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Understanding the Development of Alphabet Knowledge in At-Risk Populations: The Influence of Pre-Literacy Skills

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UNDERSTANDING THE DEVELOPMENT OF ALPHABET KNOWLEDGE IN AT-RISK POPULATIONS: THE INFLUENCE OF PRE-LITERACY SKILLS

by

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ABSTRACT
UNDERSTANDING THE DEVELOPMENT OF ALPHABET KNOWLEDGE IN AT-RISK POPULATIONS: THE INFLUENCE OF PRE-LITERACY SKILLS

by

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In the current research, alphabet knowledge has been confirmed as a critical component of children's developing emergent literacy proficiency. The assessment of pre-literacy skills, such as alphabet knowledge, plays an important role in the management of children at-risk for poor reading outcomes. This study aimed to better understand the influence of phonological awareness skills, print skills, and receptive vocabulary on the development of alphabet knowledge in at-risk preschool-age children. Statistical analyses revealed that a significant unique relationship was present between phonological awareness skills and the development of alphabet knowledge. Furthermore, this study identified three clusters of children based on the amount of growth in their alphabet knowledge. Final analyses were completed within the identified clusters to determine the specific types of letters learned by each cluster. These analyses revealed that the clusters of children learned different types of letters based on the amount of growth in their alphabet knowledge. These findings equip practitioners with the additional evidence base necessary to be confident in using

measures of alphabet knowledge and phonological awareness to identify children at-risk for later reading difficulties. The results of this study confirm that alphabet knowledge can be used as a curriculum-based measure, as well as a general outcome measure. These results are also significant in helping teachers selecting appropriate curriculum materials for teaching alphabet knowledge in pre-school and kindergarten classrooms.

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Introduction

In today's society, literacy is essential for success. *Webster's II New College Dictionary* (1995) defines the term *literacy* as "the quality or state of being literate," where being *literate* means "one who can read and write; an educated person" (p. 640). Upon entering school, young children receive formal instruction and begin to develop conventional reading and writing skills, building the foundation for future academic success. While this process is simple for many children, it proves to be very difficult for others. It is estimated that one in three children experience significant difficulty learning to read (Lonigan, Burgess, & Anthony, 2000). Those children who experience early difficulties in learning to read will likely continue to experience reading problems throughout their school years and into adulthood (Lonigan et al., 2000). Children with poor reading abilities will continue to fall further behind their more literate peers in reading and other academic areas (Lonigan, 2006). In order to understand how to prevent later reading difficulties in these children, it is important to gain a better understanding of their emergent literacy skills.

Emergent Literacy

Emergent literacy conceptualizes the idea that literacy is a developmental continuum that begins in the early childhood years and continues to develop through the school years (Whitehurst & Lonigan, 1998; Justice & Kaderavek, 2004; Sulzby & Teale, 1991; Van Kleeck, 1990). Along this continuum lie the skills, knowledge, and attitudes that are believed to be developmental precursors to conventional reading and writing (Whitehurst & Lonigan, 1998). Children develop these pre-literacy skills through

early reading and writing experiences. These literacy experiences then offer the child opportunities to begin developing ideas about how written language works and what it is used for before they begin to read (Paul, 2007).

In organizing pre-literacy skills, Whitehurst and Lonigan (1998) proposed a model of emergent literacy that includes two categories: outside-in and inside-out pre-literacy skills. The outside-in category is more general in that it includes the skills that represent the child's knowledge of the context in which the target text occurs. Examples of these skills include the child's knowledge of the world or semantic knowledge. The inside-out category is more specific in that it includes the child's knowledge of the rules for translating the writing they are trying to read into actual meaningful sounds. A sample of the skills in this category would include the child's alphabet knowledge, phonological processing skills, and vocabulary.

Alphabet Knowledge

While both outside-in and inside-out pre-literacy skills are important, evidence from school-age children indicates that inside-out pre-literacy skills, specifically alphabet knowledge and phonological awareness, have the strongest relationship with later reading ability (Lonigan et al., 2000; Wagner, Torgesen, Rashotte, Hecht, Barker, Burgess, Donahue, & Garon, 1997; Storch & Whitehurst, 2002). Alphabet knowledge can be defined as a child's ability to identify and name the letters of the alphabet (Van Kleeck, 1990).

A study completed by Lonigan et al. (2000) confirmed the importance of alphabet knowledge in predicting later reading success in children. Researchers

followed two groups of preschool children recruited from 13 different preschools and childcare centers serving middle to upper income families. One of the groups consisted of 96 preschool children that ranged in age from 25 – 61 months. The second group consisted of 97 older preschool children that ranged in age from 48 – 64 months. The first group of participants completed four tests of oral language, four tests of phonological sensitivity, and two tests of non-verbal cognitive ability in the first testing period. These participants then completed four tests of phonological sensitivity, two tests of alphabet knowledge, an environmental print task, and a print concepts task in the second testing period. The second group of participants completed one test of oral language, four tests of phonological sensitivity, two tests of letter knowledge, an environmental print task, and a print concepts task during the first testing period. These participants then completed four tests of phonological sensitivity, two tests of alphabet knowledge, a print concepts task, and two text decoding tasks during the second testing period. The researchers followed these two groups of preschool children over 1 – 2 years and documented the development of their pre-literacy skills through their test scores. The results reflected stable trajectories of performance for both phonological awareness and alphabet knowledge. Furthermore, both alphabet knowledge and phonological awareness were found to be the only unique predictors of later reading ability. This study was somewhat limited, however, in that it mainly focused on the period between preschool and second grade. This is only a small portion of the developmental course of reading acquisition.

Storch & Whitehurst (2002) addressed this limitation in their longitudinal study that systematically investigated the role of pre-literacy skills from the time of their development in 626 children from preschool to fourth grade. Researchers assessed code-related precursors and oral language in preschool and kindergarten children. The code-related precursors included the conventions of print (i.e., knowing that print in English goes from left to right and top to bottom across the page), beginning forms of writing (i.e., writing one's name), knowledge of graphemes (i.e., alphabet knowledge) and grapheme-phoneme correspondence (i.e., knowing the sound that corresponds to a letter), and phonological awareness (Storch & Whitehurst, 2002). Oral language skills included semantic, syntactic, and conceptual knowledge as well as narrative discourse. Reading accuracy and comprehension skills were then assessed in children from 1st through 4th grades. Through completing a structural equation model, the researchers were able to identify the extent to which code-related skills influence later reading ability. The results revealed that during elementary school, code-related skills maintained a strong and direct influence on later reading ability, accounting for 90% of the variance. More specifically, they found that reading ability was predominately determined by the level of print knowledge and phonological awareness a child brought from kindergarten.

Another study completed by Schatshneider, Fletcher, Francis, Carlson & Foorman (2004) further specified the importance of alphabet knowledge within the broader context of other phonological awareness measures. This study assessed the relative importance of measures of knowledge and skills obtained in a kindergarten

sample for the prediction of reading outcomes at the end of first and second grade. Researchers administered tests of phonological awareness a total of four times throughout the school-year. They also administered two measures of expressive and receptive language at the beginning of the academic year. The results revealed that measures of phonological awareness, letter sound knowledge, and naming speed consistently accounted for the unique variance across reading outcomes whereas measures of perceptual skills and oral language and vocabulary did not. Measures of alphabet and letter sound knowledge, naming speed, and phonological awareness were good predictors of multiple reading outcomes for children in first and second grade. Researchers found that alphabet knowledge accounted for 37% of the variance and letter sound knowledge accounted for 41% of the variance in reading comprehension at the end of first grade.

Measuring Children's Alphabet Knowledge

Based on the reviewed literature, alphabet knowledge has been confirmed as a critical component of children's developing pre-literacy proficiency. The assessment of pre-literacy skills, such as alphabet knowledge, plays an important role in the management of children at-risk for poor reading outcomes. Initially, assessments are used as screenings to identify children who are having difficulty with the target skill (McCauley, 2001). Once a child has been identified as struggling, the assessment can be used to describe the nature of the child's difficulties and instruction can be planned for the child based on the outcomes of the assessment (McCauley, 2001). Assessments can then be used to document pre-literacy outcomes and let the results of the assessments

guide decisions for future intervention (Blachowicz, Buhle, Frost, & Bates, 2007). The *curriculum-based measurement* literature provides guidance on identifying measures that meet the multiple demands outlined above.

Within education, curriculum-based measurement (CBM) has been described as an alternative to norm-referenced assessment or informal observations. This alternative is meant to be a simpler and more functional way for teachers to routinely monitor student achievement in the curriculum through regularly obtaining brief samples of curriculum-based performance (Deno, 1985). The teacher chooses a curriculum-based skill for a specific student and collects data points on that skill throughout the school year. For example, the teacher may collect data on a child's alphabet knowledge growth by documenting how many letters the child can identify on a monthly basis. These data points are placed on a graph to map the student's progress. The teacher then compares the student's performance to that of classroom peers to monitor any gaps between the two sets of data. Through the use of CBM, the teacher can gain several points of data throughout the academic year to more reliably measure short-term and long-term student progress (Deno, 1985). While this process was originally meant for regular education teachers, it can also be used to assess intervention outcomes in therapy as well.

