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Optimizing Early Intervention for Preschoolers' Vocabulary Development

Lindsey A. Peters-Sanders

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Optimizing Early Intervention for Preschoolers’ Vocabulary Development

by

Lindsey A. Peters-Sanders

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy with a concentration in Language and Speech Science Department of Communication Sciences and Disorders College of Behavioral and Community Sciences University of South Florida

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Stefan Frisch, Ph.D.

Date of Approval: 
June 28, 2019

Keywords: Oral Language, Vocabulary Instruction, Early Childhood, Emergent Literacy

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DEDICATION

I would like to thank my husband, parents, family, friends, and mentors who helped to support and guide my journey these last five years. This dissertation would not have been possible without you.
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ABSTRACT

Preschool is a critical time in children’s oral language and pre-literacy skill development, but this development varies greatly among children. Those with smaller vocabularies are at greater risk for developing future language and reading difficulties that persist throughout their education. Because vocabulary knowledge is essential for later reading success, early instruction in preschool is key. To better understand how to enhance preschoolers’ word learning, the current dissertation contains three studies that examined the benefits of explicit vocabulary instruction and identified the factors that best facilitated vocabulary learning among a diverse group of young children. To aid in the early identification and intervention process, we must understand what these factors are, and how they contribute to preschool children’s vocabulary acquisition.

Study 1 evaluated the effects of an automated, small-group intervention designed to teach preschoolers challenging vocabulary words. We sought to extend previous efficacy studies by determining the effects of doubling the number of words taught from two to four words per book. Seventeen preschool children listened to one prerecorded book per week for nine weeks. Each storybook had embedded, interactive lessons for four target vocabulary words. Each lesson provided repeated exposures to words and their definitions, child-friendly contexts, and multiple opportunities for children to respond verbally to instructional prompts. Participants were asked to define the weekly targeted vocabulary before and after intervention. A repeated acquisition design was used to examine the effects of embedded lessons in books on the learning of target vocabulary words. Treatment effects were observed for all children across many of the books.
Learning of at least two points (i.e., one word) was replicated for 74.5% of 149 books tested across the 17 participants. On average, children learned to define 47% of the target vocabulary words (17 out of 36). Results support teaching four challenging words per book, as children learned substantially more words when four words were taught, in comparison to previous studies.

Study 2 investigated the child, family, and classroom-level factors that relate to the vocabulary learning of 112 preschool children. A secondary data analysis was conducted using the results of an investigation examining the effects of a supplemental preschool vocabulary program. Structural equation modeling (SEM) revealed significant relations between child, family, and classroom-level factors and word learning including the child’s language skills and classroom environment. The family’s socioeconomic status related significantly to both children’s language skills and the classroom environment, but not directly to word learning. However, the Classroom Environment and Language Skills construct were moderate predictors of vocabulary learning. Understanding the individual factors that are most related to preschoolers’ word learning will aid in the development of effective strategies to enhance young children’s vocabulary acquisition.

Study 3 investigated how lexical characteristics of words relate to vocabulary learning in 112 preschool children. A secondary data analysis using multilevel modeling was used to examine the effects of a supplemental preschool vocabulary program to determine if relations between lexical characteristics and word learning exist, and to what extent these characteristics predict word learning in young children. The contributions of the following lexical characteristics to the learning of 72 words were investigated: word frequency, age of acquisition, level of
concreteness, neighborhood density, and phonotactic probability. Findings indicate that significant relations exist between word learning and all five of the lexical characteristics. When differences between children are controlled, word frequency, age of acquisition, level of concreteness, neighborhood density, and phonotactic probability accounted for approximately 2% of the variance in vocabulary learning, whereas the differences among children accounted for 26% of the variance. Further investigation is warranted to determine the impact lexical characteristics have on vocabulary learning. This has potential to inform the development of a word selection framework that will organize vocabulary targets into a developmentally appropriate sequence based on relevant predictors of word learning.

Understanding the individual differences that are most predictive of vocabulary learning will aid in the development of a flexible instructional program designed to meet the diverse needs of preschoolers. Intervening at such a critical time in children’s oral language and pre-literacy skill development has the potential to reduce the prevalence of reading difficulties among our most vulnerable populations.
CHAPTER ONE:

INTRODUCTION

The extent to which a child knows a word depends upon their developmental stage, language status, and individual experiences. For young children, the vocabulary opportunities, linguistic support, and literacy-related learning experiences at home greatly affect their cognitive and language development and emergent literacy skills (Biemiller, 2006; Dickinson & Tabors, 2001; Foster, Lambert, Abbott-Shim, McCarty, & Franze, 2005; Greenwood, et al., 2017; Hart & Risley, 1995; Zauche, Thul, Mahoney & Stapel-Wax, 2016). The number of words used and spoken by parents, as well as the quality of their lexical input (varied vocabulary, complex grammatical and syntactic structure) and the types of verbal interactions that occur between parent and child (e.g., command, open-ended questions) contribute to the overall size of a child’s vocabulary (Hart & Risley, 1995; Zauche, Thul, Mahoney & Stapel-Wax, 2016).

Parents’ lexical input can vary among socioeconomic status (SES). Many children from families with a low SES have fewer language experiences that result in limited language skills (Hart & Risley, 1995) and slower rates of language development (Dollaghan et al., 1999) compared to children from middle and high SES families. These disparities in language exposure predict children’s cognitive and language development and academic success (Crow & Leary, 2015; McLoyd, 1998).
The use of appropriate instructional interventions that target vocabulary development builds a strong foundation of literacy skills necessary to become a competent reader. Research indicates that vocabulary knowledge is one of, if not the, most important correlate to reading comprehension (Taffe et al., 2009). Although vocabulary knowledge has been identified as an important component of emergent literacy skills, preschool vocabulary instruction is limited, varies greatly in early childhood classrooms, and is often sub-standard, lacking differentiation for children most at risk for developing language and reading disabilities (Greenwood et al., 2013). Explicit vocabulary instruction rarely occurs in early childhood classrooms, and least frequently in classrooms serving low-income students (Wright, 2012). Several key components of vocabulary instruction are missing in popular preschool curricula, including a clear scope and sequence, guidance for word selection, instructional strategies, and ongoing progress monitoring (Neuman & Dwyer, 2009). Several attempts have been made to create an instructional sequence of vocabulary targets for kindergarten through twelfth grade, but none provide guidance for preschool instruction (Biemiller, 2010; Marzano & Pickering, 2005). We are missing a critical period in children’s language development by not providing preschoolers with quality instruction of sophisticated vocabulary words so crucial to later reading success. If we do not address these shortcomings surrounding vocabulary instruction in preschool programs, teachers will continue to provide substandard vocabulary instruction perpetuating the development of language and literacy disabilities. Additional research is needed to address these limitations to improve the literacy and language outcomes for all preschoolers.

The purpose of this multi-manuscript dissertation is to examine the benefits of explicit vocabulary instruction and to identify the factors that best facilitate word learning among a diverse group of preschoolers. The first paper will examine the differential effects of
preschoolers’ word learning when the number of vocabulary targets is increased from two to four words. The second paper seeks to understand the relative benefits of explicit instruction beyond word exposure alone and identify the intrinsic (receptive and expressive language) and extrinsic factors (family SES, home literacy environment, teacher and classroom characteristics) that predict word learning among a diverse group of preschoolers (differing language levels, SES, home and classroom environments). The third paper will identify the lexical characteristics predictive of word learning using data from a randomized control trial evaluating a revised version of *Story Friends* (Goldstein & Kelley, 2016).

By predicting vocabulary achievement among a diverse group of preschoolers, we can widen our approach to early childhood education to include a multifaceted approach to the prevention of reading disabilities through early identification and intervention. Using the lexical characteristics most predictive of word learning, we can begin to develop a sequence of vocabulary targets most appropriate for preschool instruction. This will facilitate the iterative development of a robust vocabulary program effective for all preschoolers.

**References**


CHAPTER TWO:
MOVING FORWARD 4 WORDS AT A TIME: EFFECTS OF A SUPPLEMENTAL PRESCHOOL VOCABULARY INTERVENTION

Note to Reader

This chapter presents a manuscript that has been submitted to Language, Speech and Hearing Services in Schools for publication and is currently under review.

Introduction

Vocabulary development begins at an early age and is influenced by several factors. A young child’s vocabulary opportunities, linguistic support, and literacy-related learning experiences at home can significantly affect their oral language development (Dickinson & Tabors, 2001; Greenwood, et al., 2017; Hart & Risley, 1995). Fewer language experiences can result in limited oral language skills and slower rates of language development, which is evident as early as preschool, and often persist throughout a child’s education. Children with limited oral language skills will struggle to acquire academic vocabulary crucial to comprehension, placing them at a higher risk for developing future reading difficulties.

The key to the preventing reading difficulties is improved identification of at-risk children combined with early interventions that focus on language-related outcomes (Gettinger
& Stoiber, 2008; Greenwood, et al., 2013; Snow, Burns, & Griffin, 1998). Early childhood classrooms have begun to adopt a response to intervention (RTI) model, which provides educators with a framework for identifying and differentiating instruction for children with limited language and early literacy skills (Greenwood et al., 2014). Once children are screened and identified, educators implement an RTI approach teaching specific skills and monitoring children’s progress to ensure that children are learning.

Oral language programs that target vocabulary acquisition in early childhood are paramount. Research indicates that vocabulary knowledge is one of, if not the, most important correlate to reading comprehension (Dickinson, Golinkoff, & Hirsch-Pasek, 2010; Taffe, Blachowicz, & Fisher, 2009). Several studies have shown significant links between children’s early vocabulary knowledge and later reading comprehension success (Cunningham & Stanovich, 1997; Scarborough, 2001; Snow et al., 1998). In a meta-analysis of 37 studies evaluating the effect of vocabulary instruction on passage comprehension in students from PreK through grade 12, Elleman and colleagues (2009) reported a positive overall effect on passage comprehension outcomes. This effect was even greater for students who were identified with reading difficulties (e.g., Nash & Snowling, 2006).

Although vocabulary knowledge has been identified as an important component of emergent literacy skills, preschool vocabulary instruction is limited and varies greatly in early childhood classrooms (Dickinson, 2011; Greenwood et al., 2013). Explicit vocabulary instruction rarely occurs in early childhood classrooms, and least frequently in classrooms serving low-income students (Wright, 2012). The development of effective interventions that target vocabulary growth are needed to build foundational language skills necessary to become competent readers. With early intervention, it is more likely that at-risk children will progress to
meet the rigorous grade-level literacy expectations dictated by state and federal education standards.

Vocabulary Selection

To maximize the time spent teaching in the classroom, it is important to select the right words for instruction. Beck, McKeown, and Kucan (2002) developed a tiered framework for word selection. They recommend targeting challenging, high-utility words for instruction as these are words children will not hear often in everyday conversation, but will encounter in academic texts (e.g. significant, establish, obvious). These are typically new terms for familiar concepts. For example, a child may already know the concept of important, so he or she will be able to use that knowledge to understand the more sophisticated term, significant. Biemiller (2006) takes a more developmental approach to word selection. For preliterate children (before third grade) he suggests specific instructional targets, which are known by 40-70% of children at the end of second grade (e.g. buckle, parcel, blab). In contrast, Beck, McKeown, and Kucan (2002) argue that children do not learn words in a specific developmental order or a highly-sequenced manner. Several researchers place emphasis on using guidelines for appropriate word selection versus teaching words from a predetermined list (Beck et al. 2002; Nation, 2001; Stahl & Nagy, 2006). One concern about selecting words from a predetermined word list is that many of the words on that list will require little to no explicit instruction. (e.g., flood, listen, stab). Classroom teachers have been found to spend time teaching more of these basic words, which young children will typically learn without the need for instruction (Wright & Neuman, 2014). Instead, valuable instructional time should be devoted to sophisticated words because these words warrant more attention and explanation. For this reason, many researchers of vocabulary instruction have favored using carefully-developed guidelines, such as those provided by Beck
and colleagues, to select words for vocabulary instruction (e.g., Coyne et al., 2009; Neuman & Dwyer, 2011; Pollard-Durodola et al., 2011; Storkel et al., 2017; Tuckwiller, Pullen & Coyne, 2010).

**Vocabulary Instruction**

Reading aloud to children has been widely recommended as a means to facilitate young children’s vocabulary growth (Bus, van Ijzendoorn, & Pellegrini 1995; Lane & Wright, 2007). However, simply reading stories to children does not appear sufficient to significantly impact the learning of challenging, more sophisticated vocabulary words. Additional explanation and explicit instruction are necessary for a read-aloud to impact word learning (Dickinson & Smith, 1994; Hargrave & Sénéchal, 2000). Beck and McKeown (2007) refer to this as rich instruction. During rich instruction, word meanings are explained using child-friendly language and provides children with multiple examples of the words in a variety of contexts. Children learn and retain more target words when read alouds employ rich, direct instruction embedded within storybooks that provide repeated exposures to words and their meanings than when compared to reading alone in elementary grades (Beck & McKeown, 2007; Coyne, McCoach, Loftus, Zipoli & Kapp, 2009; Justice, Meier, & Walpole, 2005, Storkel et al., 2017) and preschool classrooms (Goldstein et al., 2016; Kelley et al, 2015; Spencer et al., 2012; Vuattoux, Japel, Dion, & Dupéré, 2014).

For example, Justice and colleagues (2005) examined the effects of a storybook intervention that included elaborated instruction for targeted vocabulary. Using popular storybooks, six vocabulary words were selected that were unlikely to be familiar to kindergarten children. Half of the words were elaborated during the read aloud (i.e., taught explicitly), and the other half were not. They found that children made significant learning gains for elaborated words compared to non-elaborated words, and compared to their peers in the comparison group who
received business as usual. Storkel and colleagues (2017) expanded upon the study conducted by Justice and colleagues (2005) by using the same treatment condition and investigated the number of exposures children with specific language impairment required to enhance word learning. They found that 36 exposures to a word lead to optimal learning, and that exposures distributed over time were better than exposures that were concentrated to a specific time period.

The majority of these studies utilized a group design to examine the effects of instruction on word learning (Beck & McKeown, 2007; Coyne, McCoach, Loftus, Zipoli & Kapp, 2009; Goldstein et al., 2016; Justice, Meier, & Walpole, 2005; Vuattoux, Japel, Dion, & Dupéré, 2014). Treatment effects from group experimental designs are generalizable to a population in general, yet it is impossible to examine the nuances associated with individual performance when comparing outcomes at the group level. Single-case experimental designs allow for a more individualized examination of treatment effects (Horner et al., 2005). Few researchers have used this approach when investigating the effects of an instructional program on word learning (Kelley et al, 2015; Spencer et al., 2012). However, analyzing response to instruction at the individual level is a beneficial approach to intervention development because it helps elucidate the individual differences that may facilitate or hinder learning.

Considerable evidence speaks to the potential for embedding intervention into book reading contexts when teaching young children new vocabulary. Yet there is much to be learned about the effects of such intervention. For example, we need to investigate the differential effects these instructional methods have on preschoolers with varying language levels and learning profiles. Researchers have presented contradictory evidence on the effects of children’s initial language ability on vocabulary acquisition. Several studies found those with higher initial language abilities made greater word learning gains compared to peers with lower initial abilities.
(Coyne, Simmons, Kame’enui, & Stoolmeiller, 2004; Goldstein et al., 2017; Penno, Wilkinson, & Moore, 2002; Robbins & Ehri, 1994), while others found no difference in word learning outcomes between at-risk and typically developing children (Biemiller & Slonim, 2001). More studies are needed to better understand the relative benefits explicit vocabulary instruction has on all children and how intervention could be adapted to maximize learning for children with varying experiences and abilities.

