ASSESSMENT OF READING AND DYSLEXIA IN SPANISH SPEAKING ENGLISH LANGUAGE LEARNERS

by

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ABSTRACT

While significant research has been done on dyslexia with native English speakers, little is known about identifying dyslexia in English Language Learners (ELLs). This creates challenges for practitioners working with ELLs in schools who must make decisions about placement, interventions, and accommodations without having a clear indication of whether ELLs struggle with reading because of lack of English language exposure or a neurological conditions, such as dyslexia. Previous research, primarily involving monolingual native English speakers, has highlighted specific cognitive correlates of reading that help screen students with dyslexia at an early age. These cognitive correlates, which include Phonological Awareness (PA), Rapid Automatized Naming (RAN), and Processing Speed (PS), have consistently been linked to basic reading skills in English and other languages.

The present study had many objectives that could provide guidance for practitioners working with ELLs. First it explored the value of PA, RAN, and PS as predictors of basic reading skills in Spanish speaking ELLs. Second, it investigated a model that combined tasks of PA, RAN and PS that had the highest correlations to aspects of reading. Third, it explored the role of Vocabulary (V) in both English and Spanish in the development of reading skills in ELLs. Fourth, it aimed at establishing the use of the Simple View of Reading (SVR; Gough & Tunmer, 1986), which postulates that reading is the product of decoding and listening comprehension skills, for the assessment of reading in ELLs. Finally, it incorporated findings from this study for an adaptation of the SVR for use with ELLs.

Findings suggest that RAN, PA, and PS, as measured in this study, are highly correlated to basic reading skills in Spanish speaking ELLs, and that these can be used for the assessment of reading and dyslexia in this population. This study also demonstrated that a model that included RAN numbers and phoneme deletion in English can accurately predict reading performance. Findings also indicate that V in English is highly correlated to basic reading skills in English,

and that the model of the SVR can be replicated with the population sampled in this study. Finally, case study analyses illustrate how a model similar to the SVR, which incorporates RAN and PS, as well as V, can be used for the assessment of reading and dyslexia in ELLs.

CHAPTER 1

INTRODUCTION

The U.S. Department of Education (USDOE, 2009) reports that 21% of children (ages 5-17) speak a language other than English at home. Of these children, Spanish-speaking children constitute the majority and are considered among the group who speak English with difficulty. Given their second language difficulties, English Language Learners (ELLs) with Spanish as their first language (Language 1 or L1), tend to exhibit lower academic achievement, particularly in literacy (Klingner, Artiles, & Méndez Barletta, 2006). For the most part, these children fall behind in literacy because they are learning to read and write in a language that they do not speak. However, in addition to their second language learning challenges, some of these children will struggle with literacy because they have dyslexia and other reading disabilities. As with every population learning to read in any language, 10-15% of ELLs are likely to have dyslexia, a neurological disorder. However, it is very difficult to differentiate between ELLs with and without dyslexia and provide appropriate interventions that match their needs because language learning often delays academic progress. While Spanish ELLs without dyslexia need time to achieve an academic level of English, Spanish ELLs with dyslexia need early, targeted interventions that develop phonological awareness and basic reading skills in both English and Spanish. Educators recognize the different needs of ELLs with and without dyslexia, but are often faced with the dilemma of early, but inaccurate diagnosis, or delayed, but accurate diagnosis. Should educators wait until Spanish speaking ELLs develop enough English proficiency to test them for learning disabilities, or risk erroneous labeling of children with a learning disability at an early age? Unfortunately, there is no easy answer to this question, leading to different approaches to the diagnostic procedures for dyslexia in ELLs across K-12 districts in the United States (Youman & Mather, 2012). Most school districts today cannot come to a consensus regarding the best methods to diagnose dyslexia and learning disabilities with some using a discrepancy formula (an ability measure such as an intelligence test used to predict achievement), others implementing Response to Intervention (RTI) without pinpointing a specific diagnosis, and others using a Pattern of Strengths and Weaknesses (PSW) approach. All three methods have their strengths and weaknesses, but educators are still far from ensuring that overidentification and underidentification of dyslexia does not occur. The following section first reviews the current definition of reading and dyslexia, followed by a historical perspective of assessment practice in the schools. Subsequent to this review, an alternative diagnostic model, which is the basis for this study is presented.

Reading and Dyslexia

Reading is a complex activity that involves the effective and simultaneous activation of various cognitive skills related to language, memory, visuospatial thinking, and attention. To be able to read in English, an alphabetic orthography, one must be able to automatically integrate the written symbols that represent each sound into whole words that correspond to the spoken language. In most children, this ability develops sequentially after literacy instruction, reaching automaticity around the age of seven (Brunswick, 2010). For some children, however, reading remains a challenging task, even after years of instruction. These children lack the neural mechanisms that are necessary for accurate and fluent reading, thus failing to become automatic readers that can gain meaning from text. If their difficulties are at the neurological level and cannot be explained by environmental factors (e.g. language, inappropriate instruction, etc.), these students are often diagnosed as having dyslexia. Although other terms used with these students include Specific Learning Disability (SLD; Individuals with Disabilities Educational Act, IDEA, 2004), Specific Learning Disorder with impairment in Reading and Specific Learning Disorder with Impairment in Reading (DSM-V) the term dyslexia is used throughout this paper, since it is the term most commonly used in the literature. In addition, dyslexia is becoming a common term used in schools with several school districts around the U.S. beginning to screen for dyslexia in the early grades.

Dyslexia is a neurological disorder characterized by difficulties in word recognition, decoding abilities, and spelling skills (International Dyslexia Association, IDA, 2010). It is estimated that between 10 to 15% of all school children in the United States have dyslexia (Fletcher, Lyon, Fuchs, & Barnes, 2007). Although it was previously believed that dyslexia was a disorder that affected only individuals who were learning to read in English, research in a variety of languages has demonstrated that this disorder occurs across languages (Brunswick, 2010). The symptoms and manifestation of dyslexia, however, depend highly on the orthography of the language, with irregular orthographies, like English, mostly presenting challenges in accurate decoding and spelling (Martin et al., 2010), and consistent orthographies, like Spanish, mostly presenting challenges in the speed and automaticity of reading (Jiménez & Ramirez, 2002). Regardless of how dyslexia is manifested, children with dyslexia in any language have difficulty connecting the symbols they see in writing to the speech sounds that these symbols represent and therefore have difficulties using reading and writing as a source for acquiring and producing information. For this reason, it is important to screen and diagnose students with dyslexia, so that educators can find strategies to help increase their reading and writing abilities and/or find alternative ways to help students succeed in their educational and professional goals.

In-School Assessment of Dyslexia in the United States

There are several ways in which school districts assess students for dyslexia. In some cases, dyslexia is diagnosed through the use of the "discrepancy formula," a comparison of intellectual ability and reading achievement. Thus, a standardized measure of intellectual ability provides the "expected achievement" in reading based on cognitive abilities and an achievement measure in reading provides the "actual performance" in reading. When an individual fails to read efficiently, based on cognitive abilities and reading instruction, the discrepancy is defined as dyslexia. Although widely used, the discrepancy formula is problematic because it relies heavily on verbal testing through standardized measures and procedures. Consequently, individuals who are at a language disadvantage, including English Language Learners (ELLs), are often misdiagnosed or fail to reach set discrepancy criteria. The discrepancy formula also delays diagnosis of dyslexia, since most children need to get behind in reading before they can be tested for dyslexia.

As an alternative to the use of the discrepancy formula, in recent years, researchers and educators have instituted other assessment procedures for the diagnosis of dyslexia. One of these alternative assessment procedures tracks children's Response to Intervention (RTI; Fuchs, Mock, Morgan, & Young, 2003) to research-based, tiered instruction. This assessment approach provides early interventions that are essential for reading development, therefore providing a solution to the "wait-to-fail" nature of the use of the discrepancy formula. However, within this procedure, the cause or diagnosis that explains the reason for failure remains unknown. A lack of diagnosis is problematic for children with dyslexia because the interventions they need are vastly different from those that are effective with children who struggle with reading for other reasons (e.g. ELLs, children with lack of exposure to reading, etc.). Simply put, providing the same intervention to children who fall behind in reading does not recognize the neurological or environmental profile of each child.

Another alternative method to the discrepancy formula for the diagnosis of dyslexia is the use of a Pattern of Strengths and Weaknesses (PSW; Hanson, Sharman, & Esparza-Brown, 2009). This method combines assessment and intervention at specific times of reading development to determine the cause of reading failure and provide targeted interventions that match the neurological and environmental profile of each child. PSW approaches are useful for the diagnosis of dyslexia because they provide models for assessment and intervention, which are based on four primary principles. First, the use of a Full Scale IQ is irrelevant, except for Intellectual Disability (ID) diagnoses. For students with dyslexia, this is particularly important, as they tend to perform below average in standardized batteries that group together verbal and analytical skills. Second, children with dyslexia often perform in the average or above average range in all their academic and cognitive abilities, except for the isolated skills that define their disability. Thus, a student with dyslexia will show weaknesses in basic reading and spelling skills and the cognitive correlates of reading (i.e. phonological awareness, rapid naming, and processing speed). Third, results in cognitive tasks should match the academic tasks that depend on them. And finally, some of the other cognitive abilities that are not related to the disability should be average or above average. Although the PSW approach provides a combination of diagnostic exploration and an emphasis on targeted intervention, there are still few guidelines as to how to diagnose dyslexia in young children and ELLs.

A school district's model for the assessment of dyslexia (i.e., one of the three models described above) usually dictates the process that an evaluation team takes when assessing children for dyslexia. In most cases, these models are applied for the assessment of monolingual English speaking children. However, in some cases, evaluators must use their judgment to modify these evaluation procedures for the assessment of reading and dyslexia in ELLs. Unfortunately, there are no established procedures for the assessment of ELLs, leading to disparities in the methods employed by evaluators who deal with this population. The following section reviews some of the most common evaluation procedures employed by educators who are in charge of assessing reading and dyslexia in ELLs.

Current In-School Evaluation Procedures for the Diagnosis of Dyslexia in ELLs

The first, and most common evaluation practice that educators use for the assessment of ELLs is English language testing. Although the establishment of a discrepancy is the most commonly used method for assessment of learning disabilities in ELLs, it is also the one that yields the most biased results, specifically, overidentification of ELLs as having a learning disability when assessed with a discrepancy formula (Ortiz, 2011). Research reveals that, on average, ELLs tested in English perform significantly below their monolingual English-speaking peers because of their deficiencies in vocabulary and phonemic awareness (Wilkinson, Ortiz, Robertson, & Kushner, 2006). English is considered a “deep orthography” with a great variety of syllable patterns and with multiple irregularities between the sounds that make up the language and the spelling patterns that represent these sounds in writing. While all children learning to read and write in English face difficulties with the irregular nature of this language, ELLs experience a higher degree of difficulty. In some cases, phonological skills from L1 will transfer to L2, but in other cases children may experience negative language transfer that interferes with literacy development in L2 (Figueredo, 2006). An evaluator who is not aware of common L1 negative transfer errors in English would score these errors as incorrect responses during standardized assessment. Furthermore, directions and acceptable responses are highly dependent on the vocabulary used in a specific test; thus, while assessment results may suggest low performance due to lack of skill or knowledge, results may actually only reflect low vocabulary in L2.

A second assessment method for the identification of ELLs who do not make progress in reading involves the modification or adaptation of a standardized test or task. In order to meet the needs of linguistically and culturally diverse learners, evaluators often choose to eliminate test items that are considered culturally biased, repeat directions, accept responses in L1 or L2, administer only portions of standardized tests that do not rely on oral comprehension, and extend or eliminate time constraints. These practices are aimed at allowing learners from diverse backgrounds to perform at their full potential. However, when any of these modifications takes place during the evaluation of ELLs, the norms of each test or task can no longer be considered valid. Since the test was not administered using the standardized procedures, the results do not provide information on how the examinee compares to peers in the norm group. In addition, each evaluator may modify testing differently, therefore removing the objectivity of the test. In other words, because of the modifications chosen by an evaluator, a child may be diagnosed with dyslexia; however, a different evaluator, who chose different modifications, may not reach the same conclusion (Ortiz, 2011). Another modification may include using an interpreter or translator to make sure the examinee understands the questions being asked and the items being administered. This practice is problematic because it assumes that if ELLs understand the directions of the test, they will be able to perform similarly to their monolingual peers. Still, even after understanding what is being asked, an ELL may not have the necessary language to respond, or may be confused by the test content. Furthermore, a translator who may or may not have experience with standardized assessment may simplify or change the language of the test, which is often a key aspect of the standardization of the test.

A third common practice in the assessment of ELLs who are suspected of having dyslexia involves nonverbal testing. Evaluators who use this assessment method employ standardized nonverbal tests to assess the cognitive skills of ELLs. The directions and answers in these types of tests are given visually or via gestures, thereby reducing the need for oral language. Unfortunately, these types of assessment procedures have little use for the diagnosis of dyslexia. From nonverbal assessments, an evaluator may be able pinpoint memory or processing deficiencies, but these may have little to do with reading, a language-dependent task. Simply put, it is difficult to assess dyslexia, a reading disorder, without administering objective linguistic measures of reading-related abilities and reading.

A final common practice in the assessment of ELLs relies on the use of native-language tests. A number of assessment batteries have been translated into various languages and are often used in school and clinical settings to evaluate ELLs. Native-language testing, however, may not provide an accurate description of skills in ELLs (Ortiz, 2011). In particular, these tests may provide useful information about monolingual individuals in the language of the test, but could present inaccurate information about an individual who is learning a second language. The individuals included in the norming sample of translated tests are usually monolingual, learning to read in their native language, and growing up with monolingual parents. For example, most Spanish translations of tests used in U.S. schools were normed on individuals in Mexico or other Spanish-speaking countries. While these tests may be appropriate to diagnose dyslexia in monolingual Spanish speakers, they may not be appropriate for diagnosing dyslexia in Spanish-speaking children who are learning to speak, read, and write in English, but use Spanish for their oral communications with family. Basically, monolingual standardized tests often do not meet the characteristics of ELLs who have an intricate range of language skills that mixes English and their native language.

Study Purpose: An Alternative to Current Assessment of Reading and Dyslexia in Spanish Speaking ELLs

As an alternative to current reading and dyslexia assessment practice in ELLs, this study examined a data-driven model that integrates the measurement of cognitive and achievement tasks that are directly linked to reading. Based on past research, this study explored reading development in ELLs as a combination of cognitive correlates, basic reading skills, and oral language skills. The cognitive correlates, for the purpose of this study, included Phonological Awareness (PA), Rapid Automatized Naming (RAN), and Processing Speed (PS); basic reading skills involved Decoding (D) and Reading Fluency (RF); and oral language skills were measured as a combination of Vocabulary (V) and Listening Comprehension (LC). With the goal of establishing the importance of each of the variables in this study as they relate to reading and dyslexia in ELLs, the study had three main purposes: to establish the relationship between the cognitive correlates of reading and basic reading skills in Spanish speaking ELLs; to determine the role of V in the development of reading; and to adapt a model similar to that of the Simple View of Reading (SVR) for the classification of ELL students based on their reading profiles.

The first objective of this study was to establish the cognitive correlates of reading that were the best predictors of basic reading skills in Spanish speaking ELLs. As previously mentioned, the cognitive correlates of this study are PA, RAN, and non-linguistic PS. PA is the ability to perceive and manipulate the sounds that make up the language a person speaks (Mather & Wendling, 2011). This skill is essential for reading since, during the early stages of literacy development, children learn to map the sounds that make up each word into the corresponding symbols that represents these sounds in writing (Hulme & Snowling, 2009). Children who do not develop this natural perception skill are likely to experience difficulties in reading and writing (Goswami, 2010). Thus, PA can serve as a clear differentiator between children with and without dyslexia. The second variable in this study, RAN, involves rapidly naming familiar objects and symbols. When measured early, this task involving language retrieval has been linked to later performance in RF (Wolf, 2007); therefore, RAN tasks can also help differentiate between students with and without dyslexia who will struggle with reading. Processing Speed (PS) refers to the ability to quickly and accurately process incoming information (input) and/or produce an outgoing response (output). Similarly to RAN, PS relates to reading because readers need to quickly recognize symbols in writing to connect these symbols to corresponding oral language for meaning (Mather & Wendling, 2011). Though PA, RAN, and PS have been used for the early identification of individuals with dyslexia in a number of languages (Ziegler & Goswami, 2006), they are used for the assessment of Spanish speaking ELLs in this study; a population that has remained unexplored. PA, RAN, and PS are appropriate assessments for reading and dyslexia in ELLs because they can be assessed early and low performance in these tasks tends to persist in students with dyslexia despite adequate literacy instruction, thus providing insight on neurological mechanisms that are essential for literacy development. Several research studies, discussed in Chapter 2, show the persistence of these three correlates as predictors of reading performance and dyslexia.

Provided the ample research on the cognitive correlates of dyslexia, this study speculated that there would be a high correlation between PA, RAN, and PS with D and RF. Finding a significant correlation between the cognitive correlates and basic reading skills would allow evaluators working in schools to quickly classify readers according to the cognitive skills that are associated with reading and their performance on basic reading tasks. Thus, the three general categories of readers that arise from a comparison of cognitive correlates and basic reading skills include normally developing readers, readers with possible dyslexia, and readers that struggle with reading because of other environmental of neurological factors. Figure 1 was created in order to illustrate this relationship.

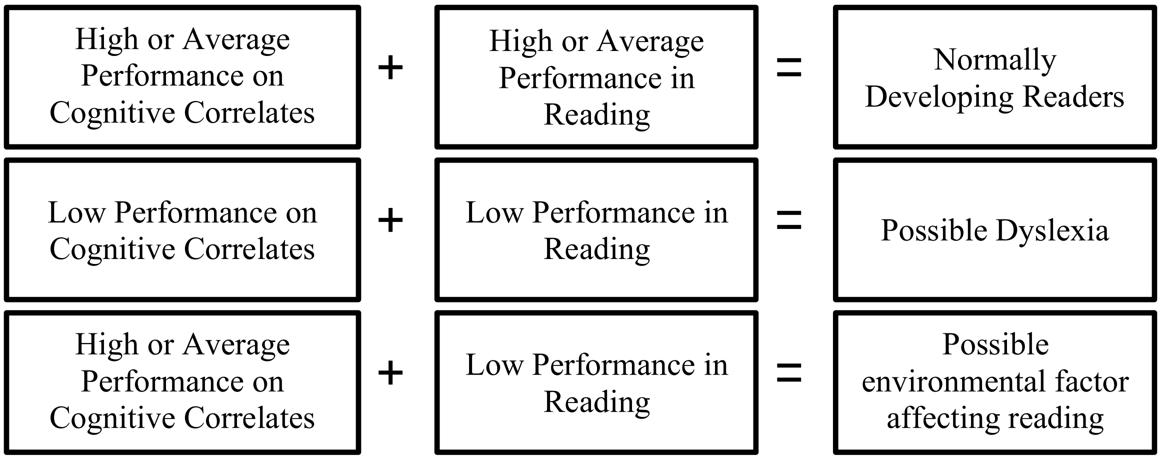

Figure 1. Categories based on cognitive correlates and basic reading skills.

A second goal of this study was to determine the role of V in the development of basic reading skills and Reading Comprehension (RC) in the population sampled in this study. Assessment of V is important because it directly impacts the ability of a reader to recognize and read words, and it directly affects reading and LC (Mather & Wendling, 2011). In ELLs, specifically, lack of exposure to vocabulary in both English and Spanish is likely to affect V development and reading (Ortiz, 2011). Simply put, if a child has low V, it would be expected that aspects of reading, in particular RC and RF, be below average. A discrepancy between V and reading skills, on the other hand, suggests dyslexia or lack of reading instruction. Figure 2 illustrates the possible profiles that could distinguish between readers based on the information provided by an assessment of V. Thus, an ELL with average or above average reading skills and average or above average vocabulary is developing reading skills as expected; an ELL with low reading skills and average or above average vocabulary could have dyslexia; and an ELL with low reading skills and vocabulary could have dyslexia and other environmental or other factors that have affected reading development.

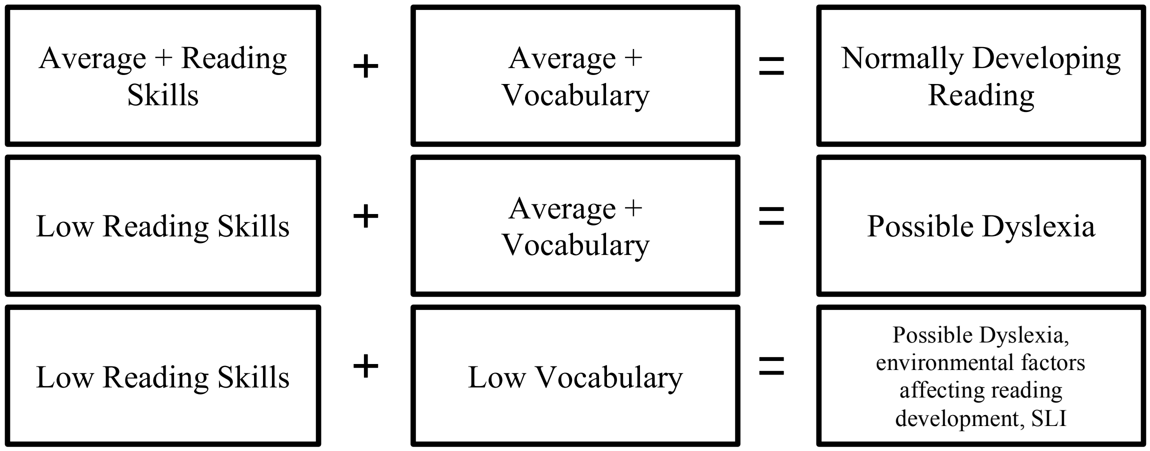

Figure 2. Categories based on basic reading skills and vocabulary.

