From Initial Phonics to Functional Phonics: Teaching Word-Analysis Skills to Students with Moderate Intellectual Disability

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Abstract: Reading instruction for students with MoID is typically limited to sight-word instruction. We developed a 2-part, phonetic instructional sequence based upon Direct Instruction teaching methodology to teach students with MoID word-analysis skills that generalize to untaught words encountered in their environment. Elementary and middle-school students with MoID learned word-analysis skills using simultaneous prompting procedures to explicitly teach verbal imitation of sounds, letter-sound correspondences, retrieval of learned letter-sounds to a predetermined rate of automaticity, and blending with telescoping. After demonstrating mastery of the word-analysis skills the students generalized taught blending skills to untaught CVC words; functional, community words; and environmental, connected-text phrases. A changing-criterion design embedded within a multiple baseline across sound and word sets was implemented for 3 elementary and 2 middle-school students diagnosed with MoID. Students reached mastery criterion for each phase of Initial Phonics and Functional Phonics, and a functional relation was demonstrated between the instructional sequence and students’ acquisition of word-analysis skills.

Students with moderate intellectual disability (MoID) who receive phonics instruction are provided the opportunity to learn generalizable word-analysis skills that increase the probability of decoding a novel, untaught word encountered in their environment. Word-analysis skills are considered an academic form of literacy and include phonological awareness, letter-sound correspondences, blending—saying each sound in a word slowly without stopping between sounds, and telescoping—saying the sounds quickly to read the word (Carnine, Silbert, Kame’ennui, & Tarver, 2004; Foorman, Francis, Shaywitz, Shaywitz, & Fletcher, 1997). For students with MoID, these generalizable word-analysis skills also can be considered a functional form of literacy because mastery of word-analysis skills allows greater access to community resources thereby increasing functional independence.

Until recently, however, phonics instruction seldom was provided for students with MoID. Joseph and Seery (2004) reviewed all forms of literacy instruction for students with all levels of intellectual disability and only found seven studies in which phonics instruction was provided, and of those studies, only one participant was diagnosed with MoID. Browder, Wakeman, Spooner, Ahlgrim-Delzell, and Algozine (2006) reported that almost 90% of published research studies examining reading instruction for students with moderate to severe disabilities (MSD) focused on acquisition of functional sight words. Sight-word instruction has been and remains the dominant form of literacy instruction to increase the functional independence of students with MoID. The reason that educators rely on sight-word instruction for students with MoID is possibly because of the difficulty these students have with phonological coding hindering their acquisition of phonetic reading (Conners, Atwell, Rosenquist, & Sligh, 2001). However, students with severe reading disabilities who were thought to be unable to learn...
Phonetic skills have been shown to benefit from systematic instruction in phonemic awareness and decoding (Torgesen et al., 2001). Similarly, students with intellectual disability may have difficulty in these areas due to lack of instruction in phonetic skills (Stanovich, 1985). A small body of research over the last 3 decades suggests that with effective instruction, students with MoID can learn generalizable word-analysis skills (Allor, Mathes, Roberts, Jones, & Champlin, 2010; Bracey, Maggs, & Morath, 1975; Browder, Ahlgren, Delzell, Courtade, Gibbs, & Flowers, 2008; Cossu, Rossini, & Marshall, 1993; Davis, Fredrick, Alberto, & Gagné, 2010; Davis et al., 2013; Hoogeveen, Smeets, & Lancioni, 1989; Katims, 1996; Nietupski, Williams, & York, 1979; Waugh, Fredrick, & Alberto, 2009).

Bracey et al. (1975) demonstrated long ago that children with MoID can learn phonetic decoding skills. Through the use of a Direct Instruction (DI) program, Distar Reading (Engelmann & Bruner, 1969), students learned letter-sound correspondences, blended sounds into words, and spelled words using their sounds. Results in another early study by Nietupski et al. (1979), revealed that students with MoID could learn letter-sound correspondences through explicit instruction although not specifically a DI program.

These early findings are supported in more recent research. Working with middle-school students, Bradford, Shippen, Alberto, Houchins, and Flores (2006) demonstrated that students with MoID are capable of learning word-analysis skills including (a) letter-sound correspondences, (b) sounding out words, (c) blending sounds, (d) decoding irregularly spelled words, and (e) reading sentences and short passages at approximately a second-grade level. In only 6 months, these middle-school students learned phonetic decoding skills through the use of the DI Corrective Reading Program (Engelmann, Becker, Hanner, & Johnson, 1980), substantiating findings by Connors (1992) and Katims (2000).

Working with elementary-school students with MoID, Flores, Shippen, Alberto, and Crowe (2004) used systematic and explicit instruction to teach phonetic decoding by incorporating modified sequences and formats of the DI program, Corrective Reading: Word-Attack Basics, Decoding A (Engelmann, Carnine, & Johnson, 1988). All five of the students learned letter-sound correspondences, blending, and sounding out. All but one student mastered the four sounds taught and were able to blend the sounds slowly on both instructional and generalization words; however, they struggled with telescoping. Only one student was able to telescope novel consonant-vowel-consonant (CVC) words.

