

**EFFECTS OF MULTISENSORY PHONICS-BASED TRAINING ON THE WORD
RECOGNITION AND SPELLING SKILLS OF ADOLESCENTS WITH READING
DISABILITIES**

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The purpose of this study was to explore the effectiveness of an Orton-Gillingham-based reading instruction system, the Barton Reading and Spelling System (BRSS; Barton 2000), that was used as a supplemental reading instruction program for increasing the lower-level reading skills of a group of adolescents with persistent reading problems. Nine students participated in the supplemental reading program based on pre-test scores of a spoken and written language assessment battery. Progress was measured at the end of intervention by post-testing students on the same assessment battery. Each student showed some improvements from their pretest to posttest scores on all of the measures utilized, with some having moderate to large effect sizes, supporting the view that the BRSS is an appropriate supplemental reading program for struggling adolescent readers within a response to instruction framework. Future research should include a larger sample size and a control group.

It has been widely documented that most children effortlessly acquire basic reading and writing skills in the elementary grades that serve as the foundation for literacy accomplishments in middle school and beyond (Adams, 1990; Bryant, Vaughn, Linan-Thompson, Ugel, Hamff, & Hougen, 2000; Chall, 1996; Moats, 2000; Shankweiler, 1999; Snow, Burns, & Griffin, 1998; Snowling & Bishop, 2000). These skills include the ability to identify letter-sound correspondences, to consciously manipulate sounds in different ways (e.g., segment, blend, and delete sounds), to rapidly decode and identify words, to recognize words' meanings in written texts, and to construct meaning from sentences, paragraphs, and longer texts (National Reading Panel, 2000). Despite the ease with which most children acquire these skills in the lower grades, some children struggle with reading acquisition and/or mastery (Archer, Gleason, & Vachon, 2003; Bryant et. al, 2000; Hiebert & Taylor, 2000; Shankweiler, Lundquist, Dreyer, & Dickinson, 1996; Torgesen, Wagner, & Rashotte, 1999), placing them at great risk for educational failure in high school (American Federation of Teachers, 2003; Barber & McClellan, 1987; Hock & Deshler, 2003; Kastle, Campbell, Finn, Johnson, & Mikulecky, 2001; Kibby, 1995; Moore, Bean, Birdyshaw, & Rycik, 1999; Snow & Biancarosa, 2003). In fact, according to the National Institutes of Health (2010), reading is the primary difficulty for most children with learning disabilities receiving special education services.

The demands placed on adolescents to read and write fluently at advanced levels increases with curricular demands in the upper grades (Ehren, 2009; Lenz, Ehren, & Deshler, 2005; Roberts, Torgesen, Boardman, & Scammacca, 2008). Snow and Biancarosa (2003) noted that *Students are expected to read and write across a wide variety of disciplines, genres, and materials with increasing skill, flexibility, and insight* (p. 5). In other words, students are required to recognize words fluently, expand their vocabulary

and knowledge, think critically and broadly, and comprehend content that is abstract and removed from previous literacy experiences (Bryant, 2003; Chall & Jacobs, 2003; Smith & Feathers, 1983). Consequently, adolescents who are unable to successfully perform these operations are more likely to have difficulty processing information in texts (Archer et al., 2003; Grigg, Daane, Ying, & Campbell, 2003; Larson & McKinley, 1995) and producing a variety of written genres (Larson & McKinley, 1995; Persky, Danne, & Jin, 2003). They are also more likely to exhibit higher rates of negative attitudes towards reading in later school years (Lyon, 1997; Stanovich, 1986), low self-esteem (Wagner, Blackorby, & Hebbeler, 1993), school discipline problems (Aaron & Baker, 1991), school dropout (Snow, Burns, & Griffin, 1998; Wagner, 2000), and future unemployment (Lyons, 1997).

Intervention studies have shown that adolescents who struggle with basic reading skills, including word analysis and identification, fluency, vocabulary development, metacognitive strategies for comprehending text and remembering content, and writing, can improve when they are provided effective, explicit instruction (Apel & Swank, 1999; Bryant et al., 2000; Bos & Anders, 1990; Daly & Martens, 1994; Mastropieri, Leinart, & Scruggs, 1999; Mercer, Campbell, Miller, Mercer, & Lane, 2000; Lenz & Hughes, 1990; Stahl & Fairbanks, 1986; Swanson, Hoskyn, & Lee, 1999; Talbott, Lloyd, & Tankersley, 1994; Vaughn, Gersten, & Chard, 2000). Orton Gillingham (OG) and Orton Gillingham-based reading instruction programs, including *The Wilson Reading System* (Wilson, 1996), *The Slingerland Approach* (Slingerland & Aho, 1994–1996), and the *Barton Reading and Spelling System* (BRSS; Barton, 2000), have been used to address the needs of both young struggling readers and college students who struggle with reading (Guyer & Sabatino, 1989; Ritchey & Goeke, 2006).