A third purpose of this study was to explore and adapt the model of the Simple View of Reading (SVR) to establish the importance of LC, D, and RC in helping distinguish normally developing readers from readers with dyslexia. According to the SVR, successful reading comprehension is the product of D skills and LC (RC = D x LC). Establishing that this formula is applicable to ELLs can further help pinpoint the cause of reading failure. It has been well established that individuals with dyslexia acquire LC skills along with their peers, but reading fails to develop along with normal oral V, despite appropriate literacy instruction (Mather & Wendling, 2011). For this reason, most diagnostic methods that determine the existence of dyslexia include a measure of LC to determine that while this area is developing normally, language development in reading and writing is lagging behind. This method, often used as part of discrepancy model and Pattern of Strengths and Weaknesses (PSW) evaluation methods, can be useful for assessing monolingual English speakers. However, in ELLs, LC in English alone cannot be used for the diagnosis of dyslexia because ELLs might have not yet developed enough second language proficiency, and may therefore fail to meet the criteria necessary for the diagnosis of an existing condition like dyslexia. LC in Spanish, on the other hand, can provide a more accurate picture of steady or delayed language development and help determine if an ELL student has dyslexia. But, relying solely on LC measures in L1 can undermine the true nature of language development in ELLs, who are growing up in a bilingual environment and developing a lexicon that mixes both their L1 and L2. To be sensitive to the complex development of LC skills in ELLs, the data-driven model tested in this study combined assessment of LC skills using English and Spanish measures that provided a more accurate picture of overall LC development. Similar to the profiles suggested by the SVR, reading profiles proposed for this population are presented in Figure 3.

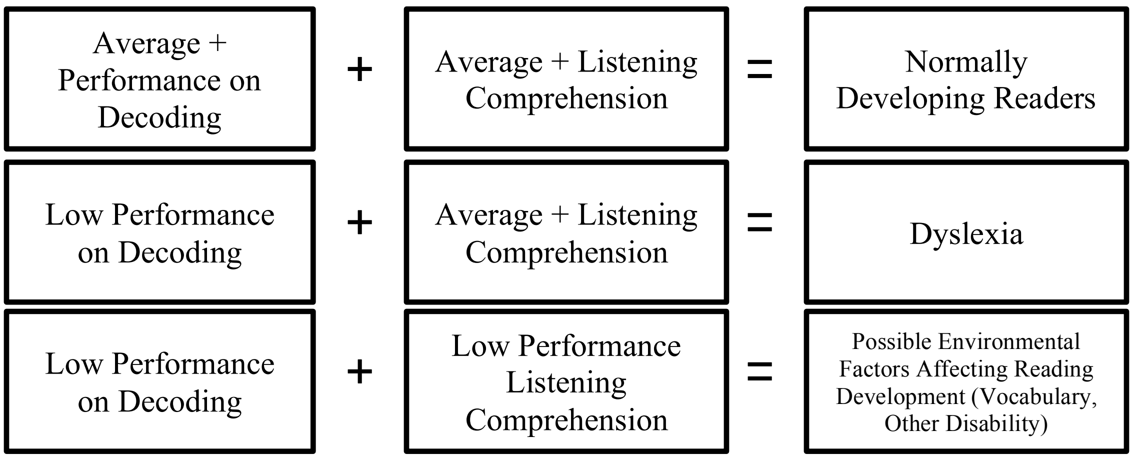

Figure 3. Categories from Decoding (D) and Listening Comprehension (LC).

The ultimate goal of this study was to take all of the interest variables to help pinpoint the cause of reading failure in order to implement appropriate interventions. It was speculated that, given the complex nature of their language and reading development, ELLs with dyslexia are likely to perform poorly on PA, RAN, PS, D, and RF, but higher by at least one standard deviation on measures of V and LC in at least one language. Thus, although they have the necessary oral language skills to learn to read, they have a neurological impairment that precludes them from developing reading skills along with their peers. Figure 4 illustrates how all of the variables in this study define a clear profile of an ELL with dyslexia.

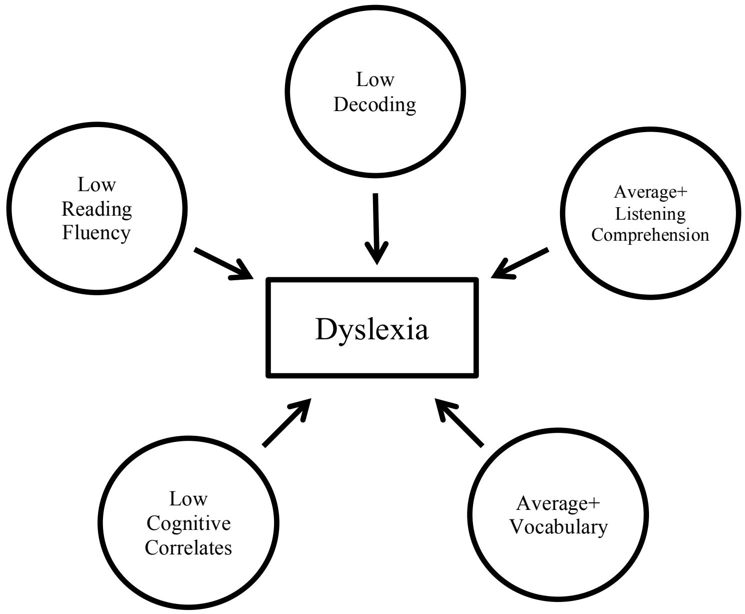

Figure 4. Profile of an ELL with dyslexia.

To explore each of the interest variables in this study, the following research questions and hypotheses were formulated:

Assessment of Reading in ELLs

1. What tasks within each cognitive correlate of reading (RAN, PA, and PS) show a high correlation to RF and D in ELLs? The general hypothesis for this question is that: There is a difference in the correlation coefficients of Rapid Automatized Naming (RAN), Phonological Awareness (PA), and Processing Speed (PS) tasks with RF and D performance in English and Spanish. The interactions between each cognitive correlate and achievement measure were separated by each cognitive correlate and basic reading skills task in order to examine the relationships between these tasks.
    a. Hypothesis 1a: Performance in Rapid Automatized Naming (RAN) is highly correlated to performance in Reading Fluency (RF) tasks.

b. Hypothesis 1b: Performance in Rapid Automatized Naming (RAN) is highly correlated to Decoding (D) tasks.

c. Hypothesis 1c: Performance in Phonological Awareness (PA) is highly correlated to Reading Fluency (RF) tasks.

d. Hypothesis 1d: Performance in Phonological Awareness (PA) is highly correlated to Decoding (D) tasks.

e. Hypothesis 1e: Performance in Processing Speed (PS) is highly correlated to Reading Fluency (RF).

f. Hypothesis 1f: Performance in PS is highly correlated to D tasks.

2. Can the cognitive correlates with the highest correlation to reading significantly predict basic reading skills?

   a. Hypothesis 2: The cognitive correlates with the highest correlation to reading skills significantly predicts basic reading skills.

Role of Vocabulary in the Reading Development of ELLs

3. Does V predict basic reading skills in ells?

   a. Hypothesis 3: Vocabulary (V) in English and Spanish, and a combination of both languages, predict reading in English and Spanish as measured by Decoding (D), Reading Fluency (RF), and Reading Comprehension (RC).

Use of The Simple View of Reading for the Assessment of Reading and Dyslexia in ELLs

4. Does the model of the SVR apply to the population in this study and can it be used to distinguish among normally developing readers, students with dyslexia and students with other language disabilities (e.g. Specific Language Impairment; SLI) in Spanish/English ELLs? The general hypothesis for this question was as follows:

   a. Hypothesis 4: D and LC can significantly predict RC and can be used to classify participants among the four possible categories of the SVR.

Assessment of Dyslexia in ELLs

5. Can measures of PA, RAN, LC, and V distinguish among normally developing readers, students with dyslexia, and students with environmental factors or other language disabilities affecting reading (e.g. lack of language exposure)?
   a. Hypothesis 5: Measures of PA, RAN, PS, V, D, RF, and LC will distinguish students with normal reading development, dyslexia, and other environmental factors.

The present study has many practical implications for the field of education and school psychology. First, it is known that PA, RAN, and PS are correlates of reading and dyslexia in monolingual speakers learning to read in their native language. This study will shed light on the correlation of PA, RAN, and PS with dyslexia in ELLs. Second, currently there are no established methods for diagnosing dyslexia and other reading disabilities in ELLs. This study will offer support for the use of reading measures in English and Spanish, compared with PA, RAN, and PS measures in two languages for the screening and diagnosis of reading and dyslexia. This is particularly important because the traditional discrepancy formula and other diagnostic methods have failed to be sensitive to the characteristics of ELLs (Geva & Farnia, 2012). Third, this study will increase knowledge of the correlates of reading and dyslexia by using ELLs as the population, something that is yet to be explored. Specifically, the present study will explore which language PA measure (English or Spanish) has a higher correlation with reading in ELLs. It will also investigate which type of RAN task (object, number, or letter) has the highest correlation to reading fluency in ELLs. Fourth, the study will support the use of reading measures, including the SVR along with RAN, PA, and PS tasks for the identification of ELLs with dyslexia; students who need one-to-one instruction in basic reading skills; students with other, language comprehension related disabilities, who need instruction on comprehension strategies; and ELLs without dyslexia, who need exposure to reading in L1 and L2 and time to develop language and literacy skills.

Definition of Terms

Alphabetic Language: a language that uses graphic symbols or combination of symbols to represent individual sounds within words in writing (e.g. English and Spanish).

Basic Reading Skills: reading skills that involve basic processes, such as D and RF.

Cognitive Correlates: cognitive skills that are highly correlated to reading, such as PA, RAN, and PS.

Decoding (D): the ability to use sound-symbol knowledge to correctly pronounce written words.

Discrepancy Model: A method for the diagnosis of Specific Learning Disabilities (SLD) that uses a comparison of an individual's cognitive performance on standardized measures of intelligence to predict performance on standardized achievement tests.

Dyslexia: A specific learning disability that is neurological in origin. It is characterized by difficulties with accurate and/or fluent word recognition and by poor decoding and spelling abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge. (International Dyslexia Association, IDA, 2010).

English Language Learners (ELLs): individuals who are in the process of learning English as a second language or L2.

Language 1 (L1): a person's native language.

Language 2 (L2): a person's acquired language that was developed after L1. Subsequent languages would be labeled according to the order in which they were acquired.

Listening Comprehension (LC): language development that represents all verbal ability, including vocabulary, syntax, inferencing, and the construction of mental schemas (Kirby & Savage, 2008).

Logographic Languages: languages that use a symbol or combination of symbols to represent entire words in writing (e.g. Chinese and Japanese Kanji).

Negative Language Transfer: Knowledge in L1 that impedes development or interferes with the development of L2 or subsequently learned languages.

Oral Language Skills (oral language skills): skills necessary to understand spoken language, such as V and LC.

Pattern of Strengths and Weaknesses (PSW): a method for the diagnosis of SLD which is based on a profile of cognitive strengths and deficiencies and the academic areas that are likely to be impacted by these strengths and weaknesses.

Phoneme: a single speech sound.

Processing Speed: the ability to process incoming information (input) and produce a response (output).

Phonological Awareness (PA): the ability to hear, distinguish, and manipulate the sounds that make up words.

Positive Language Transfer: Knowledge in L1 that helps the development of L2 or any other learned languages.

Pseudowords: words that maintain the orthographic patterns of other words in a language, but have no morphological meaning (e.g. cotch, drick, fote, etc.).

Rapid Automatized Naming (RAN): tasks that require rapid naming of familiar objects or symbols.

Reading Disability: a condition in which reading achievement (measured by an individually administered standardized test of reading accuracy or comprehension) is substantially below the individual's expected level, given his or her chronological age, measured intelligence and age appropriate education (DSM-IV-TR, 2004).

Reading Fluency (RF): the ability to read text accurately and quickly.

Rhyme: A word that corresponds with another word in its final sound.

Simple View or Reading (SVR): a definition of reading that states that Reading Comprehension (RC) is the product of Listening Comprehension (LC) and Decoding (D). RC = LC x D (Gough & Tunmer, 1986).

Specific Language Impairment (SLI): a delay in oral language development despite normal development in other cognitive abilities and intact physical development of auditory and oral mechanisms.

Specific Learning Disability (SLD): a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations, including conditions such as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. The term does not include learning problems that are primarily the result of visual, hearing, or motor disabilities, of mental retardation, of emotional disturbance, or of environmental, cultural, or economic disadvantage (Individuals with Disabilities Educational Act; IDEA, 2004).

CHAPTER 2

LITERATURE REVIEW

This chapter first reviews studies that link the cognitive correlates of reading and dyslexia, PA, RAN, and PS to reading in a number of languages. Following this review, the chapter considers the importance of the necessary mechanisms for successful reading, D, LC, and RF. The majority of the research presented in this chapter was conducted in English, but some studies that explore reading performance in different alphabetic and logographic languages also provide insights on the generalization of the variables chosen for this study.

Cognitive Correlates of Reading and Dyslexia

Phonological Awareness (PA). Regardless of characteristics of their native language, children must initially recognize the sounds and sound patterns that make up their language in order to develop effective literacy skills (Goswami, 2006). Children acquire these auditory skills progressively, beginning with simple recognition of rhymes, to later recognition of the phonemes (i.e. sounds) that make up each word. Developing PA skills is essential for the early development of literacy in alphabetic languages like English and Spanish, as each sound is assigned a symbol or combination of symbols to be represented in writing (Uhry, 2005). Individuals with dyslexia tend to have difficulties with PA, which often result in poor word reading and spelling (Mather & Wendling, 2011).

Longitudinal studies in various countries and in several languages have shown that PA is a strong predictor of later reading skills. These studies measure phonological awareness prior to enrollment into school and then compare each student's performance in reading and spelling after a few months or years of literacy instruction. For example, in their 2004 longitudinal study of 161 children in Ontario, Canada, Parrila, Kirby, and McQuarie examined the relationship between PA in kindergarten and later reading development in grades 1, 2, and 3. PA was a strong predictor of later reading skills, particularly when measured in first grade. The study also gathered data on other cognitive factors including articulation rate, verbal short-term memory (STM), and RAN. Of these factors, articulation rate and verbal STM did not predict later reading development when PA and RAN were controlled. PA and RAN combined, on the other hand, shared a large amount of the predictive variance with reading development. In particular, letter recognition in kindergarten and word reading in third grade. Other studies conducted in English, which support PA as a good predictor include Bradley and Bryant (1983), who administered a PA task to 400 children at ages 4 and 5 and later measured reading and spelling at ages 8 and 9, and Fernandez-Fein and Baker (1997), who measured rhyme knowledge in 59 prekindergarten children with a later correlation to reading skills in second grade.

Studies in languages other than English also support the predictive value of PA for later reading and spelling skills. In a study conducted in Finnish, data collected on 198 children at the ages of 3.5, 4.5, and 5.5 demonstrated that early measures of PA can accurately predict risk for dyslexia at a later age. In addition to PA, other variables that increased the predictive nature of PA included RAN, letter knowledge, and a history of dyslexia in the family (Puolakanaho et al., 2007). The findings reported by Puolakanaho et al. (2007) are particularly important because in a language such as Finnish, where there is a near one-to-one correspondence between the sounds that make up the language and the letters that represent them in writing (i.e., 21 sounds in the language and 21 letters in the alphabet), PA has been speculated to have little predictive value. However, though PA difficulties are not easily detected after literacy instruction in shallow orthographic languages like Finnish, if measured early, prior to formal literacy instruction, PA can accurately predict risk for dyslexia. In another study conducted in Greek, a language that also has near one-to-one correspondence between sounds and letters, PA was the best predictor of reading and spelling in 32 children in first grade (Porpodas, 1999). As with children learning to read in Finnish, the performance of the children learning to read in Greek, appeared to have reached a satisfactory level of PA awareness after literacy instruction, but their performance was still lower than that of those without reading difficulties.

Performance in PA has also been linked to later reading performance in non-alphabetic languages. A study of reading development in Hebrew consisting of seventy children separated into an experimental and control group showed that PA training is key to reading development (Geva, Wade-Woolley, & Shany, 1997). In this study, PA was measured at the end of kindergarten, and then subsequently at the end of first and third grades. The experimental group received an eight-month PA training program, which yielded significant differences in reading fluency and comprehension. This study is particularly important because it shows that PA awareness, even if explicitly taught, is highly linked to reading success. Similarly, in a longitudinal study of Chinese children, Ho and Bryant (1997) examined the relations between PA skills prior to reading instruction and the relationship of this performance to reading four years later. The strong relations between PA and reading, however, did not appear in this study until later stages of reading development. Instead, children showed a higher correlation between pre-reading visual skills and reading development. Researchers in this study concluded that in a logographic orthography, such as Chinese, where whole words are represented by one or two symbols, children tend to rely on visual processing during the first years of reading instruction. Thus, a child who learns the symbol for the word "man" (人) will first rely on memorization of this visual symbol as a representation of the word "man." In later stages of reading, however, as demonstrated by Ho and Bryant (1997), children begin to rely on phonological knowledge to read new words. Thus, the symbol for "wide" (广), which is read as "guang" together with the symbol for "state" (州), which is pronounced "zhou," phonetically make the word "Guangzhou" (i.e. Canton, the third largest city in China). In children with dyslexia learning to read Chinese, pseudocharacters comprised of combinations of phonetic characters (e.g. 广州) present a challenge because the parts that make up the word do not register as a whole new word. Thus, children with dyslexia reading Chinese show poor blending of phonetic characters to form a distinct word, inaccurate tonal pronunciation, and slower reading speed (Chan & Siegel, 2001; Ho & Bryant, 1997; So & Siegel, 1997).

Evidence for the relation between PA and dyslexia also comes from neurological studies of reading. The largest of these studies included a sample of 144 children with dyslexia and matched controls who received scans using functional Magnetic Resonance Imaging (fMRI) while completing PA tasks (Shaywitz et al., 2002). While reading pseudowords and real words, children with dyslexia showed a failure to activate posterior left-brain systems and instead showed an alternate pattern of activation, focused mostly on anterior portions of the left hemisphere with compensatory systems developing in the right hemisphere. This study supported that there is a neurological basis for dyslexia and that children with dyslexia process reading-related tasks, such as PA, differently. Similar neurological findings are reported in a number of languages, including Japanese (Seki, Kassai, Uchiyama, & Koeda, 2001), German (Kronbichler, Hutzler, Staffen, Mair, Ladurner, & Wimmer, 2006), and Italian (Brambati et al., 2006).

Other studies that support early performance in PA as a good predictor of later reading skills have been conducted in Swedish (Lundberg, Olofsson, & Wall, 1980), Norwegian (Hoien, Lundberg, Stanovich, & Bjaalid, 1995), Chinese (Siok & Fletcher, 2001), Dutch (Bekebrede, van der Leij, Plakas, Share, & Morfidi, 2010), Danish (Olofsson & Niedersoe, 1999), Italian (Paizi, Zoccolotti, & Burani, 2010), Japanese (Seki, Kasai, Uchiyama, & Koeda, 2007), and Spanish (Jiménez & Ramirez, 2002). Along with the studies previously discussed in this chapter, the findings support the importance of PA skills for efficient reading development and provide the basis for the use of PA tasks to differentiate between bilingual (Spanish-English) readers with and without dyslexia in the proposed study.

Rapid Automatized Naming (RAN). Similar to PA, RAN deficits are good early predictors of later difficulties in reading and spelling (Wolf, Bowers, & Biddle, 2000). Ample research has connected performance in rapid naming of objects, numbers, letters, colors, and a combination of any of these to reading. Like reading, RAN tasks require the integration of visual-verbal information within an element of time or speed (Mather & Wendling, 2011). Some believe that RAN in young children is a mini-circuit of the later-developing reading circuitry (Norton & Wolf, 2012). Thus, the same elements of visual-verbal integration that are required in RAN tasks resemble the processes that are required for successful reading. In most cases, however, RAN is mostly linked to reading speed, rather than accuracy, which is more linked to PA. Though some undermine the importance of RAN compared to PA in determining the existence of a learning disability, RAN is particularly useful when evaluating readers of languages with more consistent correspondence between letters and sounds (e.g., Spanish). In languages such as Spanish, the initial deficiencies in PA in readers with dyslexia tend to disappear after a few months of literacy instruction. This phenomenon occurs because once readers with dyslexia learn the names of the letters in the alphabet with its corresponding symbols in writing, the one-to-one correspondence between sounds and letters facilitates their phonological processing and reading and spelling accuracy, thus masking the presence of dyslexia. For this reason, measures of RAN coupled with reading fluency measures can help detect processing deficits that affect children reading more regular languages (Paizi, Zoccolotti, & Burani, 2010). Regardless of the native language of an emergent reader, RAN can, at a minimum, provide key information that helps identify children at risk of reading failure, and it is one predictor that is considered universal in individuals with dyslexia in any language (Tan et al., 2005). Several studies in English and a variety of other languages, which are described, also support the use of RAN tasks to predict reading performance.

Rudel and Denckla conducted the first studies on RAN in English during the 1970s. A particular study in 1976 involved 248 children, 128 described as children with learning disabilities, and 120 considered the control group based on reading performance in the average range when compared to peers (Rudel & Denckla, 1976). Tests of RAN tasks including objects, colors, numbers, and letters, distinguished children with dyslexia from controls and also from children with other learning disabilities within the experimental group. These findings established RAN as a key correlate of dyslexia and encouraged the exploration of RAN as a unique identifier beyond PA. Subsequent studies in English further support RAN as a correlate of dyslexia. Perhaps the largest of these studies involved a longitudinal analysis of reading skills in 945 children in grades K-2 (Schatschneider, Francis, Carlson, Fletcher, & Foorman, 2004). Results of this study revealed that along with early measures of PA and letter sound knowledge, RAN consistently accounted for the unique variance of reading performance at a later age. The correlation of RAN and reading $(r = .36)$ found by Schatschneider et al. (2004) was nearly identical to that of PA. Other studies provide similar findings, showing that RAN can help distinguish between children with and without dyslexia. Bowers and Swanson (1991), for example, collected measures of RAN in kindergarten and later reading fluency in first and second grade. The correlation of RAN performance and later reading was high $(r = 0.55)$. As with Schatschneider et al., the RAN-reading correlation was nearly identical to PA reading correlation, indicating that both measures have a similar predictive value. Other studies that further support the predictive nature of RAN to later reading skills include the prediction of reading and spelling performance in eighth grade for children whose RAN scores were measured in second grade (Scarborough, 1998), the persistence of poor RAN and reading abilities in poor readers first measured in third and subsequently fifth and eighth grades (Meyer, Wood, Hart, & Felton, 1998), and the differentiation of bilingual Chinese/English children with and without dyslexia through measures of RAN performance (Raschle, Chang, & Gaab, 2011). Similar studies that further support RAN as a predictor of later reading ability include a study of 278 children with reading disabilities (Frijters et al., 2011), a study of 21 adults with dyslexia with matched controls (Jones, Branigan, & Kelly, 2009), a longitudinal (first to second grade) study of 85 children at varying reading achievement levels (Manis, Doi, & Bhadha, 2000), a study of 154 children in third grade, from which 64 performed in the 10th percentile in grade level reading tasks (Meyer et al., 1998), an analysis of RAN among other reading correlates in 61 children in third grade grouped according to reading ability as below average, average, and above average (Savage et. al, 2005), and a study of 144 severely impaired readers in grades two and three (Wolf et al., 2002).

