PHONOLOGICAL AWARENESS SKILLS OF SIX-YEAR-OLD CHILDREN

WITH MILD AND MODERATE ARTICULATION DISORDERS

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A Thesis Submitted to

the Graduate Faculty of

Auburn University

in Partial Fulfillment of the

Requirements for the Degree of

Master of Science

Auburn, Alabama
May 11, 2006

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Keri Leigh (Estes) Gernand, daughter of Dr. Thomas Raymond Estes, Jr, and Deborah Kay (Deidiker) Kerschner, was born January 11, 1983, in Rochester, Minnesota. She graduated from North St. Paul High School in 2001. She attended Harding University in Searcy, Arkansas and graduated summa cum laude from the Honors College with a Bachelor of Arts degree in Communication Disorders in May 2004. She entered Graduate School, Auburn University, in August 2004. She married Timothy Gernand, son of Chuck and Becky (Harvey) Gernand, on December 18, 2005.

THESIS ABSTRACT

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Master of Science, May 11, 2006
(B.A. Harding University, 2004)

62 Typed Pages
Directed by Michael J. Moran

An investigation of the phonological awareness skills of children with mild and moderate articulation disorders is presented in this thesis. A sample of 24 first graders, 12 of whom had normal articulation and the other 12 having "mild" articulation disorders as determined by a standardized test, were assessed on measures of phonological awareness. A statistically significant difference was found between the performance of these two groups.

ACKNOWLEDGMENTS

The author would like to thank Dr. Michael Moran for his endless patience, help, and guidance with this project. Great appreciation is also extended to Dr. William Haynes and Dr. Nancy Haak for their contribution as committee members. This project would not have been possible without the faculty, staff, parents, and students at Smith Station Primary School and Beulah Elementary in Lee County, Alabama as well as Heather Rutledge for her encouragement and help in collecting the data. Special thanks to Timothy for his support, encouragement and faith.

Style manual used: *APA Publication Manual (5th edition)*

Computer software used: Microsoft Windows XP, Statistical Software

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I. INTRODUCTION

The ability to attend to and manipulate the sounds in spoken language is commonly referred to as phonological awareness (Catts & Kamhi, 2005). Possessing phonological awareness skills indicates that a person not only has the knowledge that words are composed of smaller segments such as syllables and phonemes (Catts, 1991b), but that the person also has the ability to rearrange those smaller units (Cunningham, 1990).

Various tasks have been determined to be indicators of phonological awareness. These tasks include: rhyming, counting the number of phonemes in words, matching sounds in words, isolating sounds in words, deleting phonemes or syllables from words, and blending phonemes to produce words (Yopp, 1988; Anthony & Lonigan, 2004). Research has established a relationship between phonological awareness skills and reading performance (Cunningham, 1990; Adams, 1990; Blachman, 1991; Catts, 1991b; Catts & Kahmi, 2005; Ehri et al., 2001; Kirby, Pfeiffer, & Parilla, 2003). Other studies have established a relationship between phonological awareness skills and spelling performance (Apel, Masterson, & Hart, 2004; Ball & Blachman, 1991; Ehri, et al. 2001; Lombardino, Bedford, Fortier, Carter & Brandi, 1997; Tangel & Blachman, 1992). Comparatively, a much smaller number of studies have investigated the relationship between speech and language impairments and phonological awareness.

Catts (1991b) found that children with language disorders are more likely to have problems with phonological awareness tasks. Webster and Plante (1992) found a relationship between phonological disorders and performance on tasks of phonological awareness. Also, Rvachew, Ohberg, Grawburg, and Heyding (2003) found that phonologically delayed four-year-olds had significantly poorer phonological awareness skills than their phonologically normal peers.

The purpose of the following review of the literature is to provide specific examples of research in phonological awareness. The literature reviewed will primarily involve phonological awareness as it relates to articulation and phonological disorders, but also as it relates to language, reading, and spelling. The review will establish areas that need further research relating to the area of speech and language as it relates to phonological awareness skills.

The purpose of the present study is to examine a possible relationship between mild and moderate phonological disorders and performance of six-year-old children on standardized and non-standardized measures of phonological awareness skills.

II. REVIEW OF THE LITERATURE

Phonological Awareness

Phonological awareness refers to the explicit sound structure of a language (Catts, 1991b). More specifically, phonological awareness involves a person's ability "to attend to, reflect on, or manipulate the speech sounds in words." (Catts & Kahmi, 2005). Stackhouse (1997) defines phonological awareness as, "the ability to reflect on and manipulate the structure of an utterance (e.g., into words, syllables, or sounds) as distinct from its meaning" (p. 157). The latter two definitions identify two aspects of phonological awareness: first, an understanding that words are composed of smaller units, namely syllables and phonemes (Catts, 1991b), and second, the ability to rearrange those smaller units (Cunningham, 1990). As will be discussed later in this section, phonological awareness is not only related to expressive speech skills but also to reading and spelling ability (Rvachew et al., 2003; Webster & Plante, 1992; Lewis & Freebairn, 1992; Larrivee & Catts, 1999; Cowan & Moran, 1997; Bird & Bishop, 1992; Bird, Bishop, & Freeman., 1995; Adams, 1990; Blachman, 1991; Catts, 1991; Catts & Kahmi, 2005; Ehri et al., 2001; Kirby, Pfeiffer, & Parilla, 2003; Apel, Masterson, & Hart, 2004; Ball & Blachman, 1991; Lombardino, et al., 1997; Tangel & Blachman, 1992).

Numerous tasks have been used to measure phonological awareness skills. These tasks include: rhyming; blending; segmentation and counting; and categorization and discrimination.

Rhyming

Tasks measuring rhyming ability have been constructed in a variety of ways. Rhyme oddity, rhyme matching, and rhyme production are all ways in which the presence of the ability to rhyme can be detected. In *rhyme oddity* tasks, children are required to choose from a group of words which one does not "sound the same" or belong on the basis of rhyme (Anthony and Lonigan, 2004). An example of rhyme oddity would be presenting the child with the words "duck, truck, and cat" then asking them which one didn't belong. During a task referred to as *rhyme matching*, subjects are asked to choose from a group which rhymes with a word given by the examiner. This task would present the child with the words "duck, truck, and cat" then ask them which two rhymed. In tasks of *rhyme production* or *rhyme supply*, children are asked to produce rhymes to a word given by the examiner. The examiner would give the child a word such as "bat" then ask them to give a word back which rhymed with "bat."

Alliteration

The phonological skill of *alliteration* can be classified in many of the same ways as rhyming. Alliteration itself means that two words begin with the same sound. Therefore tasks of *alliteration supply* can require a child to supply the investigator with a word that alliterates with a word given to the child. Tasks of *alliteration matching* require the child to respond with "yes" or "no" when asked if a word begins with the same sound as another word. There are also tasks of *alliteration oddity*. These tasks are those that would require a child to inform the investigator of words that do not begin the same as other words in a group.

Blending

The phonological awareness skill of *blending* can be divided on the segments of speech the child is being asked to blend. Tasks of *phoneme blending* involve the child being asked to listen to individual phonemes and then repeat back the blended word (Anthony & Lonigan, 2004). In tasks of phoneme blending, the child would be presented with the sounds /b/ /o/ /t/ then asked to blend them into the target word, "boat." Tasks of *syllable blending* are very similar but instead require the child to blend syllables into words. In these tasks, the child would blend "ba" and "by" to make the word "baby."

Segmentation and Counting

In tasks of *segmentation*, the child can be asked to segment sentences into words (Webster & Plante, 1992), words into syllables (Webster & Plante, 1992), words into phonemes (Catts, 1991b; Webster & Plante, 1992; Yopp, 1988), and isolate certain phonemes (Yopp, 1988). An example of a segmentation task would be asking a child to segment the word "caterpillar" into the syllables "cat" "a" "pil" "er." *Counting* tasks require the child to be able to tap the number of syllables or phonemes in words (Catts, 1991b; Yopp 1988). An example of a counting task using the same word as before would be asking a child to tap their pencil with each syllable in "caterpillar" then asking them to verbalize how many syllables there were.