More recently, researchers demonstrated the effectiveness of time delay and simultaneous prompting procedures (Cohen, Heller, Alberto, & Fredrick, 2008; Waugh et al., 2009) for students with intellectual disability. Cohen et al. used time delay procedures with five participants—three with IQs in the mild-delayed range and two with IQs in the moderate range. All five students learned decoding skills with one of the student’s whose IQ was in the intermediate range acquiring mastery the fastest. Through the use of simultaneous prompting procedures Waugh et al. found that three students with MoID learned letter-sound correspondences and applied blending skills to previously-learned sight words; although, not without difficulty in some areas. One student was unable to generalize the blending skill to novel, untaught words, while two students generalized blending to one untaught word but could not telescope.

Students with MoID can learn word-analysis skills when teachers use time delay (Cohen et al., 2008) and simultaneous prompting procedures (Waugh et al., 2009) based on Direct Instruction teaching strategies. However, some students have demonstrated difficulty in the areas of blending, telescoping, and generalization (Flores et al., 2004; Waugh et al., 2009). Difficulty with blending and telescoping could result from a lack of automatic retrieval of learned letter-sound correspondences. Automaticity with letter sounds is necessary for word reading to occur (LaBerge & Samuels, 1974), and consistent practice is necessary for automaticity to develop (Shiffrin & Schneider, 1977). Shiffrin and Schneider found that automaticity did not develop when tasks were inconsistent; moreover, the degree of automaticity depended upon the amount of consistency. Cohen, Dunbar, and McClelland (1990) found that the most important mechanism underlying automaticity is the strength-
ening of connections between stimuli and responses. Practice makes these connections stronger and performances are subsequently faster and less effortful. Taken together, these findings strongly support incorporating formal, systematic development of automaticity within reading instruction. Additionally, it is likely that once blending and telescoping skills are acquired students will need extensive practice before these skills generalize.

We designed an instructional sequence to provide many opportunities for students to learn verbal imitation of sounds, master letter-sound correspondences, become automatic with letter-sound correspondences to maximize phonological information processing efficiency, practice blending and telescoping, and then generalize these skills to novel, untaught words. The instructional sequence is based on DI teaching strategies such that it teaches components of word-analysis skills to mastery/automaticity (Carnine et al., 2004). To address automatic retrieval of letter sounds, we included a component not found in DI programs. That is, students practiced naming learned letter sounds to an individual mastery criterion that was determined by each student’s rate of naming speed demonstrated on the Rapid Object Naming (RON) subtest of the Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen, & Rashotte, 1999). Blending and telescoping sounds into words was not attempted until each student reached his or her individualized automaticity rate for taught letter-sound correspondences.

This study was part of a larger Institute of Educational Sciences (IES) research project to develop a comprehensive and integrated literacy curriculum (ILC) for students with moderate to severe disabilities (Alberto & Fredrick, 2007). The ILC includes three components. The Visual-Literacy Component provides instruction in picture and logo reading while the Sight-Word Component provides instruction in reading and demonstrating comprehension of individual sight words and connected text (Alberto, Waugh, & Fredrick, 2010). The research reported here is based on the Phonics Component of the ILC which was conducted to determine the effectiveness of the Phonics Component in teaching word-analysis skills to individuals with MoID.

The Phonics Component includes Initial Phonics and Functional Phonics. While both parts of the curriculum were designed to answer the research question through the use of the same instructional sequence, each part differed in some important aspects. Initial Phonics was introduced first to provide ample opportunities to develop initial emergent-literacy and phonological-awareness skills, to develop initial learning of instructional procedures, to teach a selection of individual letter-sound correspondences to be blended and telescoped into CVC words, and to provide many opportunities to generalize blending and telescoping skills to untaught, CVC words. That is, Initial Phonics was an opportunity for students to learn how to learn phonics. The second part of the Phonics Component, Functional Phonics, was introduced to students after they mastered all phases of Initial Phonics. The purpose of Functional Phonics was to build upon Initial Phonics by emphasizing instruction of common, functional community words and phrases. During Functional Phonics students continued to receive instruction in prerequisite skills such as phonological awareness; they were taught a much larger selection of individual letter-sound correspondences and letter-sound combinations; and they were taught to generalize blending and telescoping skills to more complex, functional words and to functional, environmental-connected text.

Method

Participants

Participants included five students with MoID and their classroom teachers. All students were between 7 and 14 years old with IQs in the 40–55 range. Students were identified by their classroom teachers based on the teacher’s report that the students communicated verbally, performed successfully in their current Edmark (Austin & Boekman, 1990) sight-word reading program, and did not have any behaviors that would interfere with 15 minutes of continuous instruction. Parents or guardians provided permission for all students. The students were served in two different self-contained special education classrooms for students with MoID, in two different schools (one elementary and one
middle), across two school districts. Two students were boys and three were girls; three students were African-American and two were Hispanic.

