject 1 had poor vocabulary, syntactic, and pragmatic abilities and low average semantic abilities. He scored in the very poor range for concepts about print, earning 10 points out of 24. He had the lowest scores on nearly all of the letter identification assessment, identifying only 14 letter sounds and eight words. He commonly confused letters with similar visual features but opposite orientation (i.e., lowercase "b" and "d" or "p" and "q", or capital "M" and "W"). Subject 1 often wrote letters backwards or upside down. His phonemic abilities were generally poor with the exception of average initial phoneme isolation skills. He was not able to decode any words at pretest. His encoding abilities were lower than most of the other subjects, and his scores did not reliably increase across the intervention. Subject 1 frequently produced Precommunicative and Semiphonetic spelling attempts on baseline and intervention probes for all target letters.

Subject 2 was also 6;6 and was the lowest performing subject. For "S" words, intervention scores show a slight upward trend across the six sessions. However, scores on "L" and “F” words reveal a downward slope. His language skills were mixed with average vocabulary and pragmatics, below average semantics, and very poor syntax. He had the lowest score on print concepts (7 out of 24), but knew 24 capital and 24 lowercase letters. He knew 20 letter sounds, but could only provide seven words. Subject 2’s phonemic awareness scores were poor or very poor, but scores on initial phoneme isolation were average. He could not decode any words prior to the intervention. Subject 2’s encoding abilities were the lowest. He predominately produced spelling attempts characteristic of the Precommunicative Stage (i.e., the Prephonemic and Early Phonemic strategies) on both baseline and intervention probes for “L” and “F” words. His spellings transitioned to predominately Semiphonetic (Stage 2) attempts on intervention probes for “S” words. Subject 2 is a first grader with a comorbid diagnosis of developmental delay and ADHD. He is the only participant who did not repeat a grade. He was present for 16 of the 18 intervention sessions, but his attitude was an obstacle to full engagement and participation in each session. He was not enthusiastic about the activity. He required frequent redirection when encoding independently on probes and with the group during intervention. He would sometimes re-engage during intervention after receiving positive feedback for brief periods of participation. His diagnosis is a contributing factor to his behavior during intervention sessions.

Subject profiles generally showed that age was a factor in performance, in that the younger subjects had lower literacy skills at baseline and made the fewest changes in encoding. In addition, skills considered to be prerequisites for reading such as phonemic awareness and alphabetic knowledge generally corresponded with higher encoding skills. Subject 3 had the highest prerequisite scores and made the greatest amount of change for encoding among the older students. Similarly, Subject 1 had the highest prerequisite skills between the two younger children and also made the most change for encoding. The effect of oral language skills was uncertain in that the two subjects with the highest language scores showed both the most (Subject 3) and least (Subject 2) amount of change. Both had a comorbid diagnosis of ADHD, but only Subject 2's behaviors interfered with learning.

To explore the relationship between student profiles and learning, the gain scores from pretest to posttest on standardized measures of oral and written language were revealing. The two youngest subjects presented similar profiles for phonemic awareness skills at pretest, although Subject 1 had stronger rhyming and phoneme blending skills. Subject 2 knew more letter-names and especially more letter-sounds (14 vs. 20). These findings appear to favor Subject 2, but he made no clinically significant gains in phonemic awareness and learned only one additional letter-sound. In contrast, Subject 1 improved in segmentation, particularly in the larger language units (sentences-to-words and words-to-sentences). He also improved in sound substitution, learned names for seven capital letters, one lower case, and five letter-sounds. He also made greater changes in encoding, suggesting a reciprocal cycle occurred during intervention (i.e., the encoding process increased awareness of units of language and sound, which in turn enabled higher stages of spelling to emerge from encoding attempts).

Subject 3, who made the greatest gains in encoding, started out with the highest phonemic awareness skills and made moderate gains (i.e., seven clinically significant changes), especially in blending and segmentation. Subject 4 had weaker skills at pretest but showed the most clinically significant gains (11), including isolation and segmentation that were practiced during encoding activities. Similar changes were made by Subject 5 who showed nine clinically significant gains, primarily on isolation and segmentation tasks. The pattern of improvements in phonemic awareness preceding improvements in encoding words is supported; Subject 3 who had the strongest skills made changes in encoding during all three phases of intervention. Subject 4 who had weaker phonemic awareness abilities did not begin to make changes in encoding until the last two sessions of the second intervention phase, presumably when phonemic awareness began to improve reciprocally with encoding practice. Subject 5 made moderate but inconsistent improvements in encoding concomitant with changes in phonemic awareness during the few sessions he attended during the first two phases of intervention.