Evidence of the correlation of RAN with reading also comes from a variety of studies conducted in languages other than English. A retrospective look of longitudinal data in a study in Finland, showed that children who were diagnosed with dyslexia at the end of second grade had performed lower than their peers on an object RAN task at the age of 3.5 (Torppa, Lyytinen, Erskine, Eklund, & Lyytinen, 2010). Among the sample of 198 children, RAN was established as one the strongest predictors of dyslexia, along with expressive and receptive language and PA, even after controlling for other variables in the model. Findings highlighted the importance of RAN in this study and the early diagnosis of dyslexia, as RAN measures can be taken at a young age and prior to any reading instruction. Another study, conducted with children learning to read in Portuguese, showed that RAN is also a strong predictor of reading skills in this language. In the sample, comprised of 70 children in first grade and 69 in second grade, RAN accurately predicted reading and writing performance when PA was controlled (Albuquerque, 2012). The study focused on different RAN tasks including colors and digits, and a Rapid Alternating Stimulus (RAS) task, which alternated shapes and colors. The strongest predictor among the subtests of RAN was the digits task.

In studies of logographic languages, RAN also showed accurate prediction of reading ability. Ding and colleagues (2009), for example, examined RAN skills in 243 Chinese Mandarin-speaking children in grades 1 through 5. Results showed that performance on RAN was a significant predictor of various Chinese reading measures (Ding, Richman, Yang, & Guo, 2010). Interestingly, Ding et al. (2010) revealed that unlike unskilled readers of English and other alphabetic languages, who tend to show poorer performance on number RAN, readers of Chinese Mandarin showed lower performance on object RAN. A subsequent study, conducted with a sample of 102 bilingual (Chinese Mandarin-English) children, also revealed a consistent relation between RAN and reading in both languages (Ding, Guo, Yang, Zhang, Ning, & Richman, 2011). The RAN and RAS tasks utilized in this study accurately differentiated low performing readers from average and above average readers, providing support for the use of RAN to diagnose dyslexia in bilingual children.

Support for RAN measures as predictors of later dyslexia also comes from neuroimaging studies. In one study (Raschle et al., 2011), 20 children with a family history of dyslexia with an age range 5.1-6.9 years revealed significant reductions in grey matter volume as compared to matched controls without a family history of dyslexia. This brain volume reduction was also correlated with performance in measures of RAN and proved particularly useful in differentiating between pre-literate children with and without dyslexia. Kronbichler and colleagues (2006) found similar brain volume reduction of grey matter in 13 adolescents with dyslexia compared to 15 nonimpaired readers (ages 14-16). As in Raschle et al. (2011) the brain abnormality in Kronbichler et al. (2006) was also positively correlated with RAN tasks. As with findings from studies of PA and structural brain abnormalities in individuals with dyslexia, studies that have explored RAN and reading in this population provide evidence that dyslexia is a neurological disorder, affecting reading and its reading-related skills and correlates.

Processing Speed (PS)

Processing speed (PS) refers to the ability to quickly and accurately process incoming information (input) and/or produce an outgoing response (output). As it relates to reading, PS is important because readers need to quickly recognize symbols in writing to connect these symbols to corresponding oral language for meaning (Mather & Wendling, 2011). Most of the PS tasks that have been linked to reading and dyslexia involve linguistic responses (e.g., RAN), but there are other non-linguistic tasks that have also been linked to dyslexia (Shanahan et al., 2006). The proposed study will include non-linguistic measures of PS in order to examine other general processing deficits, often found in monolingual English speakers, which are also likely present in ELLs who struggle with reading.

Along with other interest variables, a study by Kail, Hall, and Caskey (1999) tested the relation between reading and the Visual Matching and Cross-Out of the Woodcock-Johnson Test of Cognitive Ability in 168 children. Both of these non-linguistic PS measures showed a high correlation with reading recognition and reading comprehension. Subsequent analyses of the data showed that general PS deficits explained RAN deficits in the sample. In a similar study (Kail & Hall, 1994), children completed non-linguistic PS tasks including the Coding subtest from the Wechsler Intelligence Test for Children – Revised (WISC-R) and the Visual Matching and Cross-out subtests from the Woodcock Johnson Test of Cognitive Ability. Participants in this study who had low reading skills also showed lower performance in non-linguistic PS tasks. Both studies, Kail et al. (1999) and Kail and Hall (1994) found that the deficiencies in non-linguistic PS appeared to be the reason for the deficiencies in RAN in students with low reading skills. Another study compared reading achievement to response time (RT) tasks requiring both linguistic and non-linguistic responses (Catts et al., 2002). Non-linguistic tasks included tapping, visual search, mental rotation, and picture matching tasks. Group comparisons of the sample of 279 children classified as good and poor readers, demonstrated that children in the poor reading group had slower times on the RT non-linguistic tasks. All other processing tasks, including RAN, also showed a high correlation to reading skills.

As with RAN, evidence for the connection between non-linguistic PS and reading also comes from neuroimaging studies. In a study that examined the neuroanatomical features of 43 children and how these features related to reading, low performance on PS differentiated children with poor reading abilities from those with similar brain abnormalities who had strong reading abilities (Leonard et al., 2011). The study by Leonard et al. (2011) found an anatomical risk index (ARI) defined as lower brain volume and perysilvan asymmetry, but these abnormalities were indicative of poor reading ability only in participants who performed poorly on the Visual Matching subtest of the WJ III. Authors of the study speculated that individuals who show the ARI but have high PS skills develop good reading abilities because their high PS compensates for their anatomical deficiencies. Findings reported by Leonard et al. (2011) are important because previous studies that examined structural brain abnormalities yielded inconsistent results (e.g., Leonard & Eckert, 2008); thus, structural brain abnormalities need to be combined with tests of PS to more accurately diagnose dyslexia using brain imaging technology.

Performance on PS tasks has also been used to determine differentiation and comorbidity of dyslexia and Attention Deficit/Hyperactivity Disorder (ADHD). For example, Willcutt et al. (2007) tested 395 children with ages ranging from 8 to 18 with ADHD, dyslexia, and normal reading and attention skills. Results indicated that although PS deficits are seen in both children with ADHD and dyslexia, children with dyslexia demonstrated higher deficits in PS. Similar studies also have supported a general (i.e. beyond language) deficit in PS in children with dyslexia (e.g. Willcutt, Pennington, Olson, Chhabildas, & Hulslander, 2005).

Achievement Reading Measures

The Simple View of Reading: Decoding (D) and Listening Comprehension (LC). Decoding (D), or word recognition, refers to the ability to apply knowledge of sound-symbol correspondences to correctly pronounce a written word (Mather & Wendling, 2011). Listening Comprehension (LC), on the other hand, constitutes the process of interpreting linguistic information, whether in the form of words, sentences, or discourse, with V being an important component (Gough & Tunmer, 1986). The study of D and LC in individuals with dyslexia spans for nearly half a century. In the 1960's and 1970's researchers began to argue that the ability to decode was at the core of reading ability (e.g., Fries, 1962; Gough, 1972; Rozing & Gleitman, 1977). Along with this view, Gough and Tunmer (1986) argued that the "common denominator" in every case of dyslexia is the difficulty decoding words despite having adequate LC. Several studies support this notion, including a study of 20 individuals with dyslexia and 20 normal readers matched by intelligence in grades 2-6 (Vellutino, 1979). In the analysis of performance in decoding tasks in the sample, children with dyslexia pronounced only about 7% of words correctly in a decoding task. Their performance increased to 40% by fourth grade. In contrast, their matched controls performed at an average of 50% and 73% in second and sixth grades, respectively. Similar findings were reported by Seymour and Porpodas (1980) and Snowling (1980). The evidence of weakness for D skills in children with dyslexia, provided by these studies, encouraged investigators to explore deficiencies in PA skills as the key marker of dyslexia (Gough & Hillinger, 1980). Today, it is well established that children with dyslexia have deficiencies in D as a result of poor PA skills (Shaywitz et al., 2002). Thus, the present study attempts to provide evidence for the generalization of the relations between D and PA awareness in bilingual Spanish/English speakers, along with RAN and oral language skills taking the approach of the SVR (SVR; Gough & Tunmer, 1986)

The Simple View of Reading (SVR) defines the components that are necessary for successful reading. In the SVR, reading comprehension (RC) is the product of listening comprehension (LC) and decoding (D); thus,

$$RC = LC \times D$$

The values of LC and D range from 0 (nullity) to 1 (perfection). In most children, the product of their D skills and LC represents an estimation of their reading skills, as demonstrated by large-scale longitudinal studies including a study of 557 children in grades 1 and 4 (Hoover & Gough, 1990). The SVR also explains in a simple manner why children with dyslexia have difficulty reading: LC (1) x D (0) = RC (0). Thus, children with dyslexia are unable to understand when they read because they cannot perform the D aspect of reading. If the text were presented orally, they would demonstrate RC because their LC is not affected, unless there are other comorbid conditions that affect LC. Though not every case is this severe (i.e. D = 0), a variability of skills in children with dyslexia will place RC along a continuum based on D deficiencies (Tunmer & Greaney, 2010). Exposing these deficiencies in D in children with dyslexia can help distinguish them from normally developing readers.

Not only can the SVR help differentiate children with dyslexia from normally developing readers, but it can also expose other types of reading disabilities. Tunmer and Greaney (2010), for example, explained the classification of different categories of reading difficulty in the SVR according to a model of proximal causes (Figure 5). Given that reading comprehension requires LC and word recognition (i.e., D), readers can be classified into normally developing readers, those who have good D and good LC; readers with dyslexia, those with poor D and good LC;

readers with specific reading comprehension difficulties, those who have good D and poor LC; and children with mixed disabilities, those who have poor D and poor LC. Figure 5 provides the categories of possible reading profiles according to the SVR.

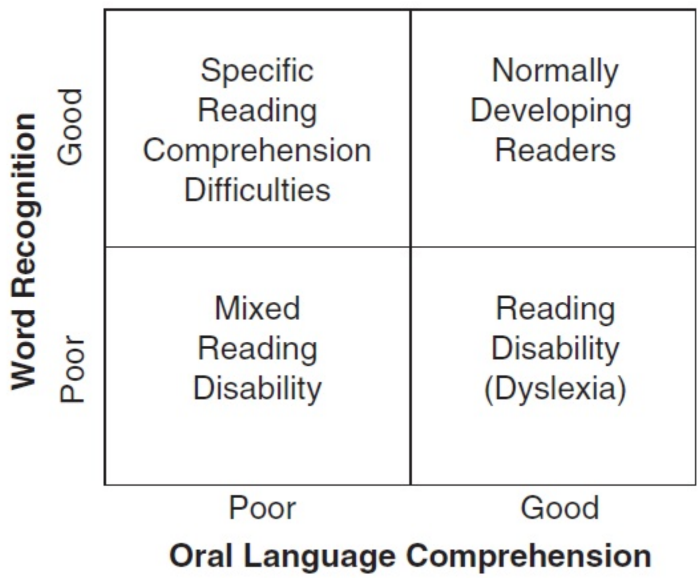

Figure 5. Classification of different categories of readers according to the Simple View of Reading (SRV).

Note: From Tunmer & Greaney (2010 p. 6).

Coupled with measures of RAN, PA, PS, and V (as part of LC) in this study, the classification that arises from comparisons of D and LC in both English and Spanish helps distinguish children with dyslexia from normally developing readers and children with other reading and language disabilities. A multitude of research has supported the use of the SVR to help classify children who fall in the category of dyslexia and to help rule out other possible language-related deficiencies that cause other types of reading difficulties (e.g., Aaron, Joshi, Gooden, & Bentum, 2008; Aaron, Joshi, & Williams, 1999; Gough & Tunmer, 1986; Joshi, 2004). The following section reviews some of the more prominent findings of these studies.

In one of the first studies of the SVR involving D and LC, Hoover and Gough (1990) explored the performance of 254 children in grades 1 and 4. Their findings demonstrated that the product of D and LC was highly correlated with RC for all children in the sample. Proposing that RC is the result of the *sum* of D and LC (rather than the product), Chen and Vellutino (1997) tested a complex model of the SVR in which the scores of D and LC of children in the sample were used to calculate RC through addition or multiplication and a combination of both. Their findings suggested that using the sum of D and LC was more appropriate for readers with average reading abilities. Using the product, however, was more appropriate when dealing with children who were at the extremes of reading abilities, as in the case of children with severe dyslexia (Chen & Vellutino, 1997). The validity of the SVR has also been tested in studies involving older readers. For example, Savage (2006) conducted a study involving the performance of 15-year-olds with severe reading delays. As with the results in Chen and Vellutino (1997), performance in D and LC was highly predictive of RC. Another study with older students involved the analysis of LC and D abilities in 60 university students who were receiving accommodations for reading delays (Savage & Wolforth, 2007). Results from this study resembled those of Savage (1996), providing evidence that the SVR is a good model for the assessment of reading abilities in individuals who have received reading instruction.

Focusing more on children with reading disabilities, Catts and colleagues (2003) investigated the reading patterns of 183 poor readers from a sample of 604 children participating in a longitudinal study from grades K-4. Their analyses focused on participants' performance on measures of D and LC in second grade and the types of profiles that separated these children according to their strengths and weaknesses. Data collected on the 183 children revealed four different subgroups of poor readers that closely resembled the classification pattern of Tunmer and Greaney (2010). Children who had low D and high LC were classified as having dyslexia;

those who had both low D and low LC were classified as children with Language Learning Disabilities (LLD); those who had high D, but low LC were classified as hyperlexic (i.e. deep dyslexia, Coltheart, Patterson, & Marshall, 1980; or comprehension problems, Tunmer & Greaney, 2010); and finally those who had adequate D and LC were classified as the nonspecified poor readers (Catts, Hogan, & Fey, 2003). The findings reported by Catts el al. (2003) highlight the utility of the SVR to help distinguish among the different types of struggling readers, particularly narrowing down deficiencies in D as the marker of dyslexia. Furthermore, a low correlation between D and LC (r = .16) found by Catts et al. (2003) demonstrated that D and LC are nearly independent of each other, yet both important for RC. Similar correlations were also reported in Carver (1998), Catts and Kamhi (1999), and de Jong and van der Leij (2002). The data obtained from these studies of D and LC provide ample support for the use of these two skills and the SVR for the assessment of reading abilities and dyslexia.

Reading fluency (RF). Many studies have shown that Reading Fluency (RF), rather than accuracy in decoding (D), characterizes dyslexia in languages with more regular orthographic patterns, such as Spanish (e.g., Davies & Cuentos, 2010). In simpler orthographies like Spanish, deficiencies in RF surpass deficiencies in D because once readers master the letters and corresponding sounds of the alphabet the one-to-one correspondence between sounds and letters facilitates reading and spelling. For individuals with dyslexia reading in these orthographies, although they may not have difficulty with accuracy, their reading speed and fluency may never reach the level of their peers, and they may consequently experience problems with reading comprehension (Zoccolotti et al., 1999). A longitudinal study that included 276 children who were followed from first grade to second grade demonstrated the ability of measures of RF to predict later performance in reading (Speece & Ritchey, 2005). The sample, which was divided into children at-risk (AR) and not-at-risk (NAR) of reading failure based on expected grade level reading performance, showed high consistency in performance in RF measures from first to second grade. Specifically, children who had high fluency in letter-sound tasks demonstrated higher RF on first grade word reading RF and second grade passage reading RF. In contrast, AR children demonstrated low performance in letter-sound RF, which accurately predicted low performance in word reading RF and passage reading RF in first and second grade. Speece and Ritchey (2005) concluded that F is a skill that develops early, along with other established early reading skills (i.e., PA and letter name knowledge). A similar study conducted earlier by Speece and colleagues (2003) showed a similar predictive value of letter-sound fluency and later RF in first grade in a sample of randomly selected children. Along with PA, letter-sound fluency showed the majority of variance accounting for later RF performance (Speece, Mills, Ritchey, & Hillman, 2003). Speece et al. (2003) used letter-name fluency along with nonsense word fluency, both of which showed predictive criterion-related validity for later RF. Comparable findings were also reported by Stage, Sheppard, Davidson, and Browning (2001), who correlated letter-sound fluency in kindergarten with later growth in oral reading fluency (ORF) measures. Eighteen percent of the sample of 59 children constituted Spanish-speaking children, but they were tested solely in English. If measures of Spanish RF would have been included the findings could have yielded different results, a possibility that will be explored in the proposed study.

Several studies have also used word and passage RF as the dependent variable of measures of PA and RAN. Cornwall (1992), for example, examined performance in PA and RAN and how these correlated to passage RF. Results suggested that PA was not significantly related to RF, but RAN was, accounting for 30% of the variance. In contrast, Bowers (1993) found that PA was uniquely and significantly related to passage RF, but RAN was not (Bowers, 1993). Schatschneider and colleagues (2004), on the other hand, found significant variance of both PA and RAN in passage RF performance in a random sample of first-grade children. These studies support the view of the proposed study, in that RAN and PA can help identify readers with dyslexia. None of the studies mentioned in this section, however, included measures of reading in Spanish if the sample included Spanish-speaking ELLs. Because of the transparency (i.e. one-to-one correspondence of letters and sounds) of L1 in participants in this proposed study, RF is considered an important factor that may expose lack of automaticity in readers with dyslexia.

Summary and Conclusions

Ample research has supported the use of the different variables selected for the proposed study for the diagnosis of reading skills and dyslexia in ELLs. The first three variables, PA, RAN, and PS are considered cognitive correlates of dyslexia that can be measured prior to literacy instruction. They are particularly important in this study because ELLs can have difficulties with reading because of second language learning deficiencies, and thus should be evaluated using measures that are as independent from academic learning as possible. The use of PA, RAN, and PS to predict reading performance is not a new concept, but a combination of these three correlates in two languages for the assessment of ELLs constitutes a relatively unexplored area.

The other four variables in this study, D, LC, V, and RF are abilities that are necessary for reading, and are therefore often analyzed in studies of reading and dyslexia. The SVR, although simple, encompasses the abstract, complex, and elaborate phenomenon that constitutes reading in English (Kirby & Savage, 2008). Providing opportunities to show D and LC in both English and Spanish, however, will be crucial in this study, as to demonstrate potential best practice for the assessment of ELLs. The literature that supports the SVR is extensive, and it has been used to develop reading and intervention programs as well as legislation around the world (e.g., England and Australia). Not only does the SVR explain the necessary mechanisms that are required for reading, it also pinpoints the area of deficiency in students who are having trouble reading, so that the appropriate interventions can be applied. As with D and LC, RF has been established as a skill that is necessary for reading. Measures of RF become particularly important when determining reading performance in languages that have consistent spelling patterns and nearly one-to-one correspondence between sounds in speaking and letters in writing, as is the case in Spanish. The current study combines research in RAN, PA, PS and the SVR along with V and RF to create a data-driven, flexible, and appropriate assessment model for use with Spanish/English ELLs.

CHAPTER 3

METHODS

This chapter provides a description of the participants selected for this study, the materials used for data collection of the variables of interest, the procedures for data collection, and the statistical analyses that were performed to derive conclusions.

Participants

Participants for this study were selected from four public elementary schools in the Tucson Unified School District (TUSD) and the Sunnyside Unified School District (SUSD). Fliers were distributed to 400 children in grades 1-4 classified as English Language Development (ELD) students with Spanish as a primary home language. A total of 158 fliers were returned, from which a random subsample of 68 students (35 male and 33 female) were selected for participation. Appendix B provides a sample of the fliers used to recruit participants for this study. A preliminary power analysis (Cohen, 1977) estimated that this sample size was large enough to explore the interest variables in this study. The 68 participants were selected based on the following a priori criteria reported by parents and caregivers on the flier, which were then confirmed in a phone interview: a) the student began school in the U.S in grades kindergarten or preschool. b) Spanish was confirmed as a primary home language, c) academic instruction was delivered only in English, d) the child had not repeated a school grade, and e) no known disabilities or physical conditions (other than difficulties with reading) that could affect performance in the tasks of the study were reported. Following consent and initial screening, parents completed a demographic questionnaire, which provided more detailed information about the subjects in this study. Appendix D provides a sample of the demographic questionnaire completed by all parents and caregivers of participants. The descriptive information reported by parents and caregivers is summarized in Table 1:

Table 1

Characteristics of Participants

Characteristic	Mean	Std. Deviation
Age of child at time of testing	8.6	1
Years the family has lived in the US	18.2	9
Number of hours of reading at home per week	3.1	2
Age at which the child began schooling	4.6	1

Grade	Frequency	Percent
First Grade	8	12
Second Grade	26	38
Third Grade	28	41
Fourth Grade	6	9

Language	Frequency	Percent
*English	7	10
Spanish	54	79
Both- Spanish/English	7	10

**Respondents reported Spanish on the phone, but selected English on the questionnaire.*

Language	Frequency	Percent
English	14	20.6
Spanish	22	32.4
Both- Spanish/English	32	47.1

Reading at Home	Frequency	Percent
Yes-English	48	71
Yes-Spanish	1	2
Yes-Spanish and English	15	22
No	4	6

Variables

In order to explore the relationships among the variables in this study, a correlational design was conducted. In a correlational design, a performance in one variable (predictor variable) predicts a performance in another variable (criterion variable; Field, 2005). It is important to note that, although there is a close relationship between predictor and criterion variables, there is not a cause and effect relationship between these variables. For example, high performance in Rapid Automatized Naming (RAN), a predictor variable, is not the cause for high Reading Fluency (RF), a criterion variable. Instead, it can be said that a child who performs well in RAN tasks is likely to perform high in F because these variables are closely correlated.