Manipulation

Tasks that require the participants to manipulate phonemes include tasks of *elision* and *substitution*. Tasks involving elision or deletion (Yopp, 1988; Anthony & Lonigan, 2004) require the child to delete a specified phoneme or syllable from a word and repeat what is remaining. For example, "say the word 'stop' without the 's.' Tasks

which involve substitution are those which ask the child to replace a sound in the word with a new phoneme and repeat the new word (Cowan & Moran, 1997). For example, "say the word 'dog' now say it with a 'f' instead of a 'd.'

Categorization and Discrimination

Tasks of *categorization* and *discrimination* are other measures of phonological awareness. Categorization requires the child to group the sounds on the basis of a common element (e.g.; rhyming, or same initial, medial, or final sound) (Cowan & Moran, 1997). This task could ask a child, when presented with the list: dog, dust, dark, and food; to tell the examiner which words belonged together based on beginning with the same sound. Categorization differs from *discrimination* in that tasks of discrimination require that the child determine if words possess a common sound. For example, "Do the words doctor and bed have sounds in common?"

Development of Phonological Awareness Skills

In 1988 Yopp looked at the performance of children on different tests of phonemic awareness and from the information gathered, he created a hierarchy of phonological awareness tasks. According to his study, the following phonological awareness tasks can be ranked from easiest to hardest: rhyme, auditory discrimination, phoneme blending, word-to-word matching, sound isolation, phoneme counting, phoneme segmentation, phoneme deletion.

Maclean, Bradley and Bryant (1987) found that children as young as three possessed an ability to analyze the sounds of words. These skills found at age three, were also found to be predictors of those same children's beginning reading. This longitudinal study, following the children through the development of their phonological skills

allowed the investigators to rule out IQ as the primary reason for their ability to learn to read. They were able to see that as the children developed more phonological awareness skills, they were able to learn how to read better.

Goldsworthy (1998) and Justice and Schule (2004) reviewed the literature and described the phonological awareness skills of children at various age levels. The following is a summary of their findings regarding the development of phonological awareness:

At age two years: Some two-year-olds are able to detect rhyme inconsistently, but at levels greater than chance. These children are able to complete *rhyme oddity* tasks by selecting the word that does not rhyme from a group of three (e.g., hat, cat, boy).

At age three years: When presented with two words, many three-year-olds are able to complete *rhyme detection* tasks by indicating if two words rhyme or not. Some three-year-olds are able to generate at least one word that rhymes with a target word. Many children at this age can recite known rhymes such as Jack and Jill. Many are able to complete *alliteration oddity* tasks by identifying a word in a group of words that begins with a different sound (e.g., mad, mop, cat). It is generally accepted that alliteration lags behind sensitivity to rhyme.

At age four years: Children begin to exhibit an awareness of syllabic distinction. This is the awareness that words can be divided into parts. For example, the word "baby" can be divided into "ba" and "by." About half of four-year-olds are able to count the number of syllables in multi-syllabic words.

At age five years: Most five-year-olds are able to generate rhyme spontaneously during play or on demand in games. They exhibit general proficiency in *rhyme detection* tasks.

Most 5-year-olds can count the number of syllables in multi-syllabic words. Some children at this age can also count the number of phonemes in words. However, in terms of recognizing phonemes, it is more likely at age five that children are able to separate the first sound of single syllable words (onset) from the rest of the word (rime) which appears to be treated as a single unit. For example, children can separate the word "top" into t (onset) and op (rime) but not into t-o-p.

At age six years: Most children demonstrate the ability to identify phonemes as units comprising syllables. Many six-year-olds are able to blend two and three sounds in order to make a word (e.g., c-a-t makes "cat").

At age seven years: Children begin to spell phonetically. They can segment three to four phonemes in words. Many seven-year-olds can complete *phoneme deletion* tasks, that is, they are able to delete sounds from words (e.g., "moose" without the /s/ is "moo").

A study investigating the development of phonological skills by Carroll, Snowling, Hume, and Stevenson, (2003) described the development of phonological awareness skills as "a progression from awareness of large units (syllables and rimes) to awareness of small units (phonemes)." This was contradictory to the generally accepted tenet that rime awareness precedes syllable awareness. The investigators found no significant difference in the development of these two skills which led them to the conclusion that development occurred in a large-unit to small-unit progression.

Anthony and Lonigan (2004) state that while researchers may disagree on whether or not phonological awareness skills fall within one construct, or are distinct abilities, a general statement can be made regarding these skills, "…there are multiple

phonological skills that are distinguished by linguistic complexity and type of operation performed." Results of their study found this to be true, that sensitivity to rhyme and sensitivity to other linguistic units are not separate entities. Rather, they found that phonological sensitivity can be measured by different tasks (e.g., detection, blending, and deletion) and those tasks can vary in their linguistic complexity through different aspects of the speech unit (e.g., rimes, onsets, phonemes, syllables).

Phonological Awareness relating to Speech and Language Impairments

Regarding speech and language, there have been numerous studies showing that phonological disorders have an effect on reading and phonological awareness skills. Bird and Bishop (1992) in their study linking phonological disorders and awareness of phonemes hypothesized that children with phonological disorders do not progress to the analysis of speech at the level of the phoneme. This idea was manifested through the children's inability to match phonemes in different word contexts.

Bird, Bishop, & Freeman's 1995 study was a replica of the one completed by Bird and Bishop in 1992. These studies investigated the relationship between expressive phonological delay, phonological awareness and literacy. The subjects were given three tests of phonological awareness, including one task of rime matching and two of onset matching at 70, 79, and 91 months of age. During the assessment at 79 and 90 months, literacy skills were also assessed. Results show that children with expressive phonological delay scored lower than their same age peers on both tasks of phonological awareness and literacy. These results were found to be independent of whether or not there was a coexisting language disorder.

Similarly, Webster and Plante (1992) found that children with phonological disorders were not performing as their peers in the area of phonological awareness. This study tested children on tasks of segmentation (sentence to word level, words to syllables, and words to phonemes) and a word recognition task (that did not require verbal responses from the children so as to accommodate the phonologically impaired children). The phonologically impaired children performed lower than their phonologically normal peers on all the tasks presented to them. The investigators hypothesized that the children's' phonological disorders might prevent the type of efficient phonological coding in their working memory that is necessary for phonological awareness.

A study by Cowan and Moran (1997) studied children with articulation impairments on three tasks of phonological awareness: rhyming, phoneme blending, and phoneme counting. The children involved in the study ranged from kindergarten through third grade and those with articulation impairments were matched with same age peers who did not have any articulation impairment. The children with articulation impairment were found to perform poorly in comparison with their age-matched peers on all three tasks of phonological awareness. This study, while showing a link between children with articulation impairments and tasks of phonological awareness, did not take into account the severity of the articulation impairment in its results.

Larivee and Catts (1999) investigated the relationship between phonological disorders and early reading ability. Results indicated that the severity of the phonological disorder was predictive of future reading ability. From the results, it was concluded that there was a link between proficiency in phonological awareness skills and phonological disorders. This study did not, however, directly investigate a relation between

phonological awareness skills and phonological disorders, but rather word recognition and word attack skills. In addition, in selecting the participants, the investigators did not disqualify those who had semantic-syntactic language disorders. The participants' language delays could have influenced the data.

Rvachew et al. (2003) investigated the relationship between phonological awareness skills and phonological disorders and took severity of the articulation impairment into account. This study investigated the phonological awareness skills of four year olds with and without moderate to severe expressive phonological delay. The subjects were tested on phonological awareness tasks of rime match, onset match, and onset segmentation. They were also tested on phonemic perception, letter names, literacy knowledge, and word knowledge. Results showed that children with expressive phonological delay scored significantly lower on all tests (rime match, onset match, and onset segmentation) of phonological awareness than their same age peers without expressive phonological delay. The method used to test the phonological awareness skills was not standardized, but rather, an adaptation of the method used by Bird and associates (1995). While the experimental and control groups were matched for vocabulary development, they were not matched for expressive language delays therefore not ruling out language delay as a possible cause of the difference in phonological awareness skills. The children were also not drawn from a homogenous pool. The phonologically disordered group was taken from speech clinics in large children's hospitals, whereas the phonologically normal group was taken from various preschool programs. This does not rule out literature and phonological awareness exposure in preschool as a possible reason for the difference in the two groups.

