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EARLY VOCABULARY ASSESSMENT WITHIN A RESPONSE TO INTERVENTION FRAMEWORK

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BY

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ABSTRACT

The current study examined the predictive and social validity of two weekly vocabulary assessments embedded within a Tier I Kindergarten vocabulary curriculum. Participants (N=250 Kindergarten students) received ongoing vocabulary instruction and their target word knowledge was monitored weekly over the course of 24 weeks using two target word assessments (a Yes/No assessment and Receptive Picture assessment). Data from the weekly vocabulary assessments were examined at multiple time points with various cut scores. Predictive validity was examined in terms of correct classification of student risk for poor vocabulary outcomes, and results were compared with standardized measures of general receptive and expressive vocabulary knowledge. Teacher judgments regarding the efficiency and effectiveness of the two weekly vocabulary assessments were examined. Considerations for vocabulary assessment within a multi-tiered or Response to Intervention framework are made.

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INTRODUCTION

Early language and literacy skills are important predictors of reading achievement and school success (Cunningham & Stanovich, 1997; Duncan et al., 2007; Moats, 2010; National Reading Panel [NRP], 2000; Torgeson, 2002). Given that students with poor early language and literacy skills are at risk for poor reading achievement, researchers and educators have recognized the urgency of identifying students at risk for low achievement and intervening early with evidence-based instruction (Coyne, Capozzoli, Ware, & Loftus, 2010; Dickinson & Tabors, 2002; Scarborough, 2001; Snow, Burns, & Griffins, 1998). While many factors can cause children to enter school with poor early language and literacy skills, educators have an opportunity to alter the trajectory of at risk students' achievement through instruction and intervention. A wealth of knowledge has been established regarding the development, instruction, and assessment of many early language and literacy skills (Dickinson & Neuman, 2006; Hosp, Hosp, & Howell, 2007; Moats, 2010; NRP, 2000; Scarborough, 2001). However, more research is needed to aid educators in accurately identifying children at risk for language and literacy difficulties, particularly in the area of vocabulary (Loftus & Coyne, 2013; NRP, 2000).

Early Language and Literacy Skills

Reading researchers have indicated that word recognition abilities and language comprehension abilities each play a foundational role in promoting skilled reading. Word recognition skills include the use of phonological awareness, decoding, and sight word recognition, while language comprehension skills include the use of background knowledge, language structures, verbal reasoning, literacy knowledge, and vocabulary (Scarborough, 2001). A report by the National Reading Panel (2000) concluded that the five “pillars” of proficient reading achievement include skilled phonemic awareness, phonics, fluency, vocabulary, and comprehension.

Research has shown that in the early grades, struggling readers often experience difficulty with word recognition skills, especially phonemic awareness (Scarborough, 2001; Torgeson, 2002). Given these findings, much attention has been devoted to bolstering word recognition skills in the early elementary grades. However, a misconception held by many educators is the belief that word recognition skills must be established prior to teaching language comprehension skills (Biemiller, 2001). Although word recognition skills tend to be the focus of reading instruction in early elementary grades, a more effective approach entails simultaneously supporting word recognition skills and language skills through high quality, systematic, and explicit instruction beginning in Kindergarten (Biemiller, 2001). A comprehensive approach to promote reading success includes explicit and direct vocabulary instruction in the early elementary grades.

Causes and Consequences of Poor Early Language and Literacy Skills

For many reasons, children enter school with considerably different levels of early language and pre-reading skills. One reason for this variability is that children from families of low socioeconomic status have far less exposure to rich oral language compared to children from families of high socioeconomic status. In a longitudinal study by Hart and Risley (1995), the researchers visited 42 families monthly over the course of two years, and recorded the language (e.g., the number and nature of utterances) that one and two year old children were exposed to through communications at home. The findings revealed that children from families of low socioeconomic status (SES) were exposed to substantially less oral language at home, in comparison to children from families of middle and high SES. The researchers extrapolated that by age three, the differences in word exposure amounted to a 30 million word gap between children from families of high SES and low SES. As a consequence, the children from low SES families were at a substantial disadvantage in terms of their vocabulary knowledge prior to entering Kindergarten. A follow-up study indicated that the children's vocabulary knowledge at age three strongly predicted their vocabulary knowledge at ages nine and ten (Hart & Risley, 1995). The follow-up findings provide evidence that the gap in word knowledge persisted over time, and initially disadvantaged children were not able to "catch up" to their advantaged peers when they began school. Replication studies (e.g., Dickinson & Tabors, 2002) with similar findings have encouraged the need for high quality early intervention for disadvantaged children.

Recent data indicate a large gap in reading achievement between advantaged and disadvantaged children. Findings from the 2012 National Assessment of Educational Progress indicate that 80% of children from lower income families scored below proficiency in fourth grade reading achievement, while 49% of children from higher income families scored below proficiency in fourth grade reading achievement (National Center for Education Statistics [NCES], 2013). While differences in exposure to rich oral language plays a role in this discrepancy, it is also necessary to acknowledge the many risk factors associated with childhood poverty, including higher rates of violence, lead poisoning, air and noise pollution, family stress, and health problems (Evans, 2004). In society today, proficient language and literacy skills promote opportunities for school success and increased control over career opportunities and life outcomes. Children with disadvantaged backgrounds often begin formal education lacking prerequisite skills for school success (Biemiller, 2001; Hart & Risley, 1995). Without early intervention, many children will continue to struggle with language and literacy.

Researchers and educators have recognized the need to close the gap by providing at risk students with early interventions to build foundational skills. Intervening early is essential, in order to minimize the problem of "Matthew Effects" (Stanovich, 1986), in which the "rich get richer and the poor get poorer" over time, increasing the achievement gap between advantaged and disadvantaged children. For example, research has demonstrated that one way children bolster their vocabulary knowledge is by frequently engaging in reading. Skilled readers tend to read widely, encountering many novel vocabulary words in texts, further bolstering their language and reading skills. However, individuals who lack the skills to read advanced texts are not exposed to rich vocabulary through texts (Stanovich, 1986). Furthermore, individuals with poor reading skills are less likely to engage in frequent reading compared to their peers with proficient reading skills (Morgan, Fuchs, Compton, Cordray, & Fuchs, 2008). Findings from the most recent National Assessment of Educational Progress report show that students who read frequently for enjoyment (almost daily, or once or twice a week) had higher levels of reading proficiency compared to students who reported reading for fun infrequently (a few times a year or less) (NCES, 2013).

Many reciprocal interactions between initial skills and learning demands cause initially disadvantaged students to fall further behind their peers over time. Scarborough (2001) reported that of the children who experience early language and literacy difficulties, 65%-75% continue to experience difficulties in subsequent years. Conversely, of children who do *not* experience early language and literacy difficulties, only 5% -10% have difficulties in subsequent years. Research has indicated that individuals with limited vocabulary tend to learn new words at a slower rate compared to their peers with larger vocabularies (Coyne, Simmons, Kame'enui, & Stoolmiller, 2004). Over time, the achievement gap between students with underdeveloped early language and literacy skills and their advantaged peers tends to increase unless interventions are put in place to close the achievement gap (Hart & Risley, 1995; Snow, Burns, & Griffin, 1998; Torgeson, 2002).

A Multi-Tiered Approach for Promoting Language and Literacy Skills

Researchers have emphasized the need for instructional practices that aim to prevent language and literacy difficulties, and to intervene as early as possible when students do not make adequate progress towards important outcomes (Bradley, Danielson, & Doolittle, 2005; Cunningham & Stanovich, 1997; Wanzek & Vaughn, 2007). Such initiatives have been guided by a public health model approach to education, based on the idea that preventing academic problems is more effective and efficient than remediating problems (Gutkin, 2012; Torgesen, 2002). A proactive approach towards language and literacy development is particularly important, considering the evidence that early reading skills strongly predict future reading acquisition (Cunningham & Stanovich, 1997; Scarborough, 2001).

Response to Intervention (RtI) is a framework for providing multi-tiered, differentiated instruction and supports to all students (National Center on Response to Intervention [NCRTI], 2010). Schools using an RtI framework recognize that students vary in terms of the level of instructional supports they need to learn and succeed academically. As such, schools that implement an RtI framework regularly and systematically identify students in need of additional support, and provide appropriate support as needed. While researchers, educators, and school psychologists have long recognized within-child factors that can affect student learning (e.g., intrinsic learning or attention problems, etc.), it is important to note that ecological factors (e.g., the quality of previous instruction, parent support, etc.) also play an important role in promoting or prohibiting student learning (Gutkin, 2012). With multiple tiers of support in place, students with diverse learning needs are supported, regardless of the underlying cause of learning difficulties. As Brown-Chidsey and Steege (2010) emphasized, "…the *nature of the interventions* provided to help students overcome school difficulties is more important than the etiology or symptoms" (p. 27).

Key components of an RtI framework include the use of evidence-based, differentiated instruction and the use of a comprehensive assessment plan that includes screening, progress monitoring, and diagnostic assessment (NCRTI, 2010). Evidence-based instruction refers to instructional methods or curricula that have empirical support for promoting learning for most students. Differentiated instruction refers to instruction that continuously targets the specific needs of individual students. The universal level of support, or Tier I support, is high quality instruction in the classroom. In an RtI model, the instructional practices provided through Tier I meet the learning needs of most students (approximately 80% of students in the classroom). For various reasons, some students (approximately 15%) will need Tier II support (e.g., more instructional time, more opportunities to practice, more feedback, small group instruction, etc.), in addition to Tier I instruction, to reach their learning goals. A few students (approximately 5%) will require additional intensive Tier III supports (e.g., increased instructional time, more explicit instruction, more opportunities to practice skills, more feedback, and one-to-one or small group instruction) to reach their learning goals (Burns & Gibbons, 2008).

Through data-based decision-making, educators identify students who need additional support, determine the specific skills that need to be targeted for interventions, and monitor how effective the interventions are in promoting learning (Brown-Chidsey & Steege, 2010). Universal screenings, diagnostic assessments, and progress monitoring are RtI assessment methods that promote timely and efficient instructional decision-making. Universal screening is typically done three times throughout an academic year within an RtI framework (Hosp et al., 2007). The purpose of universal screening is to identify all students who are low performing and in need of additional support. Screening tools should accurately predict students who are at risk for learning difficulties and therefore would benefit from additional support. In circumstances when the majority of students in a classroom are identified as being at risk, modifications should be made in Tier I instruction (Brown-Chidsey & Steege, 2010; Burns & Gibbons, 2008). In an RtI framework, individual student progress is monitored to guide instructional decision-making and bolster language and literacy development. It is important to continually monitor individual students' progress towards proficient reading using efficient and technically adequate measures. Doing so allows educators to adapt their instruction and determine whether or not a particular intervention is effective (Fuchs, Fuchs & Vaughn, 2008).

Bloom, Hastings and Madaus (1971) described the need for classroom teachers to differentiate instruction to facilitate learning for all children. Many assessments in schools today measure differences in student aptitudes for learning in a given area. Bloom et al. (1971) argued that the use of such aptitude tests lead many teachers and students to believe that high levels of achievement are only possible for initially high performing students. Carroll (1963) reasoned that "aptitude is the amount of time required by the learner to attain mastery of a learning task" (as cited in Bloom et al., 1971, p. 46). In Carroll's view, most students can become successful learners, if given appropriate time and instruction. Formative evaluations are valuable for effectively gauging students' instructional needs.

In a formative evaluation, a course or subject is broken up into smaller units of learning, and assessments are administered after the end of each unit (Bloom et al., 1971). The data obtained from formative assessments are used to determine which students have mastered the learning objectives, and which students have not. For the students who have not yet mastered a given skill, teachers can use formative assessment data to determine the specific area(s) of difficulty and provide appropriate instruction. Importantly, such assessments are not intended to grade or judge students, but rather they are intended to be used as a tool to guide instruction and improve student learning (Stiggins, 2001). Summative assessments, on the other hand, are intended for grading and evaluating the outcome of instruction and learning (Bloom et al., 1971).

Formative assessment data are used in schools today to identify student instructional needs in a timely manner (Wiliam, 2006; Burns & Gibbons, 2008). Research has demonstrated that formative assessments are powerful tools for improving student learning (Black & Wiliam, 2009). In fact, a review of over 800 studies found the use of frequent formative assessment to be the most powerful teaching variable to affect student learning (Hattie, 2009). The ongoing use of formative assessments allows educators to allocate appropriate resources within a multi-tiered service delivery framework, such as Response to Intervention (Burns & Gibbons, 2008).

Curriculum Based Assessments are widely used tools for formative assessment and evaluation. Curriculum Based Assessments are measurements that use "direct observation and recording of a student's performance in the local curriculum as a basis for gathering information to make instructional decisions" (Deno, 1987, p. 41). Curriculum Based Assessment (CBA) is considered a broad "umbrella" term, and there are many forms, including Curriculum Based Measurement (CBM), Curriculum Based Evaluation (CBE), Criterion-Referenced Curriculum Based Assessment (CR-CBA), and Curriculum Based Assessment for Instructional Design (CBA-ID) (Hintze, Christ, & Methe, 2006). Curriculum-based assessments can be divided into two major forms: *specific sub-skill mastery measurements* (CBE, CR-CBA, and CBA-ID), or *general outcomes measurements* (CBM). Each form of CBA addresses different questions regarding instructional decision-making, and no single form provides comprehensive information regarding the evaluation of and intervention for academic problems (Hintze, Christ, & Methe, 2006). Therefore, it is helpful to understand each form of CBA independently to inform the most appropriate measure to use in a given context.

In the area of *specific sub-skill mastery measurement*, a global curriculum is sequenced into short-term sub-skills, and mastery of each unique sub-skill is measured. Mastery measures are typically not standardized, and the format of measures can shift depending on the skill that is assessed. For example, within the domain of reading, decoding skills are typically sequenced beginning with relatively simple decoding skills (e.g., decoding CVC words). Once mastery measures indicate that a student has mastered a specific skill, the student receives instruction for the next short-term skill in the curriculum sequence (Hintze, Christ, & Methe, 2006). The mastery measures are closely aligned with the specific curriculum, and therefore are likely to have high content validity and social validity (i.e., the assessments measure what was taught).

With Curriculum Based Assessment for Instructional Design (CBA-ID; Gickling & Havertape, 1981), the goal is to determine a student's current instructional needs by aligning the content of the assessment with the current content of instruction. With CBA-ID, excessive amounts of unknown information are not included in the assessment, but instead the content is closely aligned with current instructional skill areas (Hintze, Christ, & Methe, 2006). Teachers use CBA-ID data to control the timing at which new instructional topics (e.g., sub-skills) are introduced to individual students (Gickling & Havertape, 1981). For example, a teacher might monitor a student's progress towards mastery of decoding CVC words before moving on to teaching and assessing CVCe decoding skills.

With Criterion Referenced Curriculum Based Assessment (CR-CBA; Idol & Paolucci-Whitcomb, 1999), the goal again is to determine a student's current instructional needs. However, within a CR-CBA, several levels of the curriculum are assessed at once. With CR-CBAs, the content consists of skills that have already been taught and skills that have not yet been taught. A student's performance is compared with mastery criteria (e.g., using local norms to determine acceptable performance levels) (Idol, Nevin, & Paolucci-Whitcomb, 1999). CR-CBAs can be used to monitor long-term growth of skills from a sequenced curriculum.

Curriculum Based Evaluation (CBE; Howell, 1986) is a process in which survey-level assessments are used to sample from a wide range of skills within a particular domain, such as reading (Hintze, Christ, & Methe, 2006). For example, oral reading fluency probes are often used as a survey level assessment of a student's current level of reading proficiency (Hosp et al., 2007). Using the results of a survey-level assessment, follow-up diagnostic assessments are administered to examine mastery levels for specific sub-skills and to determine the specific areas in which more instruction is needed (e.g., silent-e endings, digraph patterns, etc.). CBE is a systematic process for determining a student's current instructional needs, in terms of the specific skills that have or have not been mastered (Hosp et al., 2007).

In the area of *general outcome measurements,* global indicators of basic skills are measured repeatedly to monitor long-term growth in a particular domain. Curriculum-Based Measurements (CBM; Deno, 1987) are general outcome measures, or standard measures of basic skills such as reading, spelling, writing, or mathematics. In contrast to mastery measurements, CBMs are not aligned precisely with the specific content taught in the curriculum. CBMs are used as dynamic indicators of basic skills or *DIBS* to guide formative evaluation (Deno, 1987). CBMs are dynamic or sensitive to differences between individuals and within individuals over time. The measures also serve as evidence-based indicators of basic skills, such as reading (Shinn, 1998). While CBMs are not as closely aligned with the instructional curriculum as mastery measurements are, they are standardized, efficient to administer, sensitive to short-term and long-term improvement and have established acceptable psychometric properties (Hosp et al., 2007). As Shinn (1998) described, CBMs can be regarded as "academic thermometers", used to monitor indicators of overall academic health in a particular domain (e.g., reading). However, CBMs are not useful for identifying specific areas of weakness (Shinn, 1998).

While there is evidence that CBAs are useful as screening, progress monitoring, and diagnostic instructional decision-making tools in areas such as phonemic awareness, phonics, fluency, comprehension, there is currently insufficient research regarding useful vocabulary assessments within an RtI framework (Loftus & Coyne, 2013). Other reading skills work well within a general outcome or mastery measurement system (e.g., oral reading fluency); however, the measurement of vocabulary poses unique challenges. For example, given the vast number of vocabulary words (over 500,000 distinct word types; Nagy & Anderson, 1984), general outcome measures for long-term vocabulary achievement do not have adequate sensitivity to capture short-term growth in vocabulary knowledge. A general outcome approach to monitoring vocabulary growth would be less useful for informing instructional decision-making, given the vast number of words available for learning and assessing. Mastery measures are more appropriate for monitoring vocabulary knowledge, because mastery measures promote alignment between what is taught and what is assessed. However, the nature of using vocabulary mastery measurement differs from mastery measurement in other reading skills. Typically, mastery measures are used to monitor mastery of specific skills over a relatively short period of time. In the case of vocabulary, mastery monitoring could continue over the course of a lifetime as an individual continues to learn new words.

Jenkins, Graff and Miglioretti (2009) recommend using general outcome measures sparingly (not more frequently than is necessary to establish a reliable estimate of growth). Formative assessment tools that monitor progress toward mastery of specific objectives or skills are more useful for informing day-to-day instructional decision-making. General outcome measures are useful as indicators, or *indirect* measures of growth in sub-skills; however, to facilitate ongoing differentiated instruction and flexible intervention groups, mastery measurement is often more useful to educators. A summary and comparison of general outcome measurement and mastery monitoring measurement is provided in Table 1.

Table 1

Comparison of Mastery Monitoring Measures vs. General Outcome Measures

	General Outcome Measurement	Mastery Monitoring Measurement
What is measured?	Broad achievement domains (e.g., reading, spelling).	Specific skills that are mastered over a short period of time (e.g., CVC word decoding).
What do the measures look like?	Multiple standard measures of equal difficulty (e.g., multiple probes with adequate alternate form reliability).	Multiple unique measures that may vary in difficulty as the unit or objectives change.
How are the data used?	Used to monitor progress toward long-term achievement in broad domain areas (e.g., reading); Used to identify students at risk for low achievement in broad domain areas.	Used to monitor progress toward short-term achievement in specific skill areas (e.g., CVC word decoding); Used to document mastery of specific skills.
How often is it administered?	Typically administered weekly for progress monitoring; tri-annually for universal screening.	Administered at the end of each unit (frequency may vary).
What are the benefits?	Allows for continuous assessment of retention and generalization in broad domain areas; The method of assessment is consistent over time.	Strong instructional validity (teachers can evaluate what students have/have not learned); Items on measures are aligned with the specific curriculum/instruction.
What are the limitations?	Weak instructional validity; Does not provide diagnostic information.	Information regarding reliability, validity, sensitivity to improvement might not be available; Might not capture retention of previously taught content; Might not test for generalization of skills.

Note: The information included in this table was obtained from Shinn (1998) and Hintze, Christ & Methe (2006).

A wealth of research has been conducted to explore best practices in promoting code-based skills (e.g., phonemic awareness, phonics) within a multi-tiered or RtI framework (Hosp et al., 2007). For example, the Dynamic Indicators of Basic Literacy Skills or DIBELS (University of Oregon Center on Teaching and Learning, 2014; see Kaminski & Good, 1996) include widely used general outcome measures in skills such as phonological awareness, alphabetic principles, phonics, oral reading fluency, and comprehension. Far less attention has been devoted to instructional strategies and assessment tools for early vocabulary acquisition (Biemiller, 2001; Loftus & Coyne, 2013; NRP, 2000). The tools that have been developed to monitor vocabulary progress have not established adequate sensitivity for short term gains in vocabulary knowledge, and therefore are of limited use. Tools measuring general vocabulary knowledge (i.e., items reflect a sampling of words that were not necessarily targeted for direct instruction) are not likely to be effective in capturing ongoing gains in word knowledge (NRP, 2000; Paris, 2005; Stahl & Bravo, 2010).

Researchers have agreed that it is a challenge to measure vocabulary knowledge within an RtI framework (Beck, McKeown, & Kucan, 2002; Loftus & Coyne, 2013; NRP, 2000; Paris, 2005). One of the challenges of measuring word knowledge is determining what it means to know a word (Beck et al., 2002). Another challenge is determining the most effective methods for measuring word knowledge (NRP, 2000). Before discussing vocabulary assessment methods, is first helpful to provide an overview of the nature of vocabulary development and evidence-based instructional strategies.