One example of a current pre-literacy tool that utilizes CBM is the *Phonological Awareness and Literacy Screening – PreK* (*PALS-PreK;* Invernizzi, Sullivan, Meier, & Swank, 2004). This assessment is meant to be a screening, diagnostic, and progress monitoring tool teachers can use to measure the fundamental components of literacy

(Invernizzi et al., 2004). In order to be a true CBM, the tool must be meaningful (i.e., related to the curriculum). Alphabet knowledge is a key part of the *PALS-PreK* assessment and is one of the first developing inside-out skills (Whitehurst & Lonigan, 1998). The tool must also be psychometrically robust, or reliable and valid. Internal consistency was measured using Gutterman split-half reliability and Cronbach's alpha level. The internal consistency estimates for all *PALS-PreK* tasks were within an acceptable range (Invernizzi et al., 2004). The numbers fell between .71 and .94 using Gutterman split-half reliability and between .75 and .93 using Cronbach's alpha level, with the ideal number being 1.0. Inter-rater reliability was also assessed and expressed as Pearson correlation coefficients. The rates were .99 for all tasks, with the ideal number being 1. In addressing content validity, the assessment creators reviewed the current literature and included tasks that were representative of the subject matter being assessed. To assess construct validity, a factor analysis for the sample of a pilot yielded one factor with an eigenvalue of 2.9, suggesting that the *PALS-PreK* measures only emergent literacy. Concurrent validity was assessed through comparing the *PALS-PreK* assessment with three independent measures, and significantly correlated with all three measures. Predictive validity was found to be high for this assessment as well. Within the *PALS-PreK* assessment is a subtest that focuses exclusively on children's alphabet knowledge. In the alphabet knowledge subtest, the teacher randomly presents the 26 letters of the alphabet in uppercase form and asks the child to identify them (Invernizzi et al., 2004). This measure is easily interpretable by all stakeholders (e.g., teachers, parents, etc.). It is much more concrete and understandable than other

early measures, such as phonological awareness. Recently, the developers of the *PALS-PreK* developed the Quick Checks version of the *PALS-PreK* (Invernizzi et al., 2004). The Quick Checks version decreases the time needed to administer the test and increases the feasibility. The alphabet knowledge measure is part of the Quick Checks, making it a robust and clinically feasible CBM.

Specific versus General Outcome Measures

When choosing an outcome measure to use as a CBM, both specific and general outcome measures are viable options. In Deno's (1985) original description of CBMs, he recommended that teachers employ general outcome measures (GOM), which are general indicators of a child's development in a particular domain. While there may be many subcomponents of a particular skill, the GOM would be sensitive to growth in any aspect of the skill. One of the most studied GOMs is oral reading fluency, which simply documents the number of words that a child reads from a passage (Fuchs, Fuchs, Hosp, & Jenkins, 2001). Many sub-skills are required to read a passage fluently, such as sight word recognition, vocabulary knowledge, and phonological decoding. However, a weakness in any of these aspects of reading would be reflected in the child's performance on the oral reading fluency tasks, making it a GOM.

GOMs can be contrasted with specific outcome measures, which document children's skill with specific components of a skill. In reading, the *Dynamic Indicators of Basic Early Literacy Skills* (*DIBELS*) assessment battery provides CBMs for each of the essential components of reading (Good, Gruba, & Kaminski, 2001). In contrast to a GOM, practitioners used *DIBELS* to see which aspects of reading (e.g., phonological

decoding and sight word identification) are relative strengths and weaknesses for a child.

Both specific and general outcome measures have merit in the assessment of children. In following the original CBM framework proposed by Deno (1985), researchers should strive to identify measures that are GOMs. When considering alphabet knowledge as a CBM, it appears to be a specific outcome measure (i.e., documenting children's ability on a single emergent literacy skill) on the surface. However, if children's performance on an alphabet knowledge measure is strongly related to performance across a variety of emergent literacy skills, it has the potential to be used as a GOM. Further research is needed to document the relationship between children's growth in alphabet knowledge and other emergent literacy skills.

Emergent Literacy and Alphabet Knowledge in At-risk Populations

Curriculum-based measures are important for identifying children at-risk for later reading difficulties. Several studies have shown that children from low-SES homes are more likely to have fewer high-quality literacy experiences prior to entering preschool (Chaney, 1994; Senechal, LeFevre, Thomas, & Daley, 1998). Subsequently, these children display lower levels of performance on measures of language and phoneme awareness during the preschool years (Chaney, 1994; Senechal et al., 1998).

One study completed by Chaney (1998) examined the relationship between family literacy experiences and general language development, metalinguistic awareness, and knowledge about print in low- and high-SES children. Chaney (1998) studied 43 three-year-old children from a representative population. African American

children from the two lowest-income groups made up 35% of the sample. Results of this study indicated that the low-SES African American children were more likely to have lower pre-literacy skills when compared to high-SES children.

A study completed by Cabell, Justice, Konold, & McGinty (2011) explored the within-group variability in the emergent literacy skills of preschoolers who were at-risk for academic difficulties. Researchers used the Pearson-centered approach of cluster analysis to identify profiles of emergent literacy, taking into account both oral language skills and code-related skills, for 492 preschoolers enrolled in a special-needs program (Cabell et al., 2011). Analyses revealed 5 clusters of children based on their performance on measures of pre-literacy skills. The first cluster of children contained statistically more Caucasian participants. These participants achieved high pre-literacy and language scores. Children in the second cluster achieved average oral language scores and high alphabet knowledge scores. This cluster contained a larger percentage of African American participants. The third cluster contained significantly more Caucasian participants. These participants achieved average scores across all pre-literacy measures. The fourth cluster of children achieved relatively low oral language scores and broad code-related weaknesses. The final cluster of children achieved the lowest oral language scores and had broad code-related weaknesses as well. There were significantly more Hispanic participants in this cluster. The profiles of children in these clusters were then compared to midyear teacher ratings of emergent literacy and end-of-kindergarten literacy performance. The results of these comparisons indicated

that the early patterns of a child's academic performance were related to their subsequent reading achievement.

Because children who are experiencing emergent literacy deficits in their preschool years may be at-risk for later academic difficulties, early identification of these at-risk populations is absolutely crucial to encourage and promote long-term academic success (Lonigan, 2006). Without early intervention, children who have difficulty learning the letters of the alphabet and who continue to experience problems with decoding lose the opportunity to develop the fluency required to become a skilled reader, tend to experience decreased motivation to read, and miss out on opportunities to acquire vocabulary and other content knowledge (Lonigan, 2006).

Fortunately, there are pre-literacy training programs, such as Head Start and Early Reading First, which have been designed to provide minority children with literacy instruction and improve literacy outcomes. Several studies have examined the outcomes of these pre-literacy programs and have found variable results (Bierman, Domitrovich, Nix, Gest, Welsh, Greenberg, Blair, Nelson, & Gill, 2008). The study completed by Bierman et al. (2008) provided enriched intervention to 356 four-year-old children in 44 Head Start classrooms. This intervention included brief lessons, "hands-on" activities, and teaching strategies proven to promote social-emotional, language, and pre-literacy skills. Take-home materials were also given to parents for use in the home. Researchers administered multi-method assessments over the course of the year to track the children's progress. The results of this study revealed significant

differences favoring the children involved in the enriched intervention program on measures of pre-literacy and other language skills.

These educational programs have identified that alphabet knowledge is an important skill that children should acquire early in preschool. In fact, the Early Reading First program uses a measure of alphabet knowledge as one of their key indicators of program effectiveness (U.S. Department of Education, 2011), demonstrating the high importance placed on alphabet knowledge by key stakeholders.

Given the high importance of alphabet knowledge in the preschool curriculum and its use as a high-stakes assessment, it is critically important that researchers understand how children's alphabet knowledge develops and how it relates to other emergent literacy skills. This is particularly important for at-risk populations, who are at greater risk for emergent literacy difficulties.

Relationship between Alphabet Knowledge and Other Emergent Literacy Skills

So far, alphabet knowledge has been identified and confirmed as an important pre-literacy skill for children to acquire in early childhood. It is also important to understand exactly how alphabet knowledge is influencing later development. Based on the reviewed literature, it is unclear whether alphabet knowledge has a direct link to later reading abilities or if other mediating factors contribute as well. This information would provide researchers with a better understanding of the mechanisms involved in learning the alphabet. In addition, knowing the relationship between developing alphabet knowledge and other pre-literacy skills informs researchers on the potential for using a measure of alphabet knowledge as a GOM. I will next review studies that

provide greater specificity describing how alphabet knowledge may influence other pre-literacy skills.

Relationships have been identified between alphabet knowledge and other pre-literacy skills such as print skills, receptive vocabulary, and phonological awareness. A longitudinal correlational study completed by Wagner et al. (1997) examined the relations between phonological processing abilities and word-level reading skills in 216 children from kindergarten to 4th grade. The results of this study indicated that the developmental and individual differences in phonological processing abilities are related to the acquisition of reading skills, but the influence of other factors on this process is still unknown. This study also identified that children's alphabet knowledge was uniquely related to other pre-literacy skills. Individual differences in alphabet knowledge were found to uniquely influence the development of differences in phonological processing and serial naming.

A two year longitudinal study completed by Muter, Hulme, Snowling, & Stevenson (2004) further examined the relationships among early phonological skills, alphabet knowledge, grammatical skills, and vocabulary knowledge as predictors of word recognition in a group of 90 children. The results of this study indicated that word recognition skills were consistently predicted by earlier measures of alphabet knowledge and phoneme sensitivity but not by vocabulary knowledge, rhyme skills, or grammatical skills.

Development of Alphabet Knowledge

In the reviewed literature, alphabet knowledge has been identified as an important skill in predicting later reading abilities. This skill may be secondary to a close relationship with phonological awareness. It is still somewhat unclear, however, as to how children develop alphabet knowledge. A study completed by Justice, Pence, Bowles, & Wiggins (2006) examined four popular hypotheses for the development of alphabet knowledge. The first of these hypotheses was the *own-name advantage* which stated that children learn the letters that occur in their own names earlier than other letters (Treiman & Broederick, 1998). This hypothesis was based upon the idea of print exposure. It was believed that children see the letters of their own name more frequently in written form, giving those letters an advantage.