The students’ classroom teachers provided all of the instruction and conducted all of the data probes. The elementary students received 1:1 teaching sessions during Initial Phonics and the first two sound sets of Functional Phonics, and small-group instruction for the remaining sound and word sets of Functional Phonics. The two middle-school students received group instruction during both Initial and Functional Phonics.

Teacher Training

Teachers were trained prior to beginning instruction with students. Doctoral students who were part of the research project presented the overall program to teachers and modeled instructional steps for them. Teachers practiced implementing the instructional procedures by role playing with the researchers until they followed program steps with 100% accuracy based on the procedural fidelity instrument developed for the Phonics Component of the ILC. Researchers provided ongoing feedback and answered teacher questions for a minimum of one instructional sequence per week.

Independent and Dependent Variables

The independent variable (IV) was the Phonics Component of the ILC implemented with simultaneous prompting procedures. The dependent variables (DV) were the word-analysis skills that were taught in the Phonics Component—verbal imitation of sounds, letter-sound correspondences, automaticity, blending with telescoping, and generalization. Within the Phonics Component of the ILC the Blending Phase included both blending and telescoping such that students practiced saying the sounds in a word slowly without stopping between sounds and then saying the sounds quickly to read the word.

For Initial Phonics, a total of eight sounds were taught for the Sounds, Letter-Sound Correspondences, and Automaticity Phases, along with 14 blending words and 10 generalization words. For ease of learning, letter sounds were selected that had distinct auditory and visual characteristics. Words for Blending and Generalization Phases were common CVC words made up of previously-mastered letter sounds.

For Functional Phonics, a total of 16 sounds (four of which were previously-mastered sounds from Initial Phonics per the cumulative design) and four sound combinations were presented for the Sounds, Letter-Sound Correspondences, and Automaticity Phases along with 48 blending words, 15 functional generalization words, and 20 functional phrases. To select sounds and blending words for Sound Sets 1 through 4, we identified functional, community words such as “open” and “stairs.” The sounds from the functional words were taught in the Sounds, Letter-Sound Correspondences, and Automaticity Phases, and we chose words for Blending Phases that were comprised of those letter sounds. We used the originally-selected functional words as the untaught words to be blended within the Generalization Phases providing students the opportunity to generalize the skill of blending to novel, untaught words made up of previously-mastered letter sounds. For Word Sets 5 and 6 we selected two- and three-word environmental, connected-text phrases from lists of the most commonly-used functional, community phrases. For Word Set 5, we selected phrases that contained previously-mastered letter sounds and one previous generalization word from Sound Sets 1 through 4. Environmental, connected-text phrases for Word Set 6 were selected that were comprised of previously-mastered letter sounds from Sound Sets 1 through 4, yet all words within these phrases were novel words that the students had never been taught.

Assessment

Before instruction began, the RON subtest of the CTOPP (Wagner et al., 1999) was administered as a measure of naming speed. Naming speed is typically measured by asking students to name, as quickly and accurately as possible, an array of stimuli such as objects, colors, letters, or digits that are pictured on a page. Many students with MoID do not know the names of letters, digits, or colors, so the RON subtest was selected for use because it utilizes
pictures of everyday common objects such as ball, star, and chair.

Prior to the onset of instruction, in private testing areas of students’ schools, the RON subtest was administered individually by doctoral students. Raw scores were used because no standardized assessments have been developed to measure processing speed for this population.

**Design**

A multiple-baseline design across sound and word sets with an embedded changing criterion was used to determine the effectiveness of the Phonics Component. *Initial Phonics* stimuli were divided into three sound sets for a 3-tier, multiple-baseline design across sound sets. *Functional Phonics* stimuli were divided into four sound sets and two word sets for a 6-tier, multiple-baseline design across sound and word sets.

The embedded changing criterion occurred as the number of sounds and words accumulated across tiers of corresponding Sound, Letter-Sound, Blending, and Generalization Phases of the multiple baseline design. As the number of sounds and words increased across tiers, each set included at least 20% of the previously-mastered stimuli. For example, Sound Set 1 of *Initial Phonics* contained /a/ /m/ /t/ /s/ and Sound Set 2 contained the same sounds plus the new sounds /i/ and /f/. Therefore Sound Set 2 contained all previously-mastered sounds and new sounds to be learned making the entire set of sounds /a/ /m/ /t/ /s/ /i/ /f/. In the same manner, Sound Set 3 contained all previous sounds from Sound Sets 1 and 2, plus two additional sounds. Another example can be seen in Sound Set 1 of *Initial Phonics* in which the blending words were /mat/ /sam/ /at/ and /sam/. Sound Set 2 blending words included the previously-mastered words from Sound Set 1 plus the words /fit/ /tim/ and /it/ thereby forming cumulative groups of blending words across sound sets (tiers). The exception was for the Automaticity Phase in which all sounds were cumulative across all sound and word sets. The total number of sounds and words increased across sound and word sets.