**Story Friends Intervention**

Story Friends (Goldstein & Kelley, 2016) is an oral language intervention program designed for preschool that provides explicit vocabulary instruction. Small groups of children listen using headphones and respond to embedded lessons within prerecorded stories with adult supervision. Two challenging vocabulary words are embedded in each book with rich, explicit instruction that provides child-friendly definitions, multiple contexts for words, allows for active responding, and provides multiple opportunities for practice and learning. See Table 1.1 for a sample vocabulary lesson. Results from Story Friends efficacy studies (Goldstein, et al., 2016; Kelley et al., 2015; Spencer et al., 2012) found that children learned on average 30-50% of target words instructed. These promising results suggest the potential to capitalize further on the learning gains demonstrated in prior efficacy studies by increasing the number of words taught per book.

The purpose of this study was to assess the efficacy and feasibility of teaching four challenging vocabulary words in a book each week. We also were interested in examining the effects this program had on children with a range of language abilities. It was hypothesized that children would learn more words with the increase in target words taught each week, but this
learning may differ among children with varying language abilities. Specifically, we hypothesized that those with higher initial language abilities would have greater word learning gains that their peers with lower abilities. This research addressed the following questions:

1. To what extent do preschool children demonstrate vocabulary learning when explicit instruction of four target words is embedded within prerecorded storybook activities presented to small groups of children?

2. Are differential effects observed for children with differing initial language abilities?

**Method**

**Participants**

Twenty-one 4- and 5-year-olds enrolled in a voluntary pre-kindergarten school readiness program were recruited and consented from two childcare facilities in the Tampa area (Appendix A). These facilities primarily serve children from low-income families. One child was excluded from the study because limited English language skills prevented him from completing language
assessments. Three participants left the schools during the study, so results for the 17 participants who completed the full duration of the study are reported.

Children completed two norm-referenced measures to describe the language abilities of participants: a measure of single-word receptive vocabulary (Dunn & Dunn, 2007; PPVT-4) and an omnibus language measures (Wiig, Secord, & Semel, 2004; CELF-P2). Both measures provide standard scores with a mean of 100 and standard deviation of 15. Participants’ performance on these measures is presented in Table 1.2.

In previous studies, this intervention was only implemented with children who had limited language relative to normative means on the PPVT (standard scores within .5 - 1.5 SD, 92 – 78; Goldstein et al., 2016; Greenwood et al., 2016; Kelley et al., 2015, Spencer et al., 2012). In this study, we were interested in examining the differential effects this program had on children with a broader range of initial language abilities, so we included children with standard scores +/- 2.0 SDs (70 – 130) on either the PPVT-4 or the CELF-P2. The average PPVT-4 score was 98.1 (SD = 18.2, Range 70-127) and the average CELF-P2 score was 92.3 (SD = 18.2, Range 59-121).

Procedure

Story Friends word selection process. In previous versions of the program, each book included lessons for two target vocabulary words. For the current study, an additional two words were selected and lessons for the new words were created. Because the books were relatively simple, short stories, it was feasible to add two additional words without making the listening sessions much longer. Longer sessions might have a negative impact on children’s attentional capabilities, and were likely to exceed the 10-15 minutes allotted in typical classrooms for rotations through a series of small group activities.
Table 1.2. Characteristics of Participants

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<td>92.3 (18.2)</td>
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**Note:** School F received Forest Friends, and school J received Jungle Friends. PPVT = Peabody Picture Vocabulary Test-4th ed. (Dunn & Dunn, 2007); CELF = Clinical Evaluation of Language Fundamentals Preschool- 2nd ed. (Wiig, Secord, & Semel, 2004). Age at the beginning of the study is reported in years;months.

To select the additional target vocabulary, we used the same process for word selection that Kelley et al. (2015) used during past iterations of Story Friends development. Three main criteria were considered: 1) the words had to fit within the existing stories, 2) words could be defined in an easily understandable way, and 3) there were multiple child-friendly contexts for the word. Four members of the research team, including the developers of the previous 2-word versions, worked together to select words. The research team members were familiar with Beck
and colleagues (2013) tiered framework and they reviewed the criteria and process used in selecting words for previous versions. Each researcher went through the stories to create a list of possible words that fit the stories’ context and met our criteria. These words were often more sophisticated synonyms of words already in the story (e.g., *burst* instead of *pop*). We avoided words with similar semantic and phonological features as target words in same book to minimize word confusion. For example, previous studies indicated that children confused “enormous” and “ignore,” perhaps because the words sounded similar. Decisions about word selection and placement in the stories were made by group discussion and consensus. In a few cases, we had to reword the story to make the new target word fit; however, this did not alter the overall story structure, so minimal edits were made.

**Story Friends embedded explicit instruction.** In the current study, each Story Friends book provided preschoolers with embedded, explicit instruction for four challenging vocabulary words. Sample vocabulary targets are provided in Table 1.1. We created embedded lessons for the new target words that matched the existing lessons using systematic instructional language. Each lesson includes a simple definition and child-friendly contexts relating the word to young children’s everyday experiences. Throughout the lesson, the narrator provides multiple opportunities for children to respond (e.g. say the word or definition), and repeated exposures to the word. Children hear the word 8-11 times in one lesson. The target words are reviewed again at the end of the story using an additional child-friendly context, and gives children the opportunity to say the word and the definition.
**Table 1.3. Sample Vocabulary Targets in Revised Books**

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<tbody>
<tr>
<td>Ellie’s First Day</td>
<td>enormous different</td>
<td>bolt enormous destroy different</td>
</tr>
<tr>
<td>Pablo’s Prickly Problem</td>
<td>terrified protect</td>
<td>prepare terrified protect burst</td>
</tr>
</tbody>
</table>

**Story Friends implementation.** Intervention took place in an adjacent classroom free from distractions. Intervention sessions were conducted in small groups (3-4 children) with an adult facilitator who was a member of the research team (trained undergraduate and graduate research assistants). Children listened to the same prerecorded storybook three days a week under headphones in a small group while the adult facilitator supervised. The facilitator monitored children’s behaviors during the lesson (i.e. children turned to the correct page, responded to instruction, kept headphones on). Two series of Story Friends were used, *Jungle Friends* and *Forest Friends*, one in each classroom. After the third listen, children’s vocabulary learning was assessed using a curriculum-based vocabulary measure.

**Measures**

**Norm-referenced language measures.** Two standardized, norm-referenced language measures were administered to all consented children prior to the intervention. Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4; Dunn & Dunn, 2007), a measure of receptive vocabulary, was used to characterize children’s receptive vocabulary and to identify participants.
The average split-half reliability for the PPVT-4 is reported as .94 and test-retest reliability is .93 across age and grade levels. The Core Language Score (CLS) of the Clinical Evaluation of Language Fundamentals-Preschool, Second Edition (CELF-P2; Wiig et al., 2004) was used to characterize participants’ general language ability and overall language performance. The CLS includes three subtests: Sentence Structure, Word Structure, and Expressive Vocabulary. Reported split-half reliability for the CLS ranges from .92 to .94 for children between 4 and 5 years of age, and test-retest reliability for the CLS is reported to be .89.

**Curriculum-based measure.** The Story Friends mastery monitoring probe was the primary outcome measure for vocabulary learning. The mastery monitoring probes are a researcher-created, curriculum-based measure developed for use with Story Friends. The mastery monitoring probes have been the measure of vocabulary learning in previous Story Friends studies (Goldstein et al., 2016; Greenwood et al., 2016; Kelley et al., 2015; Spencer et al., 2012). For each target word, children are asked to provide a definition in response to an open-ended question, i.e. “*Tell me, what does (target word) mean?*” Responses are scored on a 0-2 point scale: zero points for an incorrect response, one point for a partial or related response, and two points for a correct response. In the current study, the mastery monitoring probes were administered before and after each week of intervention. All assessments were administered individually by trained research staff members. The internal consistency of the mastery monitoring probes was high for this sample (Cronbach’s alpha = .95).

**Fidelity and Reliability**

Trained observers assessed implementation fidelity for 20% of the vocabulary lessons using an observation checklist. The checklist included key components of the small group listening center and facilitator behavior (i.e., each child has a book and is wearing headphones,
facilitator is wearing headphones, correct and complete audio is played, behavior expectations are reviewed, non-specific positive feedback is given, facilitator does not provide additional instruction). The average implementation fidelity was 94%, ranging from 70 to 100%.

The fidelity checklist also was used to record child behaviors during the lessons to monitor active responding that included repeating the word, responding to instruction by verbally answering a question or acting out a response (e.g., *Now, pretend you are going to give Ellie a hug. Remember, she is enormous, so make your arms really big!*), and repeating the definition. On average, children responded to instruction 61% of the time, ranging from 50 to 82%.

Twenty percent of the weekly Mastery Monitoring Probes were randomly selected and assessed for administration fidelity and scoring reliability. A trained research staff member blind to assessment period (pre or posttest) listened to the audio-recorded testing sessions and completed procedural checklists specific to the probe protocol. The administration fidelity for this study averaged 99.6%, ranging from 88 to 100%. Scoring was completed using a detailed scoring guide created for the mastery monitoring probes that includes a scoring rubric and sample responses. Item-by-item interrater agreement calculated for scoring reliability averaged 98.8%, ranging from 75 to 100%.

To ensure children received the intended dosage of the intervention (listens to the story three times) attendance logs were kept noting the number of times children were present and participated in the intervention and any behavior incidents that impeded or prohibited participation. On average, children listened to each book 2.9 times. Out of 54 intervention sessions, there were two behavior incidents that impeded a child’s participation in the listening center. Overall, attendance and behavior did not seem to interfere with children’s participation in the intervention or the results of our study.
Experimental Design

A repeated acquisition experimental design was used to examine the effects of instruction on word learning. The repeated acquisition design is an alternative to multiple baseline designs when examining multiple sets of non-reversible target behaviors (Gast & Ledford, 2014; Kennedy, 2005). Unlike a multiple baseline design, a repeated acquisition design allows for repeated measurement of the same behavior (e.g., vocabulary knowledge) when the response sets are different (e.g., different target words each week) during brief baseline and treatment phases. The vocabulary targets for the Story Friends program are challenging words, rarely known and/or used by preschoolers. For this study, repeated demonstration of word learning was evaluated by comparing pre- and post-intervention responses to determine the extent to which instruction facilitated vocabulary learning. In repeated acquisition design, experimental control is demonstrated by the replication of learning effects within and across participants. One series of 9 Story Friends books provides an opportunity of learning up to 4 words, replicated 9 times within participants, as well as replicated across subjects (n=17), totaling 153 possible replications of experimental effects. Improvements are judged by posttest scores exceeding pretest scores for each book.

Results

The effects of explicit, embedded vocabulary instruction of four target words per book were analyzed by graphing the scores of the mastery monitoring probes for each child. Figure 1.1 includes panels for each participant that are ordered from low to high PPVT-4 standard scores which are shown under each Participant ID. As shown in Figure 1.1, a pretest score (open circle) and posttest score (closed circle) for each book were plotted for each child.
Consistent with repeated acquisition designs, evidence of treatment effects are repeatedly examined by comparing pretest and posttest scores for each book within and across participants. A treatment effect for each book was defined as an increase of at least 2-points from pretest to posttest, representing an improvement consistent with at least a complete definition for one word or partial definitions for two words. For example, in Figure 1.1, Child J1 had a score of zero at pretest and two at posttest for Book 2. For each participant, nine replications of treatment effects were possible (one per book). For example, Child F1 had 7 replications of treatment effects (Books 2, 3, 4, 6, 7, 8, 9). Treatment effects were replicated across all children for many of the books, 111 of 149 possible replications (75%). We had missing data for four books because of attendance. Treatment effects were observed for a mean of 6.7 books per child (range: 3 - 9). On rare occasions, children had higher pretest scores than posttest scores. For example, Child F7 had a score of two at pretest and zero at posttest for Book 9. Across all participants and books, this only occurred 5 times (3%).

Word level results were examined by calculating gain scores for each child and each word. Vocabulary scores were low at pretest ($M = 0.22$ points per book), indicating children had limited knowledge of target words prior to intervention. On average, children learned 17 words, that is approximately 2 words per book.

Next, we examined how pre-intervention vocabulary and language skills related to vocabulary learning. Intercorrelations among children’s language scores and word learning revealed strong positive relations between PPVT-4 scores and word learning ($r = .57$, $p < .05$) and CELF-P2 scores and word learning ($r = .70$, $p < .01$). Our results suggest a relation exists between the number of vocabulary words children learned and their pre-intervention oral language skills. Children with higher PPVT-4 scores knew more words at pretest and learned
more words during intervention than children with lower PPVT-4 scores. For example, in Figure 1, Child J1, whose PPVT-4 score was 70, had a pretest score of 0 for each book. Child F9, whose PPVT-4 score was 127, had an average pretest score of 2.9 points per book (range 0-6), indicating that she could provide the full definition for 1.5 words or had partial knowledge of three words per book. Second, there are observed differences in children’s word learning. For example, Child F5, whose PPVT-4 score was 100, demonstrated effects for all 9 books with an average gain of 6.2 points per book (range 4-8 points). Child J3, whose PPVT-4 score was 77, demonstrated effects for only 4 books with an average gain of 1 point per book (range 0-3).

**Discussion**

The purpose of this study was to examine the extent to which preschool children demonstrate vocabulary learning when explicit instruction of four target words per book was embedded within pre-recorded storybook activities. Additionally, we were interested in examining the differential effects this program had on children with a range of language abilities.

Previous studies examining the effects of Story Friends taught two words per book. We continued to use Beck and colleagues’ framework for word selection to incorporate two additional instructional targets into preexisting stories. Results indicate children were still able to learn sophisticated words when we increased the number of instructional targets. On average, children learned approximately 47% of the vocabulary words taught (17 out of 36). Providing decontextualized definitions is a challenging task for preschoolers and subject to measurement error. For example, a higher pretest score than posttest score could reflect a child being able to provide partial definitions for a few words at pretest, but not at posttest. Alternatively, children sometimes confuse definitions among new words at posttest.
Table 1.4 summarizes the average word learning outcomes from previous Story Friends studies. Children in the current study learned more words and the second highest percentage of words compared to children who received the two word version. Children learned less than 1 word a week in Goldstein et al. (2016) and Greenwood et al. (2016), and approximately 1 word a week in Spencer et al., (2012). Overall, children in the current study learned approximately 2
words a week, twice as many words than the previous studies. Even though the average percent of word learning is lower than the results of Kelley and colleagues (2015; 47% compared to their 56%), the number of words learned is greater as a result of the 4 word version of Story Friends, with children learning 17 words compared to their 10. When we increase the number of instructional targets, children learned more words because more words were taught.

