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Teaching Children to Decode Words: Connected Versus Segmented Phonation

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TEACHING CHILDREN TO DECODE WORDS: CONNECTED VERSUS SEGMENTED PHONATION

by

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This manuscript has been read and accepted for the Graduate Faculty in Educational Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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ABSTRACT

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Two methods of decoding instruction were compared. Kindergartners who could not decode nonwords participated in the study, $N = 38$, $M = 5.6$ years. Segmented phonation, frequently used in synthetic phonics programs, taught students to convert graphemes to phonemes by breaking the speech stream ("sss – aaa – nnn") before blending. Connected phonation taught students to pronounce phonemes without breaking the speech stream ("sssaaannn") before blending. Kindergartners were matched and randomly assigned to the two conditions. Both groups were taught to decode the same set of CVC nonwords consisting of continuant consonants and vowels that could be stretched and connected without altering their phonemic identities and without breaking the speech stream. Following learning, students completed a transfer task to decode CVC nonwords with stop consonants that are harder to blend because a schwa vowel is added when stops are pronounced separately (e.g., "də – æ – pə") and must be deleted during blending (e.g., "dap"). It was hypothesized that the connected phonation group would better understand how to blend phonemes than the segmented phonation group and hence would be able to overlook schwa vowels more easily in the transfer task. Results were supportive. Connected phonation students read the CVC nonwords with stops more accurately on the transfer task as well as a delayed posttest. Errors showed that segmented phonation students more often forgot the phonemes they had pronounced, especially initial phonemes, when they tried to blend them. In addition to treatment effects, children's sight word reading explained significant variance in nonword reading on the transfer task. Findings carry implications for how to teach decoding more effectively.

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Chapter 1

Introduction

A central aim of beginning reading instruction is to teach children to decode words accurately and automatically so that they become fluent readers with effective comprehension skills. Successful reading lies in beginning readers' ability to acquire a large sight word vocabulary in order to make the recognition of words effortless. However, in the journey to becoming automatic, readers need to acquire the necessary foundational literacy skills in order to read words. Research suggests that phoneme segmentation skills, letter knowledge, and blending skills are necessary for becoming successful readers (Roberts, 2003; Weisberg & Savard, 1993).

According to the simple view of reading, decoding skill combines with language comprehension ability to enable reading comprehension (Gough & Tunmer, 1986). According to Chall's (1983) theory of reading stages, stage one is characterized by knowing how letters correspond to parts of spoken words and using this knowledge to decode words. Chall observed children at this stage as "mumbling and bumbling" as they are glued to the text trying to sound out each word (p.16). Chall describes the ability of the beginner to move from a highly effortful struggle to sound out and blend words to reading words easily as a great discovery for the child. She refers to Sartre's own insight in learning to read where he recounts how hours of "grunting" finally resulted in a flash of insight in which he could read (p.16). While this process covers children's development from the decoding stage to the confirmation and fluency stages, questions still remain as to what instructional approaches best support beginning readers in most efficiently blending the sounds in written words for effective decoding. The present study was intended to contribute towards the goal of understanding how to facilitate this process.

Ehri (1998) explains that the most efficient way to read words that have been read before and stored in memory is by matching the written form on the page to its spelling stored in memory. Words that are not stored in memory may be read by decoding the word's letter-sound sequence, by analogizing the word to a known word in memory, or by predicting the word based on context clues. The current study focuses on how to best instruct students when learning to decode words. In order to decode words, readers must use their grapheme-phoneme skills to break down the spellings of unknown words. Once the graphemes within a spelling are isolated and connected to phonemes, the reader uses blending skill to put the sounds back together to form a recognizable word. Typically, students are taught to sound out words by first identifying each phoneme corresponding to a grapheme in the word and then blending the phonemes to form a whole word pronunciation. This is the approach used by the Wilson Reading System subprogram called Fundations (Wilson, 2015), which is commonly taught in K-3 classrooms.

The traditional instructional approach is intended to help readers decode unfamiliar words using grapheme-phoneme connections in order to transition from Chall's (1983) decoding stage to the confirmation and fluency stage. In Stage 2, the learner practices their decoding skills to become fluent and automatic readers. However, students often have difficulty correctly blending phonemes once they have segmented them. Practitioners often observe readers struggling to put the letter-sounds back together to determine the word's pronunciation. Often times, students are able to isolate the particular sounds in a word but struggle with blending those sounds. This is especially problematic when students are tasked with blending stop consonants to form a whole word. This requires students to delete the schwa vowels attached to the isolated consonant sounds (e.g., bə – æ – tə) in order to blend the sounds to form the word (e.g., *bat*).

Evidence provided by Murray, Brabham, Villaume, and Veal (2002) and Weisberg, Andracchio, and Savard (1989) shows the difficulty young readers face when tasked with correctly blending orally segmented phonemes. Murray et al. (2002) compared three ways to orally segment words to evaluate their effects on ease of blending those words correctly. One group of students heard words segmented into onset-rime (e.g., str-ing). Another group heard words segmented into body-coda (e.g., stri-ng). A third group heard words segmented into their individual phonemes. The results indicated that students were more successful at blending the sounds when they heard the words segmented into either onset-rime or body-coda than into phonemes. The likely explanation is that there were more sounds to remember and blend in the latter condition.

Weisberg, Andracchio, and Savard (1989) investigated whether pausing between phonemes of a word compared to not pausing would affect oral word blending ability in young readers. One group of students heard the investigator identify each phoneme in a word with no pause between the phonemes. That is, the phonemes were streamed together. Another group heard the phonemes identified with a one second pause. A third group heard the phonemes identified with a three second pause. Results showed that students produced more correct words after hearing the phonemes with no pauses introduced compared to hearing the phonemes segmented with pauses introduced.

The results of these two studies indicated that not pausing between phonemes in words facilitated phoneme blending compared to segmenting each phoneme by introducing a pause. This finding motivated the focus of the current study. The previous studies used an oral blending task. The question of current interest is whether the same would be true in a decoding task.

Using a decoding task rather than a phonological awareness task, Weisberg and Savard (1993) showed that students were more successful at reading printed words when they were taught not to stop between phonemes when sounding out words. They compared the effects of pausing and not pausing between phonemes on blending ability. Students in the no pause group were taught to hold each phoneme for two seconds with no pausing between the phonemes. Students in the other condition segmented the phonemes in words by pausing one second between the sounds. Results demonstrated that students in the one second pause group exhibited more difficulty blending.

Similarly, Constable (2010) worked with kindergarten children to compare the effectiveness of two approaches to sounding out words when learning to read. Using words with continuant phonemes, she taught students in one group to hold the speech stream when segmenting the sounds in words prior to blending. That is, students in this group were taught to identify each phoneme in a word by stretching out the sound without pausing. In another group, students were taught to segment the phonemes in each word by introducing a pause. Lastly, there was a control condition that engaged students in an unrelated literacy task. Once students reached criterion during training, they completed a transfer task to decode words with stop consonants. Results showed that students taught to stretch the phonemes and not pause when segmenting outperformed students who were taught to pause between phonemes. That is, the no pause group was more successful at transferring their decoding strategy to words with stop consonants.

Constable's (2010) study motivated the procedures of the current study.

The current study compared the effectiveness of two instructional approaches to sounding out words when learning to read. Similar to Constable's procedure, the effectiveness of connected versus segmented pronunciation of phonemes during decoding instruction was examined. In the connected phonation condition, readers were taught to pronounce phonemes corresponding to letters with no pauses between phonemes prior to blending the phonemes to form a word. In the segmented phonation condition, readers were taught to decode words by pausing between phonemes as graphemes in the spellings of words were sounded out. Similar to Constable's (2010) study, decoding instruction taught the same set of nonwords to both groups. The nonwords consisted of continuant consonants that could be stretched and held without breaking the sound stream. The connected phonation group was taught to decode the words using this stretching and streaming procedure. In contrast, the segmented phonation group was taught to decode by pausing between the sounds of each letter in decoding the words.

After students were taught to criterion with continuants in each group, a decoding transfer task was given as well as a delayed decoding posttest. These tasks presented students with nonwords which consisted of stop consonants. Words with stop consonants are more challenging to blend when each phoneme is pronounced separately. This is because vocalization of stop consonants in isolation requires attaching a schwa vowel. This schwa vowel must then be deleted when the consonants are blended. Thus, the current study investigated whether students in the connected condition would more readily learn to decode words with stop consonants than students in the segmented phonation condition.

Chapter 2

Literature Review

Reading Stages

Chall (1983) proposed a developmental scheme of reading consisting of six stages (stage 0 through stage 5). At stage 0, the prereading stage, readers accumulate knowledge about letters, words, and concepts about print. Children become familiar with features of spoken language such as words and syntax. Children engage in logographic reading in that they can read common signs and brand names on packages by remembering visual cues associated with the names and signs.

At stage 1, readers learn to decode. They learn to attend to the print closely and attempt to sound out words using their grapheme-phoneme knowledge. They understand that words can be segmented into parts and that these can be synthesized to make whole words. Errors made while decoding are visually similar to the print because readers are more concerned with graphic rather than semantic accuracy.

At stage 2, Chall (1983) explains that readers begin to practice reading using the decoding skills acquired at stage 1. Students at this stage practice by reading familiar stories multiple times. At this stage, readers are not reading to learn new information but rather are reading to practice their decoding skills. As students practice, they start to read fluently and feel more confident in their abilities.

After students have learned to read fluently, they enter stage 3 in which they engage in reading in order to access new ideas and learn new information. This stage is subdivided into two sections. Initially, students develop the ability to read to develop knowledge about the world. Subsequently, students develop the ability to analyze what has been read and to respond critically. At stage 4, students are able to comprehend text with multiple points of views. At stage 5, Chall (1983) explains that readers reach full maturity in their reading ability. Readers are able to use multiple higher cognitive skills such as analyzing, synthesizing, and engaging in abstract thinking when they read texts.

Different Ways that Words are Read

Ehri (1998) explains that there are different procedures that readers might use to read words as they process text. If a student comes across an unfamiliar word, he or she may utilize analogy, prediction, or decoding skills to figure out the unknown word. Readers may analogize by reading an unknown word after recognizing that its spelling is similar to a word that they already know. For example, if a reader can read the word *mountain* then they can use analogy to read *fountain*. However, use of this method requires already knowing many written words.

To read words by prediction involves using context clues in the form of illustrations as well as the text surrounding an unknown word, plus their background knowledge, which they connect to the information that they have gathered from the text so far. By using this information, a reader is able to make a prediction about the pronunciation and meaning of the unknown word. Consider the sentence, *The restaurant serves tea and coffee*. If a reader knows how to read the word *tea,* they may be able to use the surrounding known words as well as their experience about drinks related to coffee offered in restaurants to make a prediction. However, guessing words without fully analyzing their letters may yield the wrong words. A more reliable method is to analyze letter-sound relations to decode words.

Unfamiliar words might be read by decoding (Ehri, 1998). In order to decode the words, readers must apply their grapheme-phoneme knowledge to determine the sounds of the letters and then blend those sounds to determine the pronunciation. For example, to read the word *mat*, a reader must connect the letter m to the /m/ sound, a to the /æ/ sound, and t to the /t/. Then the reader needs to blend these three phonemes together "mat" to pronounce the correct word. With increased exposure to words with common letter patterns, readers are able to process these patterns as single units when decoding. When they encounter new words with familiar syllabic and morphemic units, they may use that information to break words down into larger chunks that are blended together to pronounce the word.

A common instructional approach is to teach students to pronounce each grapheme separately before blending. Although they are able to identify the sounds of letters, they may struggle with blending those sounds. This is especially problematic when students are tasked with blending stop consonants. In pronouncing stops in isolation, they must attach a schwa vowel in order to hear the sound of the stop (e.g., /bə – æ – tə/) but then must delete the schwas in order to blend the sounds to form the word (e.g., "bat").

Acquiring decoding skill is valuable not only for identifying unfamiliar words but also for storing these words in memory so that they can be read subsequently from memory "by sight" without having to apply a sounding out and blending strategy (Ehri, 2014). Share (2008) refers to decoding as a self-teaching mechanism that enables readers to remember how to read words. The most efficient way to read words is to read them automatically from memory by sight (Ehri, 1998). By accessing information stored in memory from previous exposures, all words, both regularly and irregularly spelled, can be read by sight. In this case, reading occurs via the lexical route which involves looking up a word in one's mental lexicon (Coltheart, 2005). When readers see the spelling of a word, it automatically activates their memory of its pronunciation and meaning. Unlike decoding, analogy, and prediction, reading words by sight is the most efficient way to read as it allows a reader's mental attention and energy to be allocated to comprehending the text rather than to figuring out words.

Ehri (1998) explains that a connection-forming process is responsible for sight word learning. In order to store words in memory, readers need to analyze connections between graphemes in the spellings of words and phonemes represented by these graphemes. A reader's knowledge of grapheme-phoneme connections serves as the system which bonds the written forms of words to their spoken forms in memory (*see also* Perfetti, 2007).

Thus, beginning readers may use multiple strategies to read unknown words. However, acquiring decoding skill is especially important for sight word learning (Share, 2004). The ability to decode unfamiliar words activates connections between the written forms of words and their pronunciations. As readers practice this, they are able to access the words in memory to read them by sight.

Phase Theory

Ehri (2005) distinguishes four developmental phases that children progress through as they learn to read words by sight. The four phases are pre-alphabetic, partial alphabetic, full alphabetic, and consolidated alphabetic. In the pre-alphabetic phase, readers primarily use visual or environmental cues in and around words to form connections with pronunciations and meanings. In this phase, grapheme-phoneme connections are not used. Rather, students are engaged in logographic reading.

In the partial alphabetic phase, beginning readers have learned some letter-sound connections and use their knowledge to form partial connections between the letter-sound units they know to bond spellings to pronunciations and meanings in memory, typically, the initial and final sounds in words. However, children lack decoding skills at this phase. They are limited to reading new words using partial phonetic cues plus prediction from context.

In the full alphabetic phase, readers are able to read words by forming complete connections between graphemes in the spellings of words and phonemes in their pronunciations. To learn sight words, readers need to know the major grapheme-phoneme relations as well as how to employ this knowledge in decoding words.

After accumulating substantial experiences reading words and storing them in memory, readers transition to the consolidated alphabetic phase in which they are able to use larger letter patterns to read words. These larger units are stored in memory and used to read words automatically. The consolidated units include morphemes and syllables, as well as onsets and rimes. In this phase, reading becomes more efficient because readers use these multi-letter units to reduce the memory load for storing sight words in memory.

The present study focused on the skills that beginning readers need to reach the full alphabetic phase. Children were screened to qualify as readers in the partial alphabetic phase. They knew grapheme-phoneme relations but lacked the ability to decode nonwords. They were taught to decode in one of two ways, either by stretching each phoneme and breaking the speech stream between phonemes to pronounce each grapheme, called segmented phonation, or by stretching and connecting adjacent phonemes without any breaks, called connected phonation, before blending the phonemes to pronounce a nonword. The effect of these two treatments on learning to decode was compared.

Oral Blending of Phonemes

Although alternative procedures of blending to decode words have not been studied experimentally, oral blending of phonemes in the absence of letters has been studied. Murray, Brabham, Villaume, and Veal (2008) compared two ways to orally segment CVC words into phonemes before blending. In a repeated measures design, kindergartners in Ehri's (2005) partial alphabetic phase listened to vocalized phonemes with schwa added (/bə/ /æ/ /tə/), they whispered the phonemes to minimize the schwa, (b/ /æ/ /t/), and were instructed to blend the sounds to form a real word. Results showed that students blended vocalized phonemes with schwa better than whispered phonemes. However, performance levels were low, with 57% of the students blending no phonemes correctly. One explanation for poorer performance without schwa is that mistakes were made because whispered phonemes may have been harder to hear. Alternatively, the authors suggest that superior performance with schwa may reflect the possibility that blending skill depends more on insight into the process than on a mechanical operation. When children are aware of the underlying phonemes being spoken, they are able to ignore the presence of schwa.

Another approach to oral blending is teaching children to blend larger units. Murray et al (2008) found that kindergartners were better at blending body-coda units in CVCs (ha-t) than onset-rime units (h-at). Blending onset rime units was easier than blending whispered phonemes but not vocalized phonemes with schwa. Murray et al. (2002) reason that larger sub-syllabic units were easier to blend because two units placed less demand on working memory than three units. Cassady and Smith (2004) also found that body-coda blending was easier than both onset-rime and phoneme blending which did not differ.

Weisberg, Andracchio, and Savard (1989) also studied oral blending of words when students were supplied with oral segments. They investigated whether pausing between phonemes of a word would disrupt oral blending more than not pausing between sounds. They examined three different pause intervals: a no pause (0 second pause), a one second pause, and a three seconds pause interval between phonemes. The study used 20 meaningful words and 12 nonwords composed of continuants and stop consonants. In each condition, continuants were said slowly and held for 2 seconds and stop consonants were said for a "fraction of a second" (p. 140). To provide examples of how the words were segmented, the researchers state that the word *not* was presented as *nnoot* in the 0 second pause condition, "*nn* (1-sec pause)…*oo* (1-sec pause)… *t*, and *nn* (3-sec pause)… *oo* (3-sec pause)… *t"* (p. 140). No example was provided with a stop consonant in the initial position. Additionally, the Weisberg et al. mentioned that the experimenter was careful not to add intrusive vowel sounds to either "held or stop sounds" (p.140). Students listened to the words segmented orally in each condition and were prompted to supply the word. They hypothesized that pausing for one and three seconds between consecutive sounds would have a negative effect on blending accuracy. Students would be able to orally blend words better when the individual phonemes in the words were streamed with no pauses (0 second pause) between phonemes. Results indicated that students produced more correct real words and nonwords after hearing the phonemes streamed (0-sec pause) than after hearing the phonemes segmented with breaks (1 second pause and 3 seconds pause). Although these findings were obtained on phonological awareness tasks, similar results may be achieved with a decoding task. The current study used a similar procedure of streaming and stretching phonemes in words when teaching students to decode words.

Blending Phonemes to Decode Words

Based on the findings that streaming and stretching phonemes in words rather than segmenting each phoneme by producing pauses is superior for phonemic blending, DiVeta and Speece (1990) used a comparable procedure of not stopping between phonemes when decoding to examine if a similar finding would manifest with a decoding task rather than a phonological awareness task. DiVeta and Speece used two treatments in their study, a phonic task and a spelling task. In the treatment group given the phonics decoding task, students were shown 12 CVC nonwords one at a time. Each word was displayed with the final consonant separated slightly from the first two letters (e.g., SA M). To teach the students how to decode, they were taught to pronounce the first two phonemes as a unit and add the final phoneme before blending the two parts together to read each word (e.g., /sæ/ /m). As they did this, the students were taught to move CV letter tiles together with the slightly separated final C tile and then end the procedure by producing the whole word.

The spelling treatment focused on sound to print analysis and emphasized letter-by-letter analysis. This condition used a different set of 12 CVC nonwords. Students were provided with letter tiles with all the possible letters to spell the 12 CVC nonwords. To begin, the experimenter would say a nonword aloud and ask the students to select letter tiles to spell the nonword. Once the letter tiles were selected, students were asked to pronounce each individual letter sound for those tiles. After producing each phoneme in the nonword, students were taught to blend the individually produced phonemes back together in order to read the whole nonword.