While there have been consistent results in the area of studying phonological awareness and language impairments, the area of articulation or phonological impairments has not always yielded consistent results (Vellutino and Shub, 1982; Catts, 1993; Bishop and Adams, 1990). It has been well documented that children with language impairments are at much greater risk of encountering later reading disabilities, but the question of whether or not their speech abilities really affect future reading ability remains unanswered, according to some.

Vellutino and Shub (1982) found that learning to read is primarily dependent upon the individuals language ability and that reading disabilities seem to stem from one or more linguistic deficit.

Some research has shown that problems in correctly producing speech sounds have no effect on phonological awareness or reading. Catts (1993) studied the relationship between success in 1st and 2nd grade reading and speech and language problems. It was found that while children with speech-language impairments were more likely to have reading disorders; there was low correlation between articulation disorders alone and success in 1st and 2nd grade reading. Quite the contrary, the students with articulation disorders often scored at or above what was considered normal for their age.

Bishop and Adams (1990) completed a longitudinal study on the relationship between specific language impairment, phonological disorders and learning to read. In this study, only a weak correlation between phonological disorders and a later ability to read meaningful and nonsense words was found.

Children with language disorders have been found to score more poorly on reading and spelling tasks (Magnusson & Naucler, 1990). However, in this study which

tested various aspects of language ability (phonological, morphological, syntactic, lexical, and pragmatic); linguistic awareness (phonological and syntactic); short term memory (verbal and nonverbal); information processing strategies; and reading, writing, and spelling, a mixed result was found within the children with language disorders. The children with language disorders who possessed metaphonological skills did not have a negative impact on their reading as did their peers who had a language disorder and no metaphonological skills.

An investigation by Catts, Fey, Zhang, & Tomblin (1999) found that as many as 70% of children who are poor readers had a language deficit in kindergarten. Because this study only measured the phonological awareness skills and the oral language abilities of its participants, it did not address how many of those children also had co-existing phonological or articulation disorders.

Magnusson and Naucler (1993) found that children with language disorders were less able to complete tasks of phonological awareness than a group matched on intelligence with no language disorder. The authors of this study felt that this ruled out cognition alone being the determining factor for the acquisition of phonological awareness skills. They posited that there must be some linguistic factor accounting for the difference, and questioned whether a phonological deviance might be the problem.

Phonological Awareness Skills and Reading

Extensive research has established the link between reading and phonological awareness skills (Adams, 1990; Blachman, 1991; Catts, 1991b; Catts & Kahmi, 2005; Ehri et al., 2001; Kirby et al., 2003). This is important because if there is a relationship between phonological or articulation disorders and phonological awareness skills, and

phonological awareness skills affect reading; then it is possible to identify reading problems by identifying phonological and articulation disorders. When children possess phonological awareness skills, they are able to match the sounds that correspond to different letters and then use this knowledge to begin decoding words phonetically (Catts & Hogan, 2003).

Bryant and Bradley (1983) state that "Children who are backward in reading are strikingly insensitive to rhyme and alliteration." This idea was confirmed by Catts, Fey, Zhang, and Tomblin (1999) where they found that 56% of children who were poor readers in second grade had phonological awareness problems in kindergarten. This is important in allowing us to develop ways to predict student's later success in learning to read.

In another study that was conducted longitudinally, skills in rhyme detection, alliteration detection, and phoneme detection were found to be linked to later reading success (Bryant, et al., 1990). This study tested the subjects in three different sessions. The first session involved tests of rhyme and alliteration detection with the second session testing phoneme detection. The third and final session tested reading skills. Results confirmed that phonological awareness skills could be predictive of later reading skills.

A study by Muter and associates found that phoneme sensitivity in combination with letter knowledge were predictive of later reading success (Muter, Hulme, Snowling, & Stevenson, 2004). Still another study was completed by Wimmer and associates, and found the affects of phonological awareness (as tested through phonemic awareness) on later success in reading and spelling (Wimmer, Landerl, Linortner, & Hummer, 1991).

Another similar study that investigated phonological awareness at the beginning of the subject's first school year and reading skills at the end of the first school year found the same results (Stuart, & Coltheart, 1988). However, this study linked phonological awareness skills with letter-sound knowledge as a predictor of later reading skills.

A study by Byrne and Fielding-Barnsley (1989) stated that phonological awareness skills benefit children in reading so long as the child has an understanding of three things. First, the child must understand that the phonemes represented by letters are also representative of separate segments within each word. Second, the child must understand that those same sounds also occur in other words. Last, the child must understand "the particular association between the distinguishing letters and phonemes in the known word group." What this tells us, is that children who possess knowledge of these three things will know how to read a small group of words that only differ by a single letter, and they will also have an understanding of how those letters represent sounds in other words which the children do not know.

The phonological awareness skill which entails distinguishing different sounds has been studied in isolation and linked to reading ability. A study by Bradley and Bryant (1978) found that when children three years apart in chronological age, but matched on reading age were compared on auditory discrimination, the younger children consistently performed better. In this study, the children were given three words that were similar in the first, middle or last phoneme, and another word that did not match the other three. The children were asked to tell the investigators the one that did not belong with the other three. In addition to confirming the idea that the ability to match words for similar sounds is an essential part of reading, this study also did something unique. By

matching the children on reading ability and not on age, this study proved that it was reading ability, and not other age related factors (e.g. literacy exposure, experiences, etc) that determined the phonological awareness skills.

Goswami (1990) has studied the phonological awareness task of rhyming and its relationship to reading through the use of analogies. He found that children who are better at making analogies from words they are familiar with, to those which they are not familiar, are better at the phonological awareness task of rhyming. In this study a phonological awareness task of phoneme deletion was also tested. The tasks involving rhyming showed a much stronger relationship to the children's abilities to use orthographic analogies than did the tasks involving phoneme deletion.

Ball and Blachman (1991) studied the effects of teaching phoneme awareness in addition to letter sounds and names to children of normal intelligence and language skills. In this study they found that teaching children to segment words into phonemes, in addition to teaching the names of letters and the sounds they make was beneficial to the children learning to read. The children they taught only letter names and sounds to, did not fare as well in learning to read as those who were also taught the phonemic awareness skills.

Kirby, et al. (2003) studied the effects of phonological awareness skills and naming speed on later reading development. This study began when the participants were just starting kindergarten and concluded when the children were in grade 5. The children were tested on four measures of phonological awareness: sound isolation, phoneme elision, blending onset and rime, and blending phonemes. It was found that

phonological awareness was indeed a predictor of later reading ability, however its impact was greater in the earlier elementary grades than in the later elementary grades.

The impact of phonological awareness skills has been found to play a role not only in the development of the reading skills of children, but also across the life span as demonstrated in the acquisition of reading skills in adults who had previously been illiterate. A study by Durguno-Iu and Öhey (2002) investigated Turkish women just beginning to read in Turkish. Their study found that, in the context of the Turkish language, adults gained phonological awareness skills through the process of learning to read. This extends the link of phonological awareness skills and literacy acquisition to adults and shows that the continuum is the same for both children and adults.