OG approaches to teaching reading are systematic, sequential, and multisensory and use both analytic (breaking down words into component parts) and synthetic (building up words from letters) strategies to teach phonics (Ritchey & Goeke, 2006). On the other hand, OG-based approaches are similar to OG approaches in terms of underlying principles, but typically differ from those approaches as it relates to populations targeted (e.g., adults), instructional settings and materials, and etc. (Ritchey & Goeke, 2006). A key component of both approaches is their use of the visual, auditory, and tactile-kinesthetic pathways to explicitly teach phonology, phonological-awareness, and sound-symbol correspondence.

Gillingham and Stillman (1960) developed the first OG curriculum, taken directly from the original work of Samuel Orton. Currently, many programs exist that are adaptations or extensions of the original OG methodology and may differ in instructional setting, materials, or targeted age group; however, OG-based methods still retain the underlying instructional philosophy of Orton and Gillingham and Stillman (Ritchey & Goeke, 2006).

A fundamental principle of OG or OG-based programs is to strengthen specific *links* or components of the reading process, regardless of the reason(s) underlying the student's weakened literacy skills (Snow & Biancarosa, 2003), and to use *proven* practices and principles of reading and writing instruction (Fisher & Frey, 2007; Foorman & Torgesen, 2001; National Reading Panel, 2000; Torgesen, Alexander, Wagner, Rashotte, Voeller, & Conway, 2001; What Works Clearinghouse, 2009). Through OG programs, teachers and tutors continually monitor students' acquisition and generalization of reading skills and do not proceed to new skills until current skills are mastered. These characteristics suggest that OG programs are good choices for implementation within a response to instruction framework (Bartolo, Hofsaess, & Koinzer, 2005; Humphrey, Bartolo, Ale, Calleja, Hofsaess, Janikova, Mol, Vikiene, & Wetso, 2006) particularly where instruction must be individualized and intensive. However, little empirical evidence exists related to the overall effectiveness of OG and OG-based reading instructional programs when they are used with struggling readers in one-on-one and small group situations (Snow & Biancarosa, 2003; Begeny & Silber, 2006), whether such programs are used as students' sole reading instructional method or as a supplement to other methods students are receiving (Rose & Zirkel, 2007).

Ritchey and Goeke (2006) conducted a review of the literature on OG and OG-based reading instruction programs to determine their effectiveness with students who have reading disabilities. Their search yielded only 12 studies that met the criteria of *scientifically-based research*, established by the No Child Left Behind Act (NCLB) of 2001. Studies that were included had to have (1) been published in a peer-reviewed journal or studies conducted as doctoral dissertations; (2) used an experimental, quasi-experimental, or single-subject research design to investigate OG-based methods or philosophy; (3) had a sample size of 10 or more participants per experimental condition. Ritchey and Goeke found that the OG and OG-based studies that reported effective interventions found positive results for word reading, word

decoding or word attack, spelling, and comprehension; however, not all studies reviewed found positive results or statistically significant results for OG or OG-based programs, including those studies conducted by Chandler, Munday, Tunnell, and Windham (1993), Hook, Macaruso, and Jones (2001), and Bishop, Adams, and Lehtonen (2005). Ritchey and Goeke, therefore, asserted that *despite the wide acceptance and enthusiasm for OG and OG-based programs, not all studies reported them to be superior, and caution should be taken when attempting to generalize any of the reviewed results* (p. 181).

While researchers have shown that literacy intervention with struggling readers is effective in facilitating their acquisition of basic reading and writing skills (Brooks & Weeks, 1998; Curtis, 2002; Gaskins, Cuncelli, & Satlow, 1992; Guyer & Sabatino, 1989; Lenz & Hughes, 1990; Lovett & Steinbach, 1997; McCandliss, Beck, Sendak, & Perfetti, 2003), a wider base of empirical evidence is needed to evaluate the effectiveness of specific instructional programs designed for a wide range of struggling readers (Haslum, 2007; O'Connor & Bell, 2006; Ritchey & Goeke, 2006). It is especially important to evaluate commercial programs that require a substantial financial investment for both training instructors and purchasing materials (Rose & Zirkel, 2007; Torgesen et al. 2001). The purpose of this study was to explore the effectiveness of an O-G-based system that was used as a supplemental reading instruction program for increasing the lower-level reading skills of a group of adolescents with persistent reading problems.

Method

Participants

Nine students who attended a charter school for adolescents with reading-based academic difficulties participated in the study. In the United States, charter schools are public schools of choice that operate under a performance contract, or *charter*. They are free from many regulations that traditional public schools are required to comply with (e.g., in Florida, charter schools are generally exempt from the K-20 Education Code, except for statutes pertaining to students with disabilities), but they are held accountable to performance and financial standards agreed upon in the charter (Florida Department of Education, 2005).

While charter schools are open to all students residing in a school district, they are allowed to target enrollment to specific populations (Florida Department of Education, 2005), such as students with persistent reading problems as it was the case in this study. The intervention provided here was supplemental to the specialized services that those students were already receiving in the school.