Unfortunately, because DiVeta and Speece (1990) used an alternating treatment design, the same students received training in both methods (the phonics task and the spelling task) and the researchers were not able to determine whether one method was superior to the other. However, students' decoding skills improved as measured on a posttest assessing students' ability to read nonwords accurately. Because students received instruction in both the phonics task and the spelling task, it is unclear whether one or both enhanced their decoding ability. While the findings show that explicit and systematic decoding instruction is important in learning to read, the question still remains as to which components of this instruction can facilitate decoding to read words, especially for struggling readers.

Similar to Weisberg et al. (1989), Weisberg and Savard (1993) investigated the effects of pausing between the phonemes in words compared to not pausing between the phonemes on blending ability. However, unlike Weisberg et al., Weisberg and Savard used a decoding task rather than a phonological awareness task. In one group, students learned to segment words by not pausing between the sounds (0 second pause). Students were taught to hold each phoneme for 2 seconds and not pause between the phonemes. In the other condition, students segmented the phonemes in words by pausing one second between the sounds (1 second pause). Each phoneme was thus held for 2 seconds with a 1 second pause between phonemes. The researchers used real words that ranged from two letters to six letters long with two to three phonemes. There was a mix of short and long vowel sounds as well as words with silent letters. Word difficulty increased with subsequent probes. It is not clear how the treatment procedures handled stop consonants in the no-pause condition. At the end of the intervention, students engaged in a follow-up probe to assess whole word reading.

Results showed that students in the 1 second pause group exhibited more difficulty blending the sounds previously segmented (Weisberg & Savard, 1993). Students read more words correctly when they were taught not to pause between sounds when segmenting the phonemes prior to blending compared to when they were taught to pause between sounds. In both conditions, the researchers noted that the students did not have difficulty in correctly identifying the phonemes in the target words when segmenting them. Their problems arose in blending the sounds. Notably, students in the 1 second pause condition tended to delete sounds from the target words when blending. This resulted in students mispronouncing the target words. These results indicate that to teach decoding skills, letter sound knowledge is essential but, on its own, is not sufficient, for it did not guarantee that students were able to decode words. Further, the finding that pausing between phonemes during segmentation resulted in sounds being forgotten when they were blended suggests that working memory capacity may play a role in learning to decode using this instructional procedure.

Based on previous research, it is evident that being able to identify letter-sounds in a word does not in and of itself lead to accurate whole word reading in beginning readers (Koehler, 1972; Weisberg & Savard, 1993). Even after successfully producing the appropriate letter-sounds in words, many readers struggle with blending those sounds together accurately when pauses are introduced in between phonemes.

In her dissertation, Constable (2010) compared the effectiveness of two approaches to sounding out words when learning to read. One approach involved connected speech production when analyzing CVC words. The other approach involved segmented speech production of CVC words. She worked with five and six-year old kindergarten children identified as at-risk for learning to read. Students were randomly assigned to one of the two experimental conditions or to a control group that engaged in an emergent literacy, narrative-based control condition. The connected speech production and the segmented speech production groups engaged in six training phases to identify the effect of the two approaches on individual vowel identification and production, phoneme analysis, learning to spell, and decoding. The current study used the same instructional procedure in a more focused manner. In the current study it was limited to the two forms of decoding, and training required only one session.

Constable (2010) found that students receiving connected speech production training outperformed students receiving segmented speech production training on several outcome measures while both groups outperformed the control group. The connected group showed superior word and nonword decoding compared to the segmentation group. The connected group was more successful than the segmentation group at transferring their decoding strategy to words with stop consonants. Both groups gained equally in spelling words and nonwords.

The current study followed up on the findings in Constable's (2010) study by using the same two approaches for learning to decode CVC words. Students in the current study were randomly assigned to two treatment groups, a connected speech production group or a segmented speech production group. After learning to either stretch and stream the phonemes in CVC words with continuants without introducing a pause or to segment these words by introducing a pause, students were tested using a transfer task to examine the effects on decoding words with stop consonants.

Decoding Instruction

The current study focused on students at Stage 1 of Chall's (1983) theory of reading development. Students at this stage are learning to decode words. At first children use contextual guessing to read. Then as reading skills develop, children progress to processing letters and sounds to read words. This is facilitated by phonics instruction. Ehri's (1998) phase theory offers a similar explanation about how words are read and how phonics instruction contributes by teaching grapheme-phoneme relations and phonemic segmentation skill. These enable students to decode new words. They enable students to read sight words by detecting all of the grapheme-phoneme connections to bond spellings to pronunciations of words in memory (Ehri, 2005). Additionally, to decode words, readers need phonemic blending skills in order to blend together the segmented phonemes to accurately pronounce unfamiliar words.

Acquisition of decoding skill requires explicit and systematic phonics instruction. Findings from a number of meta-analyses and research summaries (Foorman & Torgesen, 2001; Gersten et al., 2009; Swanson, 1999; Torgesen, 2004; Wanzek, Wexler, Vaugh, & Ciullo, 2010;

Wanzek & Vaughn, 2007) confirm the importance of direct, explicit, systematic instruction in teaching decoding skills. Ehri (1998) explains that instruction in phonemic awareness and systematic phonics is essential for learning to read in an alphabetic writing system such as English. Phonemic awareness instruction teaches readers to analyze and manipulate phonemes in speech. In this way, students learn to break spoken words into their individual phonemes and to blend these phonemes to say the whole word. Systematic, synthetic phonics programs teach children how to decode unfamiliar words. Synthetic phonics programs typically teach decoding by having children say the sounds of individual letters before blending them to form a word.

The National Reading Panel (2000) conducted a meta-analysis to assess the effectiveness of systematic phonics compared to unsystematic or no phonics instruction. Findings support the conclusion that systematic phonics instruction makes a greater contribution to students' growth in learning to read compared to other programs using an unsystematic or no phonics approach to instruction. The average effect size on the measure of decoding nonwords among kindergartners and first graders taught using a systematic approach was $d = .67$. Further, it was concluded that phonics instruction taught early (i.e., Kindergarten and First Grade) is most effective. This indicates that students at this developmental level benefit most from learning phonic concepts when they first start learning to read. The effect size for kindergartners was $d = 0.56$ and for first graders was $d = 0.54$. The largest number of studies utilized a synthetic approach. These findings indicate the benefit of explicit decoding instruction for learning to read unfamiliar words.

Synthetic Phonics Programs using the Segmentation Approach to Decoding. Studies have shown that synthetic phonics instruction is an effective approach for developing word reading skill. It is an explicit and systematic method of teaching that adopts a step-by-step approach to teach decoding skill, from the teaching of individual letter-sounds to the segmenting and blending of the letter-sounds to read words. Research has shown that the synthetic phonics approach is successful in teaching decoding (Azhar et al., 2016; Dixon, Schagen, & Seedhouse, 2011; Ehri, Nunes, Stahl, & Willows, 2001; Johnston & Watson, 2004; Johnston, McGeown & Watson, 2012; Torgerson et al., 2006; Vadasy & Sander, 2011; Yeung, Siegel, & Chan, 2013).

Two ways to teach decoding can be distinguished. The most common way is segmented phonation. Students are taught to sound out spellings of words by pronouncing each sound and pausing between sounds before blending them to say the word. Most of the studies reviewed below adopted this approach. A less commonly used procedure for teaching decoding is connected phonation where students are taught to connect the separate phonemes without pausing between them.

Pullen, Lane, Lloyd, Nowak, and Ryals (2005) showed that explicit and systematic instruction was most effective for teaching young children at-risk for reading difficulties how to decode. The researchers embedded a decoding intervention into reading lessons to test whether it would increase nonword reading. The explicit decoding instruction consisted of teaching students how to segment the sounds of the words, using segmented phonation, and blend those sounds together. The researchers used a multiple baseline design in which students were staggered in their treatment start time in order to monitor student performance repeatedly over time. The results showed that the performance of students who did not receive explicit decoding intervention remained at baseline with no increase in pseudoword decoding. When students received the decoding intervention, their ability to read pseudowords increased gradually. After five lessons in the intervention, all students were reading more pseudowords correctly. Further, the gains were more substantial after 10 lessons. Students were reading on average 85% of pseudowords correctly. Results indicated that explicit teaching of segmenting and blending led to increased pseudoword reading accuracy for the students.

Johnston and Watson (2004) compared the effectiveness of analytic and synthetic phonics instruction for emergent readers. They examined three training groups. An analytic phonics group, an analytics phonics with phonological training group, and a synthetic phonics group. Students received one of three different instructional approaches over the course of 16 weeks. The same words were taught in all three training conditions.

One training group received 20 minutes of analytic phonics teaching every day. This was considered the control group, as analytic phonics was the main form of instruction used in the schools from which students were recruited. In the analytic phonic group, students were taught one letter sound per week (i.e. s, a, t, i, p, n, c/k, e, h, r, m, d, g, o, u, l). When each letter and corresponding sound was introduced, students also were also introduced to regularly spelled CVC words with the taught letter appearing in the initial position of the word. The teacher told students how the words were pronounced. After pronouncing the word, the teacher drew attention to the target letter and to similar words beginning with the same letter sound. Students were then asked to think of other words starting with the same sound and the teacher would write these words to show the children while emphasizing the similar initial sounds. Irregular words were taught as sight words to be memorized.

In the analytics phonics with phonological training group, first students engaged in 10 minutes of phoneme and rime awareness training without alphabetic stimuli. Students were taught to identify initial, medial, and final phonemes in spoken words, to blend a sequence of phonemes to pronounce the words, and to segment whole words into phonemes. Then students spent 10 minutes receiving the same instructional program taught to the analytic phonics training condition described above.

In the synthetic phonics training condition, students were taught two letter sounds a day. Over time, an increasing number of letter sounds were learned and used to decode words. Students were shown words with the learned letter sounds positioned in the initial, medial, and final position of words. Then teachers modeled how each word was decoded by identifying and saying each phoneme separately using the segmented phonation procedure, and then smoothly stringing the sounds together to pronounce the words. Students were taught to run their finger underneath each word with a slow, fluid movement to represent the blending process. Students also learned to spell the words using magnetic letters. After spelling the words, students were instructed read the words using the blending procedure described above. As in the other training conditions, irregularly spelled words were taught as sight words.

Results revealed that synthetic phonics was more effective in developing reading, spelling, and phonemic awareness ability compared to analytic phonics and analytic phonics with phonological awareness training. Students in the synthetic phonics training condition outperformed students in the other two group on nonword reading ability and reading irregularly spelled words. The synthetic phonics training was more effective in teaching students letter sounds and how letter sounds function in all positions in words. Further, this instructional procedure made the blending process more explicit for children and taught them a structured approach to how to read words.

Similarly, Azhar et al. (2016) studied synthetic phonics instruction by examining the effectiveness of the Jolly Phonics program compared to a control group receiving a whole language approach to reading. The students were learning English as a Second Language (ESL).

In the synthetic phonics training condition, students learned the mechanics of decoding. Students were taught letter sound knowledge and how to use this knowledge to decode words. The decoding routine involved first pronouncing the sounds of each letter separately and then blending those sounds to pronounce the word. Resulted revealed that children in the synthetic phonics group achieved significantly higher scores on the posttests assessing decoding and letter sound knowledge than the whole language group. In another study with non-native English speaking first graders, Vadasy and Sanders (2011) found that students benefited from synthetic phonics instruction. The program was implemented for 30 min as individual tutoring, four times a week. Lessons covered the five main components: teaching letter-sound correspondences, phoneme decoding, irregular words, spelling, and oral reading practices. In both studies, decoding instruction involved using a segmented phonation procedure.

In a similar study, Yeung et al. (2013) found that synthetic phonics instruction facilitated the acquisition of phonological awareness, expressive vocabulary, decoding, and word spelling among the ESL kindergarteners. The intervention plan followed a structured sequence of teaching, starting with the teaching of individual sounds and word awareness, syllable segmentation, rhyming, onset and rime, and decoding by segmenting phonemes in words before blending those phonemes together to pronounce the word.

In sum, these studies all used segmented phonation procedure to compare synthetic phonics to a control condition. The control conditions involved analytic phonics or similar approach where decoding was not directly taught. The results support the effectiveness of using segmented phonation as a means to teach decoding. However, the current study differed from these studies in that the segmented phonation procedure was compared to an alternative procedure in which letters were transformed into phonemes, but the phonemes were taught to be connected rather than separated by pauses before they were blended.

Many popular phonics programs have incorporated synthetic phonics instruction using the segmentation procedure because it is an effective approach to teaching students to decode words. These programs include Fundations (Wilson & Wilson, 2002), EngageNY (Core Knowledge Foundation, 2013), Letterland (Wendon, 1986), Road to Reading (Blachman & Tangel, 2008), and Jolly Phonics (Lloyd & Wernham, 1992). One program commonly used in many of the school districts is the subprogram of the Wilson Reading System (Wilson & Wilson, 2002) called Fundations. Fundations is designed for K-3 students and provides explicit and systematic instruction that focuses on phonemic awareness, letter recognition, and phonics, which includes teaching the decoding process. To teach students how to decode, Fundations uses a "tapping" method in which students use their fingertips to tap out the individual phonemes in words. When a student reads a word, they use their fingertips to represent each phoneme as they orally segment the phonemes with pauses between phonemes. After segmenting each phoneme, the reader then blends the phonemes to form a word. To do this, students smoothly run their thumb under each fingertip corresponding to a phoneme in the word. This tactile act is done to represent the action of streaming the previously segmented phonemes into one smooth sound to pronounce the word. For example, when presented with the word "bag," students would use one hand to tap their thumb to the pads of three fingers as they identify each phoneme with a pause between phonemes, /b/ /æ/ /g/. Then students would bring the thumb back to the first finger and run it smoothly under the three fingers as they say "bag" as a whole, succinct word.

Another synthetic phonics used regionally is called EngageNY (Core Knowledge Foundation, 2013). It teaches students to segment phonemes in written words by saying each sound while touching their shoulder, elbow, and hand to tactilely represent each sound. Then students are taught to blend these sounds together. Thus, similar to the Wilson Fundations (Wilson & Wilson, 2002) program, it uses a segmentation approach to teaching decoding.

Similarly, Letterland (Wendon, 1986) uses the procedure of first sounding out phonemes corresponding to letters before streaming the sounds together when teaching students to decode words. Students are taught the main consonant sounds and short vowel sounds of all the letters in the alphabet. Then students learn to read words by using a blending strategy with regularly spelled CVC words. The first step of the blending strategy teaches students to sound out each letter separately. Next, students blend the first two letters smoothly together, then add the third sound. Then students are taught to blend all three sounds together to read the whole word. Additionally, students are taught to use their own arm to facilitate learning the steps of this procedure. Students "place" the sounds on their arm. Students extend one arm straight out in front of them and then use their other free arm to identify each phoneme represented in the words. The free arm touches the shoulder, elbow, and wrist of the extend arm as they slowly say each sound with pauses in between the sounds. Then, they slowly and smoothly run their free arm from shoulder to wrist to blend the three sounds together. Finally, students are instructed to run their free arm quickly down their whole arm as they blend the phonemes of the whole word together.

A similar approach is used in the Road to Reading (Blachman & Tangel, 2008) phonics program. Students learn to identify the main consonants sounds and the short for vowels in words. Then students are taught to segment those sounds in CVC words by producing a pause between the sounds before learning to blend those sounds together to pronounce the word.

Jolly Phonics (Lloyd & Wernham, 1992) is a program developed in the United Kingdom. It teaches letters sounds, including digraphs such as sh, th, ai, and ue. As students begin to master letter sounds, they are concurrently taught to blend sounds together in words to read them. Blending is taught by segmenting phonemes in words and then streaming those phonemes together to read the word. Students begin with learning a combination of continuant consonants and stop consonants, including vowels that produce the short vowel sounds. According to the program's scope and sequence, the first letters learned are: s, a, t, i, p, n. Then, students learn to blend phonetically regular CVC words using these letters to represent phonemes.

In contrast to the other programs, a connected phonation procedure is advocated for teaching decoding in The *Teaching Reading Sourcebook* (Honig, Diamond, & Gutlohn, 2018). This is a resource for teachers, reading specialists, and student teachers. These authors propose that the first step in teaching decoding is teaching students letter-sound correspondences. Next, a crucial step is learning to blend the individual sounds in a word which can be done by "continuous blending" (connected phonation) (p. 181). The continuous blending method is used with words made up of continuant consonants (Honig, Diamond, & Gutlohn, 2018). Students are taught to identify each sound and then to blend those sounds together, part by part. For example, the word *mat* would be blended as /mmm/, /mmmaaa/, /mmmaaat/, /mat/ with a pause introduced in between each sound example.

There are some problems with the approaches that use segmented phonation. One is that when stop consonants in words such as *bag* are pronounced in isolation, schwa vowels get added (e.g., /bə/ /æ/ /gə/) and must be deleted in order to form the blend "bag." Another problem is that students must remember the separated phonemes they just spoke when blending them to form the word. As the number of letters in words grows, memory for the sounds to be blended becomes more difficult (Beck, 2006)

Ways of addressing these problems to make decoding easier have been proposed. Beck (2006) recommends successive blending where students pronounce and blend no more than two sounds at a time. They begin with the first two letters, say each sound separately before forming the blend, then sound out the next letter and add it to the blend, and so forth. Because continuant consonants are easier to blend than stop consonants, Carreker (1999) recommends teaching students to decode first with continuants and then to introduce stops once students have mastered the process with continuants. The McGraw Hill Reading Wonders program (2019) has incorporated this approach in teaching oral blending and decoding. Although recommendations have been offered, no studies have compared the effectiveness of these decoding instruction procedures.

In sum, although the traditional approach involving segmented phonation to decode is popular in elementary schools, many students struggle in learning to decode. In particular, many readers are able to transform graphemes into a sequence of phonemes but struggle with blending after they have segmented phonemes in words by introducing pauses between them. Notably, this is more difficult when words are spelled with stop consonants. This is because vocalization of stop consonants in isolation introduces a schwa vowel, which a reader must delete when the consonants are blended, for example, /pə/ – /æ/ – /tə/, “pat.” The current study investigated whether teaching students to pronounce phonemes corresponding to letters with no pauses between phonemes before blending is superior to the traditional method of introducing pauses between phonemes.

Children with Specific Language Impairments and Dyslexia

It has been established that children with specific language impairments (SDI) are at risk for experiencing difficulty in the development of reading skills. The relationship between SDI and reading disabilities has been examined in several studies (Aram & Hall, 1989; Bishop & Adams, 1990; Catts, Bridges, Little, & Tomblin, 2008; Catts, Fey, Tomblin, & Zhang, 2002). In these studies, children with SDI have been identified in preschool or kindergarten and tested for reading and academic achievement in later grades. The results of longitudinal studies have consistently shown that children with SDI often have reading disabilities. In general, research indicates that 50 percent or more of children with SDI in preschool or kindergarten go on to have reading disabilities in primary or secondary grades (Catt et al., 2002). Catts and Kamhi (1999) found that children who showed language impairment in kindergarten were four times more likely to exhibit reading difficulty in second and fourth grades than children without language impairments. Catts et al. (2002) investigated the reading outcomes of 208 kindergarten children with language impairments (LI). Results showed that the group of children with LI in kindergarten read below expected levels in second and fourth grades.

