The Role of Phonemic Awareness, Phonological Recoding and Rapid Naming on Reading Comprehension Scores in Post-Primary Students

Candice Stefanou
Associate Professor,
Bucknell University
Bruce Howlett
Special Education Teacher,
Ithaca (NY) City Schools

Barbara Peck
Special Education Teacher,
Newfield (NY) School District

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Contact Information:
Bruce Howlett
379 Turkey Hill Road
Ithaca, NY 14850
800.801.1954
bruce@soundreading.com

Abstract

This paper reports on improvements in reading decoding, fluency, and comprehension of upper elementary students through instruction in phonemic awareness and rapid naming. Traditional phonics instruction was supplanted by phonological recoding practice. Third, fourth, and fifth grade students were taught with materials containing phonological recoding, phonemic awareness, and naming activities to automatize each step of the reading process. Instruction was delivered in small reading groups by minimally trained regular and special education teachers. Reading comprehension, phonological awareness, short-term auditory memory, and rapid automatic naming were assessed. Results indicate that students in the treatment condition out-performed students in the control condition in comprehension, rapid naming, and phonemic awareness.. Third grade students, overall, made larger gains in phonemic awareness and rapid naming than both fourth and fifth grade students, with fourth grade students out-performing fifth grade students in rapid naming. Phonological recoding was shown to be a highly effective alternative to traditional phonics instruction. A two-year follow-up found significant increases from post-test to follow-up for rapid naming and comprehension for the treatment school.

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The Need for Phonemic Awareness and Automaticity in Post-Primary Students

The research into reading difficulties has legitimately focused on early literacy and, for valid methodological reasons, has generally examined a limited number of auditory, speech, and language variables (Catts, 1989). The reduction of reading instruction to phonological awareness and phonics is a natural outcome of research that often involves single factor analysis.

For post-primary and secondary students, reading English is a daunting task. English is the hardest major language to learn to read using phonics, as the ratio of phonemes to letters is nearly two-to-one. While primary students learn to read a relatively simple language, mastering a limited number of words that present moderate phonological, orthographic, and semantic challenges, post-primary students are faced with the increasing complexity of the English language. The English that primary students master is similar in complexity to Spanish or Italian languages that are easily taught using phonics. Post-primary students learning to read English must confront the full complexities of one of the most phonologically and orthographically complex major languages. Virtually all post-primary students, with reading difficulties, exhibit auditory processing issues that limit their ability to link spoken and written words (Gabrieli, 2009).

The dramatic progress in our understanding of reading processes, based on a significant body of research, has had little impact on reading scores of post-primary students. The National Center for Education Statistics reported that in older post-primary students, research indicated thirteen-year-old students showed no significant improvement in overall reading ability in recent years. No measurable differences in performance were found between 1971 and 2004 when measuring reading achievement among 17 year-old students (National Center for Education Statistics [NCES], 2004). Reading interventions tend to stabilize a student's relative literacy deficits rather than bring a student's skills to a level common to proficient readers (Torgesen et al, 2001). Interventions focus on helping students in the lower quintile or below. Older students and students with moderate reading difficulties receive far less attention. With only 40 percent of students reading at proficient levels, regular classrooms are full of struggling readers (NCES, 2004). With the majority of students experiencing reading difficulties, the average student standing at the 50th percentile is not sufficient for them to be a successful reader. In our opinion, the minimal level for reading proficiency is more likely to require a reading comprehension, fluency, and decoding score at around the 70th percentile. Some interventions produce impressive effect sizes, but only propel students into the very low end of the average range with a standard score of 92, or at the 30th percentile. Some researchers (Torgesen, 2002) have identified the 30th percentile as the minimal criteria for reading success, yet evidence suggests that this level of improvement will have minimal impact on student performance.

What Instructional Practices Are Indicated?

To overcome the auditory processing issues that limit access to print, older students will need an approach that goes beyond the scope of traditional instruction in phonics and phonological awareness skills. If upper elementary and secondary students are to learn to read competently, the complex language processing issues presented by English need to be addressed in a more comprehensive manner to address the full range of skills necessary for the ultimate goal of reading with fluency and comprehension. In this section, we will discuss major processes in reading, and implications for a more comprehensive instructional approach for older students.

<u>Auditory and phonological processing</u>:

Instructional practices need to address auditory and phonological processing. As with younger students, upper elementary students need to have a strong base in phonemic awareness, although a broader scope may be needed to address a full range of phonological processing skills. The development of phonemic awareness is a critical, but insufficient, aspect of reading intervention for post-primary students. Older students with reading difficulties show deficits in phonemic and phonological awareness, as well as a broad range of subtler speech and language processes (Catts, Fey, Tomblin & Zhang, 1999). The significance of the deficits is a matter of considerable ongoing research.

It is generally recognized that the majority of students with dyslexia have the phonological subtype, demonstrating great difficulty using a phonological route to the lexicon. Phonological processes are recognized as critical to reading (National Reading Panel [NRP], 2000; Torgesen, 1999), and disruption of one or more of these processes may cause labored and inaccurate pronunciation of printed words, the signature of reading difficulties (Robinson, Menchetti & Torgesen, 2002). Phonological processing is critical to reading, as the brain uses a phonological code to represent linguistic information (Wagner & Torgesen, 1987).