Based on empirical support described in Chapter 2, the predictor variables for this study included Rapid Automatized Naming (RAN), Phonological Awareness (PA), Processing Speed (PS), and Vocabulary (V). These variables were speculated to predict performance in the criterion variables for this study, Reading Fluency (RF), Decoding (D), Listening Comprehension (LC), and Reading Comprehension (RC). Because this study explored the development of reading in Spanish-speaking ELLs, both Spanish and English measures for each variable were given to participants.

Measures

The assessment measures used in this study included three subtests of the Rapid Automatized Naming and Rapid Alternating Stimulus Tests (RAN/RAS; Wolf & Denckla, 2004), two subtests from the Test of Phonological Awareness Skills (TOPAS; Newcomer & Barenbaum, 2003), two subtests from the Test of Phonological Awareness in Spanish (TPAS; Riccio, Imhoff, Hasbrouk, & Davis, 2004), two subtests from the Woodcock Johnson Tests of

Cognitive Abilities Normative Update (WJ III NU; Woodcock, McGrew, Schrank, & Mather, 2001, 2007), three subtests from the Woodcock Johnson Tests of Achievement III Normative Update (WJ III NU; Woodcock, McGrew, Schrank, & Mather, 2001, 2007), three subtests from the Batería III Woodcock-Muñoz (Bateria III; Woodcock, Muñoz-Sandoval, McGrew, & Mather, 2004, 2007), and the Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4; Dunn & Dunn, 2007) and the Test de Vocabulario en Imagenes Peabody (TVIP; Dunn, Lugo, Padilla, & Dunn; 1981). Appendix C provides a summary of the variables and tasks used for this study.

Rapid Automatized Naming and Rapid Alternating Stimulus Tests (RAN/RAS; Wolf & Denkla, 2005). The RAN/RAS test provides a standardized assessment of a student's ability to rapidly and automatically name familiar objects and symbols, a skill highly correlated to reading. The tasks in the RAN/RAS test present visual cards with letters, objects, colors, numbers, or a combination of any or all the stimuli. The RAN/RAS test was designed based on four basic constructs that have been empirically demonstrated in several studies. First, RAN/RAS is highly correlated to age, since the ability to rapidly and accurately name objects is developmental in nature. Second, the RAN/RAS test measures skills that are important for reading, therefore they differentiate between good and poor readers. Third, all RAN/RAS tasks measure visual-verbal PS, and are hence correlated with each other. Finally, because RAN/RAS tasks measure an important skill needed for reading they should be highly correlated to other measures of reading ability. Norming, reliability and validity procedures corroborate these four basic constructs. Norming was completed using 1,461 individuals, ages 5-0 thorough 18-11, from a variety of backgrounds in 26 states in the U.S. Test-retest reliability for the RAN/RAS test ranges from .84 to .92 for all age groups, with a test-retest interval of approximately two weeks. Inter-rater reliability is reported to be .99. The validity for the RAN/RAS includes content-description validity, criterion-prediction validity, and construct-identification validity. Specifically relevant to this study, the validity of the RAN/RAN test is supported by a significant correlation to tests of word identification, including the Word-Letter Identification task in the Woodcock-Johnson Psychoeducational Battery-Revised (WJ-R; Woodcock & Johnson, 1989), an earlier version of a task used in this study. The correlation of RAN Objects, Numbers, and Letters to the WJ-R Letter-Word Identification was .40, .44, and .55 respectively.

Subtests Administered. For the purpose of this study, participants completed three subtests of the RAN/RAN Test: Objects, Letters, and Numbers. During administration, participants were asked to name the objects or symbols in the stimulus cards as quickly and accurately as they could without making any mistakes. The RAN Object task consisted of five stimulus items (hand, book, dog, star, and chair). According to the RAN/RAS technical manual, these items were chosen based on their high frequency and their membership in highly familiar semantic categories (i.e. body, school materials, animals, nature, and furniture). In addition, they are one-syllable words that are easily articulated in speaking (Wolf & Denckla, 2005). Prior to beginning the timed naming, participants were asked to name the objects to ensure familiarity. The RAN Numbers task consisted of the numbers 2, 4, 6, 7, and 9. The numbers appeared twice in each row without any number being sequentially repeated. The RAN Letters task consisted of five high-frequency lowercase letters (a, d, o, p, and s). As with the RAN Numbers task, each item appeared twice in each row without any number being sequentially repeated. The total time a participant took to name all the objects or symbols in each card provided the raw score. Each raw score of the RAN Objects, Numbers, and Letters was then converted to a standard score with a mean of 100 and a standard deviation of 15.

Test of Phonological Awareness Skills (TOPAS; Newcomer & Barenbaum, 2003). The TOPAS provided a standardized measure of a student's phonological awareness skills in English. Construction of the TOPAS was based on the rationale that phonological awareness skills are important to spoken language development, the development of the basic reading skills, and learning of the orthography of a language. The purpose of the test is to measure different aspects of phonological awareness, to present tasks that appear at different stages of children's phonological development, and to represent varied levels of difficulty. The TOPAS was normed on a national sample of 926 children, within the ages of 5-0 through 10-11, from a variety of backgrounds in 14 states. Test-re-test reliability ranges from .70 to .85 for all age groups with a test-retest interval of three weeks. Inter-rater reliability is reported at .98 to .99. The validity for the TOPAS includes content-description validity, criterion-prediction validity, and construct identification validity. Specifically relevant to this study, the subtest from the TOPAS that were utilized in this study were correlated with different reading measures including the California Achievement Tests-Fifth Edition (CAT-5; CTB/McGraw-Hill, 1992) and the Iowa Test of Basic Skills (ITBS; Hieronymus, Hoover, Dunbar, & Frisbie, 1993). The correlation for the Sound Sequencing subtest is reported at .42 for the CAT-5 Reading Total and .62 for the ITBS Reading Total. For the Phoneme Deletion subtest, the correlation is .81 to the CAT-5 Reading Total and .50 to the ITBS Reading Total.

Subtests Administered. The tasks in the TOPAS include Rhyming, Incomplete words, Sound Sequencing, and Phoneme Deletion. For the purpose of this study, participants were administered the Sound Sequencing task and the Phoneme Deletion task, both of which are considered of to be at the "difficult level" of phonological awareness tasks and were more apt to the age group tested in this study. In the Sound Sequencing task, participants were first instructed on the association of a color block with a specific sound (e.g. red for /a/; blue for /b/). The researcher then pronounced a non-word sound sequence for which the participant had to arrange the blocks in the order that matched the sound sequence (e.g. researcher said: "baba", student arranged blocks: blue, red, blue, red). For the Phoneme Deletion task, the researcher said a common word and asked the participant to repeat the word and then repeat it once again with a specific sound being eliminated (e.g. researcher said: "Say cat without the /k/ sound"). A raw score on the TOPAS was derived based on the number of correct responses to individual test items. The raw score of each subtest was then converted into a scaled score with a mean of 10 and a standard deviation of 3.

Test of Phonological Awareness in Spanish (TPAS; Riccio, Imhoff, Hasbrouk, & Davis, 2004). The TPAS is used to assess a student's phonological awareness skills in Spanish. Like the TOPAS, the TPAS was designed under the principles that phonological awareness skills are important for the development of speaking, reading, and writing skills. The TPAS is intended for three major uses; to identify Spanish-speaking children who may be significantly below their peers in Spanish phonological awareness ability; to monitor remediation programs; and to provide a tool for research in the development of phonological awareness and early reading in Spanish-speaking children. The normative sample for the TPAS constitutes 1,033 students, ages 4.0 to 10.11 from three countries: Mexico, Spain, and the United States (including Arizona). Test-re-test reliabilities range from .79 to .86 for all age groups with a test-retest interval of two weeks. Inter-rater reliability is reported at .97 to .98. The validity for the TPAS includes content-description validity, criterion-prediction validity, and construct identification validity. Specifically relevant to this study, the subtest from the TPAS that were utilized in this study were correlated to reading fluency task from the Read Naturally reading program (Ihnot,

1999) in English and an equivalent translation in Spanish. The reading fluency task in English, yielded a correlation for Final Sounds of .60 and for Phoneme Deletion of .46. For the reading fluency task in Spanish, the correlation was .60 for Final Sounds and .53 for Phoneme Deletion.

Subtests administered. Tasks in the TPAS include Initial Sounds, Final Sounds, Rhyming Words, and Deletion. Participants in this study completed the Final Sounds subtest because it provided information on their ability to discriminate between similar sounds, an ability similar to that required for Sound Sequencing in the TOPAS. They also completed the Deletion subtest, which exactly mirrored the requirements of its English counterpart on the TOPAS. In the Final Sounds task, participants repeated two given words and decided by stating, “si” or “no,” if the two words ended with the same sound (e.g. researcher said: piensas que rojo y ocho terminan igual?) For the Deletion task, the researcher said a common word and asked the participant to repeat the word and then repeat it once again with a specific sound being eliminated (e.g. examiner said: “Di bajo sin /b/”). Parallel to the TOPAS, a score on each of the interest subtests in the TPAS provided a raw score based on the number of correct responses to individual test items. The raw score of each subtest was then converted to a scaled score with a mean of 10 and a standard deviation of 3.

Woodcock Johnson Tests of Cognitive Abilities Normative Update (WJ III COG NU; Woodcock, McGrew, Schrank, & Mather, 2001, 2007). The WJ III COG NU is a test that measures a student intellectual functioning. Of particular interest to this study, the test of Visual Matching and Pair Cancellation provided insights into a participants’ functioning in the area of PS, a factor often associated with reading. The normative sample for the WJ III included a sample of 8,782 subjects. The normative update rearranged data from these subjects to closely resemble U.S. census data from more 100 geographically diverse populations of the U.S with ages ranging from 12 months to 80 years and older. A NU study of speeded tests in the WJ III found the test re-test reliability ranges from .68 to .87 for Visual Matching and .67 and .83 for Pair Cancellation with a test-retest interval of one day. Inter-rater reliabilities from many studies reveal typical correlations around .98. The validity for the two tests includes content validity, construct validity (through comparisons to similar cognitive measures), developmental patterns of scores, and internal validity. Of particular interest, among children of a similar age range as those in this study, Visual Matching showed a correlation of .32 to Letter Word Identification, .39 to Reading Fluency, and .30 to Word Attack, three tests of the WJ III ACH used to measure reading in this study.

Subtests Administered. Two tests of PS were selected from the WJ III COG NU, Visual Matching and Pair Cancellation. In the Visual Matching test, participants made visual symbol discriminations by locating and circling two identical numbers in a row of six numbers. The task increased in difficulty from single-digit numbers to triple-digit numbers with a 3-minute time limit. The Pair Cancellation task required participants to locate and circle a repeated pattern (ball, dog) as quickly as possible within a 3-minute time limit. Raw scores on Visual Matching and Pair Cancellation were obtained from the number of correct scores. These scores were then converted to standard scores with a mean of 100 and a standard deviation of 15.

Woodcock Johnson Tests of Achievement III Normative Update (WJ III ACH NU; Woodcock, McGrew, Schrank, & Mather, 2001, 2007). The WJ III ACH NU is a test that measures a student's academic abilities. This study utilized subtests of the WJ III ACH NU to measure participants' basic reading skills through the Letter Word Identification, Word Attack, and Reading Fluency tasks. The normative sample and normative update of the WJ III ACH is the same as that of the WJ III COG. A NU test-retest study with a test re-test interval of one year reported correlations of .83 to .95 for Letter-Word Identification, .59 to .88 for Reading Fluency, and .63 to .83 for Word Attack. Inter-rater reliabilities from many studies reveal typical correlations around .98. Validity coefficients for the three WJ III ACH tests used in this study includes content validity, construct validity (through comparisons to similar achievement measures), developmental patterns of scores, and internal validity.

Tests Administered. Participants in this study completed three tests of basic reading skills (Letter-Word Identification, Reading Fluency, and Word Attack), one test of listening comprehension (Oral Comprehension), and one test of reading comprehension (Passage Comprehension) from the WJ III ACH NU. The initial items of the Letter-Word Identification test required participants to provide the names of given letters. The remaining test items required participants to correctly pronounce words that increased with difficulty as the test progresses. In the Reading Fluency test, participants read a simple sentence (e.g. “An apple is red.”), decided if the sentence was true or false, and then correctly circled Yes or No completing as many sentences as possible within a 3-minute limit. The difficulty of this test increased to moderate difficulty as the items progressed. In the Word Attack test, initial items required participants to provide the sound that single letters represented. The remaining items on the test presented nonsense words that follow phonetically consistent patterns seen in written English. Participants had to pronounce each nonsense word correctly and items increased in difficulty as the test progressed. The total number of correct responses on each of the three reading tasks provided a raw score, which was converted to a standard score with a mean of 100 and a standard deviation of 15. For the Oral Comprehension test, participants were read aloud a sentence or passage and were required to supply a missing word to the end of a sentence, or related group of sentences in English. Similarly, the Passage Comprehension test required participants to read a sentence or short passage with a word missing and provide a possible word that would complete the sentence or passage. For younger participants, those in first grade, the Passage Comprehension test presented a word or group of words and four choices presented in pictures. Participants had to pick the picture that illustrated the written text.

Batería III Woodcock-Muñoz Pruebas de Aprovechamiento (Woodcock, Muñoz, McGrew, & Mather, 2005). The Bateria III Pruebas de Aprovechamiento (Bateria III APROV) is a parallel Spanish version of the WJ III ACH. This study included the four subtests in the Bateria III that corresponded to tests of the WJ III ACH, Identificación de Letras y Palabras, Fluidez de la Lectura, Análisis de Palabras, Comprension Oral, and Comprensión de Textos. These measures provided information on Spanish reading skills that could be directly compared to English reading skills. The sample used to calibrate the Bateria III consisted of 1,413 native Spanish-speaking individuals from Mexico, the U.S. (including nine states), Costa Rica, Panama, Argentina, Colombia, Puerto Rico, and Spain. The data obtained from this sample were equated to WJ IIIACH norms by scaling each task on the Bateria III according to their difficulty on the WJ III ACH. The reliability coefficients from the Bateria III calibration sample approximate those of the WJ III ACH. Reported in the Bateria III technical manual, the internal consistency reliability coefficient for Identificacion de Letras y Palabras ranges from .84 to .97; for Fluidez de la Lectura it ranges from .91 to .98; and for Analisis de Palabras range is .81 to .98. Validity coefficients for the three WJ III ACH tests used in this study includes content validity, construct validity (through comparisons to similar achievement measures), developmental patterns of scores, and internal validity. Internal structure validity analyses yielded similar factor weights and theoretical clusters as those seen in the WJ III ACH.

Subtests Administered. Four reading measures from the Baterial III APROV were administered to subjects in this study. As previously mentioned, these were parallel to their counterparts on the WJ III ACH. Identificación de Letras y Palabras is an adapted version of Letter-Word Identification. It included letters and words that were equivalent in difficulty. Initial items required paricipants to provide the names of letters and remaining items required accurate pronunciation of words that increased in difficulty. Fluidez de la Lectura was adapted from its English version on the WJ III ACH, Reading Fluency. Paricipants read simple sentences in Spanish, decided if the sentences were true or false, and marked “Si” or “No” to indicate their answer. Items increased in difficulty to the moderate level with the final score constituting the total number of correct answers in three minutes. In the Análisis de Palabras task, the initial items required participants to provide the sound that a letter made. In the subsequent items, participants had to read nonsense words that followed familiar patterns seen in written Spanish. The total number of correct responses on each of the four reading tasks provided a raw score, which was converted to a standard score with a mean of 100 and a standard deviation of 15. The Comprensión Oral test, an equivalent of the Oral Comprehension test in English provided similar items to those presented in English. Participants were read aloud a sentence or passage and were required to supply a missing word to the end of a sentence, or related group of sentences in Spanish. For the Comprensión de Textos, the equivalent of the Passage Comprehension in Spanish, participants read a sentence or short passage with a word missing and provided a possible word that would complete the sentence or passage. For younger participants, those in first grade, the Comprensión de Textos test presented a word or group of words and four choices presented in pictures. Participants had to pick the picture that illustrated the written text.

Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4; Dunn & Dunn, 2007). The PPVT-4 is an individually administered tests used to quickly evaluate receptive vocabulary without reading or writing. The norming sample of the PPVT-4 included 5,543 individuals ranging in age from 2 years 6 months to 90 years and older from 38 U.S. states. The norming sample resembles that of 2005 U.S. census data with respect to sex, race/ethnicity, SES, geographic region, and special education status. The test-retest reliability coefficients range from .91 to .94 with an average interval time of four weeks. Internal consistency reliability was obtained through split-half reliability with scores reported ranging from .94 to .97. The PPVT-4 also has an alternate form (Form B), which was used to establish reliability. The coefficients derived from the two equivalent forms range from .87 to .93. Validity coefficients include content validity and construct validity though comparisons to other measures of vocabulary, including the Expressive Vocabulary Test, Second Edition (EVT-2; Williams 2007), measures of oral language, including the Comprehensive Assessment of Spoken Language (CASL; Carrow-Woolfolk, 1999), and measures of reading, including the Group Reading Assessment and Diagnostic Evaluation (GRADE; Williams, 2001).

Subtests Administered. Participants in this study completed the PPVT-4 as it is used in clinical and educational settings. The 228 items of the test were grouped into 19 sets of 12 items each. Participants began at a specific set according to their age and continued to progress to more difficult items as they provided accurate answers. If a participant failed to provide enough correct items within a set to establish a basal score, easier items were administered. Each page on the PPVT-4 presented four numbered pictures. The researcher asked the student to provide the number of the picture that corresponded to the spoken word. In this study, participants were given the choice to either say the number of or point to the picture that corresponded to the word presented by the investigator, an accommodation allowed within standardization procedures. The total number of correct responses yielded a raw score that was then converted to a standard score of 100 with a standard deviation of 15.

Test de Vocabulario en Imagenes Peabody (TVIP; Dunn, Padilla, Lugo, & Dunn, 1986). The TVIP is a Spanish version of the PPVT derived from its first and revised versions. It's format, purpose, and administration procedures resemble those of the PPVT-4. The TVIP is used to measure receptive vocabulary skills in Spanish, which was its purpose in this study. The TVIP is not a direct translation of the PPVT-4, but rather a set of items that have been tested to be equal to items on the PPVT. According to the technical manual of the TVIP, all items have been carefully selected through rigorous item analysis for their universality and appropriateness to Spanish-speaking communities. Norming and test calibration was conducted with two samples, one from Mexico and one from Puerto Rico, totaling 2,707 individuals. Scores can be standardized to the Mexico sample, the Puerto Rico sample, or both. In this study, standard scores were obtained from the mixed sample, as technical manual instructions recommended this procedure for students living within the continental U.S. Furthermore, the difference between these subsamples was minimal, indicating low influence of regional language terms on performance on the TVIP. Validity of the TVIP was established through calibration to the PPVT and PPVT-R, which were compared to other vocabulary measures, including the vocabulary subtest of the Wechsler Intelligence Scale for Children- Revised (WISC-R; Wechsler, 1974).

Procedures

All testing was performed by the investigator, who has completed graduate level course work and practica in the administration of psychological assessments. The investigator is fluent in both English and Spanish and meets the language qualifications to administer the given tests.

All testing was conducted one-on-one with each participant according to the procedures for each subtest as they are outlined in the test manuals.

Test Administration

The subtests from the different measures used in this study were sequentially arranged in a fixed order for all participants to allow rapport building and code switching from English to Spanish. Participants began by completing English tests of reading in the following order: Letter Word Identification, Word Attack, Oral Comprehension, Reading Fluency, and Passage Comprehension. Following the English reading series, participants completed the two phonological awareness tasks: Sound Sequencing and Phoneme Deletion. Participants then completed the English vocabulary test (PPVT-4) followed by the first tests of PS, Visual Matching. The participants were then administered the RAN tasks: RAN Objects, RAN Numbers, and RAN Letters, for which they investigator noted the natural language of responses in the practice page. The Pair Cancellation subtest was then administered and served as a transition period from English to Spanish. At the culmination of Pair Cancellation, the investigator explained to participants that the remainder of the test would take place in Spanish and that students should provide answers in this language if possible. The investigator noted if the student provided answers in English during this portion of the assessment. The Spanish portion of the assessment mirrored the sequence of reading, phonological awareness, and vocabulary measures given in English. For this portion of testing, participants completed Identificación de Letras y Palabras, Análisis de Palabras, Comprensión Oral, Fluidez de la Lectura, Comprensión de Textos, Final Sounds, Deletion, and finally, the TVIP. The entire assessment lasted approximately two hours and was completed on the same day during school or after school hours. Breaks were provided between tasks and as needed.

Reliability

Reliability is an essential component for any experimental study, and several procedural steps were taken by the investigator in order to ensure that results were reliable. In particular, the investigator focused on procedural and inter-scorer reliability using known methods often utilized in similar research studies.

Procedural reliability. Procedural reliability is a set of steps that an investigator takes in order to ensure that data are collected without error (Meyer, 2010). In this study, the investigator conducted test administration self-checks immediately after data collection at the four school sites by using a checklist of steps to be used after each session. The checklists included questions such as: Were all the directions of the test read? Were practice exercises conducted, Were all suggested starting points used? Were basals and ceilings established for the test?

Procedural reliability was calculated using the following formula:

$$\left(\frac{\text{\# of examiner behaviors observed}}{\text{total \# of examiner behaviors expected}}\right) X\ 100 = \%\ of\ procedural\ reliability$$

Procedural reliability measures were obtained during 20% of the time for the administration of the battery used with all participants with an average procedure reliability result of 100%.