The International Dyslexia Association (IDA) (2018) classifies dyslexia as a specific type of learning disability (Catts, Kamhi, & Adlof, 2012; Lyon, Shaywitz, & Shaywitz, 2003). The IDA states that dyslexia is characterized by difficulties with accurate and fluent word recognition and by poor decoding and spelling abilities. Further, they assert that dyslexia results from a deficit in the phonological component of language. Notably, this deficit exists despite students' possessing otherwise satisfactory cognitive abilities and receiving adequate classroom instruction. Research indicates that children with dyslexia have significant problems decoding words which impairs their ability to read unfamiliar words and to build a sight word vocabulary

(Catts, Adolf, Hogan, & Ellis Weismer, 2005; Catts et al., 2012; Kamhi & Catts, 1986; Gough & Tunmer, 1986,).

Children with dyslexia exhibiting difficulties with word recognition and decoding ability benefit from direct, explicit, intensive, systematic phonics instruction that remediates these deficits (Catt et al., 2012). The instructional procedure investigated in the current study is structured, direct, and explicit. It provides individual instruction in explicit decoding routines with immediate corrective feedback. If participants in the current study who are typically developing readers learn to decode better with connected phonation than segmented phonation, it is likely that students with SDI and dyslexia would benefit as well from this procedure that makes it easier to blend sounds to decode words.

Pilot Study

A pilot study, which included a replication study, was conducted to follow up on findings of previous studies by comparing the effectiveness of connected versus segmented pronunciation of phonemes during decoding instruction. The procedure in Constable's (2010) connected phonation condition taught students to pronounce phonemes corresponding to letters with no pauses between phonemes prior to blending the phonemes to form a word. This procedure is similar to 0 second pause procedures in Weisberg et al.'s (1989) and Weisberg and Savard's (1993) studies that were previously reviewed. The procedure in the segmented phonation condition introduced pauses between phonemes as the spellings of words were sounded out. This was similar to the 1 second and 3 seconds pause procedures in Weisberg et al.'s (1989) and Weisberg and Savard's (1993) studies. The latter is the traditional approach used to teach students to decode words.

Similar to Constable's (2010) study, decoding instruction was structured to teach the same set of words to both the connected and segmented groups. These words consisted of continuant phonemes that could be stretched and held without breaking the speech stream. One group was taught to decode the nonwords using this stretching and streaming procedure. The other group was taught to pause between the sounds of each letter in decoding the words; for example, sssaaannn versus sss – aaa – nnn. After being taught to criterion, students were given a decoding transfer task. This task presented words that included stop consonants, which as previously mentioned are more difficult to blend when each is pronounced separately. This is because when pronounced separately, stop consonants require attaching a schwa vowel that must then be deleted when the consonants are blended. The question of interest in the pilot study was whether students in the connected phonation condition would have an easier time learning to decode words with stop consonants than students in the segmented condition. It was hypothesized that connected phonation students would better understand how to blend the phonemes targeted by letters and would be able to overlook and drop the schwa vowels. These procedures were followed to test this hypothesis in the pilot study.

Study 1. Eighteen kindergarteners were pretested on their ability to read five target nonwords (nif, nal, laf, fas, and sim) as well as on their knowledge of letter sounds for the following letters: f, l, m, n, a, s, b, k, d, p, t, i, o with the vowel letters representing short vowel sounds. These letters formed the nonwords that were used during the learning and test trials. Students selected for the study were those who knew the target letter names and sounds but were unable to read more than one of five target nonwords. Students were also pretested using the pre primer and primer reading lists of The Boder Test of Reading and Spelling Patterns (Boder & Jarrico, 1982). Pretests revealed that there were no significant differences between the two groups on letter name knowledge, letter sound knowledge, and word reading knowledge. Word reading scores placed the students at the pre-primer and primer reading levels. Thus, the groups were equivalent in letter name, letter sound, and word reading knowledge.

Students were randomly assigned to the two treatment conditions, the segmented phonation group and the connected phonation group. Students assigned to the connected phonation condition were taught to blend CVC nonwords with initial continuant consonants without breaking the speech stream. The students learned to run their fingers beneath each letter in the word, without stopping movement, as the word was pronounced aloud and blended together. For instance, the word "naf" would be read as /nnnæææfff/ without breaking the speech stream.

Students assigned to the segmented phonation condition were taught to blend the same CVC nonwords with initial continuant consonants by breaking the speech stream. Students were taught to blend a word by pointing to each letter in the word, stopping movement at each letter as the letter's sound was pronounced, then blending the sounds to say the word. For instance, the word "naf" would be read as /nnn/ /æææ/ /fff/ with a pause between phonemes. Once students in both conditions learned the procedure, they continued with additional nonwords until they could blend five words in a row correctly. Students were assessed on the number of words practiced before they reached criterion.

During the learning trials for both conditions, children practiced a blending method (either connecting sounds or segmenting the sounds). Results from the independent sample *t*-test comparing the mean number of trials to criterion revealed no significant differences between the connected phonation group ($M = 6.67$, $SD = 3.74$) and the segmented phonation group ($M = 6.56$, $SD = 3.28$) in reaching criterion, $t(16) = -0.07$, $p = 0.95$. Thus, students in the connected and segmented phonation groups reached criterion in approximately the same time. Surprisingly, they only needed to practice on average around seven words to learn to blend the words containing continuant consonants.

Immediately following the learning trials, students were presented with twenty novel nonwords printed on flashcards. The novel words were CVC nonwords with initial and final stop consonants. Students were shown one nonword at a time and were asked to read each word. The experimenter provided no corrective feedback. The experimenter proceeded through the list of twenty words once and scored students' ability to accurately read each word as a whole blended unit. Results from the independent sample *t*-test revealed a significant difference favoring the connected phonation group (M = 16.00, SD = 2.00) over the segmented phonation group (M = 9.56, SD = 2.96), $t(16) = -5.41$, $p = 0.01$. Students in the connected phonation group read many more words correctly than students in the segmented phonation group, indicating that transfer to decoding words with stop consonants was facilitated by learning to decode words with continuant consonants by connecting and stretching the sounds rather than breaking the sounds. Cohen's effect size was very large, $d = 2.60$.

Replication Study. Sixteen kindergarteners were pretested using the same assessments as Study 1. The participants were randomly assigned to the connected or segmented phonation group. The results revealed that there were no significant differences between the two treatment groups on letter name knowledge, letter sound knowledge, and word reading knowledge. Word reading scores placed the students at the pre-primer and primer reading levels. It might be noted that students in the replication study scored much higher in their ability to read real words on the The Boder Test of Reading and Spelling Patterns (Boder & Jarrico, 1982) (M = 27.6 words read) than students in Study 1 (M = 8.8 words read).

The training procedure was the same as in Study 1. However, during the Replication Study, in addition to recording students' success or failure in decoding the words, the experimenter also took note of the types of errors made by the students. Results of the learning trial revealed no significant difference between the connected phonation group ($M = 9.13$, $SD = 3.27$) and the segmented phonation group ($M = 10.25$, $SD = 4.77$) on the number of trials to reach criterion, $t(14) = 0.55$, $p = 0.59$. Thus, students in the connected and segmented phonation groups required the same amount of practice to reach criterion. It might be noted that they required somewhat more practice to reach criterion ($M = 9.7$ words) than students in Study 1 ($M = 6.6$ words). Additionally, although it was not officially recorded, it was observed that several students in the connected phonation group had to be corrected for reverting back to inserting breaks between phonemes rather than connecting the phonemes during training. The likely reason is that the connected phonation group had to overcome a previously learned segmentation procedure taught by their classroom teachers using the Wilson Fundations program.

Following decoding training, students completed the same transfer task using the same words with stop consonants as in Study 1. However, in addition to recording students' success or failure in decoding the words with stop consonants, the experimenter also took note of the types of errors made by the students. Results on the transfer task revealed a significant difference favoring the connected phonation group ($M = 16.63$, $SD = 1.19$) over the segmented phonation group ($M = 10.75$, $SD = 3.33$), $t(14) = 4.70$, $p = 0.01$. Many more words with stop consonants were decoded correctly. Cohen's effect size was very large, $d = 2.60$.

Interestingly on the transfer task, mean performance of the treatment groups was similar across the two studies. Also, in regard to showing the superiority of the connected phonation group over the segmented phonation group, the effect sizes were identical. These findings again demonstrated that the connected phonation group read significantly more words that contained stop consonants correctly than the segmented phonation group. This showed that the most effective procedure for teaching children to decode is to have them apply streaming with continuant consonants to blend phonemes prior to blending stop consonants.

An error analysis in the transfer task was conducted in the Replication Study. It revealed that students in the segmented phonation condition made a total of 27 phoneme substitution errors involving a stop consonant in the initial and final positions of the CVC words. Of the 27 errors, 12 involved substituting another stop consonant in the initial position. In contrast, in the connected phonation condition, there were a total of only eight phoneme substitution errors involving a stop consonant with only one error occurring in the initial CVC position. This suggests that one reason students in the segmented phonation condition were having more difficulty in the transfer task is that they were forgetting which phonemes they had pronounced separately, especially those in the initial position of CVCs, when they had to blend them. Further analysis revealed that the vast majority of the phoneme substitution errors in the connected phonation condition were visual letter errors. These involved reversal of the letters *b*, *d*, and *p*, which is a common mistake for this age group. About the same number of visual letter errors was observed in the segmented phonation group where, of the 40 phoneme substitution errors, eight involved visual letter errors.

Implications of Pilot Findings. The learning trial results from both Study 1 and the Replication Study revealed no significant difference between the connected phonation and segmented phonation conditions. It was surprising that there were no treatment differences on the trials to criterion measure. It was expected that the connected phonation treatment might make decoding easier. However, there is a likely explanation. Students in both studies were at the end of their kindergarten academic year and had received some instruction on blending. While the participants were not successful at blending whole words at the time of the study, the instruction they had received in school taught them to decode words in the traditional manner using the Wilson Fundations program (Wilson, 2015). This program teaches students to segment words into separately pronounced phonemes before attempting to read the whole word. This instructional approach is similar to the segmented phonation condition. It may be that this instruction added an extra burden to students in the connected phonation condition used here. These students had to learn an entirely new technique, which replaced the routine they had practiced in their classrooms. Many of the errors committed by this group during the learning trials occurred because they reverted back to pronouncing each phoneme separately which in turn caused blending errors when reading the whole nonwords. The proposed study is intended to avoid this problem by recruiting students who have not been exposed to prior decoding instruction, particularly the procedure of pausing between the sounds of letters.

Performance on the transfer task was similar in both Study 1 and the Replication study. Students in the connected phonation group read many more words correctly than students in the segmented phonation group. This replicates the finding from Constable's (2010) study, indicating that transfer to decoding words with stop consonants was facilitated by learning to decode words with continuant consonants by streaming and stretching the sounds rather than breaking the sounds. Additionally, the segmented phonation group made more than twice as many errors compared to the connected phonation group. Learning to segment by streaming and stretching the phonemes in words when decoding led students to commit fewer errors in reading CVC words with stop consonants.

It is clear that students in the connected phonation condition were more accurate in decoding words with stop consonants than students in the segmented phonation condition. Stop consonants are more difficult to blend because an intrusive schwa vowel is unavoidably attached when producing stop consonants in isolation. This schwa vowel must subsequently be deleted when the consonants are blended. Students in the connected phonation condition seemed to better understand how to blend phonemes and were able to handle dropping the schwa vowels when reading nonwords with stop consonants. Students in the segmented condition were having trouble remembering all the phonemes they had just pronounced separately when they had to blend them. When memory slipped, they would substitute another phoneme especially phonemes in the initial position of CVC nonwords.

Chapter 3

Rationale, Hypothesis, and Overview of Study

The current study was designed to follow up on findings of Constable's (2010) study and to extend results of the pilot studies. However, the two studies differed. Constable's (2010) study examined the effectiveness of connected and segmented phonation on several skills, including word production, vowel production, vowel identification, phonemic analysis, spelling, decoding, and nonword repetition. Training was more extensive and lasted for 16 sessions on average. The connected and segmented phonation decoding procedures were not applied to decoding tasks until later sessions. This makes it difficult to compare precisely the effectiveness of these two procedures, absent of other forms of training, on acquiring decoding skill.

In the current study, instruction was more focused than in Constable's (2010) study. It was limited to comparing the two decoding procedures, and training required only one session. The effectiveness of connected phonation and segmented phonation was assessed with nonword decoding tasks. Kindergartners were taught to read up to 20 CVCs containing continuant consonants to criterion, either by saying the phoneme represented by each letter with breaks between phonemes before blending, or by pronouncing phonemes without breaks before blending. An experimental research design was adopted with random assignment of children to the two treatments. The independent variable was the type of decoding training: segmented phonation versus connected phonation. The dependent variables were the speed (i.e., the number of words practiced) to reach criterion in learning to decode CVC nonwords containing continuant consonants, and the accuracy of decoding transfer words containing stop consonants.

Additionally, the current study sought to extend the results of the pilot study. One purpose was to recruit kindergarteners who had not been taught to decode words and hence would not have been exposed to the strategy of breaking between phonemes prior to blending them. Another purpose was to examine the effects of the treatments on reading real words. Additionally, the current study sought to assess students' ability to read words with stop consonants using a delayed posttest to see if the findings persisted over time. Furthermore, unlike the pilot studies, the current study investigated whether the treatment influenced students' ability to (1) read more complex nonwords, such as CCVC, (2) spell CVC words, and (3) learn sight words. The current study also pretested students' phonemic awareness ability to determine whether it predicted how easily students would learn to decode words and also to ensure that the two experimental groups did not differ on this ability prior to the treatment. The following hypotheses and research questions were investigated:

1. Will beginning readers learn to decode CVC nonwords containing continuant consonants more readily when decoding is taught with connected phonation than with segmented phonation?

It is hypothesized that readers taught to stretch and connect phonemes when sounding out letters before blending them will reach criterion sooner in learning to decode nonwords than readers taught to stretch phonemes and pause between them when sounding out letters before blending them.

2. Will decoding skill transfer more readily to new CVC words containing stop consonants when beginning readers have learned the connected phonation procedure to decode than the segmented phonation procedure?

It is hypothesized that readers taught to decode without breaks in the speech stream will read more words with stop consonants correctly than readers taught to break the speech stream before blending.

3. Will the beneficial effects of decoding instruction with no pauses persist over time on a delayed posttest assessing CVC nonword reading with stop consonants?

It is hypothesized that the benefit of learning to decode with no pauses taught to the connected phonation group will persist over time when measured using a delayed posttest with CVC nonwords.

4. Will the beneficial effects of connected phonation transfer to different literacy tasks that were not taught including reading more complex nonwords with consonant clusters (CCVC and CVCC words), reading CVC real words, and spelling CVC nonwords?

5. Will the difference in decoding training impact sight word learning in a task where students practice reading words over several learning trials?

Chapter 4

Methods

Participants

The participants were 38 kindergartners recruited from a northeastern, urban, U.S. elementary charter school, mean age 5.6 years, 20 males, 18 females. All participants received parental consent (Appendix A). In the school, students were 20% White, 40% African American, 35% Hispanic, and 5% Asian, with 52% receiving free or reduced lunch. Participants were proficient in English with no diagnosed learning disabilities. English proficiency was established by excluding any students who were receiving English as a New Language services from their school.

The school has an internally developed English Language Arts curriculum created through collaboration among teachers, reading specialist, and administration. It is based on a variety of commercial and open source curriculum programs. In Kindergarten through 2nd grade, the students use Fountas and Pinnell ("F&P"), Wilson Fundations, and Engage NY for reading and phonics as well as Teachers College Reading and Writing Project ("TCRWP"). Participants recruited were those that had not received any explicit decoding instruction which was determined from each students' teacher.

IRB approval was obtained from the CUNY Graduate Center prior to any recruitment attempts. The researcher met with the principal of the school to obtain permission to work with kindergarten students who had not yet received decoding instruction. After permission was obtained, parental consent letters were sent home to caregivers explaining the study and requesting permission for their child to participate. The 66 students whose parents gave consent to participate in the study were pretested individually to determine eligibility. Prior to working with each child, the researcher explained the activities to take place, and they were asked if they were willing to participate. Children who assented to participate were given the pretests.

Students were pretested and those selected for the study knew the sounds of 13 target letters (f, l, m, n, a, s, b, k, d, p, t, i, o) but were unable to read more than one of five CVC nonwords. Excluded were 9 students who could read more than one nonword, and 16 students who lacked complete knowledge of the target letter sounds. Students were matched on word reading scores and members of pairs were randomly assigned to the two treatment conditions. Three outliers were eliminated due to very high scores on the Boder Test of Reading and Spelling Patterns (Boder & Jarrico, 1982).

Procedures

All pretests, decoding training, and posttests were administered to individual students during three sessions, each lasting about 20 minutes. Students were pretested to determine eligibility for the study during Session 1. Pretests were used to screen students for knowledge of letter sounds and lack of decoding ability, to assess their level of literacy, and to verify that the treatment groups did not differ.

For randomization, students were paired based on similar performance on the Boder Test of Reading and Spelling Patterns (Boder & Jarrico, 1982) pretest, and then members of pairs were randomly assigned to one of the two treatment conditions. First, students were ranked based on their Boder Test of Reading and Spelling Patterns score in descending order. Pairs were formed from those with adjacent scores. Members of each pair were given a number, either 1 or 2. Then the two numbers 1 and 2 were placed in a bag. Numbers were drawn from the bag two times. The first time a number was drawn (1 or 2), it determined which student (labeled 1 or 2) would be assigned to a treatment group. The second time a number was drawn (1 or 2), it determined which condition that student would be placed in. The connected condition was label “1” and the segmented condition was label “2”.

During Session 2, students received either connected or segmented training to decode CVCs with continuant consonants. Upon reaching criterion, they were given a transfer task to decode CVCs with stop consonants. Students were then given a CCVC nonword reading task and a word learning task.

One day after the learning trials, four delayed posttests were administered (see below). Each student met three times with the experimenter. Each individual session lasted approximately 20 minutes which was sufficient to complete training and testing without tiring students or causing restlessness.

Table 1

Alignment of Research Questions, Tasks, and Day Administered

Research Question	Task	Session (Day) Administered
1	Training Task	2
2	Transfer Posttest with Stop Consonants	2
3	Delayed Posttest Nonword Decoding Task	3
4	Immediate Posttest: CCVC Nonword Reading	2
	Delayed Posttest: Real Word Reading	3
	Delayed Posttest: Spelling Nonwords	3
	Delayed Posttest: Phonemic Awareness	3
5	Word Learning Task	2

Pretests

Letter Names and Sounds. Students engaged in a letter naming task and a letter sound task. Students were shown the 10 consonant letters and 3 vowel letters. The set included the target letters that formed the CVC nonwords to be decoded in the experiment. The targets were 5 continuant consonants represented by the letters f, l, m, n, s, 5 stops represented by b, d, k, p, t, and 3 short vowels spelled with the letters a, i, o. Students were asked to say the names and sounds of these letters. To be retained for the study, students needed to know all the letter names and sounds. Letters were presented in lowercase format. The experimenter used a score sheet to record responses (Appendix B). If children said the name of a letter when asked for its sound, the experimenter said "That's the name of the letter. Can you tell me what sound the letter makes when it spells words?"