From a speech and language perspective, the development of phonological processing is a complex, multifaceted issue requiring a broad range of therapies. Numerous studies have shown the significant effects on word level reading skills from phonological training (Lovett et al., 1994; Torgesen, Wagner, Rashotte, Burgess & Hecht, 1997). However, corresponding gains in reading rate and in comprehension have been elusive.

Numerous auditory processing issues have been implicated in reading disabilities. Auditory deficits in post-primary students are more heterogeneous than phonological deficits, and include general auditory processing difficulties (Galabuda, Menard & Rosen, 1994; Ahissar, Protopapas, Reid, & Merzenich, 2000), reduced ability to filter noise (Sperling, Zhong-Lin, Manis & Seidenberg, 2005), poor phoneme discrimination (Gonzalez, Espinel & Rosquete, 2002), auditory sequencing difficulties (Hagman et al., 1992), weaknesses in verbal short-term memory, and speed of access to phonological information in long-term memory (Torgesen, 2000), temporal processing (Merzenich, 1996; Conlon, Sanders, & Zapart, S. 2004), auditory attention (Altmaier, Johnson & Richman, 1999), verbal short-term memory (Torgesen, 1999; Wagner, Torgesen & Rashotte, 1999; Gathercole & Baddeley, 1993; Hansen & Bowey, 1994), and working memory (McDougall, Hulme, Ellis & Monk, 1994) have also been linked to reading difficulties. Auditory deficits may simply aggravate the phonological deficit that lead to reading problems (Ramus et al., 2003).

It is not clear if these basic auditory and phonological issues are primary causes of reading difficulties or if they interfere with the development of phonemic awareness. Reading improvement for post-primary students may depend on identifying and treating problems with auditory and phonological processes that limit phonemic awareness, and other processes that connect written words with spoken words.

Older students will need a variety of instructional practices to develop phonological processing to support reading. The simple phonemic awareness tasks, such as segmentation and blending, may not suffice. Older students may need deeper phonemic tasks that involve working memory, such as phoneme manipulation, substitution, and deletion. The complex vowels and consonant clusters that older students must decipher require discrimination practice coupled to these complex phonemic tasks. Since the letter code for vowels is imprecise, students may need to develop flexibility strategies, where they learn to play with the phonemic patterns in words until it connects with the meaning of the word in context.

Sound-symbol application:

The ability to master the written code is highly predictive of reading ability (McCandliss, 2003; Swank & Catts, 1994). Phonics or, specifically, sound-symbol relationships, is an essential secondary step in reading an alphabetic language (NRP, 2000). Phonics is relatively effective in languages with more transparent orthographies and simpler phonological construction. However, English has been influenced by several core languages, each of which contributed its own conventions for word formations. This has made English a more complex language, considered to be the hardest language to sequentially process letters into phonemically precise spoken words. English has a relatively large number of phonemes, 44, compared to Spanish (28), Finnish (21), and Italian phonemes (25). Add to this the fact that a large number of vowel and consonant phonemes are produced with minimal contrast, making discrimination difficult. It is clear to see why English is considered to be one of the most difficult languages to master using a phonics approach. Students with reading difficulties often use less effective decoding strategies than proficient readers (Laing, 2002). Phonics instruction has been shown to be of limited benefit to older English speaking students, with marginal impact on reading fluency and comprehension (Adams, 1990). Many older students know their letters and sounds, but lack the ability to accurately and automatically process this content into an effective reading process. Decoding, using a linear phonics approach, with attention focused on letter patterns, rules, and exceptions, heavily taxes a reader's cognitive resources.

Vowels are the most inconsistent and confusing orthographic and phonological feature of English, and a significant cause of reading difficulties in youth (Bertucci, Hook, Haynes, Macaruso & Bickley, 2003). English has an exceptional number of vowel phonemes: 15 distinct vowels, three semi-vocalic /r/ phonemes, and three semi-vowel glides (/r/, /l/ and /w/). Compare this to the five distinct Spanish vowels. Frith, Wimmer, and Landerl (1998) found that seven and eight year old students who spoke and read German, which has a consistent and clear vowel sound and spelling system, made few errors when reading legal nonsense words. The error rate for English-speaking students of the same age was 30 percent. Not until the age of 12 did English recoding rates and non-word reading accuracy match that of their German-speaking peers. For children with dyslexia, the situation was vastly aggravated, with error rates of between 40 and 60 percent with children who are dyslexic English readers. In contrast, German children with dyslexia showed remarkably high accuracy rates, but exhibited severe reading-speed deficits.

Another exceptional aspect of English phonemes is the multiple spellings, and the number of letters that code for multiple phonemes. English has the poorest ratio of letters (23 functional letters) to phonemes (44). This creates a large number of words that are similar in spelling and pronunciation, but are fundamentally different words. In contrast, Finnish, Spanish, and German have 1:1 or only a few phonemes spelled multiple ways. Studies of college students with dyslexia clearly show that English can induce dyslexia in literate college students who speak phonologically and orthographically simpler languages such as Italian (Frith, Wimmer & Landerl, 1998).