Each tier of *Initial Phonics* and *Functional Phonics* included six consecutive phases: a Baseline Phase and the five skill phases (verbal imitation of sounds, letter-sound correspondences, automaticity of letter sounds, blending, and generalization). After establishing stability within the Baseline Phase of each tier, each student reached mastery for a phase before beginning a subsequent phase. The mastery criterion for each Sound, Letter-Sound Correspondence, Blending, and Generalization Phase was 80% correct for two out of three consecutive sessions for group instruction and 100% correct for two consecutive sessions for individual instruction. The individualized mastery criterion for all automaticity phases was 100% of each student’s RON pretest rate for two consecutive sessions. Phase sequences across *Initial Phonics* and *Functional Phonics* are presented in Table 1.

Baseline data were collected for each student individually. All sounds and words to be taught were presented to each student prior to the onset of the study. Additional baseline probes were conducted for all sounds and words to be taught immediately prior to the onset of the respective sound or word set. All sounds and words were printed in 150 Comic Sans MS font on white 5 x 7 index cards. During the initial Baseline Phase and baseline probes, the teacher presented a sound or word card and asked the student to touch the card as a joint-attention prompt. Then the teacher said “What sound/word?” Correct and incorrect responses were recorded, but no feedback was provided.

**Daily Sequence for Initial and Functional Phonics**

Simultaneous prompting procedures were used to teach verbal imitation of sounds, letter-sound correspondences, and blending skills within the Phonics Component of the ILC. The daily sequence of activities consisted of priming activities, probes, and a teaching session. Learning was measured before each teaching session through the use of probes, described below. The stimuli for probes and teaching sessions consisted of the sounds or words of the particular phase in which students were working towards mastery.

**Priming activities.** The researchers wrote storybooks that included a controlled vocabulary (blending and generalization words) for respective sound sets, creating six storybooks.
for elementary students and two for middle-school students. Researchers made sock puppets for some of the characters and provided objects from the stories so students could interact with the storybooks thereby increasing student interest, attention, and comprehension. The overall purpose of the storybooks was to develop emergent-literacy skills, phonological awareness, and comprehension of blending and generalization words; and to ensure that the words students were expected to blend existed in the students' receptive vocabulary. Teachers developed these skills through shared-storybook reading (Whitehurst & Lonigan, 1998) and language-expansion activities that included: modeling and having students track lines and words on pages, stressing a reading vocabulary, asking comprehension questions, and asking students to predict and retell stories. Magnetic letters also were used to promote phonological awareness through unstructured word-play activities. Teachers guided students in physical manipulation of magnetic letters to demonstrate combining sounds into words and breaking words into sounds. Priming activities also included practice naming previously-mastered letter sounds. No data were collected on priming activities.

Probe sessions. Teachers conducted one probe session in a 1:1 format for each participant prior to each instructional session using the same sound and word cards used in baseline and during instructional sessions. The data from these probe sessions are the data used to determine the effectiveness of the Phonics Component. Teachers recorded the number of correct and incorrect responses of each student on researcher-prepared, data-collection sheets. As in baseline, a joint-atten-
tion prompt was provided in all phases (e.g., touch the card). Unlike the Baseline Phase, if students made an incorrect response, the teacher provided the correct response, and if students made a correct response the teacher praised the student and repeated the correct response. During the Sounds Phase the teacher asked the student to repeat sounds she modeled (e.g., Say /s/). During the Letter-Sound Correspondence Phase the teacher presented a letter-sound card, asked the student to touch the card and then asked what sound? During the Automaticity Phase, the teacher presented a sound sheet with six rows each containing seven previously-learned letters and asked students to say the sounds as quickly as you can. The teacher recorded the number of correct sounds students provided in 1 minute. During the Blending Phase, the teacher presented a word card, asked the student to touch the card, say each sound in the word while pointing to the sounds, and then say the word fast. Probes during the Generalization Phase were conducted the same way as probes during the Blending Phase, except no corrective feedback was provided during the Generalization Phase. Probes were always conducted prior to teaching sessions in order to assess what students retained from previous teaching sessions; all correct responses counted toward mastery for that particular phase.

Teaching sessions. After probe sessions, teachers conducted a teaching session using simultaneous prompting procedures, that we adapted by adding a lead step for phonics students, in either a 1:1 or small-group format. The elementary-school students received 1:1 instruction for Initial Phonics and the first two sound sets of Functional Phonics, and small-group instruction for the remaining sound and word sets of Functional Phonics. The middle-school students received small-group instruction for both Initial and Functional Phonics. No data were collected during these teaching sessions because the controlling prompt was always provided before the students were asked to respond.

During all teaching sessions simultaneous prompting procedures that included a model, lead, test sequence were repeated until students responded correctly and independently. The teacher provided the controlling prompt simultaneously with the instructional cue and then modeled for the students by providing the correct response. Next, the teacher provided the controlling prompt simultaneously with the instructional cue and asked the students to respond with her as a lead step. Finally, the teacher provided the controlling prompt simultaneously with the instructional cue and asked individual students to respond.