The categories of clinically significant changes in general followed predictions based on the direct relevance of the skill to encoding practice. The ability to isolate phonemes in initial, final and medial word positions is fundamental to encoding and changes were predicted in this area. The three older subjects all made clinically significant changes with 1, 3, and 5 standard deviations of improvement for initial phonemes, 2 SD for final, and 3 and 1 SD for medial phonemes, as well as total scores. Segmentation is also a fundamental skill for encoding, and the four subjects who made the greatest changes all make clinically significant changes in this area, especially the three older subjects. The three older subjects gained from one-to-three SD of improvement for segmenting sentences to words or words to syllables, but also gained one-to-three SD of change at the phoneme level. Subject 1, who was younger, gained three SD of improvement at the sentence-to-word level and one at the word-to-syllable level, but not at the phoneme level. This is consistent with developmental principles, where young children begin to segment from the word level first and gradually at the syllable and phoneme levels.

In contrast, blending skills were not practiced during the intervention and improvements in blending phonemes were not predicated. Only Subject 5 improved by 1 SD in phoneme blending. For the larger unit of syllable blending, only Subject 2 improved. Similarly, phoneme substitution was not practiced, and only Subject 1 showed 1 SD of clinically significant improvement. Rhyming was not expected to change since this skill was not practiced and there were no word families in target words. Subject 4 improved in both receptive and productive rhyming, and Subject 3 improved in productive rhyming. It is possible that encoding heightened awareness of word structure for these two older subjects.

A highly unexpected outcome was improvement in oral language skills, particularly vocabulary. Although vocabulary was not targeted, four of the five subjects gained from 1 to 2.5 SD of improvement in receptive vocabulary. All improved to the average level. Only Subject 5 did not improve. The words on the test were not present within any of the intervention stories. It is possible that the discussions about the pictures during intervention improved the participants' ability to discriminate features of pictures resulting in task improvement. Likewise, Subject 4 made clinically significant changes on the three measures of language assessed by the DELV, including 4.5 SD of improvement on the Syntax subtest. Subject 1 also gained 1 SD of improvement on syntax.

Summary

Except for the oldest and most advanced student, the multiple baseline single subject design did not reveal reliable changes in encoding abilities during intervention phases. However, trends in the slopes for four of the five subjects showed emerging skills. Factors that influenced progress included age of subjects, the level of developmental spelling at baseline, the levels of prerequisite knowledge such as phonemic awareness and alphabetic knowledge, and the ability to maintain attention to the task in the case of an ADHD participant. Phonemic awareness skills that were directly practiced during encoding activities during intervention phases changed for multiple subjects at clinically significant levels, while those skills not directly related to encoding showed few gains. This suggests a reciprocal relationship, where encoding improved phonemic awareness skills which in turn improved encoding abilities. This was supported by the finding that the greatest number of gains in phonemic awareness were made by the three oldest subjects who also made the greatest changes in encoding during intervention phases. Finally, an unexpected finding was clinically significant gains in language skills, including improvements for four of the subjects in vocabulary.

Limitations

Although findings suggest that future research on encoding is warranted, this study was not without limitations. A multiple baseline single subject design was used in this study, primarily because of the small number of students with developmental delays enrolled in special education classrooms and the subsequent difficulties with finding and assigning randomized matched pairs. Small sample size is a common limitation in studies focusing on students from self-contained classrooms; however, a control group design would have allowed for statistical tests to detect small changes in encoding as well as related phonics phonemic awareness skills. While clinical significance is a valid construct for measuring gains in performance, participants' changes after the intervention were not compared to a control group limiting the reliability of the findings.

An important limiting factor was the length of the intervention. There were a maximum 18 intervention sessions completed in approximately eight weeks, and some participants were absent for multiple sessions. Since encoding is a developmental process not a behavior, it will likely take more frequent intervention sessions over a longer period of time for students to make consistent progress on outcome measures. The number of intervention sessions per week ranged from two to four depending on school holidays, class field trips, statewide testing preparation, and student absences. It is possible that if too many days passed between intervention sessions, students' performance regressed due to lack of repeated practice.