Intercorrelations revealed preliminary evidence that differences in language abilities contributed to differences in word learning. We consider these results preliminary in light of a relatively small sample size. However, this relation was not evident in prior Story Friends investigations, which found that initial PPVT-4 and CELF-P2 scores did not influence vocabulary learning (Goldstein et al., 2016; Kelley et al., 2015). The limited range of children’s PPVT-4 and CELF-P2 standard scores could explain why Goldstein and Kelley did not observe the similar relations, as it is more difficult to detect relations when conducting analyses with a restricted range of test scores.

**Table 1.4. Summary of Story Friends Studies**

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Version</th>
<th>PPVT-4 M (SD)</th>
<th>PPVT-4 range</th>
<th>CELF-P2 M (SD)</th>
<th>CELF-P2 range</th>
<th>Average Word Learning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spencer et al.</td>
<td>9</td>
<td>2 word</td>
<td>84.3 (5.45)</td>
<td>78-96</td>
<td>86.44 (7.18)</td>
<td>73-94</td>
<td>8 out of 18 (45%)</td>
</tr>
<tr>
<td>(2012)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kelley et al.</td>
<td>9</td>
<td>2 word</td>
<td>83.44 (4.22)</td>
<td>77-90</td>
<td>89.11 (8.43)</td>
<td>79-98</td>
<td>10 out of 18 (56%)</td>
</tr>
<tr>
<td>(2015)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goldstein et al.</td>
<td>85</td>
<td>2 word</td>
<td>83.9 (5.32)</td>
<td>71-96</td>
<td>83.10 (11.07)</td>
<td>not reported</td>
<td>5 out of 18 (28%)</td>
</tr>
<tr>
<td>(2016)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greenwood et al.</td>
<td>9</td>
<td>2 word</td>
<td>86.9 (11.4)</td>
<td>73-107</td>
<td>72.60 (14.20)</td>
<td>50-102</td>
<td>5 out of 18 (28%)</td>
</tr>
<tr>
<td>(2016)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>present study</td>
<td>17</td>
<td>4 word</td>
<td>98.1 (18.15)</td>
<td>70-127</td>
<td>92.30 (18.16)</td>
<td>59-121</td>
<td>17 out of 36 (47%)</td>
</tr>
</tbody>
</table>

23
Research has demonstrated conflicting evidence on the effects initial language ability has on vocabulary learning. In many studies, children with higher vocabulary scores at pretest learn more words in intervention than children with lower vocabulary scores (e.g., Penno et al., 2002; Coyne et al., 2004). However, Justice et al. (2005) reported the opposite: children with lower vocabulary scores made the largest gains. Results of our study corroborate those who found that children with limited oral language skills may struggle to learn sophisticated target words (Coyne et al., 2004; Goldstein et al., 2017; Penno et al., 2002; Robbins & Ehri, 1994). Language ability alone may not truly represent a child’s risk status. It could be that the combination of several unique factors contributes to a child’s ability to acquire new vocabulary words. Marulis and Neuman (2010) found significant differential effects on word learning outcomes when SES was combined with other risk factors (e.g. special education status). Future studies should be done to determine factors associated with word learning (e.g. home literacy practices, maternal education level). An understanding of these factors will help us design a vocabulary program that will meet the diverse learning needs of all students.

We found great variability in learning of vocabulary targets, with some words that many children learned and some that very few learned. The differences in vocabulary learning could be attributed to the words chosen for instruction. Children may be more likely to learn words that are more concrete regardless of language ability compared to words that are more abstract. As an example, children struggled to learn the word *wise* (defined as *smart*), a more abstract concept. Only 37.4% of children (3 out of 8) were able to correctly define the word. We then discovered that children could not easily define the word *smart*; even the definition was still too abstract, which made the word *wise* more difficult to learn. Interestingly, all eight children were able to define the word *sprint*, a seemingly more concrete word. We assume that many children already
had a strong representation for the concept *running*, which may have facilitated their learning of *sprint*. The sophisticated words we choose for instruction should be “a more refined label for concepts with which young learners are already familiar” (Beck & McKeown, 2007, p. 253).

There is a delicate balance between identifying the words that children will acquire and incorporate into their lexicon and words that may not be learned because they are too abstract.

**Limitations and Future Directions**

There are limitations worth noting. In the current study, members of the research team implemented the small-group lessons in this study with strict adherence to lesson dosage. Dosage was a priority and make-up sessions were easily delivered by research staff when children returned after an absence. Because of this, implementation fidelity was very high. Although the automated nature of Story Friends eliminates most barriers that educators face in achieving implementation fidelity, it may be more difficult for educators to find time to ensure children receive three lessons per week, particularly when children are absent frequently. Thus, dosage may be affected and implementation reduced when educators act as interventionists. Future studies will examine the feasibility and fidelity of implementation when educators implement the four word version of Story Friends in authentic preschool settings.

Story Friends is designed to be implemented three times a week, but it could be, for children with higher language abilities, three listens are not necessary. Further investigation is warranted to determine the optimal dosage for groups of children with differing pre-intervention language abilities. This program is intended to be used as a supplemental program in preschool classrooms. Used alone, teaching four words a week is insufficient to impact their overall language development. Vocabulary instruction should occur throughout the day. When this happens, children are learning more than just four vocabulary words a week. Teachers should
enhance whole group read alouds by teaching novel vocabulary words from storybooks, and explain words that relate new themes for the week including science, social studies, art, or music. In doing so, teachers will provide children with rich language experiences that will enhance their vocabulary growth.

Meaningful measurement of vocabulary learning in preschool children presents a challenge. In the current study, we chose to focus on the ability of children to define the target vocabulary words and to limit the amount of testing to what a teacher might reasonably be able to accomplish. Although the mastery monitoring probe provided a rigorous test of the decontextualized, definitional vocabulary knowledge of young children, it did not capture information about receptive knowledge or about children’s ability to use the vocabulary words in everyday conversations. Future studies might address this limitation by including multiple measures of vocabulary knowledge or by probing vocabulary use in multiple contexts.

It is important to note that participants in the current study had higher pre-intervention vocabulary and language scores than in previous studies, which may explain some of the vocabulary learning. Table 4 also summarizes the differences in participants across the Story Friends line of research. Participants in the current study had a wide range of initial language abilities as measured by the PPVT-4 and CELF-P2. The average PPVT-4 and CELF-P2 standard scores were higher compared to the standard scores of participants from previous studies. Including children with higher initial language abilities may have influenced the word learning outcomes for this study. We found that they learned more words as a result of the explicit embedded instruction compared to their peers with lower initial language abilities. Given that Story Friends was designed to be used with children who have limited oral language skills, future
studies will examine the effects this revised version has on the word learning of children who may require supplemental instruction to acquire sophisticated vocabulary.

Regardless of pre-intervention language abilities, all children in the current study benefitted from instruction. However, it can be difficult for educators to implement the small group Story Friends lessons with their whole class. Developing instructional strategies that educators can use outside of the small group listening center (e.g. whole group, transition times, centers) may be easier for educators to implement with all students throughout their day. Examining the extent to which these short activities enhance word learning is key to developing a comprehensive vocabulary program that is flexible enough to meet the instructional needs of all children.

**Conclusion**

When books and lessons were revised to include more vocabulary words and lessons, children in the current study learned more words than children in previous studies when fewer words were taught. This finding suggests that increasing the number of words taught to four words per book within the Story Friends program is feasible and will result in larger increases in vocabulary knowledge. These findings add to our understanding of best practices for vocabulary intervention in preschool, and provide further evidence that children can learn sophisticated vocabulary when instruction is explicit, repeated often, and provides child-friendly contexts.
References


CHAPTER THREE:
INDIVIDUAL FACTORS PREDICTIVE OF PRESCHOOLERS’ WORD LEARNING

Introduction

Vocabulary knowledge is essential for later reading success (Anderson & Nagy, 1991; Baker et al., 1998; Logan, 2017; National Reading Panel, 2000; Snow, Burns, & Griffin, 1998). Unfortunately, a child who struggles to acquire academic vocabulary faces the risk of developing later reading difficulties as they progress through school. There are still many unknowns when trying to examine word learning at the preschool level. Mainly, what is it about preschool children and programs that aid or impede word learning? Without a rigorous examination of the factors most related to word learning in this group of children, we will not be able to develop effective instructional programs for those children most at risk for developing future language and reading difficulties.

Research has examined the relations between children’s language abilities and their literacy development and found that a child’s underlying language skills can either facilitate or hinder the acquisition of new skills. This phenomenon is referred to as the Matthew effect which explains why children with enriched language skills have greater learning compared to their peers with deficient language skills (Cain & Oakhill, 2011; Penno, Wilkinson, & Moore, 2002; Stanovich, 1986). These disparities lead to a widening achievement gap that tends to persist over time. So, the rich get richer and the poor get poorer. However, there is conflicting evidence supporting the notion that a child’s language ability impacts their capacity to learn new
vocabulary words. Some researchers found that children with higher initial language abilities learned more vocabulary words compared to their lower-language peers, supporting the findings of Cain and Oakhill (2011) and other investigators (Coyne, Simmons, Kame’enui, & Stoolmiller, 2004; Penno et al., 2002; Robbins & Ehri, 1994). In contrast, others found that children with lower initial vocabulary scores made greater word learning gains as a result of instruction (Elley, 1989; Justice, Meier, & Walpole, 2005). These discrepant findings could be attributable to differences in targeted vocabulary, in instruction, in measurement, or perhaps more subtle differences in the populations sampled. Further examination of language ability and word learning is warranted. It could be that other factors, when combined with initial language ability, provide a more complete picture of contributors to preschoolers’ vocabulary learning.

Typically, preschool research examining later achievement focuses on the acquisition of code-based skills, ignoring oral language and vocabulary development (Lonigan, Burgess, Anthony, 2000; Skibbe, Justice, Zucker, & McGinty, 2008). Furthermore, researchers do not always include children from families with varying socioeconomic backgrounds (Bennett, Weigel, Martin, 2002; Lonigan, Burgess, Anthony, 2000). Although early childhood literature has documented that a family’s socioeconomic status (SES) relates to cognitive and language development, academic achievement, and overall health outcomes (Crow & Leary, 2015; Dollaghan et al., 1999; Hart & Risley, 1995; McLoyd, 1998), others caution that there are a wide range of individual differences among preschoolers from low SES that contribute to their academic performance (Cabell et al., 2011). To be sensitive to these unique differences, other attributes must be considered when examining learning outcomes of children from families with a range of SES.
Because of the lack of studies examining the factors related to preschooler’s word learning, findings from studies that examine the academic achievement of elementary students may lend insights and help guide the selection of factors that would relate to learning in preschoolers. It is important to remember that there are many differences between preschool and elementary education that must be considered, including the quality and quantity of literacy instruction, the skills taught, and the types of assessments used to measure growth. Many of the studies reviewed do not specifically focus on word learning. Rather, they examine global measures of literacy and reading achievement. But, because vocabulary acquisition is strongly related to reading, there may be parallel indicators that would strongly relate to word learning.

Several key factors significantly impact academic achievement in elementary grades in the areas of language and literacy, including socioeconomic status, home literacy environments, parent involvement, school and classroom settings, and teacher interactions (National Research Council, 1998).

Children from lower SES families tend to enter school lagging behind peers and maintain lower learning trajectories over time (Jimerson et al., 1999; Walker et al., 1994). Home environments that support and nurture a child’s growth and development are likely to provide a strong foundation for later academic success. The amount of stimulation and parent support provided in the home environment has been shown to relate to later reading success (Jimerson et al., 1999). Parents are some of the best language models children can have. These adults engage children in conversations, repeat and expand upon a child’s response, and encourage children to express themselves through the use of open-ended questions throughout the day and in a variety of contexts (Greenwood et al., 2017). In addition to modeling oral language skills, literacy environments at home and in school that provide access to books and print materials, and adults
engaging in shared storybook reading that encourages discourse around books can enhance children’s vocabulary and literacy development (Bus et al., 1995; Foster et al., 2005; Frijters, Barron, & Brunello, 2000; Lane & Wright, 2007; Payne et al., 1994).

Evidence shows that early language environments in the classroom enhance by teacher talk can influence later reading abilities. Supportive language environment in preschool that include teacher-child conversations affect children’s later language and reading abilities (Dickinson & Proche, 2011; Dickinson & Tabors, 2001). Similarly, Connor and colleagues (2005) found that preschooler teacher’s education level affects their abilities to interact with their students. Teachers who are responsive and sensitive to children positively affects their classroom environments and children’s later vocabulary skills.

If we are to investigate children’s words learning, we must examine the many settings and agents that can facilitate or hinder learning to fully understand the underlying processes related to vocabulary acquisition. The present study will use structural equation modeling to examine the associations between constructs describing different child, family, and classroom-level factors and word learning. It is hypothesized that children’s language ability, the family’s SES, home literacy practices, and classroom environments that support literacy and language development will facilitate greater word learning (Figure 2.1). Once models are tested we will be able to identify key factors that may aid in the early identification and intervention process of at-risk preschoolers.
Participants were recruited in conjunction with a cluster randomized control trial that evaluated a revised version of *Story Friends*, a supplemental preschool vocabulary program (Goldstein et al., 2016; Goldstein & Kelley, 2016). As part of the cluster randomized control trial, classrooms were randomized into one of two groups, treatment or control. For the purposes of this investigation, participants from 14 treatment classrooms were included. These 14 preschool sites provide state-funded voluntary preschool programs to children from families with a range of socioeconomic levels. Three of these classrooms were housed at Title I elementary schools, and the remaining 11 classrooms were housed in community-based childcare centers in high poverty communities. Two cohorts of children from these sites were recruited to participate across two school years (Appendix B). A total of 112 4- and 5-year-olds were enrolled. Demographic information is presented in Table 2.1.

![Hypothesized model illustrating relationships between child, home, and classroom-level factors and word learning.](image)
Table 2.1. Demographic Information.

<p>| | |</p>
<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>112</td>
</tr>
<tr>
<td>Number of Male/Female</td>
<td>55/57</td>
</tr>
<tr>
<td>Mean Age at Pretest (in months)</td>
<td>54.8</td>
</tr>
<tr>
<td>Mean PPVT-4 (SD)</td>
<td>99.04 (14.63)</td>
</tr>
<tr>
<td>Mean CELF-P2 Core Language Index (SD)</td>
<td>90.79 (14.17)</td>
</tr>
</tbody>
</table>

Procedures

**Supplemental vocabulary program.** Classroom teachers implemented the Story Friends curriculum (Goldstein et al., 2016; Goldstein & Kelley, 2016). Story Friends teaches young children sophisticated vocabulary words through a short prerecorded storybook read aloud. Explicit instruction for four challenging vocabulary words is embedded in each story and includes a child-friendly definition, provides multiple contexts for the word, allows for active responding, and offers repeated practice. Children listen to stories under headphones three times a week in small groups (3-4 children) while an adult facilitator monitors group behavior. Repeated exposure to stories ensures adequate opportunities for children to learn the targeted words. Each book contains four sophisticated vocabulary words. In addition to the listening center, there are classroom strategies teachers can use weekly to review the target words (e.g., connect to classroom activities, review words and their meaning), and home strategies teachers can share with parents to reinforce word learning at home (e.g., words get sent home with definitions, parents have access to short videos with ideas to incorporate the use of words at
home). Children’s word learning was assessed using a researcher-made measure that was administered every 4 weeks. The measure asks children to provide the meanings of the target words.