Scoring reliability. Inter-scorer reliability is an estimate of the degree of agreement or consistency between two or more independent scorers (Meyer, 2010). For this study, inter-scorer reliability was calculated by comparing the scores obtained by the examiner with the scores obtained by a second observer. This procedure was conducted using a point-by-point method of comparison with 20% of test records chosen randomly. After culmination of data collection and scoring, the investigator provided 15 test records to a trained graduate student along with a scoring checklist (Appendix F). An inter-scorer reliability percent value was then obtained by comparing the scores using the following formula:

$$\left(\frac{Total\ \#\ of\ Agreements}{Total\#\ of\ Disagreements}\right) X\ 100 = \%\ Agreement$$

The value obtained for inter-scoring reliability was 99.6 for test scoring and 100% for data entry. A single minor error was corrected based on this scoring reliability check.

Statistical Analysis

The statistical procedures conducted in order to answer the hypotheses of this study included descriptive statistics, Pearson product moment correlations, and regression analyses. Pearson correlation is a measure of the strength of the linear relationship between two variables (Brace, Kemp, & Snelgar, 2013). The linear relationship is estimated with the correlation coefficient, denoted by the symbol *r*. The range of a correlation coefficient varies from minus one to plus one. A minus one indicates a perfect negative correlation, whereas a plus one indicates a perfect positive correlation. A correlation of zero means there is no relationship between the two variables being examined. A negative correlation between two interest variables indicates that as performance on one variable increases, performance in the other variable decreases, and vice versa. On the other hand, a positive correlation exists when performance in one variable increases as the other variable also increases.

In this study, Pearson's correlation was used to investigate demographic variables that are related to the interest variables in this study and to answer questions one and three. Questions one and Three aimed at establishing the statistical significance of the association between each of the tasks in RAN, PAN in Spanish and English, PS, and V with reading measures including RF, D, and RC in both English and Spanish. Not only did this statistic allow simultaneous comparison of the correlates of reading with actual measures of reading, but it also provided the strength of each of the possible relationships between two variables. Thus, it provided the strength of RAN, PA, PS, and V in predicting RF, D, and RC and it also highlighted which of these cognitive correlates are the best predictors of reading skills for subsequent analyses in this study.

Multiple regression is a statistical technique that allows the prediction of a score on one variable on the basis of scores on several other variables (Brace, Kemp, Snelgar, 2013). Multiple regression was used for the exploration of Questions Two and Four. These questions aimed at exploring the predictive value of the cognitive correlates with highest correlation to basic reading skills, and the generalization of the SVR to the sample in this study. With this procedure, it is possible to establish that the predictor variables can actually predict the criterion variables, while also highlighting the unique contribution of each of the interest variables into the model.

Qualitative Case Study Analyses

Question five in this study, presented a more exploratory model based on the correlations and statistical significance found in questions one through four, the SVR, and the current definition of dyslexia. Based on the numerical values found through correlation and multiple regression analyses for questions one through four, the investigator created groupings according to the characteristics that defined participants' reading patterns. RAN Number and Phoneme Deletion represented the cognitive correlates, which predict basic reading skills, therefore eliminating the need to use measures of D and RF. LC and V, on the other hand, are highly correlated to RC and therefore represented participants' potential to understand written text. Figure 6 illustrates the possible categories under which readers would fit based on oral language skills, and cognitive correlate patterns.

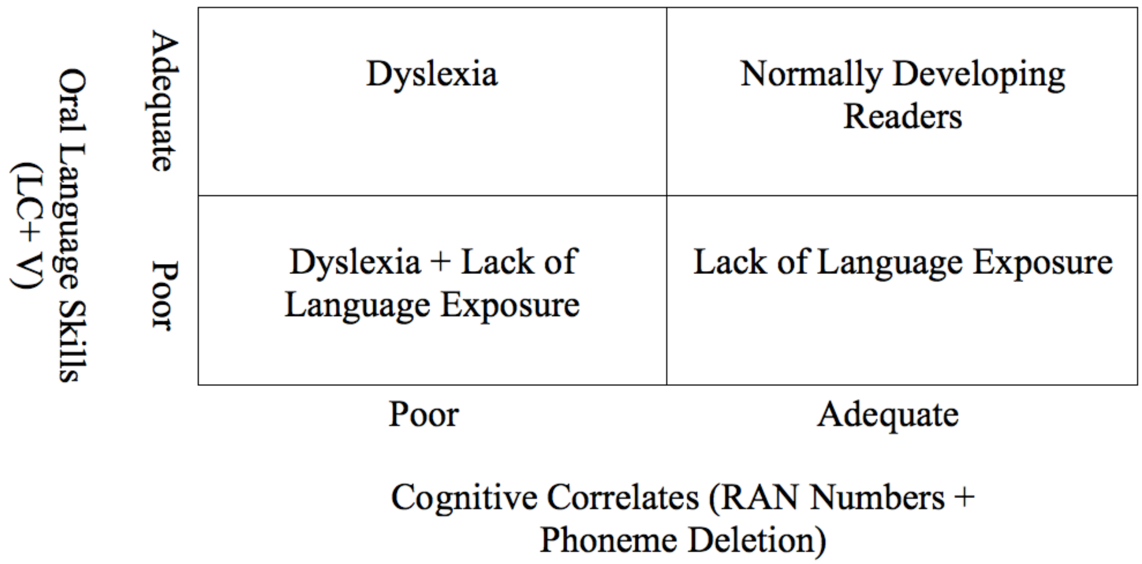

Figure 6. Categories of readers based on current study including Cognitive Correlates and oral language skills.

One case from each group was then selected for comparison analysis providing an illustrative example of the differences that distinguish among these groups.

CHAPTER 4

RESULTS

The following sections review the statistical findings related to each of the questions of this study. The first section focuses on the assessment of reading in ELLs, which is analyzed through descriptive statistics, correlational analyses, and multiple regression analyses. The second portion of this chapter presents information related to the assessment of dyslexia in ELLs based on descriptive statistics and the presentation of individual cases that follow profiles consistent with the SVR and the current definition of dyslexia. Analyses for all of this study's questions were performed using Statistical Package for the Social Sciences (SPSS; Version 22) (SPSS, 2013).

Summary of Interest Variable Means and Standard Deviations

Table 2 presents the summary of all data relevant to this study. All raw scores were converted to Standard Scores (SS) (M=100, SD=15). A correlation analysis was also completed in order to explore if any of the demographic variables reported in the demographic questionnaire were correlated to the interest variables in the study. From this analysis, correlations that were significant at the 0.05 level (one-tailed) were included in subsequent analyses as control variables. Given the large number of variables in this study, the correlation matrix highlighting statistically significant correlated variables are presented in Appendix G.

Table 2

Means and Standard Deviations for all Study Variables

Variables	Mean	SD	Variables	Mean	SD
RAN-O	91.93	14.52	Bateria III FL	64.41	18.60
RAN-N	97.00	13.92	WJ III RC	91.74	9.79
RAN-L	94.06	10.41	Bateria III RC	70.35	14.62
WJ III VM	93.01	13.17	WJ III OC	93.07	10.57
WJ III PC	99.41	6.03	Bateria III CO	83.53	16.47
WJ III LWID	95.16	12.72	PTVT	86.31	11.73
Bateria III ILP	76.69	21.65	TVIP	82.40	18.89
WJ III WA	100.25	12.89			
Bateria III AP	81.41	17.84			
WJ III RF	91.94	12.39			

Note. n = 68, RAN = Rapid Automatized Naming Test (O = Objects, N = Numbers, L = Letters, WJ III = Woodcock-Johnson (VM = Visual Matching, PC = Pair Cancellation, LWID = Letter-Word Identification, WA = Word Attack, RF = Reading Fluency, RC = Reading Comprehension, OC = Oral Comprehension), Bateria III (ILP = Identificacion de Letras y Palabras, AL = Analysis de Palabras, FL = Fluidez de la Lectura, CL = Comprension de la Lectura, CO = Comprension Oral), PPVT = Peabody Picture Vocabulary Test, TVIP = Test de Vocabulario en Imagenes Peabody.

Correlation Analyses for Study Question One

The first question of this study focused on the following question: *What tasks within each cognitive correlate of reading (RAN, PA, and PS) show a correlation to RF and D in ELLs?* Based on previous research, the running hypothesis for this question was speculated as:

Hypothesis 1: There is a difference in the correlation coefficients of Rapid Automatized Naming (RAN), Phonological Awareness (PA), and Processing Speed (PS) tasks with RF *and D performance in English and Spanish.* Table 3 presents the correlation coefficients of each RAN, PA, and PS task with RF and D.

Table 3

Correlation for RAN, PA, PS with RF, and D

	WJ III LWID	Bateria III ILP	WJ III WA	Bateria III AP	WJ III RF	Bateria III FL
RAN-Objects	.47**	.26*	.36**	.33**	.49**	.26*
RAN-Numbers	.57**	.44**	.39**	.53**	.63**	.45**
RAN-Letters	.54**	.38**	.37**	.45**	.62**	.33**
TOPAS-SS	.57**	.43**	.54**	.39**	.42**	.33**
TOPAS-PD	.63**	.54**	.61**	.58**	.53**	.46**
TPAS-FS	.44**	.38**	.45**	.45**	.41**	.33**
TPAS-PD	.58**	.68**	.67**	.65**	.41**	.51**
WJ III VM	.49**	.27*	.36**	.35**	.48**	.21*
WJ III PC	.15	.04	.08	.04	.23*	.06

**p* < .05. ***p* < .01.
Note. n = 68, RAN = Rapid Automatized Naming Test (O = Objects, N = Numbers, L = Letters, WJ III = Woodcock-Johnson (VM = Visual Matching, PC = Pair Cancellation, LWID = Letter-Word Identification, WA = Word Attack, RF = Reading Fluency, RC = Reading Comprehension, OC = Oral Comprehension), Bateria III (ILP = Identificacion de Letras y Palabras, AL = Analysis de Palabras, FL = Fluidez de la Lectura).

In order to explore the unique relations between each of the variables in this study, the analysis for this question was separated into each cognitive correlate, RAN, PA, and PS, and how they relate to each aspect of reading, D and RF. In addition, a goal of this question was to find the task within each cognitive correlate that had the highest correlation to reading for the analyses on question two. The following hypotheses were formulated to analyze how each cognitive correlate relates to each aspect of reading.

Hypothesis 1a: In ELLs, performance in Rapid Automatized Naming (RAN) is correlated to performance in Reading Fluency (RF) tasks. Overall, all RAN tasks were significantly correlated to RF tasks in English and Spanish. Thus, this hypothesis was confirmed. The highest correlation for this population was between RAN Numbers and RF in English. The Pearson correlation for these variables was significant, $r(66) = .63$, $p < .001$, one-tailed. RAN Numbers was also the most correlated variable to RF in Spanish, with a Pearson correlation $r(66) = .45$, $p < .001$, one-tailed.

Hypothesis 1b: In ELLs, performance in Rapid Automatized Naming (RAN) is correlated to Decoding (D) tasks. Similar to its correlation to RF tasks, all RAN tasks were also correlated to D in both English and Spanish. The highest correlation within these variables was between RAN Numbers and the Letter Word Identification test from the WJ III NU. The value of this Pearson correlation was $r(66) = .57$ $p < .001$, one-tailed. Similarly for its relation with RF, RAN Numbers was also the variable that was most correlated to D, as measured by the Identificacion de Letras y Palabras from the Bateria III with a significant Pearson correlation, $r(66) = .44$, $p < .001$, one-tailed.

Hypothesis 1c: In ELLs, performance in Phonological Awareness (PA) is highly correlated to Reading Fluency (RF) tasks. All PA tasks in English and Spanish were significantly correlated to RF in English and Spanish, confirming this hypothesis. The highest correlation for this analysis was between the Phoneme Deletion task from the TOPAS and RF in English. The Pearson correlation between these variables was significant, $r(66) = .53$, $p < .001$, one-tailed. The Spanish PA counterpart of Phoneme Deletion in the TPAS provided the highest correlation to RF in Spanish, with a strong Pearson correlation $r(66) = .51$, $p < .001$, one-tailed.

Hypothesis 1d: In ELLs, performance in Phonological Awareness (PA) is correlated to Decoding (D) tasks. As expected, based on the review of studies that link PA to D, the population in this study demonstrated a high correlation between their performance in PA and D tasks in English and Spanish. The highest correlation within these variables was between the Phoneme Deletion task from the TPAS and Identificacion de Letras y Palabras from the Bateria III, Pearson's $r(66) = .67$, $p < .001$, one-tailed. The Phoneme Deletion task in Spanish was also the best predictor of an English D task, the Word Attack test from the WJ III NU. This Pearson correlation was significant, $r(66) = .66$, $p < .001$, one-tailed. The conclusion for this hypothesis is that PA is highly correlated to performance in D, with Spanish PA showing the highest correlation for D in both English and Spanish.

Hypothesis 1e: In ELLs, performance in Processing Speed (PS) is highly correlated to Reading Fluency (RF). Based on the performance of participants in this study, PS, as measured through the two tasks in this study, is inconsistently correlated to RF in Spanish speaking ELLs. Therefore, generally speaking, this hypothesis is not supported. However, if taken alone, the Visual Matching test from the WJ III NU is significantly correlated to RF. The correlation coefficient between Visual Matching and RF in English is $r(66) = .48$, $p < .001$, one-tailed, and in Spanish it is $r(66) = .21$, $p = .041$, one-tailed, indicating that PS is a better predictor of RF in English than in Spanish. Although still significant, the Pair Cancellation task showed a lower Pearson correlation only to RF in English, $r(66) = .23$, $p = .030$, one-tailed, but it did not appear to be a good predictor of RF in Spanish. The conclusion for this hypothesis is that PS is not consistently correlated to RF, but a PS task that involved matching of numbers, such as the Visual Matching task, is significantly correlated to RF in both English and Spanish.

Hypothesis 1f: In ELLs, performance in PS is correlated to D tasks. Based on the performance of participants in this study, PS, as measured through the two tasks in this study, did not demonstrate a consistent level of correlation with D tasks. Visual Matching performance was significantly correlated to all D tasks, with the highest correlation being with the Letter Word Identification task in English $r(66) = .49$, $p < .001$, one-tailed. Visual Matching and Spanish D in the Identificacion de Letras y Palabras task had a moderate Pearson correlation, $r(66) = .36$, $p = .001$, one-tailed. The Pair Cancellation task did not significantly correlate to D in either English or Spanish. The conclusion for this hypothesis is that PS does not consistently correlate to performance in D, but a PS task that involved matching of numbers, such as the Visual Matching task is significantly correlated to D, particularly in English.

In summary, all tasks of RAN and PA appear to strongly correlate to reading performance, both in RF and D in ELLs. The highest correlations, as seen in other studies highlighted in Chapter 2, are between RAN Numbers and RF, and between PA and D. PS was an inconsistent predictor of reading, but there still appears to be an association between performance PS tasks that involve numbers and reading among this population.

Multiple Regression for Study Question Two

Based on questions one's findings and controlling for demographic variables that were found correlated to interest variables, question two examined if predictor variables with the highest correlation to the criterion could predict reading performance. For instance, RAN Numbers, Phoneme Deletion in English, and Visual Matching demonstrated the highest correlations to basic reading skills (D and RF). Thus, this analysis aimed at determining if a statistically significant model using the three variables above could be created to predict basic reading skills. The rationale for selecting only one measure for each predictor variable was made in order to account for multicollinearity, a statistical phenomenon that occurs when predictor variables are highly correlated with each other. Similarly, RF and D were combined into one variable by obtaining the average of both scores to account for basic reading skills. Question two asked, *Can RAN Numbers, Phoneme Deletion, and Visual Matching significantly predict basic reading skills*? And the following hypothesis was formulated based on research prior to data collection in this study:

Hypothesis 2: RAN Numbers, Phoneme Deletion, and Visual Matching significantly predict basic reading skills in ELLs..

In order to explore this hypothesis, data were analyzed through a simultaneous multiple regression analysis that included the interest variables (i.e. RAN Numbers, Phoneme Deletion, and Visual Matching) and demographic variables that could account for basic reading skills (i.e. gender, age of child at time of testing, parent language, and years the family has lived in the US). The predictive value of these variables on basic reading skills was then analyzed according to language with the following hypotheses:

Hypothesis 2a: RAN Numbers, Phoneme Deletion, and Visual Matching significantly predict English basic reading skills in ELLs

The regression analysis for this question revealed that the combined model contributed significantly to overall basic reading skills performance in the sample, F (6, 61) = 19.48, $p < .05$, $R^2 = .67$. Table 4 summarizes the statistical information obtained to answer this research question.

Table 4

Summary of Simple Regression Analysis for Variables Predicting Basic Reading Skills in English (N=68)

Variable	*B*	*SE B*	*β*
Age of child at time of testing	-3.047	.989	-.256**
Parent Language - English	1.206	3.067	.042
Parent Language - Spanish	1.511	4.179	.040
RAN-N	.331	.074	.396**
TOPAS-PD	.361	.067	.465**
WJ III VM (PS)	.082	.081	.093
R^2		.657	
F		19.479**	

*p < .05. **p < .01.

Note. n = 68, RAN = Rapid Automatized Naming Test (N = Numbers), TOPAS = Test of Phonological Awareness Skills (PD = Phoneme Deletion), WJ III = Woodcock-Johnson (VM = Visual Matching).

The obtained coefficients for this portion of the analysis indicated that Phoneme Deletion is the strongest predictor of basic reading skills accounting for 37% of the shared variability. RAN Numbers also contributed significantly to the model, with 33% of shared variability. PS, was not a significant predictor when all other variables were taken into account. The demographic variables entered into the model were not significant, except for age, which demonstrated a negative relation indicating that as the age of participants increased, their performance on basic reading skills decreased.

Hypothesis 2b: RAN Numbers, Phoneme Deletion, and Visual Matching will significantly predict Spanish basic reading skills in ELLs.

The regression analysis for this question revealed that the combined model contributed significantly to overall basic reading skills performance in the sample, F (6, 61) = 7.70, $p < .05$, $R^2 = .43$. Table 5 summarizes the statistical information obtain to answer this research question.

Table 5

Summary of Simple Regression Analysis for Variables Predicting Basic Reading Skills in Spanish (N=68)

Variable	*B*	*SE B*	*β*
Age of child at time of testing	-1.020	2.004	-.054
Parent Language - English	-.539	6.213	-.012
Parent Language - Spanish	2.716	8.466	.045
RAN-N	.486	.150	.369**
TOPAS-PD	.522	.135	.428**
WJ III VM	-.010	.165	-.007
R^2		.431	
F		7.702**	

*$p < .05$. **$p < .01$.

Note. n = 68, RAN = Rapid Automatized Naming Test (N = Numbers), TOPAS = Test of Phonological Awareness Skills (PD = Phoneme Deletion), WJ III = Woodcock-Johnson (VM = Visual Matching).

The obtained coefficients for this portion of the analysis indicated that, as in English basic reading skills, Phoneme Deletion is the strongest predictor of basic reading skills in Spanish accounting for 52% of the shared variability. RAN Numbers also contributed significantly to the model, with 48% of shared variability. PS, was not a significant predictor when all other variables were taken into account. In contrast to English basic reading skills, Age was not a significant predictor of Spanish basic reading skills.

Hypothesis 2c: RAN Numbers, Phoneme Deletion, and Visual Matching significantly predict overall basic reading skills (Spanish and English) in ELLs.

The regression analysis for this question revealed that the combined model contributed significantly to overall basic reading skills performance in the sample, F (6, 61) = 14.73, $p < .05$, $R^2 = .59$. Table 6 summarizes the statistical information obtain to answer this research question.

Table 6

Summary of Simple Regression Analysis for Variables Predicting Basic Reading Skills in English and Spanish (N=68)

Variable	*B*	*SE B*	*β*
Age of child at time of testing	-2.033	1.275	-.144
Parent Language - English	.334	3.955	.010
Parent Language - Spanish	2.113	5.389	.047
RAN Numbers	.409	.096	.413**
TOPAS- Phoneme Deletion	.442	.086	.481**
WJ III Visual Matching	.036	.105	.035
R^2		.592	
F		14.732**	

*$p < .05$. **$p < .01$.

Note. n = 68, RAN = Rapid Automatized Naming Test (N = Numbers), TOPAS = Test of Phonological Awareness Skills (PD = Phoneme Deletion), WJ III = Woodcock-Johnson (VM = Visual Matching).

Coefficients for this portion of the analysis indicated that Phoneme Deletion is also the strongest predictor of basic reading skills in the combination of English and Spanish and accounts for 44% of the shared variability. RAN Numbers also contributed significantly to the model, with 40% of shared variability. PS, was not a significant predictor when all other variables were taken into account. Age was also not a significant predictor of Spanish/English basic reading skills.

In summary, a model that combines RAN Numbers, Phoneme Deletion in English, and Visual Matching is a significant predictor of reading skills in ELLs, but Visual Matching is not a significant predictor of basic reading skills. RAN Numbers and Phoneme deletion were significant predictors of basic reading skills in English, Spanish, and a combination of Spanish/English basic reading skills. Even when relevant demographic variables were entered, RAN Numbers and Phoneme Deletion accounted for a large variability of performance on basic reading skills.

Correlation Analyses for Study Question Three

The next goal of this study was to determine the role of V in the development of reading skills in Spanish/English speaking ELLs. Thus, question five asked, *What aspects of reading are most related to Vocabulary (V) in ELLs*? To explore this question, a correlation matrix was created to highlight significant relations between V in English and Spanish and performance in basic reading skills, as measured by D and RF, and reading comprehension (RC). Table 7 presents the various correlation coefficients from this analysis.

Table 7

Correlation for Vocabulary with Reading Fluency (RF), and Decoding (D)

	PTVT	TVIP	Vocabulary in English and Spanish
WJ III LWID	.325**	0.143	.302**
Bateria III ILP	-0.051	.445**	.364**
WJ III WA	.210*	.244*	.335**
Bateria III AP	0.026	.349**	.321**
WJ III RF	.478**	0.093	.306**
Bateria III FL	0.004	.391**	.359**
WJ III RC	.682**	.250*	.519**
Bateria III RC	0.052	.629**	.562**
WJ III OC	.766**	0.088	.407**
Bateria III CO	.213*	.646**	.575**

*$p < .05$. **$p < .01$.