Arguably, the most important coding event while reading is the phonological recoding of speech sounds into meaningful words. Brunswick, McCrory, Price, Frith, and Frith (1999) suggest that English has a “qualitatively different phonological recoding process” than languages such as German and Italian, thus making phonological recoding more difficult in English, requiring more complex strategies in phonological recoding than provided by phonic letter-to-sound matching and blending.

Recently, a number of intriguing methods have been developed that shift the emphasis of reading instruction from letters and printed words to the phonological recoding of spoken words (Richards

& Berninger, 2008; Joly-Pottuz, Mercier, Leynaud, & Habib, 2008). A well-researched alternative to systematic phonics is phonological recoding (Share, 1995; Share & Leikin, 2004). Phonological recoding approaches printed words not just as letter strings but as cues for accurately retrieving the phonological and semantic features of spoken words. The reference for reading becomes the richness of spoken words, and not artificial symbols on paper. This may be why the majority of students learn to read with little or no direct phonemic instruction or systematic phonics.

The strength of phonological recoding lies in the pattern-recognition system of the brain. The classical research of Chomsky and his successors, such as Pinker (2005), suggests that humans have a neurological propensity to recognize patterns in speech and language; that language learning is pattern-based learning. Refining a student's sense of speech, and developing a deeper awareness of the how the patterns in speech are reflected in written words, becomes the goal of code instruction. This is a different framework from phonics, which requires that everything about letters and sounds must be taught, and that written words and their spellings are the key to learning to read.

Recent research in Israel (Share, 1999) and in New Zealand (Thompson & Fletcher-Flinn, 2005: Fletcher-Flinn, Shankweiler & Frost, 2004) has shown that phonological recoding, the process of translating written words into their spoken equivalent, provides effective sound-symbol instruction with far less effort. They observed that many students implicitly infer the relationship between spoken and written words, often with little or no formal phonics instruction. Like proficient readers who are able to derive the code for reading through exposure to print, phonological recoding systematically builds the speech patterns that empower reading. Reading skills are acquired through a process called lexicalized phonological recoding, where students are systematically exposed to the phonological, orthographic, and semantic patterns that connect spoken and written words. A broad range of information is used to resolve the decoding ambiguities that characterize English. Phonological recoding generalizes across words, so that the phonetic component of reading is much easier to master. Skill generalization is particularly important in a complex language like English.

A variation on phonological recoding is a specific type of word building (McCandliss, Beck, Sandak & Perfetti, 2003) designed by researchers as an alternative to phonics. Word Building uses word lists of progressive minimal pairings of words that differ by one grapheme to build accurate representations of the words in memory. Phonics instruction often develops full awareness of initial sounds in words, but not always of medial and final sounds. To overcome this limitation, Word Building develops awareness of all phonological features in words, including the hard-to-process medial vowels. This process efficiently develops sound-symbol and phonemic awareness while developing decoding skills. Unlike most phonics instruction, where every word that the student reads and spells is taught, Word Building develops a global ability to recode words that generalize to the pronunciations of unfamiliar words.

Rapid automatic naming and fluency:

Effortless, automatic recognition of words is the next step towards deep literacy (Kobayashi, Hayes, Macaruso, Hook & Kato, 2005). Decoding instruction is of little benefit to older students unless it is coupled with reading fluency instruction (Kame'enui & Simmons, 2001). Lack of fluency hinders reading comprehension, the purpose of reading (Torgesen, Rashotte, Alexander, Alexander & MacPhee, 2003). Comprehension often fails if word reading remains so slow and effortful that it devours cognitive resources (Perfetti, 1985; Pikulski & Chard, 2005).

For example, Good, Simmons, and Kame'enui (2001) reported that the odds of receiving a rating of “meets expectations” or “exceeds expectations” on the Oregon Statewide Assessment Test were 96 percent for students with reading rates greater than 110 words per minute. Conversely, 72 percent of students with reading rates below 80 words per minute scored below standards. Similar results have been reported for the Florida Comprehensive Achievement Test (FCAT-SSS). Buck and Torgesen (2002) found that 91 percent of students who read at or above a 110 words-per-minute benchmark achieved adequate performance on the reading section of the FCAT-SSS. Of the high-risk students (students reading less than 80 words per minute), 81percent performed below standards on the reading section of the FCAT-SSS.

Reading speed is governed by a phonological process called rapid automatic naming (Torgesen, Wagner & Rashotte, 1999; Bowers & Wolf, 1993; Catts, Gillispie, Leonard, Kail & Miller, 2002).

Phonemic awareness and rapid automatic naming (RAN) are generally recognized as the primary linguistic processes that support reading accuracy (Torgesen, 1999) and speed (Wolf & Bowers, 1999).

Once a reader is able to decode a word phonologically, the word can then be accessed by automatic and rapid perception of the whole word. Poor readers have difficulty in retrieving phonological codes from auditory memory so that their ability to automatically name written words is compromised (Wolf & Bowers, 1999; Wagner et al., 1999). Individuals with reading difficulties may have slowed or limited ability to automatize the naming of letters and words (Meyer, Wood, Hart & Felton, 1998). The relationship between rapid serial naming of letters and numbers and reading fluency increases with age. The relationship between rapid naming and reading fluency is well established. However, improvements in automatic naming among students with deficits in this area have been hard to realize (DeJong & Vrielink, 2004).