Early Vocabulary Development and Instruction

Although vocabulary knowledge and growth varies from one child to the next, most children's lexicons grow substantially during the second year of life (Bates et al., 1988, as cited in Snow, Burns & Griffin, 1998) and continue to grow rapidly through preschool and subsequent school years. Researchers distinguish between multiple forms of vocabulary, including receptive vocabulary and productive vocabulary (NRP, 2000). Receptive vocabulary refers to words that an individual is able to recognize (e.g., words that are understood when presented through speech or writing). Productive vocabulary refers to words that an individual is able to produce (e.g., words that an individual can produce through speech or through writing). Receptive and productive vocabularies can be further sorted into categories of *oral vocabulary* (words that are understood or produced through speech or oral language) or *reading vocabulary* (words that are understood or produced through text or writing) (NRP, 2000).

Researchers have attempted to estimate vocabulary size and rate of growth; however, this task is difficult for two reasons. First, there are challenges in defining what it means to know a word. Additionally, different procedures and measures have been used to capture vocabulary knowledge (Beck et al., 2002), leading to inconsistencies in estimations of vocabulary knowledge. Researchers have estimated that the average school-age child learns (or, becomes aware of) approximately seven new words a day (Just & Carpenter, 1987; Nagy & Herman, 1987; Smith, 1941; as cited in Snow, Burns, & Griffin, 1998). However, the number of words learned per day can vary substantially from one student to the next. While some students learn well over seven new words per day, some students learn two new words a day or fewer (Beck et al., 2002). Research has indicated that children who enter school with limited vocabularies learn new words at a lower rate compared to students who enter school with rich vocabularies (Baker, Kame'enui, Simmons, & Simonsen, 2007; Baker, Simmons, & Kame'enui, 1997; Hart & Risley, 1995).

Language and literacy researchers have asked the question, what does it mean to know a word? Carey (1978) explained that initially, a "fast mapping" process of word learning takes place. During this process, the individual has a very basic sense of the meaning of the word. According to Carey (1978) it is not until the individual has used and understood the word in multiple contexts that "extended mapping" or a more advanced knowledge of the word can occur. Several other perspectives of word learning have been put forth by researchers (see Table 2). Each perspective recognizes that word knowledge is not an *all or nothing* phenomena (Beck et al., 2000). Instead, word knowledge deepens incrementally as an individual uses and understands words in multiple contexts (Stahl, 2003; Beck et al., 2002). Determining an individual's word knowledge is a difficult and nuanced task.

One of the most important components of effective vocabulary instruction is selecting appropriate words to teach. Nagy and Anderson (1984) analyzed words in printed school materials for Grades 3-9 and identified over 88,500 distinct word families (e.g., *motivate, motivated, motivates, motivating, motivation, motivations, motives, motivational,* and *unmotivated* are categorized as one distinct word family). Given that there are thousands of words to choose from, researchers have categorized the most important types of words for educators to teach directly. Beck et al. (2002)

encourage careful selection of target words that are useful and likely to bolster language comprehension.

Table 2

Stages of Word Learning

Author	Description of Stages or Categorizations of Word Knowledge
Dale (1965)	1. Never saw it before 2. Heard it, but doesn't know what it means 3. Recognizes it in context as having something to do with ___. 4. Knows it well.
Beck, McKeown, & Omanson (1987)	1. No knowledge 2. General sense, such as knowing *mendacious* has a negative connotation. 3. Narrow, context-bound knowledge, such as knowing that a *radiant* bride is a beautifully smiling happy one, but unable to describe an individual in a different context as radiant. 4. Having knowledge of a word but not being able to recall it readily enough to use it in appropriate situations. 5. Rich, decontextualized knowledge of a word's meaning, its relationship to other words, and its extension to metaphorical uses, such as understanding what someone is doing when they are *devouring* a book.
Cronbach (1942)	1. Generalization: The ability to define a word. 2. Application: The ability to select or recognize situations appropriate to a word. 3. Precision: The ability to apply a term correctly to all situations and to recognize inappropriate use. 4. Availability: The actual use of a word in thinking and discourse.

Note: The information provided in this table was obtained from Beck et al. (2002, pp. 9-10).

Beck et al. (2002) distinguish between three tiers of words (unrelated to the tiers of support referenced in an RtI framework). Tier One words are common, everyday words such as *clock, chair,* and *hand*. Tier One words are relatively simple to conceptualize, and most individuals learn these words quickly and easily through everyday interactions and experiences. Tier Two words (e.g., *operate, maintain,* and *previous*) are less common, more abstract terms that are used across many different content areas. Tier Three words (e.g., *peninsula, abolitionist,* and *isotope*) are uncommon, specialized, and limited to specific academic domains (Beck et al., 2002).

Tier Two and Tier Three words (Beck et al., 2002) align with what Blachowicz, Fisher, Ogle, and Taffe (2013) referred to as *academic vocabulary.* Academic vocabulary refers to content-area words that are often unfamiliar to students until they are presented in academic contexts (e.g., by teachers, in texts, or other academic resources). Unlike Tier One words, Tier Two and Three words are difficult to learn through incidental exposure, because they are more abstract. Vocabulary researchers suggest that Tier Two words or general academic vocabulary terms are especially useful to teach, because they are found across disciplines and content areas, and do not require domain-specific knowledge (Beck et al., 2002).

Given the large number of words in the English language, researchers and educators have debated over the merits of a breadth versus depth approach to early vocabulary instruction. In other words, in the allotted time available for vocabulary instruction, should educators provide extensive, direct instruction for a few words, or should they aim to cover many words through brief, incidental vocabulary instruction? Research has demonstrated that direct vocabulary instruction of Tier Two words has more powerful long-term effects than incidental exposure approaches to vocabulary instruction (Coyne, McCoach, Loftus, Zipoli, & Kapp, 2009; Maynard, Pullen, & Coyne, 2010), particularly for students with underdeveloped vocabulary knowledge.

Evidence-based practices for promoting vocabulary knowledge include selecting appropriate target words, teaching words directly, using student-friendly definitions, reinforcing the definition in multiple contexts, providing rich and varied language experiences, storybook reading, fostering word consciousness, teaching word learning strategies (such as looking for prefixes and root words), and providing students with multiple opportunities for practice and feedback (Beck et al., 2002). Vocabulary researchers (Beck et al., 2002; Biemiller, 2001; Coyne et al., 2009) have cautioned educators against relying on incidental vocabulary learning to build students’ vocabulary for Tier Two words. Research has indicated that relying on contextual clues to learn new Tier Two words can provide inaccurate understandings of novel words, especially for individuals with low levels of reading achievement and vocabulary knowledge (Beck et al., 2002).

Studies have shown that repeated readings of storybooks paired with explicit, rich explanations of Tier Two words is an effective method for bolstering the vocabulary of children at risk of reading difficulty (Coyne, Simmons, Kame’enui, & Stoolmiller, 2004; Loftus, Coyne, McCoach, Zipoli, & Pullen, 2010; Maynard, Pullen, & Coyne, 2010). Vocabulary growth through shared storybook readings has also been documented with children who are English Learners (Collins, 2010; Hickman, Pollard-Durodola, & Vaughn, 2004; Silverman, 2007). Importantly, the most effective approach for promoting vocabulary growth through shared storybook approaches includes purposeful selection of Tier Two words, providing student-friendly definitions, and planning lessons and activities to promote target word use in rich contexts (Coyne et al., 2004). Incidental exposure to words through storybook reading is less effective for promoting vocabulary knowledge, particularly for students with limited vocabulary or students who are English Language Learners (Collins, 2010; Coyne et al., 2005; Coyne, McCoach, & Kapp, 2007; Maynard et al., 2010).

While educators can select storybooks, Tier Two words, student-friendly definitions, and develop activities and lessons to promote vocabulary growth, many educators prefer using available curricula for vocabulary instruction. Early vocabulary curricula are available for educators to use, with pre-selected Tier Two words, stories, and rich oral language activities included. A small number of commercially available early vocabulary curricula have been developed, allowing educators the opportunity to use systematic, evidence-based direct vocabulary instruction. Of the handful of commercially available vocabulary curricula, one of the most widely used is the *Elements of Reading: Vocabulary* curriculum by Beck and McKeown (2004).

The *Elements of Reading: Vocabulary* curriculum has been supported by research (Apthorp et al., 2012; Resendez & Azin, 2007) as an effective program for bolstering proximal (target word) vocabulary knowledge. The *Elements of Reading: Vocabulary* program is available for use in Kindergarten through fifth grade. The Kindergarten curriculum includes 20 minute daily lessons, 5 days a week over the course of 24 weeks. Each week, five new words are taught in a whole-class (Tier I) setting, using a variety of activities, including read-alouds, viewing photo cards, learning examples and non-examples of target words, and participating in increasingly challenging discussions and activities using the target words in various contexts. The target words that are used are sophisticated, unfamiliar, Tier Two words (Beck et al., 2002), such as *inquire, reluctant, glance, pursue, lively, peculiar, describe, ancient, enormous, expectation,* and *memorable.* For each of the target words (120 total target words in the curriculum) a student-friendly definition is provided. For example, the definition for the word *reluctant* is “not sure that you want to do something”, the definition for the word *describe* is “tell what something looks like or feels like”, and the definition for the word *peculiar* is “strange, unusual, or weird”. When implemented with fidelity, research has indicated that the *Elements of Reading: Vocabulary* curriculum promotes vocabulary growth for young children (Apthorp et al., 2012; Resendez & Azin, 2007).

Even with the use of evidence-based vocabulary curricula, a major challenge to effective instruction is the heterogeneity of student vocabulary knowledge in a given classroom. Research has documented that children enter formal schooling with widely differing levels of language and literacy skills (Hart & Risley, 1995; Dickinson & Tabors, 2002). Given these findings, it is important that educators not only use evidence-based instructional practices in the classroom (Tier I), but also that the instruction is differentiated depending on the instructional needs of individual children. The most effective and appropriate method for differentiating instruction is to use technically adequate formative assessments to guide instructional decision-making (Good & Kaminski, 1996).

Early Vocabulary Assessment within a Multi-Tiered Framework

Research has shown that direct assessment of early language and literacy skills provides stronger predictive validity compared to teacher judgments, in terms of correctly identifying students who are at risk for poor literacy achievement (Cabell, Justice, Zucker, & Kilday, 2009). While technically adequate curriculum-based assessments have been developed for early literacy skills such as phonemic awareness, grapheme-phoneme knowledge, phonics, and fluency (Hosp et al., 2007) there is a need for valid and efficient assessments of vocabulary knowledge and growth (Loftus & Coyne, 2013). As Paris (2005) pointed out, "there has been increased assessment and instruction on alphabet knowledge, phonemic awareness, and oral reading fluency as the main enabling skills and significant predictors of later reading achievement. There has been relatively less research and classroom emphasis on vocabulary and comprehension to date, perhaps because of the difficulty of assessing and teaching these skills to children who are beginning to read." (p. 187).

While vocabulary is considered one of the five "pillars" of reading acquisition (NRP, 2000), there are fundamental differences between vocabulary and the other pillars of reading acquisition. Paris (2005) described phonemic awareness, phonics and fluency as linear, constrained skills. For example, within a few years of instruction, most students are able to demonstrate complete mastery of skills such as letter naming, letter-sound knowledge, phonemic awareness, and decoding. However, the same is not true for vocabulary knowledge. Unlike constrained skills, vocabulary development has no ceiling for mastery. Vocabulary acquisition is an unconstrained skill that continues to develop across a lifetime (Paris, 2005).

Different methods have been developed to aid in measuring an individual's word knowledge. Some methods are intended to measure "shallow" word knowledge, while other methods aim to measure "deep" word knowledge (Beck et al., 2002). In a review of the research on vocabulary instruction and assessment, the National Reading Panel found,

> …most of the researchers [use] their own instruments to evaluate vocabulary, suggesting the need for this to be adopted in pedagogical practice. That is, the more closely the assessment matches the instructional context, the more appropriate the conclusions about the instruction will be… instruments that match the instruction will provide better information about the specific learning of the students related directly to that instruction. (NRP, 2000, Chapter 4, pp. 26-27).

In other words, tools that aim to measure vocabulary knowledge and growth should be closely aligned with the vocabulary instruction or curriculum. Curriculum-based assessments have received a great deal of attention and use for instructional decision-making in constrained areas of reading acquisition (e.g., letter-sound knowledge, phoneme awareness, phonics). With CBA's, a student's progress toward mastery of constrained skills can be monitored over time, and instruction can be differentiated based on a student's progress (or lack of progress) towards short or long-term outcomes. In order for vocabulary assessments to be useful to teachers, the content of the assessment and vocabulary curriculum must be closely aligned. However, many educators do not use a curriculum for direct vocabulary instruction, and instead rely on indirect or incidental vocabulary instruction. An unstructured, incidental approach to vocabulary instruction limits the availability and use of vocabulary assessments that are aligned with target words. In other words, curriculum-based vocabulary assessment is only possible with a vocabulary curriculum in place. The words that are taught directly should be the same words that are assessed (NRP, 2000).

With a high quality vocabulary curriculum in place, educators can identify a “ceiling” for mastering target vocabulary words over a long period of time (e.g., over the course of an academic year, or multiple years). For example, if a teacher uses a vocabulary curriculum to directly teach 100 new Tier Two words throughout the school year, the “ceiling” could be defined as mastery of the 100 target words. In this context, teachers could have an opportunity to measure the specific words that were taught directly throughout the year, and to make decisions regarding individual student learning. Using a Tier I (whole-class) vocabulary curriculum provides educators with an opportunity to use curriculum-based vocabulary assessments to make decisions regarding the effectiveness of instruction for individual students. A variety of approaches, tools, and procedures exist for measuring vocabulary knowledge. However, research is needed to explore and identify best-practices for measuring vocabulary knowledge within a multi-tiered framework (Loftus & Coyne, 2013).

The methods available for measuring Kindergarten children’s vocabulary are limited, as young children are not yet able to read and write proficiently to express their knowledge. Therefore, Kindergarten vocabulary assessments for must involve oral language tasks or the use of pictures to appropriately capture students’ word knowledge. Recent research on early vocabulary instruction has relied on the use of published, multiple choice, receptive vocabulary assessments (e.g., Wasik &

Hindman, 2011; Silverman & Hines, 2009), as well as experimenter-developed, multiple choice, receptive vocabulary assessments (Loftus, Coyne, McCoach, Zipoli, & Pullen, 2010; Biemiller & Boote, 2006). The National Reading Panel identified vocabulary assessment practices as an area needing additional research, asking, "What are the best ways to evaluate vocabulary size, use, acquisition, and retention? What is the role of standardized tests, what other measures should be used, and under what circumstances?"(NRP, 2000, Chapter 4, p. 27). Many of the nationally normed vocabulary assessments (e.g., the PPVT-4, Dunn & Dunn, 2007; EVT-2, Williams, 2007) do not have adequate sensitivity to measure short-term gains in target word knowledge. Furthermore, many of the available standardized measures of general vocabulary knowledge are not practical measures to use for universal screenings or for monitoring student progress (Loftus & Coyne, 2013). Technically adequate (reliable, valid) and useful indicators of student learning are essential in a proactive and preventative model for instructional decision-making (Deno & Mirkin, 1977).

A disadvantage of many mastery measurement curriculum-based assessments is that technical properties such as reliability and validity are often not established (Shinn, 1998). Reliability is a test property that reflects the degree to which differences in observed scores are aligned with differences in true scores (Furr & Bacharach, 2008). Adequate reliability is necessary but not sufficient for validity. The conceptualization of validity has evolved over time. Furr and Bacharach (2008) discuss traditional conceptualizations of test validity, including content validity, criterion validity and construct validity. Content validity refers to the match between the actual content of a test and the content that should be on a test. Criterion validity (concurrent or predictive) refers to the degree to which test results correlate with specific criterion variables. Construct validity refers to the degree to which test scores reflect a specific psychological construct (e.g., intelligence). A contemporary definition of validity describes it as “the degree to which evidence and theory support the interpretations of test scores entailed by the proposed uses” of a test (American Education Research Association, American Psychological Association, & National Council on Measurement in Education, 1999, p. 9).

Researchers have pointed out the need to use precise language when referring to the concept of validity (Furr & Bacharach, 2008; Scriven, 2002). Scriven suggested that “there are no valid tests of future affairs, only indicators… the use of test results may be a valid or invalid indicator of future performance” (2002, p. 258). In other words, the actual question is whether the *inferences* we make using test results are valid for a given purpose. Messick, suggested that “the essence of unified validity is that the appropriateness, meaningfulness, and usefulness of score-based inferences are inseparable and that the unifying force behind this integration is the trustworthiness of empirically grounded score interpretation” (1989, p. 5). Data based decision making within a Response to Intervention framework requires the use of tools that can efficiently and accurately predict student risk for poor outcomes in important domains. Therefore, it is appropriate to examine the predictive validity of screening assessments, or the degree to which assessments accurately classify students at risk or students not at risk for poor outcomes.

Curriculum-Based Vocabulary Assessments

In using formative assessments and screening assessments, it is important to determine whether the assessment data have predictive validity. That is, do assessment results correlate highly with future learning outcomes? It is expected that through direct vocabulary instruction, learning outcomes will include expressive or productive knowledge of target words (i.e., ability to generate definitions of words) and receptive or discriminate knowledge of target words (i.e., ability to select an accurate representation of a word, or the ability to discriminate between examples and non-examples of target words). These learning expectations are based on research on early vocabulary instruction (Coyne et al., 2010; Coyne et al., 2009; McKeown & Curtis, 1987; NRP, 2000).

In the classroom, teachers benefit from using assessments that are efficient to administer and that will guide instructional decision-making (Hosp et al., 2007). While multiple choice measures are convenient and efficient to use, disadvantages to this approach can include the availability of context clues and the possibility that the student will guess correctly. However, ongoing results from well-designed multiple choice assessments could provide a general indication regarding a student's understanding of target words. A primary advantage of receptive or discriminative methods of vocabulary assessment is the efficiency of administration; an entire classroom could be assessed in minutes using multiple choice assessments.

Classrooms that use a multi-tiered service delivery model require ongoing assessments to inform the teacher of student progress or lack of progress (Burns & Gibbons, 2008; Coyne, Kame'enui, & Simmons, 2001). As vocabulary instruction is just beginning to be emphasized in early elementary school, there is a need for vocabulary assessments that are accurate indicators of student learning. Two curriculum-based assessments are currently available in one of the most widely used commercially available Kindergarten vocabulary programs, *Elements of Reading: Vocabulary* (Beck & McKeown, 2004). In the program, five new vocabulary words are taught to Kindergarten classes each week through story book reading and a variety of other language and literacy activities. The two curriculum-specific vocabulary assessments are administered at the end of each week (i.e., the end of each unit). While teachers are encouraged to use these assessments, it is unclear whether they are technically adequate assessments of student vocabulary development, and whether the assessments are efficient and useful for teachers to administer. Research is needed to determine the practical and predictive validity of the measures, and to inform best practice in the use of these vocabulary assessments.

In the current study, data are examined from two curriculum-based vocabulary assessments completed weekly by 250 Kindergarten students over the course of an academic year. The study examines the extent to which these measures are appropriate for gauging Kindergarten students' understanding of target vocabulary words that have been through multi-tiered instruction. While ongoing formative assessment is essential for supporting differentiated instruction, it is difficult to select appropriate tools unless a core vocabulary curriculum is in place. Considering the vast number of words available to teach, it can be a challenge to select a brief, formative assessment that will capture short-term growth in vocabulary knowledge. Inadequate sensitivity can be a major barrier to measuring short-term vocabulary growth unless the assessment is aligned with words that have been taught (i.e., aligned with the curriculum or curriculum-based). With this in mind, it is evident that vocabulary assessments must be closely aligned with a curriculum or structured framework for direct vocabulary instruction. In the current study, the utility of two curriculum-based vocabulary assessments are examined within a multi-tiered vocabulary instructional framework.

Research Questions

The current study examined the predictive validity and social validity of two weekly curriculum based vocabulary assessments included in an evidence-based Kindergarten vocabulary program (Beck & McKeown, 2004). The study examines the extent to which the measures are appropriate for guiding instructional decision-making within a multi-tiered or RtI context. The following research questions are addressed in the present study:

1. *Reliability of the Curriculum Based Vocabulary Assessments.* The study examined alternate form reliability for each of the two curriculum-based vocabulary assessments in the *Elements of Reading: Vocabulary* curriculum. Correlations were examined between each of the 24 weekly probes, for both of the vocabulary assessments.
2. *Predictive validity of the Curriculum Based Vocabulary Assessments.* The current study examines the extent to which each of the curriculum-based vocabulary assessments included in the *Elements of Reading: Vocabulary* curriculum predict important end-of-year vocabulary outcomes for Kindergarten students. Correlations between measures of general vocabulary

knowledge (PPVT-4 and EVT-2) and end-of-year vocabulary outcomes were compared with correlations between curriculum-based vocabulary assessments and end-of-year proximal and distal vocabulary outcomes. Classification accuracy was examined regarding the correct classification of students at risk for poor vocabulary outcomes (sensitivity), and for correct classification of students not at risk for poor vocabulary outcomes (specificity). Classification accuracy of the curriculum based vocabulary assessments was compared with the classification accuracy of standardized measures of general vocabulary knowledge (the PPVT-4 and EVT-2).