The second hypothesis, or the *letter-order hypothesis*, stated that children learn the letters that occur earlier in the alphabet first rather than the letters occurring at the end of the alphabet (McBride-Chang, 1999). Again, this hypothesis was based upon the idea of greater exposure to those letters that occur in the beginning of the alphabet as children learn letters through songs and games.

The third hypothesis, or the *letter-name pronunciation effect*, stated that children learn the letters of the alphabet that contain their pronunciation in the name of the letter first (McBride-Chang, 1999; Treiman & Broederick, 1998; Treiman, Tincoff, & Richmond-Welty, 1997). Letters included in this hypothesis were letters with a CV or VC structure (e.g., B, P, or F) as opposed to letters that do not have their name in the

pronunciation (e.g., C, G, or H). This hypothesis was related to the intrinsic phonological characteristics of the pronunciation of individual letters.

The fourth hypothesis, or the *consonant-order hypothesis*, stated that children learn the letters corresponding to earlier-acquired consonantal English phonemes (such as B or M) first relative to phonemes acquired later (Justice et al., 2006). It was believed that children articulate the earlier-acquired phonemes more frequently and form stronger phonological representations (Borden, Harris, & Raphael, 1994). Therefore, the letters that relate to those strong representations may then be easier for the child to learn.

The Justice et al. (2006) study set out to test each of these four hypotheses and characterize the intrinsic and extrinsic influences on the order in which preschool children learn the names of individual letters. Researchers followed 339 four-year old children attending public preschool classrooms that served primarily low-income students. For each child, the researchers assessed their knowledge of the 26 alphabet letters and tested the data for the four hypotheses. The results of this study indicated that the order of letter learning was not random and some letters held an advantage over other letters to influence their order of learning (Justice et al., 2006). By far, the strongest effect was observed for the children's first letter of their first name. Specifically, children were 7.3 times more likely to know their first initials. Relatively strong effects were also observed for the remaining letters in children's names. Children were 1.5 times more likely to know the letters in their own first names. Relatively strong effects were also observed for letters that sounded like their letter

name. Children were 1.8 times more likely to know CV letters than non-CV letters. On the other hand, only a slight advantage was found for letters occurring earlier in the alphabet. Children were 1.02 times more likely to know a letter one position earlier in the alphabet. Only a slight advantage was also observed for letters that correspond with early developing sounds, which were 1.09 times more likely than to be learned than other letters (Justice et al., 2006).

Summary and Rationale

Based on the reviewed literature, it is clear that alphabet knowledge is an important skill and important predictor of later reading outcomes. Children from at-risk populations often have poor reading outcomes and poor pre-literacy skills. If at-risk children can be identified from an early age, it may be possible to provide them with additional interventions to prevent later reading difficulties. It is not surprising that alphabet knowledge has been used in preventative service delivery models – it emerges early, is easy to measure, is easy to interpret, is part of the curriculum, and is related to later reading outcomes. While this simple, effective measure is used extensively, additional data are required to equip practitioners with the evidence-base to be confident in using the measure to identify at-risk children, plan their treatment, and monitor their progress.

The first goal of this study is to better understand the characteristics of children who make early alphabet knowledge gains by identifying predictors of children with strong early growth of their alphabet knowledge skills. I want to know the relationship with other pre-literacy skills, including phonological awareness, receptive vocabulary,

and print skills so that we can better understand which skills are being documented in this measure.

Next, if measures are going to be used to classify children, I need to document that children can be classified with the measure. The second goal of this study will be to test for the presence of subgroups of children based on their baseline alphabet knowledge and early growth in alphabet skills.

Finally, to better describe the characteristics of the subgroups of children, the third goal of this study will extend Justice et al.'s (2006) analyses to document which types of letters are related to better outcomes for children. This would allow me to make predictions as to those children who will succeed and those who will continue to struggle. The information gained from this study will contribute to the development of curriculum related to pre-literacy skills. This information will also contribute to more successful early identification efforts and will aid in the planning and implementation of appropriate intervention strategies.

For this study, the following research questions were addressed:

1. Are measures of phonological awareness, receptive vocabulary, and print skills significantly correlated with growth in alphabet knowledge, and which measure has the strongest unique relationship with the growth of alphabet knowledge?
2. Do measures of baseline alphabet knowledge and early growth in alphabet skills identify subgroups of children?

3. Using the letter learning hypotheses described in Justice et al. (2006), which types of letters are significantly correlated with growth in alphabet knowledge for the entire sample as well as the sub-groupings based on the cluster analysis?

Methods

Participants

For this study, I used a database that was collected by Dr. Maura Moyle and colleagues at Marquette University. All data were collected prior to initiating this study. The children were recruited by Dr. Moyle and her colleagues and the project was funded by the Department of Education's Early Reading First program. Graduate students in speech-language pathology, trained and supervised by a licensed and certified speech-language pathologist, collected the data through administering formal tests to the individual participants at the site of their Head Start program. Institutional Review Board (IRB) approval for this initial study was previously obtained at Marquette University. Additional IRB approval was granted for the present study by Marquette University (see Appendix C).

Participants for this study were recruited from 9 different Head Start centers and community-based preschools. On average there were 14 students from each center with a range of 1 – 23 students per center. There were no significant differences in alphabet knowledge growth observed between centers ($F(8, 115) = 0.60$, $p = .78$, $\eta^2 = .04$). The dataset used for this study included 124 African American children (*M*age = 45.06 months, SD = 6.02, age range: 34 – 59 months) enrolled in Head Start programs or community-based preschools located in an urban Midwestern city. All subjects were

monolingual English speakers. There were 54 males and 70 females in the dataset. Data were collected from three cohorts of children over three consecutive years. The children in the selected classrooms were tested in the fall and spring to monitor the children's progress in their language and literacy skills. The number of days that passed between fall and spring testing was calculated and used as a variable for subsequent analysis. There was a mean number of 224.06 (SD = 15.84, range = 171-249) days between the fall and spring testing periods for each participant. *Opening the World of Learning* (Schickedanz & Dickinson, 2005), a preschool curriculum with a language and literacy focus, was implemented in each of the classrooms.

Assessment Measures

Two assessment measures were used for this study and included the *Phonological Awareness and Literacy Screening-PreK* (*PALS-PreK*; Invernizzi et al., 2004) and the *Peabody Picture Vocabulary Test-Fourth Edition* (*PPVT-4*; Dunn & Dunn, 2007). These assessment measures were both selected for this study because they were mandated by the Early Reading First program.

The *PALS-PreK* assessment is a popular measure of emergent literacy skills in children. It is among the most commonly used preschool literacy assessments (Invernizzi, Landrum, Teichman, & Townsend, 2010). For example, in the 2008 – 2009 school-year, more than 1,400 preschool teachers utilized the *PALS-PreK* with over 21,000 children (Invernizzi et al., 2004).

In terms of clinical utility, a study completed by Justice, Invernizzi, Geller, Sullivan, & Welsch (2005) examined the performance of 2,161 preschoolers between 4 –

5 years of age on the *PALS-PreK*. Their results displayed measurable (but small) differences between 4- and 5-year old children. It was concluded that the *PALS-PreK* is a valuable tool for screening children's emergent literacy skills, monitoring progress, and instructional decision making.

The *PPVT-4* is a widely-used measure for assessing receptive vocabulary skills in people ages 2;6 – 90+ (Dunn & Dunn, 2007). The *PPVT-4* was developed over a five-year period and was standardized on a national sample of over 5,500 individuals aged 2;6 – 90+ (Dunn & Dunn, 2007). The sample that was used matched the U.S. census for gender, ethnicity, region, socioeconomic status, and clinical diagnosis or special education placement (Dunn & Dunn, 2007). This measure also provides extremely reliable scores with all reliability and validity coefficients in the .90 range (Dunn & Dunn, 2007).

Alphabet Knowledge.

Alphabet Knowledge subtest of PALS-PreK. The PALS-PreK is a widely-used assessment tool used for measuring children's emergent literacy development. It is meant to be a screening, diagnostic, and progress monitoring tool teachers can use to measure the fundamental components of literacy (Invernizzi et al., 2004). This assessment includes 6 subtests (see appendix A) designed to assess children's emergent literacy skills, with one that specifically measures alphabet knowledge (Invernizzi et al., 2004). In the alphabet knowledge subtest, the teacher asks the child to name the 26 upper-case letters of the alphabet presented in random order (Invernizzi et al., 2004). If the child knows more than 16 upper-case letters, then the lower-case alphabet

recognition task is also administered (Invernizzi et al., 2004). Those children who know 9 or more lower-case letters are then asked to produce the sounds associated with the 23 letters and 3 consonant diagraphs (e.g., ch, sh; Invernizzi et al., 2004). For the current research, only the upper-case alphabet recognition subtest was used to determine alphabet knowledge growth for each child.

A pilot study was completed during the 2000-2001 school year on this subtest by Invernizzi et al. (2004) to demonstrate the predictive nature of the upper-case alphabet recognition task for reading success. The results of this study revealed that the children's Fall 2000 scores on the upper-case alphabet recognition task were significantly correlated with their Spring 2001 *PALS-PreK* Summed Score ($r=.69$, $p<.001$) and accounted for 48% of the variance in spring scores (Invernizzi et al., 2004).

Other Measures of Early Development.

Phonological Awareness. To measure phonological awareness skills for each child, three *PALS-PreK* subtests were used. These subtests included the Beginning Sound Awareness, Rhyme Awareness, and Nursery Rhyme Awareness subtests. The beginning sound awareness subtest measures the child's ability to identify and produce the beginning sound of a word (Invernizzi et al., 2004). In the rhyme awareness subtest, the child's awareness of rhymes is assessed through identifying rhyming pictures (Invernizzi et al., 2004). The child's awareness of nursery rhymes is assessed during the nursery rhyme awareness subtest through finishing lines of different nursery rhymes (Invernizzi et al., 2004).