Another limitation was the control of the stimulus words practiced during intervention. Some target words may have been too complex for the beginning stages of encoding practice, especially for the two participants with the lowest phonemic awareness and encoding skills at pretest. Additionally, instead of targeting an initial sound, it may be more appropriate to target syllable shape or spelling patterns (i.e., CVC or CVCe words). With words grouped according to initial sound, there were limited choices for short, predictable target words that fit the narrative story. For example, there are only 13 predictable CVC words beginning with "s," but there are many more predictable CVC words that begin with other letters. Due to the limited options for appropriate target words beginning with the target initial sound, it was more difficult to control for dialect sensitive words. Additionally, none of the target words were repeated during the intervention sessions. The same words should have been practiced during several intervention sessions since repeated practice promotes meaningful learning for students with disabilities. With more spelling attempts for the same word, students may have made more changes in encoding attempts.

Participants' IQ scores were not reported in IEPs, and this information is important when building a descriptive profile of each participant. There was no information collected about parent education level or whether the participants engaged in book reading at home. These factors have the potential to influence participants' progress. Participants' performance on the vocabulary measure included in the assessment battery (TOLDP:4) showed clinically significant improvements of +1.0, +2.0, or +2.5 standard deviations from the low average or poor range to the average or high range. This is a surprisingly high increase in relatively short amount of time for students with developmental and learning disabilities. Another vocabulary measure may yield more accurate performance profiles.

Future Research

Future replications of this study should include a different measure of vocabulary and a dialect sensitive spelling test. Future studies could expand this study's findings by conducting longitudinal research with an experimental and control group to capture gradual developmental changes in phonological awareness and spelling skills. Studies with an intervention period longer than 18 sessions could provide more in depth information about the encoding process and have potential for more change to occur from pretest to posttest. In addition, future research could expand encoding research to different clinical populations or to students who are bilingual.

Importantly, instead of grouping stimulus words by initial phoneme, future research should group target words by spelling pattern or syllable shape. Each stimulus word should be practiced across several intervention sessions (consecutively or randomly) to provide multiple opportunities for learning. Repeated practice is a critical element of learning for students with disabilities and would provide a more accurate profile of changes in spelling development. By targeting words with the same syllable shape or spelling pattern, there are more options and flexibility for target words to be encoded, and a wider variety of sounds will be practiced.

Classroom Implications

Literacy is an important component of our highly technological society. For students with disabilities, especially those who are nonverbal or have complex communication needs, literacy abilities have the potential to unlock a world of communication. However, historically, students in special education classrooms have received limited to no literacy instruction since many professionals believed that reading and writing abilities were not important and not attainable for this population (Browder et al., 2008).

The findings from this study and the small body of existing research on this topic challenge this belief and posits that students with disabilities have the potential to learn how to read and write when given explicit instruction in early phonics and phonemic awareness skills. Typically, literacy instruction is deemphasized and limited to sight word vocabulary instruction in special education classrooms (Browder et al., 2006). Rather than dismiss students with disabilities as incapable, we need to investigate literacy development and intervention for this population. Limited current research suggests that students with disabilities need explicit instruction and practice on the five crucial skills (i.e., vocabulary, comprehension, fluency, phonics, and phonemic awareness) to learn how to read. Current research also suggests that this instruction is best delivered in a reading, writing, or spelling context.

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VITA

Laura Delrose completed her Bachelor of Arts degree in Interdisciplinary Studies concentrating on Psychology, Linguistics, and Speech & Hearing Sciences at University of California Santa Barbara in June 2009. Upon graduation, she was accepted to the master's program in Communication Sciences & Disorders at Louisiana State University. Laura completed a master's thesis *Investigating the Use of Graphic Organizers for Writing* under the guidance of Dr. Jan Norris. Laura received her Master of Arts degree in May 2011 and was honored with the Outstanding Master's Student Award. Upon graduation, she began her clinical fellowship at Speech Therapy Services of Baton Rouge providing speech and language therapy to children under three years of age in the greater Baton Rouge area. Laura was an early intervention provider from May 2011 through May 2014. She received her Certificate of Clinical Competence in November 2013.

In Fall 2011, Laura began the doctoral program in Communication Sciences & Disorders at Louisiana State University under the continued guidance of Dr. jan Norris. During her Ph.D. program, Laura completed several small pilot studies at Baton Rouge elementary schools investigating the reading, writing, and spelling skills of students with developmental disabilities. She also served as the co-manager of the LSU Language Intervention Lab. Laura was honored with the Advisory Council Outstanding Teaching Assistant Award in Spring 2014 and participated in ASHA's Leadership Development Program for Emerging Leaders from July 2014 to July 2015. Laura will earn her Doctor of Philosophy degree on August 7, 2015. Upon graduation, she will be moving back to southern California to take a position as a speech-language pathologist in an elementary school and eventually pursue a position at a California university.