3. *Tier I vs. Tier II Group Differences on Curriculum Based Vocabulary Assessment Performance.* The current study examined whether the curriculum based vocabulary assessments included in the *Elements of Reading: Vocabulary* curriculum captured group differences in target word vocabulary knowledge between at risk students receiving Tier I instruction and at risk students receiving Tier I *and* Tier II instruction. Tier I and Tier II group differences were also examined using end-of-year proximal and distal vocabulary outcome measures.
4. *Social Validity of the Curriculum Based Vocabulary Assessments.* This study examined teacher ratings regarding the social validity of the curriculum based vocabulary assessments included in the *Elements of Reading: Vocabulary* curriculum. Teacher feedback regarding the strengths and weaknesses of the two curriculum based vocabulary assessments is reported.

CHAPTER 2

METHODOLOGY

Design

In the current study, Kindergarten students completed weekly vocabulary assessments over the course of an academic year, and the predictive and social validity of the assessments were examined. The present study was conducted in the context of Project Early Vocabulary Instruction and Intervention (Project EVI). Project EVI is an experimental vocabulary intervention developed with funding from the U.S. Department of Education Institute of Educational Sciences. Through Project EVI, Tier I (whole-class) and Tier II (supplemental, small group) vocabulary instruction was provided to Kindergarten students over the course of a school year. In Project EVI, several pre-intervention and post-intervention assessments of early language and literacy skills were administered to participants. In the current study, Project EVI participants' vocabulary knowledge was assessed weekly over the course of the year using two assessments. The design of Project EVI is described below, to aid the reader in understanding the context of the current study.

Project EVI design. Project EVI focuses on early vocabulary acquisition within a multi-tiered or Response to Intervention (RtI) framework. Through Project EVI, 19 Kindergarten teachers were trained to provide Tier I whole-class vocabulary instruction every day for 30 minutes throughout the academic year (over the course of 24 weeks). The curriculum used for Tier I instruction was *Elements of Reading: Vocabulary* by Beck and McKeown (2004). Kindergarten teachers were trained to use this evidence-based curriculum to deliver direct, whole-class vocabulary instruction. Five new target vocabulary words were taught each week in Tier I instruction, through a variety of lessons and activities in the *Elements of Reading: Vocabulary* curriculum. The target vocabulary words taught to all participants are listed in Table 3.

Table 3

Words Taught Each Week (i.e., Lesson) Through Elements of Reading: Vocabulary Tier I Instruction.

Lesson 1	comforting, fleet, glimmer, expression, lively
Lesson 2	drenched, gorgeous, peculiar, linger, vain
Lesson 3	glance, timid, frantic, reluctant, intimidated
Lesson 4	journey, glide, soar, adventure, roam
Lesson 5	stumble, pursue, collide, lounge, absurd
Lesson 6	alert, narrow, wavy, swirl, relief
Lesson 7	active, describe, broad, whisk, scamper
Lesson 8	ancient, mischievous, observe, track, hefty
Lesson 9	discouraged, hesitate, desire, respect, extraordinary
Lesson 10	splendid, celebrate, option, village, appreciate
Lesson 11	amble, displeased, request, bare, fetch
Lesson 12	snare, nestle, perilous, pounce, unlikely
Lesson 13	sprinkle, solitude, muddle, progression, expectation
Lesson 14	enormous, sway, struggle, delighted, cooperate
Lesson 15	baffled, startle, slumber, plea, flustered
Lesson 16	creak, stalk, communicate, chatter, action
Lesson 17	scraggly, prod, plump, witty, aware
Lesson 18	romp, gather, creative, fad, entertain
Lesson 19	slime, hatch, haven, slither, eager
Lesson 20	beacon, labor, memorable, survey, mammoth
Lesson 21	stroke, yank, idle, task, dive
Lesson 22	underneath, spin, lovely, transform, cycle
Lesson 23	drift, mighty, seek, swerve, inquire
Lesson 24	cramped, mimic, prowl, rhythm, dazzling

A measure of general receptive vocabulary knowledge (Peabody Picture Vocabulary Test-4 or PPVT-4, Dunn & Dunn, 2007) was administered as a universal screening tool to all Project EVI participants (N=374, 19 Kindergarten classrooms) in the beginning of the school year. The screening results were used in Project EVI to identify students at risk for language and literacy difficulties and students with typical levels of language and literacy. Students with standard PPVT-4 scores between the 5th and 30th percentile (N=79) were identified as being at risk for language and literacy difficulties. Students with standard PPVT-4 scores close to the 50th percentile (standard scores between 95 and 105; N=48) were identified as typically achieving "reference" students. The "remaining" students (N=247) did not complete additional testing for the purposes of Project EVI, but were included in the current study. A summary of Project EVI groups and instruction received is provided in Table 4.

Table 4

Project EVI Group Information

	"At Risk" on PPVT-4	Not "At Risk" on PPVT-4	Received Tier I	Received Tier II
Control (N=36)	✓		✓	
Treatment (N=43)	✓		✓	✓
Reference (N=48)		✓	✓	
Remaining (N=247)		✓	✓	

"At risk" students with PPVT-4 scores between the 5th and 30th percentile (N=79) were randomly assigned to either a control group (N=36) or a treatment group

(N=43). The control group only received Tier I (whole class) vocabulary instruction throughout the year. The treatment group received Tier I (whole class) vocabulary instruction *and* Tier II (small group) vocabulary instruction throughout the year. The "reference" group and "remaining" group only received Tier I (whole class) vocabulary instruction throughout the year. In other words, all students *except* the treatment group received only Tier I (whole class) vocabulary instruction throughout the year. The treatment group received Tier I *and* Tier II vocabulary instruction throughout the year. The primary goal of Project EVI is to examine the effects of Tier II vocabulary instruction for at risk students, compared to a control group and reference group.

Interventionists (school-based reading specialists, paraprofessionals, teaching assistants, etc.) were trained through Project EVI to provide Tier II instruction to the treatment students. Tier II instruction was delivered four days per week for 20 minutes each day to groups of 2-4 students. Students in the treatment group received 80 additional minutes of small group vocabulary instruction a week, compared to the control, reference, and remaining students. Tier II interventionists reviewed and reinforced three out of the five target words that were taught each week in Tier I instruction. For example, in Week One of Tier I instruction, five words were taught directly in a whole-class lesson (*comforting, fleet, glimmer, expression,* and *lively*). Only three of the five words were reviewed throughout the week in the Tier II intervention (*comforting, fleet,* and *glimmer*). Within the Tier II instruction, treatment students had extended opportunities to use and interact with the target words through various activities. For example, in one activity students discern between examples and non-examples of target word meanings using picture cards. In other activities, students used target words in sentences or used word webs to make connections between target words and other words. In the Tier II instruction, students received scaffolded instruction and immediate corrective feedback. Given the extended instruction and increased support, students in the treatment group were expected to develop higher levels of target word knowledge compared to the control group.

Trained Project EVI researchers collected pre-intervention and post-intervention data from the treatment, control, and reference groups related to early language and literacy skills. The pre-intervention and post-intervention data captured information regarding proximal vocabulary gains (knowledge of the target words directly taught) and distal vocabulary gains (transfer knowledge of general vocabulary). The proximal measures were developed by Project EVI researchers and included Receptive Target Word and Expressive Target Word measures. The distal or transfer measures used included the Peabody Picture Vocabulary Test-4 (PPVT-4, Dunn & Dunn, 2007), and the Expressive Vocabulary Test-2 (EVT-2, Williams, 2007). Additional information for each of the measures is included in the Measures section.

The current study collected weekly vocabulary assessment data over the course of the academic year (each week for 24 weeks), in addition to the pre and posttest data collected for Project EVI. A summary of the groups and data collected from each group is provided in Table 5. The design of the current study is described next, building from the context of Project EVI.

Table 5

Data Collected from Each Group Through Project EVI and the Current Study

	Control (N=36)	Treatment (N=43)	Reference (N=48)	Remaining (N=244)
Pre-Intervention				
PPVT-4	✓	✓	✓	✓
EVT-2	✓	✓	✓	
Target Receptive	✓	✓	✓	
Target Expressive	✓	✓	✓	
Ongoing (Weekly)				
Yes/No assessment	★	★	★	★
Picture assessment	★	★	★	★
Post-Intervention				
PPVT-4	✓	✓	✓	
EVT-2	✓	✓	✓	
Target Receptive	✓	✓	✓	
Target Expressive	✓	✓	✓	

Note: ★ indicates data that were collected in the current study; ✓ indicates data that were collected through Project EVI and used in the current study.

Current study design. In the current study, Kindergarten teachers participating in Project EVI were trained to administer two target vocabulary assessments at the end of each weekly lesson: a Yes/No assessment (see Appendix A), and a Receptive Picture assessment (see Appendix B). The weekly vocabulary assessments are both embedded in the *Elements of Reading: Vocabulary* curriculum by Beck and McKeown (2004). Detailed information about these measures is provided in the Measures section. At the end of each week, students were instructed to complete the weekly vocabulary assessments independently, without help from teachers or peers. Kindergarten teachers read each item aloud to students in a whole-group setting, and monitored independent completion of each assessment. The degree to which students actually worked independently was examined using two data sources: classroom fidelity observations and teacher reports on a questionnaire.

Fidelity observations. Two research assistants received academic credit to conduct fidelity observations in participating classrooms during the administration of the weekly target vocabulary assessments. Observers were trained to use a checklist (see Appendix C) to record teacher and classroom behavioral observations during the administration of the target vocabulary assessments. A maximum of six points were possible for the observation of each target vocabulary measure (six representing a perfect score). The three observers completed fidelity observations for the first six classrooms together to establish inter-observer agreement. Inter-observer agreement was 94% (number of agreements divided by the total number of agreements and disagreements). The remaining fidelity observations were done independently by one of three observers.

Fidelity observations were completed in 16 of the 19 Kindergarten classrooms. The three classrooms that were not observed were excluded from analyses in the current study. Of the 16 classrooms observed, two were eliminated from further analyses due to low fidelity ratings (i.e., fidelity scores below six), leaving 14 Kindergarten classrooms with high fidelity observation ratings.

Teacher questionnaires. A teacher questionnaire was completed by 18 of the Kindergarten teachers at the end of the school year (see Appendices D and E). The questionnaire included teacher reports regarding the ease of administering the two target vocabulary assessments, perceived strengths and weaknesses of the assessments, and other information. One of the items asked teachers to report the degree to which students in their classrooms completed each target vocabulary assessment independently. Teachers provided a rating from 1-10, with 10 representing the highest level of independent work from students. Classrooms with ratings lower than six on this item were excluded from further analyses. Of the 18 teachers who completed the questionnaire, four teachers reported low levels of independent student work. Three of these classrooms had already been eliminated from analyses due to low observation fidelity levels. After eliminating classrooms with either low observation fidelity scores or low teacher ratings for independent work, 13 classrooms remained for further analyses.

Participants

The participants in the current study initially included teachers and students from 19 Kindergarten classrooms in Rhode Island and Connecticut. Participants were recruited from four elementary schools in Rhode Island and Connecticut through their participation in Project EVI. The initial number of Kindergarten student participants was 374 (M_{age}=5 years 5 months, age range: 4 years 8 month to 6 years 8 months). Through Project EVI, all of the initial 374 student participants were screened at the beginning of the academic year with the Peabody Picture Vocabulary Test-4 (Dunn & Dunn, 2007) to determine their initial level of risk for language and literacy outcomes. Using screening results, 127 of the 374 students were assigned to one of three groups: treatment (n=43), control (n=36), or reference (n=48). The remaining students (n=244) were not selected for follow-up testing for Project EVI, but were included in analyses for the current study.

In the current study, weekly vocabulary data from 13 Project EVI Kindergarten classrooms (250 students; 124 males and 127 females) was examined. Six of the original 19 kindergarten classrooms (from Project EVI) were eliminated from analyses in the current study after fidelity observation data and teacher questionnaire data were reviewed. Of the final 250 student participants in the current study, 86 students completed a battery of pre and post intervention assessments through Project EVI (Control=26, Treatment=30, Reference=30), with 164 remaining participants. The current study primarily focused on analyses with data from 86 participants assigned to Project EVI groups; however, weekly assessment data from the remaining 164 students was also examined. A summary of the process for selecting participants is provided in Figure 1.

Project EVI Participants	Current Study Participants
19 Classrooms	13 Classrooms
36 Control	26 Control
46 Treatment	30 Treatment
48 Reference	30 Reference
244 Remaining	164 Remaining
374 Total Participants	250 Total Participants

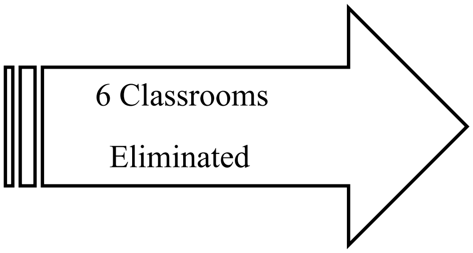


Figure 1. Summary of Project EVI Participants and Current Study Participants After Six Classrooms Were Eliminated From Analyses.

Participants in the current study were from four Title 1 elementary schools in Rhode Island and Connecticut. Table 6 presents demographic information regarding the student population in each of the four participating schools. School demographic information was obtained from the National Center for Education Statistics (2012).

Table 6

Demographic Information from Each of the Four Participating Schools

	School 1	School 2	School 3	School 4
Race/Ethnicity				
American Indian/Alaskan	0.18%	1.02%	1.08%	2.80%
Asian/Pacific Islander	6.42%	6.71%	2.69%	1.05%
Black	10.09%	19.72%	11.85%	27.62%
Hispanic	28.81%	23.98%	39.14%	29.72%
White	45.32%	45.33%	38.96%	25.52%
Two or More Races	9.17%	3.25%	6.28%	13.29%
Eligible for Free/Reduced Lunch				
Eligible	45.87%	50.00%	68.58%	87.76%

Demographic information was collected through Project EVI for the 86 participants in the Control, Treatment, and Reference groups. Of the participants in these three groups, 60.5% were female, 11.6% were English Language Learners, 4.7% were Asian, 18.6% were Black, 30.2% were Hispanic, 19.8% were Multi-racial, and 26.7% were White.

Measures

Peabody Picture Vocabulary Test-4 (Dunn & Dunn, 2007). All Kindergartener participants completed universal screening with the Peabody Picture Vocabulary Test-4 (PPVT-4). The PPVT-4 was used to screen and assign students to control, treatment, and reference groups for an early vocabulary intervention. The PPVT-4 is a standardized measure of receptive vocabulary knowledge. The test-retest reliability of the PPVT-4 is .77 (Dunn & Dunn, 2007). In Project EVI, students with standard scores between 75 and 92 were considered at risk for language and learning disabilities. At risk students were randomly assigned to either a treatment or control group. Students selected to be in the reference group had standard PPVT-4 scores between 95 and 105.

Weekly curriculum based vocabulary assessments from the *Elements of Reading: Vocabulary Curriculum* (Beck & McKeown, 2004). All student participants completed two brief target vocabulary assessments at the end of each week. The *Elements of Reading: Vocabulary* curriculum (Beck & McKeown, 2004) includes two target vocabulary assessments for each week of instruction. The target vocabulary assessments were administered to the whole class by the classroom teacher at the end of each lesson (typically on Fridays). Teachers were trained by the investigator to administer these assessments, and materials for student responses were provided to each teacher as part of the Project EVI study.

Each of the curriculum based vocabulary assessments contains five items, with one item for each of the five target vocabulary words taught each week. The format of the assessments and the administration of the assessments were standardized (consistent) from week to week, but the five target words that were assessed changed from week to week. For example, the weekly vocabulary assessments administered at the end of the first week (Lesson 1) measured student knowledge of the words *comforting, fleet, glimmer, expression,* and *lively.* At the end of the second week (Lesson 2), student knowledge of five new target words (*drenched, gorgeous, peculiar, linger,* and *vain*) were assessed. Data from the Yes/No and Receptive weekly assessments are intended to be used as indicators of student vocabulary knowledge at the end of each week. The current study examines the practical and predictive validity of these target vocabulary assessments.

Yes/No curriculum based vocabulary assessment. The first assessment is referred to in the current study as the Yes/No Curriculum Based Vocabulary Assessment (Yes/No assessment, see Appendix A). In this assessment, the teacher reads a yes or no question out loud to the class and students respond by circling "Yes" or "No" on their response probe. The yes/no format requires students to use word knowledge and comprehension of contextual clues to determine the correct response. There are five yes/no questions each week, one for each of the target words. For example, the question for the the target word *gorgeous* is, "Can a sunset be *gorgeous*?" (yes). For the target word *peculiar*, the question is, "Is it *peculiar* to see a giraffe in the zoo?" (no).

Receptive curriculum based vocabulary assessment. The other weekly assessment is referred to in the current study as the Receptive Curriculum Based Vocabulary Assessment (Receptive Picture assessment, see Appendix B). In this assessment, the teacher reads a question out loud and asks the students to mark the picture that best demonstrates the meaning of the word. For each question there are three possible choices (pictures) for the student to select. For example, one question asks, “Which picture shows something *peculiar*?” Students have a choice between a white duck standing, a white duck swimming, or a black and white striped duck swimming. This task is similar to the PPVT-4 receptive vocabulary task, except students mark their answers in their workbook instead of pointing to their answers. This allows the test to be administered to an entire classroom at once, rather than testing students individually. While the PPVT-4 measures general receptive vocabulary, this task refers to words specifically targeted in the classroom vocabulary instruction.

Expressive Vocabulary Test-2 (Williams, 2007). In the current study, the control group, treatment group, and reference group (N=86) completed the Expressive Vocabulary Test-2 (EVT-2) at the beginning of the year and again at the end of the year. The EVT-2 is a standardized assessment of expressive vocabulary. In this assessment, the student is shown a picture and asked to provide a one-word response to a stimulus question related to the picture. For example, a child is shown a picture of a dog and asked, “What do you see?” The test-retest reliability is .95 for the EVT-2 (Williams, 2007).

Target Word Expressive Vocabulary Test (Project EVI experimenter developed). In the current study, the control group, treatment group, and reference group (N=86) completed the Expressive Measure of Target Word Definitions. This measure was developed by the researchers of Project EVI. The Expressive Measure of Target Word Definitions is administered to students individually, and measures students' expressive knowledge of target word definitions (i.e., words taught in the *Elements of Reading: Vocabulary* program). In the assessment, students are asked, "What does ____ mean?" for a sample of words taught throughout the year. Responses are scored as incorrect (0), partially correct (1) or completely correct (2).

Target Word Receptive Vocabulary Test (Project EVI experimenter developed). In the current study, the control group, treatment group, and reference group (N=86) completed a Target Word Receptive Vocabulary Test. This measure was developed by the researchers of Project EVI. It is administered to students individually, and measures students' receptive knowledge of target words (i.e., words taught in the *Elements of Reading: Vocabulary* program). In the assessment, students are told a target word, and asked to select one of four pictures that best correspond with the target word. Students are instructed, "Point to the picture that shows ____". Responses are scored as incorrect (0) or correct (1).

Teacher Questionnaire. A Teacher Questionnaire (see Appendices D and E) was developed in the current study to collect information about the weekly Yes/No and Receptive Picture assessments. The questionnaire was completed by all participating classroom teachers at the end of the study. The purpose of the questionnaire was to learn about teachers' attitudes towards the assessments and recommendations related to using the weekly assessments.

Procedure

Classroom teachers were trained to administer the weekly Yes/No and Receptive Picture assessments during a teacher training in early October. Through Project EVI, Kindergarten teachers and interventionists were trained to implement

Tier I and Tier II instruction. Materials for Tier I instruction were purchased and provided by the Project EVI research team, and materials for Tier II instruction were created and provided by the Project EVI research team.

In the current study, several steps were taken to promote high fidelity during the administration of the weekly target vocabulary assessments. One copy of the weekly Yes/No assessment is included in the *Elements of Reading: Vocabulary* curriculum. To facilitate efficient and organized teacher administration, the Yes/No assessment response booklets were created for each initial participant (N=374), and sorted into containers for each teacher/classroom. Each student's Yes/No assessment response booklet contained a cover page indicating the student and teacher's names. Each booklet contained yes/no response pages for each of the 24 weeks of instruction (see Appendix A for a sample page). The Yes/No response pages were almost identical to the version provided in the *Elements or Reading: Vocabulary* curriculum. In the current study, lesson numbers were added to the bottom of each week's Yes/No assessment. A unique picture was included at the bottom of each page, next to the lesson number. This was done to ensure that students responded on the correct probe, assuming that some students might have difficulty locating page numbers alone.

Teachers were trained to instruct students to turn to the correct page in the Yes/No response booklet by referring to the lesson number and a description of the picture at the bottom of the probe (e.g., "Turn to Lesson 7 with picture of a squirrel at the bottom of the page"). The Receptive Picture assessments were included in the *Elements of Reading: Vocabulary* student workbooks. Each student had a workbook with his or her name written on the cover. Given that the participants were in

Kindergarten, teachers were trained to take steps to ensure that students were responding on the correct page, and also to ensure that students were responding independently.