Print Skills. To measure print skills for each child, two *PALS-PreK* subtests were used. These subtests included the Name Writing and Print and Word Awareness subtests. In the name writing subtest, the child's ability to write letter symbols in the correct format is assessed through having them draw a picture and write their name (Invernizzi et al., 2004). The print and word awareness subtest assesses the child's awareness of the organization of print and words on a page (Invernizzi et al., 2004). The *PALS-PreK* assessment is criterion-referenced and benchmarks are provided for the spring of the four-year-old pre-kindergarten year (Invernizzi et al., 2004).

Receptive Vocabulary. To measure receptive vocabulary skills for each child, the individual scores from the *PPVT-4* were used. The *PPVT-4* is a widely-used measure for assessing child vocabulary skills (Dunn & Dunn, 2007). The *PPVT-4* is a measure designed to assess receptive vocabulary skills in people ages 2;6 – 90+ (Dunn & Dunn, 2007). This measure is individually administered and is norm-referenced.

Several studies have been completed to identify differences in performance between the normative sample utilized in the *PPVT* series and low-SES or ethnic minority populations. One such study, completed by Champion, Hyter, McCabe, & Bland-Stewart (2003) explored the relevance of the *PPVT-3* in assessing the receptive vocabulary skills of 49 three- to five-year-old African American children enrolled in a Head Start program. The results indicated that the mean score of these children was significantly lower than that of the normative sample, despite the fact that the measure's normative sample included minority participants. The researchers performed an item analysis to identify if any items were systematically missed by the children. This

analysis revealed that few items were systematically missed; instead, performance was reflective of ethnic or socioeconomic patterns of vocabulary use. The results of this study indicated that the *PPVT-3* was potentially culturally-biased against cultural and linguistic minority populations.

Another study by Washington and Craig (1999), also examined the use of the *PPVT-3* with at-risk African American preschoolers. Although the results of this study reflected scores that were lower than those reported for the *PPVT-3* standardization sample, the performance spread resulted in a normal distribution of scores. There were no differences in performance based on gender an income apparent, but the level of education of the parent or caregiver significantly influenced performance. This study concluded that the *PPVT-3* was a culturally fair instrument that was appropriate to use with at-risk African American preschoolers.

Results

Calculating Alphabet Knowledge Growth

Each participant's growth in alphabet knowledge was calculated by subtracting the total number of letters that children correctly named on the Alphabet Knowledge subtest of the *PALS-PreK* in the fall from the total number of letters correctly named on the Alphabet Knowledge subtest of the *PALS-Prek* in the spring. Results of these calculations are summarized in Table 1. Standard scores for the *PPVT-4* and *PALS-PreK* subtests are also summarized in Table 1. As shown, the participants correctly named a mean of 5.90 (*SD* = 7.94, range = 0 – 26) out of 26 letters in the fall testing period and a mean of 14.76 (*SD* = 9.61, range = 0 – 26) out of 26 letters in the spring testing period.

The mean alphabet knowledge growth across cohorts was 8.85 (*SD* = 7.79, range = -3 – 26) letters. There was a mean number of 224.06 (*SD* = 15.84, range = 171 – 249) days between the fall and spring testing periods for each participant. During the fall testing period, the participants were a mean of 45.06 (*SD* = 6.02, range = 34 – 59) months of age. The participants scored a mean of 95.97 (*SD* = 11.22, range = 70 – 121) on the *PPVT-4* (*M* = 100, *SD* = 15). On the Beginning Sound Awareness subtest of the *PALS-PreK*, participants scored a mean of 4.35 (*SD* = 3.53, range = 0 – 10) out of 10. On the Rhyme Awareness subtest of the *PALS-PreK*, participants scored a mean of 5.44 (*SD* = 2.55, range = 1 – 10) out of 10. Participants scored a mean of 4.65 (*SD* = 2.22, range = 0 – 10) out of 10 on the Nursery Rhyme Awareness subtest of the *PALS-PreK*. Participants scored a mean of 4.52 (*SD* = 1.81, range = 0 – 7) out of 7 on the Name Writing subtest of the *PALS-PreK*. Participants scored a mean of 4.91 (*SD* = 2.63, range = 0 – 10) out of 10 on the Print and Word Awareness subtest of the *PALS-PreK*.

Table 1: Descriptive Statistics

	Mean (SD)	**Median**	**Range**
Fall Letters	5.90 (7.94)	2.00	0 – 26
Spring Letters	14.76 (9.61)	17.00	0 – 26
Alphabet Knowledge Growth	8.85 (7.79)	7.50	-3 – 26
# Days Between Test	224.06 (15.84)	229.00	171 – 249
Age (Fall)	45.06 (6.02)	44.50	34 – 59
PPVT-4 Score	95.97 (11.22)	96.00	70 – 121
PALS-PreK Beginning Sound	4.35 (3.53)	4.00	0 – 10
PALS-PreK Rhyme Awareness	5.44 (2.55)	5.00	1 – 10
PALS-PreK Nursery Rhyme Awareness	4.65 (2.22)	5.00	0 – 10
PALS-PreK Name Writing	4.52 (1.81)	4.00	0 – 7
PALS-PreK Print and Word Awareness	4.91 (2.63)	5.00	0 – 10

Testing for Potential Confounds

The strength of this dataset was its richness and large size. The data for this study were collected from three cohorts of children over three years. There were 52 participants in the first cohort, 19 participants in the second cohort, and 53 participants in the third cohort. There were some differences between the children that could have been potential confounds. A series of one way Analysis of Variance (ANOVA) tests were completed to determine if there were differences in letter growth values based on the following independent variables: cohort (years 1 versus 2 versus 3) and school. This analysis revealed a significant difference between cohorts for alphabet knowledge growth ($F(2,121) = 5.30$, $p = .01$, $\eta^2 = .08$). The third cohort had the largest mean alphabet knowledge growth ($M = 11.36$, $SD = 8.15$) and the second cohort had the smallest mean alphabet knowledge growth ($M = 6.11$, $SD = 5.93$). The first cohort had an average mean alphabet knowledge growth ($M = 7.31$, $SD = 7.37$). There were no significant differences observed between schools ($F(8, 115) = 0.60$, $p = .78$, $\eta^2 = .04$). Because a significant difference was found for alphabet knowledge growth for cohort, it was added as a covariate in subsequent analyses.

In addition, a correlation was completed between children's alphabet knowledge growth and the number of days between fall and spring testing to determine if lag time was significantly related to children's performance. This analysis revealed a non-significant correlation between days between testing and alphabet knowledge growth ($r = .07$, $p = .44$).

A second correlation between children's alphabet knowledge growth and initial alphabet knowledge score was completed to determine if baseline knowledge affects children's growth potential. This analysis revealed a significant correlation at the 0.01 level between alphabet knowledge growth and initial alphabet knowledge (r = -.25, p = .01). Due to the significance of this variable, the initial alphabet knowledge was entered as a covariate in subsequent analyses.

Relationships between Alphabet Knowledge Growth and Other Measures of Early Development

Analyses were then completed to determine if there were relationships present between alphabet knowledge growth and other emergent literacy skills, including phonological awareness (as measured by the Beginning Sound Awareness, Rhyme Awareness, and Nursery Rhyme Awareness subtests of the *PALS-PreK*), print skills (as measured by the Name Writing and Print and Word Awareness subtests of the *PALS-PreK*), and receptive vocabulary (as measured by the *PPVT-4*). After controlling for cohort and initial alphabet knowledge, a series of partial correlations were completed between alphabet knowledge growth, each of the additional *PALS-PreK* subtests, and *PPVT-4* scores. Significant correlations were identified and the strength of each correlation was interpreted based on Cohen's (1988) criteria for weak (.10-.29), moderate (.30-.49), and strong (above .50) relationships. The results of these correlations are summarized in Table 2.

As shown, the Beginning Sound Awareness and Name Writing subtests of the *PALS-PreK* were observed to be significantly correlated with alphabet knowledge growth

at the $p < .001$ level and had moderate strength according to Cohen's Criteria (Cohen, 1988). The Rhyming Awareness and Print and Word Awareness subtests of the *PALS-PreK* were observed to be significantly correlated with alphabet knowledge growth at the $p < .05$ level and had weak strength according to Cohen's Criteria (Cohen, 1988). A non-significant correlation was observed between the Nursery Rhyme Awareness subtest of the *PALS-PreK*, *PPVT-4,* and alphabet knowledge growth.

Table 2: Relationships between Alphabet Knowledge Growth and Other Measures of Early Development

	PPVT-4	PALS-PreK Beginning Sound Awareness	PALS-PreK Rhyming Awareness	PALS-PreK Nursery Rhyme Awareness	PALS-PreK Name Writing	PALS-PreK Print & Word Awareness
Alphabet Knowledge Growth	.07	.39**	.18*	.16	.30**	.22*

*Significant at $p < .05$

**Significant at $p < .001$

Unique Relationships between Alphabet Knowledge Growth and Measures of Early Development

A series of hierarchical regression equations were then completed to determine which types of pre-literacy skills had the strongest unique relationship with alphabet knowledge growth. Alphabet knowledge growth was the dependent variable. In each equation, cohort and initial alphabet knowledge were entered into the first step of the regression equation to serve as control variables. Next, I included measures of children's phonological awareness (Beginning Sound Awareness and Rhyme Awareness subtests from the *PALS-PreK*) and print skills (Name Writing, and Print and Word

Awareness subtests from the *PALS-PreK*). The *PPVT-4* scores and the Nursery Rhyme Awareness subtest of the *PALS-PreK* were not used because they were not found to be significantly related to growth in the previous correlation analyses. Two separate hierarchical regression equations were completed to determine which of the above groups of variables explained the greatest amount of unique variance in children's growth in alphabet knowledge.