Note. n = 68, WJ III = Woodcock-Johnson (LWID = Letter-Word Identification, WA = Word Attack, RF = Reading Fluency, RC = Reading Comprehension, OC = Oral Comprehension), Bateria III (ILP = Identificacion de Letras y Palabras, AL = Analysis de Palabras, FL = Fluidez de la Lectura, CL = Comprension de la Lectura, CO = Comprension Oral), PPVT = Peabody Picture Vocabulary Test, TVIP = Test de Vocabulario en Imagenes Peabody.

Hypothesis 3: Vocabulary (V) in English and Spanish, and a combination of both languages, predict reading in English and Spanish as measured by Decoding (D), Reading Fluency (RF), and Reading Comprehension (RC).

Data gathered in this study partially supports this hypothesis. V in English is correlated to reading skills in English only, with the highest correlation being between RC and V in English r (68) = .682, p < .05, one-tailed. English V was also significantly correlated to D in the Letter-

Word Identification subtest with *r* $(33) = .33$, $p < .05$, one-tailed and RF with *r* $(48) = .48$, $p < .05$, one-tailed. The pattern was similar in Spanish, with the highest correlation being between RC and V in Spanish *r* $(63) = .63$, $p < .05$, one-tailed. Spanish V was also significantly correlated to D in the Identificacion de Letras y Palabras subtest with *r* $(45) = .45$, $p < .05$, one-tailed and RF with *r* $(39) = .39$, $p < .05$, one-tailed. The average of V in English and Spanish was significantly correlated to all reading variables with RC in both languages showing the highest correlation, *r* $(52) = .52$, $p < .05$, one-tailed for English and *r* $(56) = .56$, $p < .05$, one-tailed for Spanish.

To summarize, V skills in Spanish and English are highly correlated to reading skills for the same language. A combination of V skills in both languages is significantly correlated to all aspect of reading, with the highest correlation being to RC.

Multiple Regression Analysis for Question Four

A fourth goal of this study was to explore the utility of the Simple View of Reading (SVR) with the population sampled in this study. For this purpose, Question Four asked, *does the model of the Simple View of Reading (SVR) apply to the population in this study and can it be used to distinguish among normally developing readers, students with dyslexia and students with other language disabilities (e.g. SLI) in Spanish/English ELLs?* This question was explored by conducting a multiple regression analysis for each language and a combination of skills in both languages. The general hypothesis for this questions was as follows:

Hypothesis 4: Decoding (D) and Listening Comprehension (LC) can significantly predict Reading Comprehension (RC) and can be used to classify participants among the four possible categories of the SVR.

The skills for this analysis were separated by language:

Hypothesis 4a: Decoding (D) and Listening Comprehension (LC) in English can significantly predict English Reading Comprehension (RC) and can be used to classify participants among the four possible categories of the SVR.

The regression analysis for this question revealed that the combination of D and LC significantly predicted English RC in this sample, $F(2, 66) = 169.75$, $p < .05$. $R^2 = .84$. Table 8 summarizes the statistical information obtained to answer this research question.

The obtained coefficients for this portion of the analysis indicated that D, as measured by Letter-Word Identification is the highest predictor of reading comprehension performance accounting for 56% of the shared variability. LC also contributed significantly to the model, with 38% of shared variability.

Table 8

Summary of Simple Regression Analysis for D and LC Predicting RC in English (N=68)

Variable	*B*	*SE B*	*β*
WJ III LWID	.560	.039	.727**
WJ III OC	.378	.047	.408**
R^2		.839	
F		169.754**	

*p < .05. **p < .01.

Note. n = 68, WJ III = Woodcock-Johnson (LWID = Letter-Word Identification, OC = Oral Comprehension).

Hypothesis 4b: Decoding (D) and Listening Comprehension (LC) in Spanish can significantly predict Spanish Reading Comprehension (RC) and can be used to classify participants among the four possible categories of the SVR.

The regression analysis for this question revealed that Spanish D and LC skills significantly predicted Spanish RC in this sample, F (2, 66) = 75.22, p < .05, $R^2 =$ .70. Table 9 summarizes the statistical information obtained to answer this research question.

Table 9

Summary of Simple Regression Analysis for D and LC Predicting RC in Spanish (N=68)

Variable	*B*	*SE B*	*β*
Bateria III ILP	.470	.051	.696
Bateria III CO	.221	.067	.249
R^2		.698	
F		75.228**	

**p* < .05. ***p* < .01.

Note. n = 68, Bateria III (ILP = Identificacion de Letras y Palabras, CO = Comprension Oral).

For the Spanish analysis of the SVR, the obtained coefficients indicated that D, as measured by Identificacion de Letras y Palabras is the highest predictor of RC performance accounting for 47% of the shared variability. LC also contributed significantly to the model, with 22% of shared variability.

Hypothesis 4c: Decoding (D) and Listening Comprehension (LC) in English and Spanish can significantly predict the average of Reading Comprehension (RC) in English and Spanish and can be used to classify participants among the four possible categories of the SVR.

The regression analysis for this question revealed that the entire model, which combined Spanish and English D and LC skills significantly predicted Spanish and English RC in this sample, F (4, 64) = 70.56, p < .05, $R^2 =$ .82. Table 10 summarizes the statistical information obtained to answer this research question.

Table 10

Summary of Simple Regression Analysis for D and LC in Spanish and English Predicting RC in Spanish and English (N=68)

Variable	*B*	*SE B*	*β*
WJ III LWID	.349	.063	.424**
WJ III OC	.146	.064	.147**
Bateria III ILP	.196	.040	.406**
Bateria III CO	.166	.040	.261**
R^2		.818	
F		70.564**	

*p < .05. **p < .01.

Note. n = 68, WJ III = Woodcock-Johnson (LWID = Letter-Word Identification, OC = Oral Comprehension), Bateria III (ILP = Identificacion de Letras y Palabras, CO = Comprension Oral).

The obtained coefficients for this portion of the analysis indicated that all of the D and LC skills entered into the model significantly predicted the average of RC in English and Spanish. English D, as measured by the WJ III Letter-Word ID contributed 35% to the model, Spanish D, as measured by the Bateria III Analysis de Palabras contributed 20%, and LC contributed 15% and 17% for English and Spanish respectively.

In summary, the SVR is a useful model for the assessment of reading in Spanish/English speaking ELLs as represented in this sample. However, the model works better when using English LC and D as predictors of English RC performance.

Case Study Analyses for Question Five

The final question of this study asked, *Can measures of Phonological Awareness (PA), Rapid Automatized Naming (RAN), Listening Comprehension (LC), and Vocabulary (V)* *distinguish among normally developing readers, students with dyslexia, and students with environmental factors or other language disabilities affecting reading (e.g. lack of language exposure)?* Based on the findings from Questions One through Four, participants were separated into groups according to performance on the variables that significantly predicted reading. Cognitive correlates, which predicted basic reading skills, included RAN Numbers and Phoneme Deletion in English. The average of these two skills was calculated for each participant. Oral language skills, which predict RC, were calculated by obtaining the average of V and LC. Because V and LC in each language are highly correlated to RC in the corresponding language, the value used for each participant was their highest score either in English or Spanish. Using these criteria, the groups on Figure 7 were created. Adequate oral language skills and cognitive correlate skills were defined as an average of the skills for each axis at or above a standard score of 85. Poor oral language skills and cognitive correlate skills were defined as at or below a standard score of 84. A discrepancy of one standard deviation between oral language skills and cognitive correlate was used to classify students under the category of Dyslexia and Lack of Language Exposure. The total number of participants who fell under each category included fifty Normally Developing Readers, four participants with Dyslexia, thirteen students with Lack of Language Exposure, and two with a combination of Dyslexia and Lack of Language Exposure.

The frequency of participants who fell into each of the groups is presented in Figure 7.

Oral Language Skills (LC+ V)	Cognitive Correlates (RAN Numbers + Phoneme Deletion): Poor	Cognitive Correlates (RAN Numbers + Phoneme Deletion): Adequate
Adequate	Dyslexia N=4 (6%)	Normally Developing Readers N=49 (72%)
Poor	Dyslexia + Lack of Language Exposure N=2 (3%)	Lack of Language Exposure N=13 (19%)

Figure 7. Frequency of participants in reading categories from this study.

Note. n = 68, RAN = Rapid Automatized Naming Test, LC = Listening Comprehension, V = Vocabulary.

A participant from each group was randomly selected for comparison purposes. Table 11 provides the information used for the case study analyses in Chapter 5.

Table 11

Characteristics of Participants Selected at Random for Case Study Analysis.

ID	Classification	Gender	Grade	Age	OLS	CC
RD27	Dyslexia	Female	3	9.2	107	76
RD33	Normally Developing Readers	Female	3	8.7	103	105
RD07	Dyslexia and Lack of Language Exposure	Male	1	7.4	66	76
RD06	Lack of Language Exposure	Male	2	7.9	76	99

Note. n = 4, OLS = Oral Language Skills, CC = Cognitive Correlates

Below is a description of skills of each of the participants selected for this portion of the study. The scores on the various interest variables for each participant selected at random for the case study analyses are presented in Tables 12 through 15.

Participant RD33 – "Abby" (Classification: Normally Developing Readers). Abby is an 8-year old female student in third grade. The average of her standard scores in cognitive correlates yielded a score of 105. The average of her oral language skills was similar in Spanish (SS = 103) to (SS = 101) and thus she can be considered truly bilingual, the average of her oral language skills in Spanish was considered the best measure of her oral language skills. In the demographic questionnaire, her parents identified themselves as primarily Spanish speakers, and Abby's primary language was also reported as Spanish. The family has lived in the US for five years, and Abby began her schooling in preschool at the age of four. Academic instruction has been only in English, and she has never been retained or classified as having a learning disability. Abby has one sibling, who is also reported as Spanish dominant. Abby's parents report that at home Abby reads approximately one hour per week with books that she brings from school, which are primarily in English. Table 12 provides information on Abby's performance on the different measures of this study.

Table 12

Performance of Participant RD33 – "Abby" on Interest Variables

Variables	Standard Score	Variables	Standard Score
RAN-N	108	Bateria III FL	88
TOPAS-PD	114	WJ III RC	106
WJ III LWID	111	Bateria III RC	90
Bateria III ILP	104	WJ III OC	107
WJ III WA	123	Bateria III CO	103
Bateria III AP	104	PPVT	92
WJ III RF	100	TVIP	103

Note. n = 68, RAN = Rapid Automatized Naming Test (N = Numbers), TOPAS = Test of Phonoogical Awareness Skills (PD = Phoneme Deletion), WJ III = Woodcock-Johnson (LWID = Letter-Word Identification, WA = Word Attack, RF = Reading Fluency, RC = Reading Comprehension, OC = Oral Comprehension), Bateria III (ILP = Identificacion de Letras y Palabras, AL = Analysis de Palabras, FL = Fluidez de la Lectura, CL = Comprension de la Lectura, CO = Comprension Oral), PPVT = Peabody Picture Vocabulary Test, TVIP = Test de Vocabulario en Imagenes Peabody.

Participant RD27 – "Mya" (Classification: Dyslexia). Mya is a 9-year old female student in third grade. The average of her standard scores in cognitive correlates yielded a score of 107. The average of her oral language skills was slightly higher in English (SS = 107) than in Spanish (SS = 104) and thus she can also be considered bilingual. The average of her oral language skills in English was considered the best measure of her oral language skills. In the demographic questionnaire, her parents identified themselves as primarily Spanish speakers, and Mya's primary language was reported as both English and Spanish. The family has lived in the US for ten years, and Mya began her schooling in kindergarten at the age of five. Academic instruction has been only in English, and she has never been retained or classified as having a learning disability. Mya is an only child, and she communicates with her parents in both English and Spanish. Like Abby, Mya's parents report that Mya reads at home approximately two hours per week with English books from school. Table 13 provides information on Mya's performance on the different measures of this study.

Table 13
Performance of Participant RD27 – "Mya" on Interest Variables

Variables	Standard Score	Variables	Standard Score
RAN-N	86	Bateria III FL	45
TOPAS-PD	62	WJ III RC	89
WJ III LWID	82	Bateria III RC	70
Bateria III ILP	54	WJ III OC	110
WJ III WA	77	Bateria III CO	105
Bateria III AP	53	PPVT	104
WJ III RF	88	TVIP	103

Note. n = 68, RAN = Rapid Automatized Naming Test (N = Numbers), TOPAS = Test of Phonoogical Awareness Skills (PD = Phoneme Deletion), WJ III = Woodcock-Johnson (LWID = Letter-Word Identification, WA = Word Attack, RF = Reading Fluency, RC = Reading Comprehension, OC = Oral Comprehension), Bateria III (ILP = Identificacion de Letras y Palabras, AL = Analysis de Palabras, FL = Fluidez de la Lectura, CL = Comprension de la Lectura, CO = Comprension Oral), PPVT = Peabody Picture Vocabulary Test, TVIP = Test de Vocabulario en Imagenes Peabody.

Participant RD06 – "Alex" (Classification: Lack of Language Exposure). Alex is a 7-year old male student in second grade. The average of his standard scores in cognitive correlates yielded a score of 99. The average of his oral language skills was slightly higher in English (SS = 76) than in Spanish (SS = 71) indicating a deficiency in both languages. The average of his oral language skills in English was considered the best measure of his oral language skills. In the demographic questionnaire, his parents identified themselves as primarily Spanish speakers, and Alex' primary language was also reported as Spanish. The family has lived in the US for seven years, and Alex began his schooling in kindergarten at the age of five. Academic instruction has been only in English, and he has never been retained or classified as having a learning disability. Alex does not have any siblings. According to Alex's parents, Alex reads books at home in English for approximately five hour per week. Table 14 provides information on Alex' performance on the different measures of this study.

Table 14

Performance of Participant RD06 – "Alex" on Interest Variables

Variables	Score	Variables	Score
RAN-N	93	Bateria III FL	88
TOPAS-PD	114	WJ III RC	92
WJ III LWID	109	Bateria III RC	80
Bateria III ILP	96	WJ III OC	78
WJ III WA	109	Bateria III CO	69
Bateria III AP	88	PPVT	74
WJ III RF	103	TVIP	72

Note. n = 68, RAN = Rapid Automatized Naming Test (N = Numbers), TOPAS = Test of Phonoogical Awareness Skills (PD = Phoneme Deletion), WJ III = Woodcock-Johnson (LWID = Letter-Word Identification, WA = Word Attack, RF = Reading Fluency, RC = Reading Comprehension, OC = Oral Comprehension), Bateria III (ILP = Identificacion de Letras y Palabras, AL = Analysis de Palabras, FL = Fluidez de la Lectura, CL = Comprension de la Lectura, CO = Comprension Oral), PPVT = Peabody Picture Vocabulary Test, TVIP = Test de Vocabulario en Imagenes Peabody.

Participant RD07 – "Jose" (Classification: Dyslexia and Lack of Language Exposure). Jose is a 7-year old male first grader. The average of his standard scores in cognitive correlates yielded a score of 66. The average of his oral language skills was slightly higher in English (SS = 66) than in Spanish (SS = 62) indicating a deficiency in both languages. The average of his oral language skills in English was considered the best measure of his oral language skills. In the demographic questionnaire, his parents identified themselves as primarily Spanish speakers, and Jose's primary language was also reported as Spanish. The family has lived in the US for 23 years, and began his schooling in kindergarten at the age of five Jose has a sibling who is reported as primarily English speaking. Academic instruction has been only in English, and he has never been retained or classified as having a learning disability. According to Jose's parents, Jose does not read at home. Table 15 provides information on Jose's performance on the different measures of this study.

Table 15

Performance of Participant RD07 – "Jose" on Interest Variables

Variables	Score	Variables	Score
RAN-N	76	Bateria III FL	56
TOPAS-PD	77	WJ III RC	68
WJ III LWID	81	Bateria III RC	50
Bateria III ILP	70	WJ III OC	75
WJ III WA	87	Bateria III CO	54
Bateria III AP	47	PPVT	57
WJ III RF	72	TVIP	70

Note. n = 68, RAN = Rapid Automatized Naming Test (N = Numbers), TOPAS = Test of Phonoogical Awareness Skills (PD = Phoneme Deletion), WJ III = Woodcock-Johnson (LWID = Letter-Word Identification, WA = Word Attack, RF = Reading Fluency, RC = Reading Comprehension, OC = Oral Comprehension), Bateria III (ILP = Identificacion de Letras y Palabras, AL = Analysis de Palabras, FL = Fluidez de la Lectura.

CHAPTER 5

DISCUSSION

This chapter discusses the results from Chapter Four and how these apply to current methods of assessment of reading in ELLs. The discussion begins with the findings concerning the correlation between cognitive correlates (RAN, PA, and PS) and reading, and particularly the cognitive correlates that demonstrate the highest correlations to D and RF. Following this, the results concerning the predictability of a model that uses a combination of RAN Numbers, Phoneme Deletion, and Visual Matching are reviewed. The next section discusses the correlation of V in Spanish and English to various aspects of reading. Then, the chapter focuses on the application of the SVR to the population sampled in this study and how applicable this formula is considering language differentiation. The next section of this chapter discusses how the combination of results from questions one through four are applied to create a new model that could potentially be used to assess reading and diagnose dyslexia in ELLs. This analysis is followed by qualitative case illustrations using one participant that matches each of the different profiles of reading. The final section presents conclusions and implications for researchers and practitioners.

Cognitive Correlates of Reading in ELLs

The relationship between the different correlates of reading (RAN, PA, and PS) was examined through Pearson correlations. Previous research, highlighted in Chapter Two, suggests that RAN, PA, and PS are correlated to reading, with RAN being mostly associated to RF, PA mostly being associated to D, and PS being associated to both RF and D. The correlations derived from the performance of participant in this study are mostly consistent with previous findings, with the exception of one of the tasks in PS, Pair Cancellation. The strongest correlations observed were between RAN Numbers and RF in English, Phoneme Deletion and D, and Visual Matching and D.

The confirmation of this hypothesis indicates that cognitive correlates are performance tasks that consistently and reliably correlate to aspects of basic reading skills and could potentially predict reading performance. This finding is significant and of particular importance for the assessment of reading and dyslexia in ELLs because these measures do not require mastery of a language, reading instruction, or a high vocabulary. Thus, RAN, PA, and PS measures could potentially be used as screeners to highlight potential neurological impairments that lead to reading difficulties. As stated in Chapter One, reading requires the simultaneous activation of various cognitive skills related to phonological awareness, memory, vocabulary, and attention. RAN and PA likely require similar neurological demands, and therefore can be associated to reading (Mather & Wendling, 2011).

Another interesting finding of this study relates to the specific tasks that were found to most significantly correlate to reading. Does this information provide further insight on the use of RAN, PA, and PS as predictors of reading in ELLs? Perhaps performance on RAN Numbers was the most related to RF in this population because, even though it still requires processing of symbols (as in reading), it is not language specific. RAN Letters, on the other hand, requires a more systematic association between the symbol and its corresponding letter name, and may be more sensitive to language mastery and instruction. For PA tasks, the Phoneme Deletion task yielded the highest correlation to D in English. In fact, the correlation between Phoneme Deletion and all reading tasks was high, with the Spanish equivalent of this task mirroring similar correlations. This pattern may be due to the universality of reading development and pre-reading skills across languages. As Brunswick (2010) indicated, basic aspects of reading, such as the ability to segment language into parts to represent these in writing are abilities that develop naturally in most children. Those who lack these skills are likely to experience difficulties in reading. This study supports Brunswick's position and suggests that PA skills in English predict reading in English, but also in Spanish, and vise-versa. Finally, PS measures produced inconsistent correlations in this study. However, as in RAN Numbers, the Visual Matching task involves scanning of numbers, which are symbols, and therefore potentially more comparable to reading. Pair Cancellation on the other hand, involved scanning of objects, which may not directly associate to the neurological demands of reading.

Continuing the exploration of cognitive correlates of reading to reading, question T\two used the information from question one to test the possibility of a model that could accurately predict reading. For this purpose, one task from RAN, PA, and PS, which demonstrated the highest correlation to reading, was selected as the predictor of the combination of D and RF, which was considered to represent basic reading skills. The purpose of this analysis was twofold. First, it aimed at establishing the predictability of these measures given demographic variables. Second, it explored if this model could be used as a fast, accurate, and reliable predictor of basic reading skills in ELLs. With demographic variables inserted in the model, Visual Matching was no longer a significant predictor of reading. RAN Numbers and Phoneme Deletion, on the other hand, remained significant with a large portion of the variance explaining reading performance. This partially supported the hypothesis of question two and it further establishes RAN and PA as predictors of basic reading skills in this population, but it does not support PS, as measured by Visual Matching, as a significant predictor.

Another interesting finding highlighted by the analysis of Question Two involved the significance of age as a predictor variable. Age significantly predicted basic reading skills in

English only, and this relationship was negative, indicating that as the age of participants in this study increased, their basic reading skills decreased. A few hypotheses could be speculated from this finding. For example, as established in ample research (e.g. Ortiz, 2012), ELLs fall exponentially behind in reading as the demands of reading increase in higher grades. Thus, while ELLs in younger grades may develop basic reading skills that reflect those of their monolingual peers, their reading begins to lag behind as they lack English language skills in older grades. The fact that age was not a significant predictor of Spanish basic reading skills or Spanish/English basic reading skills supports this hypothesis. Another possibility may have to do with the nature of English orthography. As mentioned in Chapter One, English is considered a deep orthography, with many spelling irregularities that make accurate D challenging. Thus, participants in this study had to use their PA skills to decode written words in English and Spanish. As items on the decoding tasks used for this study increased, the irregularity of the words that participants had to decode increased. Therefore, older participants had to read words and nonwords that reflected more complicated, irregular spelling patterns in English. In Spanish reading, on the other hand, the regularity of spelling patterns could facilitate more accurate reading of more difficult words. As Bruswick (2010) explained, the simplicity of a shallow orthography like Spanish, can act as a prop for decoding.

Overall, the utility of cognitive correlates of reading is confirmed by the findings in this study. Like monolingual English speakers, performance in RAN, PA, and PS tasks in ELLs is correlated to their performance in D and RF. Cognitive correlates could potentially be utilized in school settings to screen ELLs who may fall behind in reading.