Nonword Decoding. Students were shown five nonword spellings and asked to read each. The nonwords were: *nif, fas, mol, lon, sim* (Appendix C). Excluded were students who could read more than one nonword.

Word Reading. The Boder Test of Reading and Spelling Patterns (Boder & Jarrico, 1982) is a test of word reading. It includes lists of 20 words at progressively higher reading levels, Levels used in the current study ranged from preprimer to the fourth-grade level. Half of the words in each list are regularly spelled and half are irregularly spelled. In the current study, performance on this task was interpreted as assessing students' sight word reading ability since students who were selected for the study were unable to decode unfamiliar words. Test-retest reliability for the task is 0.97 as reported in the test manual.

Phonemic Awareness. Students were given an experimenter-created oral phonemic awareness assessment to test their ability to segment and blend spoken phonemes in words. The blending task consisted of 10 CVC words formed with the 13 target phonemes (*bit, fan, son, tan, dip, kid, lap, mad, pot, nap*). The experimenter pronounced each phoneme with a one second pause between phonemes, and students were told to say the whole word. The experimenter provided an example to explain the task. If the student did not blend the first four items correctly, the task was stopped. The number of correctly blended words was scored (Appendix D).

The segmenting task consisted of ten CVC words formed with the 13 target phonemes (*mom, sin, bad, top, fat, lid, not, kit, pal, dim*). The experimenter pronounced the whole word and asked students to say each sound in the word. The experimenter provided an example to explain the task. If the student did not segment the first four items correctly, the task was stopped. The number of correctly segmented words was scored (Appendix E). Reliabilities for the separate and combined tasks were calculated. Cronbach alpha reliabilities were: blending = .54; segmenting = .51. Treating the two tasks as parallel forms of a measure of phonemic awareness yielded a reliability of .90.

Spelling Nonwords. Students listened to 6 CVC nonwords aloud containing the same target phonemes represented by letters used in the word learning and transfer tasks. Students were asked to write out the words in order to assess spelling. Each word was read aloud twice (see Appendix F). The experimenter provided no corrective feedback. Students' responses were scored in two ways. They were scored on the number of nonwords accurately spelled, and on the number of correct letters not out of order. If letters were out of order, the experimenter counted only the first one as correct. For example, SNA (for san) received two points for S and N. The alpha reliability calculated on words correct was low, 0.08, possibly because there were too few test items.

Decoding Training with Continuants

Connected Phonation Condition. Students assigned to the connected phonation condition were taught individually to decode up to 20 CVC nonwords, each containing two continuant consonant letter sounds (*f, l, m, n,* or *s)* and a short vowel letter sound (*a, i,* or *o).* Each nonword was displayed on a flashcard. The letter sounds were varied and equally represented across the nonwords (Appendix G). Each student continued through the sequence of cards until they could blend five nonwords in a row correctly. Students were scored on the number of words practiced to reach criterion. The nonwords were printed in capital letters to avoid letter reversal errors that were observed in the pilot studies.

Connected phonation instruction involved teaching students to sound out CVC nonwords without breaking the speech stream. This was made possible by the presence of continuant phonemes that can be held and transitioned to adjacent phonemes without interrupting or distorting the sounds, for example, *mmmmaaaaffff*. First, students were taught the connected decoding procedure. They learned to slide their finger beneath the nonword as they pronounced and stretched the sound of each letter. Then they blended the sounds by constricting their duration to pronounce the nonword as a whole. For instance, the nonword *nif* was read as /nnnnIIIIffff/ without breaking the speech stream while a finger moved beneath *nif*. Then they pronounced it “nif.” The experimenter modeled and students copied, decoding the first five nonwords with corrective feedback (Appendix H). Students applied the connected phonation procedure to decode subsequent nonwords. All misreadings and deviations from the procedure were corrected. The experimenter used a scoring sheet to indicate success or failure for each encountered word (Appendix I).

Segmented Phonation Condition. The same sequence of nonwords printed on cards was taught to individual students in the segmented phonation condition, and the same procedures were followed except that students were taught to sound out CVC nonwords by breaking the speech stream between each phoneme rather than connecting the phonemes. Segmented decoding instruction involved teaching students to point to each letter in the nonword as they pronounced and stretched each phoneme and to break the sound between phonemes. Then they blended the sounds to pronounce the nonword. For instance, the nonword *nif* was read as /nnnn - IIII - ffff/ with breaks between each phoneme while a finger pointed to each letter. Then they pronounced it "nif." The experimenter modeled and students copied, decoding the first five words with corrective feedback (Appendix J). Students applied the segmented procedure to decode subsequent nonwords and continued through the cards until they read five perfectly in a row. All misreadings and deviations from the procedure were corrected.

In sum, the procedures followed in the two treatment conditions were identical except for the way that spellings of words were sounded out prior to blending, either by stretching and holding the sounds of letters with no breaks between sounds, or by pronouncing the sounds of letters separately with breaks between each.

Immediate Posttests

Transfer Posttest with Stop Consonants. Immediately following the learning trials with continuant consonants, students were presented with 20 new CVC nonwords printed on flashcards. Each nonword contained two stop consonant letters (*b, k, d, p,* or *t)* and a short vowel letter (*a, i,* or *o)*. The letter-sounds were varied and equally represented across the nonwords (Appendix K). Students were asked to read each. The experimenter provided no corrective feedback. The number of nonwords read correctly was scored (Appendix L). The experimenter recorded the types of errors made by students. The nonwords were printed in capital letters to avoid letter reversal errors. The alpha reliability was 0.72.

CCVC Nonword Reading. After the nonword reading transfer task, students were presented with eight CCVC nonwords made up of continuant and stop consonants using the same letters used for the nonwords in the training and transfer tasks (Appendix M). The nonwords were *slif, flam, snom, sman, stip, spak, skib, klod*. Students were shown one word at a time and were asked to read each word. The experimenter provided no corrective feedback. The experimenter proceeded through the list of eight words once and scored students' ability to accurately read each word as a whole, succinct word. The alpha reliability was 0.28.

Word Learning Task. Next, the experimenter taught children to read a set of nine similarly spelled words over trials similar to the procedure in Ehri and Wilce's (1987) study. These words were spelled using the same consonants and vowels used in the treatment conditions. Similar spellings were used to force students to pay attention to all the letters and their corresponding sounds. The words included seven CCVC and two CVCC words. They were: *slam, film, plan, snip, flop, pills, spot, flat, plot.*

First, students engaged in a study trial in which the experimenter showed the students how to read the words. Each word was then presented in a meaningful sentence. Five test trials followed. During the test trials the experimenter showed each word on a flash card to the students and said, "read this" and had the student read each word. The experimenter then repeated the word aloud (Appendix N). The experimenter recorded the words they read (Appendix O). The experimenter recorded success or failure in reading the words correctly. Cronbach's alpha was calculated by treating each of the five test trials as a separate item. The reliability of scores across trials was 0.86.

Delayed Posttests

Nonword Decoding Task. Students were presented with twenty CVC nonwords made up of continuant and stop consonants using the same letters used for the nonwords in the training and transfer task (Appendix P). First, they read 10 nonwords composed of stop consonants, one at a time, followed by 10 nonwords containing continuant consonants. Students were shown one word at a time and were asked to read each word. The experimenter provided no corrective feedback. The experimenter proceeded through the list of twenty words once and scored students' ability to accurately read each word as a whole, succinct word. To calculate the reliability of the task, the two 10-item tests were treated as parallel forms. The resulting reliability was 0.70.

Phonemic Awareness. Students were given the same experimenter-created oral phonemic awareness assessment used as a pretest. Students were tested on their ability to blend phonemes into words and to segment orally heard words into phonemes. The Blending Phonemes into Words task contained ten CVC words made up of phonemes used in the training and transfer tasks. The experimenter pronounced each phoneme with a one second pause between phonemes. The students were asked to pronounce the whole word. Students were scored on their ability to provide the correct word.

The Segmenting Words into Phonemes task included ten CVC words made up of phonemes used in the training and transfer tasks. The experimenter said the whole word and asked the student to provide each individual phoneme that constituted the word. The students were scored on their ability to identify and segment the three correct phonemes for each word (see Appendices D and E). To calculate the reliability of the task, the two 10-item tests were treated as parallel forms. The resulting reliability was 0.77.

Real Word Reading. Students were presented with twelve real CVC words made up of continuant and stop consonants using the same letters from the training and transfer tasks. Three words contained continuants in the initial and final position of the word. Three words contained stop consonants in the initial and final position. Three words contained continuants in the initial position and stops in the final position of the word. Finally, three words contained stop consonants in the initial position and continuants in the final position of the word (Appendix Q). Students were shown one word at a time and were asked to read each word. The experimenter provided no corrective feedback. The experimenter proceeded through the list of twelve words once and scored students' ability to accurately read each word as a whole, succinct word. The alpha reliability was 0.59.

Spelling Nonwords. Students listened to and repeated each of ten novel CVC nonwords aloud spelled with the same target letters. Students were asked to write out the words in order to assess spelling. Each word was read aloud twice (Appendix R). The experimenter provided no corrective feedback. Students were scored on the number of nonwords spelled correctly and the number of letters correct. The alpha reliability on the number of nonwords spelled was 0.53.

Chapter 5

Results

Characteristics of Participants. Independent sample *t*-tests were conducted to verify that the connected and segmented treatment groups did not differ significantly on any of the pretests. Mean performance of the two experimental groups on pretests and test statistics are given in Table 2. The two treatment groups did not differ on any of the measures. Word reading scores placed students at the pre-primer reading level. Participants knew all of the target letter names and sounds but the majority was unable to read any nonwords. The remaining students read no more than one nonword. Students' phonemic awareness was assessed. They showed some ability to segment and blend phonemes in words. Students' ability to spell nonwords was assessed. Students were able to spell some of the words. On average students spelled about half of the nonwords correctly.

To be eligible for the study, students had to lack nonword decoding skill. We admitted those who read no more than one nonword on the pretest. About half the students read no nonwords and half read one nonword (see Table 2). To determine whether the latter group was more advanced in reading ability, we calculated Spearman correlations between nonword reading pretest scores (0 or 1) and performance on the sight word reading and phonemic awareness pretests. Results revealed correlations close to zero, with ps > .97. This indicates that the sample was homogeneous in their nonword decoding and beginning literacy skills. Students who were able to read one nonword were not more advanced than students who read no nonwords.

Table 2

Mean Performance, Standard Deviations, and Test Statistics to Compare the Connected and Segmented Phonation Conditions on Pretests

Characteristics and Pretests	Connected Phonation *M (SD)*	Segmented Phonation *M (SD)*	*t*-statistic (*p*)
Age (in years)	5.58 (0.51)	5.63 (0.50)	-0.32 (0.75)
Gender ($N = 38$)	9F; 10M	9F; 10M	
Read Words (40)	14.05 (4.37)	14.00 (4.47)	0.04 (0.97)
Name Letters (13)	13.00 (0.00)	13.00 (0.00)	
Letter Sounds (13)	13.00 (0.00)	13.00 (0.00)	
% Zero Nonwords[a]	53%	47%	
Phonemic Awareness (20)	13.53 (2.29)	12.47 (2.63)	1.31 (0.20)
Segmentation (10)	6.79 (0.98)	6.05 (1.43)	1.85 (0.07)
Blending (10)	6.74 (1.41)	6.42 (1.31)	0.72 (0.48)
Spelling Nonwords			
Words (6)	3.79 (0.63)	3.53 (0.84)	1.09 (0.28)
Letters (18)	15.37 (0.76)	15.11 (1.15)	0.83 (0.41)

[a] Proportion of students who read no nonwords correctly.

Performance during Learning. The first research question was whether beginning readers would learn to decode CVC nonwords containing continuant consonants more readily when they practiced sounding out and blending phonemes without breaking the speech stream than when they practiced by breaking the speech stream between phonemes. Students were scored on the number of words practiced to reach a criterion of decoding five words in a row accurately. An independent sample *t*-test was conducted. Mean performance and test statistics for the decoding training measure are given in Table 3.

Table 3

Mean Performance Reading CVCs, Standard Deviations, and Test Statistics to Compare the Connected and Segmented Phonation Conditions During Decoding Training and on the Stop Consonant Transfer Task

Task	Connected Phonation *M (SD)*	Segmented Phonation *M (SD)*	*t*-statistic (*p*)	Cohen's *d*
Decoding Training (TTC)	7.84 (3.69)	10.37 (3.78)	-2.09 (0.04)*	-0.68
Transfer Read Stops (20)	16.37 (2.03)	12.89 (3.23)	3.97 (.000)*	1.32
Mispronunciations				
Initial Consonant	0.42 (0.61)	2.58 (1.43)	-6.07 (.000)*	-1.51
Final Consonant	1.89 (1.10)	2.68 (1.46)	-1.89 (0.07)	-0.62
Vowel	1.16 (1.12)	2.00 (1.60)	-1.88 (0.07)	-0.62

Note. There were 19 students per condition with *df* = 36. TTC = number of trials to reach a criterion of 5 perfect successive trials. Cohen's *d* = difference between means divided by pooled *SD* or divided by larger SD when floor effects reduce SD of one group.

Results from the independent sample *t*-test revealed significant differences between the connected phonation group and the segmented phonation group on reaching criterion (see Table 3). The connected group took significantly fewer trials to learn to decode than the segmented group. Results are displayed in Figure 1. In fact, after copying the experimenter decode five practice nonwords, the connected phonation group needed to complete on average only three more trials on their own with corrective feedback before they were able to decode the nonwords perfectly. In contrast, after copying the experimenter decode five nonwords, the segmented phonation group required on average five additional trials before reaching criterion. The results show that the connected phonation procedure was more effective in teaching students to decode than the segmented procedure.

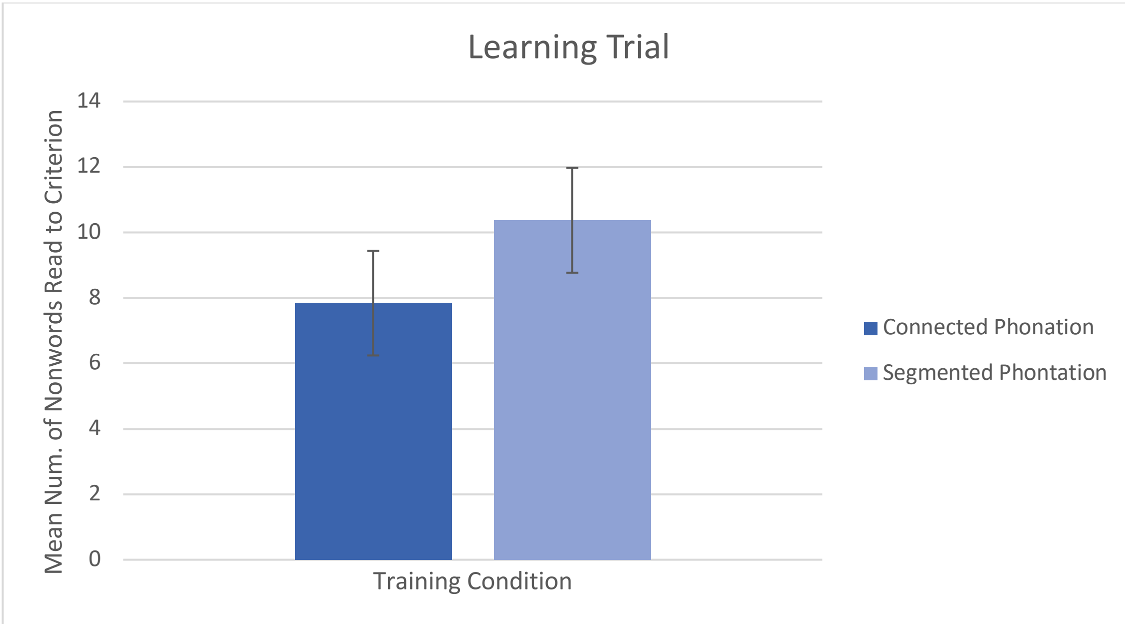

Figure 1. Mean performance on the training task reading nonwords with continuant consonants.

Performance on the Transfer Task. The second research question explored which form of decoding training would transfer more readily to the reading of CVC nonwords containing stop consonants. Students were given 20 nonwords to decode with no corrective feedback. The number of nonwords read correctly was scored. An independent sample *t*-test was conducted (see Table 3). Results revealed a significant difference favoring the connected phonation group over the segmented phonation group. Results are displayed in Figure 2. Cohen's effect size was large, $d = 1.32$.

These findings reveal that the most effective form of decoding instruction included two components: giving students a set of CVCs containing continuant consonants to read and teaching them to decode the CVCs by stretching and connecting the phonemes without breaking the speech stream before blending the sounds to produce the nonword. This procedure improved children's ability to transfer their decoding skill in reading CVCs with stop consonants compared to a procedure that taught children to break the speech stream as they pronounced each phoneme before blending them.

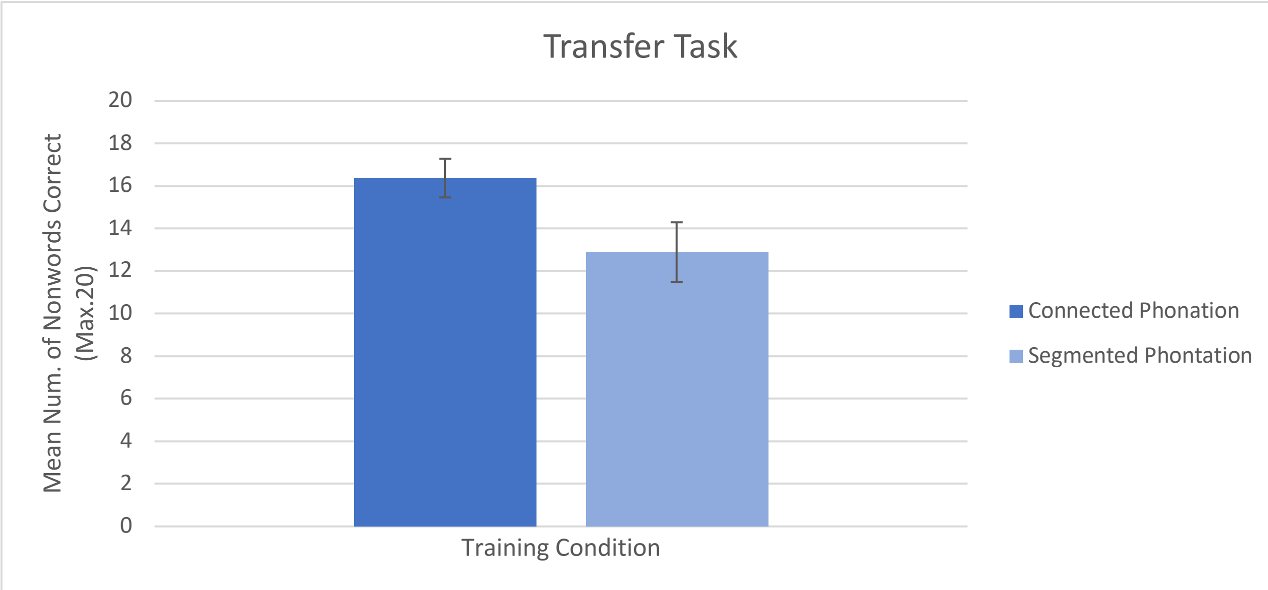

Figure 2. Mean performance on the transfer task reading nonwords with stop consonants.