The first hierarchical regression equation explored the unique relationship between phonological awareness and alphabet knowledge growth. The results are summarized in Table 3. The cohort and initial alphabet knowledge were entered to control for any significant differences in Model 1. These factors were controlled to ensure that the differences between cohorts and the initial alphabet knowledge did not account for growth in alphabet knowledge. The Name Writing and Print and Word Awareness subtests of the *PALS-PreK* were also entered in Model 1 to control for print skills.

Model 2 identified the unique relationship between phonological awareness and alphabet knowledge growth after controlling for cohort, initial alphabet knowledge, and print skills. Together, the *PALS-PreK* Rhyme Awareness and the *PALS-PreK* Beginning Sound Awareness were significantly correlated with alphabet knowledge growth (r = .53). After adding these measures, the explained variance increased from 18% to 25%, an adjusted net increase of 8%. A one-way ANOVA was completed to determine if the increase in explained variance was significant. The 8% increase in explained variance was significant ($F(2,117)=6.86$, $p < .05$).

Table 3: Summary of Hierarchical Regression Analysis with Phonological Awareness Measures Uniquely Predicting Alphabet Knowledge Growth in Model 2

Model	Predictors	*r*	Adjusted r^2	r^2 Change	*F* change	*Sig.*
1	***Cohort*** ***Fall Letters*** ***PALS-PreK Print and Word Awareness*** ***PALS-PreK Name Writing***	.45	.18	.20	7.52	.000
2	Cohort Fall Letters *PALS-PreK* Print and Word Awareness *PALS-PreK* Name Writing ***PALS-PreK Rhyme Awareness*** ***PALS-PreK Beginning Sound Awareness***	.53	.25	.08	6.86	.002

The second hierarchical regression equation explored the relationship between print skills and alphabet knowledge growth. The results are summarized in Table 4. The cohort and initial alphabet knowledge were again entered to control for any significant differences in Model 1. These factors were controlled to ensure that the differences between cohorts and the initial alphabet knowledge did not account for growth in alphabet knowledge. The Rhyme Awareness and Beginning Sound Awareness subtests of the *PALS-PreK* were also entered in Model 1 to control for phonological awareness skills.

Model 2 did not identify a unique relationship between print skills and alphabet knowledge growth after controlling for cohort, initial alphabet knowledge, and phonological awareness skills. Together, the *PALS-PreK* Name Writing and the *PALS-PreK* Print and Word Awareness subtests were not significantly correlated with alphabet knowledge growth (r = .53). After adding these measures, the explained variance increased from 23% to 25%, an adjusted net increase of 3%. A one-way ANOVA was

completed to determine if the increase in explained variance was significant. The 3% increase in explained variance was not significant ($F(2,117)=2.63$, $p = .076$).

Table 4: Summary of Hierarchical Regression Analysis with Print Skill Measures Not Uniquely Predicting Alphabet Knowledge Growth in Model 2

Model	Predictors	*r*	Adjusted r^2	r^2 Change	*F* change	*Sig.*
1	***Cohort*** ***Fall Letters*** ***PALS-PreK Rhyme Awareness*** ***PALS-PreK Beginning Sound Awareness***	.50	.23	.25	10.10	.000
2	Cohort Fall Letters PALS-PreK Rhyme Awareness PALS-PreK Beginning Sound Awareness ***PALS-PreK Print and Word Awareness*** ***PALS-PreK Name Writing***	.53	.25	.03	2.63	.076

Identifying Clusters of Children

A K-means cluster analysis was then completed to identify clusters of children within the dataset using the following predictor variables: fall alphabet knowledge, spring alphabet knowledge, and growth in alphabet knowledge. When completing the K-means cluster analysis, the data were analyzed to determine if there were distinct clusters that share similarities. The K-means cluster analysis did not make any a priori predictions regarding the clusters' structure. Rather, the data guided the development of the clusters. The results of this analysis are summarized in Table 5.

As shown, three clusters were identified that were fairly well distributed across the sample based on the predictors. The first cluster included 55 participants that displayed low fall alphabet knowledge and low spring alphabet knowledge with little

growth in alphabet knowledge (Low initial—Low growth). The second cluster included 23 participants that displayed high fall alphabet knowledge and high spring alphabet knowledge with little growth in alphabet knowledge (High initial—Low growth). The third cluster included 46 participants that displayed low fall alphabet knowledge and high spring alphabet knowledge with high alphabet knowledge growth (Low initial—High growth).

Table 5: Clusters of Children

		Cluster One	Cluster Two	Cluster Three
	# of Participants	55	23	46
Average Scores	Fall Alphabet Knowledge	1	21	4
	Spring Alphabet Knowledge	5	25	21
	Alphabet Knowledge Growth	4	4	18

Types of Letters Learned across Clusters of Children

The final analysis was an extension of the analyses describes in Justice et al. (2006) to determine the types of letters that children in each of the clusters were learning. Justice et al. (2006) documented that the *own-name advantage* and *letter-name pronunciation effect* were the two factors that best predicted children's letter learning. Because the other letter-learning hypotheses had notably smaller effects, the analyses focused on letters that occurred in children's names and letters with the CV structure.

For each child, the letters that the child learned over the course of the year were coded and placed into one of the following three categories: present in the child's

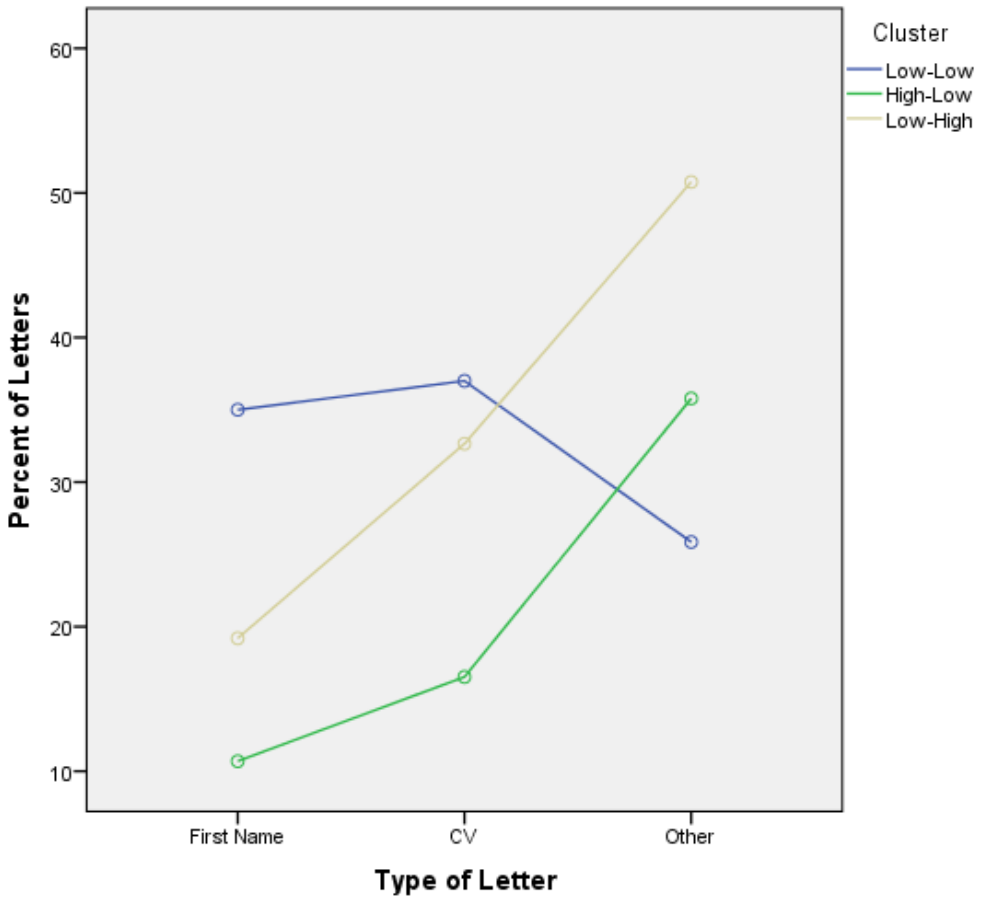
name, has the CV structure (e.g., B, D, and P), or "other letter." Within each category, the percentage of total letters learned that fall within that category was calculated. For example, if a child learned six letters over the course of the year and three of the letters were in the child's name, he/she received a value of 50% for the child's name category. If three of the letters had a CV structure, the child received a value of 50% for that category as well. If one of the letters was neither in the child's name nor had a CV structure, the child received a value of 16.7% for that category. The total percentage for some children could exceed 100% because some letters were both in the child's name and had a CV structure. See Appendix B for a full summary of coding results.

To determine if there were differences across clusters for each of the types of letters learned, a mixed-model ANOVA was completed with letter type (first-name versus CV structure versus other) as the repeated measure and the cluster (Low initial—Low growth, High initial—Low growth, Low initial—High growth) was used as the between-groups variable. A significant main effect was observed for letter type ($F(2, 242) = 11.3$, $p < .001$) and a significant main effect was observed for cluster ($F(2, 121) = 10.5$, $p < .001$). In addition, there was a significant letter type and cluster interaction ($F(4, 242) = 10.6$, $p < .001$).