Teacher feedback midway through the study indicated that some students had difficulty circling their intended responses on the Yes/No assessment. For example, some students circled both "Yes" and "No" as a response for the same item. The original version of the response probe did not include lines separating each item, which seemed to create visual-spatial confusion for some students. For this reason, revised Yes/No assessment booklets with lines separating each item were delivered to classroom teachers beginning on Lesson 11. Response booklets for Lessons 1-10 were stored in the classroom for teachers to access until the end of the study.

Two research assistants were trained to conduct fidelity observations of classrooms during target word measure administration (see Appendix C for observation criteria). Observations were conducted with sixteen Project EVI classrooms. The remaining three Project EVI classrooms were not observed due to limited time, and were removed from further analyses in the current study. Fidelity observations and teacher ratings were taken into consideration when selecting classroom data for analysis. Six of the 19 Project EVI classrooms were eliminated from analysis in the current study due to low fidelity levels, no fidelity observation, or teacher reports of low fidelity (i.e., students were not completing the measures independently).

After all of the classrooms completed the final vocabulary lesson of the year, weekly target word data were collected from the original 19 classrooms. Each Project

EVI teacher received a questionnaire regarding his or her experience administering the weekly target word measures. Teachers were asked to complete the questionnaires honestly, and were given two weeks to complete them. The Yes/No responses booklets and Receptive workbooks were collected from all students (N=374) and stored in a secure location until data entry.

Data from the weekly curriculum based vocabulary assessments were entered into a Microsoft Excel spreadsheet. Over 90,000 data points were entered in total for the current study, in addition to over 2,000 data points that were obtained from Project EVI testing. Three research assistants received academic credit for aiding in data entry for the current project. For the weekly Yes/No assessment, the research assistants were trained to enter student responses for each item into a spreadsheet. Student responses on each item were coded in the following manner: “Y” for a clear response of “Yes”, “N” for a clear response of “No”, “Both” if both yes and no were circled or marked, “No Answer” if the item was left blank, “Unclear” if the response was ambiguous, and “Absent” if all five items were left blank. For the weekly Receptive Picture assessment, research assistants were trained to code student responses on each item in the following manner: “A”, “B”, or “C” for a clear response to one of the three multiple choice options, “Multiple” if more than one option was circled or marked, “No Answer” if the item was left blank, “Unclear” if the response was not clear, and “Absent” if all five items were left blank. Items that were coded as “Unclear” were reviewed by the primary investigator, and a decision was made regarding the correct coding.

After all raw data were entered into a spreadsheet formulas were created in Excel to automatically score student responses. Automated scoring was done to minimize the human error in scoring. Unique formulas were created to score each item of the Yes/No assessment (120 items) and each item of the Receptive Picture assessment (120 items). For each item, the formula coded a score of "1" for a correct response, and "0" for an incorrect response. Missing data ("Absent", "Both", "Unclear", or "No Answer" responses) were coded as "missing". If any items were "missing" in a given week, the student's score for that week was eliminated from analyses. This was done to prevent artificial deflation of scores for students with missing data. For example, rather than scoring a missing response as "0", the entire test was considered invalid for interpretation, and the student's score for the week was coded as "missing".

The conservative approach taken to address missing data from absences and ambiguity of item responses resulted in a relatively high incidence of missing data. After student absences and unclear responses to items were considered, 18% of weekly data was coded as "missing" for the Yes/No assessment (1078 missing out of 6000). For the Receptive Picture assessment, 16% of weekly data was coded as "missing" (965 missing out of 6000). An individual student's score for each weekly assessment was coded as "missing" or invalid for interpretation if one or more of the five items contained a missing score due to ambiguity of item responses or absences.

CHAPTER 3

RESULTS

After the data entry and coding process was complete, the Microsoft Excel spreadsheet was uploaded into the statistical analysis program SPSS Version 20. Descriptive statistics, graphs, and inferential statistics were examined to assess the utility of the weekly Yes/No and Receptive picture assessments. In all inferential analyses, missing data were excluded pairwise. In other words, a participant's score was excluded from a given analysis only if the data required for the specific analysis was missing. If the same participant had the necessary data to be included in other analyses, those results were included.

The Yes/No and Receptive Picture assessment each consist of five items per week, consistent with the target vocabulary words taught on a given week. Therefore, the lowest score possible for each measure was a score of "0" and the highest score possible for each measure was a "5". Given that the assessments were administered weekly over the course of 24 weeks, many options were possible for data analysis. For example, scores could be examined separately for individual weeks, or scores could be averaged across a number of weeks, among many other options.

In the current study, weekly vocabulary data were analyzed using two methods. First, data were examined separately for each of the 24 weeks. In other words, Yes/No and Receptive scores from Week 1, Week 2, Week 3, etc. were examined independently. Next, participants' scores for each week were averaged with scores from previous weeks (e.g., Weeks 1-2 averaged, Weeks 1-3 averaged, Weeks 1-4 averaged, etc.). An example of each approach to analyzing weekly data is presented in Table 7. The use of incrementally averaged scores allows for a quick and simple method of examining student performance over multiple weeks, and for using the most recent averaged score as an indicator of student risk level. It was reasoned that including multiple weeks of data should increase the accuracy of decisions regarding student level of risk. The incremental averaging method was also used to examine the earliest point in time at which averaged scores accurately predicted end-of-year outcomes. Averaging the scores incrementally over time allows decision makers to take multiple weeks of data into consideration.

Table 7

Example of Weekly Scores vs. Incrementally Averaged Scores

Weekly Scores Example						
	Week1	Week 2	Week 3	Week 4	Week 5	Week 6
Participant A	3	2	3	4	3	2
Incrementally Averaged Scores Example						
	Week 1-2	Week 1-3	Week 1-4	Week 1-5	Week 1-6	
Participant A	2.5	2.67	3	3	2.83	

Prior to conducting inferential data analyses, the assumption of normality was examined separately for each of the 24 weeks, for the Yes/No assessment and for the Receptive Picture assessment. Means, standard deviations, skewness, and kurtosis were examined separately for Week 1, Week 2, Week 3, and so on for each of the weekly measures. Next, the assumption of normality was examined for incrementally averaged sets of data (Weeks 1-2, Weeks 1-3, Weeks 1-4, etc.). The assumption for normality was examined for the total sample (N=250), and again for the Project EVI sub-sample (N=86).

Assumption of Normality for Weekly Scores

The normality of distributions was first examined for the entire sample (N=250). The assumption of normality was examined for independent Yes/No weekly scores. The distribution of scores varied from week to week, and ranged from -2.29 to -.01. The majority of distributions were negatively skewed but greater than -1.00 on the Yes/No assessment (i.e., the skewness was closer to zero than -1.00). Figure 2 shows sample histograms from Lessons 3, 9, 13 and 17 of the Yes/No data. The assumption of normality was not met for the Yes/No assessments when scores were examined for individual weeks (Kolmogorov-Smirnov=.00 for each week) for the total sample (N=250).

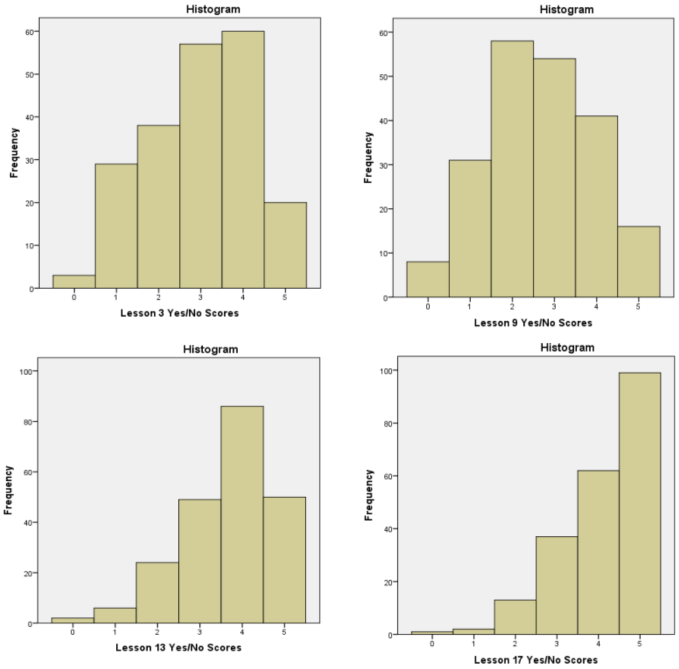


Figure 2. Sample Distributions of Yes/No Scores on Individual Weeks.

Examining weekly Receptive Picture assessment distributions for the total sample (N=250), the assumption of normality was not met (Kolmogorov-Smirnov=.00 for each week). The distribution of scores was negatively skewed each week, to a greater extent than the Yes/No assessment distributions. The skewness of Receptive Picture assessment distributions ranged from -3.85 to -1.02. The majority of weekly Receptive Picture assessment distributions had skewness between -1.00 and -3.00. Figure 3 shows sample histograms from Lessons 3, 9, 13 and 17 of the Receptive data.

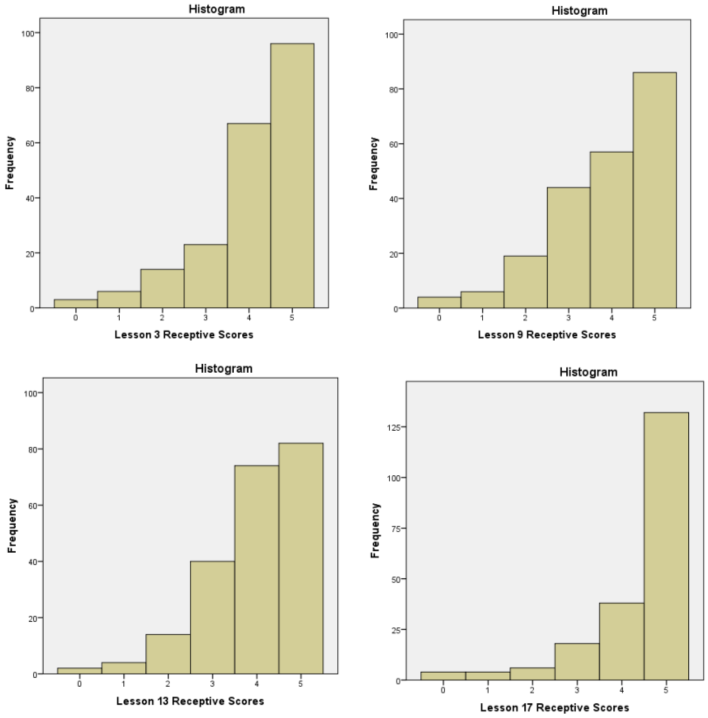


Figure 3. Sample Distributions of Receptive Scores on Individual Weeks.

The skewness of the Yes/No and Receptive distributions and violations of normality were somewhat expected, given that the total sample (N=250) included a majority of participants who scored at or above “Average” on the screener (78% scored above 92 on the PPVT-4). Next, the normality of distributions was examined for the sub-sample of Project EVI participants in the treatment, control or reference groups (N=86). It was expected that these distributions would be closer to normal, given that only 34% of participants (the reference group) scored in the "Average" range on the PPVT-4 screener.

Assumption of normality for the sub-sample (N=86). The assumption of normality was examined for the Yes/No scores each week, in the sub-sample of 86 participants in the Project EVI control, treatment or reference groups. The distribution of scores varied from week to week. The skewness of distributions ranged from -1.23 to .20. The majority of distributions were negatively skewed but greater than -.80 on the Yes/No assessment for the sub-sample (i.e., the skewness of distributions was closer to zero than -.80). As expected, the distribution of scores for the sub-sample of treatment, control and reference participants was more normal than the distribution of the total sample. However, the assumption of normality was not met for the Yes/No assessments when scores were examined for individual weeks (Kolmogorov-Smirnov=.00 for each week) for the sub-sample (N=86).

Next, the assumption of normality was examined for the sub-sample (N=86) distributions of Receptive scores each week. The distribution of scores varied from week to week. The skewness of distributions ranged from -2.87 to -.69 on the Receptive Picture assessment. The majority of distributions were negatively skewed but greater than -2.00 on the Receptive Picture assessments (i.e., the skewness of distributions was closer to zero than -2.00). The assumption of normality was not met for the Receptive Picture assessments when scores were examined for individual weeks (Kolmogorov-Smirnov=.00 for each week) for the sub-sample (N=86).

Assumption of Normality for Incrementally Averaged Scores

The normality assumption for incrementally averaged sets of data from the Yes/No and Receptive Picture assessments was examined for the entire sample (N=250). The skewness of distributions ranged from -1.09 to -.48. The majority of distributions were negatively skewed but greater than -1.00 (i.e., the skewness of distributions was closer to zero than -1.00). The assumption of normality was not met for the Yes/No assessments when incrementally averaged weekly scores were examined (Kolmogorov-Smirnov=.00 for each week) for the total sample (N=250). Similarly, the assumption of normality was not met for the Receptive Picture assessments when incrementally averaged weekly scores were examined (Kolmogorov-Smirnov=.00 for each week) for the total sample (N=250).

Next, normality of incrementally averaged distributions was examined for the sub-sample (N=86). The distribution of scores varied from week to week. The skewness of distributions ranged from -1.20 to .17. From Lesson 6 on, the majority of distributions' skewness values fell between -.10 and .17, indicating more normal distributions. Figure 4 shows sample histograms from Lessons 6, 9, 12 and 18 of the Yes/No incrementally averaged data. The assumption of normality was met for Weeks 1-6, Weeks 1-7, Weeks 1-8, Weeks 1-9, Weeks 1-10, and Weeks 1-11, and Weeks 1-12 (Kolmogorov-Smirnov>.05). The assumption of normality was not met for the remaining incrementally averaged weeks (Kolmogorov-Smirnov<.05).

Finally, the normality of incrementally averaged Receptive Picture assessment distributions was examined. The assumption of normality was not met for any of the incrementally averaged Receptive Picture assessments (Kolmogorov-Smirnov=.00 for each week). The distribution was negatively skewed, with most participants achieving high scores on the incrementally averaged weekly Receptive Picture assessments.

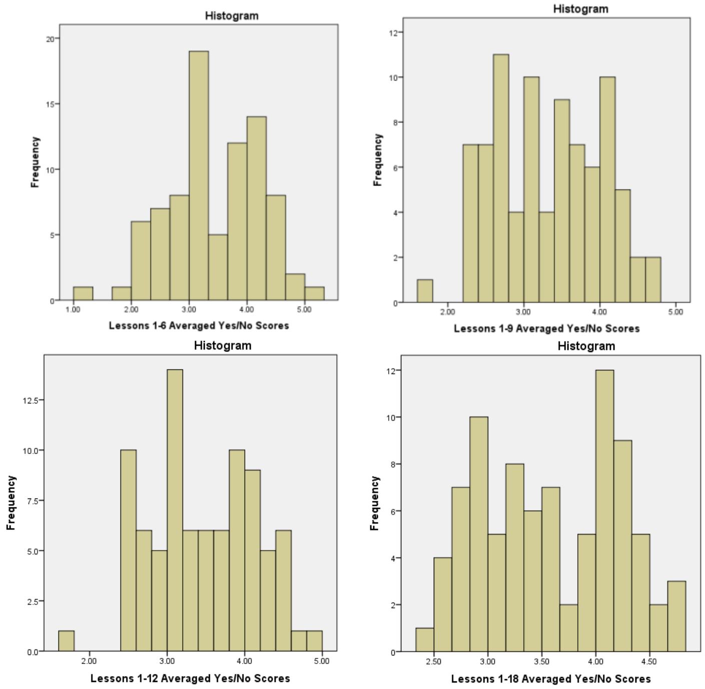


Figure 4. Sample Distributions of Incrementally Averaged Yes/No Data.

Stability of Yes/No and Receptive Picture Scores from Week to Week

To assess the stability of scores on the Yes/No and Receptive Picture assessments from week to week, means and standard deviations were calculated on individual weeks for the entire sample (N=250). The mean score on the Yes/No assessment ranged from 2.66 (Lesson 9, SD=1.27) to 4.56 (Lesson 19, SD=0.84). The mean score on the Receptive Picture assessment ranged from 3.86 (Lesson 9, SD=1.27) to 4.74 (Lesson 19, SD=0.73). In Figure 5, mean scores for the Yes/No assessment and Receptive Picture assessment are displayed. As shown in the figure, mean scores varied across weeks on both the Yes/No and Receptive Picture assessments. However, as shown in Figure 5 the trajectories for mean scores on the

Yes/No and Receptive weekly measures were similar. It is helpful to compare the trajectories between two measures that assessed the same target words, because it can provide information regarding the cause of the variability. Given that the trajectories are similar, it is likely that the source of variability of mean scores across weeks is related to the difficulty of the target words assessed on a given week. For example with both measures, participants performed the lowest on Lesson 9 (target words *discouraged, hesitate, desire, respect,* and *extraordinary*). Similarly, on both measures the highest mean score was for Lesson 19 (target words *slime, hatch, haven, slither,* and *eager*).

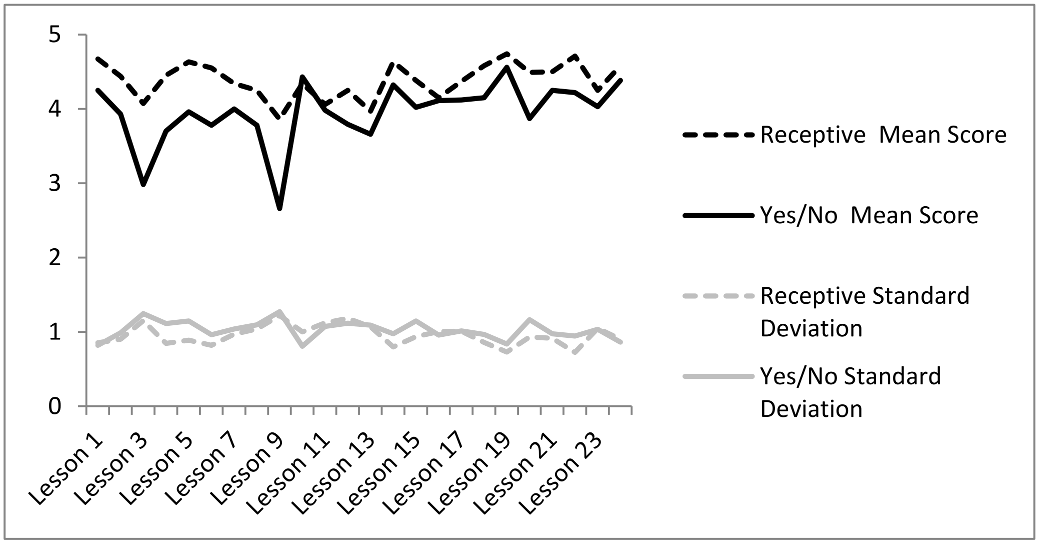


Figure 5. Weekly Mean Scores and Standard Deviations for the Yes/No Assessment (Solid Line) and Receptive Picture assessment (Dashed Line).

To provide a more accurate (or typical) representation of individual student data, sample Weekly Yes/No scores are presented in Figure 6, with graphs from sample Control, Treatment, and Reference students. These graphs are displayed to provide a visual of data for individual students. Reviewing such graphs could provide important information regarding instructional decision-making.

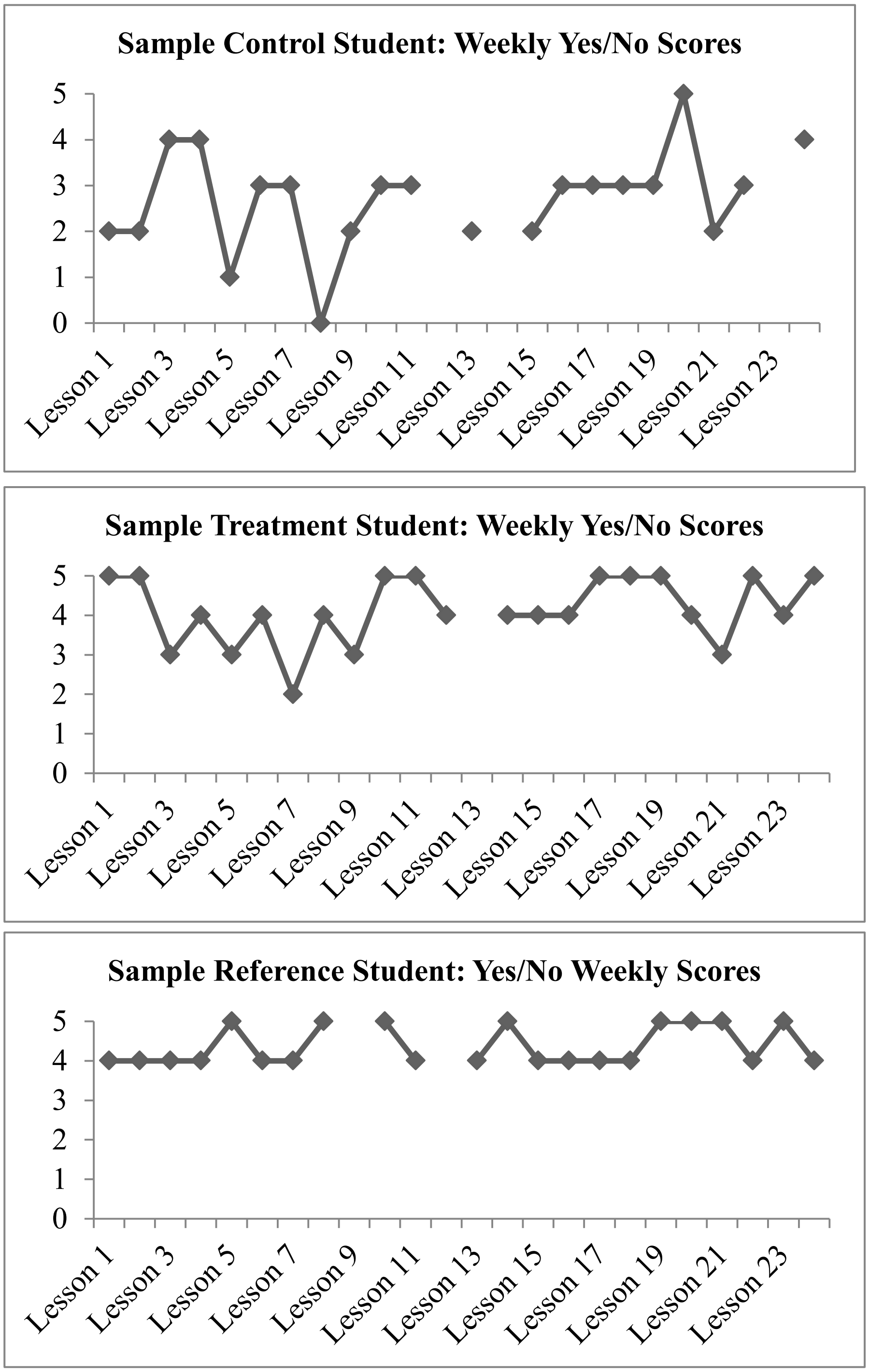


Figure 6. Weekly Scores on the Yes/No Assessment from a Control, Treatment, and Reference Students.