Error Analysis. It was expected that during the learning trials, students would acquire decoding skill faster when taught to stretch and connect continuant phonemes than when taught to break between phonemes. This was supported by the results. Students in the connected phonation condition learned faster than students in the segmented condition (*Ms* = 7.84 vs. 10.37 trials to criterion), thus supporting our expectation that the connected procedure would make it easier to learn to decode.

On the transfer task, students in the segmented condition mispronounced significantly more nonwords containing stop consonants than students in the connected condition (see Table 3). Almost all of the mispronunciations consisted of substituting one incorrect phoneme. Very few errors changed more than one sound or added a sound. An error analysis was conducted to compare the connected and segmented treatment groups. Results are shown in Table 3. Segmented students misrecalled many more initial stop consonants when blending the sounds to say the nonword than connected students, with the difference significant statistically. Mean performance is displayed in Figure 3. The effect size was large, $d = -1.51$. In fact, almost all of the segmented students (95%) committed this error at least once whereas only 37% of the connected students misrecalled initial consonants at least once. Final consonants and vowels were misrecalled more often by segmented students, but the differences fell short of significance, with a moderate effect size, $d = -.62$.

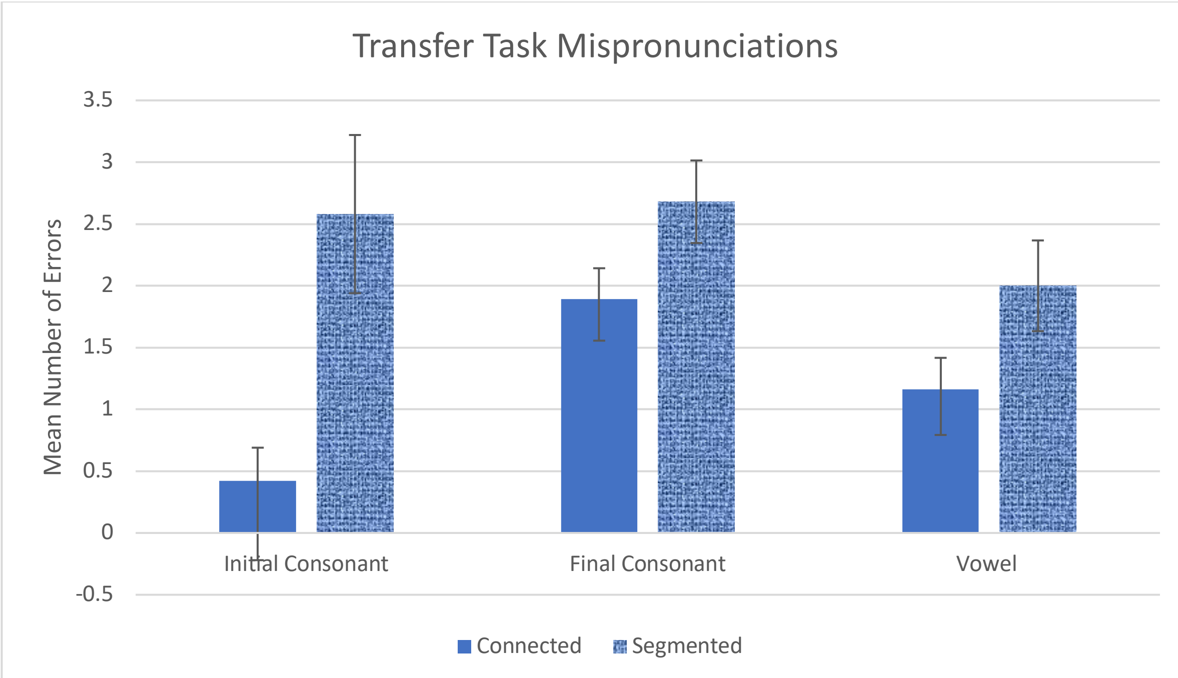

Figure 3. Mean number of errors in the initial consonant, final consonant, and medial vowel position by students in the connected and segmented phonation group.

These errors reflect the two different ways that students were decoding the transfer nonwords. Children in the segmented condition spoke the sound of each letter separately, as they had been taught, before blending the nonword. This caused them to add schwa vowels that had to be deleted. In addition, this made it harder to remember the sounds they had just spoken when attempting to blend them. When memory slipped, they would substitute another phoneme. Memory for the initial consonant suffered the most, very likely because it occurred earliest and was eroded by subsequent phonemes.

In contrast, children in the connected condition did not have these problems. When they decoded the CVCs with stop consonants, the stretching procedure they had been taught did not apply because stops cannot be stretched, so they skipped stretching and simply connected the sounds of the letters to produce a blended nonword. This made memory for the phonemes much easier, especially memory for initial consonants. They decoded the nonwords by pronouncing the first letter and immediately blending it with adjacent phonemes without pausing and without intrusion from schwa vowels.

In sum, these results show that connected phonation training was more effective because it eliminated the intrusion of schwa vowels and it reduced the chances of students' forgetting which phonemes to blend. Blending flowed directly from seeing and saying letters in the spelling of the word rather than indirectly from memory for the separated phonemes spoken in isolation after the spelling had been transformed into sounds.

Correlational Analysis. A supplementary analysis was conducted to examine the relationship between students' word reading and phonemic awareness skills on the pretests and their performance decoding nonwords during training and on the transfer task. Two pretests were administered. The Boder Test of Reading and Spelling Patterns (Boder & Jarrico, 1982) task assessed students' ability to read real words that presumably had been learned by sight because students lacked decoding skill. The second task assessed students' phonemic awareness by combining scores on the oral segmentation and blending tasks which were highly correlated (r = .82). A question of interest was whether these entry level abilities were correlated with performance on the decoding training and transfer tasks. Results revealed no significant relationship between either pretest and the decoding training trials-to-criterion measure (rs < -.10, ps > .56). On the decoding transfer task, scores on the phonemic awareness pretest were not significantly correlated with decoding transfer scores (r = .27, p = .11) but the Boder Test of Reading and Spelling Patterns pretest (Boder & Jarrico, 1982) was significantly correlated with decoding transfer scores (r = .35, p = .03). These findings indicate that phonemic awareness did not explain significant variance in performance on the decoding training and transfer tasks. However, sight word reading did explain significant variance on the transfer task.

To determine whether the two pretests might explain significant additional variance beyond that explained by the training conditions, a hierarchical linear regression was conducted. Condition was entered first, and word reading and phonemic awareness second and third. Results reported in Table 4 show that word reading explained significant additional variance beyond that explained by the training conditions but phonemic awareness did not. When the decoding training condition was entered first, it explained 30% of the variance on the transfer task. When word reading ability was entered second, it explained an additional 12% of the variance. These findings indicate that in addition to the decoding training that students received, their sight word lexicon predicted their ability to read nonwords containing stop consonants on the transfer task. However, their phonemic awareness was not a significant predictor.

Table 4

Model Summary of Hierarchical Regression Analysis Displaying Significant Unique Predictors of Performance Reading Stop Consonant Nonwords on the Transfer Task

Predictors[a]	Beta	R	R^2	R^2 Change	F Change	df1/2	Sig. F Change
Training	-.549	.55	.30	.30	15.74	1/36	.000
Word Read	.343	.65	.42	.12	7.13	1/35	.011

[a]Excluded predictor: Phonemic awareness. Standardized Beta -.087, t = -.52, p = .605

Delayed Nonword Decoding Task. The third research question explored whether the benefit of connected phonation training would persist over time on a delayed posttest assessing nonword reading with stop consonants. One day following training, students read 10 CVC nonwords containing stop consonants followed by 10 CVC nonwords with continuant consonants. An ANOVA was conducted on nonwords correct with treatment and consonant type as the independent variables. Results presented in Table 5 revealed no significant main effects of treatment or consonant type but a significant interaction between the two variables. Figure 4 depicts the interaction. Comparison of means reveals the source of the interaction. The connected group decoded substantially more stop consonant nonwords than the segmented group, with d = 0.62. However, there was no comparable difference between the groups in their decoding of continuant nonwords. In fact, the segmented group decoded slightly more than the continuant group. Examination of the distributions of scores revealed greater variation among segmented students in decoding nonwords with stops (see *SD*s in Table 5). At the low end, no student in the connected group scored below six correct but six segmented students did. At the high end of the distribution, 63% of the connected students read at least 9 out of 10 nonwords correct whereas 42% of the segmented students performed at this level.

Table 5

Mean Performance, Standard Deviations, and Test Statistics Decoding CVC Nonwords Containing Stop Consonants and Continuant Consonants on the Delayed Posttest by Students Who Received Connected and Segmented Decoding Training

	Connected Phonation *M (SD)*	Segmented Phonation *M (SD)*	Mean Diff.	*F*-statistic (*p*)	Cohen's *d*
Consonant Type					
Stops (10)	8.58 (1.26)	7.42 (2.48)	1.16	T 0.21 (.651)	0.62
Continuant (10)	7.26 (1.85)	7.89 (2.16)	-.63	C 2.11 (.155)	-0.32
				TxC 9.54 (.004)**	

Note. There were 19 students per condition with *df* = 36. Cohen's *d* = difference between means divided by pooled *SD.* Independent variables T = treatment; C = consonant type.

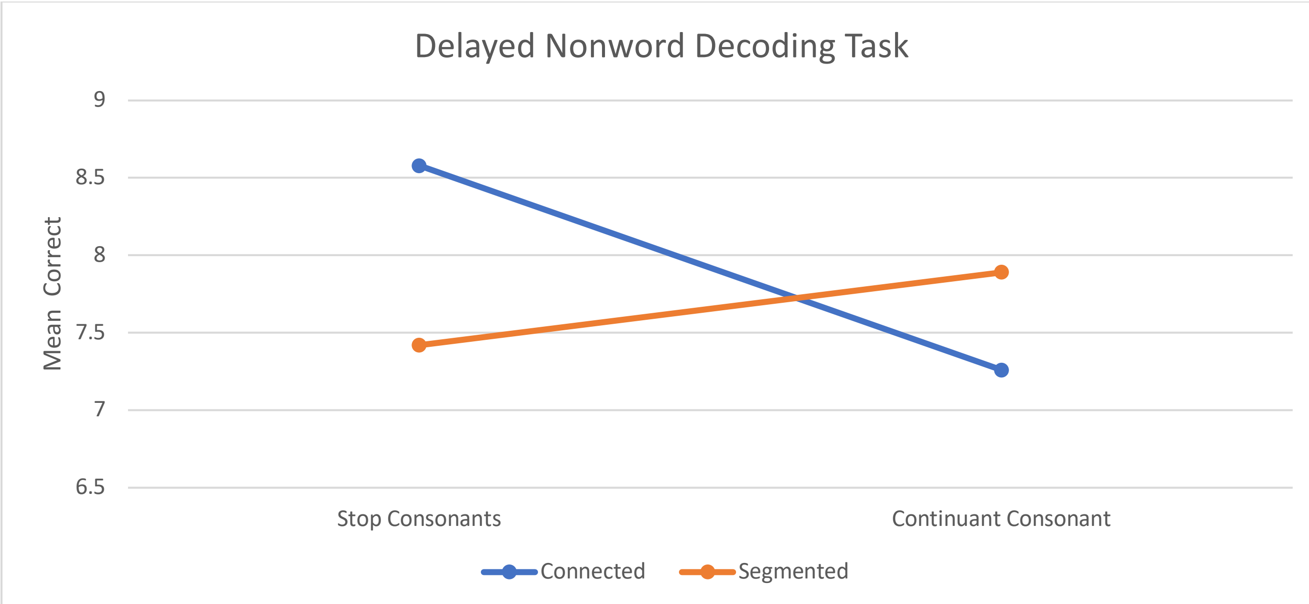

Figure 4. Significant interaction between treatment and consonant type. Students in the connected phonation group read on average more words with stop consonants correct compared to students in the segmented phonation group.

These findings support results of the immediate transfer task showing that connected decoding instruction enabled students to read nonwords with stop consonants more effectively than segmented decoding instruction. In addition, results show that the effects of decoding instruction lasted beyond the end of the training session. Students across groups were able to decode on average 78% of the nonwords on the delayed posttest given one day later.

CCVC Nonword and Real Word Reading Tasks. The fourth research question explored whether the effects of training would transfer to different literacy skills not taught during the training. Following the transfer task with stop consonants, students read eight CCVC nonwords. An independent sample *t*-test (see Table 6) revealed no significant difference between the connected phonation group and the segmented phonation group. Students in both training conditions read on average approximately the same number of nonwords correctly. Interestingly, even though they were not trained to read nonwords containing consonant clusters, they succeeded in reading on average 73% correctly. This suggests that both forms of decoding training transferred and enabled students to read more complex nonwords.

Table 6

Mean Performance, Standard Deviations, and Test Statistics for Decoding CCVC Nonwords and CVC Real Words Containing Stop Consonants and Continuant Consonants on the Delayed Posttest by Students Who Received Connected and Segmented Decoding Training

Task	Connected Phonation *M (SD)*	Segmented Phonation *M (SD)*	*t*-statistic (*p*)	Cohen's *d*
Decoding CCVC Nonwords (8)	6.11 (0.88)	5.53 (0.96)	1.93 (.06)	0.63
Reading CVC Real Words (12)	9.95 (1.31)	9.74 (1.66)	.434 (0.67)	0.14

Note. There were 19 students per condition with *df* = 36.

Students were given 12 real words to read one day after the decoding training and transfer tasks. As shown in Table 6, the two treatment groups did not differ significantly in reading these words. They were able to read on average over 80% of the words. This reveals that both forms of training enabled children to read real CVC words.

Delayed Nonword Spelling Task. Students listened to ten CVC nonwords containing the same target phonemes represented by letters in the learning and transfer tasks. Students were asked to write out the words in order to assess spelling. The number of words and number of correct letters were scored. Independent sample *t*-tests (see Table 7) revealed no significant differences between the connected phonation group and the segmented phonation group. Performance was similar for students in both training conditions. Students spelled on average over 70% of the words and approximately 90% of the letters correctly.

Table 7

Mean Performance, Standard Deviations, and Test Statistics for Spelling CVC Nonwords Containing Stop Consonants and Continuant Consonants on the Delayed Posttest by Students Who Received Connected and Segmented Decoding Training

	Connected Phonation *M (SD)*	Segmented Phonation *M (SD)*	*t*-statistic (*p*)	Cohen's *d*
Spelling Task Score				
Spelling Whole Word Score (10)	7.16 (1.68)	7.46 (1.68)	-0.58 (0.57)	0.18
Spelling Individual Letter Score (30)	26.84 (1.80)	27.26 (1.79)	-0.72 (0.48)	0.23

Note. There were 19 students per condition with *df* = 36. Whole word score represents the score for accurately spelling the whole word. The individual letter score represents the number of phonemes accurately represented by letters used in each spelled word.

Phonemic Awareness Delayed Posttest. Phonemic awareness was assessed with two tasks, a phoneme segmentation task and a phoneme blending task. Both were administered as a pretest and repeated as a posttest. An ANOVA was conducted separately on scores on each task, with treatment condition and test time as independent variables. Test statistics and means are reported in Table 8. The main effect of treatment and the interaction between treatment and test time for both segmenting and blending task were not statistically significant. However, a main effect of test time was detected. It is apparent from Table 8 that students' oral segmenting and blending ability improved from pretest to posttest. These results suggest that decoding instruction boosted students' oral segmenting and blending abilities. Interestingly, the test of the interaction on the segmentation measure fell just short of statistical significance. Inspection of mean gains shown in Figure 5 reveals that the segmentation group improved more from pretest to posttest than the connected group. This may have resulted from the explicit segmentation training they received during decoding instruction where they were taught to pause between phonemes as they sounded out the letters. The same interaction was not apparent on the segmentation task (see Figure 6).

Table 8

Mean Performance, Standard Deviations, and Test Statistics of Students Who Received Connected and Segmented Decoding Training on the Phonemic Awareness Pretest and Posttest

	Connected Phonation *M (SD)*	Segmented Phonation *M (SD)*	*F*-statistic (*p*)
Phonemic Awareness			
Segmenting (10)			
Pretest	6.79 (0.98)	6.05 (1.43)	T 2.09 (0.16)
Posttest	8.42 (0.77)	8.21 (1.08)	PP 196.86 (0.001)***
Gain	1.63	2.16	T x PP 3.80 (0.06)
Blending (10)			
Pretest	6.74 (1.41)	6.42 (1.31)	T 1.25 (0.27)
Posttest	8.79 (0.98)	8.32 (0.95)	PP 185.44 (0.001) ***
Gain	2.10	1.90	T x PP 0.30 (0.59)

Note. There were 19 students per condition with $df = 36$. *** $p < .001$. Independent variables T = treatment condition, PP = pre posttest.

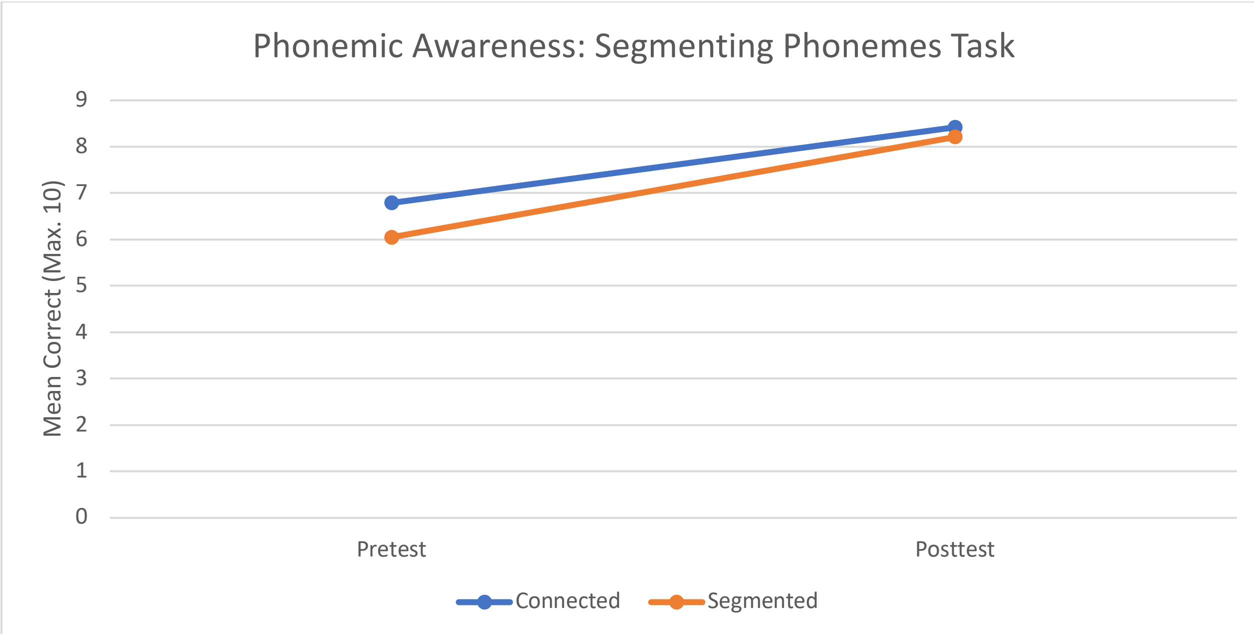

Figure 5. Significant main effect of test point. Students in both group showed significant gains in their ability to orally segment the phonemes of CVC words heard aloud from pretest to posttest.