While phonological awareness has been found to be linked to success in reading, there are studies that show that phonological awareness is not a prerequisite for reading. Perfetti and associates found that certain tasks of phonological awareness develop as a result of learning to read, therefore making the relationship reciprocal (Perfetti, Beck, Bell, and Hughes, 1987; Durguno-Iu & Öhey , 2002). Other studies completed on non-literate adults can confirm this. A study done on non-literate adults showed that the phonological awareness task of sound segmentation does not develop on its own as shown by non-literate adults with no alphabetic knowledge (Read, Zhang, Nie, & Ding, 1986). Another similar study investigated sound segmentation skills in formerly illiterate adults compared with the skills of those who are illiterate (Morais, Bertelson, Cary, & Alegria, 1986). Results showed that the formerly illiterate adults did indeed possess the sound segmentation skills whereas the illiterate individuals did not. Still one more study yielded the same results. Non-literate adults were compared with adults who had learned

to read rudimentarily (Morais, Cary, Alegria, & Bertelson, 1979). Results of the study showed that the non-literate adults were unable to add or delete a phoneme at the beginning of a non-word whereas the adults who had learned to read had better results.

Castles & Coltheart (2004) studied the relationship between phonological awareness skills and reading. Their study researched numerous past studies on the topic, focusing primarily on longitudinal and training studies. From their research, they concluded that, to date, there have been no studies establishing a link between phonological awareness skills and success in future reading.

Phonological Awareness and Spelling

There is also extensive literature indicating a relationship between phonological awareness and spelling (Apel, et al., 2004; Ball & Blachman, 1991; Ehri, et al. 2001; Lombardino, et al., 1997; Tangel & Blachman, 1992). Clarke-Klein (1994) suggested that children who have phonetic errors (e.g., those who spell "candle" as "candol," or "square" as "skwar") are likely to possess normal phonological awareness skills and are no more likely than other children to have phonological problems. However, children who show non-phonetic or "bizarre" spelling patterns (e.g., those who spell "smoke" as "scoteser," or "crayons" as "carinsteds") are more likely to have phonological awareness problems. Clarke-Klein (1994) suggested that children who have histories of severe expressive phonological deviations are at risk for these unusual or bizarre type spelling errors. Lombardino et al., (1997) suggested that children who do not exhibit expected spelling patterns should be provided with phoneme awareness training.

In addition to finding the same results as previous studies relating to the problems children with expressive phonological disorders have with spelling, Clarke-Klein and

Hodson (1995) found that these children also have less effective strategies for spelling. These same children were found to have poorer phonological skills than their same-age peers. The authors concluded, in agreement with past studies, that phonological awareness skills increase the ability to phonetically spell words.

Silva and Martins (2003) tested the spelling and phonological awareness skills of children who were identified as not yet able to read and whose spellings were found to be pre-phonetic. The participants were divided into a control group and an experimental group with the experimental group receiving instruction in phonetic spelling. The authors found that after the instruction in spelling, the subjects phonological awareness skills were found to be higher than at the outset of the study. This study is also an indicator of the possible reciprocal nature of phonological awareness abilities with the development of reading and writing skills.

Severity Rating Measures of Phonological Disorders

A study by Garret and Moran (1992) compared measures of the severity of phonological impairment. This study compared 20 phonologically impaired children using 5 different measures of severity: phonological deviancy score (PDS) used in the Assessment of Phonological Processes- Revised (Hodson, 1986), percent consonants correct (PCC) in connected speech and single words, and perceptual ratings from two groups trained differently. This study found that PCC and the PDS are "of similar value" to the clinician when making decisions about the nature and severity of a client's phonological disorder.

III. JUSTIFICATION

Several previously reported studies have demonstrated that children with expressive phonological disabilities perform poorly on tasks of phonological awareness skills (Bird et al., 1995; Catts, 1991b; Catts, Fey, Zhang, & Tomblin, 1999; Cowan & Moran, 1997; Magnusson & Naucler, 1993; Vellutino & Shub, 1992; Larivee & Catts, 1999; Rvachew et al., 2003; Webster & Plante, 1992). These findings, however, have been confounded by two factors: the presence of concomitant language problems, and the severity of the phonological disorder. For example, Catts (1991b) suggests that children who have pure articulation disorders, without language disorders, are not at-risk for later phonological awareness difficulties. On the other hand, Rvachew et al. (2003) reported that children with expressive phonological delay, independent of a language deficit, performed poorly on tasks of phonological awareness when compared with their peers. Also, a study by Cowan & Moran (1997) suggests that even children with mild articulation errors may perform more poorly on phonological awareness tasks than their same age peers with no articulation problems.

Understanding the relationship between phonological awareness and phonological disorders is important for at least two reasons. First, defining the relationship between phonological performance and phonological awareness could help determine when phonological awareness testing and treatment should be part of the assessment and intervention with phonologically impaired children. Second, despite Castles & Coltheart

(2004), phonological awareness has been linked to reading problems (Blachman, 1984; Blachman & James, 1986; Bradley & Bryant, 1983; Juel, 1988; Juel, Griffith, & Gough, 1986; Lundberg, Olofsson, & Wall, 1980; Mann, 1984; Mann & Lieberman, 1984; Share, Jorm, Maclean, & Matthews, 1984; Stanovich, Cunningham, & Cramer, 1984; Torneus, 1984; Vellutino & Scanlon, 1987). Determining those phonologically impaired children who are likely to exhibit phonological awareness problems could also provide an early indication of children at risk for reading problems.

To date evidence that phonological disorders alone, independent of a language disorder, are associated with phonological awareness skills, is limited. While Rvachew et al. (2003) isolated the relationship between phonological disorders and phonological awareness abilities, the only aspect of language testing used to rule out a concomitant language disorder was a test of receptive vocabulary. Cowan & Moran (1997) also reported finding a relationship between phonological awareness and articulation disorders independent of language disorders. However that finding was not the main focus of the study and was based on a very small sub-group of participants.

The present study proposes to investigate whether children with mild and moderate phonological impairment and no coexisting language disorder perform differently than children with normal language and phonology on tasks of phonological awareness skills. There have also been few studies examining the relationship between phonological awareness skills and phonological disorders using standardized measures of phonological awareness skills.

The present study was designed to investigate the phonological awareness skills of children who exhibit mild and moderate articulation disorders as compared with their

typically articulating same age peers. In this study a comparison was made on the performance on a standardized test of phonological awareness skills between six-year-olds divided and classified on the basis of their performance on the Assessment of Phonological Processes-Revised (Hodson, 1986). The following questions were addressed:

1) Do six-year-old children who exhibit mild and moderate phonological disorders and no language problems differ significantly from those with normal articulation on standardized tasks of rhyming, incomplete words, sound sequencing, and sound deletion?
2) Do six-year-old children who exhibit mild and moderate phonological disorders and no language problems differ significantly from those with normal articulation on non-standardized tasks of phoneme counting, rhyming and blending?
3) Is there a difference in the performance of these children on the various types of tasks used to assess the phonological awareness skills of six-year-old children?

IV. METHOD

Participants

The participants in the present study were 24 six-year-old students (plus or minus two months at the time of testing) who attended Smith Station Primary School or Beulah Elementary in Lee County, Alabama. The participants ranged in age from 5;11 to 7;2. Twenty-three participants were Caucasian, one was African-American. The African-American participant did not exhibit features of African-American English on any test or in interaction with the examiner. All participants passed a pure-tone audiometric screening test at 25 dB HL ISO for 500, 1000, 2000, and 4000 Hz bilaterally (ANSI, 1989). All participants also participated in an informal oral-mechanism exam consisting of the following tasks: tongue elevation, tongue lateralization, tongue depression, lip protrusion, lip retraction, velum elevation, and notation of any abnormal dentition. No abnormalities were noted with any of the participants. Participants who were receiving special education services other than speech and language (e.g., Emotionally Conflicted, Mentally Retarded, Multiple Disabilities, and Specific Learning Disabilities) were excluded from the present study. All participants were administered the Clinical Evaluation of Language Fundamentals-Fourth Edition, Screening Test (CELF-4 Screening) (Semel, Wiig, and Secord, 2003) and the Assessment of Phonological Processes-Revised *(APP-R)* (Hodson, 1986). The Clinical Evaluation of Language Fundamentals-Fourth Edition, Screening Test (CELF-4 Screening) was administered in

order to rule out a language disorder. This particular screener was found to over-identify children as having language disorders when, in fact,

they did not. The Assessment of Phonological Processes-Revised *(APP-R)* was administered in order to assess the participant's phonology.