During the Sounds Phase, verbal imitation of sounds was taught for the respective group of sounds within each sound set. The teacher modeled continuous sounds (e.g., /m/, /s/) by saying them for 2 seconds and stop sounds (e.g., /v/, /b/) by saying them quickly without adding uh (e.g., tuh, buh). Students imitated each sound. During the Letter-Sound Correspondence Phase, letter-sound correspondences were taught for the respective group of letter sounds within each sound set. The teacher held up a letter-sound card (the same ones used in baseline) and said Touch the card. This sound is ___ , what sound? following simultaneous prompting procedures of model, lead, test until the student responded correctly and independently.

During the Automaticity Phase automatic retrieval of learned letter-sound correspondences was taught for the respective group of letter sounds within each sound set. The authors created automaticity charts consisting of previously-mastered letter sounds in random order and in the same format as objects on RON charts. Students practiced naming the sounds as fast as they could for 1 minute until their naming rate, measured as correct sounds per minute (CSPM), matched their individual RON pretest rate. Only after students reached this level of automaticity was the skill of blending introduced.

During the Blending Phase for each sound and word set, students were taught to blend and telescope the previously-mastered letter sounds into words. Blending was operationally defined as holding each continuous sound (e.g., /s/, /m/) in the blending word for 2 seconds without stopping between sounds. This is called “saying the word slowly” and is a DI technique (Engelmann et al., 1988) used as an indicator that the student actually manipulated and blended sounds rather than having memorized the word as a sight word after seeing it in many teaching sessions. After
blending the sounds, the student was asked to telescope, or to "say the word fast" in order to practice the correct pronunciation of the word. Teachers used simultaneous prompting procedures that included a model, lead, test sequence for students to practice saying the words slowly and saying the words fast until they responded correctly and independently. After each correct blending and telescoping response students selected the corresponding object from an array of objects displayed on the table. This motor demonstration of comprehension ensured that the students understood the meaning of the words they read.

During the Generalization Phase of Initial Phonics, students were presented with untaught consonant-vowel-consonant (CVC) words made up of previously-mastered sounds to test for generalization of blending and telescoping. During the Generalization Phase of Functional Phonics students were presented with untaught, functional words made of previously-mastered sounds to test for generalization. There was no instruction during the Generalization Phase.

Procedural Fidelity

To measure procedural fidelity each week, teachers and the researchers used video cameras to record 20% of instructional sequences. The investigator viewed the tapes while comparing procedures to a behavior checklist. The total number of teacher behaviors observed during the session was divided by the total number of teacher behaviors on the behavior checklist and multiplied by 100%. Procedural fidelity for teacher implementation ranged from 91% to 100% with a mean of 96%.

Interobserver Agreement

The researcher observed probe sessions on video while simultaneously recording correct and incorrect student responses. Data were compared to data collected by the primary data collector, the teacher. Interobserver agreement was calculated using point-by-point agreement. The total number of agreements was divided by the total number of agreements plus disagreements and converted to a percent. Interobserver agreement was calculated for 20% of probe sessions and ranged from 93% to 100% with a mean of 95%.

Social Validity

Teachers were provided with a social validity rating scale to complete at the end of the study. They were asked to answer questions pertaining to the usefulness of the study in determining appropriate instruction for their students, ease of implementation, and relevance to curriculum development for students with MoID. They also were asked how important they felt phonics instruction was for their students, and how likely they would be to continue to develop word-analysis skills and automaticity with their students. Teachers rated their responses on a 1 to 5 Likert-type scale with 1 indicating strongly disagree and 5 indicating strongly agree for a maximum positive score of 25. Teachers’ scores ranged from 20 to 25 with a mean of 23.

Results

Visual analysis was conducted for all five participants revealing a functional relation between the Phonics Component of the ILC and mastery of word-analysis skills as evidenced by a pattern of increase in correct responding during intervention phases replicated across sound and word sets. Due to space limitations graphic presentation of data is provided for a sample of one elementary student who received individual and group instruction, and for the middle-school group of two participants who received group instruction. The data for each sample are displayed in a 3-tier (Initial Phonics) and a 6-tier (Functional Phonics) multiple baseline design across sound and word sets with an embedded changing criterion, depicting the number of correct responses on the left y-axis and the number of correct sounds per minute on the right y-axis. Dashed lines across each phase indicate the criterion for that phase and the numbers in parentheses indicate the actual number of correct responses needed for mastery. Also, we have provided a table that includes the mastery criterion for all Blending and Generalization Phases as well as the number of sessions required to reach mastery for the elementary student and for the middle-school...
group of students, highlighting the change in rate of learning across sound and word sets.

Taniesha represents the elementary students who received individual instruction during Initial Phonics (see Figure 1). Taniesha demonstrated mastery of all phases of Initial Phonics except the Generalization Phase of Sound Set 1 (Tier 1). Her learning was replicated across subsequent tiers representing Sound Sets 2 and 3. Baseline data points of zero indicate that Taniesha did not know any sounds or blending words before instruction began and an increase in word-analysis skills did not occur until treatment was introduced in each phase. Baseline probes were conducted immediately prior to the onset of each sound set to measure her most current knowledge of verbal imitation of sounds, letter-sound correspondences, and words for each respective tier. The baseline probes just prior to instruction in each tier show that Taniesha retained previously-mastered sounds and words that were included in subsequent sound sets. As seen in Table 2, during Sound Set 1 Taniesha reached the mastery criterion of 12 correctly blended words in 14 sessions. In Sound Set 2 she reached the mastery criterion of 21 correctly blended words in 17 sessions, and in Sound Set 3 she reached the mastery criterion of 24 correctly blended words in 10 sessions. During generalization Taniesha read zero novel words in Tier 1, 12 in Tier 2, and 18 in Tier 3.