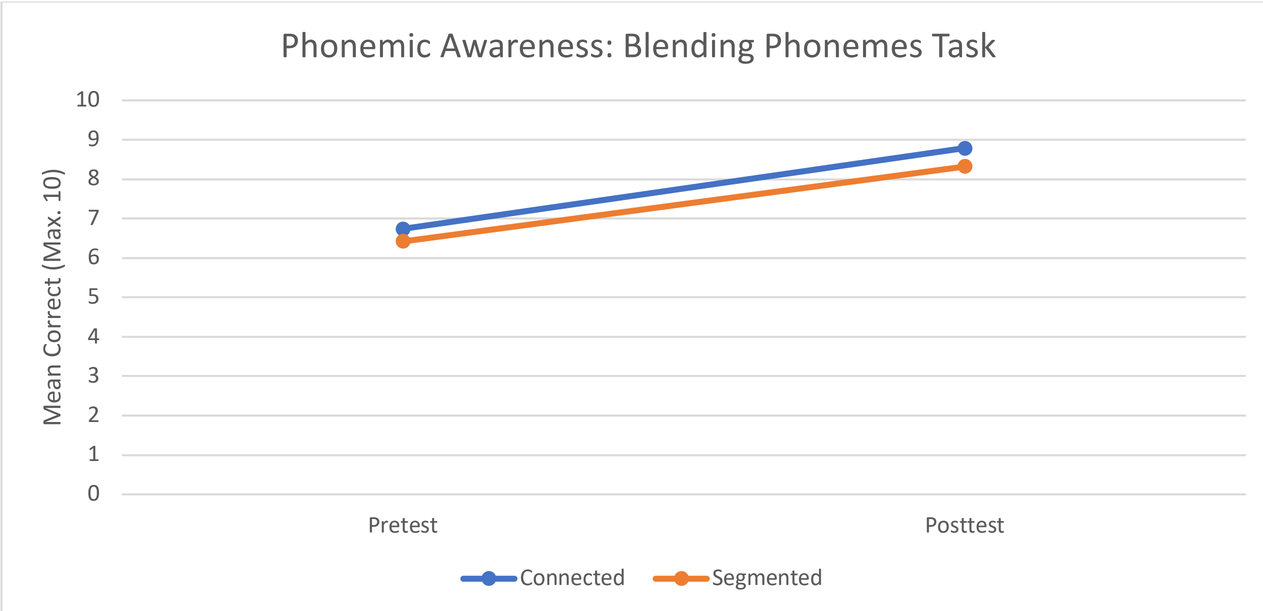

Figure 6. Significant main effect of test point. Students in both groups showed significant gains in their ability to orally blend phonemes of CVC words.

Word Learning Task. The fifth research question explored whether the difference in decoding training would impact sight word learning. Students were taught to read a set of nine similarly spelled real words over trials. These words were spelled using the same consonants and vowels used in the treatment conditions. The words were seven CCVCs and two CVCCs words. Students engaged in a study trial followed by five test trials. An ANOVA was conducted on scores, with treatment condition and trials as independent variables. Test statistics are reported in Table 9. Means are shown in Table 9 and Figure 5. The main effect of treatment and the interaction between treatment and trials were not statistically significant. However, a main effect of trials was detected. From Figure 5 it is apparent that students read an increasing number of words correctly as the test trials progressed. Mean scores were very similar in the connected and segmented groups. By the final trial, they were reading most of the words correctly. The gradual increase over trials suggests that they were learning to read the words from memory.

Table 9

Mean Performance, Standard Deviations, and Test Statistics on the Word Learning Task by Students Who Received Connected and Segmented Decoding Training

	Connected Phonation *M (SD)*	Segmented Phonation *M (SD)*	*F*-statistic (*p*)
Word Learning Task (9 max)			
Trial 1	3.42 (1.50)	3.95 (1.65)	T 0.001 (0.978)
Trial 2	4.89 (1.15)	5.05 (1.22)	R 146.88 (0.001)***
Trial 3	5.63 (1.46)	5.79 (1.48)	T x R 2.035 (0.121)
Trial 4	7.53 (1.22)	7.00 (2.01)	
Trial 5	8.47 (0.84)	8.11 (1.20)	
Total Correct Across Trials	29.95 (4.89)	29.89 (6.43)	

Note. There were 19 students per condition with $df = 36$. *** $p < .001$. Independent variables T = treatment condition, R = trials.

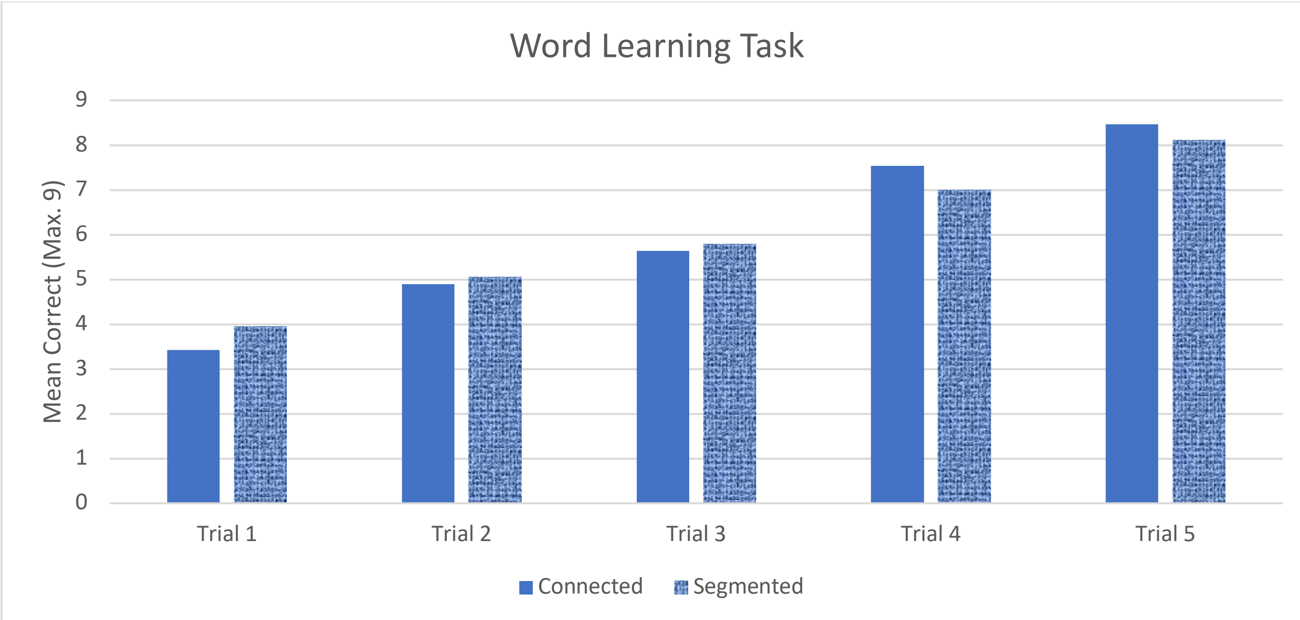

Figure 7. Mean number of words read correctly across by students in both training groups. Figure depicts that learning increased and was commensurate across trials for both training conditions.

Chapter 6

Discussion

Summary of Results. The first research question addressed whether connected phonation training would enable children to learn to decode nonwords more easily than segmented phonation training. Results supported our expectation. Students receiving connected phonation training learned to read nonwords in significantly fewer trials than students receiving segmented phonation training. Because current participants had not received any segmented decoding instruction prior to the study in their schools, students in the connected phonation condition were not inhibited by this procedure in learning to decode in contrast to students in the pilot studies. By repairing this limitation of the pilot studies, the current study showed that connected phonation instruction conducted with continuant consonants is a more effective way to teach beginners to decode.

The second research question investigated whether connected phonation instruction would transfer and enable students to read new CVC nonwords containing stop consonants more accurately than segmented phonation instruction. Stop consonants are more difficult to blend because unlike continuants they cannot be stretched and held. When spoken in isolation, their duration is brief. To extend it, an intrusive schwa vowel is unavoidably attached that must be deleted when the consonants are blended. Results showed that students taught to connect phonemes were much more successful in reading CVCs with stop consonants. In fact, the effect size was large.

The error analysis offered a view of the difficulties created by segmented phonation instruction on the decoding transfer task. The two groups were observed to use different strategies to read the nonwords. The segmented phonation group would first look at each letter and pronounce its sound. Then they would attempt to access from memory the sounds they had just pronounced to produce a blend. In doing this, they would forget one of the sounds they had spoken, especially the most remote initial sound, and would substitute another sound. In contrast, when students in the connected group decoded the nonwords, they produced a whole, succinct word without stretching or breaking between phonemes. By eliminating the segmentation step, blending flowed directly from seeing the succession of letter-sounds in the spelling rather than indirectly from memory for the separated sounds generated from the spelling. As a result, connected students mispronounced many fewer nonwords. This suggests that the connected phonation procedure was effective because it reduced the chances of students' forgetting which phonemes to blend.

The third research question investigated whether the advantage of connected phonation training would persist over time on a delayed posttest assessing nonword reading with stop consonants. The results of an ANOVA showed no significant main effects of treatment or consonant type but a significant interaction between the two variables. The connected group decoded more stop consonant nonwords than the segmented group but did not differ from the segmented group in decoding continuant consonant nonwords. This may be because students in both treatment groups received training and corrective feedback in reading nonwords with continuant phonemes until they had mastered them. These findings show that the beneficial effects of connected phonation training on reading nonwords with stop consonants were still evident one day later.

The fourth research question investigated whether the beneficial effects of connected phonation instruction would transfer to novel literacy tasks that were not taught. In a delayed posttest assessing the ability to read real CVC words, the treatment effect was not significant.

Both training groups performed similarly by reading approximately the same number of words. On average, students read about 75% of the words correctly. In a delayed posttest to measure students' ability to read CCVC nonwords, students in both training groups performed similarly. It was thought that the decoding instruction involving connecting and stretching phonemes with no pauses might help connected phonation students better understand how to blend phonemes more complex nonwords with consonant clusters. However, students in both groups read approximately 83% of the CCVC nonwords correctly. The inclusion of consonant clusters did not complicate the decoding task for the students. Further, in the delayed spelling posttest, it was expected that students in the connected phonation group would outperform the segmented phonation group. Again, this was not the case. Students in both groups spelled approximately 72% of the CVC nonwords correctly.

In the phonemic awareness tasks, oral segmenting and blending were assessed with pretests and posttests. There was a significant main effect of test time but no main effect of treatment. Students in both treatment groups made gains in oral segmenting and blending ability from pretest to posttest. The interaction just missed significance, suggesting that students taught segmented phonation to decode words were better able to segment spoken words into phonemes than students taught connected phonation. The difference may reflect an advantage of phoneme segmentation practice during segmented phonation training.

The fifth research question explored whether the type of decoding training received would influence sight word learning. Following the transfer task, students were given a word learning task. After a study trial, students completed five test trials to learn to read nine CCVC and CVCC words. It was thought that the connected phonation group might outperform the segmented group either in applying a decoding strategy or in accessing the words from memory to read the words. However, no difference as a function of treatment was observed.

To summarize findings, students who received connected phonation training learned to decode CVC nonwords containing continuant consonants more rapidly than students who received segmented training. Because both groups received decoding training until they had mastered the task, they possessed equivalent decoding skill with continuant consonant CVCs prior to the transfer tasks. In the first transfer task, students who had received connected phonation training were more accurate in reading CVC nonwords with stop consonants than the segmented phonation training group, and this advantage was evident one day later. However, the benefit of connected phonation training did not transfer to any of the other literacy tasks, including a task reading nonwords containing consonant clusters, a task giving students several trials to learn to read real word containing consonant clusters, a task assessing phonemic segmentation and blending, a real word reading task, and a nonword spelling task. Students in both treatment groups performed well on all of the transfer tasks. The fact that both treatments involved teaching students to decode nonwords to a mastery criterion may have given them sufficient decoding skill to handle these other tasks. Higher scores on these posttest supported this possibility. On the transfer tasks that involved decoding words and nonwords, the segmented group was correct on 69% to 81% of the test items, and the connected group was correct on 76% to 83%, indicating strong decoding skill by both groups.

Learning to Decode by Connecting Phonemes. The results from the pilot Study (study one and the replication study) regarding the first research question revealed no significant difference between the connected phonation and segmented phonation conditions in learning to decode CVCs containing continuant consonants. Students in both conditions reached criterion in about the same number of trials. The error analysis suggested the likely explanation. The Fundations (Wilson & Wilson, 2002) decoding instruction that students had received in their classrooms had taught them to segment words into separately pronounced phonemes, similar to our segmented phonation procedure even though it had not taught them to decode. As a result, the connected phonation group had to unlearn this habit, and this slowed them down in learning to stretch and connect adjacent phonemes without breaking the speech stream. In contrast, students in the segmented condition already knew the segmentation procedure and this facilitated their learning. Hence, the two groups did not differ in the average number of trials to reach criterion.

This finding was inconsistent with Constable's (2010) finding which showed that the segmented phonation group reached criterion in fewer trials than the continuous phonation group. This was an unexpected finding. One possible explanation is that Constable's students were already familiar with the segmented phonation procedure as a result of prior instruction they had received in their classrooms, so applying it was easier than applying the connected phonation procedure. The latter required students to shift from the segmentation method that they had already learned to the streaming method and this delayed their learning.

To avoid this problem, the current study was conducted with students who had not received any form of decoding instruction. Results here supported our expectation. Students receiving the connected phonation training learned to read nonwords in significantly fewer trials than students receiving segmented phonation training. Neither group was influenced by a previously taught segmentation procedure. These results indicate that connected phonation instruction conducted with continuant consonants is a more effective way to teach beginners to decode.

Decoding Nonwords with Stop Consonants. On the stop consonant decoding transfer task, students in the connected phonation group read many more nonwords correctly than students in the segmented phonation group. This replicates the finding from the pilot study, indicating that transfer to decoding words with stop consonants was facilitated by learning to decode words with continuant consonants by stretching and connecting the sounds rather than by breaking the sounds. Similar to the current study, the effect sizes for the Pilot Study were very large.

In the pilot study and the current study, students in the segmented phonation group made many more errors in decoding CVCs with stop consonants than students in the connected phonation group. The analysis of errors revealed that these involved forgetting the initial sounds in CVC nonwords when students tried to blend the sounds they had just segmented. Forgetting was not a problem for students who learned to decode by stretching and connecting phonemes in words.

Our findings replicate the results of Constable's (2010) study. Both showed that decoding words with stop consonants was facilitated by first teaching students to decode words with continuant consonants by stretching and connecting the sounds rather than by breaking the sounds. It is noteworthy that much less training time was required to teach decoding in the current study, just one 20-minute session. This contrasts with Constable's study which required on average 16 sessions each lasting 35 minutes. One reason for the greater amount of time in her study is that instruction was more elaborate and extensive. In Constable's (2010) study, children were taught the segmentation, blending and decoding procedures embedded in other instruction involving letter-sounds and phonological processing.

For the transfer task, schwa vowel deletion was expected to cause substantial difficulty when children in the segmented phonation group had to blend words with stop consonants. However, our results suggest that forgetting phonemes was a bigger problem to overcome. Children were not observed to struggle with schwa deletion, at least not overtly, in their blending attempts. The absence of schwa interference is supported by Murray et al.'s (2008) study where students were able to orally blend phonemes better when they were vocalized with schwa vowels than when they were whispered without schwas. The authors suggest a reason why schwas do not create a problem. They can be overlooked when students recognize the particular phonemes being represented by graphemes and when they possess insight into how blending works. Schwas may be easier to ignore because they are redundant whereas stop consonants are distinctive and are recognized as the relevant part of the sound by children who know letter-sound relations.

Relationship to Previous Studies. In the present study, when students in the segmented phonation group decoded words with stop consonants, they were observed to correctly identify the phonemes when segmenting the words but then to make errors when blending the phonemes. This is in agreement with Weisberg and Savard's (1993) results. They noted in their study that when students in the 1-second pause condition were asked to read the posttest words, they almost always identified the sequence of separate phonemes correctly. However, similar to the current study, inserting pauses between phonemes caused them to make more errors when blending the sounds to read the words.

Further, Weisberg and Savard (1993) also found that not pausing when segmenting the phonemes in words prior to blending was superior to pausing between each phoneme. However, Weisberg and Savard (1993) used words with a mix of stop consonants and continuants in their intervention and posttest. Further, it was unclear how schwas were handled, particularly when words with stop consonants were taught in the 0-second pause condition. This is an important point to consider when teaching decoding because the presence of a schwa makes decoding more challenging. The current study clearly shows that students benefit from learning to stretch and connect phonemes in words without breaking the speech stream. Unlike Weisberg and Savard's (1993) study, this procedure was used exclusively with words composed of continuants. In this manner, it was clearly shown that learning the procedure with continuants transferred to benefit decoding words with stop consonants.

Current findings are consistent with the study of oral blending conducted by Weisberg et al. (1989). They showed that students were most successful in an oral blending task when no pauses occurred between phonemes than when pauses were introduced prior to blending. Our findings extend theirs by showing that the same holds in teaching students how to decode written words.

It was interesting that children learned to decode so quickly in both the pilot study and the current study given that they could not decode nonwords on the pretest. Several explanations are possible. First, students possessed the relevant background knowledge so were prepared to benefit from decoding instruction. They knew all the letter-sound relations that were needed to sound out letters in the CVC nonwords. Additionally, they were able to read at least some real words from memory by sight. Thus, reading words was not foreign to them. Also, all students possessed at least some phonemic awareness. They were able to orally blend at least half of the 10 CVC items on the blending pretest. Students in the pilot study had received instruction in how to decode in their classrooms. Although this did not enable them to decode nonwords, they were not unfamiliar with the process. In addition, the individual instruction that students received may have been particularly effective. The experimenter modeled sounding out and blending with five

CVC nonwords, students copied the procedure, then performed independently with new CVCs, and were given immediate feedback. This may contrast with group administered class instruction with limited corrective feedback which allows some students to fall through the cracks.

Students in the pilot study had received decoding instruction in their classrooms but were unable to decode nonwords on our pretest. Since decoding training required only 20 minutes, it remained uncertain whether our instruction really taught them decoding skill, or whether improvement resulted from situational factors such as task clarification or motivation. Also it remained uncertain whether improvement was only temporary. These uncertainties were addressed in the current study which was conducted with students who had not received prior decoding instruction. Nevertheless, they performed similarly to students in the pilot studies. They learned to decode after receiving the same procedures and length of training as those in the pilot study. Moreover, results on the delayed posttest showed that these students' decoding ability was not temporary. A day later, they were still able to decode nonwords. These findings indicate that our training did teach decoding skill in all these studies.