Based on performance on those two tests, the participants were assigned to two groups of 12.

Group one (mild to moderate articulation disorders) met or exceeded the criterion score on the CELF-4 Screener and exhibited one or more articulation errors and scored in the mildly to moderately impaired range on the APP-R.(See appendix A for individual scores). Passing the CELF-4 Screener involves achieving a "Criterion Score" as determined in the test construction by age. This group consisted of 2 females and 10 males ranging in age from 5;11 to 7;0 with an average age of 6;5.

Group two (control) met or exceeded the criterion score on the CELF-4 screener and did not exhibit articulation/phonological errors. This group consisted of 6 females and 6 males ranging in age from 6;3 to 7;2 with an average age of 6;9.

Alabama has considerable resources in training teachers to incorporate phonological awareness into the reading and pre-reading curriculum. While both schools were in the same school district (Lee County, Alabama), there were two different methods in the instruction of reading. As a result seven students were included in each group from school one and five students were included in each group from school two.

Procedure

Each participant was administered the Test of Phonological Awareness Skills (TOPAS) (Newcomer & Barenbaum, 2003). The TOPAS is a standardized test of

phonological awareness skills. The test consists of four subtests: Rhyming, Incomplete Words, Sound Sequencing, and Sound Deletion.

The rhyming portion involves the investigator reading a phrase with a word missing. The participant is asked to supply the missing word that should rhyme with a stressed word in the phrase. For example, "The *frog* sat on the ____[log]."

The incomplete word portion involves the investigator reading a word with a syllable or phoneme missing. The participant is required to give the investigator the entire target word. For example, "I'm going to say part of the word, I want you to tell me what the whole word I was trying to say is. 'abbage' (*target word: Cabbage).*

The sound sequencing portion involves the investigator training the participant to use different colored blocks which represent syllables. Then the participant is asked to blend the syllables when the investigator places them in different combinations. For example, "The blue block says 'ab' and the yellow block says 'az.' How would it sound if we put the blocks in this order: [blue, yellow, blue, yellow]?"

The sound deletion subtest requires the participant to say what a word given by the investigator would be if a sound was deleted. For example, "Say 'stop' without the 's.'"

From the raw scores obtained from these four subtests, a standard score is given. Also, once standard scores are determined for each of the subtests, a composite score can be obtained using each of the four standard scores.

In order to compare the results of the present study with previous investigations that did not use a standardized test such as the TOPAS, participants were also administered three non-standardized measures. These measures were similar to those

used by Cowan and Moran in 1997. This assessment consists of three subtests: Phoneme Counting, Rhyming, and Phoneme Blending. The scores used to compare the non-standardized subtests were simply a percentage of each subtest the participants got correct.

The phoneme counting portion of the assessment required the participant to listen to words and sounds (C, V, CV, VC, or CVC) and count by tapping with a pencil how many sounds the word or sound contained.

The rhyming portion required the participant to simply say "yes" or "no" to whether or not to simple words rhymed. For example, "do fun and sun rhyme?"

The phoneme blending portion required the participant to blend between two and three phonemes in to familiar words. For example, "what word does r-e-d make?"

Each participant was tested individually in a quiet room of his/her school by the investigator and a graduate student of speech-language pathology. The graduate student was in the middle of her last semester of graduate school and had completed all of the course work related to articulation and language assessment. The investigator and graduate student administered the first 50% of the assessments together. The two were in agreement on 100% of responses. Because they appeared to be well calibrated to what was expected on each task, the two examiners scored the remaining subjects separately. The participant's parents or guardians were given an informed consent form that was signed prior to participation. The participants themselves were also administered a verbal assent informing them that if, at any time during the testing, they did not want to complete it, they would be taken back to their classroom immediately. All subtests of the TOPAS were administered in one session.

During assessment, the subjects were seated at a table with the examiner seated behind the table. This was done in order to eliminate visual cues. The investigator transcribed and a second-year Master's student in speech-language pathology monitored the child's responses while seeing the transcriptions 50% of the time through live observation. In cases where the graduate student assistant was simultaneously scoring, she was seated next to the investigator. The tests were then scored according to the procedure given by the test authors.

The standard scores achieved by both groups on each of the four portions of the TOPAS were compared by means of a two-factor (group x task) anaysis of variance (ANOVA) with repeated measures. The composite TOPAS scores for each group were subjected to a two-tailed t-test. Finally, the percent of correct responses for each group on the three non-standardized phonological awareness tasks were subjected to a two-factor (group x task) analysis of variance (ANOVA) with repeated measures.

V. RESULTS

The means and standard deviations of the scaled scores on each subtest on the TOPAS are presented for both groups in Table 1.

Table 1. Means and standard deviations (in parentheses) of scaled scores on each subtest of the TOPAS for phonologically impaired and non-impaired groups.

	Phonologically Impaired	Non-impaired	Total
Rhyming	**9.83 (2.82)**	**12.58 (2.07)**	**11.21 (2.74)**
Incomplete Word	**10.92 (2.94)**	**12.58 (1.83)**	**11.75 (2.49)**
Sound Sequencing	**11.83 (3.74)**	**15.75 (2.34)**	**13.79 (3.57)**
Phoneme Deletion	**11.42 (4.23)**	**14.42 (3.85)**	**12.92 (4.15)**

The participants' performance on the TOPAS was subjected to a two-factor (group x task) ANOVA with repeated measures. The results of the ANOVA are presented in Table 2.

Table 2. Summary of Analysis of Variance for Scores on the Subtests of the TOPAS

Source	SS	df	MS	F	P
Between Groups	**697.3331**	**23**			
Factor A	**192.6669**	**1**	**192.6669**	**8.399**	**.0083**
Sub. Within Groups	**504.6662**	**22**	**22.93938**		
Within Groups	**447.9998**	**72**			
Factor B	**97.08348**	**3**	**32.36116**	**6.3661**	**.0007**
A X B	**15.41617**	**3**	**5.13872**	**1.0109**	**.3936**
B X Sub. Within Groups	**335.5002**	**66**	**5.08334**		
Total	**1145.333**	**95**			

Results of the ANOVA indicated that the non-impaired group performed significantly better (p.=.008) than the phonologically impaired group on the TOPAS. The ANOVA also indicated that there was a significant difference (p=.0007) among the scores attained

on the subtests of the TOPAS. There was no significant interaction between the group and task factors. A Newman-Keuls post-hoc analysis was performed to identify significant differences among the four TOPAS subtests. The results of the Newman-Keuls are presented in Table 3.

Table 3. Q values for the Newman-Keuls comparisons among subtests.

	Sub-test I Rhyming	**Subtest II Incomp. Word**	**Subtest IV Phon. Del.**	**Subtest III Snd.Sequencing**
Sub-test I Rhyming		**1.177**	**3.713**	**5.614 ***
Subtest II Incomp. Word			**2.535**	**4.437***
Subtest IV Phon. Del				**1.901**

*** Indicates significant at the .01 level.**

From Table 3 it can be seen that that scores on the sound sequencing subtest were significantly higher than scores on the rhyming and the incomplete word sub-tests. No other significant differences were detected. It should be noted, however, that the difference between the phoneme deletion subtest and the rhyming subtest was very close to significant at the .05 level. The Q value obtained when comparing these two subtests was 3.713 and the criterion level for significance at .05 was 3.737.

Participants were also compared on the TOPAS composite score. The non-impaired group demonstrated a mean composite score of 124.083 (S.D.=12.36) compared to a mean score of 106.917 (S.D. = 18.84) for the phonologically impaired group. This indicates a better performance by the non-impaired group. A two-tailed t test indicated that this difference was significant (t=-2.647, df=22, p.0147).

In addition to the standardized TOPAS, the participants in the present study were also administered three non-standardized assessments of phonological awareness which have been used in previous investigations. These measures included tasks of rhyming, phoneme counting and phoneme blending.

The mean and standard deviations of the percentage of correct responses on each of these tasks for both groups are presented in Table 4.

Table 4. The mean and standard deviations of the percentage of correct responses on each of three non-standardized phonological awareness tasks for two groups.