Students were selected from a pool of 30 students who were in the ninth to eleventh grades. The charter school was located in a small rural town in central Florida but drew students from the more populated surrounding areas. Parental consent to participate in the reading intervention program was received for 20 students. Two students dropped out of the study before pre-testing began because of schedule conflicts; the remaining 18 students were assessed with a norm-referenced test battery to determine study eligibility. Nine of the 18 students met study inclusion criteria.

All students were native English speakers and passed a pure tone hearing screening conducted by the first author. The students ranged in age from 15.2 years to 17.5 years of age. There were four males and five females. Seven of the students were in grade 10 and two were in grade 11. In terms of exceptional student eligibility (ESE) classification, five students had a primary classification of specific learning disability (SLD), two had a primary classification of SLD with an additional exceptionality of speech-language impaired (SLI), one had a classification of other health impaired (OHI), and one had no classification.

Spoken and written language difficulties, as a condition of being admitted to the charter school, were not verified prior to the study with formal or norm-referenced testing. Rather, these difficulties were known to exist given the mission of the charter school or were independently verified through review of student educational records and background information. Gender, grade, age, and special education classifications are listed in Table 1. Subtests from the *Woodcock-Johnson III Tests of Achievement* (WJ III ACH; Woodcock, McGrew, & Mather, 2001) were used to determine student eligibility. The students were required to demonstrate below average ability in single word spelling, single word reading, or nonword decoding as determined by scores of at least one standard deviation below the mean score of 100 (i.e., standard score of ≤ 85) on at least two basic reading skills from the WJ III ACH. These same subtests were used to measure post-training abilities. Twelve students qualified for the treatment based

on this criterion, but three could not participate due to schedule conflicts. Thus, there were nine students who participated in this study.

The *Test of Word Reading Efficiency* (TOWRE; Torgesen, Wagner, & Rashotte, 1999) was given pre- and post-training to measure the students' sight word and phonemic decoding accuracy and fluency in timed conditions, but this test was not used to qualify students for participation in the study. The students were also required to pass the *Barton Student Screening* before participating in this study.

Table 1. Reading-Intervention Group Characteristics

Id. #	1	2	3	4	5	6	7	8	9
Gender	M	M	F	M	F	F	F	M	F
Grade	10	10	10	10	10	10	10	11	11
CA (Years;Months)	15;11	15;4	16;4	15;11	15;5	15;2	16;2	17;5	16;7
ESE Class	SLD ^a	SLD	None	SLD SLI ^b	SLI	OHI ^c	SLD	SLD SLI	SLD

^aSLD = Specific Learning Disability (primary classification). ^bSLI = Speech Language Impaired (additional exceptionality). ^cOHI = Other Health Impaired (primary classification).

All students continued to receive their day-to-day academic curriculum, which followed the state's general education requirements for their grade level. Classroom teachers incorporated classroom technology to enhance their teaching, but this did not alter the general education curriculum.

Materials

The *Barton Reading and Spelling System*® (BRSS; Barton 2000) is an OG-based reading instruction program. Reflecting its OG roots, the BRSS is designed to employ simultaneous multisensory instruction by appealing to students' visual, auditory, tactile, and kinesthetic senses. It is divided into ten levels of progressively challenging decoding and spelling rules of the English language. The levels are delivered in a ten-step systematic and cumulative sequence. After a quick review of the prior lesson and a phonemic awareness drill, the instructor introduces a new rule to the student using tiles of different colors, letters, and letter combinations. The student practices the new rule first by reading and spelling real and nonsense words with tiles and then by reading and spelling real and nonsense words on paper. Once the student masters the new rule at the word level, he progresses to reading and spelling phrases and sentences on paper; reading fluency, accuracy, and phrasing are emphasized beyond word-level reading and writing. Finally, the student further practices reading fluency, accuracy, and phrasing with phonically-controlled text. Throughout these procedures, the student uses both analytic and synthetic phonics by segmenting whole words into smaller parts (analytic) and blending individual sounds/letters into whole words (synthetic).

The specific multisensory strategies used in the BRSS include tapping out vowel sounds with associated key words while saying the sound and key word, touching each letter tile and saying the corresponding sound, finger-spelling words while saying corresponding sounds, and visualizing the grapheme form of sight words. As the student progresses through the levels, some of the steps are discontinued. The BRSS strategies are follows:

- *Step 1-Tutor dictates word.* The tutor gestures to herself with her hand each time she dictates a word to the student.
- *Step 2-Student repeats word.* The tutor gestures with her hand to the student each time the student repeats a word.
- *Step 3-Touch and say.* The student taps each tile, starting with the index finger, and says the sound represented by the tile. In the initial sessions, the tutor demonstrates this process for the student.
- *Step 4-Tapping a vowel sound.* A specific procedure is used to tap the vowel sound. Using a two-syllable key word to represent the short vowel sound, the student begins by tapping the index finger on the table while saying the onset/vowel sound; next the student taps the middle finger on the table while saying the rime. This is repeated two times and the student ends by tapping out the vowel sound with the index finger three times. For example for the short vowel sound of /i/ and the key word *itchy*, the student would start tapping with the index finger and say /i/ tap with the middle finger and say *i tchy*, repeat this two times, and finish with tapping the /i/ three times with the index finger- *i-tchy, i-tchy, i, i, i*.