For example, the sample Control student's graph in Figure 6 indicates that he or she may have struggled to learn some of words that were taught during Lessons 1 and 2. The information provided in the graph could prompt a teacher to provide additional instruction and support to the student to bolster his or her understanding of the target words. Additionally, teachers can use individualized graphs to make decisions about the effectiveness of instruction for individual students, by examining overall patterns of achievement over time.

Next, Pearson product-moment correlation analyses were conducted to compare Yes/No scores across weeks. The purpose of these analyses was to examine the relative standings of participant scores from week to week. Pearson product-moment correlation coefficients were examined between all of the weeks for each measure. On the Yes/No assessment, 99.95% of the pairs of weekly scores were positively correlated (261 out of 276). The Pearson product-moment correlations ranged from r=.17 to r=.58, indicating small to large correlations between Yes/No weekly measures. Of the 15 pairs of Yes/No assessments that were not correlated, seven were associated with Lesson 9 scores.

Pearson product-moment correlation analyses were also conducted to compare Receptive scores across weeks. Correlation coefficients were again examined between weeks on the Receptive Picture assessment, and 100% of the pairs of weekly scores were positively correlated. The Pearson product-moment correlations ranged from r=.22 to r=.70, with the majority of pairs having large, positive correlations (r>.50).

Descriptive Information for Each Group

Descriptive information was examined for each of the groups (Control, Treatment, Reference, and Remaining) on each of the pre-intervention and post-intervention measures (PPVT-4, EVT-2, Target Expressive, and Target Receptive Picture assessments). As indicated in Table 8, the Remaining group (students who were not followed for the purposes of Project EVI but participated in the current study) obtained the highest scores on the PPVT-4 pre-intervention, but did not complete other pre-intervention or post-intervention measures. As expected, the Reference group (typically achieving students) obtained the highest average scores on most of the pre-intervention and post-intervention measures. However, the Treatment group (at risk students who received Tier II supports) obtained the highest scores on the two target word post-intervention measures.

Descriptive data were also examined regarding the average Yes/No and Receptive scores (from weeks 1-24), for each group. As predicted, the control group's weekly Yes/No and Receptive scores were the lowest (Yes/No *M*=3.29; Receptive *M*=4.05). The Treatment group scored higher than the Control group (Yes/No *M*=3.67; Receptive *M*=4.30). The Reference group scored higher than the treatment group (Yes/No *M*=4.02; Receptive *M*=4.46). The Remaining group scored highest on the averaged weekly assessments (Yes/No *M*=4.02; Receptive *M*=4.48), and similarly to the reference group. Table 8 provides a summary of mean group scores on each of the pretest, posttest, and averaged weekly vocabulary assessments.

Table 8

Summary of Descriptive Results for Each Group

	Control (n=26)		Treatment (n=30)		Reference (n=30)		Remaining (n=164)	
Test	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*
Pretest PPVT	86.00	(4.08)	85.80	(5.67)	101.30	(2.48)	110.66	(12.94)
Pretest EVT	88.38	(6.86)	91.47	(7.92)	99.72	(8.05)	- - - -	- - - -
Yes/No Average	3.29	(0.52)	3.67	(0.60)	4.02	(0.56)	4.02	(0.62)
Receptive Average	4.05	(0.82)	4.30	(0.67)	4.46	(0.51)	4.48	(0.48)
Posttest PPVT	89.96	(8.84)	95.21	(7.99)	104.39	(9.93)	- - - -	- - - -
Posttest EVT	91.12	(8.09)	97.17	(7.53)	103.83	(9.50)	- - - -	- - - -
Posttest Receptive	10.39	(4.05)	14.57	(2.47)	13.70	(3.03)	- - - -	- - - -
Posttest Expressive	10.73	(10.79)	22.90	(11.21)	20.17	(9.64)	- - - -	- - - -

Note: Yes/No and Receptive Picture average scores represent the mean score from all (24) weeks.

Inferential Findings

Next, inferential statistics were calculated to examine the following:

1. *Correlations between Predictor Measures and Outcome Measures.* Pearson product momentary correlation coefficients were calculated to examine the correlation between the Yes/No and Receptive Picture assessments and end-of-year vocabulary outcomes. Additionally, the correlation between two pre-intervention vocabulary measures (PPVT-4 and EVT-2) and end-of-year vocabulary outcomes was explored, as a comparison.
2. *Between-Group Differences on the Weekly Vocabulary Assessments.* Mann-Whitney *U* Tests were conducted to examine whether the weekly vocabulary assessments differentiate between at-risk students who receive Tier II interventions (Project EVI treatment group), at risk students who do not receive Tier II interventions (Project EVI control group), and typically achieving students who do not receive Tier II interventions (Project EVI reference group). Additional analyses examined treatment and control group differences on Tier I words and Tier II. It was expected that the treatment group's performance would be higher than the control group's performance for Tier II words; however, group differences were not expected for Tier I words.
3. *Classification Accuracy of the Weekly Vocabulary Assessments.* Sensitivity, specificity, positive predictive power, and negative predictive power were examined for the weekly vocabulary assessments (Yes/No and Receptive Picture assessments) and general vocabulary measures (PPVT-4 and EVT-2), using target vocabulary and general vocabulary outcome measures. Receiver

Operating Characteristic Curves (ROC Curves) were generated to examine levels of sensitivity and specificity with various predictor cut-scores. These analyses were conducted to closely examine the utility of the weekly vocabulary assessments in correctly classifying students at risk for poor vocabulary outcomes (sensitivity), and correctly classifying students not at risk for poor vocabulary outcomes (specificity).

4. *Social validity of the Weekly Vocabulary Assessments.* Results from teacher questionnaires are reported, providing teacher feedback regarding the use of the weekly vocabulary assessments. A summary of teacher ratings regarding the social validity of the weekly vocabulary assessments is provided, along with qualitative feedback.

Correlations between Weekly Vocabulary Assessments and Outcomes

Pearson product-moment correlation coefficients were calculated to examine the relationship between scores on the incrementally averaged weekly measures and post-intervention outcome scores on the Target Receptive, Target Expressive, PPVT-4 and EVT-2 measures. The analyses were only conducted with the Project EVI sub-group (N=86), given that outcome data were not available for the “remaining” group.

As indicated in Table 9, there were medium to large, positive correlations between Yes/No incrementally averaged scores each week and each outcome measure, with higher Yes/No scores associated with higher scores on outcome measures. The incrementally averaged weekly Receptive Picture assessments did not correlate significantly with any of the outcome measures. This finding is somewhat expected, given the ceiling effect that was found in the distribution of the weekly Receptive

Picture assessments, with most participants demonstrating high scores. The correlation between the pre-intervention measures (PPVT-4 and EVT-2) and the post-intervention outcome measures was positive, and ranged from medium to large (see Table 9).

Table 9

Correlations Between Pretest Measures, Weekly Assessments, and Posttest Measures.

	Posttest Outcome Measures			
	Target Receptive	Target Expressive	Post PPVT-4	Post EVT-2
Pre-Intervention Measures				
PPVT-4	.32**	.30**	.62**	.55**
EVT-2	.32**	.40**	.60**	.70**
Yes/No Weekly Assessment				
Total Lesson 1	.45**	.33**	.36**	.36**
Mean Lessons 1-4	.36**	.36**	.25*	.28**
Mean Lessons 1-8	.38**	.40**	.32**	.32**
Mean Lessons 1-12	.53**	.56**	.55**	.30**
Mean Lessons 1-16	.58**	.62**	.52**	.44**
Mean Lessons 1-20	.61**	.65**	.55**	.51**
Mean Lessons 1-24	.61**	.65**	.55**	.50**
Receptive Picture Weekly Assessment				
Total Lesson 1	-.21	-.12	-.10	.02
Mean Lessons 1-4	-.06	-.03	-.07	.01
Mean Lessons 1-8	-.04	.17	.13	.15
Mean Lessons 1-12	-.17	.17	.10	.14
Mean Lessons 1-16	.17	.18	.09	.15
Mean Lessons 1-20	.17	.19	.11	.16
Mean Lessons 1-24	.12	.15	.07	.11

Note: The Pearson correlation coefficients can be interpreted using Cohen's (1988) guidelines (r=.10 to .29 is small; r=.30 to .49 is medium; .50 to 1.0 is large).

** indicates that correlation is significant at the .01 level (2-tailed).

Between-Group Differences in the Weekly Vocabulary Assessments

Group differences on the Yes/No assessment were explored by conducting Mann-Whitney *U* Tests. The Mann-Whitney *U* Test is a non-parametric method of analyzing between-group variance. This method was used given that not all of the distributions of incrementally averaged data conformed to the assumption of normality. The Mann-Whitney U test was conducted to examine differences in Yes/No incrementally averaged scores between the treatment and control groups. It was expected that the treatment group scores would be significantly higher than the control group scores on the Yes/No assessment. This finding was expected given that the treatment group received supplementary (Tier II) instruction throughout the year that the control group did not receive. Group differences were explored separately for each incrementally averaged week (e.g., Weeks 1-2, Weeks 1-3, Weeks 1-4, etc.). This approach allowed the researcher to explore the earliest point in time at which group differences emerge between the treatment, control, and reference groups.

First, differences were explored between the treatment and control group performance on the Yes/No assessment. The treatment group scores were higher than the control group scores on each incrementally averaged week. A series of Mann-Whitney *U* tests revealed that from Weeks 9 to 24, there were significant group differences in scores on the Yes/No incrementally averaged measure between the treatment group and the control groups (p<.03), with small to medium effect sizes (see Table 10).

Table 10

Mann-Whitney U Test Results for Incrementally Averaged Yes/No assessments

	Treatment > Control		Reference > Control		Reference > Treatment	
	p	*r*	*p*	*r*	*p*	*r*
Lessons 1-2	.23	.13	.01*	.28	.06	.20
Lessons 1-4	.14	.16	.00*	.34	.02*	.25
Lessons 1-6	.05*	.21	.00*	.38	.01*	.29
Lessons 1-8	.14	.16	.00*	.36	.01*	.27
Lessons 1-10	.04*	.22	.00*	.36	.09	.18
Lessons 1-12	.02*	.26	.00*	.40	.03*	.24
Lessons 1-14	.02*	.26	.00*	.43	.02*	.25
Lessons 1-16	.01*	.26	.00*	.44	.03*	.24
Lessons 1-18	.01*	.28	.00*	.45	.03*	.24
Lessons 1-20	.02*	.26	.00*	.45	.03*	.25
Lessons 1-22	.02*	.25	.00*	.43	.02*	.24
Lessons 1-24	.02*	.25	.00*	.44	.02*	.25

Note: * Indicates significant at the $p<0.05$ level. Using Cohen's (1988) criteria for effect size *r*, .1= small effect, .3= medium effect, .5=large effect.

Next, differences between the reference and control group scores on the Yes/No assessment were explored. The reference group scores were higher than the control group scores on each incrementally averaged week. Mann-Whitney *U* tests were conducted and effect sizes were calculated to determine the magnitude of the group differences. It was expected that the reference group scores would be significantly higher than the control group. A series of Mann-Whitney *U* tests revealed that from Weeks 4 to 24, there were significant group differences in scores on the

Yes/No incrementally averaged measure between the reference group and the control group (p=.00), with medium effect sizes (see Table 10).

Group differences were also examined between the treatment and reference groups. The reference group scores were higher than the treatment group scores on each incrementally averaged week. Mann-Whitney *U* tests were conducted and effect sizes were calculated to determine the magnitude of the group differences. It was expected that the reference group scores would be significantly higher than the treatment group. A series of Mann-Whitney *U* tests revealed significant differences between the reference and treatment group scores on incrementally averaged Yes/No scores for the majority of weeks (p<.05), with small to medium effect sizes. No significant group differences were found between the treatment and reference group incrementally averaged scores on Week 2 and Week 10 (p>.05).

In summary, the Yes/No assessment captured statistically significant differences in scores between the treatment, control, and reference groups in Project EVI, with small to medium effect sizes. As expected, the Yes/No incrementally averaged scores were higher for the treatment group compared to the control group. However, statistically significant group differences did not emerge until Week 6 of instruction. Statistically significant differences were seen between the treatment and reference group by Week 4 (*p*<.02, *r*=.25), and statistically significant differences were found between the control and reference groups by Week 2 (*p*<.01, *r*=.28). These findings provide support for the utility of the Yes/No assessment in measuring varying levels of target word knowledge.

Given that the treatment group received additional instruction for the Tier II words, it was expected that the treatment group would demonstrate higher performance for Tier II words. A Mann-Whitney *U* test revealed that the treatment group's performance on the Yes/No Tier II words (*Md*=2.16, n=30) was significantly greater than the control group's performance (*Md*=2.00, n=26), *U*=265.50, *z*=-2.05, *p*=.04. The effect size was small to medium (*r*=.27). This finding indicates that, as expected, the Yes/No assessment distinguished between the treatment group and control group on Tier II word learning.

Next, the same analysis was done to compare the treatment and control group performances on Tier I words. A Mann-Whitney *U* test revealed that the treatment group's performance on the Yes/No Tier I words (*Md*=1.54, n=30) was significantly greater than the control group's performance (*Md*=1.28, n=26), *U*=238.00, *z*=-2.50, *p*=.01. The effect size was medium (*r*=.33). This finding indicates that the Yes/No assessment distinguished between the treatment group and the control group on Tier I word learning. Interestingly, the treatment group's performance was higher than the control group for Tier I words, despite the fact that the two groups received the same instruction for Tier I words throughout the study.

A series of Mann-Whitney *U* tests were also conducted to examine Receptive Picture assessment group differences between the treatment and control group on Tier I and II words. Results indicated that there were no significant differences in Tier II Receptive scores between the treatment group and the control group, *U*=313.50, *z*=-1.26, *p*=.21. Similarly, there were no significant differences in Tier I Receptive scores between the treatment and control group, *U*=339.50, *z*=-.83, *p*=.41. This finding provides more evidence that the Receptive Picture assessment did not distinguish between varying levels of target word knowledge. As indicated in preliminary findings, the Receptive Picture assessment had a ceiling effect (most participants earning high scores), which limits the utility of the measure for accurately gauging word learning. However, the results provide initial evidence that the Yes/No assessment did differentiate between varying levels of word knowledge.

Classification Accuracy of the Weekly Vocabulary Assessments

Analyses were conducted to examine the sensitivity (SE), specificity (SP), positive predictive power (PPP), and negative predictive power (NPP) of the weekly Yes/No assessment, pre-intervention PPVT-4 , and pre-intervention EVT-2. The Receptive weekly measure was eliminated from further analyses given that previous analyses indicated a ceiling effect. The formulas used for identifying classification accuracy for the Yes/No assessment, PPVT-4, and EVT-2 are presented in Figure 7.

	Positive on Outcome (Failed)	Negative on Outcome (Passed)
Positive Predictor (Predicts a Fail)	True Positives (TP)	False Positives (FP)
Negative Predictor (Predicts a Pass)	False Negatives (FN)	True Negatives (TN)
Sensitivity = TP/(TP + FN) Specificity = TN/(TN + FP) Positive Predictive Power= TP/(TP+FP) Negative Predictive Power= TN/(TN+FN) Base Rate= (TP+FN)/(TP+FP+FN+TN)		

Figure 7. A 2 x 2 Table of Predictors and Posttest Outcomes and Formulas Used to Examine Classification Accuracy.

To calculate classification accuracy results, multiple pass/fail cut-scores were selected for each of the predictor measures (the Yes/No weekly measure, the pre-intervention PPVT-4, and the pre-intervention EVT-2). Cut-scores were also selected to dichotomize "passing" and "failing" for each of the target word outcome measures (post-intervention Target Receptive and post-intervention Target Expressive).

Multiple cut-scores were examined for each of the predictor measures (Yes/No assessment, Pretest PPVT-4 and Posttest EVT-2). For the Yes/No incrementally averaged measures, the cut-scores examined were scores below 3.25, 3.50, and 3.75 (see Table 11). The goal in examining classification accuracy using multiple pass/fail cut-scores was to find the most appropriate cut-scores to maximize sensitivity and specificity. For example, setting a very high pass/fail predictor cut-score would likely result in high levels of sensitivity, but low levels of specificity. Setting a very low pass/fail predictor cut-core would likely result in high levels of specificity but low levels of sensitivity. Conducting multiple classification analyses using a range of cut-scores aided decision-making regarding the most appropriate cut-score for predictor measures.

The cut-scores for post-intervention Receptive Target and post-intervention Expressive Target measures were determined by examining base rates of "failing" participants using various cut-scores. Cut-scores on the Target Expressive and Receptive Picture assessments that categorized the lowest 30% of scores in the sample as "failing" were used for the classification analyses. Participants scoring below the 30th percentile on the Target Receptive Picture assessment achieved scores under 12; therefore, 12 was used as the pass/fail cut-score for the classification analyses.

Similarly, participants scoring below the 30^{th} percentile on the Target Expressive measure achieved scores under 10; therefore, 10 was used as the pass/fail cut-score for the classification analyses.

Using the formulas presented in Figure 6, the sensitivity (SE), specificity (SP), positive predictive power (PPP), and negative predictive power (NPP), the weekly Yes/No assessment, pre-intervention PPVT-4 , and pre-intervention EVT-2 were calculated for each of the target word outcome measures. Table 11 presents the classification accuracy of Yes/No incrementally averaged data sets, using the post-intervention Target Receptive outcome measure. Table 12 presents classification accuracy results for the pre-intervention PPVT-4 and EVT-2, also using the post-intervention Target Receptive outcome measure. The purpose of conducting these analyses was to examine the predictive validity of the Yes/No incrementally averaged measure in comparison to other methods (the PPVT-4 and the EVT-2).

As shown in Table 11, the Yes/No incrementally averaged data sets provided adequate levels of sensitivity and specificity on a number of occasions. For example, setting the Yes/No predictor cut-score at 3.25, the Yes/No incrementally averaged measure showed a sensitivity of .83 and a specificity of .71 (Kappa=.46) as early as Week 4 of instruction. In other words, of the participants who achieved low scores on the Target Receptive outcome measure (24 out of 86 participants, or 27.9% of the sample), 83% (20 out of 24 participants) were identified as at-risk by the Yes/No incrementally averaged data at Week 4. Similarly, of the participants who achieved high scores on the Target Receptive outcome measure (62 out of 86 participants, or 72.1% of the sample), 71% (44 out of 62 participants) were identified as *not* being at-risk using the Yes/No incrementally averaged data at Week 4. In Table 11, incrementally averaged Yes/No data sets with adequate classification accuracy are highlighted in bold font.

In Table 12, classification accuracy data is displayed for the pre-intervention PPVT-4 and EVT-2 data. Again, the outcome measure used was the post-intervention Target Receptive Picture assessment with a “failing” base rate of 27.9%. A cut-score of 90 yielded the highest trade-of regarding the level of sensitivity (.75) and specificity (.61) for the PPVT-4. A cut-score of 92 yielded the highest trade-off for sensitivity (.71) and specificity (.68) on the EVT-2. Comparing the classification accuracy of the Yes/No assessment and the PPVT-4 and EVT-2 measures, there is evidence that incrementally averaged Yes/No data were more useful for accurately predicting students who were at risk for low performance on an end-of-year target word outcome measure (Target Receptive outcome). Comparing classification accuracy data from Tables 11 and 12, the Yes/No assessment was more accurate than the pre-intervention PPVT-2 or EVT-2 in predicting performance on the Target Receptive outcome measure, beginning with data from Week 3 (SE=.79; SP=.68; K=.39).

Table 11

Classification Accuracy of the Yes/No Incrementally Averaged Measures in Predicting the Target Receptive Post-Intervention Outcome (Base Rate of Fails=27.9%).