	Phonologically Impaired	**Non-impaired**	**Total**
Phoneme Counting	**60.17 (26.28)**	**76.00 (14.82)**	**68.08 (21.90)**
Rhyming	**75.83 (13.95)**	**85.42 (7.82)**	**80.63 (11.84)**
Blending	**80.00 (26.26)**	**97.58 (3.39)**	**88.79 (19.96)**

The performance of the participants on these non-standardized tasks was subjected to a two-factor (group x task) ANOVA with repeated measures. The results of the ANOVA are presented in Table 5.

Table 5. Summary of Analysis of Variance for Non-Standardized Tasks of Phonological Awareness

Source	**SS**	**df**	**MS**	**F**	**P**
Between Groups	**16839.34**	**23**			
Factor A	**3698.001**	**1**	**3698.001**	**6.1908**	**.0209**
Sub. Within Groups	**13141.33**	**22**	**597.3334**		
Within Groups	**12830.68**	**48**			
Factor B	**5222.581**	**2**	**2611.291**	**15.5353**	**<.0001**
A X B	**212.2578**	**2**	**106.1289**	**.6314**	**.5366**
B X Sub. Within Groups	**7395.838**	**44**	**168.0872**		
Total	**29670.01**	**71**			

Results of the ANOVA indicated that, as on the TOPAS, the non-impaired group performed significantly better (p.=.021) than the phonologically impaired group. The ANOVA also indicated that there was a significant difference (p= <.0001) among the scores attained on these three phonological awareness tasks. There was no significant interaction between the group and task factors. A Newman-Keuls post-hoc analysis was performed to identify significant differences among the three non-standardized tasks. The results of the Newman-Keuls are presented in Table 6.

Table 6. Q values for the Newman-Keuls comparisons among three non-standardized phonological awareness tasks

	Task I Phoneme Counting	**Task II Rhyming**	**Task III Blending**
Task I Phoneme Counting		**4.740****	**7.827****
Task II Rhyming			**3.087***

*** Significant at .05**
**** Significant at .01**

From Table 6 it can be seen than all three tasks differ significantly from each other with the best performance on sound blending, next best on rhyming and the poorest performance on phoneme counting.

VI. DISCUSSION

Previous research has demonstrated that children with severe phonological disorders are more likely to exhibit difficulty with phonological awareness tasks than are children without phonological impairments. (Bird et al., 1995; Catts, 1991b; Catts, Fey, Zhang, & Tomblin, 1999; Cowan & Moran, 1997; Magnusson & Naucler, 1993; Vellutino & Shub, 1992; Larivee & Catts, 1999; Rvachew et al., 2003; Webster & Plante, 1992). Some authors (Bishop & Adams, 1990) have suggested that that children with children with phonological disorders and accompanying language problems are more likely to experience problems in phonological awareness than children with phonological problems and no accompanying language problems. The results of the present study indicate that children with mild and moderate phonological disorders independent of any coexisting language disorder performed more poorly on both standardized and non-standardized tests of phonological awareness than did a control group of children without phonological errors. This finding supports the suggestion by Cowan and Moran (1997) that children are at risk for problems with phonological awareness with much milder degrees of expressive phonological impairment than previously thought. The results of the present study also support the findings of Bird, Bishop and Freeman (1995) and Rvachew and associates (2003) that phonological disorders independent of a language disorder can affect the children's phonological awareness skills. This is an important

finding because of the extensive literature which links phonological awareness abilities and later abilities in reading and spelling (Blachman, 1984; Blachman & James, 1986; Bradley & Bryant, 1983; Ehri, et.al, 2001; Juel, 1988; Juel, Griffith, & Gough, 1986; Lundberg, Olofsson, & Wall, 1980; Mann, 1984; Mann & Lieberman, 1984; Share, Jorm, Maclean, & Matthews, 1984; Stanovich, Cunningham, & Cramer, 1984; Torneus, 1984; Vellutino & Scanlon, 1987). A child's academic success in any subject area is ultimately based upon their ability to read. Therefore, it is important to identify children who are at risk for reading problems at the youngest age possible. Knowing that children with phonological disorders are at risk for phonological awareness deficits, school personnel should, at the very least, closely monitor the reading development of children referred for articulation disorders. Because phonological awareness assessments are generally not lengthy and tend to be "game-like" in nature they are quick and easy to administer. Such evaluations could easily be added to the typical speech and language assessments performed in school settings providing valuable predictive information regarding the potential for later reading problems. Additionally, the fact that a readily available standardized test such as the TOPAS appeared to yield the same results as those non-standardized tasks used in research, the present study suggests that such tests could be employed in routine phonological assessments to provide the benefits of a standardized test.

One cautionary note should be sounded. With regard to the performance on the TOPAS it must be pointed out that, although the mild to moderately phonologically impaired children in the present study performed more poorly on tasks of phonological awareness as compared with the control group, they did not, in most cases, score outside

the average range for their age group according to the test's normative data. As stated in the TOPAS manual, "Norms for the subtests are presented in terms of standard scores called scaled scores having a mean of 10 and a standard deviation of 3." (Newcomer & Barenbaum, 2003). According to the manual, this distribution is used on many other aptitude tests. From this information, one can then compute an "Ability Score." This score has a mean of 100 and a standard deviation of 15. The authors of the TOPAS consider an ability score of 90 or above to be "Average." All but three (Subjects 1, 3, and 15) scored in the average range for their age. This means that all but the three mentioned participants achieved an "Ability Score" of 90 or above. This is consistent with a observation reported by Bird, Bishop and Freeman (1995) that children with mild or moderate articulation impairments generally do not score lower than what is considered normal for their age. It is not clear that the participants who performed lower on the TOPAS but were still within the average range would be seriously at risk for reading problems. This appears to be an area for future research.

One possible reason that the phonologically impaired children in the present study were still within the average range on the TOPAS is that, as mentioned previously, both groups receive phonological awareness training as part of their curriculum. School A incorporated a traditional approach to reading using the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) assessment methods (University of Oregon Center on Teaching and Learning, retrieved January 21, 2006). These include Initial Sound Fluency (the child's ability to produce the initial sound of a word), Phoneme Segmentation Fluency (ability to produce individual sounds within a given word), Nonsense Word Fluency (letter-sound correspondence as well as blending ability), and

finally Oral Reading Fluency (reading grade-level texts). School B was involved in its first year of the new "Alabama First Reading Initiative." This initiative (http://www.alsde.edu/html/sections/section_detail.asp?section=90&footer=sections), begins at the Kindergarten level. The initiatives explicit goals include providing "linguistically-rich environments that develop phonemic awareness through play with the sounds of the language" as well as, "Systematic, explicit phonics instruction that is engaging and involves students in building and decoding words." (http://www.alsde.edu/html/sections/section_detail.asp?section=90&footer=sections). As stated in the Method section, participants were matched for pre-reading program. Although it is not the primary focus of the present study, it is interesting to examine the performance of the participants in relation to the type of pre-reading program in which they participated. Because the number of children in each group are small and unequal (14 from School A, seven normal, seven phonologically impaired; 10 from School B, five normal, five phonologically impaired), for purposes of the present study a simple comparison of means was used to make this comparison. As seen in Table 7, the mean scores obtained by those participants in the DIBELS program were consistently lower (while still very close) than those obtained by participants in the Alabama Reading Initiative.