Model

Child factors. Research has demonstrated children’s receptive and expressive language abilities are associated with vocabulary acquisition (Coyne, Simmons, Kame’enui, & Stoolmiller, 2004; Penno et al., 2002; Robbins & Ehri, 1994). The child-level factor includes a language skill construct measured by three observed variables that reflect receptive, expressive, and general language abilities. These were measured by norm-referenced language assessments.

Family factors. The family factors are composed of observed variables from the home environment including the family’s average annual income, parent’s education, and home literacy practices. Research indicates links between a child’s home environments and their acquisition of literacy-based skills (Connor et al., 2005; Jimerson et al., 1999; Walker et al., 1994). Specifically, the family’s socioeconomic status has been shown to impact children’s academic performance (Hart & Risley, 1995; Jimerson et al., 1999; Walker et al., 1994). The language and literacy activities that occur in the home can also affect children’s language and early literacy skills, such as shared book reading and adult/child conversations about books (Bus et al., 1995; Foster et al., 2005; Frijters, Barron, & Brunello, 2000; Greenwood et al., 2017; Jimerson et al., 1999; Lane & Wright, 2007; Payne et al., 1994). Two constructs were modeled, family’s SES and home literacy practices. Several recommendations have been made to capture the family’s SES, which includes the number of family members in the household, parents’ occupation, annual income, and/or parental education level (Hauser, 1994). Family SES and home literacy practices were measured using a parent-reported family survey. On this survey we
ask parents to report the frequency in which they engage their children in literacy-based activities weekly. The items include telling stories, practicing letter names and sounds, singing, and reading stories with their child.

**Classroom factors.** Several researchers have found that a child’s classroom environment facilitates the acquisition of new skills (Connor, et al., 2005; Dickinson & Porche, 2011; Dickinson & Tabors, 2001). A classroom construct was modeled and is composed of observed variables from the classroom environment that include teacher education, classroom environment (i.e. organization of the classroom, classroom management, opportunities for child choice), and literacy and language practices (i.e., opportunities to extend conversation, efforts to build vocabulary, access to books). A teacher survey and a classroom observational tool measured this construct.

**Vocabulary knowledge.** Children’s word learning was measured using three curriculum-based vocabulary tests. A summary of the latent constructs and measured variables can be found in Table 2.2. Each measure is described below.

**Measures**

**Child-level factors.** The Peabody Picture Naming Test, Fourth Edition (PPVT-4; Dunn & Dunn, 2007) measures a child’s single word receptive vocabulary. Sets of four pictures are presented, and the child is asked to identify the picture that represents the word spoken by the examiner. The average split-half reliability is high (.94) and test-retest reliability is .93 across age and grade levels. The Picture Naming Individual Growth and Development Indicator (PN-IGDI; Missall & McConnell, 2010) is an expressive language measure that requires children to name common objects and animals when presented with an image. The alternate form reliability reported for PN-IGDI is .44-.78, and test-retest reliability is .67. The Core Language Score
(CLS) of the Clinical Evaluation of Language Fundamentals-Preschool, Second Edition (CELF-P2; Wiig et al., 2004) provides a descriptive measure of general language ability and overall language performance. The CLS includes three subtests: Sentence Structure, Word Structure, and Expressive Vocabulary. The Sentence Structure subtest evaluates the child’s ability to understand spoken sentences, the Word Structure subtest examines their knowledge of grammatical rules, and the Expressive Vocabulary subtest evaluates their ability to name pictures of people, objects, and actions. The split-half reliability for the CLS ranges from .92 to .94 for children between 4 and 5 years of age, and test-retest reliability for the CLS is reported to be .89.

**Family-level factors.** A researcher-developed survey asked parents to report demographic information about their child, home language, parent(s) level of education and their average annual income. Home literacy practices included the frequency with which parents tell their children stories, practice letter names and sounds, sing, and read stories to their children. Parents were asked to rate the frequency of each behavior on a 1-4 scale indicating never (1), 1-2 times a week (2), 2-3 times a week (3), or every day of the week (4). Scores were added together to get a single indicator of the literacy practices that take place in the home.

**Classroom-level factors.** A researcher-developed survey collected teacher’s demographic information, teaching experience, education level, and classroom practices. The Early language and Literacy Classroom Observation Tool, Pre-K (ELLCO Pre-K; Smith, Brady, & Anastasopoulos, 2008) is an observational tool used to examine the language and literacy practices in preschool classrooms. There are two subscales of the ELLCO Pre-K, the *General Classroom Environment* subscale addresses classroom organization, curriculum and instruction, and the *Language and Literacy* subscale addresses literacy instruction (i.e. book reading, print
awareness) and opportunities to develop and practice oral language and emergent literacy skills in the classroom (i.e. vocabulary, phonological awareness).

**Vocabulary knowledge.** Children’s vocabulary knowledge was assessed at three different time points using an expressive curriculum-based assessment. Each unit vocabulary test ask children to provide definitions for the target words, i.e. “Tell me, what does (target word) mean?” Responses were scored on a 0-2 scale: zero points for an incorrect response, one point for providing a partial or related response, and two points for a full definition. Scoring was completed using a detailed scoring guide created for the unit tests that includes a scoring rubric and sample responses.

**Design**

The relationships among measured variables and latent constructs was analyzed using structural equation modeling (SEM) which combines techniques of factor analysis, path analysis, and multiple regression (Vogt & Johnson, 2011). Individual word learning data from 112 preschool children was used as the primary outcome of vocabulary learning. A hypothesized model in which a child’s language skills, their family’s socioeconomic status, home literacy practices, and classroom factors impact word learning is depicted in Figure 2.2. These factors are modeled as latent variables each with 1-3 indicators (described in Table 2.2).

**Data Analysis**

Examining the associations between constructs describing different child, family, and classroom-level factors and word learning required two steps: analyzing the measurement models and estimating the structural model. The data were prepared for analyses by checking the
univariate distributions for normalcy and outliers. None of the variables required transformation. Descriptive statistics for each observed variable including means and standard deviations were analyzed and are presented in Table 2.3. The model was estimated using lavaan version 0.6-3 (Rosseel, 2012) in R version 1.2 (R Core Team, 2019). This package uses maximum likelihood estimation and full information maximum likelihood (FIML) for missing data when the missingness is random. FIML uses parameter estimates and standard errors from available data to estimate parameters for missing data without deleting any missing values (Kline, 2016).
The first step was to conduct a confirmatory factor analysis to measure the relations among the observed variables and the hypothesized latent variables (Jackson, Gillaspy Jr, & Purc-Stephenson, 2009; Schreiber, Nora, Stage, Barlow, & King, 2006). The second step was to include the structural model into the analyses to estimate the relations among the hypothesized latent variables. The following measures of goodness of fit were used to compare how well our model fits the data: Model Chi-square ($\chi^2$), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR).

Figure 2.2. Hypothesized structural equation model illustrating relationships between child, home, and classroom-level factors and word learning. Note. Ovals represent latent variables and rectangles represent measured variables.
Table 2.3. Descriptive statistics of measured variables.

<table>
<thead>
<tr>
<th>Measured Variable</th>
<th>N</th>
<th>Mean (SD)</th>
<th>% Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Picture Naming IGDI</td>
<td>103</td>
<td>48.42 (2.45)</td>
<td>8.03%</td>
</tr>
<tr>
<td>PPVT-4</td>
<td>112</td>
<td>99.04 (14.63)</td>
<td>0%</td>
</tr>
<tr>
<td>CELF-P2 Core Language Index</td>
<td>112</td>
<td>90.79 (14.17)</td>
<td>0%</td>
</tr>
<tr>
<td>Average Annual Household Income</td>
<td>75</td>
<td>$34,155 (17,300)</td>
<td>33.03%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>($10,000 - $50,000+)</td>
<td></td>
</tr>
<tr>
<td>Caretaker Education Level</td>
<td>80</td>
<td>some 4-year (some</td>
<td>28.57%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>high school-graduate/</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>professional degree)</td>
<td></td>
</tr>
<tr>
<td>Home Literacy Score</td>
<td>84</td>
<td>12.05 (3.36)</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>some 4-year (high</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>school graduate-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>graduate/professional degree)</td>
<td></td>
</tr>
<tr>
<td>Teacher Education Level</td>
<td>112</td>
<td>some 4-year (high</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>school graduate-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>graduate/professional degree)</td>
<td></td>
</tr>
<tr>
<td>ELLCO General Education Environment Subscale Average</td>
<td>112</td>
<td>14.86 (1.43)</td>
<td>0%</td>
</tr>
<tr>
<td>classroom structure</td>
<td>112</td>
<td>17.69 (1.81)</td>
<td>0%</td>
</tr>
<tr>
<td>curriculum</td>
<td>112</td>
<td>12.04 (1.17)</td>
<td>0%</td>
</tr>
<tr>
<td>ELLCO Language &amp; Literacy Environment Subscale Average</td>
<td>112</td>
<td>16.35 (1.94)</td>
<td>0%</td>
</tr>
<tr>
<td>language environment</td>
<td>112</td>
<td>16.68 (2.00)</td>
<td>0%</td>
</tr>
<tr>
<td>books &amp; book reading</td>
<td>112</td>
<td>20.07 (2.96)</td>
<td>0%</td>
</tr>
<tr>
<td>print &amp; early writing</td>
<td>112</td>
<td>12.28 (2.07)</td>
<td>0%</td>
</tr>
<tr>
<td>Unit 1 Vocabulary Test</td>
<td>112</td>
<td>15.1 (7.1)</td>
<td>0%</td>
</tr>
<tr>
<td>Unit 2 Vocabulary Test</td>
<td>112</td>
<td>13.24 (6.88)</td>
<td>0%</td>
</tr>
<tr>
<td>Unit 3 Vocabulary Test</td>
<td>112</td>
<td>11.46 (6.99)</td>
<td>0%</td>
</tr>
</tbody>
</table>

The model chi-square, considered together with the significance level ($p$-value), assesses a model’s overall fit. Chi-square can take on values greater than one; smaller values coupled with a $p$-value greater than .05 indicate better fit. The larger the value of chi-square and/or the smaller the $p$-value ($<.05$), the worse the fit (Kline, 2016). The CFI is a goodness of fit test. It can take on a value between 0 and 1. Values that approach one indicate a stronger fit (Kline, 2016). The RMSEA and the SRMR are absolute fit indices that tests error. To indicate a better fit the
RMSEA and SRMR will have a low value. Kline (2016) recommends anything greater than 0.1 is considered a poor fit, and anything less than 0.05 indicates a strong fit for both RMSEA and SRMR. Whereas some agree with Kline’s recommendation of RMSEA values below .06 to indicate good fit (Hu & Bentler, 1999; Kline, 2016), others suggest values of .01 (excellent fit), .05 (good fit), and .08 to indicated mediocre fit (MacCallum, Browne, and Sugawara, 1996). While model building, changes to hierarchical models can be assessed using the chi-square difference statistic ($\chi^2_D$). Hierarchical models are nested; one model is the subset of another (Kline, 2016). This is used to assess the overall model fit as a parameter is trimmed or added. It is important to note that fit indices can be affected by sample size and degrees of freedom. Analyzing models with a smaller sample size and fewer degrees of freedom can result in fit statistics that incorrectly misidentify model fit (Kenny, Kaniskan, & McCoach, 2015, Taasoobshirazi & Wang, 2016). This needs to be considered when analyzing and interpreting the results of this study, as the sample size is relatively small (N=112), and many of the measurement models were estimated using 1-2 degrees of freedom.

Results

Evaluation of Measurement Models

**Language.** The language latent construct was modeled using children’s scores from three language assessments measuring their receptive, expressive, and general language abilities (PPVT, CELF-P, and PN-IGDI). Because the PPVT and CELF scores were on a similar scale that differed from the PN-IGDI, their factor loadings were set to be equal, and the PN-IGDI path was freely estimated. Results indicate the model fit well, $\chi^2 (1)=.29$, $p=.59$, CFI=1.00, RMSEA=.00, SRMR=.015. These three language assessments were good indicators of language.
**Family SES.** The SES latent construct was modeled using the family’s average annual income and parent education level. At first the model would not identify with only two indicators. When the factor loadings for income and parent education were equal to one another, the model identified but education had a negative variance. To account for this, the variance for education was set to one. The results indicate good model fit $\chi^2(1) = .872, p = .35, CFI = 1.00, RMSEA = .00, SRMR = .051$.

**Vocabulary.** Children’s scores from the three unit tests measured the vocabulary latent factor. Because these assessments were very similar to one another, the factor loadings for all three were set to be equal. Results indicate very good fit for the model, $\chi^2(2) = .366, p = .83, CFI = 1.00, RMSEA = .00, SRMR = .017$. The three unit tests were very good indicators of vocabulary.

**Classroom environment.** The classroom latent factor was first modeled using the subscale scores from the general classroom environment and the language and literacy environment and teacher education. These three indicators did not model classroom environment well at all, even when the factor loadings were set to be equal. Because it can be difficult to identify a model with only two measured variables, a new model was specified in which the five observed subscales from the ELLCO-PreK (i.e., classroom structure, curriculum, language environment, books and book reading, and print and early writing) were included in the model along with teacher education, and all paths were estimated freely. However, the resultant model had poor fit. After iteratively trimming the model by removing the teacher education, classroom structure, and curriculum, the model fit somewhat improved, $\chi^2(1) = 2.876, p = .09, CFI = .982, RMSEA = .129, SRMR = .029$. While the chi-square, CFI, and SRMR indicate good fit, the RMSEA did not. RMSEA can be affected by sample size and degrees of freedom; models with a
small N and fewer degrees of freedom result in RMSEA values that incorrectly identified poor fitting models (Kenny, Kaniskan, & McCoach, 2015). Because the other fit statistics indicate good fit, the model of classroom environment was considered acceptable.

**Home literacy practices.** Finally, the home literacy practices latent construct was modeled using parents’ rating of the frequency in which they tell their children stories, reviewed letters and letter sounds, sang to their children, and read stories with their children weekly. The factor loading for story frequency was scaled to one, and the others were estimated freely. Results indicate good fit for the model, $\chi^2(2)=1.53, p=.466$, CFI=1.00, RMSEA=.00, SRMR=.020. Now that the measurement models have been identified, the structural parts can be added to estimate the model.

**Evaluation of Structural Model**

Following the iterative process of evaluating the measurement models, the structural parts of the model were added. The model was modified by including the effects of language, SES, classroom environment, and home literacy practices on vocabulary. This resulted in $\chi^2=146.73$ (N=112, $d_f=87$, $p<.0001$), CFI=0.898, RMSEA=0.078, SRMR=0.096. The overall model fit was poor ($\chi^2=146.73$, $p$ was less than .05). The CFI was less than the recommended .09 and the RMSEA was greater than .05, which indicates mediocre fit.

Next, the path coefficients were examined to see if there were changes that could be made to the model that may improve fit. Language and classroom environment significantly influenced vocabulary (language standardized parameter estimates=.413, $p=.005$; classroom standardized parameter estimates=.328, $p=.024$). There was no significant effect of SES on vocabulary (standardized parameter estimate=-.124, $p=.516$) or of home literacy practices on
vocabulary (standardized parameter estimate=.038, \( p=.815 \)), so these paths were trimmed and the model was evaluated again. Results indicate little to no change in fit, \( \chi^2=147.198 \) (N=112, \( df=89, p=.00 \)), CFI=0.901, RMSEA=0.076, SRMR=0.096. This model was compared to the first model to assess the overall fit of the reduced model. There was not a significant change in chi-square (\( \chi^2_D (2)=0.47 \)), so trimming the paths from SES and home literacy practices to vocabulary knowledge fit the data equally as well as the model that included those paths.