- *Step 5-Slowdown step.* The tutor makes a swooping motion with her dominant/writing hand towards the student as the student repeats the dictated word. The tutor starts the swoop at the student's left shoulder, brings her arm down toward the table in an arc, and moves her arm upward towards the student's right shoulder to finish the swoop.
- *Step 6-Slowly blend the sounds.* The student runs his index finger along the table, below the tiles used to spell the word, in a half-circle, u-shape while slowly saying the word on the tiles.
- *Step 7-Say it fast like a word.* After the student has slowly blended the word, he draws the index finger in a line below the tiles and says the word using a normal speaking rate.
- *Step 8-Finger spelling.* Starting with the thumb of the non-writing hand and moving from left to right, the student holds up one finger per sound to spell the word on his fingers.

The ten levels of the BRSS are comprehensive in scope, beginning with basic phonemic awareness skills illustrated by various vowel-consonant combinations and culminating with Latin roots and Greek forms. Within this scope, the levels are sequenced according to the following hierarchy: (1) *Level 1:* Phonemic Awareness; (2) *Level 2:* Consonants and Short Vowels; (3) *Level 3:* Closed and Unit Syllables; (4) *Level 4:* Multisyllable Words and Vowel Teams; (5) *Level 5:* Prefixes and Suffixes; (6) *Level 6:* Six Reasons for Silent E, (7) *Level 7:* Vowel-R's; (8) *Level 8:* Advanced Vowel Teams; (9) *Level 9:* Influence of Foreign Languages; and (10) *Level 10:* Latin Roots and Greek Combining Forms (see Table 2).

Reading Tutors

Reading tutors were recruited from first year graduate students in the Communication Sciences and Disorders Program of a large southern university who expressed interest in participating in the research study. All reading tutors were females; two had clinical experience at the undergraduate level, one was currently employed as an SLP in the public school system, and three had no previous clinical experience.

Table 2. BRSS Levels

Barton Levels	Name of Level
1	Phonemic Awareness
2	Consonants and Short Vowels
3	Closed and Unit Syllables
4	Multi-Syllable Words and Vowel Teams
5	Prefixes and Suffixes
6	Six Reasons for Silent E
7	Vowel-R's
8	Advanced Vowel Teams
9	Influence of Foreign Languages
10	Latin Roots and Greek Combining Forms

Tutors were trained through a series of BRSS instructional video tapes. The introductory tapes describe the nature of reading disability and provide an example of what is taught in the program and how it is taught, concluding with the Tutor and Student Screenings. All graduate clinicians who acted as tutors and two additional student research assistants had to pass the tutor screening and participate in the tutor training sessions. To pass the tutor screening, they had to demonstrate a minimal level of phonological awareness by breaking words down into their smallest sounds, manipulating sounds in words, deleting sounds, and blending individual sounds into words.

A total of nine training sessions and 27 training hours occurred. In the training tapes, BRSS explains a spelling or reading rule then demonstrates the procedures used to teach the rule by role-playing with a demonstration student. After the demonstration, BRSS encourages the viewer to stop the tape and practice the procedure with a partner; this protocol was followed in the tutor training. For the current study, the reading tutors and research assistants paired-up with each other to practice the procedures and took turns being the tutor and the student. The first author observed the role-playing and provided guidance when questions arose. The training tapes were always available to the tutors after the required training sessions were completed in the event that the tutors felt unsure of a procedure and/or wanted extra practice.

To determine the level at which the tutor should begin tutoring, the tutor gave her student a pre-test since the BRSS recognizes that some older students may possess enough knowledge to skip the first two levels. Strict pass/fail criteria, as prescribed by BRSS, were followed to determine a student's starting level.

The Level 1 pre-test contained four tasks: Task A: Break-Apart Nonsense Words; Task B: Break-Replace-Remove; Task C: Compare Two Words; and Task D: Blend 2 and 3 Sounds into Real Words. A student who completed all four tasks with 100% accuracy was deemed to have sufficient knowledge to skip Level 1 entirely. Before a student could move on to the next task, he had to meet pass criteria of zero or one error for that task. The pre-test was stopped when the student missed two or more items and tutoring began with the lesson that corresponded with the given task.

The Level 2 pre-test contained six tasks: Task A: Test of Letter Name and Sound Knowledge; Task B: Spelling Individual Sounds on Paper; Task C: Identifying First, Last, and Middle Sounds; Task D: Read These Words; Task E: Spelling Real and Nonsense Words on Paper; and Task F: Read these Sentences. Different pass/fail criteria were used for Level 2. Both Task A and Task B were given, regardless of the number of errors a student made on Task A; the tutor continued with Task C only if a student made no errors on either Task A or B. If a student misread two consonants or two digraphs on Task D, Read These Words, the tutor began with Lesson 5 of Level 2. If a student misread one or more vowels and the vowels were /a/ as in *apple*, /i/ as in *itchy*, or /o/ as in *olive*, the tutor began with Lesson 3; if the vowels were /u/ as in *uncle* or /e/ as in *Eddy* the tutor began with Lesson 4. If a student incorrectly spelled a consonant or vowel on Task E, tutoring began with Lesson 3; if a student incorrectly spelled only a digraph, tutoring began with Lesson 5. Finally, if a student made it to Task F, Read These Sentences, and made more than 3 mistakes, including re-readings, or read in a choppy manner, the tutor began with Lesson 5 in Level 2. Based on the pre-testing protocol, five students began tutoring at Level 1, Lesson 1, one student began tutoring at Level 1, Lesson 3, two students began at Level 2, Lesson 1, and one student began at Level 2, Lesson 2.