Repeated reading has been shown to improve fluency, but rapid naming is usually not measured in these studies (Felton, 1992). In separate studies of rapid naming practice, repeated serial namingwith speed at the phonemic level using nonsense words, two and three-phoneme printed words, and multisyllable words have been shown to improve fluency at the word recall level (Wolf, 1991).

<u>Comprehension:</u>

As we have discussed, reading difficulties arise from impairments in the awareness, representation, storage, and retrieval of phonemic words (Shaywitz et al., 1998). Numerous spoken language processes must function for written language to make sense and, ultimately, be used for reading comprehension (Torgesen et al., 2001; Meyers et al., 1998; Das, Mok, & Mishra, 1994). To develop full text comprehension among students with reading difficulties, in upper elementary and secondary school, intervention will be needed in decoding, fluency, and oral language comprehension skills (Manis, Lindsey & Bailey, 2004). Phonemes serve to distinguish words and help determine meanings. Thus, precise phonemic decoding aids comprehension. In a study of nine-year olds, passage comprehension was best predicted by phonemic awareness (Catts, Fey, Zhang, & Tomblin, 1999). Other studies link phonological recoding to comprehension (Shankweiler, Lundquist, Katz & Stuebing, 1999; Leonard, 2001).

From a speech and language perspective, reading comprehension is a subset of oral language comprehension, loading heavily onto the receptive areas of the brain (Brunswick et al., 1999). Students who decode accurately and read automatically, yet still have comprehension difficulties, tend to have oral language comprehension issues (Catts et al., 1999). Language theory also holds that comprehension has two aspects: receptive language comprehension, including word identification, receptive vocabulary, and phrase generation; and expressive language comprehension. The same auditory and phonological issues that compromise decoding and fluency may hinder speech perception and listening comprehension. (Catts et al., 1999). The input phase is centered in the receptive language areas of the brain, *Wernicke's area*. Input comprehension relies on a precise sequence of auditory and phonological processes, the same processes that support reading decoding and fluency. In addition, semantic naming, and word retrieval processes are involved.

The second aspect, identified by speech and language theory as essential for reading comprehension, is intact expressive language or output comprehension. This is the realm of classic reading comprehension instruction, including strategic and higher-level thinking. Just as accurate decoding and fluent reading are prerequisites for comprehension, higher-level understanding of text requires efficient output comprehension. This is the classic garbage in, garbage out condition. If the message is distorted by poor listening attention, weak auditory memory, or limited word retrieval, then higher-level comprehension is compromised.

Implementation of Instructional Practices

A critical issue in reading revolves around implementation: who should receive reading instruction, what constitutes successful reading, and which methods will be readily adapted and integrated into classroom instruction by classroom teachers. Schools have been slow to adopt research-validated practices (Lyon, 1999), and this resistance to change has been one of the greatest impediments to improving reading scores (Simmons, Kuykendall, King, Cornachione &

Kameenui, 2000). The shift from identifying students based on the aptitude-achievement-discrepancy formula towards a response-to-treatment approach (Fuchs, Fuchs & Speece, 2002; Gresham, 2002) brings research-based instruction into the regular classroom, maximizing the number of students who can learn to read well. This model does not wait for students to exhibit reading problems before offering intensive intervention.

Our Study

The purpose of this study was to determine if the instructional practices and methods, outlined above, would result in improved phonological processing, decoding, rapid naming, fluency, and comprehension. Also, we wanted to know if these gains would be sustained over time.

In order to accomplish our purpose, we selected a program, Sound Reading, which is designed along the parameters outlined above. Sound Reading (Howlett 2000, Howlett & Howlett, 2000) is a reading intervention and improvement program that is research-based. Sound Reading provides a broad range of phoneme, sequencing, discrimination, and awareness activities, including phonological recoding exercises to substitute for traditional sound-symbol instruction, for the purpose of enhancing reading accuracy. Reading automaticity and fluency are developed using a series of rapid naming exercises in combination with timed, repeated reading of short, code progressive stories. The more challenging and unique features of English, such as its complex vowel structure and divergent spelling code, are addressed using a broad range of phonological and orthographic activities. Reading comprehension is addressed as both receptive language comprehension and higher-order comprehension strategies. These activities are delivered using an auditory processing format, including auditory working memory and attention. The activities are presented using reduced error and distributed instruction, over-learning, and a high degree of auditory interaction.

Method

Participants:

Participants came from grades 3, 4, and 5 at two small rural schools in New York. Students at one school participated in the intervention; students at a nearby elementary school, similar in demographics, provided data for a control group. There were a total of 268 students across all grades and from both schools. There were 149 regular education students and 41 special education students in the experimental treatment group; and 58 regular education students and 20 special education students in the control group. Table 1 provides a grade-level breakdown of the regular education and special education students in the experimental control groups.

INSERT TABLE 1 HERE

Materials:

Students were pre-tested and post-tested with the Sound Reading Responsiveness Assessment (SRRA), a nationally-normed responsiveness instrument. SRRA is comprised of four tests that assess phonemic awareness, short-term memory, rapid automatic naming, and reading comprehension with fluency. The assessment is primarily designed to measure responsiveness to instruction. The national norms of the test were established by giving it to whole classes or whole schools in 24 schools in 12 states.