Next, we examined the potential indirect effects SES and home literacy practices had on vocabulary learning. Each of these factors were significantly correlated with language (SES: \( r=.39, p=.001 \); home literacy practices: \( r=.246, p=.042 \)), so there could be a mediating effect where SES and/or home literacy practices could influence language, which in turn would influence vocabulary learning. Each path was modeled separately. First, a path from SES to language was included in the model. While the path from SES to language was significant (standardized parameter estimate=.454, \( p=.003 \)), the model fit did not change much, \( \chi^2=148.95 \) (N=112, \( df=91, p=.00 \)), CFI=0.901, RMSEA=0.075, SRMR=0.098. The chi-square difference statistic indicates the revised model fit the data as well as the previous model where a path from SES to language was modeled (\( \chi^2_D (2)=1.75 \)).

Next, the path from home literacy practices to language was modeled. This resulted in a non-significant path. After examining the model’s paths, home was not significantly related to any of the latent factors, so this construct was removed from the model to see if it improved the fit. Results indicate that while the fit was not ideal, it had improved: \( \chi^2=71.88 \) (N=112, \( df=46, p=.009 \)), CFI=0.946, RMSEA=0.071, SRMR=0.078. The change made to this model included the removal of more than one parameter. This new model is no longer a hierarchical model, so the chi-square difference statistics is no longer an appropriate measure to assess model fit. To
compare two non-hierarchical models the Akaike’s Information Criteria (AIC; Akaike, 1974) and Bayes Information Criterion (BIC; Raftery, 1995) are examined (Kline, 2016). Values closer to 0 indicate better fit. The AIC and BIC for the larger model that included a path from home literacy practices to language were 7139.82 and 7262.16, respectively. The smaller model with the latent construct home literacy practices removed had improved fit (AIC=6292.97, BIC=6377.25). This improved fit indicates the model where the home literacy practices construct was completely removed from the model fit the data better than when a path from home literacy practices to language was modeled.

Overall, the $\chi^2$ was smaller (71.88 compared to the previous model’s 148.95). The CFI was .946, and the RMSEA was less than .08. While some recommend RMSEA values below .06 to indicate good fit (Hu & Bentler, 1999; Kline, 2016), others suggest a cut off of .08 to indicated mediocre fit (MacCallum, Browne, and Sugawara, 1996). The SRMR value of .078 falls below Kline’s (2016) .1 criteria for poor fit. Figure 2.3 illustrates the resultant model.

Standardized path coefficients were estimated to determine the relationship between latent and observed variables (Figure 2.3) and their relation to preschooler’s vocabulary learning. Standardized path coefficients correspond to effect sizes; paths with values less than .1 indicate a small effect, values around .3 indicate a medium effect, and anything greater than .5 indicates a large effect (Suhr, 2006). Children’s language skills had a medium effect on vocabulary learning (standardized path coefficient=.342, $p=0.003$). Similarly, children’s language and literacy classroom environments moderately influenced preschoolers’ vocabulary learning (standardized path coefficient=0.296, $p=0.012$).
Family SES had a moderate effect on children’s language (standardized path coefficient=.447, \( p=0.003 \)), and when mediated by language, SES had a small indirect effect on vocabulary knowledge (standardized parameter estimate=.155). There is a moderate positive relationship between the family’s SES and classroom environment (\( r=.427, p=.003 \)).

**Discussion**

The purpose of the present study was to examine the relations among child, family, and classroom-level factors and their influence on preschoolers’ vocabulary learning. Structural equation modeling was used to specify these relations. Results of the present study indicate a child’s language skills and their classroom environment influenced preschoolers’ vocabulary
knowledge, the family’s SES influenced children’s language levels and indirectly affected vocabulary learning, and children’s classroom environment was correlated with family SES.

Other studies have used SEM to examine the ways in which children’s language and literacy development are influenced by a variety of factors including professional development, SES, classroom, teacher, home, and child characteristics (Connor, Son, Hindman, & Morrison, 2005; Downer, Pianta, Fan, Hamre, Mashburn, & Justice, 2011). In each of these studies, language and literacy was assessed using standardized language measures (i.e., Pre-CTOPPP, Woodcock–Johnson Tests of Achievement-R, PLS). Our study is unique in that we used a dynamic outcome measure of vocabulary learning that directly related to the program of instruction implemented in the classroom. To ensure our analysis modeled learning for a diverse group of preschoolers, we included children from 14 classrooms in schools that served families with varying levels of socioeconomic backgrounds, and children had a range of initial language abilities.

Results indicate children’s language skills had a moderate effect on their vocabulary learning. Children with higher initial receptive, expressive, and general language abilities learned more sophisticated vocabulary words as a result of instruction. Our findings support previous research that examined word learning and children’s language abilities (Coyne, Simmons, Kame’enui, & Stoolmiller, 2004; Penno et al., 2002; Robbins & Ehri, 1994). It appears that the Matthew effect (Cain & Oakhill, 2011; Stanovich, 1986) is evident as early as preschool. Penno and colleagues (2002) found children with higher initial language abilities made greater gains on vocabulary measures than their peers with lower language abilities as a result of an intervention that taught vocabulary through shared storybook readings. When examining the effects of vocabulary instruction on word learning in preschool classrooms, those with stronger
foundational language abilities seem to be at an advantage compared to their peers with weaker language skills. It is important to remember that language level was not the sole influence of vocabulary knowledge in this study, rather it was one part of a complex system of factors that contributed to preschoolers’ vocabulary acquisition.

Family SES did not directly influence preschoolers’ vocabulary learning, but it did have a moderate effect on children’s language abilities, and had a small indirect effect on vocabulary learning. It has been well documented that children from lower-SES families tend to enter school lagging behind their higher-SES peers on measures of language and literacy skills (Connor, Son, Hindman, & Morrison, 2005; Hart & Risley, 1995; Jimerson et al., 1999; Walker et al., 1994). Once children are behind, they tend to remain behind (Jimerson et al., 1999). Many researchers take a deficit perspective when discussing the differential learning outcomes of children from upper- and lower-SES families. But we must take care in making a broad generalizations when it comes to SES and academic performance. SES is often related to other underlying factors that relate to learning (Cabell et al., 2011; Connor, Son, Hindman, & Morrison, 2005; Foster et al., 2005).

Often children from poverty are described as at-risk. Although SES is frequently attributed to later reading ability, Cabell and colleagues (2011) caution that there are a wide range of individual differences among preschoolers from low SES that contribute to their academic performance. It is important to remember that socioeconomic status and the constructs that measure it (i.e., parent education level, occupation, income) are global indicators at best, used to classify families and their children. SES does not explain how poverty is associated with development; rather it influences the ways in which parents structure the home environment,
their interactions with children, and learning experiences; all contexts for development that relate to later school success (Foster et al., 2005).

It makes sense then that the family’s SES would have a positive moderate relationship with the classroom environment. As family’s SES increases, the quality of the language and literacy classroom environment also increases. A family’s SES often influences the neighborhood they live in and the schools their children will attend. Connor and colleagues (2005) found that children from lower SES families were more likely to attend preschools with lower-quality classroom environments compared to their peers from higher SES families. Wright (2012) found that although vocabulary instruction rarely occurred in early childhood classrooms, teachers were least likely to implement instruction in classrooms that served children from low-income families. However, we found that when a vocabulary program was implemented, the language and literacy classroom environment significantly enhanced preschoolers’ vocabulary learning.

Classroom environments that enriched children’s language and literacy development affected their ability to learn sophisticated vocabulary words. Our findings support previous research that found more supportive, high-quality preschool environments significantly improved children’s vocabulary skills, even if children came from families with lower SES (Connor, Son, Hindman, & Morrison, 2005; Dickinson & Tabors, 2011). This finding is interesting because it demonstrates the power the classroom environment has on children’s ability to make academic gains regardless of other factors that may impact learning. Teachers who engaged children in extended conversations and provided opportunities to build vocabulary through shared book reading and conversations about stories influenced children’s vocabulary skills (Coyne,
Simmons, Kame’enui, & Stoolmiller, 2004; Dickinson & Porche, 2011; Dickinson & Smith, 1994; Justice, Meier, & Walpole, 2005).

Surprisingly, home literacy practices did not influence vocabulary learning, nor were they related to family’s SES or to children’ language abilities in this study. Our findings are inconsistent with previous findings where researchers found relations between language development, vocabulary skills, and home literacy activities. For example, Frijters and colleagues (2000) found children’s receptive oral language development was influenced by parent-initiated literacy practices at home that included shared book reading, trips to the library, and the access to books in the home. Previous research has shown that children from lower-SES homes had weaker home learning environments that affected their vocabulary skills compared to peers from higher-SES families (Connor, Son, Hindman, & Morrison, 2005).

The failure to detect significant relations between home literacy practices and vocabulary knowledge and family SES could be due to a measurement issue. The measure used to capture home literacy practices for this study was a short 5-item questionnaire. These 5 items may poorly represent the literacy activities that occur in the home. It could be that more robust measures of home literacy practices are needed to capture the diversity in interactions and activities employed by parents and caregivers. Similarly, the measurement model for the classroom construct may need to include other measured variables that correctly represent the unique differences between classrooms. Dickinson and Porche (2011) suggest using detailed descriptions of teach-child interactions and conversations to provide greater insights into the ways in which teachers and the classroom environments foster development in young children.

Others have examined how multiple factors impact language and early literacy development (Connor, Son, Hindman, & Morrison, 2005; Downer, Pianta, Fan, Hamre,
Mashburn, & Justice, 2011). For example, Connor and colleagues found that a model that included SES, home, preschool and child characteristics influenced children’s language and literacy development in complex ways. Yet their language and literacy outcomes were derived from standardized assessments. Their findings contribute to the understanding of the many factors related to language and literacy achievement using static measures. Because our results mirrored results of other studies, it is important to continue to examine the factors that influence a more dynamic measure of vocabulary learning. The words were chosen for instruction because they are the words children will need to know for later reading comprehension. Research has demonstrated the importance of teaching these types of words to children (Beck, McKeown, & Kucan, 2002; Biemiller, 2006; Biemiller & Boote, 2006). If these words are so crucial to later reading achievement, then we must continue this line of research.

Future studies should expand upon the work of the current study with some modifications. Additional measures used to indicate the family and classroom environment latent variables must be examined. More robust assessments are likely to be more sensitive to detecting relations among measured and construct variables. The small sample size, and the relative complexity of the model may have impacted our results as well. Replicating the study with a larger sample and more sensitive measures may result in data fitting the model better, and may reveal relations that were not observed in this study. It is also important to note that results from this analysis pertain to vocabulary knowledge when a robust instructional program was provided to teachers. Outcomes may differ when alternative instructional programs are used.

Implications

The effects of child, family, and classroom-level factors on language outcomes often are investigated separately. But when studied in isolation, researchers may be ignoring other
important concomitant factors that may affect outcomes. Based on the findings of this study, a systemic approach to early childhood that encompasses child, family, and classroom-level factors to enhance each of the areas that most influenced vocabulary learning.

Family SES is a sensitive subject, because it is not an easily malleable independent variable that researchers can manipulate. Consequently, we may want to rethink how it should be considered when designing intervention programs. Providing parents and teachers with materials and strategies to enhance children’s foundational language skills may help to mitigate the differences in children’s experiences that contribute to their language development. However, other factors associated with low SES, often diminish effects of this approach. Research is needed to help us identify simple and sustainable ways to help parents and teachers structure home and classroom environments in ways that will provide ample, extended adult-child conversations that are so critical to language and literacy development.

Providing teachers with effective vocabulary programs is key to enhancing their ability to teach preschoolers sophisticated vocabulary targets. Along with this program, strategies and materials that can be used through the school day in a variety of settings have the potential to facilitate teachers’ ability to extend conversations about new vocabulary targets in a variety of contexts (i.e., whole group, center time, transitions, or outside play). In addition to vocabulary instruction, we must ensure that all classrooms and teachers are equipped with the materials and training necessary to deliver effective instruction to all of the children they serve. By taking a holistic approach to vocabulary acquisition, we have an opportunity to develop interventions that will support and enhance children’s word learning, leading to improved reading outcomes later in school.
References


CHAPTER FOUR:
THE INFLUENCE OF LEXICAL CHARACTERISTICS ON PRESCHOOLERS’ WORD LEARNING

Introduction

Vocabulary impacts social interaction, participation in classroom routines, and learning in academic content areas. Unfortunately, there is no established method of teaching vocabulary in the early primary grades (National Reading Panel, 2000). Despite the well-established role of vocabulary instruction in children’s development of oral language and reading skills, little is known about what words to teach and when. It is impossible to teach all the words children will need to learn (Stahl & Nagy, 2007). To facilitate vocabulary instruction, several researchers developed word lists or guidelines to help teachers identify target words to teach (Beck, McKeown, & Kucan, 2002; Biemiller, 2006; Biemiller & Boote, 2006).

Beck, McKeown, and Kucan (2002) developed the concept of word tiers. This tier system classifies words based on their utility, frequency of use, and specificity. Tier 1 words are basic, familiar words used on a daily basis; children tend to learn these words because of their frequent exposure so they need not be directly targeted for instruction (e.g., good, pretty, big, sad). Tier 2 words are more sophisticated than Tier 1 words and are important to literacy development, because they occur in multiple contexts (e.g., complex, verify, coincide). Tier 3 words tend to be less frequent and domain-specific. Tier 3 words are not necessarily harder to learn, they just have very specific utility (e.g., environment, radius, piano). Children are not likely to encounter Tier 2
words often in everyday conversation, but they will encounter them in academic texts. Due to the lack of transparency of Tier 2 words, it would be difficult for children to derive meaning from print alone. Because of individual factors relating to a child’s language experiences, it is important to focus vocabulary instruction on Tier 2 words to ensure reading comprehension success. Tier 2 instruction translates across multiple grade levels, affords educators flexibility in instruction by finding target words in current instructional texts, and has the potential to increase comprehension and generalization skills (Gray & Yang, 2015).

Biemiller agrees with Beck and colleagues’ (2002) principle of word tiers, but he defines them differently; there are groups of words that are learned without instruction (Tier 1), words with meanings worth teaching (Tier 2), and words with meanings to be learned later on (Tier 3). Additionally, Biemiller (2010) notes the importance of distinguishing between sets of tiers for the primary grades (kindergarten-second grade) and upper-elementary grades (third-sixth grade), a distinction Beck, McKeown, and Kucan (2002) do not make.

Although Biemiller (2010) notes word selection is at the teacher’s discretion, he has found that words are learned in a similar sequence even when examining the learning of children from different populations (e.g. disadvantaged, second language learners) or when a variety of assessment methods are used (Biemiller, 2005). He and colleagues presented children in grades 1 through 5 with a series of sentences that provide a context for a vocabulary word and then ask children to define the word (Biemiller & Boote, 2006; Biemiller & Slonim, 2001). Results were used to derive a sequence of vocabulary acquisition across children in elementary school.