Vocabulary

Another goal of the present study was to explore the role of V in the development of reading in ELLs. It is expected that, in any language, V would influence reading, but how exactly does the relationship between language and reading develop in ELLs, who have a mixture of V skills, was a main focus of this study. To explore this question, a correlation analysis was performed in order to highlight reading tasks that are most correlated to V in English, Spanish, or a combination of both. Not surprisingly, from this analysis, it was established that V is mostly significantly correlated to reading tasks in its equivalent language, with the highest correlation emerging between V and RC. Some other interesting findings from this analysis also emerged. Particularly, the average of V skills in English and Spanish significantly correlated to all aspects of reading, suggesting that ELLs who have a high average combination of V in English and Spanish are likely to perform better in all aspects of reading.

Another interesting finding involves the correlation of English and Spanish V among participants. This correlation was not significant, r (.09) = .097, suggesting that participants in this study do not have V skills that correlated between English and Spanish, and thus, ELLs sampled in this study tend to master either English or Spanish, but not both. For the most part, participants in this study were more proficient in English than in Spanish. This finding is significant because it is common practice in schools to assess ELLs in Spanish because this is considered their 'native' language. However, as demonstrated in the sample of this study, ELLs tend to develop better English skills if they started school in kindergarten, even if their parents are monolingual Spanish speakers. The mean of English and Spanish V for this sample, however, is well below the average, at SS = 86 and SS = 82 respectively, indicating that ELLs sampled in this population have low V skills in both languages. The overall lack of V skills generally seen in ELLs is likely to adversely affect academic performance (Ortiz, 2011).

In summary, the third question of this study, which asked if V in English and Spanish, and a combination of both languages, predicts reading in English and Spanish, is confirmed. However, V in English is mostly associated to reading in English, with the equivalent relationship occurring in Spanish. The combination of V skills in both languages, on the other hand, is correlated to all aspects of reading in Spanish and English, but the numerical correlation for this relationship is less. Thus, when possible, educators working with ELLs should first establish V skills in ELLs prior to assessing reading.

The Simple View of Reading

The next focus of this study aimed at determining the utility of the SVR for the assessment of ELLs. In their original study, Gough and Tunmer (1986) found that reading comprehension was the product of listening and decoding skills (RC = LC x D). The analyses on Question Four of this study suggest that this relationship also applies to ELLs. Thus, the SVR is a useful model for the assessment of reading skills in ELLs. Further information on the nature of the relationship between RC, LC, and D according to language was also derived from this portion of the study.

The first analysis, which involved multiple regression including only English predictor and criterion variables, yielded results that reflected those found by Gough and Tunmer (1986). Not only was the overall model including D and LC tasks a significant predictor or RC, but it also showed that D and LC are responsible for a large portion of the variance in RC. In the second analysis, however, which involved variables in Spanish only, the variance of both D and LC was lower. Specifically, D accounted for 47% of the variance, while LC accounted for 22%, leaving 25% of the variance unexplained. Finally, all D and LC variables in English and Spanish were entered as predictors of the average of RC in Spanish and English, D in English remained as the strongest predictor, while D in Spanish, and LC in English Spanish accounted for 20% or less of the shared variability. It appears that, from the statistical findings for this question of the study, RC in ELLs is best predicted by measures of D and LC in English.

Overall, the SVR appears to apply to the population sampled in this study, particularly in English. Using this model, practitioners in schools could classify students according to the four categories of readers under the SVR. Of particular interest in this study, ELLs who have adequate D skills and LC can be considered normally developing readers and will not require specific interventions. ELLs who have adequate LC, but poor D, on the other hand, are those who exhibit a pattern consistent with dyslexia. However, it is possible that in ELLs, D skills are low because of lack of exposure to English print, or delayed academic progress due to second language learning. As explained in Chapter One, dyslexia is a neurological disorder that exists across languages. In English, specifically, poor D is a clear indicator of dyslexia, but poor D skills can also be explained by the environmental factors that affect ELLs. In order to substitute D for variables that are independent of academic instruction, the next analysis in this study substituted D for the cognitive correlates of reading, and it also added V to LC.

Assessment of Reading and Dyslexia in ELLs

The data collected in this study, as well as the statistical analyses conducted, aimed at one goal: providing information that would assist practitioners in the assessment of reading and dyslexia in ELLs. Particularly, the study attempted to discern reading difficulties in reading that ELLs experience due to second language learning from those that have to do with neurological traits consistent with dyslexia. In monolingual English speakers, a model, such as the one provided by the SVR may suffice for the classification among different types of readers, but in ELLs, the complexity of language and reading development is mediated by simultaneous exposure to two languages. Thus, all of the analyses in questions one through four provided the rationale for the categorization of ELL readers as seen in Figure 7. This figure can be considered an adaptation of the SVR for the assessment of reading and dyslexia in ELLs. Given the high value of RAN Numbers and Phoneme Deletion as predictors of BSR, the model substituted D for these cognitive correlates. Unlike D, these two tasks are independent of academic instruction and the complexity of English spelling. They can be administered in English or in Spanish and are associated with reading performance in either language. Furthermore, given the importance of V, LC for the model developed in this study was expanded to oral language skills, which combined LC and V. Using the criteria defined in Chapter Four, participants were classified as normally developing readers (adequate cognitive correlates and oral language skills), readers with dyslexia (poor cognitive correlates and adequate oral language skills), readers who struggle with reading because of lack of language exposure (adequate cognitive correlate and poor oral language skills), and finally, readers with both dyslexia and lack of language exposure (poor cognitive correlates and oral language skills). From this analysis, 49 participants of the sample were classified as normally developing readers, 4 as dyslexia, 13 as lack of language exposure, and 2 as dyslexia and lack of language exposure. A qualitative case study analysis of a randomly selected participant from each group provides further information of interest to this study. A fictitious name is given to participants selected for this portion of the discussion and their profiles are described in present tense in order to describe their characteristics at the time of data collection.

Participant RD33 – "Abby" (Classification: Normally Developing Readers). The variability of Abby's scores reflects the complexity of her language and reading development. For example, Abby's English LC (SS = 107) is higher than her Spanish LC (SS = 103), but her Spanish V (SS = 103) is higher than her English V (SS = 92). Understanding Abby' language exposure may explain how these skills developed in Abby. Specifically, both of these scores represent one aspect of Abby's oral language skills, but LC, as measured on the Oral Comprehension task of the WJ III mostly required Abby to listen to situations that resemble stories from a book, which Abby has mostly experienced at school, in English. English and Spanish V on the PPVT and TVIP, on the other hand, measured receptive V that reflect knowledge of the meanings of words in different contexts more consistent with a variety of settings in and out of school. Abby has likely expanded her Spanish V more than in her English V while spending time with her family, which communicates in Spanish. Abby would likely not be referred for a Special Education evaluation because her reading skills in both languages are within the average range, but consider the different outcomes that arise when her reading skills were evaluated as a monolingual student. In English, using the criteria of the SVR, Abby would be classified as a normally developing reader with good D skills (SS = 111) and good LC skills (SS = 107). Her actual obtained score in RC was as expected (SS = 106). Like in English, in Spanish her D skills (SS = 104) and LC skills (SS = 103) are good, but her actual obtained score on RC is much lower than expected (SS = 90). Possibly, Abby can decode well in Spanish because she has adequate PA skills, a high V, and the simplicity of Spanish orthography helps her decode accurately. However, she seldom reads for content in Spanish, and thus her lower score on Spanish RC could be due to lack of exposure to this kind of task. Using the classification model developed in this study, D is replaced by cognitive correlates, which do not rely on academic instruction or exposure, and LC is replaced by oral language skills, which incorporate V and LC, both of which influence Abby's RC skills. Educators working with Abby should continue to monitor her English language development and reading, but Abby is benefitting from the general education curriculum and should continue receiving the same services as her monolingual peers.

Participant RD27 – "Mya" (Classification: Dyslexia).. Mya scores, especially in reading tasks, vary greatly between English and Spanish, even though her oral language skills are at least average in both languages. In a traditional school setting, she may not be referred for a Special Education evaluation because her reading scores are in the low average range, and her scores may be attributed to her lack of English skills, as she is likely classified as an ELL student. However, her V and LC in both English and Spanish are at least average, and she has had access to reading instruction in English, and thus her reading skills should be higher. Under the SVR and the model developed in this study, Mya's scores would classify her as a student with dyslexia, but her performance on the cognitive correlates suggests that she is not reading as expected because she may have neurological deficits consistent with dyslexia. The interventions that are likely to help Mya improve reading should involve systematic instruction, such as phonics instruction. Technology and accommodation that minimize reading and writing are likely to allow Mya to perform better in academic tasks.

Participant RD06 – "Alex" (Classification: Lack of Language Exposure). Like Abby and Mya, Alex's scores vary widely across tasks and between English and Spanish. He demonstrates strong PA skills in both English and Spanish, which are likely influencing his D skills, and his cognitive correlates score was 99, which suggests that he has the neural mechanisms to perform well on these tasks, and likely also in measures of basic reading skills.

His oral language skills, however, are significantly below in both English and Spanish, which are likely affecting his RC. Using the SVR, Alex would fall under the category of Specific Reading Comprehension Difficulties, which denote a processing disorder, but in actuality, Alex's lack of RC is likely the result of poor oral language skills. The model developed in this study helps make this distinction and it highlights that Alex could benefit from interventions that target V development. Like Mya, Alex struggles with RC and will probably begin to fall behind academically in higher grades, but the interventions that he needs differ from those that Mya needs. Alex does not need systematic instruction in PA skills or technology to help him express his ideas using his oral language skills. In fact, PA is an area of strength for Alex, which will somewhat mask his low oral language skills in reading. Alex is in second grade and, thus far, academic demands have mostly required basic reading skills. However, as the reading in higher grades moves away from D into RC demands, Alex's V deficits will begin to affect RC and academic performance in most academic subjects.

Participant RD07 – "Jose" (Classification: Dyslexia and Lack of Language Exposure). Jose scored below average in most of the tasks in this study. In the SVR, he would fall under the category of Mixed Reading Disability, which implies dyslexia and a RC disorder. The model developed for this study, however, exposes oral language skills that include V as culprits of Jose's RC difficulties. A student like Jose will need intensive basic reading skills instruction as well as V expansion interventions. Like Mya and Alex, Jose's difficulties in reading will become more pronounced in older grades when academic demands increase. However, Alex will need support in a number of areas in order to access the curriculum. Educators working with Jose should target both language development while also providing interventions and accommodations that are adequate for students with dyslexia (e.g. phonics instruction, and technology to aide in reading and writing).

In summary, the statistical analyses described in this chapter, as well as the illustrative case studies, provide useful and relevant information to be considered by practitioners working with ELLs. First, cognitive correlates appear to relate to reading in both languages, and thus they can be used for ELLs who are dominant in English or in Spanish. Second, V this study corroborated findings reported in other studies, which indicate that ELLs have below average V skills in both English and Spanish and the lack of V skills will affect RC and most likely academic performance in all other subjects, since school instruction relies heavily on reading. In addition, V is highly correlated to all aspects of reading, but mostly RC. In ELLs, assessments of reading should include a measure of V. Third, the results from the model developed for this study, which replaced D for cognitive correlates, did not produce results that were much different from the SVR. However, given the high correlation of cognitive correlates to reading, cognitive correlates could replace D for ELLs who have not learned to read or who have not received enough English instruction (i.e. recent immigrants). Practitioners working with ELLs should still apply ample caution when making Special Education eligibility determinations for these students, but a model like the one developed for this study can provide a screener from which interventions and accommodations can be designed. Future research should continue to investigate how models that apply cognitive correlates of reading relate to ELLs with different profiles than the sample of this study.

Limitations

The present study has a number of limitations to be considered, however. First, although the size of the sample is large enough, it may still not represent ELLs from different cultural backgrounds. Specifically, all participants in this study are from Mexican heritage and they reside in the Southwest of the US. The cultural, linguistic, and environmental factors affecting ELLs in other regions of the country could potentially influence reading and performance on the variables of this study in a different manner. Thus, findings in this study are more generalizable to ELLs with similar profiles to those sampled in this study. In addition, although unexpected, the sample of participants in this study had English reading skills that were comparable to monolingual peers. Even though participants had language and economic disadvantages, which often lead to below average reading skills, the majority had average reading abilities (N=49). This may suggest that the population sampled for this study is not a true representation of ELLs living in the US.

Another limitation was not having the opportunity to cross-validate the results of this study with a new sample. Comparing these results to other studies with a similar sample may provide more information on how the interest variables in this study relate to reading in ELLs. There have been very few studies that have involved the study of reading and dyslexia in ELLs and future researchers should focus on studies that guide practitioners in the assessment of this population.

Other limitations of the current study involve measures not included in the study. Particularly, several studies in the past (e.g. Kail et al., 1999; Catts et al., 2002; Leonard et al., 2011) have established PS measures as good predictors of reading, but this study did not. This could have been the result of the PS tasks chosen for this study, rather than a general indication that PS is not a good predictor of basic reading skills. In addition, PS may be a good predictor of reading skills in poor readers because reading difficulties are often due to deficiencies in skills similar to those needed for PS tasks (i.e. simultaneous activation of visuospatial thinking and attention). Participants in this study had reading skills that were mostly in the average range, and PS may not be a good predictor of reading skills for average and above average readers. In average readers, PS skills may vary widely and may not necessarily correspond to better reading skills. Thus, exceptional abilities in processing speed, for example, may not correspond to exceptional abilities in reading. In poor readers (i.e. those with dyslexia), on the other hand, low PS skills may prevent them from activating the needed visuospatial skills and attention to extract meaning from text. Future studies that explore similar relations, should include a wider variety of tasks in order that measure PS and should discern if PS are good predictors of reading skills in individuals with low basic reading abilities.

Practical Implications

Should findings be replicated, there are several implications for the assessment of reading and dyslexia in ELLs. As mentioned in Chapter One, currently, the methods used for the assessment of reading and dyslexia do not specifically include measurements of PA, RF, or the cognitive correlates of dyslexia. Of particular importance for the assessment of ELLs, cognitive correlates can help screen students who may develop reading difficulties due to cognitive deficiencies (i.e. low performance on PA and RAN), even before they learn English. Simply put, incorporating measures of PA and RAN to assessment of reading can improve current methods used for the assessment of dyslexia, such as the discrepancy formula, RTI, and PSW.

For the discrepancy formula, adding measures of RAN and PA could provide further information on the cognitive mechanisms that lead to such a discrepancy. For example, in the state of California, school psychologists use the discrepancy formula to determine if a student meets criteria for SLD in reading (with dyslexia being mentioned in the SLD definition). However, in addition to a significant discrepancy between the best estimate of cognitive functioning and reading, a "processing deficit" must be found. Currently, there is little guidance on how to establish the presence of a processing deficit (McGill, 2014). Given the findings of this study, and the ample research that demonstrates the association of RAN and PA, school psychologists in CA could use performance on tasks of RAN and PA to establish the presence of a processing deficit in a student with SLD in basic reading skills (i.e. dyslexia). With regards to RTI, RAN and PA can play a key role in the identification of ELLs with dyslexia. For example, although standardized assessment is not part of the identification process under RTI, failure to respond to intervention is, and measures of RAN and PA can help screen students in Tier 1 who can then receive interventions in Tiers 2 and 3. In their RTI handout for families and educators, Sun, Nam, and Vanderwood indicate that in the universal screening of ELL students under Tier 1, should include measures of early literacy, PA, letter naming fluency, alphabetic knowledge, and oral reading fluency. Low performance on these measures help highlight deficiencies for intervention in Tier 2. In assessment methods that include the PSW approach, measures of reading and the cognitive correlates of reading would help highlight cognitive areas of weakness within a student that directly affect academic performance. Thus, as suggested by results in this study, an ELL with dyslexia would perform poorly on measures of PA and RAN as well as in measures of RF and D. Further studies of the correlates of dyslexia and how these apply to different methods of assessment with ELLs can help continue guiding practitioners who work with these children.

APPENDIX A: IRB HUMAN SUBJECTS DETERMINATION

THE UNIVERSITY OF ARIZONA.

Human Subjects
Protection Program

1618 E. Helen St.
P.O. Box 245137
Tucson, AZ 85724-5137
Tel: (520) 626-6721
http://orcr.arizona.edu/hspp

HSPP Correspondence Form

Investigator: Martha Youman, M.S. **Department:** Education
Advisor: Michelle Perfect, Ph.D
Project No./Title: 13-0151; Assessment of Reading and Dyslexia in Spanish Speaking English Language Learners
Expiration Date: March 21, 2014
Submit the "FORM: Continuing Review Progress Report" no later than 45 days prior to the expiration date.

IRB Committee Information

IRB2 – IRB00001751 **Expedited Review – New Project**
FWA Number: FWA00004218

Documents Reviewed Concurrently

F200 (signed 2013-01-25; revised 2013-03-18)
Consenting Instruments:
ICF Parent (version 2013-03-18)
F107 (version 2013-03-18)
Site Authorizations:
SUSD, Cragin Elementary, Erikson Elementary, Puebla Gardens Elementary, White Elementary, Rosemarie Rivera Elementary, Mission Manor Elementary
Recruitment Materials:
Flyer Spanish
Flyer English
Data Collection Instruments:
Investigator's Booklet Questionnaire
Student Booklet Questionnaire
Other (define):
CV Youman

Determination

Approved as submitted effective as of the signature date below

Regulatory Determination(s)

Criteria for Approval has been met (45 CFR 46.111): The criteria for approval listed in 45 CFR §46.111 have been met (or if previously met, have not changed)

Eligible for Expedite Approval (45 CFR §46.110): Identification of the subjects or their responses (or the remaining procedures involving identification of subjects or their responses) will NOT reasonably place them at risk of criminal or civil liability or be damaging to the their financial standing, employability, insurability, reputation, or be stigmatizing, unless reasonable and appropriate protections will be implemented so that risks related to invasion of privacy and breach of confidentiality are no greater than minimal.

Expedite Approval (45 CFR 46.110 Category 7): Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Vulnerable Population – Children: As documented in the file, research involving not greater than minimal risk and adequate provisions are made for soliciting the assent of the children and permission of their parents or guardians, as set forth is 45 CFR 46.408.

Reminders: **No changes to a project may be made prior to IRB approval except to eliminate apparent immediate hazard to subjects.**

Waiver of Assent (45 CFR 46.408(a): As documented in the file, the IRB has taken into account the ages, maturity, and psychological state of the children involved and determined that the capability of some or all of the children is so limited that they cannot reasonably be consulted; therefore, the assent of the children is not a necessary condition for proceeding with the research.

Waiver of One Parental Signature (45 CFR 46.408(b): permission of one parent is sufficient as it is research involving not greater than minimal risk as defined in 45 CFR 46.404.

Elaine Jones

03/22/2013

Elaine G. Jones, PhD, RN
Chair, University of Arizona IRB
EGJ:KF
cc: Scientific/Scholarly Reviewer

Date

APPENDIX B: RECRUITMENT FLIERS

THE UNIVERSITY OF ARIZONA.

Special Education,
Rehabilitation, and
School Psychology Department
College of Education

P.O. Box 210069
Tucson, AZ 85721-0069
Tel: (520) 621-7822
Fax: (520) 621-3821

The University of Arizona Consent to Participate in Research
PARENT PERMISSION FORM

Dear Parent/Guardian,

Your child has been invited to participate in a study that will explore better methods of reading assessment for students who speak a language other than English at home. If you agree to the study, your child will meet with the investigator one-on-one to complete a series of short tasks. The study will take place at your child's school at your choice of during school hours or after school hours. The study will be conducted by a doctoral candidate at the University of Arizona who has ample training in the assessment of reading and dyslexia. Your child's participation in this study will provide important information about your child's reading skills and possible difficulties that he/she may be encountering while reading. If you wish, I will share findings about your child with you, so that you can implement strategies to improve reading in the future. Except for this purpose, results of all tests will be confidential, and reports of the study will not include the names of any children.

This project has been approved by the school district and the principal. If you are willing to have your child participate in this study, please sign on the line below and return the form to your child's teacher. Your cooperation in this important project will be very much appreciated.

Sincerely,

Martha Youman, M.S.
Doctoral Candidate

If you have any questions about this project, please feel free to call me at (516) 633-3833.

Please provide the information below if you are interested in participating in the study:

Your Name: ____

Your Child's name ______________________________ **Date** _________

What grade is your child in? ______________________________

Phone number where you can be reached: ____________________

THE UNIVERSITY OF ARIZONA.

Special Education,
Rehabilitation, and
School Psychology Department
College of Education

P.O. Box 210069
Tucson, AZ 85721-0069
Tel: (520) 621-7822
Fax: (520) 621-3821

Consentimiento para Participar en una Investigación de la Universidad de Arizona
FORMULARIO DE PETICION DE PERMISO PARA PADRES

Estimado Padre/Guardian,

Su hijo ha sido invitado a participar en un estudio que analizará mejores métodos de evaluación de la lectura para los estudiantes que hablan inglés como segundo idioma. Si usted esta de acuerdo en participar, su hijo/a completara una serie de actividades cortas individualmente con la investigadora. El estudio se llevará a cabo en la escuela de su niño durante las horas de escuela o después de horas de escuela como sea su preferencia. El estudio será realizado por una estudiante de doctorado en la Universidad de Arizona, quien tiene una amplia formación en la evaluación de la lectura y la dislexia. La participación de su hijo en este estudio proporcionará información importante acerca de las habilidades de lectura de su hijo y las posibles dificultades que él / ella puede encontrar durante la lectura. Si su hijo/a participa en la investigación, tiene usted la oportunidad de descubrir el perfil de su hijo/a en la lectura y problemas potenciales que pueden interferir con el desarrollo normal de la lectura. También se proveerán estrategias para mejorar la lectura las cuales serán derivadas directamente del perfil académico y cognitivo de su hijo/a. Puede usted poner en práctica estas estrategias para mejorar la lectura en el futuro. Siguiendo las reglas de la Universidad de Arizona, los resultados de todas las pruebas serán confidenciales, y no se incluyeran los nombres de los participantes en informes del estudio.