Teachers working with students in the experimental groups, used the Sound Reading Emerging Readers Program or the Sound Reading Elementary Program in conjunction with their usual instructional methods. The teachers used a guided reading approach with leveled readers, based on Degrees of Reading Power (DRP) scores. They did not use any other systematic reading instruction, such as basal readers or Reading Recovery. In the control school, instruction was literature-based. Again, no systematic reading instruction, including basal readers, was in place.

Procedure:

Two teachers were certified by Sound Reading. They served as turn-key instructors and trained the teachers that participated in the study. The participating teachers were given a half-day of training on how to use the program and construct the necessary materials. Students participated in Sound Reading instruction during their reading groups. Reading group size was generally 5-12 students per group. Sound Reading instruction was delivered for an average of 30 hours over the course of the school year in each reading group. No other explicit, systematic reading instruction was offered to the students in the post-primary reading groups.

Pre- and post-testing methods were used to determine whether gains had been made in the skills of phonological awareness, memory, rapid naming, silent reading fluency, and comprehension. Students were pre-tested using the Sound Reading Responsiveness Assessment (SRRA). The first two tests (timed test of reading comprehension and phonological awareness) from the SRRA were group administered in the classroom setting. The second two tests (reading memory and rapid automatic naming) were individually administered outside the classroom setting. All tests were administered by teachers and trained school staff.

Pre-test data was collected for students in third, fourth, and fifth grades in the experimental and control schools. Post-data was collected for students who received the minimum required instruction in the Sound Reading Program in the experimental school, and for the control population. Follow-up data was collected two years following treatment for the experimental school only. The testing was conducted following the recommended procedure of group administration for the first two tests and individual administration for the remaining two tests.

Analysis:

The data were analyzed using a Multivariate Analysis of Covariance (MANCOVA), with the pre-test scores for comprehension, phonemic awareness, rapid naming, and memory serving as the covariates; and post-test scores on these same variables as the dependent variables. The groups were separated by special education or regular education, and performance between the grades and between the experimental and control school was compared. A two-year follow-up study was completed on the original third-grade students from the experimental school when they were fifth-grade students. Paired sample t-tests were conducted using third-grade post-test scores in comprehension and rapid naming, and two-year follow-up scores as paired comparisons for both the students in special education and regular education.

Results

The purpose of this study was to measure the effects of a comprehensive phonemic awareness, phonological recoding and rapid naming reading program on the reading outcomes of upper elementary students. The students were taught in their regular reading groups using either their regular curriculum or the Sound Reading intervention in conjunction with the regular curriculum. Performance was measured across the major domains of reading: phonemic awareness, rapid naming, memory, and comprehension (with fluency).

Special Education Students:A two-way MANCOVA was conducted for the special education students to determine the effect of grade and treatment on reading comprehension, rapid naming, phonemic awareness, and memory, while controlling for pre-test levels on reading comprehension, rapid naming, phonemic awareness, and memory. The main effect of treatment (Pillai's Trace = .622, $F_{(4, 50)}$ = 20.592, p = .000, n^2= .622) indicates a significant effect on the combined dependent variable. Univariate ANOVA results indicate that the dependent variables of post-test comprehension ($F_{(1, 53)}$) = 26.70, p = .000, n^2= .335), post-test phonemic awareness ($F_{(1, 53)}$ = 35.89, p = .000, n^2= .404), post-test memory ($F_{(1, 53)}$) = 6.66, p = .013, n^2= .112), and post-test rapid naming ($F_{(1, 53)}$ = 26.14, p = .000, n^2= .330) were significantly affected by treatment.

The partial etas squared indicate that the effect of treatment accounts for approximately 33.5 percent of the total variability in the post-test comprehension score, approximately 40.4 percent of the total variability in the post-test phonemic awareness score, approximately 11.2 percent of the total variability in the post-test memory score, and approximately 33 percent in the total variability of the post-test rapid naming score.

These effect sizes would be considered medium-sized, with the exception of memory, which would be considered a small effect. The main effect of grade was not significant. The covariates of reading comprehension (Pillai's Trace = .595, $F_{(4, 50)}$ = 18.35, p = .000, n^2 = .595), memory (Pillai's Trace = .413, $F_{(4, 50)}$ = 8.81, p = .000, n^2= .413), and rapid naming (Pillai's Trace = .577, $F_{(4, 50)}$ = 17.04, p = .000, n^2= .577), significantly influenced the combined dependent variable. Univariate ANOVA results indicate that the dependent variables of post-test comprehension ($F_{(1, 53)}$ = 38.54, p = .000, n^2= .421) and post-test rapid naming ($F_{(1, 53)}$ = 14.91, p = .000, n^2= .220) were significantly affected by the covariate pre-test reading comprehension; that the dependent variable of post-test memory ($F_{(1, 53)}$ = 35.60, p = .000, n^2= .402) was significantly affected by the covariate pre-test memory; and the dependent variables of post-test comprehension ($F_{(1, 53)}$ = 6.07,

p = .017, n^2= .103), post-test memory ($F_{(1, 53)}$ = 5.00, p = .03, n^2= .086), and post-test rapid naming ($F_{(1, 53)}$ = 50.12, p = .000, n^2= .486) were significantly affected by the covariate pre-test rapid naming.