It is important to note that although words may be acquired sequentially, learning is likely to relate more to the size of a children’s vocabulary rather than the grade they are in. The number of words known by children within any grade level will differ greatly, as a result it is
difficult to assign a group of words to just one grade level. Additionally, we do not know how this sequence of words extends into the preschool classroom. Expanding our understanding of sophisticated word learning to include preschool children would be invaluable for early childhood curricula and program development. This would enhance early instruction and intervention by targeting appropriate vocabulary earlier, which has the potential to influence the future learning trajectories of children.

**Lexical Characteristics**

**Word frequency.** The use of words in a language is referred to as word frequency. Words with a high frequency are used more often than those with a low frequency. There are several measures of American English word frequency. The SUBTLEX Us word frequency measures are based on American English subtitles from movies and television shows, and include a corpus of 51 million words. This corpus is available and easily accessed online, and provides frequencies for spoken language that approximates everyday language use (Brysbaert & New, 2009). This is a departure from other frequency measures that rely on language found in texts, which may not yield frequency values that best represent the sample of words used for this analysis.

The Kučera and Francis corpus compiled word frequencies for 1.014 million words. These frequency counts are based on 500 samples of text including editorials, essays, technical writings, and various types of fiction printed in 1961 (Francis & Kučera, 1982). Thus, the words selected may better represent the lexicon of an adult than that of a child (Gierut & Dale, 2007). Although the Francis & Kučera metrics have been considered the norm for quite some time, they are dated and do not estimate raw frequency well due to its relatively small corpus size (Balota et al., 2007). Brysbaert and New (2009) note other frequency norms that are not readily available or
released due to copyright protection (i.e. Zeno, MetaMetrics, and Celex), and as such were not considered for use in this study.

**Age of acquisition.** The age at which a person learns a word is referred to as the age of acquisition (AoA). Important factors in word recognition include word frequency, length, and word similarity; however, Kuperman et al., (2012) argues that AoA is an equally important variable for two reasons. First, word frequency measures do not account for individual differences in word exposures and may underestimate the frequency for words typically used in childhood (Kuperman et al., 2012). Second, the time when words are learned influences the ease of use and recollection. Words learned earlier are easier to use than those learned later. Kuperman and colleagues (2012) compiled AoA ratings for 30,000 words selected from the SUBTLEXUS corpus. These ratings were obtained by asking 1,960 people to rate the age at which they learned a word; meaning that they were able to understand the word if others used it, but not necessarily used it themselves.

**Level of concreteness.** Brysbaert and colleagues (2014) define concrete words, or words that are imageable, as things you can experience through the five senses, and abstract words as things that cannot be experienced but their meanings must be defined by other words. They call abstract words “language based” and concrete words “experienced based.” Often words that are more concrete, or highly imaginable, are easier to learn and recall than abstract words. We consulted concreteness ratings that were collected for 40,000 words (Brysbaert et al., 2014). This database contains a larger sample size and ratings consistent with norms from ratings gathered in the past by Spreen and Schultz (1966) and Paivio (1968). Participants had to rate these words on a scale of 1 to 5; 1 being abstract and 5 being concrete.
**Neighborhood density.** Neighborhood density describes the organization of phonetically similar words in the mental lexicon. Words in a neighborhood differ by one sound substitution, deletion, or addition. Depending on the number of possible neighbors, words can be identified as either high or low density. A high density word has many neighbors, while a low density word has few phonetically similar words. High frequency words, or words that occur most often in a language, are easier to recognize than words with a low frequency of occurrence. Similarly, words from a low density neighborhood are easier to distinguish than words from a high density neighborhood. According to Luce and Pisoni’s (1998) Neighborhood Activation Model, the frequency with which words are used, and the density of the neighborhood, effect spoken word recognition, discrimination, and the amount of time needed to find and produce a word.

**Phonotactic probability.** Phonotactic probability refers to the frequency with which phonological segments and sequences of phonological segments occur in words in a given language (Vitevitch & Luce, 2004). Words that contain common sound sequences will have a higher phonotactic probability than those with combinations not as common. Phonotactic probability and neighborhood density are significantly correlated with one another and have an inverse relationship. Hoover and colleagues (2010) found that words were easier to learn when they were composed of common sound sequences from dense neighborhoods, and when words were composed of uncommon sound sequences from sparse neighborhoods.

Investigators have examined the effects of lexical characteristics, such as word frequency, age of acquisition, level of concreteness, neighborhood density, and phonotactic probability on word retrieval in children and adults (Hoover et al., 2010; Newman & German, 2002; McDonough, Song, Hirsh-Pasek, Golinkoff, & Lannon, 2011; Storkel et al., 2006). Most studies examined word retrieval, which differs from word learning; they do not require children
to provide definitions for words, but simply name the word after exposure to an illustration or a sentence. However, it is important to examine different cognitive tasks related to vocabulary, as it may provide insight into the processes of lexical access that could have implications for more demanding tasks like retrieval of words and their meanings.

McDonough and colleagues (2011) discovered a relation between word imageability (or concreteness) and age of acquisition. Words that were easier to picture and more concrete were learned earlier. They also found that imageability predicted age of acquisition in infants’ word learning. In a study by Newman and German (2002), word frequency, neighborhood density, age of acquisition, and stress patterns were examined to determine the influence they had on children’s word retrieval. They found these lexical factors influenced lexical access. Words with typical stress patterns, high in frequency, and low in neighborhood density and age of acquisition were easier for children to name. Hoover and colleagues (2010) conducted a study examining preschooler’s word learning, and found a facilitative interaction between phonotactic probability and neighborhood density. Words were easier to learn when they contained common sound sequences in dense neighborhoods, and when they contained rare sound sequences in sparse neighborhoods. Storkel and colleagues (2006) examined adult word learning and found that phonotactic probability facilitated new word learning, while neighborhood density contributed to the integration of new and existing lexical representations. It is important to note that different learning tasks will yield different results. In both studies, pseudo-words were created to control for phonotactic probability and neighborhood density (Hoover et al., 2010; Storkel et al., 2006). Because of this, the outcomes from these studies may overgeneralize the effects neighborhood density and phonotactic probability have on word learning when compared to more authentic word learning tasks where neither of these factors are controlled.
Although these findings demonstrate that lexical characteristics influence word learning, we do not know the relative contributions lexical characteristics have on preschool children’s ability to learn sophisticated vocabulary words. To facilitate vocabulary instruction and to better understand the developmental sequence of vocabulary acquisition, we must examine the relation between lexical characteristics and world learning in preschool. This study focuses on the first step in this line of research by addressing the following question:

1. To what extent do lexical characteristics relate to, and are predictive of, word learning in young children?

It is hypothesized that word frequency, age of acquisition, level of concreteness, neighborhood density, and phonotactic probability will influence children’s learning of word meanings taught in a supplemental vocabulary program. We expect to find words with higher frequencies will yield greater learning gains because children will have had more exposure to more frequently used words. We expect to find words with an age of acquisition younger than, or matching that of, a student’s current age will have a higher rate of learning success than those words with older age of acquisition ratings. Children will have had more opportunities for exposure to words acquired at an earlier age than those words learned later in childhood. Learning will be greater for words that have higher levels of concreteness. These words are easy to picture compared to words with lower concreteness ratings that tend to be more abstract. Because neighborhood density and phonotactic probability were not controlled for, it may be difficult to determine the effects these factors have on word learning. We hypothesize that words from smaller neighborhoods will be easier to learn because there will be fewer similar words competing for access in the lexicon. Words with higher phonotactic probabilities will be easier for children to learn because they will be made up of common sounds and sound combinations.
If relations exist between lexical characteristics and word learning, it will be possible to
determine which characteristics best predict word learning. By identifying the lexical
characteristics that best predict word learning, we can better organize academic vocabulary
targets for instruction based on relevant predictors that would follow a scope and sequence of
acquisition that mirrors the developmental process of word learning.

**Method**

**Participants**

Word learning outcomes were collected for 112 preschool children who took part in a
larger randomized control trial investigating the effects of a revised version of Story Friends
(Goldstein & Kelley, 2016, Goldstein et al., 2016), a supplemental preschool vocabulary
program.

**Supplemental vocabulary program.** The data used to determine the effects of lexical
characteristics on preschoolers’ word learning were gathered from an evaluative study of Story
Friends. Story Friends (Goldstein & Kelley, 2016) is a supplementary vocabulary program
designed to be used in preschool classrooms. This program embeds vocabulary instruction into
short prerecorded storybooks. Each embedded vocabulary lesson provides a child-friendly
definition, multiple contexts for the word, repeated exposures to the word and their definition,
and allows for several opportunities to interact with, and respond to, the prerecorded lesson.
Children listen to the same book three times a week in small group listening centers (3-4
Each series takes approximately 13 weeks to complete and teaches 36 sophisticated vocabulary
words. Children either received Forest Friends or Jungle Friends series in their classrooms.
The learning outcomes used for this analysis were derived from a researcher-made measure that was administered approximately every 4 weeks. Children are asked to provide a definition for the target words, e.g. “Tell me, what does enormous mean?” If the definition is not provided, a secondary prompt is given to the child. This prompt uses the target word in a sentence from the story (e.g. Ellie is enormous. Enormous means…). This was added to the assessment as a way to elicit the definition using context from the story. Responses are scored on a 0-2 point scale: zero points for an incorrect response, one point for providing a partial or related response, and two points for a correct response.

**Coding of lexical characteristics of words.** After evaluating the effects of Story Friends, a total of 72 target vocabulary words were characterized for analysis based on available database estimates of their individual word frequency, age of acquisition, phonological phonotactic probability, neighborhood density, and level of concreteness. Word frequency values and phonological neighborhood density counts were obtained from the Irvine Phonotactic Online Dictionary version 2.0 (Vaden, Halpin & Hickok, 2009), which reports frequency measures from the SUBTLEXus corpus. Concreteness level ratings were derived from a database of 37,058 English words developed by Brysbaert et al. (2014). Age of acquisition ratings for 30,121 English content words were reported by Kuperman et al. (2012 Phonotactic probability was calculated using a web-based interface developed by Vitevitch and Luce (2004). In some instances, the targeted vocabulary word was a derivation and not included in the databases.

Each database was either available for download or was converted to an Excel file to streamline data collection. Using the search and retrieval functions in Excel, the various databases were searched for all 72 target words. A secondary matching function and random
searches by the researcher were done to ensure correct words and values were reported from each database.

**Design**

Children’s word learning was assessed at different time points throughout the study. Word-level learning data were compiled for all 72 words, and included measures for each of the lexical characteristics, and each child’s learning score for that word. Children were nested within vocabulary assessment occasions.

**Data Analysis**

To examine the joint and unique predictive variance of lexical characteristics on vocabulary learning, multilevel modeling was used to analyze the data. Multilevel modeling is a better alternative because it analyzes relationships among variables at multiple levels simultaneously (Dedrick et al., 2009). It also accounts for missing data points, allowing for an examination of unbalanced data sets (Baayen, Davidson, & Bates, 2008). The data used for analysis were complete. The Mixed Model function of JMP Pro 14 (SAS Institute Inc., 2019) was used to analyze the effects of lexical characteristics on word learning. Restricted maximum likelihood (REML) method was used to fit the model. By default the statistical software JMP mean centers parameter estimates (i.e. word frequency, age of acquisition, concreteness ratings, neighborhood density, and phonotactic probability). Main effects were not mean centered.

To examine fit between different models, the following indices were examined and compared: Akaike’s Information Criteria (AIC; Akaike, 1974), Schwartz’s Bayesian Information Criterion (BIC; Schwartz, 1978). AIC and BIC values closer to 0 indicate better fit. The indices can be compared to indicate the model with the best fit (Dedrick, et al., 2009).
Children’s raw vocabulary score for each word was the dependent variable. Intra-class correlations were calculated to account for the proportion of variance across children. Child was entered into the model as a random effect. Next, the lexical characteristics word frequency, neighborhood density, concreteness level, age of acquisition, and phonotactic probability were entered into the model as fixed effects to examine the extent to which they predicted vocabulary learning when the differences between children were accounted for.

Results

Preliminary Analysis

Descriptive statistics for the child- and word-level characteristics are presented in Table 3.1. The distribution of each variable was analyzed for normalcy and outliers using the distribution function in JMP. Values of skewness and kurtosis between -2 and 2 indicate a normal distribution (George & Mallery, 2010). Word frequency was heavily skewed and had several extreme outliers that resulted in higher kurtosis. To address this, the data were transformed so the log of the word frequency was used, which had a more normal distribution. Age of acquisition did not have any outliers. Neighborhood density and phonotactic probability had a few outliers, but these were left in the analysis because the purpose of this investigation was to see how these lexical characteristics impacted word learning. By excluding outliers it may limit our ability to generalize results. Because the distribution of neighborhood density clustered around very low or very high values, words were categorized as having either a sparse (low) or dense (high) neighborhood density.
Next, correlational analyses were completed to examine relations among lexical characteristics and the relations among word learning and lexical characteristics. Intercorrelations among lexical characteristics and word learning are presented in Table 3.2. Only some of the lexical characteristics related to vocabulary learning. Word frequency had a weak inverse relation with word learning ($r = -0.09$, $p < 0.001$); concreteness ($r = 0.12$, $p < 0.001$) had a slightly higher (positive) correlation with vocabulary learning; and neighborhood density ($r = 0.07$, $p < 0.001$) had a very weak relation with vocabulary learning. Age of acquisition and phonotactic probability were not significantly related to vocabulary learning. Each of the lexical characteristics were significantly related to one another. Because of this, each of the lexical characteristics were examined with multilevel modeling.

**Table 3.1. Descriptive statistics for word- and child-level characteristics (N=4036)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
<th>Skew</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word Frequency</td>
<td>43.42</td>
<td>83.73</td>
<td>0.196-590.69</td>
<td>4.38</td>
<td>22.66</td>
</tr>
<tr>
<td>Log$_{10}$ Word Frequency</td>
<td>2.89</td>
<td>0.66</td>
<td>1.04-4.48</td>
<td>-0.20</td>
<td>-0.014</td>
</tr>
<tr>
<td>Age of Acquisition</td>
<td>7.04</td>
<td>1.09</td>
<td>4.9-9.5</td>
<td>0.33</td>
<td>-0.40</td>
</tr>
<tr>
<td>Concreteness</td>
<td>2.86</td>
<td>0.77</td>
<td>1.25-4.67</td>
<td>0.37</td>
<td>-0.62</td>
</tr>
<tr>
<td>Neighborhood Density</td>
<td>9.43</td>
<td>10.81</td>
<td>0-42</td>
<td>1.55</td>
<td>1.72</td>
</tr>
<tr>
<td>Phonotactic Probability</td>
<td>0.267</td>
<td>0.12</td>
<td>0.083-0.615</td>
<td>0.89</td>
<td>0.28</td>
</tr>
<tr>
<td>Word Learning Raw Score</td>
<td>0.58</td>
<td>0.49</td>
<td>0-2</td>
<td>-0.23</td>
<td>-1.89</td>
</tr>
</tbody>
</table>

**Table 3.2. Correlations Among Lexical Characteristics and Word Learning**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lg$_{10}$WF</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. AoA</td>
<td>-0.59***</td>
<td></td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Concreteness</td>
<td>-0.44***</td>
<td>0.097***</td>
<td></td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>4. N_Den</td>
<td>0.03*</td>
<td>-0.23***</td>
<td>0.39***</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>5. Ph_Prob</td>
<td>-0.05**</td>
<td>0.13***</td>
<td>-0.21***</td>
<td>-0.56***</td>
<td>-</td>
</tr>
<tr>
<td>6. Word Learning Score</td>
<td>-0.09***</td>
<td>-0.016</td>
<td>0.12***</td>
<td>0.07***</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Note. * $p < .05$, ** $p < .001$, *** $p < .0001$
The Effects of Lexical Characteristics on Word Learning

First, the unconditional model was examined (AIC=11171.12, BIC=11183.72, \(\chi^2=11173.65\)) to compare the change in fit of subsequent models. Then child was entered into the model as a random effect. Results indicate that child was significant (\(B=1.11, \ SE\ B=.048, p<.0001\)). The model fit improved with the addition of the random effect (AIC=10235.36, BIC=10254.26, \(\chi^2=10229.35, R^2=.283\)). The ICC for child was .26 indicating differences among children accounted for 26% of the variance in vocabulary learning.