A summary of the letter type and cluster interaction is displayed in Figure 1. As shown, the first cluster of participants (Low initial—Low growth) learned a higher percentage of letters in their first name and those letters that have the CV structure rather than other letters. The second (High initial—Low growth) and third (Low initial—High growth) clusters of participants followed a similar pattern in which they learned a

small percentage of letters in their first name, a somewhat larger percentage of letters with the CV structure, and a very large percentage of other letters.

Figure 1: Types of Letters Learned by Clusters



Discussion

Overview

This study aimed to better understand the influence of key pre-literacy skills on the development of alphabet knowledge in at-risk preschool-age children. Specifically, this study examined the influence of phonological awareness skills, print skills, and receptive vocabulary on the development of alphabet knowledge. Statistical analyses revealed that a significant unique relationship was present between phonological awareness skills and the development of alphabet knowledge. Furthermore, this study

identified three clusters of children based on the amount of growth in their alphabet knowledge. Final analyses were completed within the identified clusters to determine the specific types of letters learned by each cluster. These analyses revealed that the clusters of children learned a wider variety of letters based on the amount of growth in their alphabet knowledge.

Testing for Potential Confounds

When testing for potential confounds, the one-way ANOVA revealed a significant difference in alphabet knowledge growth between cohorts. The dataset used in this study was originally collected to support the effectiveness of the Wisconsin Reading Acquisition Program (WRAP). This program sought to increase the development of pre-literacy skills, such as alphabet knowledge, in at-risk populations through training instructors on teaching best-practices and encouraging parent involvement. Therefore, the significant difference in alphabet knowledge growth between cohorts might be attributed to a greater degree of emphasis on alphabet knowledge in the teacher training during year three of the WRAP program.

Another contributing factor to the significant difference in the third cohort may have been the length of teacher involvement or teacher education level. Some teachers had been involved in WRAP since the beginning, so these teachers may have been more effective than in previous years. The teachers that were new to WRAP also tended to have more education due to the upcoming Head Start requirement that lead teachers possess bachelor's degrees. Both of these factors may have contributed to the higher alphabet knowledge growth in the third cohort.

Other factors to consider that may have also contributed to the higher alphabet knowledge growth in the third cohort would include parent involvement and/or the child's initial alphabet knowledge level. The parents of children in the third cohort may have been more involved in their child's language and literacy learning than in previous years. As a result of this, the child may have come into the program with higher initial alphabet knowledge when compared to the previous two cohorts, contributing to the higher mean alphabet knowledge growth in the third cohort.

Two additional correlations were completed to test for other potential confounds as well. One correlation was completed between the participants' alphabet knowledge growth and the number of days between tests to determine if lag time was significantly related to the growth in alphabet knowledge. Analyses revealed that there was a non-significant relationship present, meaning that lag time did not affect the amount of growth in alphabet knowledge a child experienced. These results suggest that the growth of alphabet knowledge for the children, as a group, was not overly sensitive to subtle differences in lag time. That is, children did not experience growth or decline in alphabet knowledge due to a longer or shorter lag time between testing.

The second correlation was completed between participants' alphabet knowledge growth and their initial level of alphabet knowledge. Analyses revealed that there was a significant relationship present, meaning that the child's initial level of alphabet knowledge may have impacted their potential for growth in alphabet knowledge. This result is consistent with descriptions of the *Matthew Effect*, where "the rich get richer and the poor get poorer" (Stanovich, 1986). Those children who

come into school with high alphabet knowledge will most likely continue to be high-achievers in reading and academics. Those children who come into school with low alphabet knowledge, however, will most likely continue to fall behind their peers in reading and academics.

Relationships between Alphabet Knowledge Growth and Other Measures of Early Development

I was next interested in examining the relationships between alphabet knowledge growth and other measures of early development. The series of partial correlations between these variables revealed some significant correlations. Alphabet knowledge growth was found to be significantly correlated at moderate strength with the Beginning Sound Awareness and Name Writing subtests of the *PALS-PreK*, revealing that these two measures had the strongest relationship with growth in alphabet knowledge. A significant correlation with weak strength was found between alphabet knowledge growth and the Rhyme Awareness subtest of the *PALS-PreK*. Although rhyming skills are in the phonological awareness category, this could indicate that they were not as important as beginning sound awareness when it comes to influencing other pre-literacy skills (Duncan, Seymour, & Hill, 1997; Lonigan et al., 2000). Another significant correlation with weak strength was found between alphabet knowledge growth and the Print and Word Awareness subtest of the *PALS-PreK*. This indicated that a child's knowledge about the concepts of print may have a slight influence over the development of alphabet knowledge. Non-significant correlations were observed between the *PALS-PreK* Nursery Rhyme Awareness subtest and the child's *PPVT-4*

scores. This indicated that a child's receptive vocabulary skills may not be as important when it comes to measuring alphabet knowledge growth. These correlations suggested that early identification and intervention should put more emphasis on phonological awareness skills, such as beginning sound awareness, when targeting alphabet knowledge growth.

These findings were consistent with those of related research. A study completed by the National Institute for Literacy (2008) examined the predictive relations between pre-literacy skills measured in kindergarten or earlier and later reading achievement. The results of this study confirmed the strong relationship between measures of alphabet knowledge and phonological awareness. This study concluded that measures of global oral language were among the weakest predictors of later reading achievement.

Unique Relationships between Alphabet Knowledge Growth and Measures of Early Development

After identifying that relationships were present between phonological awareness skills and print skills with the growth in alphabet knowledge, I wanted to know which set of skills had the most influence on the growth of alphabet knowledge. Two separate hierarchical regression equations were completed to identify which set of skills explained the most variance in alphabet knowledge growth. The first equation identified the unique relationship between phonological awareness skills and growth in alphabet knowledge. In this equation, phonological awareness skills accounted for an increase of 8% variance in alphabet knowledge growth, above and beyond the 18%

explained by the control variables and print skills, which was significant at the $p < .05$ level. This indicated that phonological awareness measures, such as beginning sound awareness, were the strongest unique predictors of children's growth in alphabet knowledge. The results of this equation indicated that alphabet knowledge and phonological awareness were very closely related for these children, which may be important for early identification of children at-risk for later reading and academic difficulties.

The second hierarchical regression equation examined the relationship between print skills and growth in alphabet knowledge. In this equation, print skills accounted for an increase of 3% variance in alphabet knowledge growth, above the 22% variance accounted for by the control variables and phonological awareness skills, which was not significant. This indicated that print skills did not have a strong unique relationship with growth in alphabet knowledge for these children. While significantly correlated with alphabet growth, nearly all of the variance explained by print skills could be explained by phonological awareness.

Identifying Clusters of Children

The K-means cluster analysis revealed three distinct clusters of children in the dataset based on their alphabet knowledge growth. Two of the clusters entered Head Start with strikingly low alphabet knowledge scores and one cluster came into Head Start came in with high alphabet knowledge growth. Some of the children who came in with low scores could possibly have had limited exposure to literacy experiences or they may have come from poor home literacy environments. These findings were not

surprising; research has suggested that children from low-SES homes are more likely to have fewer quality literacy experiences and lower levels of performance on measures of language and phoneme awareness during the preschool years (Chaney, 1994; Senechal et al., 1998)

The first cluster of children included those who started with a low level of alphabet knowledge and made small gains across the school-year. These children could be those that are at-risk for later reading and academic difficulties due to their initial low level of alphabet knowledge and inability to make substantial gains throughout the school year. There were several possible explanations for the low growth that this first cluster experienced. These children may have had limited exposure or a poor response to the alphabet curriculum, possibly due to poor attendance or limited home support. These children may also have true language disorders. When compared to the third cluster of children (Low initial—High growth) who made substantial gains throughout the school-year, it is more likely that these children had a true language disorder based on the principles of RTI (Justice et al., 2006).

The second cluster of children included those who started with a high level of alphabet knowledge and maintained that high level of knowledge throughout the school-year. These were the children that came to school with strong language and pre-literacy skills and maintained them throughout the school year. These children likely had positive literacy experiences at home and knew a lot of letters to begin with. The children in this cluster did not learn very many letters over the school-year due to the fact that there were very few letters left for them to learn.

The third cluster of children included those who started with a low level of alphabet knowledge and made substantial gains in alphabet knowledge across the school-year. These children came into the program with weak pre-literacy skills and benefitted from the instruction that was provided for them. This cluster of children could provide the most information in terms of how to design an alphabet knowledge curriculum that specifically targets at-risk children. Through examining the types of letters learned in this cluster, researchers can better understand the strategies and cues used by at-risk children to learn letters of the alphabet. This information could then provide teachers with an evidence-base to select appropriate curriculum materials for teaching alphabet knowledge.

Types of Letters Learned across Clusters of Children

When examining the letter-learning strategies used by each cluster of children, it was observed that there were differences across the clusters. The first cluster of children (Low initial—Low growth) learned a higher percentage of letters in their first name and letters with a CV structure. This means that the few letters that the first cluster learned were in their first name or had the CV structure.

The remaining two clusters of children followed a similar letter-learning pattern. The second cluster of children (High initial—Low growth) learned a low percentage of letters in their first name, a slightly higher percentage of letters with the CV structure, and a substantial percentage of "other" letters. These children started out knowing most of the letters in their first name, they learned a few letters with the CV structure, but they mostly learned letters in the "other" category.

The third cluster of children (Low initial—High growth) learned a low percentage of letters in their first name, a slightly higher percentage of letters with the CV structure, and a substantial percentage of "other" letters as well. These children learned a lot of letters over the school-year and the percentages reflected that. They learned the letters in their name as well as the letters with the CV structure, but most of the letters were "other" letters. These children may have started out by using the own-name and CV-structure strategies, but they transitioned to the use of other strategies when learning the remaining letters of the alphabet. It is also possible that learning letters in the child's first name and those letters with the CV structure were important precursors for these children to be able to learn other letters.