Inspection of means indicates that students in the treatment group out-performed students in the control group in all areas where statistical significance was found. Table 2 provides the means for the dependent variables by grade and treatment for special education students. Figure 1 provides post-test means by treatment for special education students. Figure 2 provides pre- and post-test means by treatment for special education students.

INSERT TABLE 2 ABOUT HERE

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INSERT FIGURE 2 ABOUT HERE

Regular Education Students:A two-way MANCOVA was conducted for the regular education students to determine the effect of grade and treatment on reading comprehension, rapid naming, phonemic awareness, and memory, while controlling for pre-test levels on reading comprehension, rapid naming, phonemic awareness, and memory. The main effect of treatment (Pillai's Trace = .666, $F_{(4, 196)}$ = 97.917, p = .000, n^2= .666) and grade (Pillai's Trace = .237, $F_{(8, 394)}$ = 6.636, p = .000, n^2= .119) indicates a significant effect on the combined dependent variable. Univariate ANOVA results indicate that the dependent variables of post-test comprehension ($F_{(1, 199)}$ = 132.04, p = .000, n^2= .399), post-test phonemic awareness ($F_{(1, 199)}$ = 80.10, p = .000, n^2= .287), post-test memory ($F_{(1, 199)}$ = 9.672, p = .002, n^2= .046), and post-test rapid naming ($F_{(1, 199)}$ = 218.31, p = .000, n^2= .523) were significantly affected by treatment; and that the dependent variables of post-test rapid naming ($F_{(2, 199)}$ = 20.993, p = .000, n^2= .174) and post-test phonemic awareness ($F_{(1, 199)}$ = 80.10, p = .000, n^2= .287) were significantly affected by grade.

The partial etas squared indicate that the effect of treatment accounts for approximately 39.9 percent of total variability in post-test comprehension scores; approximately 28.7 percent of total variability in post-test phonemic awareness scores; approximately 4.6 percent of total variability in post-test memory scores and approximately 52.3 percent of total variability in post-test rapid naming scores. The partial etas squared indicate that the effect of grade accounts for approximately 17.4 percent of total variability in post-test rapid naming scores and approximately 28.7 percent of total variability in post-test phonemic awareness scores.

These effect sizes are considered small to medium-sized effects. The covariates of reading comprehension (Pillai's Trace = .299, $F_{(4, 196)}$ = 20.86, p = .000, n^2= .299), phonemic awareness (Pillai's Trace = .287, $F_{(4, 196)}$ = 19.73, p = .000, n^2= .287), memory (Pillai's Trace = .298, $F_{(4, 196)}$ = 20.76, p = .000, n^2= .298), and rapid naming (Pillai's Trace = .288, $F_{(4, 196)}$ = 19.85, p = .000, n^2= .288) significantly influenced the combined dependent variable. Univariate ANOVA results indicate that the dependent variables of post-test comprehension ($F_{(1, 199)}$ = 81.29, p = .000, n^2= .290) and post-test rapid naming ($F_{(1, 199)}$ = 6.69, p = .010, n^2= .032) were significantly affected by the covariate pre-test reading comprehension; that the dependent variables of post-test comprehension ($F_{(1, 199)}$ = 10.35, p = .002, n^2= .049) and post-test phonemic awareness ($F_{(1, 199)}$ = 68.48, p = .000, n^2= .256) were significantly affected by the covariate pre-test phonemic awareness; the dependent variables of post-test memory ($F_{(1, 199)}$ = 78.04, p = .000, n^2= .282) and post-test rapid naming ($F_{(1, 199)}$ = 4.09, p = .045, n^2= .020) were significantly affected by the covariate pre-test memory; and the dependent variable of post-test rapid naming ($F_{(1, 199)}$ = 79.27, p = .000, n^2= .285) was significantly affected by the covariate pre-test rapid naming.

Inspection of means indicates that students in the treatment condition out-performed students in the control condition in all areas where statistical significance was found. Third grade students overall made larger gains in phonemic awareness and rapid naming than both fourth and fifth grade students; and fourth grade students made larger gains in rapid naming than fifth grade students.

Table 3 provides the means for the dependent variables by grade and treatment for regular education students. Figure 3 provides post-test means by treatment for regular education students. Figure 4 provides pre- and post-test means by treatment for regular education students.

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INSERT FIGURE 4 ABOUT HERE

Two-year follow-up: Experimental School Sample

Two paired sample t-tests were calculated to compare the mean post-test comprehension and rapid naming scores to the mean two-year follow-up comprehension and rapid naming scores. The mean post-test score for comprehension for students in special education was 83.1 (sd = 19.7) and the mean two-year follow-up score for this group was 97.9 (sd = 16.54). A significant increase from post-test to follow-up was found ($t_{(9)}$ = -2.157, p = .05). The mean post-test score for rapid naming for students in special education was 77 (sd = 8.8) and the mean two-year follow-up score for this group was 108.67 (sd = 18.1). A significant increase from post-test to follow-up was found ($t_{(8)}$ = -5.266, p = .001).

The mean post-test score for comprehension for students in regular education was 91.17 (sd = 13.35) and the mean two-year follow-up score for this group was 111.98 (sd = 10.41). A significant increase from post-test to follow-up was found ($t_{(51)}$ = -10.324, p = .000). The mean post-test score for rapid naming for students in regular education was 82.01 (sd = 3.43) and the mean follow-up score for this group was 121.85 (sd = 9.68). A significant increase from post-test to follow-up was found ($t_{(51)}$ = -30.815, p = .000).