Next, the word level predictors were entered into the model as fixed effects with child as a random effect. Each of the lexical characteristics were significant predictors of vocabulary learning (word frequency, age of acquisition, level of concreteness, neighborhood density, and phonotactic probability). Unstandardized parameter estimates for each fixed effect included in the final model are listed in Table 3.3. Word frequency (\(B=-0.06, p=.025\)), age of acquisition (\(B=-0.095, p<.0001\)), and neighborhood density (\(B=-0.036, p=.047\)) had inverse relations with word learning. Higher frequency words were harder to learn. Words with lower age of acquisition ratings were easier to learn. Words that had fewer phonological neighbors were easier to learn. Words that were more concrete (\(B=0.109, p<.0001\)) were easier to learn. Similarly, words with higher phonotactic probabilities (words that were made up of more common sound sequences) were easier to learn (\(B=0.64, p<.0001\)).

Fit indices indicate improved fit compared to the unconditional model (AIC=10131.12, BIC=10175.22, \(\chi^2=10143.66, R^2=.304\)). This model had improved AIC and BIC values indicating a better fit. There was a significant change in \(\chi^2\) when the fixed effects were added to the random effects model, indicating the model with both fixed and random effects fit the data.
better than a model with only a random effect. The difference in $R^2$ between the two models indicate the fixed effects accounted for 2.1% of the variance in vocabulary learning.

**Table 3.3. Summary of unstandardized parameter estimates.**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>$B$</th>
<th>SE $B$</th>
<th>$p$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log$_{10}$ Word Frequency</td>
<td>-0.063</td>
<td>.028</td>
<td>.025</td>
</tr>
<tr>
<td>Age of Acquisition</td>
<td>-0.096</td>
<td>.015</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Concreteness</td>
<td>0.109</td>
<td>.021</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Neighborhood Density</td>
<td>-0.036</td>
<td>.018</td>
<td>.047</td>
</tr>
<tr>
<td>Phonotactic Probability</td>
<td>0.64</td>
<td>.136</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

**Discussion**

A secondary data analysis of an investigation examining the effects of a supplemental preschool vocabulary program was conducted to determine if relations exist between lexical characteristics and vocabulary learning, and to determine the extent to which these lexical characteristics predicted word learning in young children. The learning of 72 words by 112 preschoolers was analyzed. The lexical characteristics examined were word frequency, age of acquisition, level of concreteness, phonotactic probability, and neighborhood density. Multilevel modeling revealed all five characteristics were significant predictors of vocabulary learning. Overall, a model that included both random and fixed effects contributed to approximately 30% of the variance in preschoolers’ vocabulary learning. Differences among children accounted for approximately 27% of variance in word learning. Upon closer examination of the impact lexical characteristics had on learning alone, only 2% of the variance in vocabulary learning can be attributed to the influence of lexical characteristics. Our findings are unique because no one has investigated the relations between lexical characteristics and word learning in the same way.

Each of the characteristics used to describe a word captures something different, and it is their unique combined effect that best predicts vocabulary learning. Unfortunately, lexical
characteristics accounted for only 2% of the variability in word learning. The number of words (72) examined in the current study was small. Future studies will examine a larger number of vocabulary words with a wider range of characteristics to see if relations between lexical characteristics and vocabulary learning exist. Examining a larger set of vocabulary words may detect a larger effect of lexical characteristics on word learning and further support the preliminary findings of this study.

Results from this study revealed a significant inverse relationship of word frequency on preschoolers’ vocabulary learning. Words with lower frequency measures were easier for children to learn. Word frequency values ranged from .2 to 591, but the majority of values fell below 100. The words in this study did not include words with very high measures of word frequency, so this finding must be interpreted carefully due to the restricted range of frequency measures. In this study, words were selected using Beck and colleagues’ (2002) framework for word selection. They recommend choosing target vocabulary words that children will not likely hear in everyday conversation, but ones that would have high utility and appear later in academic texts. Other researchers have found that words that occur more frequently were easier for children to name in a lexical access study (Newman & German, 2002).

While the words chosen may not seem to have a lower frequency among adults, they may have infrequent use by preschoolers. Further analyses should investigate a word frequency norms for children by examining childhood literature or television shows and movies made for children. Either of these methods would mirror popular adult word frequency norms derived from print or television and movies (Brysbaert & New, 2009; Francis & Kučera, 1982). If differences exist between the frequency norms of children and adults, it would allow for a more robust measure
that can be used to examine the relations between frequency and young children’s vocabulary learning.

Our findings revealed significant relations between age of acquisition and preschoolers’ vocabulary learning. This is surprising considering the nature in which these ratings were obtained. Adults were asked to recall the age at which they learned a word. Learned was defined as understanding the word if others used it, but that they did not necessarily use it themselves. This can be a difficult task, especially when trying to recall learning at a very young age. Yet researchers have examined the validity of this and found that adult ratings of age of acquisition are valid (Gilhooly & Gilhooly, 1980; Gilhooly & Logie, 1980).

We found that words with a younger age of acquisition rating were easier for children to learn than words with older age of acquisition ratings. Our findings support the results of a lexical access study by Newman and German (2002) who found children had an easier time naming words with lower age of acquisition. Although this seems rather intuitive, and somewhat circular, this is an interesting factor to discuss. This characteristic can play an important role in word selection, especially when creating a developmental sequence of vocabulary targets. Now that we know age of acquisition predicts sophisticated vocabulary learning in preschoolers, additional analyses and studies are warranted to discover the ranges of AoA ratings that lead to optimized learning. It may be that teachers should focus instruction on words acquired later (within reason given the age of preschoolers) because they are more difficult for children to learn than words that are acquired at an earlier age.

Our results indicate words that were more concrete, or high in imageability, were easier to learn than words that were more abstract, meaning they are more difficult to explain and picture. Research examining the early word learning of infants found that more imageable words
were learned earlier and more easily than words that were less imageable (McDonough, Song, Hirsh-Pasek, Golinkoff, & Lannon, 2011). Again, this finding is rather intuitive. Words that are more concrete have specific meanings, whereas words that are more abstract often have nuanced meanings that depend on context. Children can acquire more abstract terms, but if they have no referent to associate the word with, it can be difficult to retain the word’s meaning.

Interestingly, we found neighborhood density and phonotactic probability predicted preschoolers’ vocabulary learning. Words with higher phonotactic probabilities, which are made up of more common sound sequences, were easier to learn, and words with fewer phonological neighbors were easier to learn than words with many neighbors. Research has demonstrated the effects that neighborhood density and phonotactic probability have on word learning. In several studies that taught nonwords to children and adults, phonotactic probability facilitated word learning (Storkel, 2001; Storkel, 2003). Others found a facilitative interaction between both phonotactic probability and neighborhood density that contributed to word learning (Hoover et al., 2010; Storkel et al., 2006). For example, Hoover and colleagues (2010) found that an interaction between phonotactic probability and neighborhood density impacted preschoolers’ word learning. Ours is a novel finding because the studies previously noted controlled for neighborhood density and phonotactic probability by constructing non-words a priori. That was not done in this study, nor was either lexical characteristic even considered when choosing target words. Yet we still found significant relations between neighborhood density and vocabulary learning, and phonotactic probability and word learning. There could a unique interaction between phonotactic probability and other factors, such as neighborhood density, that were examined that could explain this observed relation. Additional investigations are warranted to
confidently describe and explain the relations between neighborhood density, phonotactic probability, and vocabulary learning.

To assess the validity of these predictions, they must then be tested empirically. Once we have confidently identified relevant predictors for word learning, we can organize a sequence of words for instruction using relevant predictors and examine children’s word learning to see if the relevant predictors facilitated learning. This line of research holds promise for reorganizing vocabulary targets into a sequence that better-aligns with measures of influential lexical characteristics. Developing a sequence of vocabulary words based on these predictors may provide a developmentally appropriate framework for vocabulary instruction that would facilitate improved word learning in young children.

The cornerstone of vocabulary instruction is to select words children will need to know to comprehend academic texts. These words are often sophisticated synonyms for known words (i.e., gorgeous instead of pretty), but are difficult to infer meaning from context alone. Trying to organize vocabulary targets for instruction can be difficult. Among various attempts to order vocabulary targets (Beck, McKeown, & Kucan, 2002; Biemiller, 2006; Biemiller & Boote, 2006; Marzano & Simms, 2013), there is still much variability in the words chosen for instruction. This is especially true in early childhood classrooms where little-to-no focus is placed on vocabulary instruction (Greenwood et al., 2014; Neuman & Dwyer, 2009; Wright, 2012).

There will always be an element of personalization when it comes to word selection, however. Teachers ultimately will chose the word meanings their students need for instruction. Many teachers and researchers have adopted Beck, McKeown, and Kucan’s (2002) three tiers for vocabulary selection, focusing heavily on Tier 2 words. There is still room for interpretation in determining what qualifies as a Tier 2 word and it may change with age. Our own personal
experiences and biases play into the words we think children should learn. This variability must be minimized to make word selection a more uniform process. Further investigations are needed to determine the optimal developmental groupings for words using relevant predictors. Grouping words based on developmental appropriateness will provide teachers a more focused list of words, reducing the variability and increasing the uniformity in the word selection process.

The results of these future studies could expand our understanding of the manner in which word characteristics, and not simply a word’s tier, affects children’s vocabulary mastery across various developmental stages. This may not completely resolve the issue of “which words to teach when,” but it is an attempt to fill one of the gaps in vocabulary instruction.

References


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Although vocabulary skills have been identified as important components of emergent literacy skills, preschool vocabulary instruction is limited and varies greatly in early childhood classrooms. Often, instruction is sub-standard and lacks differentiation for children most at risk for developing language and reading difficulties (Greenwood, et al., 2013; NELP, 2008). Explicit vocabulary instruction rarely occurs in early childhood classrooms, and least frequently in classrooms serving low-income students (Wright, 2012). Neuman and Dwyer (2009) examined several common preschool curricula for key indicators of vocabulary instruction and found that most programs are missing a clear scope and sequence, guidance for word selection, instructional strategies to enhance word learning, and do not provide teachers with tools to monitor children’s ongoing progress. These gaps in early childhood curricula combined with little focus on effective teaching strategies result in questionable vocabulary instruction in preschool classrooms (Greenwood, et al., 2013; NELP, 2008; Neman & Dwyer, 2009).

Several researchers have examined other factors that relate to children’s language and literacy development and found that the family’s SES, children’s language skills, and the classroom all relate to learning. Yet many researchers focus on only one aspect, like SES, and how it influences language and literacy development. If we are going to significantly enhance children’s vocabulary development, we must consider a system of factors and how together they influence children’s learning. Connor and colleagues (2005) found a complex system of child,
teacher, classroom, and home factors related to language levels and later literacy learning, but they used static measures of early literacy and vocabulary skills as their outcome measures. Examining a system using a more dynamic measure of vocabulary learning may provide more insightful implications for designing interventions to address the many agents and settings that can influence children’s learning.

Efforts have been made to support teachers’ in selecting words for instruction. There are several researchers who have developed guides for word selection (Beck, McKeown, & Kucan, 2002; Biemiller, 2010; Marzano & Pickering, 2005), yet none include recommendations for preschool. Although these methods have helped guide teachers to select words children need to know, there is still great variability in determining what words to teach. Furthermore, teaching some words may be better suited for older children. Other studies have examined the effects lexical characteristics have on children and adult’s abilities to perform lexical and word learning tasks, and found that word frequency, age of acquisition, level of concreteness, neighborhood density, and phonotactic probability influenced their ability to learn or name words. Often, words used in these studies are nonwords that have been carefully constructed to control for these characteristics. Examining the nature in which words are acquired and how lexical characteristics contribute to acquisition in a more natural process of word learning has the potential to change the ways in which words are selected for instruction.

The purpose of this multi-manuscript dissertation was to contribute knowledge with the potential to reduce the risk of language and literacy delays in young children. We examined the benefits of explicit vocabulary instruction and sought to identify the factors that best facilitated word learning among a diverse group of preschoolers. The first study examined the differential effects of preschoolers’ word learning when the number of vocabulary targets was increased
from two to four words. Results demonstrated that preschool children can learn sophisticated vocabulary words when a robust instructional program is implemented; but learning varied among children. These variations could be explained by other factors that relate to word learning. The second study sought to identify the child, family, and classroom-level factors that influenced vocabulary learning among a diverse group of preschoolers (differing language levels, SES, home and classroom environments). We found children’s initial language abilities and the language and literacy environment of their classroom were shown to influence preschoolers’ learning. The family’s SES was shown to influence children’s language abilities, which also indirectly affected learning. We did not observe significant direct relations between the home environment and word learning. The third study identified the lexical characteristics predictive of preschoolers’ vocabulary learning. The lexical characteristics of words, their word frequency, age of acquisition, level of concreteness, neighborhood density, and phonotactic probability may also affect learning. Surprisingly, we found that only 2% of the variance in word learning was accounted for by these characteristics. Given the novelty of this approach, larger-scale investigations are warranted. These findings address pressing questions in the area of early language and literacy development by contributing to our existing knowledge of evidenced-based vocabulary interventions for preschoolers and by highlighting the underlying factors that influence word learning.

Effective vocabulary programs are needed to enhance preschoolers’ word learning. Whereas there is an extant literature base examining word learning, more research needs to be done focusing on preschoolers. The early acquisition of vocabulary would facilitate children’s literacy achievement once they enter school. We found that when explicit instruction is provided, children were able to learn sophisticated vocabulary words. Others have demonstrated this as
well (Beck & McKeown, 2007; Coyne, McCoach, Loftus, Zipoli & Kapp, 2009; Goldstein et al., 2016; Justice, Meier, & Walpole, 2005; Kelley et al, 2015; Vuattoux, Japel, Dion, & Dupéré, 2014). There is still more work to be done in the development of effective vocabulary programs for preschool children.