Taniesha also represents the elementary-school students who received instruction in Functional Phonics. They received individual instruction for Sound Sets 1 and 2, during which mastery for each phase was 100% correct responses for two consecutive sessions (Figure 2, Tiers 1 and 2). Students received group instruction for Sound Set 3 and 4 and for Word Sets 5 and 6, during which mastery was a group average of 80% correct responses for two out of three consecutive sessions.
Taniesha mastered all word-analysis skills in Sound Set 1 only after instruction was introduced for each phase. This is replicated across Sound Sets 2–4 and Word Sets 5 and 6. Baseline data for Sound Sets 1 through 4 show that Taniesha knew a range of two to three items and indicate that she retained the previously-mastered sounds and words from Initial Phonics. Baseline probes immediately prior to the onset of Sound Sets 2 through 4 also show that she retained previously-mastered items from previous Functional Phonics sound sets. Baseline data show that Taniesha did not know any of the functional, connected-text phrases prior to beginning Word Sets 5 and 6. Table 2 shows that during Sound Sets 1 through 4 Taniesha demonstrated mastery of 16, 24, 27, and 29 blending words in 8, 12, 8, and 4 sessions respectively. She correctly generalized the skills of blending and telescoping to 6, 10, 16, and 24 novel, functional words in 5, 4, 5, and 6 sessions respectively.

During Word Set 5 of Functional Phonics, Taniesha mastered 10 functional, connected-text phrases (in which one word was a previously-mastered generalization word) in 10 sessions, and during Word Set 6 she mastered 14 functional, connected-text phrases (in which all words were novel, untaught words) in eight sessions. During Word Set 5 Taniesha successfully generalized blending and telescoping skills to 14 functional, connected-text phrases (all novel, functional words) in 12 sessions. During Word Set 6, she successfully generalized these skills to 14 functional, connected-text phrases in 9 sessions (See Table 2).

Figure 3 displays average learning performance during Initial Phonics for a middle-school group of two students. For group instruction, mastery criterion was 80% correct for two out of three consecutive sessions for each phase. The group demonstrated mastery of all phases of Initial Phonics, and learning was replicated across subsequent tiers representing Sound Sets 2 and 3. Students knew a range of two to four items before instruction began for Sound Set 1. Increases in verbal imitation of sounds, letter-sound correspondences, automaticity of letter-sounds, blending, and generalization did not occur until treatment was introduced within each phase.

Baseline probes were conducted immediately prior to the onset of each sound set and show that the students retained previously-mastered sounds and words that were included in previous Initial Phonics sound sets per the cumulative design. As seen in Table 3, during Sound Sets 1 through 3 the students reached the mastery criteria of 6, 11, and 13 correctly blended words in 5, 3, and 8 sessions respectively. During Generalization Phases of Sound Sets 1 through 3, the students successfully generalized the skills of blending and telescoping to 2, 6, and 10 novel words in 2 to 3 sessions.

Figure 4 depicts the learning performance during Functional Phonics for the middle-

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| Generalization Phases               |                                        |
| Mastery Criterion                   | Mastery Criterion                      |
| # of Sessions Required              | # of Sessions Required                  |
| for Mastery                         | for Mastery                             |
| N/A                                 | 5                                      |
| 10                                  | 4                                      |
| 8                                   | 5                                      |

TABLE 2

Initial and Functional Phonics Blending Phases mastery criteria (number of words) along with number of sessions required to reach blending mastery, and Generalization Phases mastery criteria (number of functional words and environmental connected-text phrases) along with number of sessions required to reach generalization mastery for one elementary-age student.
Figure 2. A multiple baseline design across sound sets with an embedded changing criterion design depicting the number of correct responses produced by one elementary student during functional phonics. Open square data points depict automaticity rates and correspond with the secondary Y-axis.
school group of two students, whose mastery criterion was a group average of 80% correct responses across two out of three consecutive sessions. The students mastered all phases of Tier 1, and mastery of all phases was replicated across each tier representing Sound Sets 2, 3, and 4 and Word Sets 5 and 6. Initial baseline data for Sound Sets 1 through 4 show that the students knew a range of two to four items and indicate that students retained the previously-mastered sounds and words from Initial Phonics. Baseline probes immediately prior to the onset of Sound Sets 2 through 4 show also that students retained previously-mastered items from previous Functional Phonics sound sets. Students did not know any of the functional, connected-text phrases prior to beginning Word Sets 5 and 6. During Sound Sets 1 through 4 students mastered blending and telescoping of 13, 19, 27, and 29 words in 3, 5, 3, and 5 sessions, respectively. The students generalized these skills to 5, 8, 16, and 24 novel, functional words in 2 to 3 sessions (see Table 3).