Discussion

This trial was a quasi-experimental study. Our assertion was that post-primary students exhibit a broad range of auditory, phonological, and receptive language issues, and exhibit them in a heterogeneous manner. Our objective was to supplement teacher materials to increase the reading ability of the students by addressing this broad range of skills.

Children classified in special education, who received the SRP, significantly outperformed their counterparts, who did not receive SRP, in all areas assessed. Greater gains were noted across the board for students taught with the Sound Reading Program regardless of grade level. This supports the proposal that, because reading involves multiple processes, interventions aimed at each of these processes may result in greater progress, and continued progress. The children in this study not only out-performed their peers in classrooms receiving traditional methods of reading instruction and intervention, but continued to show progress two years later, rather than reaching a plateau. Effect sizes indicate that the gains are not insignificant. With the exception of the effect for memory, the effect sizes were of moderate size indicating that treatment produces noticeable results in three of the four areas associated with the multiple processes involved in reading.

The results of this study further suggest that students, regardless of their starting reading ability, are capable of improvements in reading skills and comprehension using a receptive language-based approach. These findings are especially important because the improvements were seen in the post-primary population (third through fifth grades) whereas, research in reading has mainly focused on primary-aged students.

Significant increases were observed from post-test to follow-up for all fifth-grade students who received the treatment in third grade. These increases were observed regardless of whether the students continued to receive additional hours of instruction with SRP. While it remains uncertain, the assumption is that this continued growth is related to the students’ ability to access the reading curriculum in their reading groups. The growth observed among the regular education students who received instruction with SRP is noteworthy. There is often reluctance to incorporate additional instructional interventions on a class-wide basis when those interventions are considered to be relevant only to students with special needs. The results of this study suggest that even students without disabilities can benefit by exposure to these techniques.

Limitations of the Study:

a. Inconsistent implementation of the Sound Reading program across reading groups. There was some teacher resistance to implementation of the SRP, resulting in variable hours of instruction among reading groups (though a minimum of 30 hours was achieved). There were also differences in teacher attitudes, that ranged from resistance to enthusiasm, that could have affected the delivery of the instruction.
b. All variables, other than the experimental treatment in reading instruction, were not held constant in the control group. As is typical in schools, there was variability among reading groups regarding the instructional tools used to teach their standard reading instruction, in addition to the Sound Reading program.
c. The sample size was small and uneven.

Recommendations for Future Studies:

a. Further research into the complex relationships between rapid naming, phonological recoding and phonemic awareness is called for.
b. For efficacy studies of the Sound Reading program, larger sample sizes would be needed. However, the purpose of this study was not to assess efficacy of the Sound Reading program, but to determine if gains in reading skills could be seen with implementation of an instructional tool that addressed the gaps in instructional practices with regard to what is indicated by current research.
c. For cross comparison, data collection using tests with a large norm sample, such as the WJ-III tests of reading fluency and passage comprehension would be appropriate to confirm the significance of the gains in reading.

Conclusion:

This study was based on the assumption that post-primary students, who experience reading difficulties, often have issues with auditory processing and find phonics instruction to be of limited help. Thus, the study was designed to determine the role of phonemic awareness and rapid naming on reading comprehension scores for post-primary students.

Sound Reading showed potential as a tool to address gaps in this school's reading curriculum in phonological processing, rapid naming, fluency, and comprehension. Reading gains appeared to be significant for students who received the minimum 30 hours of instruction. We believe that this is the first study showing that rapid naming practice resulted in gains in timed comprehension in post-primary students. Further research could determine whether the significant gains in rapid naming were due to the rapid naming practice or a combination of improved phonological processing and rapid naming. Future studies should explore the nature of the observed grade-level differences in rapid naming and comprehension. Researchers might also examine the significance of the rapid naming increases, and the relationship these increases had to improve the other variables

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About the Authors

Tina Wheeler-Vizy is a practicing school psychologist. She has worked in this field in a public school setting for the past nine years, with experience across all grade levels, kindergarten through twelfth grade. She earned her diploma in school neuropsychology in 2005. She is a member of NYASP and ABSNP.

Candice Stefanou is an Associate Professor of Education at Bucknell University where she teaches and directs the graduate program in school psychology.

Barbara Peck has been teaching special education at the elementary level for over 25 years. She received her undergraduate degree from SUNY Geneseo and her Master's degree from Syracuse University.