Este proyecto ha sido aprobado por la oficina del distrito escolar y el director de la escuela. Si usted está dispuesto a que su hijo participe en este estudio, por favor firme en la línea de abajo y devuelva este formulario al maestro de su hijo. Su cooperación en este importante proyecto será muy apreciada.

Atentamente,

Martha Youman, M.S.
Estudiante Doctoral

Si usted tiene alguna pregunta sobre este proyecto, por favor no dude en llamarme al (516) 633-3833.

Por favor provea la información siguiente si esta interesado/a en participar en esta investigación:

Su Nombre: ____

Nombre de su niño ____________________________**Fecha** ______________

En que grado esta su niño? ___________________________________

Número de teléfono donde puedo contactarle: ________________________

APPENDIX C: CONSENT FORM

T502a – Consent Form

The University of Arizona Consent to Participate in Research (Interpreted to Spanish as needed)

Study Title:	**Assessment of Reading and Dyslexia in Spanish Speaking English Language Learners**
Principal Investigator:	**Martha Youman**
Sponsor:	

This is a consent form for research participation. It contains important information about this study and what to expect if your child decides to participate. Please consider the information carefully. Feel free to discuss the study with your friends and family and to ask questions before making your decision whether or not to participate.

Your child may or may not benefit as a result of participating in this study. Also, as explained below, your child's participation may result in unintended or harmful effects for you that may be minor or may be serious, depending on the nature of the research.

1. Why is this study being done?

This study is being done to explore better methods of assessing reading and dyslexia (low reading skills) in Spanish speaking students in our schools.

2. How many people will take part in this study?

A total of 100 children who are Spanish speaking English Language Learners (ELLs) will participate in this study.

3. What will happen if my child takes part in this study?

If your child participates in this study, he/she will spend approximately 2.5 hours with the principal investigator completing short oral and written tests related to reading and reading-related skills.

4. How long will my child be in the study?

The study will take approximately 2 hours. If possible, your child will complete all the tests in one session, but two sessions may be necessary if we need more time to finish.

5. Can my child stop being in the study?

Yes. If your child or you on behalf of your child wish to stop being in the study, you just need to contact the principal investigator at myouman@email.arizona.edu or by phone (516) 633-3833. You or your child can also tell the principal investigator that you want to stop. All testing will stop at this point.

Your child's participation is voluntary. You child or you on behalf of your child may refuse to participate in this study. If you child decides to take part in the study, your child may leave the study at any time. No matter what decision you and your child make, there will be no penalty and you or your child will not lose any of your usual benefits. Your decision will not affect your child's grades at school or you or your child's future relationship with The University of Arizona. If you are a student or employee at the University of Arizona, your decision will not affect your grades or employment status.

6. What risks, side effects or discomforts can I expect from being in the study?
There are no known risks. If your child participates, he or she will lose time in the regular classroom. If you prefer that your child not lose any regular class time, the principal investigator can arrange to have testing completed after school hours. Please feel free to contact Martha Youman at *myouman@email.arizona.edu* or at (516) 633-3833. You can also request this accommodation verbally now or at any time.

7. What benefits can I expect from being in the study?
The academic evaluation will provide very detailed information on your child's reading skills. If you would like the principal investigator to share this information, a meeting can be arranged. The principal investigator can also give provide you with some strategies to improve reading skills based on your child's profile.

8. What other choices do I have if my child does not take part in the study?

You or your child may choose not to participate without penalty or loss of benefits to which you are otherwise entitled.

9. Will my child's study-related information be kept confidential?

Efforts will be made to keep your study-related information confidential. However, there may be circumstances where this information must be released. For example, personal information regarding your participation in this study may be disclosed if required by state law.

Also, your records may be reviewed by the following groups (as applicable to the research):

- Office for Human Research Protections or other federal, state, or international regulatory agencies
- The University of Arizona Institutional Review Board or Office of Responsible Research Practices

10. What are the costs of taking part in this study?

Your child will spend 2.5 hours of his of her time completing the study. You may choose whether your child completes the study during school hours or after school. You will take approximately 0.5 hours completing the demographic questionnaire for this study.

11. Will I be paid for taking part in this study?

No.

12. What happens if my child is injured because he/she took part in this study?

There is minimal risk of injury in this study. Your child will be at school completing activities that are similar to school work. If your child suffers an injury from participating in this study, school procedures will be followed. The University of Arizona has no funds set aside for the payment of treatment expenses for this study.

13. What are my child's rights if he/she take part in this study?

If your child and you on behalf of your child choose to participate in the study, you may discontinue participation at any time without penalty or loss of benefits. By signing this form, you do not give up any personal legal rights your child may have as a participant in this study.

You will be provided with any new information that develops during the course of the research that may affect your decision whether or not to continue participation in the study.

You may refuse to participate in this study without penalty or loss of benefits to which you are otherwise entitled.

An Institutional Review Board responsible for human subjects research at The University of Arizona reviewed this research project and found it to be acceptable, according to applicable state and federal regulations and University policies designed to protect the rights and welfare of participants in research.

14. Who can answer my questions about the study?

For questions, concerns, or complaints about the study you may contact **Martha Youman** **at myouman@email.arizona.edu.**

For questions about your rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact the Human Subjects Protection Program at 520-626-6721 or online at http://orcr.arizona.edu/hspp.

Signing the consent form

I have read (or someone has read to me) this form, and I am aware that my child is being asked to participate in a research study. I have had the opportunity to ask questions and have had them answered to my satisfaction. I voluntarily give permission for my child to participate in this study.

Neither my child nor I are giving up any legal rights by signing this form. I will be given a copy of this form.

Printed name of subject	Signature of subject
	AM/PM Date and time
Printed name of person authorized to consent for subject (when applicable)	Signature of person authorized to consent for subject (when applicable)
Relationship to the subject	AM/PM Date and time

Investigator/Research Staff

I have explained the research to the participant or the participant's representative before requesting the signature(s) above. There are no blanks in this document. A copy of this form has been given to the participant or to the participant's representative.

Printed name of person obtaining consent	Signature of person obtaining consent
	AM/PM Date and time
Printed name of child	Date and time (Entered by PI)

APPENDIX D: DEMOGRAPHIC QUESTIONNAIRE COMPLETED BY PARENTS OF PARTICIPANTS

Cuestionario para Padres/Representantes

1) Nombre de su hijo/a: ________________________________

2) Cual es la fecha de nacimiento de su hijo/a? _______________

3) Que idioma prefiere usted y los adultos en su casa? ________________

4) Que idioma hablan los niños en su casa? __________

5) Cuantos años ha estado su familia en los Estados Unidos? ____________

6) A que edad comenzó su hijo/a la escuela en los Estados Unidos? _____________

7) En que grado comenzó su hijo/a la escuela en los Estados Unidos? _________________

8) Leen libros en casa? _______________

    i. En que idioma? ____________
    ii. Cuantas horas por semana? ____________

9) Quien vive en la misma casa con su niño/a? Por favor especifique cuantas personas.

a. madre: ___ idioma preferido: _________
b. padre: ___ idioma preferido: _________
c. hermano(s): ___ idioma preferido: ____
d. hermanas(s): ___ idioma preferido: ____
e. abuela maternal: ___ idioma preferido: _
f. abuelo maternal: ___ idioma preferido: _
g. abuela paternal: ___ idioma preferido: _
h. abuelo paternal: ___ idioma preferido: _
i. otro(s) pariente(s): ________ idioma preferido: _________
j. otro, por favor especifique:___________

10) Cuantas horas diarias duerme su hijo/a en noches que hay escuela el siguiente día? __________

11) Cuantas horas diarias duerme su hijo/a en noches que no hay escuela el siguiente día?

12) Ha repetido su hijo/a algún año escolar? ________

13) En que tipo de clases generales a estado su hijo/a en la escuela?

- ☐ Ingles solamente (inmersión). Cuantos años ________
- ☐ Bilingüe (ingles/español combinado en la misma clase). Cuantos años ________
- ☐ Dual Language (ingles/espanol en clases separadas). Cuantos años ________
- ☐ Espanol solamente. Cuantos años ________
- ☐ Otro: _______________. Cuantos años ________

14) Ha sido diagnosticada algunas de las condiciones siguientes en su hijo/a (indique todos los que apliquen):

- ☐ Attention Defcit/Hyperactivity Disorder ADHD *(Desorden de atención)*
- ☐ Specific Language Impairment (SLI) *(Desorden de Lenguaje)*
- ☐ Autismo
- ☐ Emotional Disturbance (ED) *(Desorden Emocional)*
- ☐ Other Orthopaedic Impairment (OHI) *(Discapacidad física):* _______________
- ☐ Specific Learning Disabilities *(deficiencias en el aprendizaje)*
    - o *Lectura*
    - o *Matematicas*
    - o *Otra:* _____________
- ☐ Cognitive Impairment (CI) o Mental Retardation (MR) *(Discapacidad o Retardación Mental)*
- ☐ Hearing Impairment *(Deficiencias Auditivas)*
- ☐ Visual Impairment *(Deficiencias Visuales)*
- ☐ Traumatic Brain Injury (TBI) *(Traumatismo Craneal)*
- ☐ Otra condición medica o mental: _______________

15) Tiene su hijo/a un IEP (Individualized Education Program)? ____________

Gracias por tomar tiempo para completar este cuestionario. Por favor converse con su doctor si tiene preguntas o preocupaciones acerca de los servicios que esta recibiendo o si desea averiguar sobre servicios que están disponibles para su niño/a.

APPENDIX E: SUMMARY OF MEASURES USED FOR THE STUDY

Variable	Measure	Tasks and Descriptions
Rapid Automatized Naming (RAN): tasks that require rapid naming of familiar objects or symbols	Rapid Automatized Naming and Rapid Alternating Stimulus Tests (RAN/RAS; Wolf & Denckla, 2004).	Participants completed timed rapid naming of the following (presented on a card): - objects - numbers - letters
Phonological Awareness (PA) in English: the ability to hear, distinguish, and manipulate the sounds that make up words in English	Test of Phonological Awareness Skills (TOPAS; Newcomer & Barenbaum, 2003)	Phoneme Deletion – Participants repeated a word out loud, and then said the word with a certain phoneme missing (e.g. say "cat" without the /k/). Sound Sequencing – Participants were given a set of colored blocks and told that each colored block represents a speech sound (phoneme). After hearing a series of speech sounds, participants had to arrange the colored blocks in order.
Phonological Awareness (PA) in Spanish: the ability to hear, distinguish, and manipulate the sounds that make up words in Spanish	Test of Phonological Awareness in Spanish (TPAS; Riccio, Imhoff, Hasbrouk, & Davis, 2004).	Phoneme Deletion – Participants repeated a word out loud, and then had to say the word with a certain phoneme missing (e.g. di "mesa" without the /m/). Final Sounds – Participants repeated two words and decided (yes or no) if the words ended with the same sound (e.g. piensas que gato termina igual que pato?)
Processing Speed (PS)- the ability to process incoming information (input) and produce a response (output)	Woodcock Johnson Tests of Cognitive Abilities Normative Update (WJ III COG NU; Woodcock, McGrew, Schrank, & Mather, 2001, 2007)	Visual Matching – As quickly as possible for three minutes, participants circled two identical numbers in each row of six numbers. Pair Cancellation – As quickly as possible for three minutes, participants circled repeated patterns (ball and a dog).

Variable	Measure	Tasks and Descriptions
Decoding (D) in English: the ability to use sound-symbol knowledge to correctly pronounce written words	Woodcock Johnson Tests of Achievement III Normative Update (WJ III-ACH NU; Woodcock, McGrew, Schrank, & Mather, 2001, 2007)	Letter-Word Identification – Participants identified letters and words correctly, with the examiner marking the number of correctly read words. Word Attack – Participants used phonic and structural analysis skills to read phonetically regular nonsense words that resemble English spelling patterns (e.g. dright).
Decoding (D) in Spanish: the ability to use sound-symbol knowledge to correctly pronounce written words	Batería III Woodcock-Muñoz (Bateria III APROV; Woodcock, Muñoz-Sandoval, McGrew, & Mather, 2004, 2007)	Identificación de Letras y Palabras – Participants identified Spanish letters and words correctly, with the examiner marking the number of correctly read words. Análisis de Palabras – Participants used phonic and structural analysis skills to read phonetically regular nonsense words that resemble Spanish spelling patterns (e.g. quedrir).
Reading Fluency (RF) in English- the ability to read text accurately and quickly	Woodcock Johnson Tests of Achievement III Normative Update (WJ III-ACH NU; Woodcock, McGrew, Schrank, & Mather, 2001, 2007)	Reading Fluency – With a three-minute time limit, participants quickly read simple sentences in English and decided if the statements were true or false, and circled Yes or No to indicate their decision.
Reading Fluency (RF) in Spanish- the ability to read text accurately and quickly	Batería III Woodcock-Muñoz (Bateria III APROV; Woodcock, Muñoz-Sandoval, McGrew, & Mather, 2004, 2007)	Fluidez en la Lectura – With a three-minute time limit, participants quickly read simple sentences in English and decided if the statements were true or false, and circled Yes or No to indicate their decision.
Listening Comprehension (LC) in English: language development that represents all verbal	Woodcock Johnson Tests of Achievement III Normative Update (WJ III-ACH NU; Woodcock, McGrew,	Oral Comprehension – Participants were required to supply a missing word to the end of a sentence, or related group of

Variable	Measure	Tasks and Descriptions
ability, including vocabulary, syntax, inferencing, and the construction of mental schemas	Schrank, & Mather, 2001, 2007)	sentences in English.
Listening Comprehension (LC) in Spanish: language development that represents all verbal ability, including vocabulary, syntax, inferencing, and the construction of mental schemas	Batería III Woodcock-Muñoz (Bateria III APROV; Woodcock, Muñoz-Sandoval, McGrew, & Mather, 2004, 2007)	Comprensión Oral - Participants were required to supply a missing word to the end of a sentence, or related group of sentences in Spanish.
Reading Comprehension (RC) in English: ability to decode and understand written information.	Woodcock Johnson Tests of Achievement III Normative Update (WJ III-ACH NU; Woodcock, McGrew, Schrank, & Mather, 2001, 2007)	Passage Comprehension – Participants were required to read short phrases and passages in English with a word missing and provide possible answers to complete the missing word. Participants in 1st grade read a word or phrase and pointed to the corresponding picture from 4 choices.
Reading Comprehension (RC) in Spanish: ability to decode and understand written information.	Batería III Woodcock-Muñoz (Bateria III APROV; Woodcock, Muñoz-Sandoval, McGrew, & Mather, 2004, 2007)	Comprensión de Textos - Participants were required to read short phrases and passages in English with a word missing and provide possible answers to complete the missing word. Participants in 1st grade read a word or phrase and pointed to the corresponding picture from 4 choices.
Vocabulary (V) in English	Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4; Dunn & Dunn, 2007)	Complete Test – the examiner presented a series of pages that contained four pictures. Each picture was numbered. Then, the researcher said a word and the

Variable	Measure	Tasks and Descriptions
		participant identified the number of the picture that best corresponded to the word.
Vocabulary (V) in Spanish	Test de Vocabulario en Imagenes Peabody (TVIP; Dunn, Lugo, Padilla, & Dunn; 1981)	Complete Test – the examiner presented a series of pages that contained four black-and-white pictures. Each picture was numbered. Then, the researcher said a word and the participant identified the number of the picture that best corresponded to the word.

APPENDIX F: INTER-SCORER RELIABILITY CHECKLIST

Participant Number: ____________________

Total Number of Scoring Agreements: ______ /20

Total Number of Scoring Disagreements: ______ /20

Total Number of Data Entry Agreements: ______ /37

Total Number of Data Entry Disagreements: ______/37

APPENDIX G: CORRELATION MATRIX OF DEMOGRAPHIC AND INTEREST VARIABLES

	Gender	Grade at Time of Testing	Age of child at time of testing	Parent Language - English	Child Language - English	Years the family has lived in the US	Does the child read books at home?	Number of hours of reading at home per week
Gender	1							
Grade at Time of Testing	-.19	1						
Age of child at time of testing	-.24*	.89**	1					
Parent Language - English	-.16	-.29**	-.26*	1				
Child Language - English	.02	.20*	.12	.12	1			
Years the family has lived in the US	-.00	-.18	-.20	.52**	.35**	1		
Does the child read books at home?	-.06	-.18	-.12	.01	.12	-.01	1	
Number of hours of reading at home per week	-.03	.013	-.03	-.06	-.08	.06	-.30**	1
RAN-O	.17	-.20	-.30**	-.15	.01	-.13	.09	-.06
RAN-N	-.13	-.04	-.05	-.20*	.01	-.22*	-.01	.07
RAN-L	-.02	-.06	-.12	-.20*	.09	-.18	-.04	.18
TOPAS-SS	.09	-.25*	-.32**	-.12	-.15	-.09	.12	.14
TOPAS-PD	-.18	-.025	-.11	-.22*	-.31**	-.25*	.01	.18

* Correlation is significant at the 0.05 level.

** Correlation is significant at the 0.01 level.

APPENDIX G: CORRELATION MATRIX OF DEMOGRAPHIC AND INTEREST VARIABLES (CONTINUED)

	Gender	Grade at Time of Testing	Age of child at time of testing	Parent Language - English	Child Language - English	Years the family has lived in the US	Does the child read books at home?	Number of hours of reading at home per week
WJ III VM	-.19	-.24*	-.33**	.06	.08	.09	.12	-.10
WJ III PC	-.03	.02	-.07	.14	.21*	.07	.02	-.24*
WJ III LWID	-.09	-.29**	-.41**	-.05	-.17	-.17	.16	.11
Bateria III ILP	-.17	-.09	-.12	-.18	-.31**	-.51**	.19	.05
WJ III WA	-.05	-.25*	-.36**	-.016	-.20*	-.17	.13	.22*
Bateria III AP	-.19	-.04	-.09	-.20	-.22*	-.36**	.12	.12
WJ III RF	-.07	-.13	-.21*	-.19	-.12	-.15	.09	.04
Bateria III FL	-.17	-.02	-.07	-.18	-.29**	-.39**	.13	.06
WJ III RC	-.09	-.15	-.29**	-.18	-.14	-.17	.06	.12
Bateria III RC	-.26*	-.05	-.11	-.21*	-.23*	-.44**	.22*	.04
WJ III OC	-.04	-.13	-.22*	-.15	.03	.01	.07	-.04
Bateria III CO	-.43**	.12	.06	-.26*	-.24*	-.26*	.03	-.07
PPVT	-.04	-.04	-.14	-.18	.09	.04	.01	.05
TVIP	-.29**	.04	-.07	-.10	-.21*	-.27*	.14	-.01

* Correlation is significant at the 0.05 level.

** Correlation is significant at the 0.01 level.

APPENDIX G: CORRELATION MATRIX OF DEMOGRAPHIC AND INTEREST VARIABLES (CONTINUED)

	RAN-O	RAN-N	RAN-L	TOPAS-SS	TOPAS-PD	TPAS-FS	TPAS-PD	WJ III VM	WJ III PC
RAN-O	1								
RAN-N	.58**	1							
RAN-L	.58**	.78**	1						
TOPAS-SS	.44**	.32**	.34**	1					
TOPAS-PD	.31**	.29**	.32**	.53**	1				
TPAS-FS	.38**	.34**	.35**	.37**	.43**	1			
TPAS-PD	.27*	.32**	.23*	.40**	.61**	.57**	1		
WJ III VM	.49**	.42**	.47**	.32**	.31**	.45**	.39**	1	
WJ III PC	.36**	.23*	.24*	.09	.06	.29**	.05	.43**	1
WJ III LWID	.47**	.57**	.54**	.57**	.62**	.44**	.58**	.49**	.15
Bateria III ILP	.26*	.44**	.38**	.43**	.53**	.37**	.67**	.27*	.04
WJ III WA	.36**	.39**	.37**	.54**	.60**	.45**	.67**	.36**	.09
Bateria III AP	.32**	.53**	.45**	.39**	.58**	.45**	.65**	.35**	.04
WJ III RF	.49**	.63**	.62**	.42**	.53**	.41**	.41**	.48**	.23*
Bateria III FL	.26*	.45**	.33**	.33**	.46**	.33**	.51**	.21*	.06
WJ III RC	.49**	.43**	.49**	.45**	.62**	.42**	.48**	.43**	.12
Bateria III RC	.22*	.29**	.21*	.33**	.51**	.40**	.62**	.31**	.05
WJ III OC	.28*	.15	.28*	.03	.11	-.03	-.01	.17	-.10
Bateria III CO	.15	.14	.13	.13	.35**	.28**	.32**	.17	.07
PPVT	.32**	.16	.25*	.08	.19	.02	.02	.28**	.01
TVIP	-.01	-.08	-.06	.07	.29**	.18	.35**	.08	.04

* Correlation is significant at the 0.05 level.

** Correlation is significant at the 0.01 level.

APPENDIX G: CORRELATION MATRIX OF DEMOGRAPHIC AND INTEREST VARIABLES (CONTINUED)

	WJ III LWID	Bateria III ILP	WJ III WA	Bateria III AP	WJ III RF	Bateria III FL	WJ III RC	Bateria III RC	WJ III OC	Bateria III CO	PPVT
WJ III LWID	1										
Bateria III ILP	.61**	1									
WJ III WA	.85**	.61**	1								
Bateria III AP	.66**	.87**	.67**	1							
WJ III RF	.85**	.45**	.61**	.56**	1						
Bateria III FL	.61**	.83**	.59**	.83**	.52**	1					
WJ III RC	.83**	.40**	.74**	.49**	.83**	.42**	1				
Bateria III RC	.56**	.81**	.56**	.78**	.39**	.78**	.45**	1			
WJ III OC	.24*	-.18	.14	-.13	.33**	-.15	.58**	-.07	1		
Bateria III CO	.28*	.44**	.19	.40**	.35**	.38**	.41**	.55**	.16	1	
PPVT	.33**	-.05	.21*	.02	.48**	.01	.68**	.05	.77**	.21*	1
TVIP	.14	.45**	.24*	.35**	.09	.39**	.25*	.63**	.08	.65**	.09

* Correlation is significant at the 0.05 level.

** Correlation is significant at the 0.01 level.

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