Clinical Implications

Alphabet knowledge as a general outcome measure. These findings equipped practitioners with the additional evidence base necessary to be confident in using measures of alphabet knowledge and phonological awareness to identify children at-risk for later reading difficulties. The completed analyses supported the idea that phonological awareness and print skills were significantly related to alphabet knowledge growth. This indicated that alphabet knowledge could be used as an effective curriculum-based measure (CBM) and general outcome measure (GOM). This measure is easy to administer and is predictive of long-term growth in reading and academic skills. Through measuring alphabet knowledge, it is possible to also measure a wide-range of skills, such as phonological awareness, without measuring skills that are not as

important, such as receptive vocabulary. Data from this study confirmed that alphabet knowledge could be a good CBM as well as a good GOM.

Significant relationships or partial correlations were identified between alphabet knowledge and most other emergent literacy measures. The non-significant relationship between the *PALS-PreK* Nursery Rhyme Awareness and alphabet knowledge growth was not expected. However, this finding was consistent with related research which revealed that rhyming may not be as important as other phonological awareness skills in learning to decode text (Duncan et al., 1997; Lonigan et al., 2000). There was also no relationship identified between alphabet knowledge growth and receptive vocabulary. Again, this was acceptable because I only wanted to measure emergent literacy skills. The hierarchical regression analyses revealed that phonological awareness was the best unique predictor of alphabet growth. These findings were important because phonological awareness could be used as a key emergent literacy skill for identifying children at-risk for low alphabet knowledge growth.

These findings also suggest that measures of alphabet knowledge could be used for dynamic assessment purposes related to RTI. In this study, the children placed in the Low initial – Low growth and Low initial – High Growth clusters would initially be identified as at-risk children and placed in Tier 2 of RTI. Through administering measures of alphabet knowledge throughout the school-year, it would be possible for educators to track the alphabet knowledge growth and phonological awareness skills of these children to determine whether they are experiencing any gains. Those children

who did not make any substantial gains in alphabet knowledge growth would continue to receive intensive interventions and may be identified as having a true disability.

Planning treatment based on children's alphabet knowledge testing. These results were also significant in selecting appropriate curriculum materials for pre-school and kindergarten classrooms. The children grouped into the Low initial—High growth cluster followed a distinct pattern in the strategies they used to learn letters. The percentages reflected that these children learned a small amount of the letters in their first name, slightly more letters with a CV structure, and a substantial amount of other letters. In this study, there was no set order identified for when the child learned each type of letter. However, it can be speculated that the children in this cluster initially learned the letters of their first name, then moved on to those letters with the CV structure, and finally began to learn the other letters of the alphabet.

When selecting curriculum materials for alphabet knowledge, teachers should include phonological awareness skills, such as beginning sound awareness, in their lesson plans to support alphabet knowledge development. When teaching letters of the alphabet, teachers could start with the basic strategies—teaching the letters in the child's first name and those with a CV structure. In order for children to make substantial gains in alphabet knowledge, however, the teacher should take a comprehensive approach that includes all letters of the alphabet.

Limitations and Future Directions

One limitation of this study that requires consideration concerns the participants and dataset used. The dataset used in this study was originally intended to support the

WRAP, which was a separate original study related to alphabet knowledge. Over the three years that the data were collected, there was a significant difference in alphabet knowledge growth between cohorts. Although the significant difference between cohorts for alphabet knowledge did not have a large effect on the subsequent analyses, the results may have been different if the participants had received the same instruction over the three years.

Directions for future research involve the variables used when testing for potential confounds. This study tested for lag time between testing, cohort differences, school, and initial baseline alphabet knowledge. It might be beneficial to use data related to how many days the participants attended the program as well as data on which strategies each individual classroom teacher used. Future researchers could also further examine the differences between cohorts to determine if the participants from each cohort were equally distributed among the subtypes. This may offer more specific information related to why some children learned more or less letters compared to other children. The different strategies could then offer more information related to curriculum design.

To further analyze the development of alphabet knowledge, future studies could utilize a wider variety of variables and comparisons. This study focused solely on phonological awareness skills, print skills, and receptive vocabulary. Due to the fact that a significant relationship was found between phonological awareness and alphabet knowledge growth, researchers could further analyze the effects of specific phonological awareness skills. This would give practitioners additional information regarding which

phonological awareness skills are the best predictors of alphabet knowledge growth in children.

To further examine the effects of this study, it would be interesting to implement an alphabet curriculum that follows the findings of this study. Teachers would start by teaching letters found in the child's first name and those letters with a CV structure and then move on to teaching a wide range of letters. An analysis could be completed to determine if children experience faster alphabet knowledge growth as a result of this curriculum design.

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Appendix A: *PALS-PreK* subtests

pals Phonological Awareness Literacy Screening

PreK

Fall/Spring Child Summary Sheet

Child's Name (First & Last) _____

Fall Assessment Date: _____ Spring Assessment Date: _____

Section I: Name Writing (See pages 5 and 6)

Section II: Alphabet Knowledge

Part A: Upper-Case Alphabet Recognition

Fall

M	G	S	I
B	X	L	Q
H	W	T	R
J	C	O	V
P	F	D	U
A	Y	N	Z
K	E		

Upper-Case Score: ____ (26 possible)

Spring

M	G	S	I
B	X	L	Q
H	W	T	R
J	C	O	V
P	F	D	U
A	Y	N	Z
K	E		

Upper-Case Score: ____ (26 possible)

General Observations and Comments

Part B: Lower-Case Alphabet Recognition *(administer only if 16 or more correct on Upper-Case Alphabet Recognition)*

Fall

s	g	m	i
b	r	l	f
h	w	t	q
j	c	o	v
p	x	d	u
a	y	n	z
k	e		

Lower-Case Score: ____ (26 possible)

Spring

s	g	m	i
b	r	l	f
h	w	t	q
j	c	o	v
p	x	d	u
a	y	n	z
k	e		

Lower-Case Score: ____ (26 possible)

General Observations and Comments

Part C: Letter Sounds *(administer only if 9 or more correct on Lower-Case Alphabet Recognition)*

Fall

B	S	R	F	W
T	O	J	A	H
K	Sh	V	I	P
Z	L	C	Th	U
E	D	Y	G	N
Ch				

Letter Sounds Score: _____ (26 possible)

Spring

B	S	R	F	W
T	O	J	A	H
K	Sh	V	I	P
Z	L	C	Th	U
E	D	Y	G	N
Ch				

Letter Sounds Score: _____ (26 possible)

General Observations and Comments

Section III: Beginning Sound Awareness

Fall

Beginning Sound: /M/	/S/	/B/
Practice Items: man	sock sink	bag
1. _____milk	6. _____sick	
2. _____ball	7. _____meat	
3. _____six	8. _____bear	
4. _____bird	9. _____mop	
5. _____map	10._____sad	

Beginning Sound Score: _____ (10 possible)

Spring

Beginning Sound: /M/	/S/	/B/
Practice Items: man	sock sink	bag
1. _____milk	6. _____sick	
2. _____ball	7. _____meat	
3. _____six	8. _____bear	
4. _____bird	9. _____mop	
5. _____map	10._____sad	

Beginning Sound Score: _____ (10 possible)

General Observations and Comments

Section IV: Print and Word Awareness

Fall

+/-	
____	1. points to the words in the title
____	2. points to **each** of the three words in the title
____	3. points to the word *Hey*
____	4. points to both words, *Diddle* and *Diddle*
____	5. points to word *The*
____	6. left to right directionality
____	7. moves finger along line of print
____	8. identifies either letter, *A* or *O*
____	9. each printed word matched 1-to-1 with each spoken word in order
____	10. points to white space between *The* and *End*

Print and Word Awareness Score: ____ (10 possible)

Spring

+/-	
____	1. points to the words in the title
____	2. points to **each** of the three words in the title
____	3. points to the word *Hey*
____	4. points to both words, *Diddle* and *Diddle*
____	5. points to word *The*
____	6. left to right directionality
____	7. moves finger along line of print
____	8. identifies either letter, *A* or *O*
____	9. each printed word matched 1-to-1 with each spoken word in order
____	10. points to white space between *The* and *End*

Print and Word Awareness Score: ____ (10 possible)

General Observations and Comments

Section V: Rhyme Awareness

Fall

+/-				
____	1. **mop**	**top**	bike	can
____	2. **sled**	kite	**bed**	fruit
____	3. **bee**	flag	**tree**	cup
____	4. **cake**	bell	fruit	**snake**
____	5. **moon**	**spoon**	cat	sock
____	6. **fox**	wall	rain	**box**
____	7. **man**	book	**can**	pig
____	8. **ring**	**swing**	bed	mop
____	9. **clock**	road	pen	**sock**
____	10. **rain**	bell	**train**	box

Rhyme Awareness Score: ____ (10 possible)

Spring

+/-				
____	1. **mop**	**top**	bike	can
____	2. **sled**	kite	**bed**	fruit
____	3. **bee**	flag	**tree**	cup
____	4. **cake**	bell	fruit	**snake**
____	5. **moon**	**spoon**	cat	sock
____	6. **fox**	wall	rain	**box**
____	7. **man**	book	**can**	pig
____	8. **ring**	**swing**	bed	mop
____	9. **clock**	road	pen	**sock**
____	10. **rain**	bell	**train**	box

Rhyme Awareness Score: ____ (10 possible)

General Observations and Comments

Section VI: Nursery Rhyme Awareness

Fall

+/-	
____	1. went up the ***hill***
____	2. broke his ***crown***
____	3. the lamb was sure to ***go***
____	4. how I wonder what you ***are***
____	5. like a diamond in the ***sky***
____	6. Jack jump over the ***candlestick***
____	7. climbed on the ***rocks***
____	8. three bags ***full***
____	9. who lives down the ***lane***
____	10. touch the ***ground***