Table 1

Student Population in the Study

	Experimental School		**Control School**		**Total**	
Grade	Special Education	Regular Education	Special Education	Regular Education	Special Education	Regular Education
3	7	14	9	20	16	68
4	14	39	5	23	19	62
5	20	62	6	15	26	77

Table 2

Means for Post-test Comprehension, Phonemic Awareness, Memory and Rapid Naming by Grade and Treatment for Special Education Students

	Experimental Post-test				**Control Post-test**			
Grade	Comp	PA	Memory	RAN	Comp	PA	Memory	RAN
3	102.86	103.14	84.29	107.14	90.33	70.89	83.44	94.67
4	92.71	101.07	94.50	108.36	87.6	68.60	84.00	105.00
5	95.35	94.00	87.75	104.20	74.33	84.67	82.00	95.67
Total	96.93*	99.60*	89.70*	111.68*	83.02*	74.41*	80.91*	89.94*

* = $p < .05$

Figure 1

Post-test Means for Treatment and Control Groups for Special Education

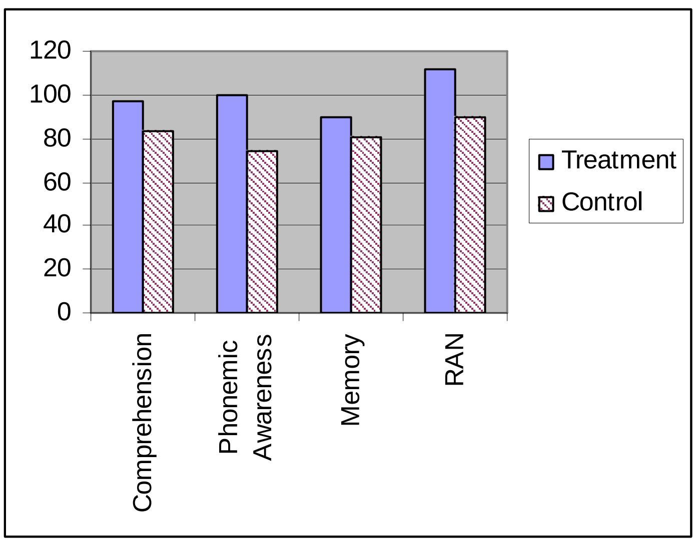

Figure 2

Pre and Post Means for Special Education Students by School

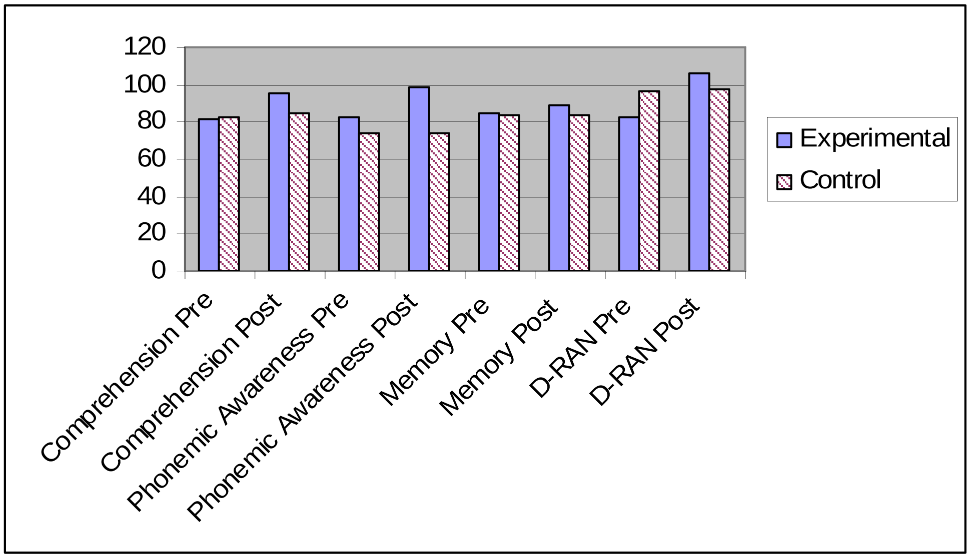

Table 3

Means for Post-test Comprehension, Phonemic Awareness, Memory and Rapid Naming by Grade and Treatment for Regular Education Students

Grade	Comp	PA	Memory	RAN
3	105.35	100.34*	96.29	114.83*
4	103.98	94.93	96.39	107.96*
5	104.24	93.59	94.92	104.79
Experimental School	113.23*	103.28*	98.94*	120.10*
Control School	95.82	89.30	92.79	98.29

* = $p < .05$

Figure 3Means for Treatment and Control Groups for Regular Education

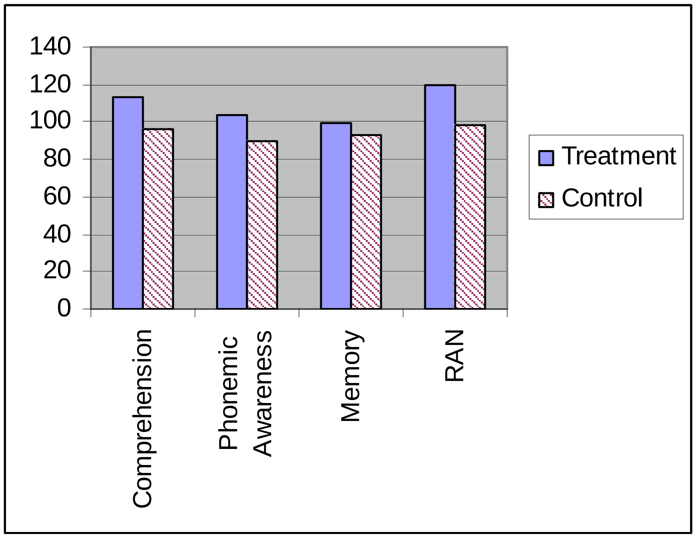

Figure 4

Pre and Post Means for Regular Education Students by School