Evidence in the current study improves on evidence in the studies of Pullen et al. (2005) and DiVeta and Speece (1990). By using an experimental design, the current study was able to show that stretching and connecting the phonemes without stopping was the cause of superior decoding skill. Pullen et al. (2005) and DiVeta and Speece (1990) attempted to study this but embedded their decoding instruction in other literacy activities so at the conclusion of their studies, it was unclear which aspect of instruction was the cause of improved decoding ability.

Acquisition of decoding skill is considered a developmental milestone. Ehri (2005) identifies the ability to decode unfamiliar words as the skill enabling beginning readers to move from the partial alphabetic phase to the full alphabetic phase. Share (2004) shows that decoding is a self-teaching procedure that readers can use on their own to unlock the identities of unfamiliar words they read in text. Application of a decoding strategy enables readers to build their memory for written words and to increase their knowledge of the pronunciations and meanings of new vocabulary words (Chambre, Ehri, & Ness, 2019). Current findings suggest how to help students move from the partial to the full phase and self-teach unfamiliar words that they read.

Students selected for the current study were in Ehri's (2005) partial phase of development. We examined whether two abilities assessed by pretests were predictive of their ability to decode nonwords on the transfer task following training: their phonemic awareness measured by oral segmenting and blending, and their accumulation of a sight word vocabulary measured by a word reading task. A correlational analysis involving hierarchical regression revealed that students' sight word vocabulary but not their phonemic awareness explained additional unique variance beyond that explained by the decoding training conditions. This suggests that more extensive knowledge of sight words contributed to students' ability to learn to decode nonwords. In other words, students in the partial phase may be helped to acquire decoding skill and move into the full phase by accumulating a larger vocabulary of words they can read from memory. This possibility awaits further study.

Implications for Instruction. Considering the findings of the current study and the large effect size, the connected phonation method holds much promise for teaching students to decode in the classroom. Learning to decode is an important step in becoming an accurate and automatic reader. There are many programs used in classrooms to teach decoding. The Wilson Fundations program (2002) is one of the most popular. It is explicit and systematic in its instruction. However, for teaching decoding, it relies on the segmented phonation method. Findings in the current study suggests that the program could be made more effective by implementing the connected phonation procedure. This would involve teaching students first to decode CVC words with continuant consonants until they master the procedure, and then progressing to the decoding of words with stop consonants.

The operation of decoding words requires students to transform individual graphemes into phonemes represented by the graphemes and then to blend the sequence to pronounce the word. The traditional method of teaching students to decode has been to divide the operation into two steps, pronouncing each of the letter-sounds separately, and then blending them together. Results of the current study serve to challenge the traditional approach. Students who received continuous phonation instruction learned to decode better than students who received the traditional two-step approach of segmenting and then blending. How might these results be explained? How did continuous phonation instruction facilitate the decoding operation? Two factors are thought to be responsible. First, limiting the consonants in CVC nonwords to continuants during instruction enabled students to pronounce the sequence of letter-sounds without breaking the speech stream. This eliminated the step of pronouncing each grapheme separately and reduced the number of decoding steps to only one, that involving blending. Also, it eliminated the problem created by stop consonants, the need to add schwa vowels when pronouncing them separately and the impossibility of pronouncing stop consonants without breaking the speech stream. Because connected phonation instruction eliminated the segmentation step, the transition to decoding with stop consonants was not burdened by schwa vowel production and deletion, and by the greater possibility of forgetting segmented sounds during blending. Connected phonation students just applied the single step of blending.

The error analysis revealed that the segmented phonation group had more difficulty remembering the segmented sounds when blending those sounds together to pronounce the nonwords. The way students in each treatment group tackled reading the nonwords on the transfer task was particularly illuminating. When asked to read the nonwords with stop consonants, students in the connected phonation group would pronounce the whole word. In contrast, students in the segmented phonation group would first segment the phonemes in the word, pronouncing each separately, before blending the segmented sounds to read the word. This extra step allowed phonemic substitution errors to creep into their blends. They seemed to forget the sounds that they had initially segmented and would substitute another phoneme when blending.

Strengths, Limitations and Future Research. Several features of the study contribute to its strength. Students were pretested to select those likely to benefit from decoding instruction. They knew letter-sounds but were unable to decode words. Students were randomly assigned to the treatment groups, and the two groups did not differ on pretests relevant to the treatments, thus strengthening the internal validity of the study, that is, the likelihood that effects could be attributed to the treatments rather than to extraneous causes. Students sampled in the pilot study and the current study were from different SES levels and ethnic groups which strengthens the external validity/generalizability of the findings.

Although the sample size in the pilot study was small, the current study replicated its findings with a larger sample, thus increasing confidence in the results. Moreover, the effect sizes were large across all studies, indicating that the studies had sufficient power to detect differences. Importantly, results add to our understanding about the processes involved in learning to decode words under different instructional conditions and how decoding might be taught more effectively.

Although decoding instruction conducted with segmented phonation was less effective than connected phonation in the current study, other studies of synthetic phonics instruction have shown that segmented phonation is an effective way to teach decoding when compared to procedures not teaching decoding explicitly (Johnston & Watson, 2004). In the current study a trend was detected favoring the segmented approach on one task, the phonemic segmentation posttest. Although falling just short of statistical significance, students in the segmented group divided oral CVCs into phonemes more accurately than students in the connected group. This suggests a possible strength of the segmentation condition. Explicit instruction in identifying phonemes and pausing between phones as students sounded out words may benefit their phonemic segmentation skill.

Training in segmented phonation might have benefited performance on another posttest that required students to spell words. It was thought that because segmented phonation training provided explicit practice pronouncing the separate phonemes associated with letters in nonwords, this might have enhanced students' ability to detect the separate phonemes in nonwords when they spelled phonemes in the words. However, the two treatment groups performed similarly in spelling words and letters correctly. Thus, unlike the evidence of a positive effect on the phoneme segmentation task discussed above, there was no evidence on the spelling task.

A limitation of the pilot study was that participants had already been exposed to the phoneme segmentation procedure for decoding words. This appeared to interfere with the performance of students receiving the connected treatment during the learning trials. However, the current study was conducted with students who had received no prior decoding instruction. Results confirmed that connected phonation training was more effective than segmented phonation among students who had not received any prior segmented phonation instruction in their classrooms.

Our study was conducted with beginning readers who were taught to decode regularly spelled nonwords in English. However, the English writing system is opaque with many orthographic and phonological complexities making it difficult to apply a decoding procedure to read many words successfully. The purpose of the connected phonation procedure was to make the decoding procedure easier for beginners to learn when decoding is first taught and words are more regularly spelled, especially in decodable texts. Whether the method might be applicable in helping more advanced readers decode longer and orthographically complex words awaits study. However, it may be that segmented phonation is a more effective procedure, that is, teaching students to decode multisyllabic words by segmenting and pronouncing the separate syllables and morphemes. This was shown to be more effective for teaching students to read multisyllabic words than practice reading whole words repeatedly by Bhattacharya and Ehri (2004).

Our study had two training groups which were compared in their sight word learning ability on a posttest. No significant difference was observed between the two groups. Both learned to read the sight words with equal ease across the test trials. It appears that both types of decoding training helped students learn to read the sight words. By the end of the 5^{th} trial, they read 90% of the words on average. In future studies, comparison of their learning to a group who received no decoding training would clarify the extent that decoding instruction contributed to their sight word learning.

The addition of pretests and the inclusion of a no-treatment control group in future studies could also shed light on the contribution of decoding training to improvement in the other transfer tasks. In the phonemic awareness tasks, a significant main effect of test time was detected. Students showed significant gains in their ability to orally segment and blend phonemes from pretest to posttest. The inclusion of a no-treatment control group in future studies could clarify the extent that gains resulted from decoding instruction rather than from repetition of the phonemic awareness pretest on the posttest . Further, the inclusion of posttests following a longer delay (e.g., 1 week or 1 month) would show whether the effects of training persist over a greater period of time.

Another limitation of the current study was the low reliability scores on the spelling pretest and the delayed posttest. This may be one reason why differences were not detected between the two groups in their spelling performance, and why the segmented group might not have shown greater gains than the connected group. Future research might add more items to the tasks in order to be more sensitive and reliable.

A future direction for research might also include examining the effectiveness of connected phonation decoding instruction with students diagnosed as SDI. Based on current findings, continuous phonation instruction would be expected to enhance these students' ability to master the processes in learning to decode which is known to create difficulty for them. Interestingly, Constable (2010) found that students receiving connected phonation training improved their performance from pretest to posttest on the CTOPP nonword repetition task. This task measures phonological memory for nonwords which is an area in which students with SDI may exhibit difficulty. Thus, the connection phonation decoding procedure might not only help with decoding but also with phonological memory.

Current findings show that decoding skill transferred more readily to new CVC words with stop consonants when beginning readers had learned to blend without breaks in the speech stream compared to the inclusion of breaks in the speech stream. Future research might examine how this method might be adapted for classroom instruction. The method used in the connected phonation group is one that is easily incorporated into classrooms to help students acquire decoding skills. Teaching readers how stretch and connect phonemes when sounding out letters in words is particularly useful for teaching students who struggle in blending phonemes to decode words. The learning trial procedure with corrective feedback used in the current study took approximately 20 minutes. Students met with the experimenter for a single session to learn how to use connected phonation. Visuals were used which included flashcards displaying printed nonwords, which are easy to make. Similar to many synthetic phonics programs, the current study also used a tactile method to reinforce the procedure of connecting phonemes by having students slide their finger beneath the letters in each word. This procedure holds much promise for improving decoding instruction in the classroom, especially for struggling readers.

In conclusion, current findings advance our understanding about decoding processes and their application to instruction. The findings clarify the difficulties created when children are taught to decode by converting letters into a sequence of separately pronounced sounds before blending them to form a word. The results of the current study suggest that synthetic phonics programs may be effective in teaching decoding but are not as effective as they potentially could be if instruction started with continuants and used the connected phonation strategy. Current findings suggest how decoding instruction can be made more effective, by teaching first with continuants and then transitioning to stop consonants, and by teaching children to stretch and connect the continuant phonemes associated with letters before blending them. Learning to decode new words is particularly difficult for struggling readers. Current findings identify a possible way to ease their difficulty and suggest this as a direction for future research.

Appendix A

Parental Consent

THE CITY UNIVERSITY OF NEW YORK
CUNY Graduate Center
Educational Psychology

THE CITY UNIVERSITY OF NEW YORK
CUNY Graduate Center
Educational Psychology

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Title of Research Study: Teaching Children to Decode Words

Principal Investigator: Selenid Gonzalez Frey, MS
Childhood Education Certified Teacher, K-6
Doctoral Student at CUNY Graduate Center

Faculty Advisor: Linnea Ehri, Ph.D
Distinguished Professor, Educational Psychology, CUNY Graduate Center

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Your child is being invited to participate in a research study because they are a Kindergartener in the process of learning to read.

Purpose:
The purpose of this research study is to determine how to improve reading instruction in kindergarten. To attain reading skill, all children must learn how to read new words, referred to as decoding. In this study, they will be taught how to do this in one of two ways, the traditional way and a new way. The question to be answered is whether one method is more effective than the other method.

Procedures:
If you allow your child to participate in this research study, she or he will be asked to perform several tasks that teachers typically use as part of reading instruction in their classrooms. The investigator will work with each student individually in a quiet location in the school deemed appropriate by the principal and the child's teacher.

- During the first 20-minute session, students will complete several literacy tasks to assess what they know about letter names and sounds, whether they can read beginning level words, and whether they can process sounds in words. Children who know many letters but who have not yet learned to decode words will be accepted to continue in the study. Children who have not yet learned letters and children who have already learned to decode new words are not expected to benefit from our training and therefore will not continue in the study.

- During the second 20-minute session, students will be taught to decode new three-letter words, by pronouncing the sounds of letters either with or without breaks between the sounds, and then combining the sounds to form a whole word. Each word will be shown, and the teacher will give students practice reading the words with feedback until they can read them perfectly. Then students will be given additional words to read on their own, to assess the effects of learning.
- During the third 20-minute session, students will be asked to read, spell, and process sounds in words to see whether students remember what they were taught and can apply their learning to new literacy tasks.

Time Commitment:

Your child's participation in this research study is expected to last for a total of three days for 20 minutes each day.

Potential Risks or Discomforts:

- Children who qualify for the study will meet individually with the investigator for three 20-minute sessions, each on a separate day. During this time, the student will leave the classroom. However, the investigator will consult with the teacher to ensure that the student will not miss important instructional activities.

- Although boredom or frustration might occur, this is unlikely because we have screened students to make sure that they have the background to benefit from our instruction. The literacy tasks given during the first session will identify students who either lack the background or who have already learned the skill being taught, and these students will not participate in the rest of the study.

- If during the tasks or procedures, your child becomes frustrated or expresses the wish to stop, all procedures will be halted.

Potential Benefits:

Children who participate in the study will receive several benefits.

- They will receive individualized attention and instruction from a credentialed teacher.
- They will be taught to decode new words, which is an essential step in learning to read.
- In performing the literacy tasks, they will experience success in showing what they know and what they learn.

Results of the study will contribute new knowledge to the science of teaching reading.

- Results are expected to indicate how to teach reading more effectively to beginning readers and to struggling readers.
- Results are expected to show how systematic phonics instruction can be improved by modifying the traditional method of teaching students to decode new words.
- Struggling readers find the process of decoding new words especially difficult. Our findings should reveal a method of teaching that will ease their difficulty.

Payment for Participation:
Your child will not receive any payment for participating in this research study.

New Information:
You and your child will be notified about any new information regarding this study that may affect your willingness to allow your child to participate in a timely manner.

Confidentiality:
We will make our best efforts to maintain confidentiality of any information that is collected during this research study, and that can identify your child. We will disclose this information only with you and your child's permission or as required by law.

We will protect your child's confidentiality by using only the minimum necessary identifiers. This will serve the purpose of being able to locate students over the course of the three days. All students will be given an identification number, which will be used in lieu of names when analyzing the data. All subjects' name will be deleted from the record sheets when they are no longer needed, and only numerical identifiers will be used thereafter. The names will be stored in a locked file cabinet in a locked office where only my faculty advisor and I will have access.

The research team, authorized CUNY staff, and government agencies that oversee this type of research may have access to research data and records in order to monitor the research. Research records provided to authorized, non-CUNY individuals will not contain identifiable information about your child. Publications and/or presentations that result from this study will not identify your child by name.

Participants' Rights:

- Your child's participation in this research study is entirely **voluntary**. If you decide not to have your child participate, there will be no penalty to you or your child, and you and your child will not lose any benefits to which you are otherwise entitled.

- You can decide to withdraw your consent and have your child stop participating in the research at any time, without any penalty.

Questions, Comments or Concerns:
If you have any questions, comments or concerns about the research, you can talk to one of the following researchers:

- Selenid Gonzalez Frey, Doctoral student, at (305) 979 – 2562
- Linnea Ehri, Distinguished Professor, at (212) 817 – 8294

If you have questions about your rights as a research participant, or you have comments or concerns that you would like to discuss with someone other than the researchers, please call the CUNY Research Compliance Administrator at 646-664-8918 or email HRPP@cuny.edu. Alternately, you can write to:

CUNY Office of the Vice Chancellor for Research

Attn: Research Compliance Administrator
205 East 42nd Street
New York, NY 10017

Signature of Participant's Parent or Guardian:
If you agree to have your child participate in this research study, please sign and date below. You will be given a copy of this consent form to keep.

____
Printed Name of Student

____
Printed Name of Parent/Guardian

____ _______________
Signature of Parent/Guardian Date

Signature of Individual Obtaining Consent

____
Printed Name of Investigator Obtaining Consent

____ _______________
Signature of Investigator Obtaining Consent Date

Appendix B

Letter Name and Sound Score Sheet

Script for letter name assessment: *I am going to show you some letters. When you see each letter, I want you to tell me the name of the letter.*

Script for letter sound assessment: *I am going to show you some letters. When you see each letter, I want you to tell me sound of the letter.*

If child names letter, say *"that is the letter's name. Can you tell me the sound it makes in words"*

Record with a check if correct or record the letter or sound given if incorrect.

	Letter name response	Letter sound response
a		
f		
k		
p		
b		
o		
l		
m		
d		
n		
s		
i		
t		
Totals		

Appendix C

Pretest: Ability to Read Nonwords

Script: *I am going to show you five silly sounding words. These are words that you have never read before and don't have meaning. These are words that I made up, but you may be able to read them. I will show you each word one at a time. I want you to look at each word carefully and read them to me aloud the best you can.*

The experimenter will show each word one at a time. The experimenter will not provide any corrective feedback. She will record success or failure for reading each word, will record any audible method used by the students while reading the word, and will record mispronunciations.

☑ □if correct. Write students' response if incorrect.

nif ☐ _____________

fas ☐ _____________

mol ☐ ____________

lon ☐ _____________

sim ☐ _____________

Appendix D

Phonemic Awareness: Blending Phonemes into Words

Blending Phonemes into Words
Say: "I am going to say some sounds. I want you to listen carefully. Your job will be to listen to the sounds, repeat the sounds aloud, and then put the sounds together to make a word. Let me give you an example: n – o – p. Again, those sounds are /n/ /o/ /p/. Those sounds put together say Nope. Listen, n – o – p, nope.
Okay, I will say some more sounds. Your job is to listen carefully, repeat the sounds and put them the sounds back together to make a word. Here is the first one: b-i-t"

Experimenter says the sounds separately, with no schwa, and holding each pause for 2 seconds. Students are expected to repeat the sounds and then blend the sounds into a word. Write a ☑ or ☒ if the student responds correctly. If the student responds incorrectly, record the incorrect response.

For the pretest, experimenter should stop the task if the child misses the first four items by saying nothing or guessing at an answer that is substantially off the mark.

1. b-i-t ☐ ___________ /b/ /I/ /t/

2. f-a-n ☐ ___________ /f/ /æ/ /n/

3. s-o-n ☐ ___________ /s/ /a/ /n/

4. t-a-n ☐ ___________ /t/ /æ/ /n/

5. d-i-p ☐ ___________ /d/ /I/ /p/

6. k-i-d ☐ ___________ /k/ /I/ /d/

7. l-a-p ☐ ___________ /l/ /æ/ /p/

8. m-a-d ☐ ___________ /m/ /æ/ /d/

9. p-o-t ☐ ___________ /p/ /a/ /t/

10. n-a-p ☐ ___________ /n/ /æ/ /p/

___/10

Appendix E

Phonemic Awareness: Segmenting Words into Phonemes

Segmenting Words into Phonemes
Say: "Okay, now we will do something different. This time, I am going to say a whole word. The word has several sounds put together to make the word. Your job is to listen carefully to the word, repeat the word, and break the word up into its separate sounds. You will tell me what those sounds are. Here is an example. The word is *nope*. Again, I will repeat the word, it is *nope*. That word has three sounds, listen: – nope, n – o – p (hold up a finger as you say each sound). Okay, now I will say some more words, and this time you will first repeat the word and then break up the word and tell me its sounds."