Nursery Rhyme Awareness Score: ____ (10 possible)

Spring

+/-	
____	1. went up the ***hill***
____	2. broke his ***crown***
____	3. the lamb was sure to ***go***
____	4. how I wonder what you ***are***
____	5. like a diamond in the ***sky***
____	6. Jack jump over the ***candlestick***
____	7. climbed on the ***rocks***
____	8. three bags ***full***
____	9. who lives down the ***lane***
____	10. touch the ***ground***

Nursery Rhyme Awareness Score: ____ (10 possible)

Fall

General Observations and Comments

Spring

General Observations and Comments

Section I: Fall Name Writing

Name Writing Score: _____ (7 possible)

Section I: Spring Name Writing

Name Writing Score: _____ (7 possible)

Appendix B: Data Coding Chart

Subject	Letter Growth	% Name	% CV	% Other	PPVT	Beg Sounds	Rhyme	Nursery Rhyme	Name Writing	Print & Word
1	0	40	50	20	82	1	2	8	7	6
2	2	50	0	0	99	1	4	8	6	6
3	4	40	20	40	120	6	10	6	7	9
4	4	0	0	100	94	1	4	3	4	6
5	8	11	55	44	94	5	10	5	6	10
6	-1	0	0	0	97	9	10	8	7	9
7	7	29	43	43	87	6	5	4	4	6
8	12	42	17	42	98	9	4	5	4	4
9	-1	0	0	0	102	0	3	2	3	1
10	2	50	0	50	86	2	4	3	2	1
11	17	29	47	35	84	9	10	3	4	5
12	0	0	0	0	86	1	4	2	2	1
13	-1	0	0	100	95	2	2	6	3	4
14	1	100	0	0	103	0	8	3	2	2
15	5	17	0	83	109	9	6	7	7	8
16	3	33	0	67	81	1	3	4	0	1
17	5	40	60	20	82	0	7	5	1	3
18	24	21	25	46	97	1	4	5	6	4
19	23	13	26	61	94	9	5	8	7	7
20	1	50	50	0	116	6	10	8	2	6
21	11	36	55	27	114	9	7	4	5	6
22	6	14	29	57	86	10	7	6	6	9
23	8	13	50	38	103	10	3	5	6	9
24	6	17	50	50	95	1	5	4	0	0
25	2	50	0	50	97	10	3	6	6	8
26	19	21	37	47	96	1	4	4	4	4
27	24	21	29	54	79	9	10	7	6	7
28	0	50	50	0	88	2	6	1	5	6
29	14	29	36	43	121	10	10	8	7	9
30	17	18	47	41	73	1	6	5	4	6
31	0	0	0	0	107	0	4	5	3	1
32	6	14	43	43	89	2	3	4	4	4
33	24	21	29	50	86	0	4	3	4	1
34	2	50	100	0	93	5	3	2	3	2
35	17	24	35	41	99	8	6	2	4	7
36	3	25	75	25	78	0	2	2	4	4
37	13	14	29	57	97	4	3	2	7	9

38	0	0	0	0	101	10	5	6	5	8
39	3	100	0	0	94	3	6	3	6	5
40	13	15	23	62	117	6	9	5	6	7
41	2	33	0	67	111	7	4	5	6	8
42	7	22	44	33	106	5	3	3	5	5
43	0	0	0	0	70	3	6	2	1	3
44	12	17	33	58	80	2	4	2	5	1
45	7	13	38	50	80	1	6	2	5	6
46	14	29	36	36	90	10	4	3	5	6
47	2	50	100	0	96	0	3	2	4	4
48	-2	0	0	0	89	0	4	5	2	4
49	13	14	29	57	86	2	2	6	7	6
50	1	100	0	0	85	0	4	1	4	0
51	9	20	20	60	121	3	5	5	1	3
52	12	8	33	58	116	5	10	8	3	3
53	-1	0	0	100	100	3	3	1	5	1
54	2	67	100	0	112	0	8	5	2	2
55	9	10	20	70	109	10	9	8	7	10
56	18	0	39	61	99	10	7	6	6	9
57	13	13	31	63	102	10	3	5	7	3
58	6	0	50	50	96	10	10	8	7	9
59	16	19	44	38	97	0	4	6	6	2
60	1	100	100	0	92	0	4	4	2	3
61	8	10	30	60	91	0	4	3	5	4
62	0	0	0	0	107	10	10	8	7	8
63	4	0	0	100	88	6	4	6	6	7
64	0	0	0	0	110	6	5	5	7	7
65	2	50	25	25	107	0	10	3	4	3
66	4	25	50	25	94	1	3	5	6	7
67	11	15	31	62	88	1	6	6	4	6
68	-3	33	66	0	74	1	4	0	4	2
69	26	15	31	50	96	5	7	2	4	5
70	9	36	45	18	100	6	4	3	4	6
71	3	67	100	0	95	4	6	2	3	3
72	18	28	28	44	89	9	1	4	5	4
73	0	0	0	0	78	0	4	0	4	2
74	17	11	28	61	94	5	5	2	7	4
75	20	30	30	55	93	0	5	0	4	6
76	6	17	33	50	84	4	4	2	7	9
77	9	36	55	18	94	6	2	2	3	6
78	6	50	33	33	96	1	4	3	4	5

79	16	13	40	47	95	6	4	4	4	5
80	1	0	100	0	101	3	9	6	2	6
81	4	100	25	0	90	0	9	3	4	5
82	16	31	31	38	88	5	2	4	2	2
83	8	36	27	36	80	4	5	3	4	6
84	16	25	31	44	105	8	10	5	5	5
85	23	9	30	52	98	9	6	7	5	9
86	12	8	23	69	97	0	2	5	6	3
87	8	45	18	36	97	10	7	6	7	3
88	21	18	23	59	97	3	5	4	4	4
89	21	18	27	55	104	10	10	4	7	8
90	0	0	0	0	111	10	9	4	7	7
91	4	25	50	25	106	3	4	4	5	6
92	10	40	40	30	115	2	10	7	4	4
93	9	10	30	60	89	2	6	2	3	0
94	15	33	40	33	81	6	4	3	3	3
95	24	17	29	54	105	4	9	4	4	8
96	21	9	33	62	108	6	3	3	1	3
97	0	0	0	0	114	8	5	8	6	9
98	23	22	26	57	96	9	10	4	4	7
99	20	25	35	50	83	4	4	6	3	0
100	14	14	36	50	101	8	9	5	4	0
101	8	25	38	38	98	0	4	5	4	0
102	3	67	67	0	91	1	3	5	3	4
103	22	27	36	45	91	7	8	7	6	6
104	4	25	50	50	96	2	3	5	4	5
105	19	26	32	53	92	2	5	3	4	1
106	0	0	0	0	115	10	10	10	7	9
107	13	31	31	38	116	0	2	5	3	3
108	10	9	45	45	113	0	3	3	1	3
109	6	0	43	57	106	4	7	8	6	6
110	14	0	21	79	85	5	5	8	6	5
111	21	14	24	67	86	4	7	6	6	5
112	10	0	10	90	99	2	3	8	7	5
113	17	35	35	35	88	7	3	7	4	6
114	1	0	100	0	91	3	3	9	4	5
115	1	0	50	50	78	4	5	5	4	5
116	2	25	50	25	83	6	5	9	6	5
117	9	33	33	44	84	5	5	2	6	6
118	1	100	0	0	99	3	2	2	1	1
119	22	18	36	50	96	4	4	5	3	2

120	22	18	27	55	113	3	8	7	7	8
121	7	29	43	43	94	0	3	7	3	2
122	2	33	0	67	82	3	6	5	3	6
123	14	6	40	53	98	10	6	6	4	6
124	0	0	0	0	111	10	10	9	7	9

Appendix C: IRB Approval

MARQUETTE UNIVERSITY
Be The Difference.

Office of Research Compliance
560 N. 16th Street, Room 102
P.O. Box 1881
Milwaukee, Wisconsin 53201-1881
P 414.288.6271
F 414.288.6281
W marquette.edu/researchcompliance

July 9, 2012

Dr. Maura Moyle
Speech Pathology and Audiology

Dear Dr. Moyle:

Your protocol number HR-2440, titled, *"Understanding the Development of Alphabet Knowledge in At-Risk Population* was expedited on June 28, 2012, by a member of the Marquette University Institutional Review Board.

Subjects who go through the consent process are considered enrolled participants and are counted toward the total numb of subjects, even if they have no further participation in the study. Please keep this in mind when conducting your research. This study is currently approved for the records of 1178 subjects.

If you need to increase the number of subjects, add research personnel, or make any other changes to your protocol you must submit an IRB Protocol Amendment Form, which can be found on the Office of Research Compliance web site: http://www.marquette.edu/researchcompliance/research/irbforms.shtml. All changes must be reviewed and approved by the IRB before being initiated, except when necessary to eliminate apparent immediate hazards to the human subjects. Any public advertising of this project requires prior IRB approval. If there are any adverse events, please notify the Marquette University IRB immediately.

Your approval is valid until June 27, 2013. Prior to this date, you will be contacted regarding continuing IRB review.

An IRB Final Report Form must be submitted once this research project is complete. The form should be submitted in a timely fashion, and must be received no later than the protocol expiration date.

If you have any questions or concerns, please do not hesitate to contact me. Thank you for your time and cooperation.

Sincerely,

Amanda J. Ahrndt, RN, MS, MSN, CIM, CIP
IRB Manager

cc: Dr. Christopher Okunseri, IRB Chair

AA/rr