During Word Set 5 of Functional Phonics, the middle-school group mastered 10 functional, connected-text phrases (in which one word was a previously-mastered generalization word) in three sessions, and during Word Set 6 they mastered 14 functional, connected-text phrases (in which all words were novel, untaught words) in four sessions. During Word Set 5 they generalized blending and telescoping skills to 14 functional, connected-text phrases (all novel, functional words) in three sessions. During Word Set 6, the students generalized these skills to 14 functional, connected-text phrases in five sessions (See Table 3).

Discussion

This study supports and extends previous demonstrations of the effectiveness of simultaneous prompting procedures in teaching...
word-analysis skills to students with MoID (Waugh et al., 2009). All five students acquired word-analysis skills that included verbal imitation of sounds, letter-sound correspondences, retrieval of letter-sound correspondences to a level of automaticity, blending of the learned letter sounds to words by holding each sound for 2 seconds without stopping (“saying it slowly”) and producing each sound quickly without stopping (telescoping), and generalizing the skill of blending to untaught words and connected-text phrases. A clear rise to mastery is shown for all phases, compared to baseline phases, for all students except Taniesha’s first opportunity to generalize the skill of blending to a novel word during Sound Set 1 of Initial Phonics. We anticipated that students with MoID needed many more opportunities to generalize phonetic skills to untaught words than have been provided in the past (Bracey et al., 1975; Bradford et al., 2006; Flores et al., 2004). Our cumulative data within the changing-criterion across tiers buoyed this important aspect of the Phonics Component. Per the design, Taniesha was provided additional opportunities to practice and master precursor word-analysis skills before attempting to generalize the skills to untaught words. The next set of generalization words included the original generalization word (sat) plus three additional, untaught words (mat, at, am), and she was able to read all of them. In addition to identifying and addressing blending and generalization as specific areas of difficulty, we have shown that repetition of systematically presented stimuli is an effective approach to successful learning of phonetic skills for students with MoID. Historically, teachers may have “given up” before students received sufficient systematic repetition to facilitate learning, leading to the generally accepted assumption that students with MoID cannot learn phonics.

The use of cumulative stimuli within the design revealed another important finding. As the students progressed through sound sets of Initial Phonics and Functional Phonics the number of sessions required to reach mastery often decreased even though the mastery criterion increased. Students began mastering more items in progressively fewer sessions. As seen in Table 2, during Initial Phonics Taniesha reached the mastery criteria of 12, 21, and 24 correctly blended words in 14, 17, and 10 sessions, respectively. During Generalization Phases Taniesha did not read any novel words in Tier 1, but read 12 in Tier 2, and 18 in Tier 3.

In Sound Set 1 of Functional Phonics Taniesha demonstrated mastery of 16 words in eight blending sessions and generalized blending and telescoping to six novel, functional words in five sessions. In Sound Set 4, she correctly read 29 words in half as many sessions as she read 16 words in Sound Set 1, and she generalized blending and telescoping to 24 novel,
Figure 4. A multiple baseline design across sound sets with an embedded changing criterion design depicting the average number of correct responses produced by one middle school group of two students during functional phonics. Open square data points depict automaticity rates and correspond with the secondary Y-axis.
functional words. During Word Set 5 of Functional Phonics, Taniesha mastered 10 connected-text phrases (in which one word was a previously-mastered generalization word) in 10 sessions, and during Word Set 6 she increased her mastery of connected-text phrases to 14 while decreasing the number of sessions required for mastery. During Word Set 5 Taniesha generalized blending and telescoping to 14 connected-text phrases (all words within phrases were novel functional words) in 12 sessions. During Word Set 6, she generalized to 14 connected-text phrases and decreased the number of sessions to nine.

As can be seen on Table 3, during Sound Set 1 of Initial Phonics the middle-school group reached a mastery criterion of six correctly blended words in only five sessions. By Sound Set 3 they reached a mastery criterion of 13 correctly blended words in eight sessions. For Generalization Phases, during Sound Set 1 the students reached a mastery criterion of two correctly-blended words in two sessions, and by Sound Set 3 generalized to 10 untaught words in only three sessions. Although, the data do not show the same decrease in number of sessions to mastery as for Taniesha, students mastered progressively more items in approximately the same number of sessions. Also, they began mastering skills in fewer sessions than Taniesha (e.g., 14 vs. 5 sessions for mastery of the Blending Phase during Sound Set 1 of Initial Phonics). The older students might have learned more quickly because they had better-developed attention skills, more prior practice with in-seat behavior, and more opportunities to interact with reading stimuli because of additional years in school.

As the students acquired basic word-analysis skills, and then applied them to words and phrases that increased in number and complexity, they demonstrated that word-analysis skills are strategy-based skills that once learned can be applied to many, unanticipated words in an individual’s environment. This use of a strategy-based skill remains in contrast to sight-word reading that requires the same amount of memory load for every word memorized, and does not prepare an individual to read untaught words that have a functional use in the individual’s environment.