To introduce a new spelling, reading, or syllable division rule, the tutor built words with tiles that illustrated the rule and guided the student dialogue so that the student discovered the rule on his own. Once a rule had been introduced, the student practiced the rule by building and reading a variety of words in which the rule applies. The tutor always asked the student if there were any sounds or letters the student needed help with. If the student was sure of his work, he read the word, phrase, or sentence to make sure all the words were correctly pronounced and spelled. If the student was unable to discover an error on his own, the tutor drew the student's attention to the word and engaged the student in a problem-solving exercise to find the error. When writing sentences, the tutor always asked the student if he remembered to start the sentence with a capital letter and ended the sentence with punctuation.

For example, in teaching consonants and short vowels (Level 2), the instructor/tutor introduced one vowel and 5-6 consonants per lesson using lettered tiles; in Lesson 1 at this Level, the short vowel /a/ as in *apple* is first introduced followed by the consonants /m/, /p/, /t/, /s/, /f/, and /b/. The tutor explained the concept of the vowel and guides the student to think of a key word to help the student remember the vowel sound. The student learned how to tap out a vowel sound with his finger while repeating the name of the vowel; this was meant to strengthen the use of kinesthetic and auditory cues. After the student consistently identified the names of the vowel and consonants and their corresponding pronunciations, the student practiced reading and spelling real and nonsense words with the tiles. Finger-spelling was used in the early lessons; the student assigned one sound per finger as he spells a word aloud. The student then pulled down a tile that corresponds to the sound. These procedures incorporated the tactile-kinesthetic, auditory, and visual senses. Once the student was confident spelling with the tiles, he progressed to spelling words on paper using the finger-spelling procedure, if necessary. A final procedure at this Level entailed the student generating longer words from the consonants and vowel taught in Lesson 1. For example, from the CVC root *fam*, the student might have generated *family*, *fabulous*, and *famous*. This exercise was used to build the student's confidence in reading and writing longer words and to demonstrate that larger words often contain easily identifiable and familiar smaller parts (i.e., root words). These procedures were continued throughout Level 2 as the student learned the remaining short vowel sounds and consonants. The words and nonsense words used in each lesson were restricted to those vowels and consonants that had already been taught.

Data collection

The researcher developed a tracking sheet that each tutor used at every session. The sheet allowed the tutor to record the student number, the date, time of the session, the number of the session, and the beginning and ending procedure for each lesson.

Inter-observer agreement and reliability

Two research assistants were trained in the BRSS as observers to make sure the tutors were carrying out the procedures according to the Barton protocol. The assistants participated in all tutor training sessions and were familiar with all Barton procedures. If the observers' assessments did not agree or if the observers did not observe the required BRSS procedures in the tutoring sessions, the tutors would undergo additional training.

The assistants observed one day a week. They observed one tutor and her assigned student for an hour, followed by a different tutor and her assigned student for an hour. They made a check-mark on a list to indicate if a (1) required or expected procedure occurred, (2) procedure was required or expected but did not occur, or (3) procedure was not required or expected in a given segment of the tutoring session.

A point-by-point agreement ratio was calculated to measure reliability. According to Kazdin (1983), this ratio is appropriate when there are discrete opportunities for the behavior to occur. The following formula was used to compute point-by-point agreement for each session observed where *A* represents agreements and *D* represents disagreements: Point-by-Point Agreement = $A/A+D \times 100$. Of the 14 sessions observed, there was 100% agreement six times, 90% agreement two times, 80% agreement four times, and 70% agreement 2 times ($M = 88\%$).

Results

A pretest-posttest design was used in this study. Gain scores and effect sizes were calculated. A visual analysis of the pretest and posttest results for reveals that the mean scores for the posttest are consistently higher than pretest scores. Gain scores were calculated for all students by subtracting pretest standard scores from posttest standard scores. Effect sizes (Cohen's *d*) were calculated to measure the size of the impact that the intervention had on the students' posttest scores. Cohen's (1988) descriptive guidelines (i.e., .2 = small, .5 = medium, .8 = large) for interpretation of effect sizes are included in Table 5, and effect sizes listed in Tables 3 and 4 that are medium or large in magnitude are indicated by an asterisk. Not every student experienced gains in each subtest (in some cases scores stayed the same or went slightly down), but the trend suggests that the students made at least some gains across the measures. Overall, the effect sizes indicate that the students made small to large gains in targeted skill areas.