Table 7. A Comparison of Standardized and Non-Standardized Phonological Awareness Scores from Two Schools in Lee County, Alabama

	School A (Alabama Reading Initiative School) (N=14)	School B (DIBELS Method School) (N=10)
Average Non-Standardized Phoneme Counting Score	**71.71429**	**61.6**
Average Non-Standardized Rhyming Score	**82.5**	**78**
Average Non-Standardized Phoneme Blending Score	**89.35714**	**88**
Average Standardized Rhyming Score	**11.42857**	**10.9**
Average Standardized Incomplete Words Score	**12.71429**	**10.4**
Average Standardized Sound Sequencing Score	**14.78571**	**12.4**
Average Standardized Phoneme Deletion Score	**13.35714**	**11.3**

Another purpose of the present study was to compare the performance of the participants on the individual phonological awareness tasks that made up the standardized and non-standardized assessments. When looking at the non-standardized subtests: rhyming, phoneme counting, and blending, it is interesting to see that students performed best on blending, then on rhyming, and lastly on counting. As addressed previously, blending requires analysis at the level of the phoneme, and rhyming at the level of the syllable. This would contradict the previously mentioned norms for the way phonological awareness develops. However, another plausible explanation would be that this skill-that of sound blending- is one heavily drilled in the two different elementary school's reading programs. Both schools focused on their students' ability to blend sounds together to make non-sense words. Therefore, it is possible that this skill has been learned, and did not come into occurrence implicitly through natural development,

but because of explicit teaching. This idea would confirm the research that states that phonological awareness skills can, in fact, be taught.

The performance of both groups of children on the standardized assessment (TOPAS) was uniform in a couple of ways. First of all, both of the group's scores rank the tasks in the same order of difficulty, which as previously mentioned, goes against what is known about development. Rhyming, the task found to be most difficult by both groups, is generally accepted to be the earliest developing phonological awareness skill out of the ones assessed by the TOPAS. The method of assessing rhyming ability was rhyme supply, however this method also required some semantic knowledge. The participants were required not only to supply a word that rhymed with a word, but also one that was semantically appropriate given the context (e.g., the fat CAT wore an ugly ___[hat]). This could have increased the difficulty level, thus being the cause of why the participants all scored comparatively lower on this subtest than on the other, typically later developing ones.

Confirming this hypothesis is that children did not find the rhyming task used in the non-standardized assessment to be the most difficult. The rhyming task used in the non-standardized assessment is that of rhyme detection (e.g., do fun and sun rhyme?). While the children still performed better on the phoneme blending tasks (on both non-standardized and standardized assessments), rhyming was at least improved when it was a task that did not require semantic processing.

The task the children performed highest on was sound sequencing. In this task, the investigator assigned different sounds to different colored blocks (e.g., the red block says /a/ and the blue block says /b/). The children were then required to make nonsense

phonemic combinations with the blocks such as “b-a-b-a” (the child would then arrange the blocks as blue, red, blue, red). While, at first glance this task would appear to be more difficult than rhyming due to the processing being at the phoneme level, there is an alternate explanation for the participants performing so well on this task. One, there is visual cuing involved. The assessment provides for training with the participant, teaching them in a concrete way that red says “a” and blue says “b.” Two, as mentioned earlier, the children at both schools had been taught to blend sounds to make nonsense words, so this was not a foreign concept to them.

The tasks that were used to test phonological awareness in these children, both standardized and non-standardized required different types of processing on the part of the child. The rhyming tasks require analysis at the level of the syllable, where as the phoneme deletion tasks, and sound blending tasks require analysis at the level of the phoneme. This further displays that children with even mild or moderate degrees of phonological impairment score lower on items which require them analyzing of the sounds of our language, which involves attending to and manipulating (Catts, 1991b) phonemes. Five of the twelve participants in the phonologically impaired group had three or fewer class errors. The most common errors were in the liquid (phonemes /r/ and /l/) category. While some of the children exhibited errors that at first glance might indicate a more severe phonological impairment (Seven of the 12 still exhibited consonant sequence omission, typically thought to be suppressed by age 3 (Stoel-Gammon & Dunn, 1985). However, these children often only exhibited one or two instances of each of the earlier suppressed processes leaving most of their articulation errors falling under the category of liquids. Typically, a child who has a problem with /r/

would be less likely to picked up on a school speech pathologist's caseload, especially at the age of six. However, as this study shows, children with mild and moderate articulation problems are already showing a discrepancy with their phonological awareness abilities as compared with their same age peers.

The results of this study show that, along with many others (Bird et al., 1995; Catts, 1991b; Catts, Fey, Zhang, & Tomblin, 1999; Cowan & Moran, 1997; Magnusson & Naucler, 1993; Vellutino & Shub, 1992; Larivee & Catts, 1999; Rvachew et al., 2003; Webster & Plante, 1992), phonological impairments can affect a child's ability to manipulate and analyze the sounds of speech. However, this study was different in that it utilized standardized testing as a one of its methods of measuring phonological awareness skills.

Given the No Child Left Behind (NCLB) legislation enacted January 8, 2002 (ASHA, retrieved January 21, 2006), it would be beneficial for these schools to begin testing children referred for even mild and moderate articulation disorders for phonological awareness skills as a means of predicting and addressing future problems in reading or writing. By predicting, and ideally circumventing future reading problems, it would be possible to raise a schools percentage of students who are "proficient" according to NCLB.

Limitations of the study are the small number of participants and the two different reading programs that these students participated in. Ideally, one would have a large enough number of participants to gather the data in one school, or even to be able to compare the students of different reading programs, such as the two mentioned by this study. It should also be mentioned that the screening used to rule out the language

disorder is not a comprehensive measure of both expressive and receptive language. According to the norming information provided by the CELF-4 Screener (Semel, Wiig, and Secord, 2003), the screener was found to over identify children as having language disorders, when in fact they did not, however, a more comprehensive language assessment involving standardized and non-standardized methods would be ideal because of the information that could be gained regarding their language skills.

Another potential limitation of the present study was that the articulation impaired group included only two females while the control group included six females and six males. Very little is known about gender differences in the development of phonological awareness skills however it has been demonstrated that girls tend be slightly ahead of boys in phonological development, particularly up to age six (Kenny & Prather, 1986; Smit, Hand, Freilinger, Bernthal and Bird , 1990). On the tasks of phonological awareness, the females in the phonologically disordered group were not the highest scorers on either standardized or non-standardized tasks of phonological awareness. So despite the fact that the groups were not evenly balanced for gender, it does not appear that gender can account for the differences between the two groups. Informal comparison of the performance of the female participants to the male participants in the control group also does not appear to suggest any systematic differences between genders.

The study was also limited as to the order in which the subtests of the TOPAS were administered. The investigator administered the subtests in the order they appeared in the testing booklet. In this particular assessment, rhyming was always first. For the non-standardized assessment, the order was randomized thus eliminating this as the cause of the difference in the performance on the different tasks. With the TOPAS, it is

possible that the reason the children did not perform as well as expected on the rhyming (as compared with what is expected developmentally) because it was always done first meaning it could have influenced performance on the other tasks.

The present study raises several issues that suggest a need for additional research. Among these issues are the following:

In the present study participants with mild and moderate phonological disorders performed more poorly on phonological awareness tasks than those with no phonological impairment. However, the impaired group was still in the average range according to the TOPAS. The effects of such an apparently mild delay in phonological abilities on reading is not clear and merits further investigation.

The results of the present study raise the possibility that different reading readiness programs may have differing effects on improving the phonological awareness skills of children. A comparison of such programs in terms of the development phonological awareness skills would be of interest.

Although the presence of reduced phonological awareness skills in children with mild and moderate phonological impairments has now been demonstrated in at least two studies, the numbers are still small and the distribution of participants geographically limited. Larger scale studies are needed before wide application of these findings can be fully encouraged.