Measure	Cutoff Score	SE	SP	PPP	NPP	K
Yes/No assessment						
Lessons 1-2	**3.25**	**.63**	**.75**	**.52**	**.84**	**.38**
Lessons 1-2	**3.50**	**.63**	**.77**	**.52**	**.84**	**.38**
Lessons 1-2	3.75	.75	.61	.43	.87	.30
Lessons 1-3	**3.25**	**.79**	**.68**	**.49**	**.89**	**.39**
Lessons 1-3	**3.50**	**.88**	**.60**	**.46**	**.93**	**.37**
Lessons 1-3	3.75	.92	.45	.39	.93	.26
Lessons 1-4	**3.25**	**.83**	**.71**	**.53**	**.92**	**.46**
Lessons 1-4	3.50	.83	.55	.42	.90	.29
Lessons 1-4	3.75	.92	.44	.39	.93	.25
Lessons 1-5	**3.25**	**.83**	**.66**	**.49**	**.91**	**.41**
Lessons 1-5	3.50	.88	.60	.46	.93	.37
Lessons 1-5	3.75	.92	.45	.39	.93	.26
Lessons 1-6	**3.25**	**.83**	**.69**	**.51**	**.92**	**.44**
Lessons 1-6	3.50	.83	.61	.46	.91	.36
Lessons 1-6	3.75	.92	.45	.39	.93	.26
Lessons 1-8	**3.25**	**.79**	**.68**	**.49**	**.89**	**.39**
Lessons 1-8	3.50	.83	.63	.47	.91	.37
Lessons 1-8	3.75	.92	.45	.39	.93	.26
Lessons 1-10	**3.25**	**.79**	**.68**	**.49**	**.89**	**.39**
Lessons 1-10	**3.50**	**.88**	**.65**	**.49**	**.93**	**.42**
Lessons 1-10	3.75	.96	.47	.41	.97	.30
Lessons 1-12	**3.25**	**.88**	**.74**	**.57**	**.94**	**.53**
Lessons 1-12	**3.50**	**.92**	**.65**	**.50**	**.95**	**.45**
Lessons 1-12	**3.75**	**1.00**	**.55**	**.46**	**1.00**	**.40**
Lessons 1-24	**3.25**	**.67**	**.84**	**.62**	**.87**	**.49**
Lessons 1-24	**3.50**	**.88**	**.73**	**.55**	**.94**	**.51**
Lessons 1-24	**3.75**	**1.00**	**.66**	**.53**	**1.00**	**.52**

Table 12

Classification Accuracy of the PPVT-4 and EVT-2 Measures in Predicting the Target Receptive Post-Intervention Outcome (Base Rate of Fails=27.9%).

Measure	Cutoff Score	SE	SP	PPP	NPP	K
Pretest PPVT-4						
25th Percentile	85	.56	.87	.56	.79	.31
	86	.50	.81	.50	.81	.30
	87	.50	.79	.48	.80	.29
	88	.54	.81	.48	.81	.30
	89	.63	.66	.42	.82	.25
	90	.75	.61	.43	.86	.30
	91	.75	.53	.38	.85	.22
30th Percentile	92	.75	.47	.35	.83	.16
	93	.75	.44	.34	.82	.14
	94	.75	.39	.32	.80	.10
Pretest EVT-2						
25th Percentile	85	.25	.89	.46	.75	.16
	86	.29	.84	.41	.75	.14
	87	.42	.77	.42	.77	.19
	88	.42	.77	.42	.77	.19
	89	.50	.71	.40	.79	.20
	90	.50	.69	.39	.78	.18
	91	.54	.68	.39	.79	.20
30th Percentile	92	.71	.68	.46	.86	.33
	93	.71	.61	.42	.84	.26
	94	.83	.58	.44	.90	.32

Next, classification accuracy was examined using the post-intervention Target Expressive measure as the outcome. The classification accuracy of the Yes/No incrementally averaged data was again compared with the pre-intervention PPVT-4 and EVT-2 measures. As shown in Table 13, the Yes/No incrementally averaged data sets provided adequate levels of sensitivity and specificity on a number of occasions (highlighted in bold font). For example, setting the Yes/No predictor cut-score at 3.25, the Yes/No incrementally averaged measure achieved a sensitivity of .78 and a specificity of .68 (Kappa=.39) as early as Week 4 of instruction. In other words, of the participants who achieved low scores on the Target Expressive outcome measure (23 out of 86 participants, or 26.7% of the sample), 78% (18 out of 23 participants) were identified as at-risk by the Yes/No incrementally averaged data at Week 4. Similarly, of the participants who achieved high scores on the Target Expressive outcome measure (63 out of 86 participants, or 73.3% of the sample), 68% (43 out of 63 participants) were identified as *not* being at-risk using the Yes/No incrementally averaged data at Week 4.

In Table 14, classification accuracy data are displayed for the pre-intervention PPVT-4 and EVT-2 data. Again, the outcome measure used was the post-intervention Target Expressive measure with a base rate of 26.7% of the sample "failing". A cut-score of 90 yielded the highest trade-off regarding the level of sensitivity (.74) and specificity (.60) on the PPVT-4. A cut-score of 92 yielded the highest trade-off regarding the level of sensitivity (.70) and specificity (.67) on the EVT-2.

Comparing the classification accuracy findings between the Yes/No assessment and the PPVT-4 and EVT-2 measures, there is evidence that incrementally averaged Yes/No data were more useful for accurately predicting students who were at risk for low performance on an end-of-year target word outcome measure (Target Expressive outcome). Comparing classification accuracy data from Tables 13 and 14, the Yes/No assessment was more accurate than the pre-intervention PPVT-2 or EVT-2 in predicting performance on the Target Expressive outcome measure, beginning at Week 4 (SE=.78; SP=.68; K=.39).

Table 13

Classification Accuracy of the Yes/No assessment In Predicting the Target Expressive Post-Intervention Outcome (Base Rate of Fails was 26.7%)

Measure	Cutoff Score	SE	SP	PPP	NPP	K
Yes/No assessment						
Lessons 1-2	3.25	.52	.73	.41	.81	.23
Lessons 1-2	3.50	.52	.73	.41	.81	.23
Lessons 1-2	3.75	.70	.59	.38	.84	.22
Lessons 1-3	3.25	.70	.64	.41	.85	.27
Lessons 1-3	3.50	.74	.54	.37	.85	.21
Lessons 1-3	3.75	.78	.40	.32	.83	.12
Lessons 1-4	**3.25**	**.78**	**.68**	**.47**	**.90**	**.39**
Lessons 1-4	3.50	.83	.54	.40	.90	.27
Lessons 1-4	3.75	.87	.41	.35	.90	.19
Lessons 1-5	3.25	.78	.64	.44	.90	.33
Lessons 1-5	3.50	.83	.57	.41	.90	.30
Lessons 1-5	3.75	.87	.43	.36	.90	.21
Lessons 1-6	**3.25**	**.78**	**.67**	**.46**	**.89**	**.37**
Lessons 1-6	3.50	.78	.59	.41	.88	.29
Lessons 1-6	3.75	.87	.42	.36	.90	.21
Lessons 1-8	**3.25**	**.78**	**.67**	**.46**	**.89**	**.37**
Lessons 1-8	**3.50**	**.83**	**.62**	**.44**	**.91**	**.35**
Lessons 1-8	3.75	.87	.43	.36	.90	.21
Lessons 1-10	**3.25**	**.78**	**.67**	**.46**	**.89**	**.37**
Lessons 1-10	**3.50**	**.87**	**.64**	**.47**	**.93**	**.40**
Lessons 1-10	3.75	.91	.44	.38	.93	.25
Lessons 1-12	**3.25**	**.87**	**.73**	**.54**	**.94**	**.50**
Lessons 1-12	**3.50**	**.91**	**.64**	**.48**	**.95**	**.43**
Lessons 1-12	3.75	.96	.52	.42	.97	.34
Lessons 1-24	**3.25**	**.83**	**.89**	**.73**	**.93**	**.69**
Lessons 1-24	**3.50**	**.91**	**.73**	**.55**	**.96**	**.53**
Lessons 1-24	**3.75**	**.96**	**.64**	**.49**	**.98**	**.45**

Table 14

Classification Accuracy of the Pre-Intervention PPVT-4 Measure and the Pre-Intervention EVT-2 Measure in Predicting the Post-Intervention Target Expressive Outcome (Base Rate of Fails was 26.7%)

Measure	Cutoff Score	SE	SP	PPP	NPP	K
Pretest PPVT-4						
25th Percentile	85	.44	.81	.56	.81	.33
	86	.52	.81	.50	.82	.33
	87	.52	.79	.48	.82	.31
	88	.57	.78	.48	.83	.33
	89	.65	.67	.42	.84	.27
	90	.74	.60	.41	.60	.27
	91	.78	.54	.38	.87	.24
	92	.78	.47	.35	.86	.19
	93	.83	.46	.36	.88	.20
	94	.83	.41	.34	.88	.16
Pretest EVT-2						
25th Percentile	85	.26	.89	.46	.77	.17
	86	.30	.84	.41	.77	.16
	87	.48	.79	.46	.81	.27
	88	.48	.79	.46	.81	.27
	89	.57	.73	.43	.82	.27
	90	.57	.71	.42	.82	.25
	91	.61	.70	.42	.83	.27
	92	.70	.67	.43	.86	.30
	93	.74	.62	.42	.87	.29
	94	.83	.57	.41	.90	.30

Receiver Operating Characteristic Curve (ROC Curve) Analyses

Next, Receiver Operating Characteristic (ROC) curve analyses were conducted with each of the predictors (Yes/No assessment, pre-intervention PPVT-4, and pre-intervention EVT-2). ROC curves plot the true-positive rate against the false-positive rate for varying cut off scores on a predictor measure (Compton, Fuchs, Fuchs, & Bryant, 2006). The ROC curve analysis allows for the examination of the combinations of sensitivity and specificity that are possible for a given predictor and a given outcome. The Area Under the Curve (AUC) is an indicator of the overall classification accuracy of a predictor. In the current analysis the AUC indicates the degree to which a predictor measure correctly classifies students according to end-of-year outcomes. According to Compton et al. (2006) an AUC below .70 is poor; between .70 and .80 is fair; .80 to .90 is good; and .90 and above is considered excellent. The AUC may be interpreted as the average percent correct achievable for classifications using a given pair of predictor and criterion variables, across all possible cut-off values of the predictor variable.

The purpose of conducting ROC curve analyses was to examine the utility of incrementally averaged Yes/No scores for correctly classifying students at risk for poor end-of-year outcomes. Additionally, ROC curve analyses were conducted using the pre-intervention PPVT-4 and EVT-2 scores. These analyses allowed for a comparison of the predictive validity between the Yes/No assessment and pre-intervention PPVT-4 and EVT-2 measures. ROC curve analyses were conducted with each predictor measure (Yes/No assessment incrementally averaged, pre-intervention PPVT-4, and pre-intervention EVT-2) to examine classification accuracy for each of the outcome measures (post-intervention scores on the PPVT-4, EVT-2, Target Expressive, and Target Receptive). Table 15 summarizes the Area Under the Curve (AUC) for each predictor, on each of the outcomes.

Table 15

ROC Curve Results: Area Under the Curve (AUC) for Predictor Measures on Each Outcome Measure

	Post-Intervention Outcome Measures			
	Target Receptive	**Target Expressive**	**Post-Int. PPVT-4**	**Post-Int. EVT-2**
Cut Point	<12=Fail	<10=Fail	<92=Fail	<92=Fail
Base Rate of "Fails"	25.5% Fail	27% Fail	25.5% Fail	26.7% Fail
Predictor				
PPVT-4	.70	.73	.76	.71
EVT-2	.72	.72	**.82**	**.80**
Yes/No Lessons 1-2	.75	.67	.68	.57
Yes/No Lessons 1-3	.77	.68	.65	.59
Yes/No Lessons 1-4	.75	.73	.66	.58
Yes/No Lessons 1-5	.79	.75	.67	.61
Yes/No Lessons 1-6	.79	.76	.69	.62
Yes/No Lessons 1-7	.78	.75	.68	.61
Yes/No Lessons 1-8	**.81**	.78	.70	.61
Yes/No Lessons 1-9	**.84**	.79	.71	.64
Yes/No Lessons 1-10	**.82**	.78	.70	.63
Yes/No Lessons 1-11	**.85**	**.82**	.72	.65
Yes/No Lessons 1-12	**.86**	**.82**	.72	.65
Yes/No Lessons 1-13	**.86**	**.82**	.72	.65
Yes/No Lessons 1-14	**.86**	**.84**	.73	.67
Yes/No Lessons 1-15	**.88**	**.86**	.72	.67
Yes/No Lessons 1-16	**.87**	**.86**	.73	.67
Yes/No Lessons 1-17	**.88**	**.87**	.73	.68
Yes/No Lessons 1-18	**.88**	**.88**	.73	.68
Yes/No Lessons 1-19	**.88**	**.88**	.74	.69
Yes/No Lessons 1-20	**.89**	**.88**	.75	.70
Yes/No Lessons 1-21	**.88**	**.88**	.76	.71
Yes/No Lessons 1-22	**.88**	**.87**	.76	.71
Yes/No Lessons 1-23	**.87**	**.87**	.76	.71
Yes/No Lessons 1-24	**.88**	**.88**	.76	.71

Note: Area Under the Curve (AUC) below .70 is poor; between .70 and .80 is fair; **.80 to .90 is good;** and .90 and above is considered excellent (Compton et al., 2006).

Cut-scores for “passing” or “failing” outcome measures were again selected based on scores that yielded a “failing” base rate for less than 30% of participants. This method categorized the lowest 30% of scores as “failing” outcome vocabulary assessments. Cut-scores for the Posttest PPVT-4 and EVT-2 were selected using nationally normed base rates for standard scores (Dunn & Dunn, 2007 for the PPVT-4; Williams, 2007 for the EVT-2).With the PPVT-4 and EVT-2, scores that fell under the 30th percentile (standard scores under 92) were categorized as “failing” scores for the purposes of classification analyses.

PPVT-4 and EVT-2 ROC curves. As indicated in Table 15, the Area Under the Curve (AUC) for the pre-intervention PPVT-4 measure was “fair” for each outcome measure. On the Target Receptive outcome, the pre-intervention PPVT-4 AUC was .70. On the Target Expressive outcome, the pre-intervention PPVT-4 AUC was .73. On the post-intervention EVT-2 outcome, the pre-intervention PPVT-4 AUC was .71. On the post-intervention PPVT-4 outcome, the pre-intervention PPVT-4 AUC was .76. Overall, the results indicate that pre-intervention PPVT-4 measure provided fair classification accuracy for target word outcomes, and fair classification accuracy for general or distal vocabulary outcomes.

Next, the AUC for the pre-intervention EVT-2 measure was examined for each of the outcome measures. On the Target Receptive and Target Expressive outcomes, the pre-intervention EVT-2 AUC was considered “fair” (AUC=.72). On the post-intervention PPVT-4, the pre-intervention EVT-2 AUC was considered “good” (AUC=.82). On the post-intervention EVT-2, the pre-intervention EVT-2 AUC was also considered “good” (AUC=.80). Overall, the results indicate that the pre-intervention EVT-2 measure provided fair classification accuracy for the target word outcomes, and good classification accuracy for general or distal vocabulary outcomes.

Yes/No assessment ROC curves. The AUC for the incrementally averaged Yes/No assessments varied across outcome measures and number of weeks (see Table 15). On the Target Receptive outcome, the Yes/No AUC ranged from .75 (Lessons 1-2) to .88 (Lessons 1-24). The Target Receptive results provide evidence that the incrementally averaged data from the Yes/No assessment provided stronger target word classification accuracy by Week 2 (AUC=.75) than the pre-intervention PPVT-4 (AUC=.70) and the pre-intervention EVT-2 (AUC=.72).The Yes/No AUC was considered to be “fair” by Week 2 (AUC=.75), and the AUC was considered to be “good” by Week 8 (AUC=.81). As shown in Figure 8, the Yes/No assessment had stronger classification accuracy by Week 8 than the pre-intervention PPVT-4 measure.

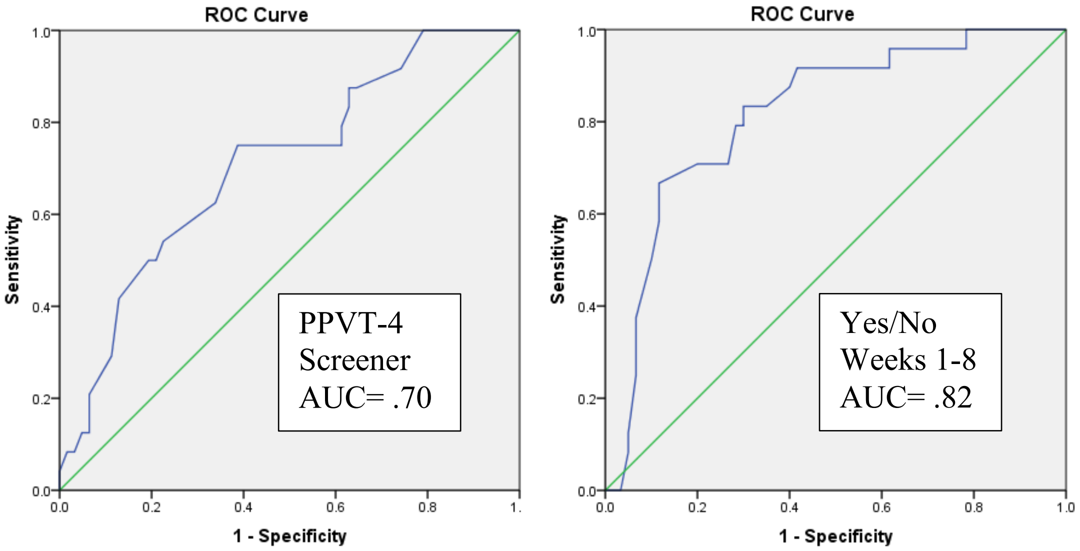


Figure 8. ROC Curves Comparing the PPVT-4 Screener (left, AUC=.70) and the Incrementally Averaged Yes/No assessment for Weeks 1-8 (right, AUC=.81), Using the Target Receptive Picture assessment as the Outcome.

On the Target Expressive outcome measure, the Yes/No AUC ranged from .67 (Lessons 1-2) to .88 (Lessons 1-24). The AUC was considered "fair" by Week 4 (AUC=.73), and the AUC was considered to be "good" by Week 11 (AUC=.81). The Yes/No AUC was greater than the PPVT-4 and EVT-2 AUC by Week 5. However, the AUC for the PPVT-4 and EVT-2 was greater than or equal to the AUC for the Yes/No assessment from Weeks 1 to 4. This finding indicates that the PPVT-4 and EVT-2 provide stronger target word classification accuracy than the Yes/No assessment up until Week 4. However, with four weeks of Yes/No data, the classification accuracy becomes stronger using the Yes/No data compared to the PPVT-4 and EVT-2 pre-intervention screening data. As shown in Figure 9, the Yes/No AUC at Week 11 is substantially greater than the pre-intervention PPVT-4 AUC on the Target Expressive outcome.

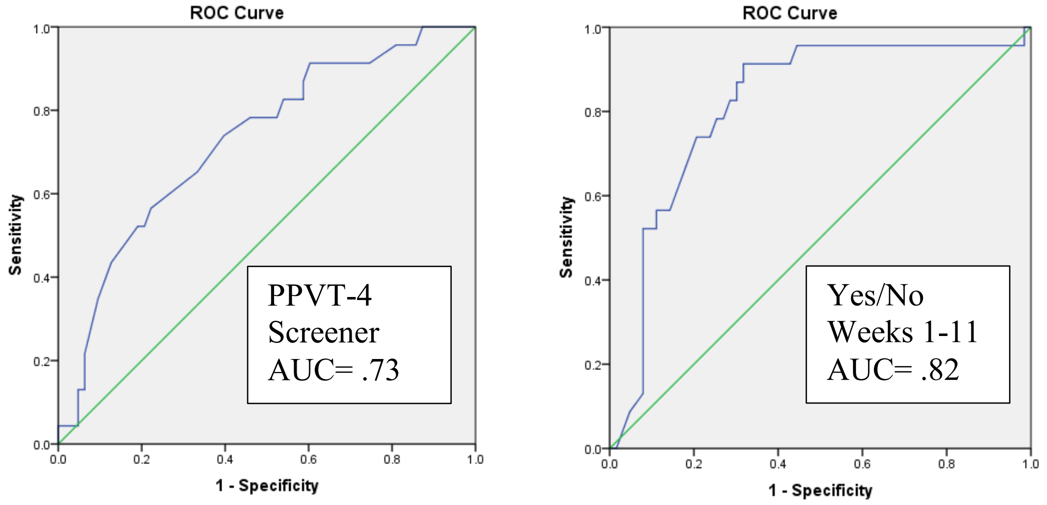


Figure 9. ROC Curves Comparing the PPVT-4 Screener (left, AUC=.73) and the Incrementally Averaged Yes/No assessment for Weeks 1-11 (right, AUC=.82), Using the Target Expressive Measure as the Outcome.