In addition to the word-analysis skills targeted in this study, students developed prerequisite-reading skills for which we did not collect data. These prerequisite-reading skills developed during Automaticity Phases and storybook-priming activities. When presented with an automaticity chart consisting of 42 previously-mastered letter sounds, and asked to name the sounds as quickly as they could for one minute, most of the students could not attend to individual stimuli on a page nor track left to right and from one line to the next. To address this we alternated between red and black font for each line, and used hand over hand guidance until the students learned to attend to each stimulus on the page and to track independently. Not only were students increasing their ability to retrieve letter sounds quickly and accurately, they learned the emergent-literacy skill of tracking and improved their attention skills.

The shared-storybook activities facilitated their learning of prerequisite-reading skills including, phonological awareness, emergent literacy, comprehension, language expansion, and vocabulary. The age-appropriate storybooks corresponded with the curriculum and as the students participated in the interactive reading we observed these skills begin to emerge. As the study progressed, students began to make predictions about events in the stories, identify sentences and words on pages, provide a motor demonstration of comprehension of reading vocabulary, read individual sounds in CVC words, and practice saying CVC words slowly and quickly.

Phonological awareness and emergent literacy are prerequisite skills for phonetic-reading acquisition (Ehri, 2004; Share, Jorm, MacLean, & Matthews, 1984). Prior to participating in this study, our students had not been systematically taught these prerequisite skills because phonics instruction is seldom provided for children with MoID (Browder et al., 2006). Because sight-word instruction is the most common method of reading instruction for students with MoID, these prerequisite-reading skills are often not acquired, with the exception of some emergent-literacy skills.

When word-analysis skills have been taught (Bracey et al., 1975; Bradford et al., 2006; Flores et al., 2004) they have not included an automaticity requirement. Automaticity training was one of the most unique aspects of the
Phonics Component. Due to limited working-memory capacity, we speculated that the students needed to learn to retrieve letter-sound correspondences to some level of automaticity before attempting to blend them into words. For the Automaticity Phase mastery criterion we selected each student’s rate on the RON subtest as the best reflection of the individual student’s phonological processing rate. All students blended successfully after first reaching mastery in Automaticity Phases suggesting that automaticity practice facilitated the skill of blending. However, we do not know if the criterion for automaticity that we selected is a necessary threshold for successful blending, or if the automaticity practice is sufficient with a less stringent criterion.

The Phonics Component included academic-literacy and functional-literacy goals. Historically, the definition of literacy instruction has been binary. Academic literacy has been viewed as the approach for typically-developing students and has involved phonetic-decoding skills while functional literacy has been viewed as the approach for individuals with developmental delays and has included sight-word instruction (Cegelka & Cegelka, 1970). We have shown that the two types of goals can be combined. With this alignment of goals, students with MoID can be taught phonetic-decoding skills to promote optimal participation in their community. Typically-developing students are taught phonics as a method of obtaining information from connected-narrative text which includes sentences and passages. Students with MoID should be provided the same opportunity even if their full potential may be connected-environmental text which consists of functional words and short phrases.

Limitations and Future Recommendations

One limitation of this study is a change that we made to the changing-criterion requirement. The elementary students began phonics instruction before the middle-school students. As originally designed the elementary students had three trials in each session. Because of the increase in the number of sounds and blending words in Functional Phonics, the number of trials was reduced from three to two trials per session and we applied this new criterion to all future participants. By the time the middle-school students began Initial Phonics the criterion had changed to two trials per session. The mastery criterion for 1:1 instruction was 100% correct for two consecutive sessions and the criterion for group instruction was a group average of 80% correct across two out of three consecutive sessions. The elementary-school students received 1:1 instruction throughout Initial Phonics and the first two sound sets of Functional Phonics, and the middle-school students received group instruction throughout the study.

Considering our participants were from multiple schools in multiple districts, and at multiple age levels, we were not able to control for their previous literacy experiences beyond the Edmark program that all of the participants received prior to this research. Further, all students with MoID may not be equally successful. There were only three elementary-school students and two middle-school students who completed the Phonics Component limiting the external validity.

We have not found the floor effect of cognitive ability for students who can learn to read phonetically. Future research should include different students with MoID with varied previous literacy instruction and cognitive abilities. It will be important to examine cognitive and language skills such as vocabulary level, processing speed, and working memory as possible predictors of phonetic reading ability to better understand what skills need to be developed to be successful in this program. Close inspection of underlying cognitive processing skills for reading can facilitate identification of students who are prepared to learn to read phonetically.

Future research also should include a close examination of automaticity requirements for blending acquisition. In this study all students mastered Blending and Generalization Phases after mastering individual automaticity requirements. However, it is possible that students could have mastered Blending and Generalization Phases with lower levels of automaticity than what were required in this study.

Finally, it would be helpful to collect data on the development of phonological-awareness skills. Anecdotally, we observed important phonological-awareness skill acquisition,
but without systematic measurement and careful inclusion of this in the design of our study, it is impossible to know the extent to which the shared-storybook activities impacted the development of phonological-awareness skills.

References


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