Write a ☑ or ☒ if the student responds correctly. If the student responds incorrectly, record the incorrect response.

For the pretest, experimenter should stop the task if the child misses the first four items by saying nothing or guessing at an answer that is substantially off the mark.

1. mom	☐	______________ /m/ /a/ /m/	7. not	☐	______________ /n/ /a/ /t/
2. sin	☐	______________ /s/ /I/ /n/	8. kit	☐	______________ /k/ /I/ /t/
3. bad	☐	______________ /b/ /æ/ /d/	9. pal	☐	______________ /p/ /æ/ /l/
4. top	☐	______________ /m/ /a/ /p/	10. dim	☐	______________ /d/ /I/ /m/
5. fat	☐	______________ /f/ /æ/ /t/			____/10
6. lid	☐	______________ /l/ /I/ /d/			

Appendix F

Spelling Nonwords Pretest

Instructions: Experimenter will say each word aloud to the students two times and ask the student to write the word.

Say: *We are going to do something a little bit different. I am going to say 6 words aloud one at a time. I will repeat each word. Your job is to listen carefully to the word and then spell the word on the paper I have given you. I want you to try to spell it the best you can.*

Script for each word:

1. The word is ______."
2. "You say it." (Child responds; correct if mispronounced)
3. "Now write ______."

lin

pok

maf

bop

fos

tad

Appendix G

Training Words Taught in Connected and Segmented Decoding Condition

CVC nonwords spelled with combination of:
Continuants: f, l, m, n, s
Short vowels: a, i, o

nif
fas
mol
lon
sim
nal
faf
mon
lim
sif
lan
fom
mil
naf
som
nos
fil
mas
lis
san

Letter Usage Count for Training Words			
Letter	Count	Initial Position	Final Position
f	8	4	4
l	8	4	4
m	8	4	4
n	8	4	4
s	8	4	4
a	7		
i	7		
o	6		

Appendix H

Connected Phonation Condition Script

Round one:

Training procedure for segmenting and blending with connected phonation (5 words)

1. Introduction of procedure

nif

"I am going to teach you to how to read some silly words that you have never read before. I have made up these nonsense words. You can pronounce them, but they don't have any meanings. I will teach you a special way to read the words. We will look at each letter and say its sound. Then we will put the sounds together to say the whole word.

"We will say the sounds in a special way. We will slide our finger under each letter as we say and stretch its sound. We will stream the sounds together without any breaks. Then we will say the whole word as one short sound. Watch how I slide my finger as I read this nonword: nnnniiiiffff (slide finger beneath letters). Nif."

"As I say and stretch the sounds, I run my finger under each letter without stopping." Watch and listen, /nnn/ /III/ /fff/, 'nif'." Experimenter runs finger under the word slowly as she says each sound without stopping and then says the whole word.

"Now you try. Say and stretch each sound in the word without stopping while running your finger under the letters, then read the whole word."

"Let's practice a few more words together"

2. Practice procedure with experimenter and student together.

- fas

Watch and listen as I say and stretch the sounds in the words without stopping between the sounds while sliding my finger: /fff/ /æææ/ /sss/, 'fas.'

"Now you try, say and stretch each sound in the word without stopping while running your finger under the words without stopping then read the whole word." (Child performs task. Provide reinforcement and corrective feedback until the child follows the procedure correctly. The child should say and stretch each sound continuously, with no breaks, while sliding finger under the letters and then says the whole word quickly).

- mol

Watch and listen as I say the sounds in the words without stopping between the sounds while sliding my finger: /mmm/ /aaa/ /lll/, 'mol.'

"Now you try, say and stretch each sound in the word without stopping while running your finger under the words without stopping then read the whole word." (Child performs task. Provide reinforcement until the child follows the procedure correctly. The child says and stretches each sound continuously, with no breaks, while sliding finger under the letters and then says the whole word quickly).

- lon

Watch and listen as I say and stretch the sounds in the words without stopping between the sounds while sliding my finger: /lll/ /aaa/ /nnn/, 'lon.'

"Now you try, say and stretch each sound in the word without stopping while running your finger under the words without stopping then read the whole word." (Child performs task. Provide reinforcement and corrective feedback until the child follows the procedure correctly. The child should say and stretch each sound continuously, with no breaks, while sliding finger under the letters and then says the whole word quickly).

- sim

Watch and listen as I say and stretch the sounds in the words without stopping between the sounds while sliding my finger: /sss/ /III/ /m/, 'sim.'

"Now you try, say and stretch each sound in the word without stopping while running your finger under the words without stopping then read the whole word." (Child performs task. Provide reinforcement and corrective feedback until the child follows the procedure correctly. The child should say and stretch each sound continuously, with no breaks, while sliding finger under the letters and then says the whole word quickly).

Test Procedure for segmenting and blending with connected phonation (15 words)

Have student continue until they can blend five words in a row correctly. Using a scoring sheet, the experimenter will indicate success or failure for each encountered word. The student needs to say and stretch the sounds continuously (with no breaks) and then say the whole word quickly to have a success. Feedback should be provided after each attempt if the child makes an error with applying the procedure, produces the wrong letter sound, or incorrectly reads the whole word. The experimenter will write the incorrect responses on the score sheet as well.

"Now you try to read some more words by yourself. When you see each word on the flashcard, say and stretch each sound without stopping while sliding your finger beneath the letters and then blend the sounds together to say the word like we just practiced"

Format to follow for each item:

1. Show nonword on card.
2. "Stretch and connect sounds while sliding your finger under the letters."
   If any part is wrong:
   "Watch me." Experimenter performs response.
   "Now you do it like that
3. Say the whole word."
   If wrong, Experimenter repeats stretching and connecting response, then says the whole word.

nal
faf
mon
lim
sif
lan
fom
mil
naf
som
nos
fil
mas
lis
san

<u>Round two</u>:

Transfer Task:

"Now, we are going to read some more silly words. I want you to read the whole word printed on the flashcard. This time I will let you read the words by yourself without any help from me."

The experimenter will proceed through the list of 20 words once through and write the word read by the students to note mistakes made. A correct word is read as a whole word (one succinct word). No corrective feedback or reinforcement should be provided. Experimenter will avoid saying "good." After each word say, *"Here's the next one"* or *"next one."*

bap
pak
tod
kib
dak
bot
pid

tat
kod
bip
dod
pab
kot
tik
dit
bak
pib
dop
tib
kap

Appendix I

Learning Trial Scoring Sheet

	Pronounces sounds correctly?	**Uses procedures correctly?**	**Blends sounds correctly?**	**Errors made**	**Comments made**
nif					
fas					
mol					
lon					
sim					
nal					
faf					
mon					
lim					
sif					
nan					
fom					
mil					
laf					
som					
nos					
fil					
mas					
lis					
san					

Appendix J

Segmented Phonation Procedure

Round one

Training procedure for segmenting and blending with segmented phonation (5 words)

1. Introduction of procedure

nif

"I am going to teach you how to read some silly words that you have never read before. I have made up these nonsense words. You can pronounce them, but they don't have any meanings. I will teach you a special way to read the words. We will look at each letter and say its sound. Then we will put the sounds together to say the whole word."

"We will say the sounds in a special way. We will tap each letter with our finger as we say and stretch its sound. Then we will put all the sounds together to say the whole word. Watch how I tap with my finger as I read this nonword: nnnn – iiii – ffff, nif." Tap each letter as you say and stretch its sound.

"As I say and stretch the sounds, I place my finger under each letter and lift off when I stop the sounds." Watch and listen again, /nnn/ - /III/ - /fff/, nif." Experimenter uses finger to tap under each letter as she says and stretches each sound, pausing between the sounds, and then says the whole word.

"Now you try. Say and stretch each sound in the word, stop and tap your finger under its letter and then read the whole word." (Child does it. Provide reinforcement until the child follows the procedure correctly. The child says and stretches each sound by breaking between the sounds, while tapping each letter with their finger and then says the whole word quickly).

"Let's practice a few more words together"

2. Practice procedure with experimenter and student together

- fas

Watch and listen as I say and stretch the sounds in the words while stopping between the sounds while I tap my finger: /f/ /ææ/ /s/, 'fas.'

"Now you try. Say and stretch each sound in the word, pausing between the sounds while tapping your finger under the letter then read the whole word." (Child does it. Provide reinforcement until the child follows the procedure correctly. The child says and stretches each sound by breaking between the sounds, while tapping each letter with their finger and then says the whole word quickly).

- mol

Watch and listen as I say and stretch the sounds in the words while stopping between the sounds and tapping my finger: /m/ /a/ /l/, 'mol.'

"Now you try. Say and stretch each sound in the word, pausing between the sounds while tapping your finger under the letter then read the whole word." (Child does it. Provide reinforcement until the child follows the procedure correctly. The child says and stretches each sound by breaking between the sounds, while tapping each letter with their finger and then says the whole word quickly).

- lon

Watch and listen as I say and stretch the sounds in the words while stopping between the sounds and tapping my finger: /l/ /a/ /n/, 'lon.'

"Now you try. Say and stretch each sound in the word, pausing between the sounds while tapping your finger under the letter then read the whole word." (Child does it. Provide reinforcement until the child follows the procedure correctly. The child says and stretches each sound by breaking between the sounds, while tapping each letter with their finger and then says the whole word quickly).

- sim

Watch and listen as I say and stretch the sounds in the words while stopping between the sounds and tapping my finger: /s/ /I/ /m/, 'sim.'

"Now you try. Say and stretch each sound in the word, pausing between the sounds while tapping your finger under the letter then read the whole word." (Child does it. Provide reinforcement until the child follows the procedure correctly. The child says and stretches each sound by breaking between the sounds, while tapping each letter with their finger and then says the whole word quickly).

Test Procedure for segmenting blending with segmented phonation (15 words)

Have student continue until they can blend five words in a row correctly. Using a scoring sheet, the experimenter will indicate success or failure for each encountered word. The student needs to say and stretch each sound by breaking between the sounds, while tapping each letter with their finger and then read the whole word correctly to have a success. Feedback should be provided after each attempt if the child makes an error with applying the procedure, produces the wrong letter sound, or incorrectly reads the whole word. The experimenter will write the incorrect responses on the score sheet as well.

"Now you try to read some more words by yourself. When you see each word on the flashcard, say and stretch each sound while stopping and tapping its letter, and then blend the sounds together to say the word like we just practiced"

Format to follow for each item:

1. Show nonword on card.
2. "Stretch each sound to say it while tapping its letter."
   If any part is wrong:
   "Watch me." Experimenter performs response.
   "Now you do it like that
3. Say the whole word."
   If wrong, Experimenter repeats stretching and tapping response, then says the whole word.

nal
faf
mon
lim
sif
nan
fom
mil
laf
som
nos
fil
mas
lis
san

<u>Round two</u>:

Transfer Test with Stop Consonants

"Now, we are going to read some more silly words. I want you to read the whole word printed on the flashcard. This time I will let you read the words by yourself without any help from me."

The experimenter will proceed through the list of 20 words once through and write the word read by the students to note mistakes made. A correct word is read as a whole word (one succinct word). No corrective feedback or reinforcement should be provided. Experimenter should avoid saying, "good." After each word experimenter can say *"here's the next one"* or *"next one."*

bap
pak
tod

kib
dak
bot
pid
tat
kod
bip
dod
pab
kot
tik
dit
bak
pib
dop
tib
kap

Appendix K

Transfer Words Assessed Following Training

CVC nonwords spelled with combination of
Stop consonants: b, k, d, p, t
Short vowels: a, i, o

bap
pak
tod
kib
dak
bot
pid
tat
kod
bip

dod
pab
kot
tik
dit
bak
pib
dop
tib
kap

Letter Usage Count for Training Words

Letter	Count	Initial Position	Final Position
b	8	4	4
k	8	4	4
d	8	4	4
p	8	4	4
t	8	4	4
a	7		
i	7		
o	6		

Appendix L

Test Trial Scoring Sheet

	Pronounces sounds correctly?	Uses procedures correctly?	Blends sounds correctly?	Errors made	Comments made
bap					
pak					
tod					
kib					
dak					
bot					
pid					
tat					
kod					
bip					
dod					
pab					
kot					
tik					
dit					
bak					
pib					
dop					
tib					

kap					

Appendix M

CCVC Nonwords Posttest

- Nonword reading: CCVC nonwords made up of continuants and stops using the same letters from the training and transfer tasks
    - 8 words mixed:

Nonwords with Continuants	Nonwords with Stops
SLIF FLAM SNOM SMAN	STIP SPAK SKIB KLOD

- *I am going to show you some words on flashcards. These are made up words that you have never read before. I made up these nonsense word and they don't have meanings, but you can still read them. I am going to show you each word one at a time. I want you to look carefully and read each word aloud to me the best you can.*

- The experimenter will show each word one at a time. The experimenter will not provide any corrective feedback. She will record success or failure for reading each word and will record any audible method used by the students while reading the word.

Appendix N

Word Learning Task: Words and Script

- Students will be presented with nine words:

Word Learning Task words		
slam	snip	spot
film	flop	flat
plan	pills	plot

- Order of words will vary with each trial. There are three unique order of words that repeat to form six different trials (one study trial and five test trials)

Study Trial	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
slam	film	pills	slam	film	pills
film	pills	snip	film	pills	snip
plan	slam	flop	plan	slam	flop
snip	flat	plan	snip	flat	plan
flop	plot	slam	flop	plot	slam
pills	snip	flat	pills	snip	flat
spot	plan	plot	spot	plan	plot
flat	spot	spot	flat	spot	spot
plot	flop	film	plot	flop	film

- Script:

Study Trial:

The experimenter will show students each word one at a time and tell students how to read each word. The experimenter will point at each word as she reads it. She will give the word in a meaningful sentence.

Introduction: *I am going to show you nine words. I will tell you how to read the words and you will repeat after me. I want you to look at the word and listen carefully as I read it to you.*

- SLAM

This word is SLAM. Your turn. Student repeats word.

Peter will ***slam*** *the door shut when he is angry.*

The experimenter repeats word: *SLAM*

- FILM

This word is FILM. Your turn. Student repeats word.

*Maria's mom will **film** her dance performance to show her family.*

The experimenter repeats word: *FILM*

- PLAN

This word is PLAN. Your turn. Student repeats word

*Sam is excited to **plan** his birthday party at the zoo.*

The experimenter repeats word: *PLAN*

- SNIP

This word is SNIP. Your turn. Student repeats word.

*Ana needs to **snip** the tags off the dresses she just bought.*

The experimenter repeats word: *SNIP*

- FLOP

This word is FLOP. Your turn. Student repeats word.

*It feels good to **flop** on my bed after a long day at school.*

The experimenter repeats word: *FLOP*

- PILLS

This word is PILLS. Your turn. Student repeats word.

When I got sick, the doctor told me to take two ***pills*** every day until I felt better.

The experimenter repeats word: *PILLS*

- SPOT

This word is SPOT. Your turn. Student repeats word.

*Chris' new puppy is all white with one brown **spot** on his ear.*

The experimenter repeats word: *SPOT*

- FLAT

This word is FLAT. Your turn. Student repeats word.

We got a ***flat*** *tire on our way to school this morning.*

The experimenter repeats word: *FLAT*

- PLOT

This word is PLOT. Your turn. Student repeats word.

We made a **plot** at school to be good so we could get extra recess.

The experimenter repeats word: *PLOT*

Test Trial:

The experimenter will present each word to the students again. The experimenter will ask students to the read the word after which the experimenter will repeat the word. The experimenter will record the words that the students read and any visible strategies.

Introduction: *Now I am going to show you the words one by one. I want you to read each word aloud by yourself.*

Experimenter will show each word one by one. After showing each word, the experimenter will say, "Read this."

After each attempt by the student to read the word, the experimenter will read the word aloud. The experimenter will continue the same procedure for all words.

The test trial will repeat four more times for a total of five test trials.

Appendix O

Word Learning Score Sheets

	Trial 1		Trial 4	
	☑/☒ Note errors	Strategy used?	☑/☒ Note errors	Strategy Used?
film				
pills				
slam				
flat				
plot				
snip				
plan				
spot				
flop				

	Trial 2		Trial 5	
	☑/☒ Note errors	Strategy used?	☑/☒ Note errors	Strategy Used?
pills				
snip				
flop				
plan				
slam				
flat				
plot				
spot				
film				

	Trial 3	
	☑/☒ Note errors	Strategy used?
slam		
film		
plan		
snip		
flop		
pills		
spot		
flat		
plot		

Appendix P

CVC Nonwords Delayed Posttest

- Nonword reading: Novel CVC nonwords made up of continuants and stops using the same letters from the training and transfer tasks.
    - 20 words

Nonwords			
Continuants		Stops	
FIS	LAN	BIK	BOP
LAM	LIF	KAD	KIP
MOS	NIL	DAP	DAT
MIF	NOF	POB	TOD
SOF	SIM	TAK	TID

- Script:

I am going to show you silly some words on flashcards. These are made up words that you have never read before. I made up these nonsense word and they don't have meanings, but you can still read them. I am going to show you each word one at a time. I want you to look carefully and read each word aloud to me the best you can.

The experimenter will show each word one at a time. The experimenter will not provide any corrective feedback. She will record success or failure for reading each word and will record any audible method used by the students while reading the word.

Appendix Q

Real CVC Words Delayed Posttest

- Real word reading: Novel CVC words made up of continuants and stops using the same letters from the training and transfer tasks.
    - 3 words with continuants in the initial and final position
    - 3 words with stops in the initial and final position
    - 3 words with continuants in the initial position and stops in the final position
    - 3 words with stops in the initial position and continuants in the final position

SON	PAD	SIT	BAN
FIN	KIT	LOT	PIN
MAN	DOT	NAP	TOP

- Script:

I am going to show you some real words on flashcards. These words have meanings you will recognize. I am going to show you each word one at a time. I want you look carefully and read each word aloud to me the best you can.

The experimenter will show each word one at a time. The experimenter will not provide any corrective feedback. She will record success or failure for reading each word and will record any audible method used by the students while reading the word.

Appendix R

Nonword Spelling Delayed Posttest

- Nonword Spelling: Novel CVC words made up of same continuants and stop consonants used in the learning trial and transfer task.

Nonwords with Continuants	Nonwords with Stop Consonants
fos	bop
lin	tad
maf	dab
nol	tok
saf	dib

Script: *We are going to do a spelling activity. You will use this piece of paper and pencil for this activity. I am going to say a word aloud to you. It will be a nonsense word. This means it is a word I made up, but you can still spell them. When I say the word aloud, you will listen carefully, and then write the word on the paper. I will say each word a total of two times. Let's try an example:*

When I say the word, you write it on the paper:

1. "The word is ***mos***"
2. "You say it." (Child responds; correct if mispronounced)
3. "Now write ***mos."***.

If the student writes out a word on the paper continue with the posttest. Provide corrective feedback by reminding them that they need to write the word.

Ok, let's continue. The experimenter will go through each word, saying it two times. No corrective feedback will be provided.

Script for each word:
1. The word is ______."
2. "You say it." (Child responds; correct if mispronounced)
3. "Now write ______."

lin

bop

maf

tok

saf

dib

fos

tad

nol

dab

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