Average group scores for all students and measures, along with the effect sizes of these differences, are presented in Table 3. As seen in Table 3, the average scores were consistently higher for posttests across all measures, with effect sizes ranging from .19 (small) to 1.06 (large). Average gains in standard scores on the WJ III ACH ranged from 2.89 to 8.11, with the greatest average gains being on the *Spelling*, *Word Attack*, and *Sound Awareness* subtests of the WJ III ACH (effect sizes of .53, 1.06, and .54, respectively). An analysis of individual student's pretest and posttest scores on the WJ III ACH subtests (Table 4) illuminates these average score gains. On the *Spelling* subtest, seven of the nine students had higher posttest scores, with the remaining two making modest declines (-1 and -2 points). All nine students had higher posttest scores on the *Work Attack* subtest, with individual gains ranging from five points to 17 points. On the *Sound Awareness* subtest, six students made gains, one had scores remain consistent, and two students had slight declines (-2 and -4 points). Of the WJ III ACH subtests, the students showed the least improvement on the *Letter-Word Identification* subtest. Although the average scores for the group suggest a small effect size, only four of the nine students had higher posttest scores on this measure.

Table 3. Average Pretest and Posttest Standard Scores and Effect Sizes

Source	Pretest Mean (SD)	Posttest Mean (SD)	Effect Size <i>d</i>	Description
Letter-Wd Id	69.22 (15.46)	72.44 (18.46)	.19	small
Spelling	64.11 (13.71)	72.11 (16.32)	.53	medium
Word Attack	76.78 (6.78)	88.47 (12.50)	1.06	large
Sound Awareness	74.67 (12.03)	82.78 (17.46)	.54	medium
TOWRE				
Sight Word Efficiency	64.78 (13.24)	68.89 (10.83)	.34	small
Phonemic Decoding Efficiency	67.45 (12.15)	70.33 (12.50)	.22	small

Table 4. WJ III ACH Pretest-Posttest Difference (Gain) Scores and Effect Sizes (d) by Participant and Subtest

Participant	Letter-Word Identification	Spelling	Word Attack	Sound Awareness
	Gain Score (effect size)	Gain Score (effect size)	Gain Score (effect size)	Gain Score (effect size)
1	-5 (-.33)	2 (.13)	8 (.53)*	1 (.07)
2	-1 (-.07)	6 (.40)*	11 (.73)*	19 (1.27)*
3	-4 (-.27)	-2 (-.13)	5 (.33)	-4 (-.27)
4	10 (.67)*	-1 (-.07)	8 (.53)*	0 (0)
5	-3 (-.20)	9 (.60)*	5 (.33)	-2 (-.13)
6	-1 (-.07)	10 (.67)*	7 (.47)*	1 (.07)
7	8 (.53)*	5 (.33)	5 (.33)	3 (.20)
8	3 (.20)	5 (.33)	5 (.33)	5 (.33)
9	18 (1.2)*	38 (2.53)*	17 (1.13)*	50 (3.33)*

Note. Medium and large effect sizes are indicated by an *

The group effect sizes for the two TOWRE subtests administered showed a small improvement across students after completion of the intervention (.34 for the *Sight Word Efficiency* and .22 for the *Phonemic Decoding Efficiency* subtests, respectively). Further analysis of individual performance on the TOWRE was made (Table 5). The results of the *Sight Word Efficiency* subtest show that of the nine students, four had pretest scores that were <55, indicating the lowest possible standard score. For the purposes of analysis, these scores were entered as 55, as the exact score is unknown, however this may have artificially inflated the average pretest scores for this subtest. On the posttest, only one student had a score of <55, suggesting that some gains were made for those students with the lowest skill levels in this area. On the *Phonemic Decoding Efficiency* subtest, three of the nine students made small to large gains, and two had consistent scores after the intervention.

Table 5. TOWRE Pretest-Posttest Difference (Gain) Scores and Effect Sizes (d) by Participant and Subtest

Participant	Sight Word Efficiency	Phonemic Decoding
	Gain Score (effect size)	Gain Score (effect size)
1	0 (0)	0 (0)
2	7(1.47)*	-7 (-.47)
3	3 (.20)	14 (.93)*
4	-7 (-.47)	-3 (-.20)
5	-1(-.07)	0 (0)
6	0 (0)	-2 (-.20)
7	7 (.47)*	-4 (-.27)
8	2 (.13)	2 (.20)
9	26 (1.73)*	27(1.8)*

Note. Medium and large effect sizes are indicated by an *

Discussion

This study addressed the need to identify effective and intensive, age-appropriate treatments for older students with persistent reading problems, a challenge for many educators and practitioners. The effectiveness of an OG-based treatment that was used as a supplemental reading instruction program for increasing the lower-level reading skills of a group of adolescents with persistent reading problems was explored. Older students in remedial reading programs must have a solid foundation of phonological awareness skills as they move through more difficult reading and spelling materials. The type of explicit instruction provided to the students in this study for lower-level reading skills has been shown to be effective in improving the word recognition and spelling abilities of older students with persistent written language problems (Apel & Swank, 1999; Curtis, 2002; Gaskins et al., 1992; Lenz & Hughes, 1990; Lovett & Steinbach, 1997; O'Connor & Bell, 2006).