There is preliminary evidence that children’s language skills are strong predictors of word learning. We found children with higher language skills at pretest learned more words than children with lower language skills. Our findings are consistent with others who found that children with higher initial language abilities learned more vocabulary words than their peers with lower language abilities (Coyne, Simmons, Kame’enui, & Stoolmiller, 2004; Penno et al., 2002; Robbins & Ehri, 1994). This is not always the case, others have found that children with lower initial language abilities learned more vocabulary words than their peers who were not at risk (Elley, 1989; Justice, Meier, Walpole, 2005).

Children’s language levels significantly relate to a number of other factors. Our SEM analysis demonstrated the family’s socioeconomic status (SES) influenced children’s language abilities. This has been well documented in early childhood literature (Cabell, et al., 2011; Crow & Leary, 2015; Dollaghan et al., 1999; Hart & Risley, 1995; Jimerson et al., 1999, National Research Council, 2001). In a seminal study, Hart and Risley (1995) found that children from families with a low SES had fewer language experiences that result in limited language skills. Dollaghan and colleagues (1999) also found that the limited language skills of children from low SES families resulted in slower rates of language development compared to children from middle and high SES families. The differences in children’s early language experiences predict children’s development, academic success, and long-term health outcomes (Crow & Leary, 2015).
Children from different levels of SES enter school with varying levels of language and literacy skills that can affect their later academic success (Bowman, Donovan, & Burns, 2001; Connor, Son, Hindman, & Morrison, 2005; Hart & Risley, 1995; Jimerson et al., 1999; Walker et al., 1994). Although low SES is often attributed to later reading ability, there are individual differences among preschoolers from low SES that can contribute to their academic performance (Cabell, et al., 2011). Care must be taken when generalizing the effects of SES on language and literacy achievement.

The words chosen for instruction matter. Our findings demonstrated a small effect of lexical characteristics on word learning. The small number of vocabulary words analyzed in our study could have contributed to this. Replicating the study with a larger set of vocabulary words that have a wider range of lexical characteristics may detect larger effects on word learning. If we can identify the lexical characteristics that are predictive of vocabulary learning, we can then develop a better sequence of vocabulary targets used for instruction. This method of word selection would allow for an examination of a developmentally appropriate sequence of vocabulary targets.

**Future Directions**

How can we address these factors to enhance preschoolers’ word learning? Community initiatives need to be mounted to educate parents and teachers about the importance of early language development at home and at school. Getting parents involved in our study was a challenge. Yet, parents can significantly influence children’s language development. Future studies will examine strategies to enhance parent participation and involve them as important stakeholders in language and literacy research. Providing parents with effective strategies to
build foundational language skills has the potential to mitigate the disparities among children when they enter school.

Similarly, teachers and their structuring of classroom environments affect children’s language and literacy development. Connor and colleagues (2005) found that classroom environments can significantly enhance children’s language and literacy, so much so that it overcame other factors, like SES, that would otherwise hinder learning. Early childhood teachers need effective programs to enhance the language and early literacy skills of their students, ones that focus on more than just the acquisition of code-based skills. But teachers need more than effective programs to facilitate language and literacy development. They also need to understand the key role they play as language models. Training and education that focuses on the ways in which adults can model and enhance language should include: engaging children in conversations, repeating and expanding upon children’s utterances, and encouraging children to express themselves (Greenwood et al., 2017).

Most research focuses on single factors that affect vocabulary learning, mainly the provision of specific interventions. Explicit vocabulary interventions can have robust effects, but we need to understand the other child, home, classroom, and lexical factors that impinge on learning. Prior to the series of the current studies, we had little understanding of the underlying factors that predict vocabulary learning. Findings from these studies provide implications for vocabulary instruction in preschool classrooms, and address the factors that can influence children’s learning.
References


APPENDICES
Appendix A: USF IRB Approved Consent Form

Consent to Participate in Research & Parental Permission for my Child to Participate in Research

Pro # Pro22916

The following information is being presented to help you and your child decide whether or not you would like to be a part of a research study. Please read this information carefully. If you have any questions or if you do not understand the information, we encourage you to ask the researcher.

We are asking permission for you and your child to take part in a research study called: Explicit Vocabulary Instruction in Automated Listening Centers for Young Children with Language Delays

The person who is in charge of this research study is Howard Goldstein. This person is called the Principal Investigator. However, other research staff may be involved and can act on behalf of the person in charge.

The research will be conducted at your child’s school. Other preschool classrooms in Florida will also participate.

Purpose of the study:

This small-scale study aims to find out how effective supplemental classroom and home-extension activities are in teaching early language and literacy skills necessary to learn to read. We are interested in learning how well supplemental instruction teaches children school readiness skills such as vocabulary and comprehension. We have developed an early literacy curriculum that has shown promise in earlier studies. This study explores its implementation by teaching staff in pre-Kindergarten settings.

Teachers will have the opportunity to incorporate a learning center curricula into their classroom. This curriculum will be used with students who are experiencing difficulty learning some school readiness skills. Students’ language and literacy performance will be assessed: (a) before the start of the learning center, (b) weekly during the curriculum, (c) after all the lessons have been completed. The researchers will analyze the students’ performance to determine the effects of the curricula. The results of this study will provide information to classroom teachers, school administrators, and parents regarding vocabulary, comprehension, and pre-reading curricula for children at risk for reading disabilities. This information should lead to earlier and more appropriate services for children.
Why are you & your child being asked to take part?

We are asking you and your child to take part in this research study because the classroom teacher has agreed to participate. We are interested in learning how we can develop effective vocabulary activities that can be applied at home to reinforce children’s learning at school. The vocabulary activities are designed to be very easy to implement by parents.

We also want to identify children who may be struggling to learn early reading skills, and we would like to assess as many children in each classroom as possible. This gives us information about how many children in preschool classrooms are struggling to learn early reading concepts and ways that we can prevent children from falling behind academically.

Study Procedures:

If you and your child agree to participate in this study, you will be asked to:

Participate by helping your child practice the words he/she is learning at school. Your help will be minimal, and take less than 3 minutes per week. Your child will be given a sticker or other prompts to ask him/her to define a vocabulary word. You will be asked to tally the number of times that your child asks you for help. This will take less than 1 minute a week. At the end of the study, you will be asked to fill out a survey to provide the researcher with feedback regarding the intervention. This survey will take less than 10 minutes to complete.

If your child takes part in this study, s/he will be asked to.

Your child will be asked to spend about 6 weeks in this study. We will be monitoring your child’s development multiple times per week to identify participants who are likely to benefit from additional instruction.

The children will listen to storybooks in small groups. The storybooks will contain vocabulary instruction. Each learning center lesson will last about 10 minutes a day, and children will participate in 3 lessons each week. Children will be given stickers, small books, notes or other prompts (example: necklaces with dog tags) to reinforce the words learned at the end of the week. The prompts are designed to encourage children to discuss the words they learned with their parents. Your child will be instructed to prompt adults to ask them what the target word means (example: “Ask me what brave means?”). Your child’s knowledge of the vocabulary words targeted will be assessed before and after each book is read. Each test will be brief and take approximately 3 minutes to complete. Trained members of our staff will conduct assessments in a quiet area in the classroom, or a small room or hallway close to the classroom. We will share general information about your child’s progress with his or her classroom teacher and what your child has been learning.

Total Number of Participants

About 36 individuals will take part in this study at USF. A total of 18 children and 18 parents will be asked to participate in this study.

Alternatives / Voluntary Participation / Withdrawal

If you decide not to let your child take part in this study and you do not participate, that is okay. Instead of being in this research study you and your child can choose not to participate.

You and your child should only take part in this study if both of you want to. You or your child should not feel that there is any pressure to take part in the study to please the study investigator or the research
staff.

If you decide not to let your child take part:

- Your child will not be in trouble or lose any rights he/she would normally have.
- Your child will still get the same services he/she would normally have.
- Your child can still get their regular classroom instruction from your regular teacher.

You can decide after signing this informed consent form that you no longer want your child to take part in this study. We will keep you informed of any new developments that might affect your willingness to allow your child to continue to participate in the study. However, you can decide you want your child to stop taking part in the study for any reason at any time. If you decide you want your child to stop taking part in the study, tell the study staff as soon as you can. If you decide to stop, your child will continue receiving his/her regular classroom instruction.

Even if you want your child to stay in the study, there may be reasons we will need to withdraw him/her from the study. Your child may be taken out of this study if we find out it is not safe for your child to stay in the study or if your child is not coming for the study visits when scheduled. We will let you know the reason for withdrawing your child’s participation in this study.

Benefits

The potential benefits to your child include:

- Learning early language and reading skills taught in the learning center lessons should help improve kindergarten readiness and future academic achievement
- The results of this study will provide information to classroom teachers, school administrators, and parents regarding vocabulary, comprehension, and early reading instruction that may prevent reading disabilities.

We do not know if this study will help children with reading difficulties, that is why we are doing this study. By volunteering you are helping us learn more about preventing reading difficulties. We will learn more about what does or does not help individuals with this condition. What we learn may help others in the future.

There are no known risks to those who take part in this study. All procedures to be used are commonly used with preschool children. Therefore, they do not involve activities that would cause discomfort to your child or put your child at risk in any way. However, if your child should become upset for any reason, the child can be excused from testing or the learning center for the day.

Compensation

Neither you nor your child will receive payment or other compensation for taking part in this study.

Costs

It will not cost you anything to either participate or let your child take part in the study.

Conflict of Interest Statement

The person leading this research study might benefit financially from this study. Specifically, Dr. Howard Goldstein is an author of the curriculum being studied. Research studies like the one you are thinking about joining are done to determine whether the new curriculum is effective. If research shows
the new curriculum is effective, the person leading this study would receive a part of the profits from any sales of this curriculum.

The Institutional Review Board that reviewed this study and a committee at the University of South Florida have reviewed the possibility of financial benefit. They believe that the possible financial benefit to the person leading the research is not likely to affect your safety and/or the scientific quality of the study. If you would like more information, please ask the researchers or the study coordinator.

Privacy and Confidentiality
We will keep your child’s study records private and confidential. Certain people may need to see your child’s study records. By law, anyone who looks at your child’s records must keep them completely confidential. The only people who will be allowed to see these records are:

- The research team, including the Principal Investigator, Howard Goldstein, study coordinator, research assistants, and other research staff at The University of South Florida- Tampa.
- The research team, including the Co-Principal Investigator, Elizabeth Spencer Kelley, study coordinator, research assistants, and other research staff at The University of Missouri-Columbia.
- Certain government and university people who need to know more about the study. For example, individuals who provide oversight on this study may need to look at your records. This is done to make sure that we are doing the study in the right way. They also need to make sure that we are protecting your rights and your safety.
- Any agency of the federal, state, or local government that regulates this research. This includes the Department of Health and Human Services (DHHS) and the Office for Human Research Protection (OHRP).
- The USF Institutional Review Board (IRB) and its related staff who have oversight responsibilities for this study, staff in the USF Office of Research and Innovation, USF Division of Research Integrity and Compliance, and other USF offices who oversee this research.

The sponsors of this study and contract research organization (i.e. The U.S. Department of Education) We may publish what we learn from this study. If we do, we will not include your child’s name. We will not publish anything that would let people know who your child is.

You can get the answers to your questions, concerns, or complaints.
If you have any questions, concerns or complaints about this study, call Howard Goldstein at (813) 974-9613.

If you have questions about your child’s rights, or have complaints, concerns or issues you want to discuss with someone outside the research, call the USF IRB at (813) 974-5638.
Consent to Participate and Parental Permission for My Child to Participate in this Research Study

I freely give my consent take part and to let my child take part in this study. I understand that by signing this form I am agreeing to take part in and to let my child take part in research. I have received a copy of this form to take with me.

Signature of Person and Parent of Child Taking Part in Study

Date

Printed Name of Person and Parent of Child Taking Part in Study

Statement of Person Obtaining Informed Consent

I have carefully explained to the person taking part in the study what he or she can expect from their participation. I confirm that this research subject speaks the language that was used to explain this research and is receiving an informed consent form in their primary language. This research subject has provided legally effective informed consent.

Signature of Person Obtaining Informed Consent

Date

Printed Name of Person Obtaining Informed Consent
Appendix B: USF IRB Approval of Study Amendment Letter

8/29/2017

Howard Goldstein, Ph.D.
Communication Sciences and Disorders
13301 Bruce B. Downs Blvd
MHC 1100
Tampa, FL 33612-3807

RE: Expedited Approval of Amendment
IRB#: Ame10_01000022016
Title: Explicit Vocabulary Instruction in Automated Listening Centers for Young Children with Language Delays

Dear Dr. Goldstein:

On 8/28/2017, the Institutional Review Board (IRB) reviewed and APPROVED your Amendment. The submitted request and all documents contained within have been approved, including those outlined below, as described by the study team.

As planned, they will begin the Year 3 cluster-randomized pilot study this fall. This amendment is to update our consent forms to reflect the procedures and design of the Year 3 pilot. They are also submitting new recruitment flyers for review to replace the previous recruitment flyers. These flyers have the same information as the previously approved flyers, but they have changed the format of the flyer to present the information more clearly to potential participants.

The Year 3 pilot was already described in the initial research protocol and the original IRB application. However, the following clarification will be added to the protocol and to the study procedures section of this form:

The Year 3 cluster-randomized pilot study will begin in the fall of 2017 and will last approximately one full school year. Teachers who participate in this pilot will implement small-group listening centers in their classrooms.

Students in treatment and control groups will participate in small-group learning centers 3-5 days per week and be exposed to about 18 stories over the course of the school year.

Teachers in the treatment condition will receive the curricula consisting of prerecorded children’s stories with embedded vocabulary instruction. They also will receive classroom and home extension materials and prompts that will provide opportunities for children to practice and review the target words throughout the school day and at home. Treatment teachers will participate in about 90 to 120 minutes of training to learn how to implement storybook learning centers and additional strategies for reviewing words throughout the school day as well as ways to share these strategies with parents.

Teachers in the control condition will receive the same prerecorded children's stories without the embedded
vocabulary instruction or additional practice and review materials. Control teachers will receive about 90 minutes of training to learn how to implement the storybook learning centers. They will also provide these teachers with basic strategies on how to share books with children and ways to share book-sharing strategies with parents.

The following outlines the changes from our previous protocol:

1. The design of the study (a control condition will be added).

2. The length of the study (Previously, during the development phase of this research, the studies were small-scale and lasted about 2 months. The Year 3 pilot will last for the duration of the school year once they have approval to proceed).

3. The intervention and control will include multiple curricular components (i.e., audiobooks PLUS classroom and home strategies) as opposed to the past studies where they examined components separately.

4. Teachers will implement the learning centers in the Year 3 pilot and, therefore, must receive training on all the components (in the past, researchers ran the learning centers so teachers only needed a brief overview of the program, but training will now last 90 to 120 minutes).

Approved Item(s):
Protocol Document(s):

Consent Document(s)*:
Pro22916 YEAR 3 SB Adult Minimal Risk Teacher v1 8.8.17.docx.pdf
Pro22916 YEAR 3 SB Combined Consent and Parental Permission v1 8.8.17.docx.pdf

*Please use only the official IRB stamped informed consent/assent document(s) found under the “Attachments” tab on the main study’s workspace. Please note, these consent/assent document(s) are valid until they are amended and approved.

The IRB does not require that subjects be reconsented.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with USF HRPP policies and procedures and as approved by the USF IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

John Schinka, Ph.D.
USF Institutional Review Board