On the post-intervention PPVT-4 outcome, the Yes/No AUC ranged from .68 (Lesson 1) to .76 (Lesson 24). The Yes/No AUC was considered to be "fair" by Lesson 8 (AUC=.70). On the post-intervention EVT-2 outcome, the Yes/No AUC ranged from .57 (Lesson 1) to .71 (Lesson 24). The Yes/No AUC was not considered to be "fair" until Lesson 20 (AUC=.70). Compared to the pre-intervention PPVT-4 and EVT-2 measures, the Yes/No assessment showed weaker classification accuracy for predicting post-intervention PPVT-4 and EVT-2 outcomes. This finding indicates that the Yes/No assessments did not provide strong classification accuracy for predicting general or distal vocabulary outcomes, as indicated in Figure 10.

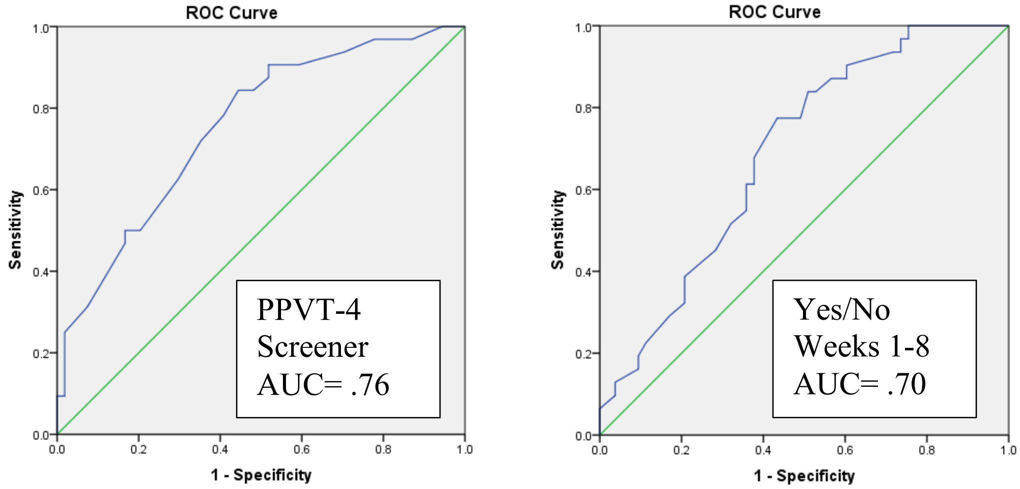


Figure 10. ROC Curves Comparing the PPVT-4 Screener (left, AUC=.76) and the Incrementally Averaged Yes/No assessment for Weeks 1-8 (right, AUC=.70), Using the Post-Intervention PPVT-4 as the Outcome.

In summary, ROC Curve analyses indicated that the Yes/No assessment provided greater classification accuracy for target word outcomes compared to the pre-intervention PPVT-4 and EVT-2 measures. Area Under the Curve indicated that the Yes/No assessment was "good" by Week 8 for predicting Target Receptive outcomes, and "good" by Week 11 for predicting Target Expressive outcomes. The findings also indicate that the pre-intervention PPVT-4 measure did *not* provide "good" classification accuracy for the target word outcomes (AUC=.73). Similarly, the pre-intervention EVT-2 measure did *not* provide "good" classification accuracy for the target word outcomes (AUC=.72). On the other hand, the pre-intervention PPVT-4 and EVT-2 measures did provide "good" classification accuracy for the general vocabulary outcome measures (post-intervention PPVT-4 and EVT-2), while the Yes/No assessments did *not* provide "good" classification accuracy for general vocabulary outcomes. The findings indicate that the Yes/No assessments were stronger in predicting target vocabulary word outcomes, while the PPVT-4 and EVT-2 measures were stronger in predicting general vocabulary outcomes.

Teacher Questionnaire Results

Eighteen Kindergarten teachers from Project EVI completed brief questionnaires (see Appendices E, F) regarding their experiences administering and using the weekly vocabulary assessments (Yes/No and Receptive). Responses from the 13 teachers who participated in the current project are presented in Table 16. As summarized in Table 16, participating teachers reported that the Yes/No and Receptive Picture assessments were somewhat time consuming to administer. As measured during the fidelity observations in the current study, the average time administering the Yes/No assessments was 3.82 minutes (*SD*=1.89 minutes), and the average time administering the Receptive Picture assessment was 3.80 minutes (*SD*=1.75 minutes). On the Yes/No assessment, teachers provided an average of 21.50 seconds for students to select their response for each item (*SD*=1.74 seconds). On the Receptive Picture assessment, teachers provided an average of 20.63 seconds for students to select their response for each item (*SD*=5.37 seconds).

Table 16

Teacher Responses to a Yes/No and Receptive Picture assessment Questionnaire

	Teacher Rating			
	Yes/No		Receptive	
	M	(SD)	M	(SD)
1. How time-consuming to administer? (1=Not time consuming, 10=Very time consuming)	4	(2.50)	4	(2.34)
2. How easy to administer? (1= Not easy at all, 10= Very easy)	9	(1.41)	9	(0.91)
3. How many times did you use the results? (Responses ranged from 0 to 24 times)	8	(10.95)	8	(11.18)
4. How independently did students work? (1=Never Independent, 10=Always Independent)	8	(1.51)	7	(1.84)

The teacher questionnaire also captured teachers' perceptions of the strengths of the Yes/No and Receptive Picture assessments, and recommendations for improving the assessments. Teachers reported that some of the strengths of the Yes/No assessment included, "*Auditory learning component, following directions… I was able to see who understood the "testing" concept vs. just circling the answer… Easy way to assess results… Quick! Students liked it- made it into a game- fast and no peeking…*

the simple yes/no format… Clear questions… Good questions- made students think deeper… You see if the students remember the meaning of the words… Students learned how to take a test, stay seated, no talking, and listening to directions… and, A useful, quick check for understanding; shows who is struggling".

Teachers also provided weaknesses or areas for improvement on the Yes/No assessment, including, "*At the beginning of the year, many students didn't know the number names and it was very difficult to administer… Adding lines between each item helped… The assessment in the workbook showed "more accurate" results of their knowledge because of the pictures. Yes/no questions had too many unknown words… Thumb icons could be placed next to each "Yes,No" because beginning of year Kindergarten students need a visual… Maybe put a picture next to each number like a star, circle, etc. for those who can't identify numbers at the beginning of the year… No visuals so really hard to pay attention to verbal questions… The wording of the questions confused the students at times- the term "might" was confusing."*

Teachers reported that strengths of the Receptive Picture assessment included, "*The pictures were very helpful as were the colorful borders on the pages… Visual component… It gave kids the visual for assessments- that some tend to need…Great pictures, easy to follow…Children were able to do independently… Great pictures, easy to track… Assesses all words…Clear illustrations… Re-enforced vocabulary weekly words… Put words in context, gave good visual examples of words… It reinforces the vocabulary words and meanings… The pictures made it easy for this age kids…The pictures were helpful at times…. Another nice quick check for understanding".*

Teachers also reported weaknesses or areas for improvement on the Receptive Picture assessment, including, “*Finding page numbers is difficult at the beginning of the year… Some pictures were difficult to interpret… Some items were too easy as the year went on… Some of the pictures were not appropriate for this age level- or too similar… The pictures were confusing and often subjective or didn’t match the meaning of the word.”*

Teachers were asked if they would use the Yes/No assessment in the future. Eleven out of 13 teachers (85%) responded that they would use the Yes/No assessment in the future. Teacher responses included, “Yes, *it gives a lot of useful information about the students’ understanding of the vocabulary words… Yes, it tunes their comprehension and distractibility… I would use it to have results and to see who is retaining information… Yes, it would help to know if I needed more exaggeration for teaching the vocabulary… and, Yes, good auditory practice”.*

Teachers were asked if they would use the Receptive Picture assessment in the future. Ten out of 13 teachers (77%) responded that they would use the Receptive Picture assessment in the future. Teacher responses included, “*Yes, it gives practice with the words and is a good quick check for understanding… Yes, but I would do it in smaller groups… Yes, to send home so families can see… Yes, to check comprehension of word meanings… Yes, it wraps up each week… Yes, again it would give me an idea as to how well I was getting the word across… Yes, but I would ask students to explain their thinking behind wrong answers (sometimes pictures are tricky)… Yes, if it was not too costly and there was funding available”.*

CHAPTER 4

DISCUSSION

The implementation of multi-tiered systems of support in schools holds promise for addressing low achievement for disadvantaged and struggling students. Research has demonstrated that Kindergarten interventions are particularly effective in preventing reading difficulties for at risk students (Cavanaugh, Kim, Wanzek, & Vaughn, 2004). While there is extensive research informing instruction and assessment for word recognition skills within a multi-tiered context, less attention has been focused on promoting early vocabulary growth (Biemiller, 2001; Loftus & Coyne, 2013; Paris, 2005). Recent research (Beck & McKeown, 2007; Blachowicz et al., 2013; Coyne et al., 2004, 2007, 2009; Loftus et al., 2010) has contributed greatly to inform educators of best practices regarding early vocabulary instruction and intervention. However, within a multi-tiered framework, educators must have adequate and useful tools for identifying students who are at risk.

While many curriculum-based assessments and tools have been developed to identify student risk level for word recognition skills and reading comprehension skills (e.g., DIBELS; University of Oregon, 2014; see Kaminski & Good, 1996), more research is needed to examine methods of assessing early vocabulary knowledge within an RtI framework (Loftus & Coyne, 2013; NRP, 2000). The purpose of the current study was to examine the utility of two curriculum-based assessments of vocabulary that are embedded within the *Elements of Reading: Vocabulary* curriculum

(Beck & McKeown, 2004). Specifically, the current study examined teacher perceptions of the assessments (social validity) and the extent to which either or both of the assessments accurately identified students who were at risk for poor end-of-year vocabulary outcomes (predictive validity).

Summary of Results

The findings of the current study provided evidence that the Yes/No assessment embedded within the *Elements of Reading: Vocabulary* curriculum (Beck & McKeown, 2004) accurately identified students who were at risk for poor end-of-year outcomes in target word knowledge. In other words, the results support the use of the Yes/No assessment for identifying students who are at risk and therefore would benefit from additional instructional support (i.e., Tier II or Tier III vocabulary interventions). Furthermore, the findings indicate that averaged Yes/No assessment data from Weeks 1-8 provided greater classification accuracy for end-of-year target word outcomes than the PPVT-4 or EVT-2 screening measures. Additionally, the Yes/No assessment data captured statistically significant differences in target word vocabulary knowledge between at risk students who received Tier I support only (Project EVI control group, lowest scores), at risk students who received Tier I *and* Tier II support (Project EVI treatment group), and typically achieving students who received Tier I supports (Project EVI reference group, highest scores).

On the Receptive Picture assessment embedded within the *Elements of Reading: Vocabulary* curriculum, a ceiling effect (i.e., most students achieved high scores) limited the ability to use the assessment to identify students who were at risk. While there may be advantages to administering the Receptive Picture assessment (e.g., providing students with an additional opportunity to practice using target words), the current findings indicate that the Receptive Picture assessments in the *Elements of Reading: Vocabulary* curriculum are not useful for predicting end-of-year vocabulary outcomes, or for differentiating between students receiving Tier I versus Tier II support.

Results from teacher questionnaires indicate that Kindergarten teachers found the assessments to be very easy to administer and they did not believe that the administration of the assessments was particularly time-consuming. While some teachers chose to examine the results of student assessments often, other teachers chose not to examine student responses at all. The majority of the teachers indicated that they would be likely to use the assessments in the future (85% would use the Yes/No assessment; 77% would use the Receptive Picture assessment). However, teachers noted areas for improvement on the assessments. Recommendations for improving the Receptive Picture assessment include increasing the difficulty of items, and selecting pictures that were less ambiguous for interpretation. Recommendations for the Yes/No assessment included changing the visual-spatial organization of probes to clearly separate each item, and to include explicit visuals next to each item (e.g., a thumbs up picture paired with each "Yes" and a thumbs down picture paired with each "No").

Limitations

While the findings of the current study provide initial evidence of the utility of the Yes/No assessment for predicting end-of-year target word vocabulary outcomes, many limitations must be noted. First, strong evidence for classification accuracy was not established until Week 8 of the Yes/No assessment. Assessment methods with good classification accuracy that could identify at risk students *earlier* than eight weeks would be preferable. Additionally, the classification accuracy of the Yes/No measure was “good” by Week 8 (AUC>.80), but not “excellent” (AUC>.90). Educators using this assessment to identify students at risk should be mindful that the measure does not have perfect classification accuracy. Some students who are truly at risk might perform well on the Yes/No assessments, and some students who are not at risk might perform poorly on the assessments. While the current study demonstrates that the Yes/No assessment had good classification accuracy for identifying student risk on target word assessments, the assessment was *not* accurate in classifying student risk for end-of-year general vocabulary outcomes, as measured by the PPVT-4 and the EVT-2.

In the current study, teachers administered the weekly assessments, rather than researchers. While the teachers were trained and fidelity observations were conducted, it is possible that the teachers did not always administer the assessments in a standardized method. Additionally, the assessments were administered in a whole-class format, which increases the possibility that students did not always complete the assessments completely independently. Teachers were trained to take steps to ensure that students completed the assessments independently, and fidelity observations noted a few instances where students did not complete the assessments independently (i.e., ‘peeking’ at neighbors’ responses); however, it was not possible for the researcher to comprehensively monitor the degree to which assessments were completed independently. To minimize error, six of the initial 19 classrooms (31.5%) were eliminated from analyses in the current study due to low levels of independent work on the assessments (either during fidelity observations, or as reported in the teacher questionnaire). The relatively high percentage of classes that were not able to complete the assessments independently brings into question the social validity of whole-group test administration in early Kindergarten.

Finally, some students struggled with visual-spatial orientation for the Yes/No assessments in early Kindergarten, and some student responses were ambiguous (e.g., both "Yes" and "No" were circled for the same item). For each item with an ambiguous response, the student's score for the entire week was omitted from analyses, leading to the problem of occasional missing data. Additionally, because the current study took place in elementary schools rather than a controlled environment, student absences also led to missing data. While these limitations pose challenges for research purposes, they accurately reflect the day to day considerations for assessment practices at the early elementary level.

Considerations for Early Vocabulary Assessment

Given that vocabulary is an "unconstrained" skill (Paris, 2005) the method used to identifying at risk students in the current study differs from the conventional methods used to screen for poor word recognition skills. For example, most screening tools do not align exactly with the content of the curriculum, yet contain at least *some* material that is known to the student, even if the amount of known material is minimal. It is expected that the target words selected for direct vocabulary instruction will be *unknown* to students prior to instruction; therefore, it would not be appropriate or useful to screen students prior to instruction using target words. Many researchers have relied on measures of general vocabulary knowledge, which sample both *known* and *unknown* words, to identify students at risk for poor vocabulary outcomes. However, these methods have substantial limitations for use in a classroom context. The current study examined the utility of standard, *ongoing* curriculum-based vocabulary assessments to identify students at risk for poor vocabulary outcomes. In other words, ongoing or formative curriculum-based vocabulary assessment results were used to identify students who did not respond to Tier I instruction.

In selecting tools to identify students at risk, it is important to specify the outcome. In other words, it is necessary to specify exactly *what* a student is or is not at risk for. Within a Tier I direct vocabulary instruction curriculum such as the *Elements of Reading: Vocabulary,* the primary instructional goal is for students to learn the target words or proximal words that were taught directly. A secondary goal for instruction is to expand students' transfer or distal word learning and language comprehension. Although a handful of studies have demonstrated initial evidence for distal vocabulary gains through short term vocabulary instruction and intervention (e.g., Coyne et al., 2010; Elleman, Lindo, Mophy, & Compton, 2009); there is strong research supporting increases in target word learning through direct vocabulary instruction (Beck et al., 2002; Biemiller & Boote, 2006; Loftus et al., 2010).

The use of standardized measures of general vocabulary knowledge as a universal screener or outcome assessment for early vocabulary instruction is problematic for several reasons. First, such measures lack sensitivity to capture knowledge of the specific target words taught. For example, imagine a Kindergarten student who learned over 100 "Tier Two" vocabulary words over the course of an academic year through direct vocabulary instruction. An outcome assessment that measured target word knowledge is more sensitive and appropriate for capturing the student's gains, compared to standardized measures of general vocabulary knowledge.

Within an RtI context, screeners typically provide teachers with two levels of important information. First, screening results identify individual students who are at risk for poor outcomes and are in need of additional support. Additionally, screening results provide teachers with an overall conceptualization of Tier I instructional effectiveness, by examining the number of students who are not responding to Tier I instruction. A limitation to relying on standardized measures of general vocabulary knowledge as screeners is that such measures do not allow teachers to examine the overall effectiveness of their direct vocabulary instruction. For example, imagine that most students in a kindergarten class were not responding to Tier I vocabulary instruction. The use of curriculum based vocabulary assessments could inform the teacher that there is a need to change Tier I instruction to increase the percentage of students who respond positively. Unlike curriculum based assessments, measures of general vocabulary knowledge do not provide specific information regarding the effectiveness of the local instruction.

Another limitation to using standardized measures of general vocabulary knowledge is that the scores are typically interpreted in terms of percentile ranks and compared with national norms. This means that even if a student's performance improves (raw score increases), the student's relative ranking (standard score) is not likely to indicate an improvement unless the gain is substantial. Additionally, general measures such as the PPVT-4 and EVT-2 are not designed to be administered repeatedly within a short period of time. In schools, these measures are commonly administered to students by specialists in schools, for the purposes of evaluations. Using these tools too frequently can result in practice effects and invalidate the use of the data for multiple purposes.

A practical limitation to using standardized measures of general vocabulary knowledge is the amount of time and training needed to administer the measures and score the protocols. Such measures require individual administration, and can take 20 to 30 minutes to complete. In a classroom of 20 Kindergarten students, it would take over six hours to complete testing using a measure such as the PPVT-4 or EVT-2, with an additional two to three hours dedicated to scoring and interpreting results. In the current study, the average time spent administering the Yes/No assessments was 3.82 minutes, and weekly results for an entire class could be calculated within several minutes.

In early vocabulary intervention studies, researchers typically conduct pre-tests of target word knowledge. Doing so allows researchers to account for initial target word knowledge, and make accurate claims regarding growth in target word knowledge at the time of the posttest. In practice, it may not be appropriate to administer such pretests of target word knowledge, particularly if “Tier Two” words are selected for instruction and it is not likely that students have prior word knowledge (Beck & McKeown, 2002). Instead, assessment of target word knowledge can provide valuable information for teachers when administered *after* direct instruction has occurred. Collecting multiple weeks of data can aid teachers in identifying students who are not responding to Tier I instruction, and are in need of additional support.

In the current study, assessments were administered on a weekly basis, following direct vocabulary instruction. The weekly scores were averaged incrementally over time for each participant, and interpreted as students' response to the vocabulary instruction. Students with higher averaged scores (i.e., scores above 3.50) were considered to be responding well to the Tier I instruction, with low levels of risk for poor end-of-year vocabulary outcomes. Students with lower averaged scores (i.e., scores below 3.50) were considered to be struggling to learn with Tier I instruction alone, with high levels of risk for poor end-of-year vocabulary outcomes. In the current study, at risk students who did *not* receive Tier II supports demonstrated an average score of 3.29 on the Yes/No assessment, and at risk students who *did* receive Tier II supports demonstrated an average score of 3.67 on the Yes/No assessment. Students who were identified as low risk earned an average score of 4.02 on the Yes/No assessment.

Jenkins, Hudson and Johnson (2007) reviewed considerations to be made when selecting appropriate screening tools, emphasizing the importance of efficiency and classification accuracy. Criterion validity is often used by researchers to evaluate the utility of measures. While criterion validity provides useful information regarding the relationship between two measures, the information provided is insufficient for establishing the utility of a screening or predicting measure. Effective screening measures not only correlate with important and relevant outcomes, but also accurately classify students as being at risk or not at risk for poor outcomes (Jenkins et al., 2007).

The National Center on Response to Intervention (2011) provides a review of technical information regarding commonly used screening tools. Each measure is given a rating of having “Convincing Evidence”, “Partially Convincing Evidence” or “Unconvincing Evidence” on a number of criteria. The criteria include classification accuracy, generalizability, reliability, validity, disaggregated data, efficiency of administration, scoring time, and availability of benchmarks/norms. With screening tools, *classification accuracy,* as measured by the Area Under the Curve (AUC) statistic, is particularly important (Jenkins et al., 2007; NCRTI, 2011). Using the standards outlined by the Technical Review Committee of the National Center on Response to Intervention (2011), the Yes/No assessment would be rated as having “Partially Convincing Evidence” in classification accuracy by Week 8 (AUC>.75) for identifying students at risk for poor target word outcomes. Using the same standards, the PPVT-4 and EVT-2 would have “Unconvincing Evidence” (AUC<.75) for correct classification of students at risk for poor target word knowledge.

Using general receptive and expressive vocabulary knowledge as the “gold standard” outcome measures, the Yes/No assessment did *not* demonstrate adequate classification accuracy (AUC<.75). However, the PPVT-4 showed only fair classification accuracy for predicting end-of-year risk as measured by end-of-year PPVT-4 performance (AUC=.76). Furthermore, pre-intervention PPVT-4 scores were not accurate in classifying students who were at risk for poor performance on the end-of-year EVT-2 (AUC=.71) or the target word measures (AUC<.73). While the EVT-2 measure did not show adequate classification accuracy for target word outcomes (AUC=.72), in the current study the EVT-2 had good classification accuracy for general receptive and expressive vocabulary knowledge at the end of the year (AUC>.80).