The findings of this study compare favorably with other reading intervention studies that have employed OG-based interventions with older struggling readers. Guyer and Sabatino (1989) found that college students with reading and spelling disabilities who received an adaptation of an OG intervention for lower-level word recognition and production performed significantly higher on measures of word attack, word analysis, and spelling skills than students in the comparison group. In another study, Brooks and Weeks (1998) found that students with dyslexia learned significantly more words when trained using a visual-semantic method (e.g., visualizing words; recalling a word's composition; pointing to words while naming them) for recognizing words, similar to one of BRSS' components, than students in the comparison group.

Apel and Swank (1999) discussed an effective reading intervention for a college student that focused on phonological awareness skills and development of visual orthographic images. They stress that good decoding skills are essential and foundational to good comprehension skills. While Apel and Swank did not use a packaged or commercial OG or OG-based program, the description of the successful techniques mirror those used in the BRSS. For example, Apel and Swank taught their student how to tap out the number of phonemes heard in a word progressing from short CV combinations to longer strings of words. This is a procedure used early-on in the Barton program. To create mental images of words for storage in memory, Apel and Swank taught their student how to visualize the shape of word on written on a card, how to visualize that word in the air, and how to check back and forth between the visualized word and the printed word. Barton employs this visualization technique to teach spelling rules.

The intervention method used in this study can be considered a form of peer-tutoring, an instructional arrangement where peers deliver instructional material to other students (Stenhoff & Lignugaris/Kraft, 2007). In their review of the effects of peer tutoring on secondary students with mild disabilities, Stenhoff and Lignugaris/Kraft (2007) found support for peer-tutoring as evidence-based practice and found strong support for tutor training prior to the tutoring sessions. As the BRSS was implemented in the current study, peers were used as tutors and received thorough training in the OG-based method before and during its implementation. The lead researcher also monitored the peer-tutors during their sessions. Both these features reflect the evidence-based practice found to be effective in peer-tutoring in Stenhoff and Lignugaris/Kraft's review of the literature. Specific components of the BRSS may account for the better posttest scores that were seen among the students. The BRSS consistently uses phonetically regular words and nonsense words that follow the rules of English to teach each spelling rule. The nonsense words follow the rules of English spelling, but are not real words. For example, to teach a rule governing the spelling of the /k/sound as in *cat* (i.e., when to use /ck/ vs. *k*), the tutor instructed the students to practice the rule by reading regular and nonsense words and by spelling regular words. When the pretest and posttest scores were compared, the students had increases in their standard scores at posttest on the *Letter-Word Identification* (gain score of 3.22) and *Word Attack* (gain scores of 7.89) subtests of the WJ III ACH. The *Word Attack* subtest requires students to read nonsense words that increase in difficulty. It is likely that students had little practice in reading nonsense words at pretest. However, because the BRSS routinely incorporates nonsense word reading into every lesson, the students were familiar with this practice and successfully generalized their knowledge of this skill on the *Word Attack* subtest at posttesting.

Similarly, the students' improvement on the *Spelling* subtest of the WJ III-ACH (effect size = .53) can be attributed to the emphasis on phonics and practice in spelling that they received. Students attending the charter school do not take spelling tests routinely nor did their classroom teachers regularly correct their spelling errors during daily work. The students practiced spelling words at every training session, and the tutors used a guided discovery process to help the students detect any spelling errors.

A final component of the BRSS that might have influenced the students' posttest improvement is consistent practice in reading and spelling sight words, irregular words that do not follow patterns and cannot be sounded out (Shaywitz, 2003). Students with reading disabilities often have great difficulty reading and spelling sight words. A common way to practice reading sight words more quickly and efficiently is to read the words on flash cards until they are recognized quickly and effortlessly. That method is used in the BRSS but coupled with visualization and tactile-kinesthetic tracing exercises on sight words that are consistently misread or misspelled. Although the students made modest gains in this skill (effect size = .34), it is unlikely that many older students with reading disabilities work on their ability to read sight words efficiently on their own accord so this gain is important.

Clinical Implications

The demands placed on adolescents to read and write fluently at advanced levels increases with curricular demands in the upper grades (Ehren, 2009; Lenz, Ehren, & Deshler, 2005; Roberts, Torgesen, Boardman, & Scammacca, 2008). Snow and Biancarosa (2003) noted that *students are expected to read and write across a wide variety of disciplines, genres, and materials with increasing skill, flexibility, and insight* (p. 5). In other words, students are required to recognize words fluently, expand their vocabulary and knowledge, think critically and broadly, and comprehend content that is abstract and removed from previous literacy experiences (Bryant, 2003; Chall & Jacobs, 2003; Smith & Feathers, 1983). Consequently, adolescents who are unable to successfully perform these operations are more likely to have difficulty processing information in texts (Archer et al., 2003; Grigg, Daane, Ying, & Campbell, 2003; Larson & McKinley, 1995) and producing a variety of written genres (Larson & McKinley, 1995; Persky, Daane, & Jin, 2003). They are also more likely to exhibit higher rates of negative attitudes towards reading in later school years (Lyon, 1997; Stanovich, 1986), low self-esteem (Wagner, Blackorby, & Hebbeler, 1993), school discipline problems (Aaron & Baker, 1991), school dropout (Snow, Burns, & Griffin, 1998; Wagner, 2000), and future unemployment (Lyon, 1997).