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APPENDICES

APPENDIX A

Subject	Gender	DOB	CELF	APP-R∇	Errors*
1	Male	11/16/99	14(12)	19.8 mi	1,2,5,8,10
3	Male	12/11/98	14(14)	25.7 mo	1,2,5,6,7,10
4	Male	12/08/98	14(14)	15.45 mi	6
5	Male	10/30/98	20(16)	26.42 mo	5,8
6	Female	11/07/99	16(12)	24.37 mo	5,7,8
14	Male	10/06/99	14(12)	25.32 mo	2,4,5,8,10
15	Male	01/10/00	11(11)	24.38 mo	2,4,5,6,7,8
16	Male	08/26/99	18(12)	23.61 mo	2,4,5,8
17	Female	05/16/99	22(14)	17.2 mi	2,4,5,6,8
18	Male	08/27/99	15(14)	19.93 mo	2,4,5,6,8
20	Male	07/20/99	19(12)	15.25 mi	2
23	Male	08/31/99	12(12)	15 mi	str. distortions
8	Female	09/14/98	19(16)	0	NONE
9	Male	09/25/98	23(16)	0	NONE
10	Male	10/07/98	16(16)	0	NONE
11	Female	04/28/99	14(14)	0	NONE
12	Male	01/28/99	23(14)	0	NONE
19	Male	01/19/99	23(14)	0	NONE
21	Female	04/18/99	19(14)	0	NONE
22	Male	01/09/99	20(14)	0	NONE
24	Female	03/29/99	16(14)	0	NONE
25	Male	02/02/99	16(14)	0	NONE
26	Female	08/31/99	23(12)	0	NONE
27	Female	07/28/99	19(12)	0	NONE

Note: Subject 2 was dropped due to failing the CELF-4 Screener, and Subjects 7 & 13 were dropped due to absences. In the CELF column, the first number indicates the participants standard score, while the number in parenthesis indicates the criterion score for that participant based on their age. ∇The APP-R column has their "Phonological Deviancy Score" as determined by the scoring methods on that particular assessment. The abbreviations "mi" represent a "mild" score and "mo" represent a "moderate" score. The errors column gives the type of errors as indicated on the score sheet of the APP-R. *The numbers represent the following: 1=Syllable Omission, 2=Consonant Sequence Omission, 3=Prevocalic Singleton Omission, 4=Postvocalic Singleton Omission, 5=Strident Deficiencies, 6=Velar Obstruent Deficiencies, 7=Liquid(l) Deficiencies, 8=Liquid(r) Deficiencies, 9=Nasal Deficiencies, 10=Glide Deficiencies.

APPENDIX B

Sub#	Group	DOB	NS-PC	NS-RY	NS-BL	S-RY	S-IW	S-SS	S-PD	Ability Score
1	Artic	11/16/99	28	65	53	6	8	9	9	87
3	Artic	12/11/98	72	65	80	6	8	6	6	77
4	Artic	12/08/98	72	75	93	11	8	12	8	98
5	Artic	10/30/98	52	85	96	10	12	15	14	118
6	Artic	11/07/99	30	60	83	12	11	9	9	102
14	Artic	10/06/99	16	70	33	8	14	7	7	93
15	Artic	01/10/00	70	50	30	6	8	12	7	88
16	Artic	08/26/99	82	95	100	14	14	16	19	138
17	Artic	05/16/99	94	80	100	11	15	9	15	117
18	Artic	08/27/99	38	90	96	13	13	16	13	125
20	Artic	07/20/99	86	85	100	12	13	16	15	127
23	Artic	08/31/99	82	90	96	9	7	15	15	113
8	Normal	09/14/98	80	85	96	12	10	12	14	113
9	Normal	09/25/98	88	95	100	14	12	15	15	127
10	Normal	10/07/98	74	70	93	9	11	12	8	100
11	Normal	04/28/99	52	90	90	15	13	16	14	130
12	Normal	01/28/99	68	90	96	14	11	18	16	132
19	Normal	01/19/99	88	90	100	13	13	16	17	132
21	Normal	04/18/99	96	90	100	14	16	16	17	138
22	Normal	01/09/99	80	85	100	11	14	14	10	115
24	Normal	03/29/99	90	90	100	12	13	15	17	128
25	Normal	02/02/99	64	85	96	9	14	17	8	113
26	Normal	08/31/99	50	70	100	13	10	19	10	120
27	Normal	07/28/99	82	85	100	15	14	19	17	142

NS-PC=Non-Standardized Assessment, Phoneme Counting; NS-RY=Non-Standardized Assessment, Rhyming; NS-BL=Non-Standardized Assessment, Phoneme Blending; S-RY=Standardized Assessment, Rhyming; S-IW=Standardized Assessment, Incomplete Words; S-SS=Standardized Assessment, Sound Sequencing; S-PD=Standardized Assessment, Phoneme Deletion; Ability Score is the score obtained from all scores on the standardized assessment (TOPAS).

APPENDIX C

Phoneme Blending Subtest

Subject #:_____ Group:_____ Date:_____ Test #:_____
Examiner:_____ Time to Administer:_____

Directions: Tell me what word we would have if these sounds were put together.
Examples: d-o, b-all, b-e-d
Section 1:

	response		response
1. a-t	_____	6. u-p	_____
2. th-e	_____	7. b-ee	_____
3. z-oo	_____	8. g-o	_____
4. i-f	_____	9. t-o	_____
5. o-n	_____	10. s-ew	_____

Section 2:

	response		response
1. st-ep	_____	6. gr-een	_____
2. f-at	_____	7. ch-ip	_____
3. fl-ag	_____	8. th-in	_____
4. l-ong	_____	9. m-ilk	_____
5. j-ump	_____	10. sl-ide	_____

Section 3:

	response		response
1. c-a-t	_____	6. r-e-d	_____
2. d-e-sk	_____	7. y-e-ll	_____
3. v-a-n	_____	8. m-a-n	_____
4. h-ou-se	_____	9. b-ir-d	_____
5. w-a-sh	_____	10. c-u-t	_____

Total number correct = _____ out of 30 = _____ %

APPENDIX D

Phoneme Counting Subtest

Subject #:_____Group:_____ Date:_____ Test #:_____
Examiner:_____ Time to Administer:_____
Directions: We are going to play a listening and tapping game today. I'm going to say some words and sounds and tap them after I say them. Listen, so you'll see how to play the game.

Examples: /u/, boo, boot; /ae/, as, had; /o/, toe, tall; /i/, ma, cut.
Directions: Now we are ready to play the real game. I'll say a word or sound, but I won't tap it because you know how to play the game yourself. So, you say the word after me then tap it. After each word, be sure to put your pencil down so I'll know you've finished tapping.

	response		response
1. is	_____	27. /au/	_____
2. /ʃ/	_____	28. /U/	_____
3. my	_____	29. /toys/	_____
4. toy	_____	30. cake	_____
5. /dʒ/	_____	31. cool	_____
6. /i/	_____	32. /e/	_____
7. /soap/	_____	33. Ed	_____
8. /I/	_____	34. cup	_____
9. his	_____	35. at	_____
10. pout	_____	36. book	_____
11. mine	_____	37. lay	_____
12. out	_____	38. /o/	_____
13. red	_____	39. /θ/	_____
14. /æ/	_____	40. give	_____
15. cough	_____	41. chew	_____
16. pot	_____	42. wing	_____
17. /u/	_____	43. Joe	_____
18. heat	_____	44. yam	_____
19. he	_____	45. shirt	_____
20. /a/	_____	46. this	_____
21. pa	_____	47. blue	_____
22. mat	_____	48. snow	_____
23. /tʃ/	_____	49. bath	_____
24. so	_____	50. grow	_____
25. /ai/	_____		
26. up	_____		

Total number correct = _____ out of 50 = _____%

APPENDIX E

Rhyming Subtest

Subject #:_____ Group:_____ Date:_____ Test #:_____
Examiner:_____ Time to Administer:_____

Directions: Do you know what a rhyme is? A rhyme is "words that sound the same at the end." I'm going to say two words and you say "yes" if they rhyme or "no" if they do not rhyme.

Examples: cat/hat, man/fan, child's name with rhyme
Counterexamples: run/green, bag/bat, dog/mall.

	response
1. pig/big	_____
2. gum/sum	_____
3. sun/stove	_____
4. sandal/candle	_____
5. thing/rug	_____
6. buzz/fuzz	_____
7. mat/hat	_____
8. cub/come	_____
9. yellow/fellow	_____
10. top/cop	_____
11. watch/wish	_____
12. lathe/fade	_____
13. train/mean	_____
14. chair/bear	_____
15. bike/kite	_____
16. the/she	_____
17. cage/maid	_____
18. bath/half	_____
19. yell/mess	_____
20. snake/lake	_____

Total number correct = _____ out of 20 =_____%