A challenge of identifying adequate vocabulary assessments in an RtI framework is the necessity of a Tier I vocabulary curriculum. With a whole-class vocabulary curriculum in place, educators have the opportunity to test the same words that they teach, aligning the assessment with the curriculum. At the secondary level, many educators use vocabulary curriculum-based assessments to monitor student learning, however few assessment practices are currently available for early vocabulary instruction. A common method of curriculum-based assessment for vocabulary at the secondary level is the use of vocabulary matching CBAs (Espin, Shin & Busch, 2005). However, at the Kindergarten level such methods are unavailable because students have not yet learned to read and write to demonstrate their vocabulary knowledge.

A recent review of early vocabulary intervention research (Hardy, Furey & Loftus, 2013), examined the types of experimenter-developed target word measures that have been used to evaluate the efficacy of vocabulary interventions in early elementary grades (Kindergarten through Grade 3). From 2003 to 2013, 32 early vocabulary intervention studies were conducted, and 26 studies included measures that assessed target word knowledge. An overview of the types of experimenter developed target word measures is provided in Table 17. The majority of experimenter developed target word measures require one-to-one administration. In some circumstances, the Contextual Word Knowledge: Yes/No assessment, Picture Receptive Vocabulary assessment, and Categorical Word Knowledge assessment could be administered in a whole-group setting; however, few studies have examined the efficacy of whole-group administration of early vocabulary assessments.

Table 17

Review of Experimenter Developed Target Word Measures Used from 2003 to 2013

Type of Measure	Description of Measure	Studies Using the Measure
1. Expressive Definition	Child produces an oral definition for the word.	50% (n=16)
2. Picture Receptive Vocabulary	Child identifies the picture that corresponds with the target word.	34.4% (n=11)
3. Contextual Word Knowledge: Open-Ended	Child answers a contextual question about the target word orally.	28.1% (n=9)
4. Expressive Word Knowledge	Child is shown a picture of a target word or is given verbal definitions of the word, and produces the target word orally (i.e., says the word).	15.6% (n=5)
5. Contextual Word Knowledge: Yes/No	Child answers a contextual question about a target word, with a response of "Yes" or "No".	12.5% (n=4)
6. Story Retell	Child listens to a story and retells the story immediately following.	6.25% (n=2)
7. Metalinguistic Awareness	Child demonstrates ability to reflect on and manipulate language.	6.25% (n=2)
8. Language Samples	Child's use of general vocabulary is observed and recorded by the researcher.	6.25% (n=2)
9. Spelling Target Word	Child listens to target words read aloud and writes the words.	3.1% (n=1)
10. Categorical Word Knowledge	Child demonstrates ability to sort words into appropriate categories.	3.1% (n=1)

Note: This table was adapted from Hardy, Furey, & Loftus (2013). Twenty-six early vocabulary intervention studies were examined, and some of the studies used more than one experimenter developed target word measure.

Future Directions

Early vocabulary assessments that are aligned with Tier I instruction can provide useful information regarding the effectiveness of Tier I instruction and individual students' level of risk for poor target word outcomes. However, the current study only explored two methods of vocabulary measurement (Yes/No and picture Receptive Picture assessments). More research is needed to examine other forms of vocabulary assessment (e.g., expressive assessments), as well as other methods of assessing vocabulary (e.g., one-to-one, peer assessments, computer-based assessments, etc.).

A promising area of research on early vocabulary assessment involves the use of technology (computers, tablets, etc.) to administer assessments and provide teachers and students with immediate feedback. In the current study, only 56% of the teachers took the time to examine assessment results. It is essential that teachers are able to access assessment results in a timely manner, in order to make appropriate instructional decisions (Fuchs & Fuchs, 1986; Stecker, Fuchs & Fuchs, 2005). Technology-based assessments have the potential to provide teachers with immediate feedback and store information regarding classroom outcomes and district outcomes. Educators would benefit from easily accessible data regarding student progress and level of risk. Additionally, researchers and practitioners are encouraged to collect local screening data and conduct classification analyses using relevant "gold standard" outcomes (National Center on Response to Intervention, 2010).

Another consideration for future research involves examining the trade-off between using vocabulary assessments that provide comprehensive information and using vocabulary assessments that are efficient and manageable to administer. For example, most of the vocabulary assessments used at the Kindergarten level are administered to students individually, given that Kindergarten students are not yet able to read or write to express their word knowledge. Assessments that can be administered individually have benefits in terms of the type of information that can be gathered at the Kindergarten level, and individual administration ensures that students respond independently. However, individually administered assessments are more time consuming. Assessments that can be administered in a whole class or small group setting have important benefits in terms of efficiency. Maximizing the quality of the vocabulary assessments (psychometric and predictive properties) and the efficiency of administering the assessment (time and ease of administration) is crucial for promoting data-based instructional decision making for vocabulary development.

Conclusions

Findings from the current study suggest that the ongoing use and interpretation of curriculum-based vocabulary assessments within a Response to Intervention framework can provide useful and accurate information regarding student response to instruction and level of risk. In fact, the findings demonstrated that curriculum based assessments of vocabulary knowledge can provide more useful information than standardized measures of general vocabulary knowledge, regarding risk level for target word outcomes. Previous research on early vocabulary instruction and intervention has largely used proximal or direct, experimenter-developed assessments of target words as the gold standard outcome measures (Coyne et al., 2010; NRP, 2000). A primary reason for developing or selecting measures that assess target word knowledge directly is that such “proximal” measures have higher levels of sensitivity to growth in vocabulary, compared with standardized measures of general or “distal” word knowledge. In short, researchers agree that the most direct method of capturing student learning within a multi-tiered vocabulary curriculum is to assess the same words that were taught, or to use curriculum-based assessments (NRP, 2000).

The current study incrementally averaged multiple weeks of Yes/No assessment data were over time, with the goal of examining how well individual students respond to Tier I vocabulary instruction, which students are at risk for poor end-of-year target word outcomes, and how many data points are necessary for accurate classification accuracy. It is not typical practice to use ongoing assessment results as a universal screener to identify students at risk for poor outcomes. More typically, researchers have used standardized measures of general vocabulary knowledge to screen students and identify students who are likely to be at risk for poor vocabulary outcomes (Coyne et al., 2009). Indeed, standardized measures of general vocabulary knowledge such as the PPVT-4 or EVT-2 are more useful for identifying at risk students *prior to instruction* when compared with curriculum-based assessments. It stands to reason that most students would achieve low scores vocabulary curriculum-based assessments that were administered *prior to* receiving direct vocabulary instruction, because it is expected that the words assessed had not yet been learned. However, the use of standard, ongoing curriculum-based vocabulary assessments can allow educators and researchers to assess individual student response to instruction or intervention.

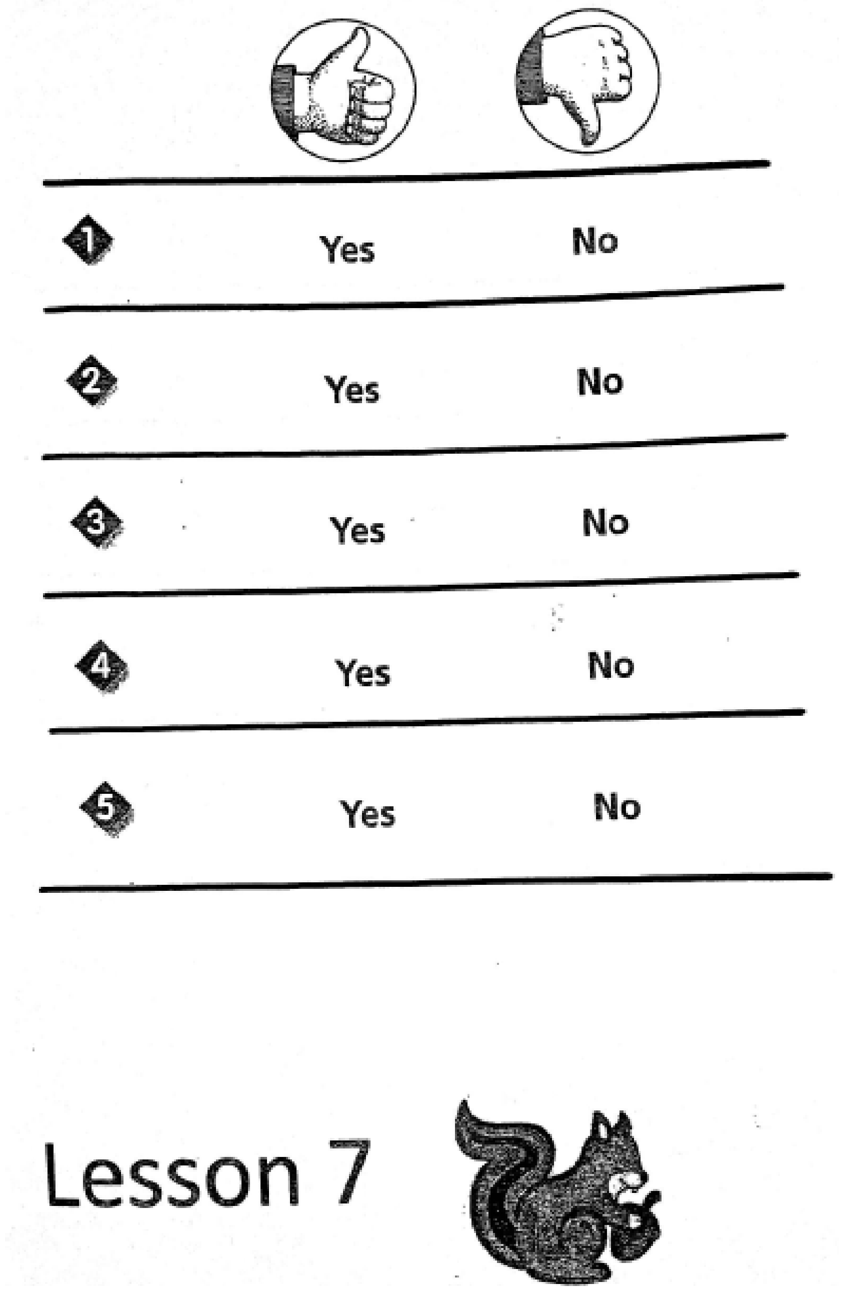
If the intended use of assessment data is to accurately identify students who are at risk for a given outcome, it is important to examine classification accuracy of the assessment using relevant outcomes. Surprisingly, many of the widely used screening measures in the domain of reading have not demonstrated adequate levels of classification accuracy (National Center on Response to Intervention, 2011). Considering that it is nearly impossible for an assessment to have perfect classification accuracy, researchers have emphasized a need for balancing levels of sensitivity and specificity. In recognition of the inherent measurement error that is associated with assessments, researchers and educators must consider trade-offs between selecting cut scores that yield high sensitivity (i.e., the screener detects almost all of the at risk students) yet sacrifice specificity (i.e., some of the students identified as being at risk are not actually at risk) (Petscher, Kim, & Foorman, 2011). While it is desirable to provide every at risk student with additional supports, screeners with high sensitivity and poor specificity will over-identify the number of students at risk. Given the limited resources for Tier II and III (supplemental) instructional supports, it is in the best interest of schools to use measures with adequate sensitivity *and* specificity for important outcomes. However, in an RtI framework, researchers have emphasized the need to maximize sensitivity in order to provide timely services for students who are at risk (Jenkins et al., 2007; Petscher et al., 2011).

The current study provides a framework for examining the predictive validity of curriculum based vocabulary assessments within a multi-tiered system of instruction. Importantly, vocabulary assessments that are technically adequate *and* are efficient to use will be the most useful in a classroom context. While more research is being conducted regarding best practices for early vocabulary instruction and intervention (e.g., Biemiller & Boote, 2006; Coyne et al., 2010), less research is focused on early vocabulary assessments within an RtI framework. Perhaps one of the greatest challenges to examining vocabulary assessment within an RtI framework is the necessity of a Tier I vocabulary curriculum. With increased attention to early vocabulary instruction and intervention, there are increased opportunities to simultaneously evaluate the utility of vocabulary assessments. Researchers are encouraged to examine the utility of vocabulary assessments within the context of multi-tiered early vocabulary instruction and intervention. Appropriate and efficient tools for identifying students at risk for poor vocabulary outcomes will permit educators to intervene early and support learning outcomes for all students.

APPENDIX A

Sample Yes/No Curriculum Based Vocabulary Assessment

1. Can you be **active** on a playground? (yes)
2. Does a bird **scamper** while it flies in the sky? (no)
3. Is a piece of string **broad**? (no)
4. Can a cook **whisk** some cake batter? (yes)
5. Is *blue* a word that can sometimes **describe** the sky? (yes)

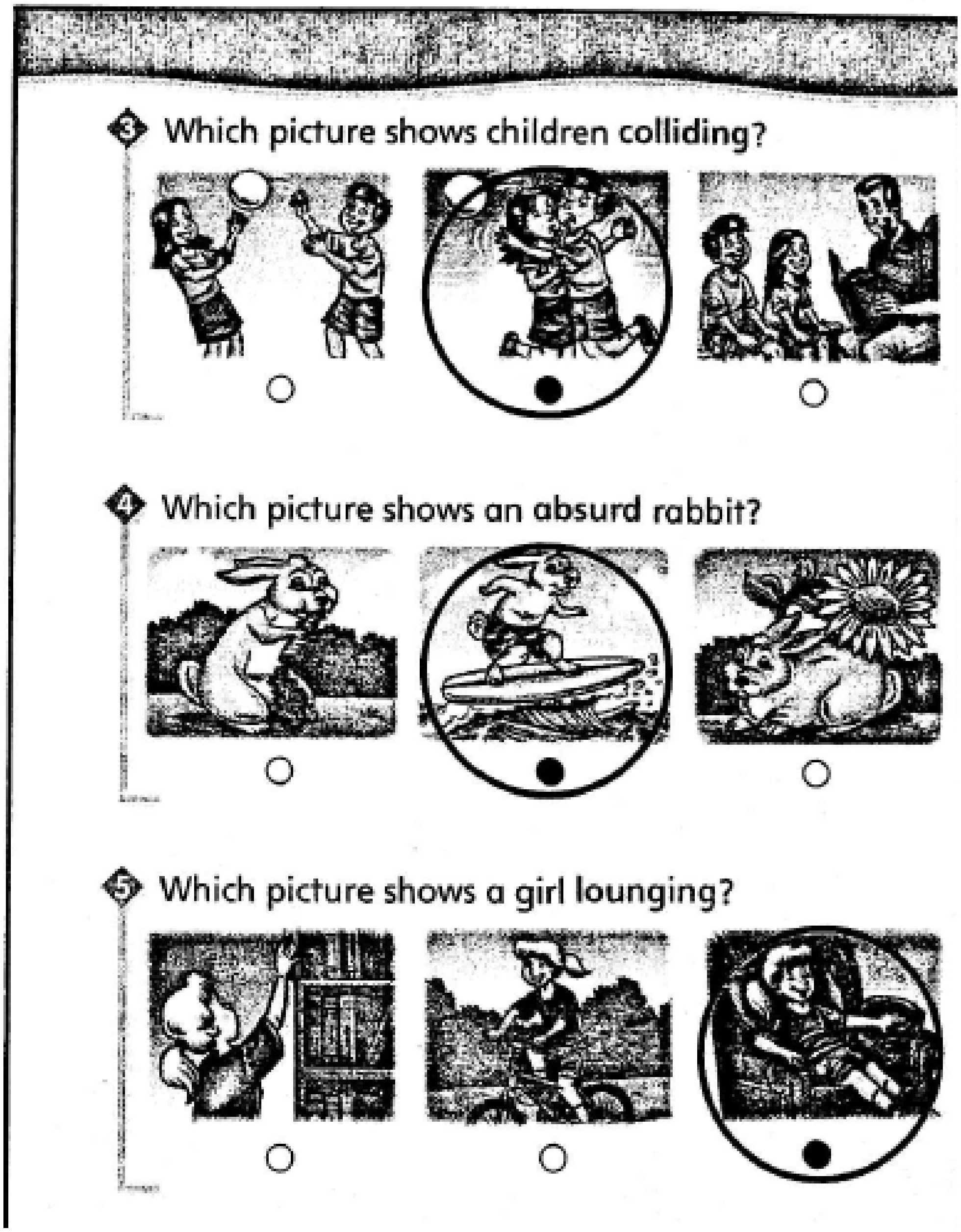


	👍	👎
1	Yes	No
2	Yes	No
3	Yes	No
4	Yes	No
5	Yes	No

Lesson 7

APPENDIX B

Sample Receptive Picture Curriculum Based Vocabulary Assessment



3 Which picture shows children colliding?

○ ● ○

4 Which picture shows an absurd rabbit?

○ ● ○

5 Which picture shows a girl lounging?

○ ○ ●

APPENDIX C

Fidelity Observation for Teacher Administration of Weekly Assessments

Teacher: ___________________________ Observer: ____________________

School: ____________________________ Date: ______________________

Yes/No assessment (Booklet)	Observed	Not Observed	Notes
1. Teacher **does not provide target word definitions** before administering the assessments.			
2. Teacher ensures that each student has the **correct Yes/No Booklet** (either by handing booklets out individually, putting the booklets on the appropriate desks, etc.).			
3. Teacher ensures that all students **have a writing utensil** for completing the Yes/No assessment.			
4. Teacher asks students to turn to **appropriate page in the Yes/No booklet** (or, teacher takes steps to ensure that the students are responding on the correct page of the Yes/No Booklet).			
5. Teacher reads each question **loudly and clearly**, and gives students **enough time** to respond.			
6. Teacher ensures that each student **completes assessments independently**; no guidance is given related to the correct or incorrect answers (until after responses have been recorded).			

Yes/No assessment Start Time: _____ Yes/No assessment End Time: _______

Time for Q1	Time for Q2	Time for Q3	Time for Q4	Time for Q5
____ seconds	____seconds	_____seconds	_____seconds	____seconds

APPENDIX C Continued

Fidelity Observation for Teacher Administration of Weekly Assessments

Receptive Picture assessment (Workbook)	Observed	Not Observed	Notes
7. Teacher **does not provide target word definitions** before administering the assessments.			
8. Teacher ensures that each student has the **correct Receptive Workbook** (either by handing workbooks out individually, putting the workbooks on the appropriate desks, etc.).			
9. Teacher ensures that all students **have a writing utensil** for the completion of the Receptive Picture assessment.			
10. Teacher asks students to turn to **appropriate page in the Receptive Workbook** (or, teacher takes steps to ensure that the students are responding on the correct page of the workbook).			
11. Teacher reads each question **loudly and clearly**, and gives students **enough time** to respond.			
12. Teacher ensures that each student **completes assessments independently**; no guidance is given related to the correct or incorrect answers (until after responses have been recorded).			
13. Teacher **collects** the Yes/No Booklets and Receptive Workbooks.			

Picture assessment Start Time: ___ Picture assessment End Time: ____

Time for Q1 ___ seconds	Time for Q2 ____seconds	Time for Q3 ____seconds	Time for Q4 ___seconds	Time for Q5 ___seconds

APPENDIX D

Teacher Questionnaire: Yes/No Vocabulary Assessment

Please indicate your response to the following questions about the Yes/No assessment.

1. How **time-consuming** was it to administer the Yes/No assessment each week?

1	2	3	4	5	6	7	8	9	10
Not Time Consuming									Very Time Consuming

2. How **easy** was it to administer the Yes/No assessment each week?

1	2	3	4	5	6	7	8	9	10
Not Easy At All									Very Easy

3. Approximately how many times did you score the results **for your own use**? ____

4. To what extent were your students able to complete the assessments **independently** (i.e., **without peeking** at each other's responses)?

1	2	3	4	5	6	7	8	9	10
Never Working Independently									Always Working Independently

5. Please list some of the strengths of the Yes/No assessment:

____

____

6. Please list some areas for improvement for the Yes/No assessment:

____

____

7. Would you use the Yes/No assessment to monitor student progress if you were using the *Elements of Reading: Vocabulary* program independently (i.e., not as part of a study)? Why or why not?

____

____

8. Please use the space below for any additional comments regarding the Yes/No assessments:

____

____

APPENDIX E

Teacher Questionnaire: Receptive Vocabulary Assessment

Please indicate your response to the following questions about the Receptive Picture assessment.

1. How **time-consuming** was it to administer the Receptive Picture assessment each week?

1	2	3	4	5	6	7	8	9	10
Not Time Consuming									Very Time Consuming

2. How **easy** was it to administer the Receptive Picture assessment each week?

1	2	3	4	5	6	7	8	9	10
Not Easy At All									Very Easy

3. Approximately how many times did you score the results **for your own use**? ____

4. To what extent were your students able to complete the assessments **independently** (i.e., **without peeking** at each other's responses)?

1	2	3	4	5	6	7	8	9	10
Never Working Independently									Always Working Independently

5. Please list some of the strengths of the Receptive Picture assessment:

____

____

6. Please list some areas for improvement for the Receptive Picture assessment:

____

____

7. Would you use the Receptive Picture assessment to monitor student progress if you were using the *Elements of Reading: Vocabulary* program independently (i.e., not as part of a study)? Why or why not?

____

____

8. Please use the space below for any additional comments regarding the Receptive Picture assessment:

____

____

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