Although this study did not address higher order written language skills of comprehension and composition, it did address the lower level written language skills that serve as a foundation for higher order skills. Students who struggle to decode words do not read fluently. When students devote mental energy to figure out the words in the text, they sacrifice attention to comprehending the text. Older students with reading disabilities have experienced many years of frustration and failure with reading. Thus, clinicians interested in helping such students face a difficult task on two fronts. First, teachers and clinicians will likely be met with some students who are not motivated to practice reading and spelling and who have a negative attitude about reading in general and treatment in particular. Several of the students in this study had this attitude. Second, older students with reading disability need to work with material that is interesting and age-appropriate in content. In fact, some of the students in this study expressed that the BRSS materials were childlike. Packaged reading instructional programs, such as the BRSS, are meant to appeal to a wide range of ages, but this is frequently a hard goal to meet when practicing foundational skills such as phonics. In many situations, it is necessary to individualize the intervention so that older students will be more motivated to become involved in the program, with the recognition that there are no instant fixes (O'Connor & Bell, 2006).

Although remedial reading programs are not meant to be a student's main source of reading instruction, such programs will have a greater impact if they are broad in scope. They should be sufficiently broad to address many key components of reading. Important components of reading instruction should include word recognition (Curtis, 2002; Lenz & Hughes, 1990), vocabulary expansion and analysis (Alvermann, 2001), conceptual knowledge development and expansion (Guthrie & Wigfield, 2000), reading fluency and comprehension across varied texts (Chall, 1996; Ehren et al., 2006; Vaughn, Klingner, & Bryant, 2001), integration of reading and writing (Alvermann, 2001; Tierney & Shanahan, 1991), self-efficacy and goal setting (Guthrie & Wigfield, 2000), and peer-led discussions and journal writing (Alvermann, 2001). The gains shown in this study underscore that (1) it is never too late to help the struggling reader improve his reading skills and (2) the need for a national effort to address the needs of older students who struggle with reading.

Future Directions

Alexander and Slinger-Constant (2004) noted that many of the studies supporting multisensory education are quasi-experimental in design and lacking in either comparison groups or randomly assigned groups. In addition, many multisensory remedial reading programs are carried out in schools and must operate under the confines of the educational system. Lack of resources in time, money, and personnel contribute to studies that use small sample sizes and are of short duration. These factors combine to produce findings that cannot be generalized to larger populations. This study was bound by similar constraints. However, based on Stenhoff and Lignugaris/Kraft (2007) review of the literature on the effectiveness of peer tutoring and on Apel and Swank's (1999) successful phonological intervention with an older student, there is every reason to believe that the OG-based program featured in this current study offers a viable intervention method for older students who struggle with reading disability.

High school peers could easily be trained as tutors to implement BRSS and similar OG-based programs. In fact, Stenhoff and Lignugaris/Kraft (2007) found that heterogeneous tutoring, where same-grade peers with higher level skills are used as tutors was supported as an evidence-based practice. While our study

did not use same-grade peers, such an instructional arrangement would be an obvious fit in a school system. Futures studies should implement the BRSS in a high school with heterogeneous tutoring.

Future research should also address methodological weaknesses and include a larger sample size and a control group. First, a larger sample size would be less sensitive to factors such as unequal number of reading treatment sessions among students, prior history of similar reading treatment, and grade levels. A larger sample size might also have minimized the impact of the wide variance of mean scores, providing a more accurate representation of skill growth.

Second, rather than using a randomized controlled treatment design, a quasi-experimental pretest-posttest design was used. This decision was made because the scope of the study did not allow for the selection of a comparable control group to be utilized. Future studies using this approach would be greatly strengthened by a between-groups approach.

Finally, the BRSS was used as a supplemental program to the school's reading curriculum. Therefore, the precise contribution of the intervention the students' gains at the termination of the study could not be determined.

Given the popularity of OG influenced reading intervention programs used with school-age children, there is a critical need for controlled trials with randomization to study the efficacy of such programs. Thus, future research should focus on comparing the academic performance of children randomly assigned to an OG based intervention and children who receive a contrasting, comparison intervention. However, as researchers strive to meet this *gold standard*, it is imperative that the research community accept the valuable, interesting, and worthwhile information provided by other levels of research. Our study has shown how a multi-sensory, OG-based supplemental reading program can be effectively implemented in a real secondary setting with students who continue to experience the debilitating effects of reading disability. Future studies, in addition to the current research, will serve to continue to strengthen the available evidence-based research.

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